CASTING FOR RAPID PROTOTYPING SUCCESS

By MCP HEK Tooling GmbH, Lübeck, Germany

RAPID REALISATION

MCP

Create prototypes in plastic and metal **within hours with**
MCP Vacuum Casting Technologies

- Eliminate long delivery times for prototypes
- Reduce development costs
- Improve quality and output

Colour matched functional prototypes

Optically perfect functional lenses

Zinc aluminium bronze castings

EP 250 injection moulds
rapid tooling system

CITROEN
AUDI
FORD
VOLKSWAGEN
SKODA
BMW
DAIMLER
CHRYSLER
FIAT
GM
ELECTROLUX
DAEWOO
SIEMENS
PORSCHE
ROVER
BOSCH

Prove it? -

Visit your nearest MCP sales centre and see why so many international companies have chosen MCP Vacuum Casting Technologies

MCP- The single solution company for prototyping needs
- MCP Casting Equipment
- MCP Materials
- MCP Training

A Lifetime of Technical Support and Service From MCP

First Class Results
First Time-Every Time with MCP

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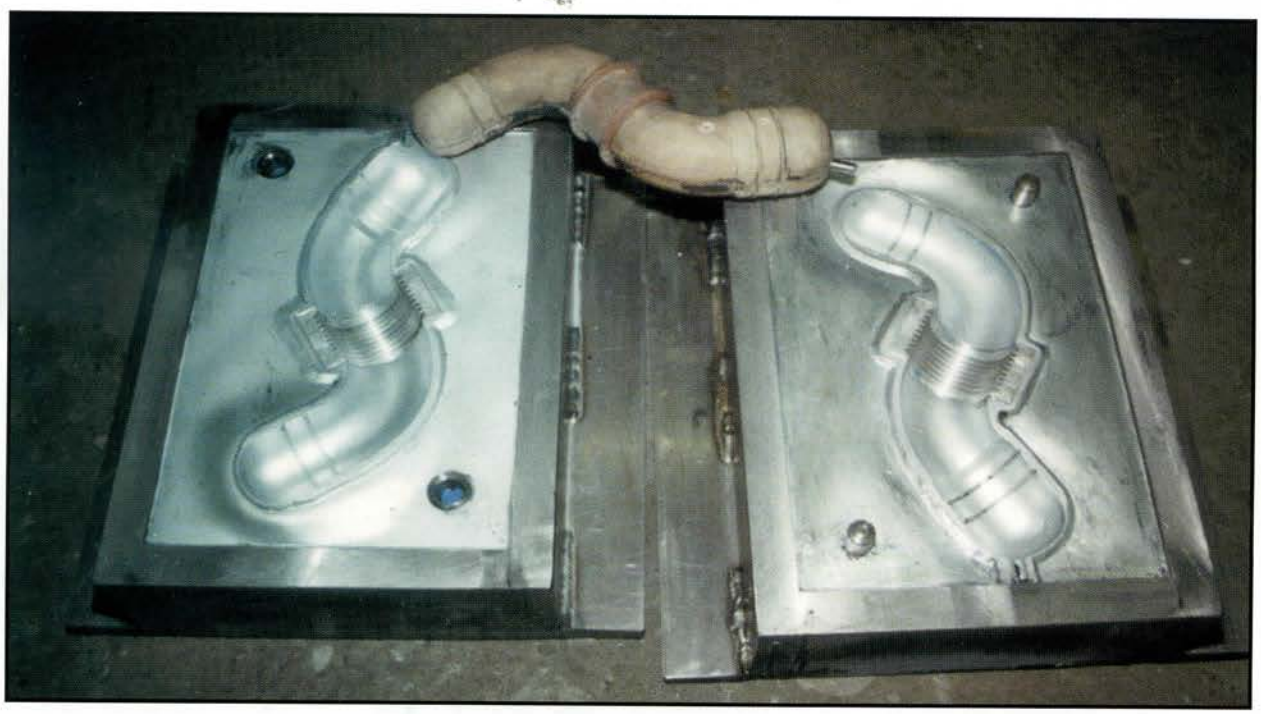
MCP
MCP-HEK TOOLING

Reprinted from International Appliance Manufacturing 2001

CASTING FOR RAPID PROTOTYPING SUCCESS

MCP-HEK Tooling GmbH, Lübeck, Germany



A Blow Mold produced with MCP Metal Spray Mold Technology

Rapid Realisation of Plastic and Metal Parts

MCP – HEK is a member of the 60 years old MCP Group of companies, the oldest producer of low melt alloys worldwide. Low melt alloys were first used in USA for casting quick, low cost sheet metal tooling. Following its success, the concept was introduced by MCP to Europe and low melt alloys were used to cast cavities against various types of model including metal gypsum and wood to produce quick low or sample run molds for easy processable materials such as PVC, polyethylene and polypropylene. A little over 10 years ago Americans started referring to this type of process generically as Rapid Prototyping utilising advanced software and CAD data. In the middle of the 1950s, MCP developed metal spray technology for spraying their proprietary low melt alloys onto models to achieve better definition. This metal spray mold process was used for the next 20 years. Its biggest application was for producing short run, geometrically simple injection molds, but popularity soared world wide when platform polyurethane shoe soles, so called units, were being made at the beginning of the 1970s.

The metal spray mold technology was the quickest and most efficient method of manufacturing polyurethane processing molds with the amount of detail, such as leather grain, that is required on this type of product. However, at the beginning of the 1980s new, more robust metal spray equipment using higher melting metals integrated into existing technology to produce low cost tooling for RIM, blow molds and injection molding solutions – and in each case the advantages are different.

