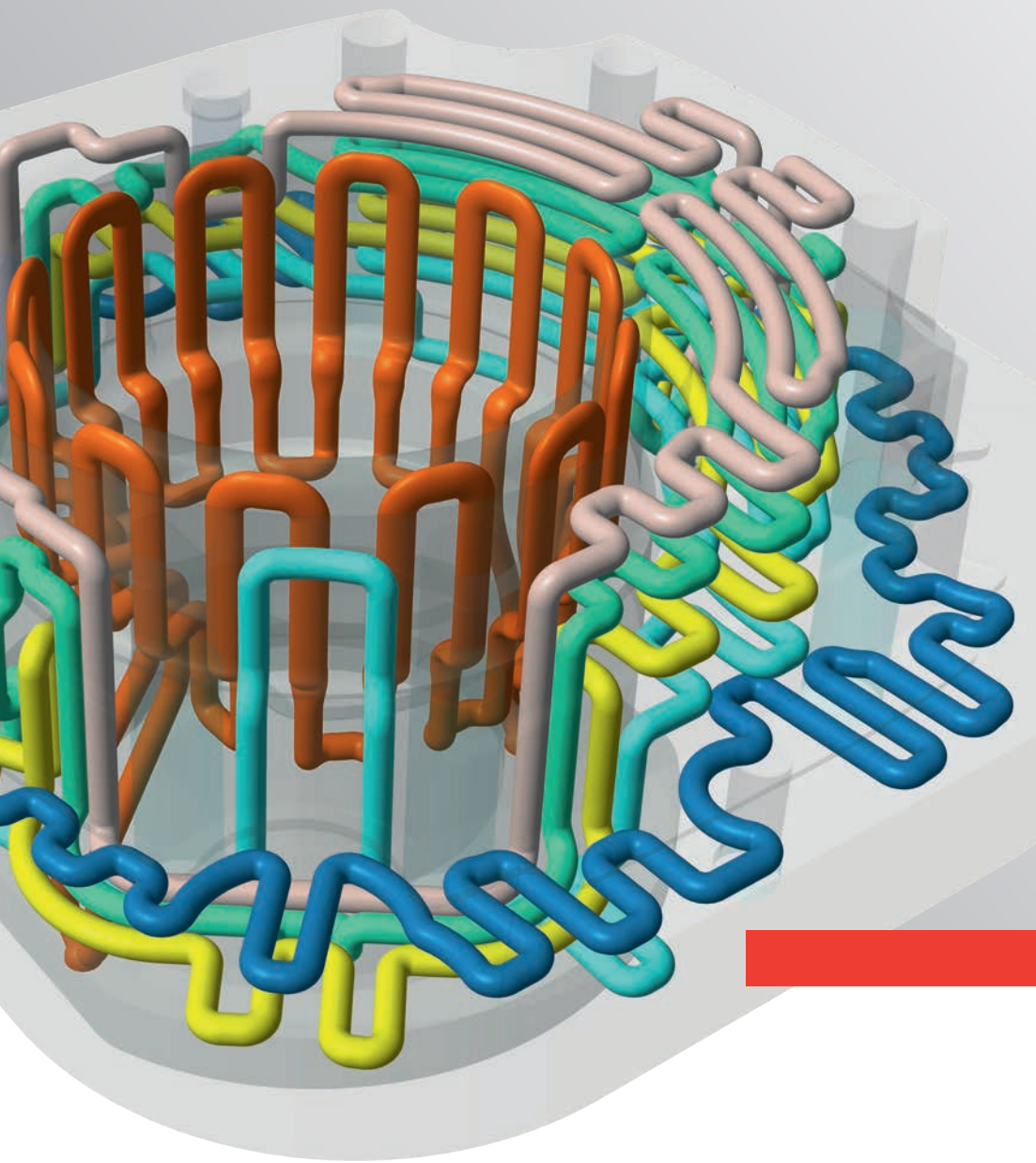


iQ temp

Intelligence + quality for moulds and dies

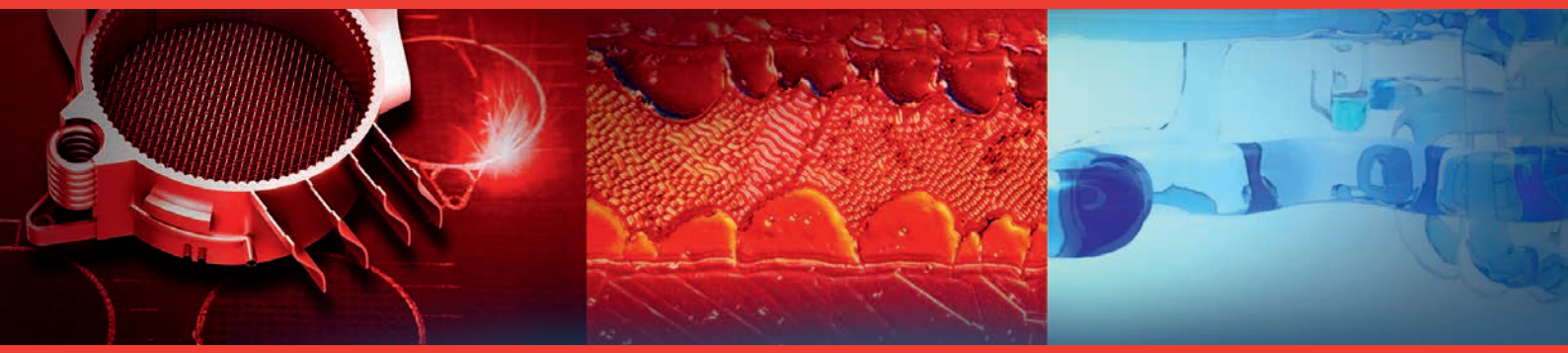
CONFORMAL COOLING
PAR EXCELLENCE

www.iqtemp.com

centre of excellence for conformal
cooling of the hotset group

hotset

Intelligence + quality for moulds and dies



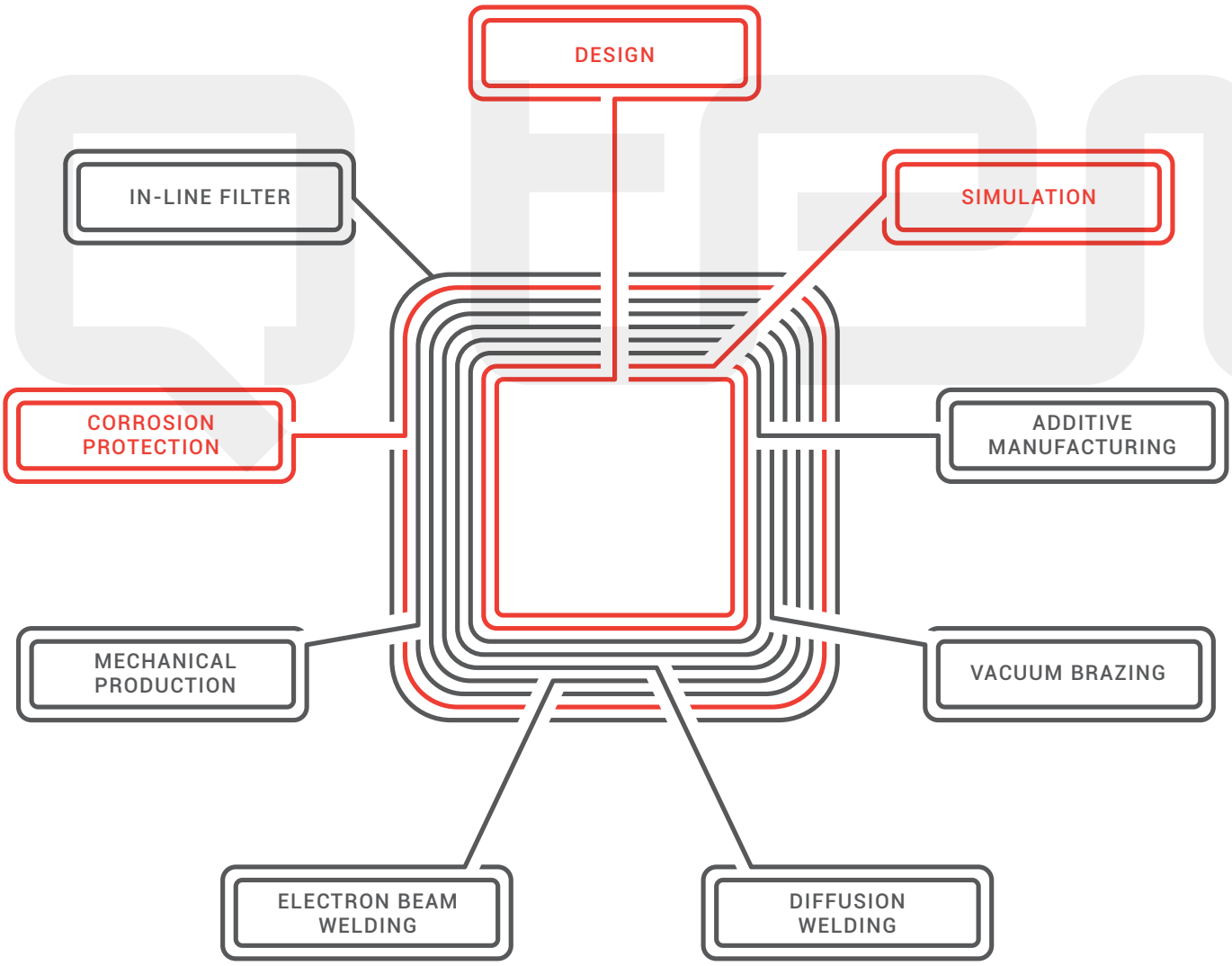
iQtemp – a division of hotset group

The key to an efficiently temperature-controlled tool lies in an intelligent technology mix of different processes. We offer trans-technological solutions individually for your mould.

