H E A T & C O O L

Casting/ Metal Mould

Manual

FUJI SEIKO LIMITED MATSUI MFG. CO., LTD. Mitsubishi Corporation Technos



1. What is HEAT&COOL Casting · Metal Mould?

We propose a solution for moulding problems with our metal moulds.

A problem that is troubling the Moulding Industry; the weld line. The engineering invention that solves this problem is our HEAT&COOL metal mould. (2000)

We have succeeded in making weld lines nearly invisible by heating the mould's surface to 150 °C, resulting in better liquidity of the resin to delay hardening of the resin joining part. Heating and cooling alternate repeatedly in the same route using steam heat from the boiler (medium temperature of 180°C) and cooling water from the cooling tower (medium temperature of 30-35°C). Using the same medium route helps to achieve smooth heating and cooling. Heating and cooling the mould's surface is technology to create cast products with added value.

The metal mould and controller are merely the means. Our target is to help create moulded products with added value and that is why we provide support to our customers.

HEAT&COOL Metal Moulds

If the product is a 2D shape, a stable temperature distribution can be maintained even with a straight line medium route. However, if the product shape is a 3D and the medium route is in a straight line the temperature distribution will vary resulting in irregular transfer (for colour and shine).

We have created a medium route parallel to the 3D surface by dividing the cavity surface in two. This improves the cycle with uniform temperature distribution during the cooling process and enables creation of stable moulded products.

We have the idea, but how do we process such complicated shapes?

It was the "Aerial Multi-Faceted Metal Mould Processing Machine", the so called "Mr. Rotation", developed by the Makino Milling Machine Co., Ltd. that resolved this problem.





2. HEAT&COOL Device

a) Heated water system (MATSUI MFG. CO., LTD.)

Mould's surface temparature is maximum of 140 °C.

Hot water is used as the heating medium (medium temperature of 160°C is supplied from the mould temperature controller) and water as the cooling medium (temperature 40°C). It is suitable for trial, testing, and mass production, and for moulding machines of less than 200 tons.

The temperature controller is a common type which can be used as a normal mould temperature controller.



b) Steam system (MATSUI MFG. CO., LTD.) RHCM-100G and RHCM-200G (Under development).

Mould surface temparature is maximum of 160 °C.

Hot water is used as the heating medium (medium temperature of 180°C supplied from the mould temperature controller) and water as the cooling medium (from cooling tower at temperature 30-35°C).

It is suitable for mass production moulding.

The machine comes in two systems i.e. One-system control (100G) and Two-system control (200G).

One-system control is the standard system, and the Two-system control is useful for setting different temperatures in the cavity and the core, or for using multi-technologies.



This machine's product catalogue is available from the download box.

c) Oil system (MATSUI MFG. CO., LTD.)

Mould surface temparature is maximum of 250 °C.

Hot oil is used as the heating medium (Barrel Therm 400: maximum medium temperature of 320°C) and oil as the cooling medium (Barrel Therm 400: minimum temperature 40°C). It is suitable for R&D and mass production moulding (special use: metallic material or super engineering plastic). One heating device is the standard and one more heating devices can be added as back-up.

The back-up device is useful to prevent any sudden decrease in temperature or to maintain the temperature for a certain period of time when using a large quantity of oil with a large-size metal mould.





d) Electromagnetic guidance ROCTOOL

Mould surface temparature is maximum of 380 °C.

Heat source is the coil set in the mould where a magnetic field and heat are generated by charging the coil.

Cooling medium is water (medium temperature of 30-35°C supplied from the mould temperature controller).

It is suitable for R&D and mass production.

It is suitable for press forming of Carbon Fiber Reinforced Thermo-Plastic (CFRTP), compounds of next generation materials, heat reversible resins, and carbon fiber. Electromagnetic induction heating (generator) can be selected from 50kw/100kw/200kw. It requires a cooling device and a 400V transformer to cool the generator and the work head.

The principle is the same as for an IH cooing heater. (IH = Induction-Heating)



Please refer to the URL below for details http://www.roctool.com/jp/index.php 3. Examples (in Historical Order of Development)

a) Resolution of Appearance Problems (Weld line): Weldless Casting (Developed in 2000)

We have resolved problems such as weld line and silvering by heating the mould's surface to improve resin liquidity and delay hardening of the resin joining part.





b) Polished surface: Piano Black with Filler (Developed in 2000)

Sheen is obtained even when contaminated with glass filler, which remains hidden below the surface. It is believed that methacrylic acid in the resin develops a protective skin layer.





c) Realization of thinness (below 1mm to 0.3mm) (Developed in 2000)

Heating the mould's surface improves liquidity of the resin to achieve thinness and areas that could not be moulded previously.

d) Resolution of problems for thickening (over 5mm to 25mm) and improvement of the cycle (Developed in 2000).

Conventional thick-section moulding had problems such as deepening weld lines, flow marks, and vacuum voids leading to air-bubbles.

However, all these problems were resolved by heating the mould's surface.

Also the cycle time has been shortened significantly with the high cooling effect.

e) Improvement of size precision and thinning, resolution of sink marks, and bowing: Gas press moulding (Developed in 2007).

By injecting nitrogen gas from the core side, the product's surface is pressed evenly. As it does not depend on projection pressure, it achieves a reduction in size of the moulding machine at the same time.

An anti-gas leak wall is not required with this device in the mould, even for a product with holes.



f) Prevention of bleaching of the gate. In-mould gate cutting (Developed in 2007).

This is a technology to prevent or making it difficult to see whitening in the gate due to ingenuity in the gate cut. It makes a significant contribution to intensification of processes in overseas production facilities.







No whitening in the gate cut

g) Easing of internal stress, shortening of thickening cycle, improvement of a smooth surface (MOULD PRESS) (Developed in 2010).