System Specification:

MCP supply standard metal spray equipment for mold making applications. Equipment includes the metal spray and dust extraction equipment release agents and backing resins depending on mold size and application.

models in wax, polystyrene (SLS) or Quick Cast or, three days when using other types of model. From which molds for casting waxes need to be made.

To apply the new process, wax castings or meltable models are required, which are encapsulated in ceramic and heated and melted out to leave a cavity which is filled with metal either under vacuum, pressure or gravity using the MCP Metal Part Casting Equipment.

The automated Metal Part Casting Equipment is suitable for a clean laboratory type environment not usually associated with a foundry application.

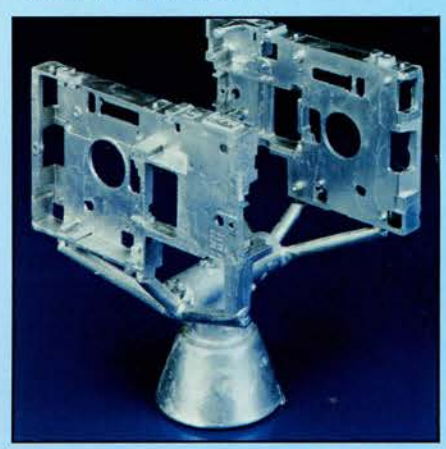
1. Set up the wax models adding the gate & some risers.

2. Place the casting flask over the wax models.

3. Mix and cast ceramic under vacuum to encapsulate the wax models in the flask. Place in the oven.

4. Remove the flask from the oven and place into the casting unit and close.

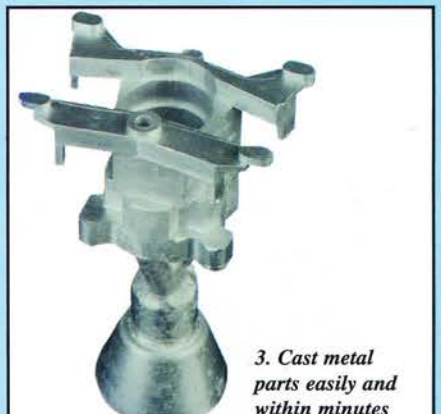
5. The PLC touch screen controller will operate all important parameters of the casting process. Melting takes between 15 and 20 minutes depending on the type and amount of metals. The casting operation is performed automatically in just a few seconds giving perfect results. No heat radiation, no dirt, no fumes..



6. The metal part can be removed from the ceramic mold within 30 to 60 minutes after casting.

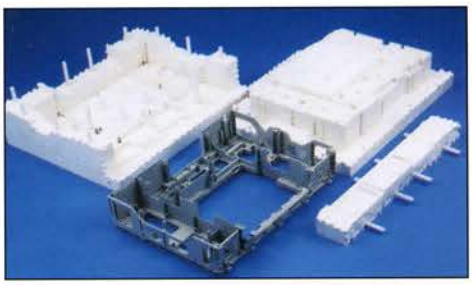
1. Produce silicone tooling from a rapid prototyping pattern and cast wax models using the MCP Vacuum Casting Process.

2. Encapsulate wax models in ceramic

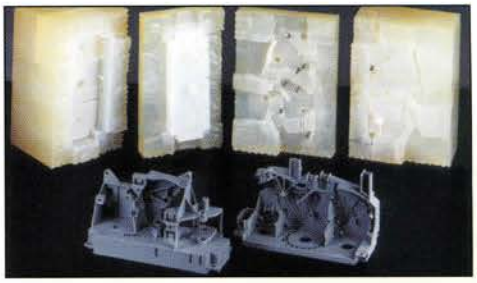


3. Cast metal parts easily and within minutes

Right: A six part mold in Silicone Rubber with the vacuum casting which is a video recorder chasis. The vacuum casting resin has ABS properties.



Far Right: A four part mold in silicone rubber with the vacuum casting - front and rear. The vacuum casting resin has high temperature properties.



Marilyn Monroe/Albert Einstein:
Top: An impressive example of the MCP vacuum casting technology showing both the accuracy and surface reproduction possible with this vacuum process.

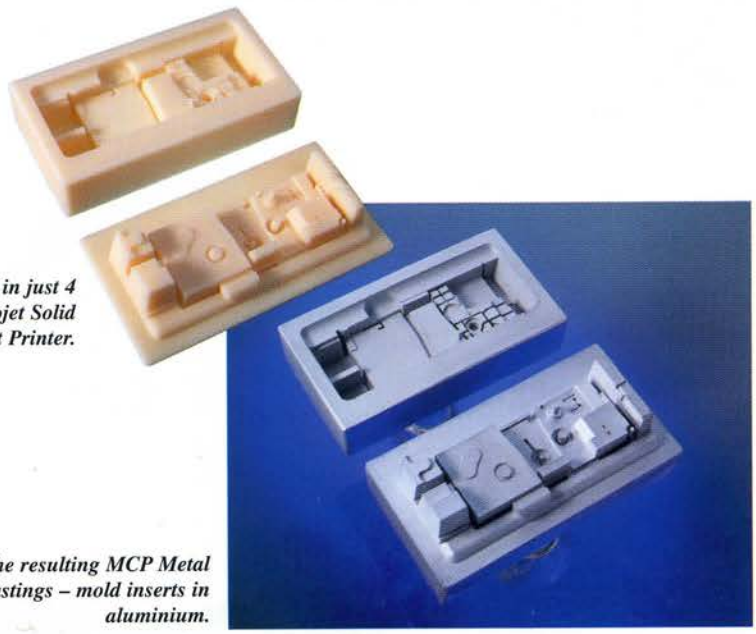
Below: The corresponding rapid prototyping models made with thermojet.

An example of colour matched, vacuum cast prototypes.