Even more important than selecting the right technologies is the design of the temperature control system. We place great importance on homogeneous temperature distribution, balanced flow conditions in cooling channels and even wall temperature of the inserts subject to conformal temperature control.

For the best solution regarding temperature control, we work closely with our customers in order to get a full understanding of their exact requirements and to be able to propose the optimum solution.

THE BIGGER PICTURE



The intelligent technology mix for conformal temperature control

ENGINEERING FROM IDEA ALL THE WAY TO FULL-PRODUCTION COMPONENT

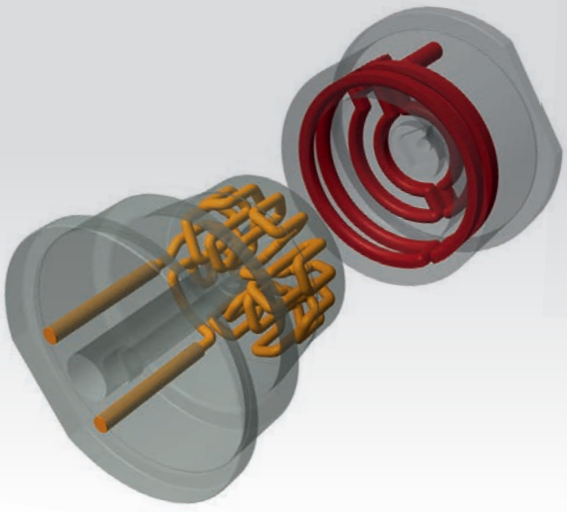