This was achieved only with ingenuity in the mould without using an ink injection press. Resin stress becomes stable in the mould in a regular moulding machine preventing shrinkage and distortion. It achieves more than a 30% shorter cycle time compared to regular moulding.



h) Product with zero-draft angle. Draft-less mould (Developed in 2010).

This is a unique technology where the product cannot be removed if there is no draft angle. It is a special meal mould using the contraction coefficient of aluminium material without any sliding structure. Our experience in development of aluminium moulds for mass production (1 million shots achieved) is fully utilized in this technology. It significantly increases the degree of freedom in design and products.



i) New proposal for surface design (Developed in 2011).

A new idea for surface designing proposed by the Makino Milling Machine Co., Ltd. Photographic images and design data are received as STL data and NC data is developed using the special software STL-CAM. The design is then transferred directly and processed onto the mould surface in the Makino Machining Centre where stable and high-speed processing is made possible for a long period of time. Also, heating the mould's surface improves transferability of the design pattern onto the product's surface. The Fuji Seiko Co., Ltd. also manufactures moulds incorporating this technology.





Design by D3Texture(R)

j) Metallic material orientation-less moulding (Developed in 2011).

For over a decade, the market has been expecting metallic material technology but they could not resolve the problem of orientation. We have achieved a moulding technology to make such orientation nearly invisible by heating the mould's surface to over 200°C, using a special metal mould structure that manipulates even particles of aluminium flakes that caused such orientation as well as a high-heat resistant resin.



In normal moulding, orientation ocurrs in the resin merging section.



High temperature heating of mould's surface eases orientation



Orientation is resolved with high temperature heating of the mould's surface + a special mould

4. Q&A

a) How much longer is the HEAT&COOL moulding cycle compared to normal moulding?

Generally it takes 1.1 to 1.2 times longer.

In some cases the cycle time has been shortened by using HEAT&COOL moulding for moulded products requiring high appearance quality and products requiring a long cooling time for anti-distortion. For thick section moulds of over 5mm, 0.5~0.7 times has been achieved in some cases.

b) How much more does a HEAT&COOL mould cost compared to a normal mould?

Generally, it costs about 1.1~1.2 times for 2D, and for 3D about 1.5 times.

c) Can you give us some examples of using HEAT&COOL moulding?

The very first user in the world was one of the domestic electronic manufacturers for their note PC's exterior parts. Korean electronic manufacturers used it for their flat screen TV's bezel parts, which has contributed to promoting the product's global popularity. An increasing number of companies are adopting our HEAT&COOL technology in the global product development field for environmental protection and cost reduction efforts.

d) What is the current trend in market demand?

Demand for cost reduction is ever increasing. Since we proposed less-orientation moulding of metallic materials (IPF2011), demand for coating-less and reduction in the pre-decoration process is becoming stronger.

The quality requirement by Japanese customers is the highest in the world and we are making our best efforts to develop a practical application of this technology along with our customers and resin developers.

e) Can you tell us about the patents for HEAT&COOL moulds and metal mould patents?

There is no patent restriction for 2D HEAT&COOL moulds. For 3D moulds, Fuji Seiko has the patent. The license fee is included in the cost of moulds produced by Fuji Seiko. Patents owned by SABIC Innovative Plastics Japan, the resin developer, and those by Ono Sangyo Co., Ltd., are cross licensed. Rights to use this license are included in the steam system device provided by the Matsui MFG Co., Ltd. Patents owned by ROCTOOL can be used only by customers having a license agreement with ROCTOOL for production. (Packages for development, testing, and for mass production are available).

f) Does surface hardness change with HEAT&COOL?

Grade	HEAT&COOL Process	Regular Casting
CYCOLOY*CU6800	HB	2B
(PC/ABS)		
LEXAN*DMX2415	2H	Н
(PC)		
LEXAN*SLX	Н	HB
(PC)		
ABS Resin	2B	2B

It depends on the type of resin but the surface hardness will improve.

(Provided by SABIC)

g) Is there any problem with the durability of HEAT&COOL?

All the moulds we provide are all for mass production and we have provided our products all over the world and we have never experienced any mould structure related issues with our customers.

Some troubles we have experienced are;

- Steel material eroded due to use of pure water as the cooling water. (Site: China)
- Impurities (silica) in the cooling water blocked the medium route. (Site: Thailand)
- h) Is Fuji MDG the only company that can manufacture HEAT&COOL?

We have provided HEAT&COOL mould manufacturing technology (2D) to over 20 companies overseas. We plan to continue provision of 2D/3D mould manufacturing technology in the future. (Please contact us).

 i) Is Mitsubishi Corporation Technos the sole sales agent for all HEAT&COOL moulds/ devices?

For moulds for mass production, Fuji MFG, the manufacturer is basically the sales agent. Mitsubishi Corporation Technos is the sales agent for purchases of trial moulds and devices as a package or purchased of all devices.

j) What about confidentiality for trial production?

A confidentiality agreement will be drawn between Fuji MFG, Mitsubishi Corporation Technos, and the customer as required by the customer.

k) What shall we do if we want to know more about HEAT&COOL moulding/ moulds or conduct tests?

We propose the following steps.

- Step 1) Please come and see us at Fuji Seiko (Ohta City, Gunma pref., Japan). You will be able to know more about us through seeing our mould samples and factory visit.
- Step 2) You can try our moulds from the selection of our trial moulds owned by Fuji Seiko (for a fee of Yen250,000 per day excluding tax). The customer needs to bring the necessary materials and is required to attend the trial.
- Step 3) Customer orders a trial mould in order for us to test the customer's actual products. We provide an estimate including details of the moulding cycle time.
- Step 4) Arrangement for mass production, selection, and installation of machinery and HEAT&COOL moulding start-up.



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