System Specification:

The maximum size of component to be produced determines the dimensions of the vacuum casting equipment, maximum mold size, and, maximum casting capacity. MCP supply vacuum casting machines in more than ten configurations ranging from 1kg (2.2 lbs) casting capacity and maximum mold size of 500 mm x 450 mm x 425 mm up to over 12 kg (26 lbs) and a maximum mold size of 3 metres long x 650 mm x 900 mm. A full training course is part of the package system worldwide.

Custom built, customer specified equipment can also be supplied.



Models produced in just 4 hours with the Thermojet Solid Object Printer.

24 hours later, the resulting MCP Metal Part Castings – mold inserts in aluminium.

The MCP Metal Part Casting Process

Investment Casting Technology

The MCP Metal Part Casting Process has been designed specifically to meet the increasing demand for quick, economical metal castings for prototypes, low and medium runs of several hundred parts.

A new and complete package process for producing quick metal prototypes and mold inserts in as little as one day in materials such as zinc, aluminium, bronze, brass and copper when using "burn out"

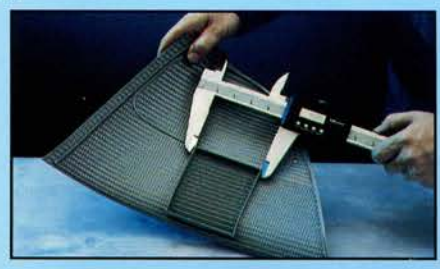
The MCP Vacuum Casting System

A full package turn key system for producing exact and complicated prototype components in plastic and wax materials.A package system will generally include a combination of vacuum casting machines and ovens of the size required, tooling materials – usually silicone rubber – and a range of over 30 vacuum plastics (comparable in performance to thermoplastics), important accessories and a course of training in-house at the customer's premises worldwide.

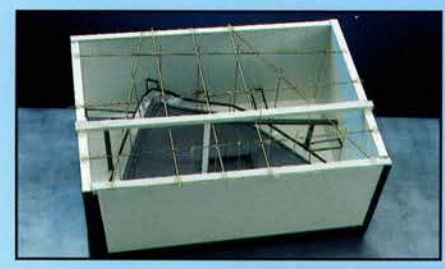
With this process multi segment molds can be made overnight to be cut open the next day ready for casting the first prototypes on the vacuum casting equipment. Using the vacuum casting technique 30 to 50 colour matched functional prototypes can be produced within two to three days from the model coming off theRapid Prototyping machine. Vacuum casting is now becoming the state – of – the – art technology for achieving technical prototypes for exhibition and functional testing and mold design checks. On average users can expect to save 97% in time and cost compared to conventional steel tooling.

New: Produce wax components for metal part casting (lost wax process)

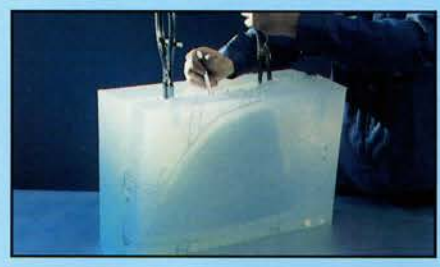
1. Check the master model, which can be created using any of the current modelling techniques...



2. The model is suspended in the casting frame and venting rods are attached.

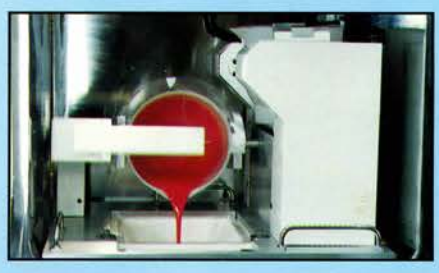


3. When fully cured and removed from the frame, the silicone rubber is then cut following the visible parting line marked on the tape edge...

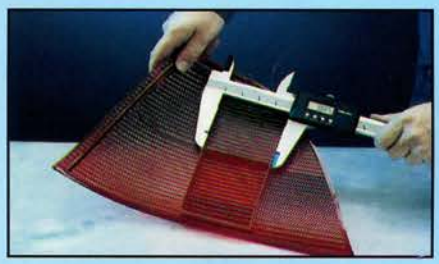


4. Revealing the master model faithfully reproduced in the silicone. The master model is then removed.

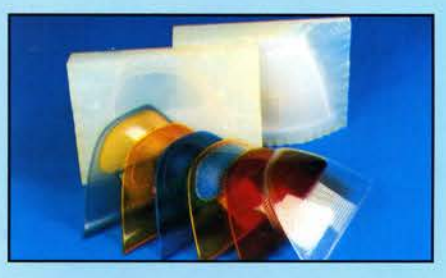
5. Once programmed, the automatic casting cycle will mix and pour the casting resin...



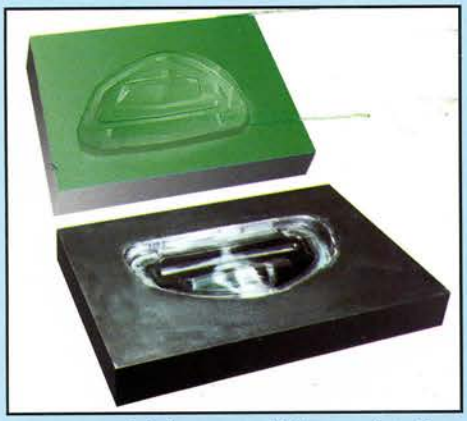
6. Finally, check for dimensional accuracy to master model; the component is now ready for the final finishing.