In a structured process we ascertain the client needs, work up proposed solutions and select the optimum process and technology in terms of quality, efficiency and cost. Our specialists are available as advisors with their tool and design expertise for targeted, temporary reinforcement of client projects. As a result of taking this approach, we have become a much in-demand partner when it comes to sophisticated temperature control jobs.

The iQtemp engineering team has over 17 years of experience in the design and simulation of conformal cooling systems.

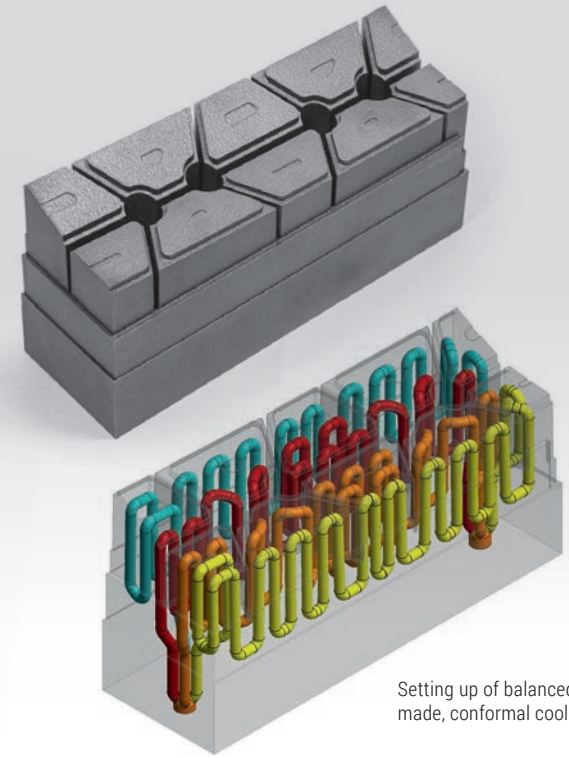
We place great value on holistic, cross-technology optimisation, in which account is taken of conventional temperature control too.