7. Two colour prototypes. Produced with the MCP Vacuum Casting System.

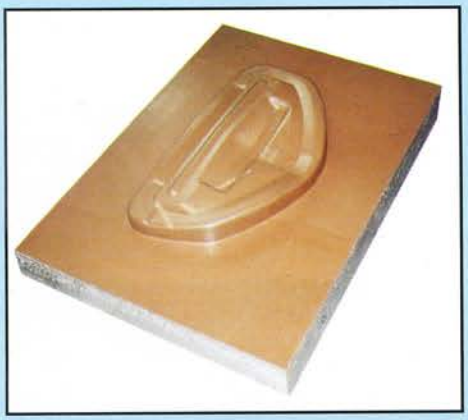


MCP Vacuum Casting (Above): The state of the art process for quick low cost prototypes.



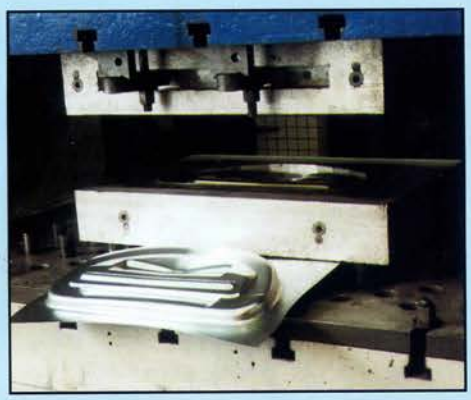
Prepare a model of any material i.e.: wood, tooling board, styrofoam or SLA (Stereolithography)

Sheet Metal Compnents produced in MCP 137 Tooling.



Coat with wax sheet in the thickness of the sheet metal to be used...

...and cast the MCP Alloy to produce the bottom die.



The finished component, manufactured in an MCP Sheet Metal Forming Die.

Prototype sheet metal forming tooling using MCP low melt alloys

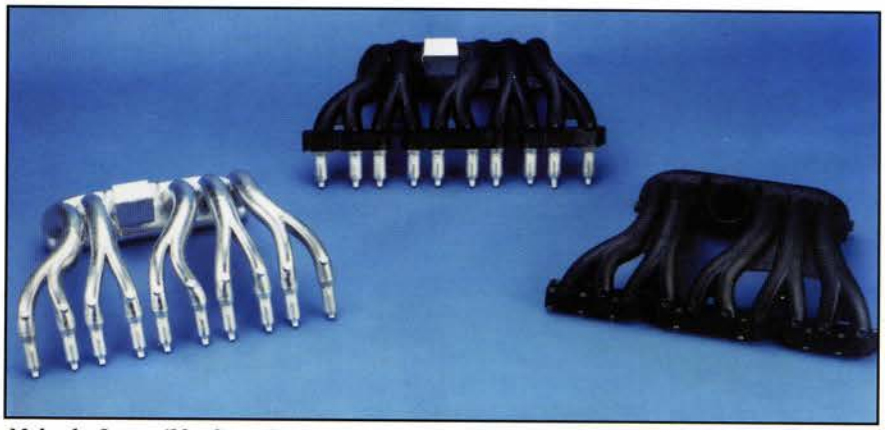
Sheet metal forming tooling produced with MCP 137 Low melting point alloy is used by many European automotive manufacturers, such as BMW, and Mercedes Benz (Daimler Chrysler). These automakers use this process as it offers a simple, quick and inexpensive system for solving the tooling problems for small and prototype runs of 100 – 200 pressings. This technology offers a multitude of tool making options for the user:

The most straight forward procedure is to use an existing sheet metal component (with the required modifications), suspend this in a casting frame and cast the alloy to produce the top and bottom tool simultaneously. Generally, the standard method of tool manufacture is to produce a model of either one or other side of the component required. The Low melt alloy is

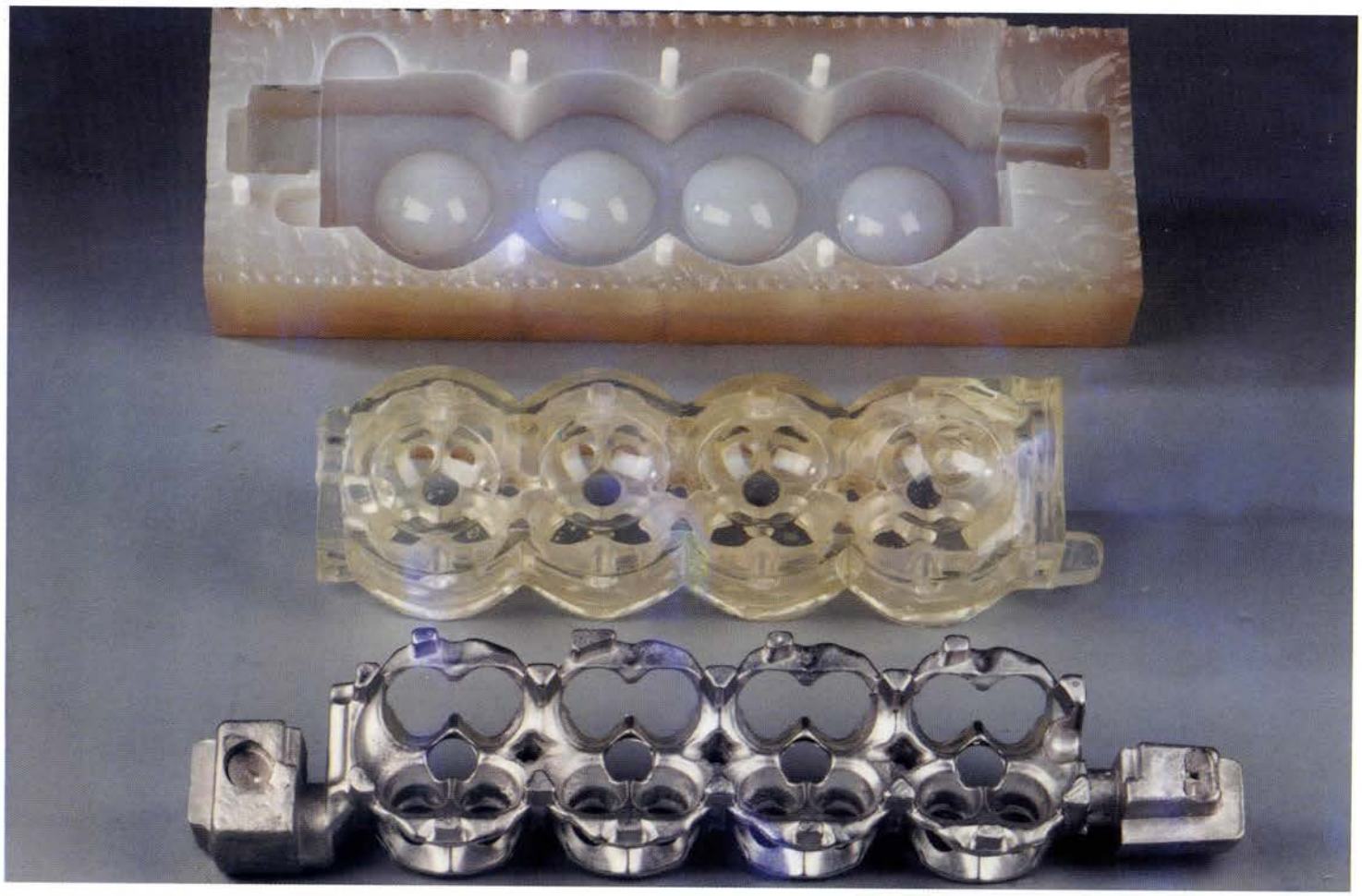
Fusible Core Technology with MCP Low Melting Point Alloys

Make the "impossible".

Fusible core technology is a modern and extremely effective process for realising internally undercut components in engineering plastics. The process requires two molds. The first mold is used to cast the core in a low melt alloy. The core is then placed into the regular injection mold and over molded and later melted out in a high temperature fluid, leaving behind a fully integral, internally undercut high strength plastic molding. Some of the most popular applications for this process are impellers for water pumps, tennis racquets and automotive inlet manifolds where the extremely important internal surface geometry and finish can be dictated by the metal core. Extremely quick cycles times can be achieved as low as 60 seconds per manifold which includes all operations of metal core casting, over molding and melt out.



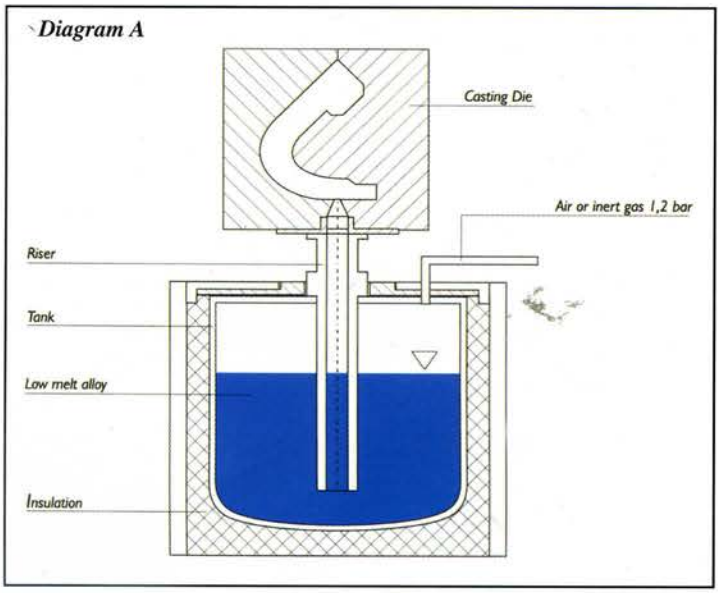
Make the Impossible: five cylinder inlet manifold (Daimler Chrysler) in 35% glass filled nylon. Photo shows from left to right: 1) The metal core in MCP Low Melt Alloy, 2) The metal core, overmolded in plastic, 3) The finished component, internally undercut, impossible to produce with conventional Tooling methods