We work very successfully with cooling channels connected in parallel, with which we ensure short flow paths with the highest possible flow rate and optimum flow. Through our balancing of the cooling system we guarantee in the process identical flow conditions in all channels. The cooling system is positioned uniformly parallel to the tool wall. In this way the greatest possible heat transfer and a homogeneous temperature distribution are achieved.
Suitability for series production and high maintainability are both equally important to us.

DESIGN



Highly efficient moulds thanks to an intelligent technology mix



Setting up of balanced, additively made, conformal cooling

OUR PERFORMANCE RANGE:

- **Design of the optimized and balanced temperature control**
- **Generation of 3D data for temperature control**
- **Preparation of production drawings for the semifinished products with dimensions and tolerances (blank parts for brazing, hybrids)**

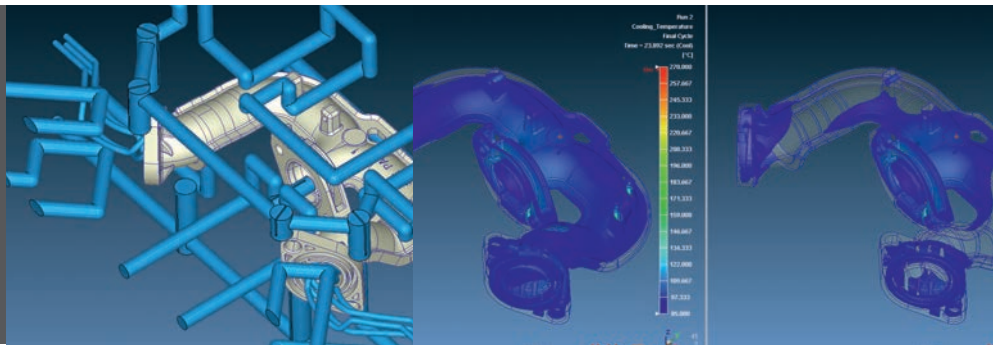
Simulation services will help you to shorten the development times of your products and optimize component and process quality with the help of improved knowledge right from the start. Every component has its own history. With our many years of experience in designing and simulating mould temperature control systems, we can help you to optimize your mould inserts in a targeted way to suit your application.

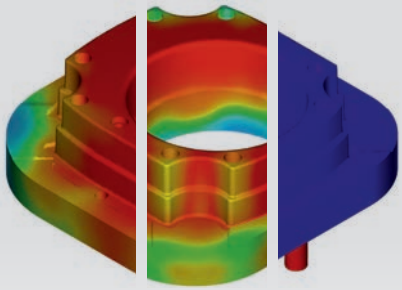
With our **injection moulding simulation**, we carry out a virtual optimization of your injection mould tools. We reproduce your injection moulding process and ascertain the potential for improvement. From this we design the optimized temperature control, with which a further, comparative simulation is performed. The results get compared in a presentation.

CFD simulation is used for reliably determining flow velocity and flow rate of the conformal cooling. These results are incorporated into the injection moulding simulation and ensure a high level of precision. Simulating complex heat exchange processes is equally possible (see next page).

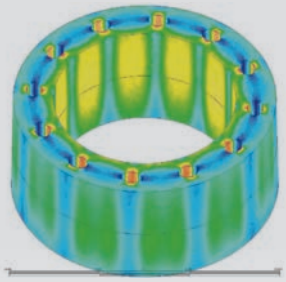
Core strength calculations, mechanical optimization and lightweight constructions are carried out and verified by means of **FEM structure analysis**. In this process we can calculate among other things whether your tool components can withstand the forces from injection pressure and melt front.