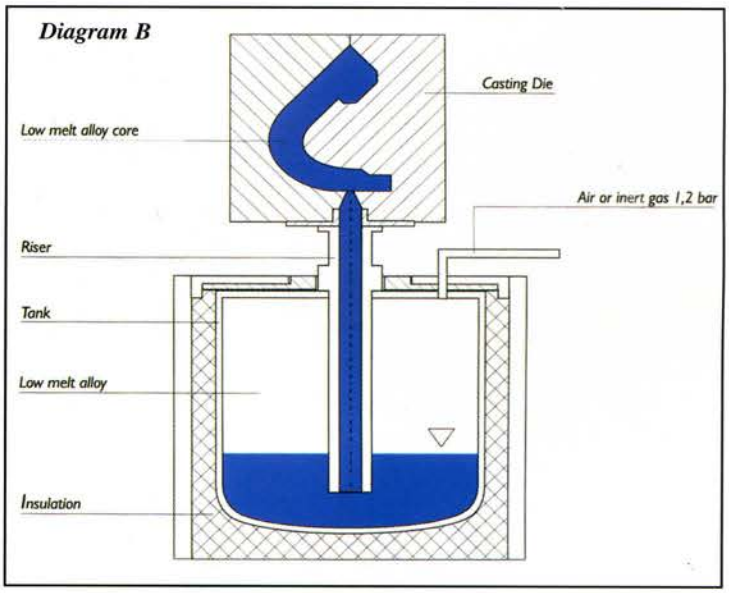


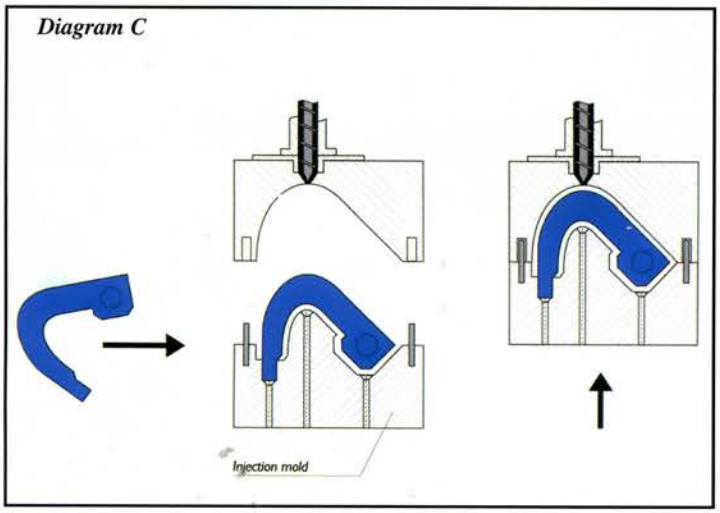
Automotive Cylinder Head Water Jacket in Transparent Plastic.

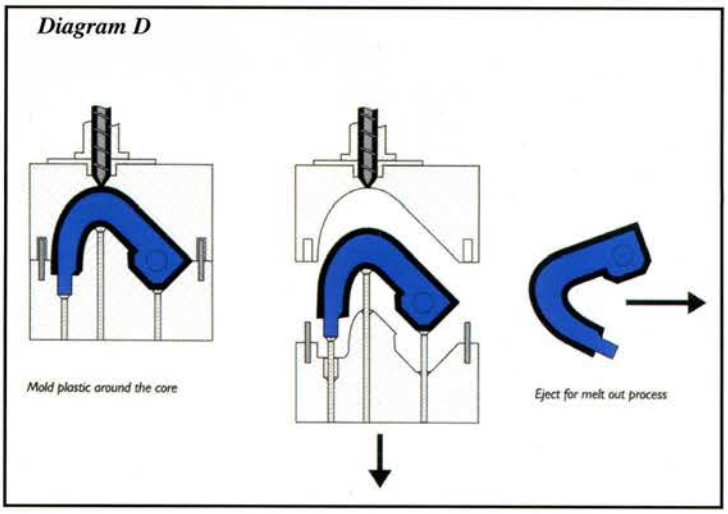
Using the advantages of the MCP Vacuum Casting Process combined with one of MCP's Low Melt Alloys is the perfect solution for producing the test bed prototypes for water flow testing. An alloy core is produced in silicone tooling with a melting temperature well under 100°C. Completely transparent, optically perfect resin is cast around the core using the vacuum casting process. The alloy core is then melted out in hot water leaving a hollow and internally undercut, one piece water jacket.

HOW FUSIBLE CORE TECHNOLOGY WORKS

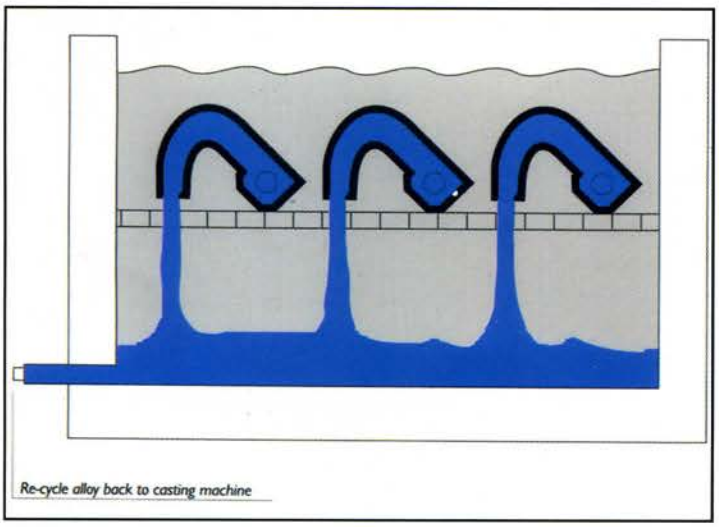


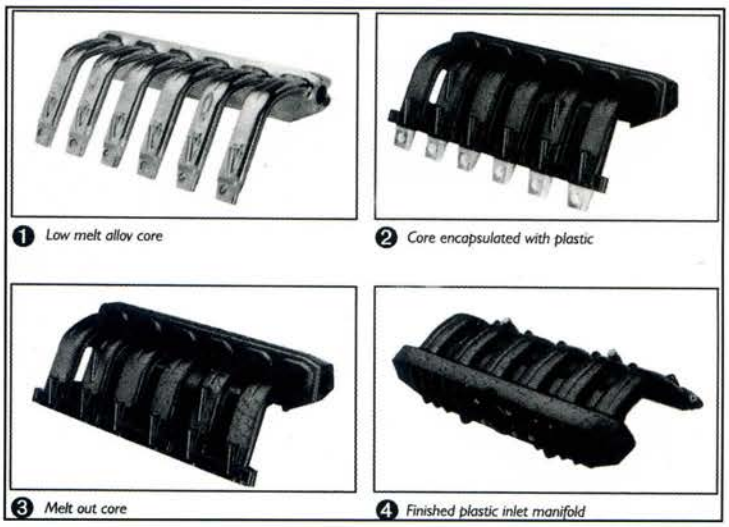






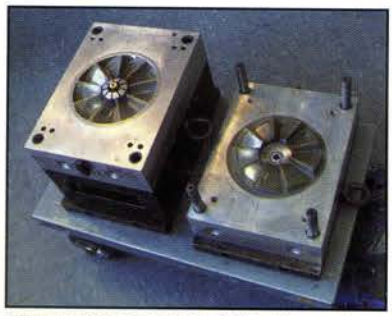
ALLOY CORE MELT OUT



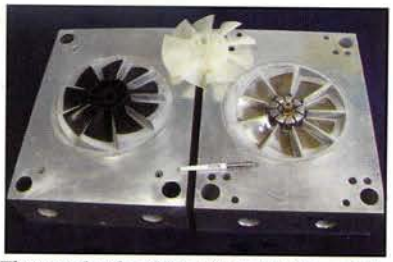


Producing an injection mold for a nylon fan in EP tooling resin.

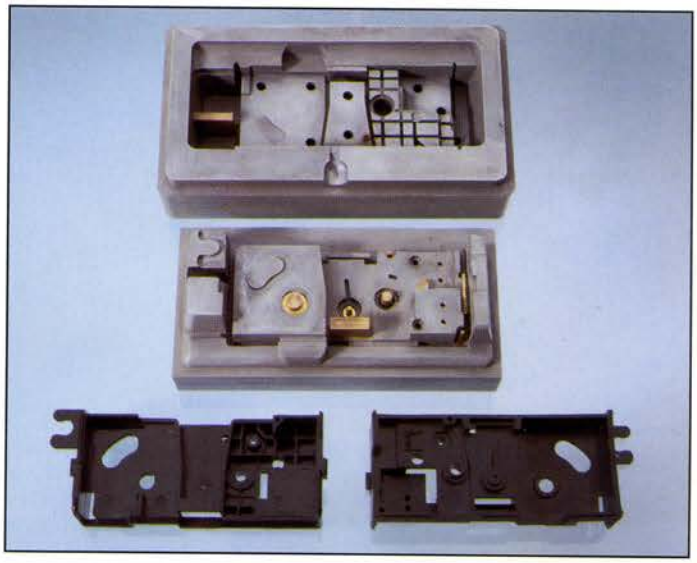
The fan model in SLA (Quick Cast)



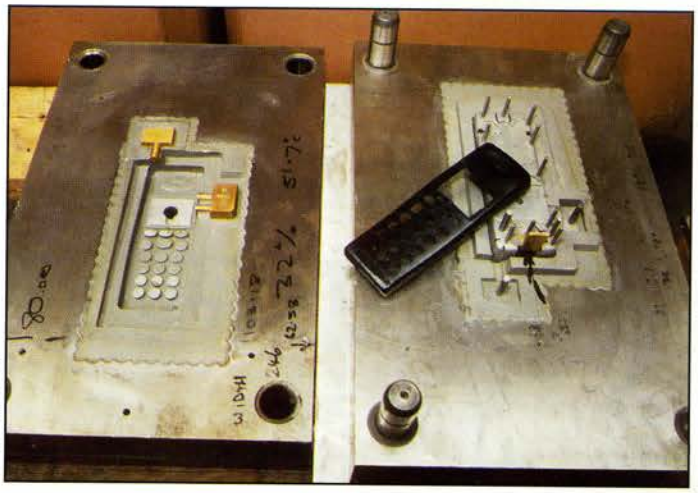
The completed model in EP tooling resin.



The completed mold together with the model and a sample molding in PA6.6 (Nylon).



Automotive door lock mold in EP tooling resin . Parts produced 600.

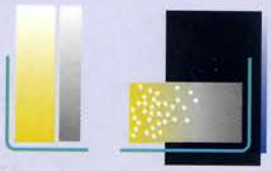


Mold for mobile phone in EP tooling resin with brass inserts. 1500 parts in ABS produced.

Day One

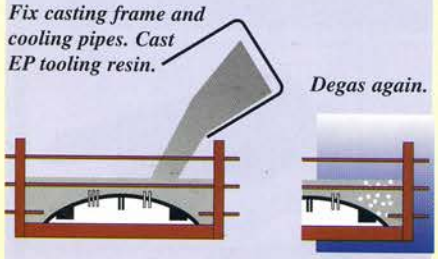
Use models in any materials: wood, plaster, leather, silicone, resin or any type of rapid prototyping model.
Fit metal inserts if required.

Mix EP tooling resin with hardener and degas.



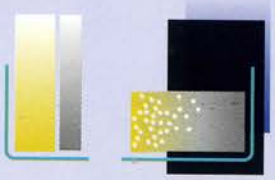
Fix casting frame and cooling pipes. Cast EP tooling resin.

Degas again.

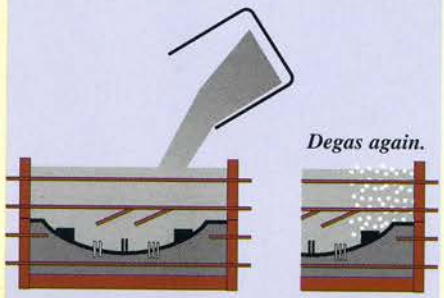


Day Two

Mix EP tooling resin with hardener and degas.



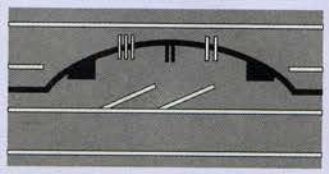
Degas again.



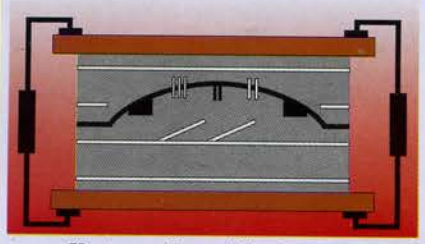
Fix upper casting frame.

Cast EP tooling resin.

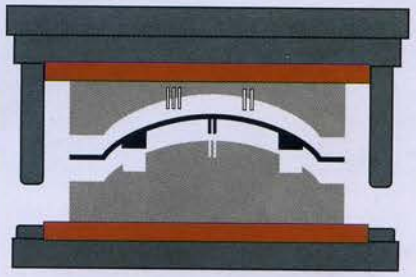
Day Three



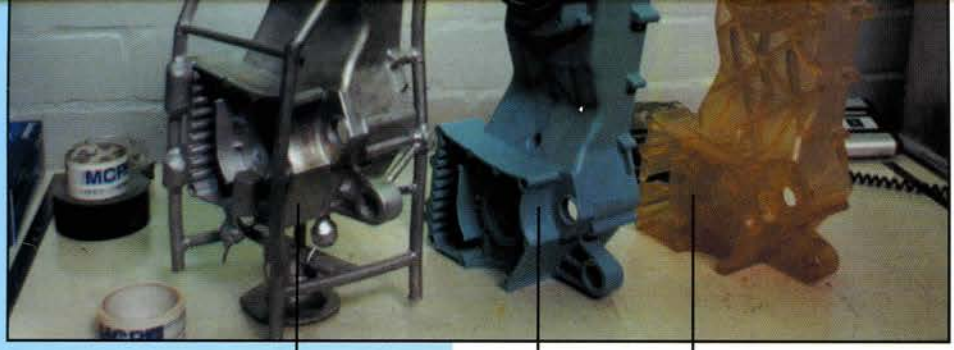
Remove the casting frame.



Heat cure the mold in the oven.



Completed injection tool.



Crank cast in aluminium: 7.2 kg (15.5lbs) Cast on MPA 300/700 equipment (3)

Wax casting produced by vacuum casting (2)

Produce Rapid Prototyping Model in SLA (1)

132 hours

Table 1: Sizes of Metal Part Casting Units.

Machine type	Casting volume of metal	Flask size
MPA 150	1,5 litres (4 kg Aluminium)	Ø 250 x 350 mm
MPA 300	3,0 litres (8 kg Aluminium)	Ø 350 x 500 mm
MPA 1000	10,0 litres (28 kg Aluminium)	Ø 550 x 700 mm

The Rapid Prototyping Model.

The wax model produced with the MCP Vacuum Casting Technology.

The resulting complex aluminium component made with the MCP Metal Part Casting Process.

System Specification:

Equipment size is determined by the volume and geometry of the metal components required. Three standard machine package configurations are available with the following dimensions and casting capacity.

The Metal Part Casting units are supplied in the following sizes in Table 1:

All ancillary equipment included in the package is designed around each particular MPA casting unit to match the required sizes. A full training course is part of the package system worldwide.

One day from the model to the metal casting

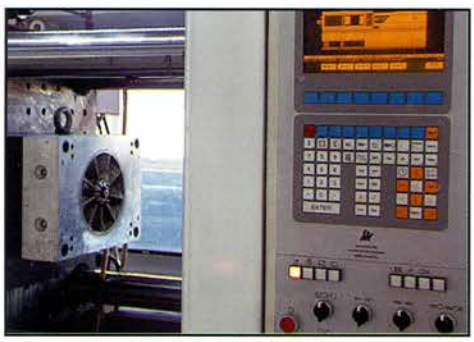
Polystyrene "burn out" model and the resulting Metal Part Casting in aluminium.

tooling. Injection molding is internationally the most used plastics processing method but conventional tooling for this process is expensive and time consuming to produce. New methods of Rapid Tooling such as EP tooling resins show that it can be achieved quicker and at a lower cost. Decisive is a material which is easy to use and which will produce tooling to fulfil all the requirements of injection molding. Further, the material needs to have similar stability to aluminium

Some finished components. 1000 parts produced.

with a high surface quality. With EP tooling resins, MCP-HEK has developed a material which fulfils all the requirements completely. Molds produced in EP 250 show an extremely high glass transition temperature and compressive strength. Shrinkage is negligible at approximately + 0.02 percent.
Despite the high aluminium filler content of 80 percent, EP tooling resin demonstrate excellent casting properties with high surface finish reproduction from any type of model.

Chemical resistivity is above average and the high quality dense surface can be polished to a mirror like finish if required. For mold changes and alterations, EP tooling resin molds can be reworked easily without losing mold stability and strength. EP tooling resin tooling resin makes possible the manufacture of quick, economically acceptable injection molds and quality parts.



The mold in production on the injection molding machine.

MCP melting pots & tanks for casting and re-cycling MCP alloys. Capacities from 150kg up tp 60.000kg.

cast against this model to produce the first half of the tool. Demolded the model after cooling and lay up the casting with pattern maker´s sheet wax in the required thickness of sheet metal required, for example 0.8 mm and cast low melt alloy against the wax sheet. Within a matter of hours after casting, the tool can be on the press to produce prototypes and small runs in materials up to 3 – 4 mm. The process offers options of integrating steel inserts and die plates for extending tool life up to 2 – 3000 parts and casting tools with blank holders for deep drawing applications.

Literally any size of tool, when left to cool overnight can be opened the following day to produce metal pressings. Due to the accuracy and excellent surface finish of the alloy, no extra machining, fitting or dressing is required.

System Specification:

MCP 137 Low melting point alloy and melting equipment are the basic requirements to produce tooling. Melting tanks are supplied in sizes ranging from 150 kg (approx 330 lbs) melting capacity and up to 60 metric tons alloy capacity for producing automotive floor pan press tools.