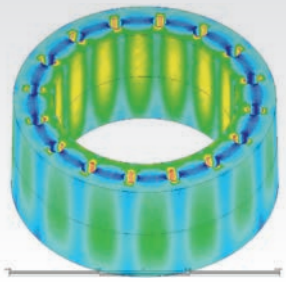
SIMULATION





CFD simulation – heat exchange process





Modelling based on the Finite Element Method (FEM) - component stress levels with 12 elliptical cooling channels in comparison to 16 round cooling channels

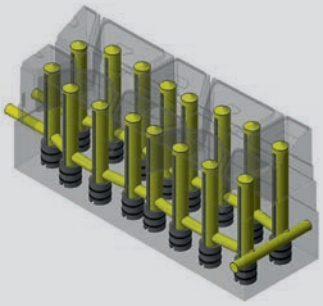
OUR PERFORMANCE RANGE:

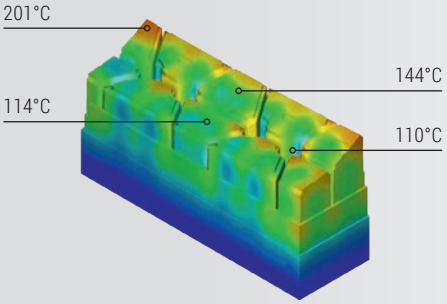
- **Injection moulding simulation**
- **CFD simulation (flow, flow rate, heat exchange)**
- **Simulation of highly efficient variothermal temperature control**
- **FEM structure analysis**

COOLING VARIANTS — A COMPARISON

INITIAL TEMPERATURE 250°C - COOLING TIME 10 S - WATER TEMPERATURE 20°C

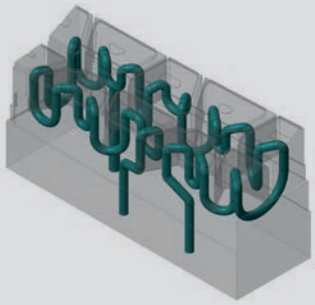
Conventional model using riser bores and baffle

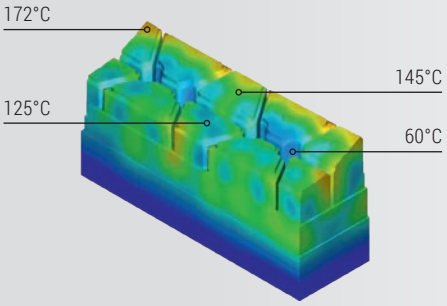




	3.5 bar	6 bar
Volume flow	4 l/min	5.2 l/min
Mean flow velocity	2.7 m/s	3.5 m/s
Reynolds number	9,800	12,740

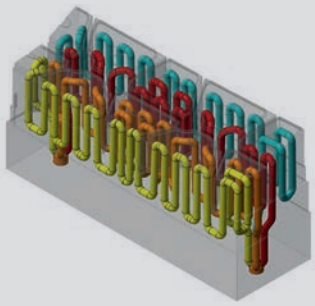
Non-optimized, simple additively manufactured temperature control

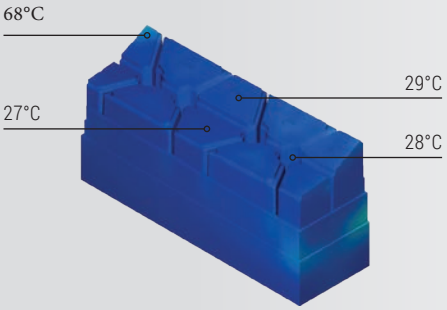




	3.5 bar	6 bar
Volume flow	10.5 l/min	13.7 l/min
Mean flow velocity	4.5 m/s	5.9 m/s
Reynolds number	22,500	29,250

Optimized additively manufactured temperature control at iQ temp





Temperature control system completely balanced. Identical flow conditions in all channels

	3.5 bar	6 bar
Volume flow	10.2 l/min	13.2 l/min
Mean flow velocity	3.5 m/s	4.5 m/s
Reynolds number	14,000	18,200

Simulated flow rate per channel at 3.5 bar:

Channel 1	2.53 l / min
Channel 2	2.56 l / min
Channel 3	2.53 l / min
Channel 4	2.55 l / min
Total	**10.2 l / min**

MANUFACTURING PROCESS

BETTER COMPONENT QUALITY WITH SIMULTANEOUS REDUCTION OF PRODUCTION CYCLE TIMES

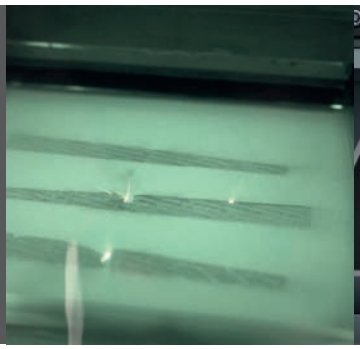
The additive manufacturing technology on metal basis offers excellent engineering freedom for complex and conformal temperature control in injection moulds and die-casting tools. Such an active conformal cooling can be reliably used even in intricate contour areas of c. 3 mm or more.

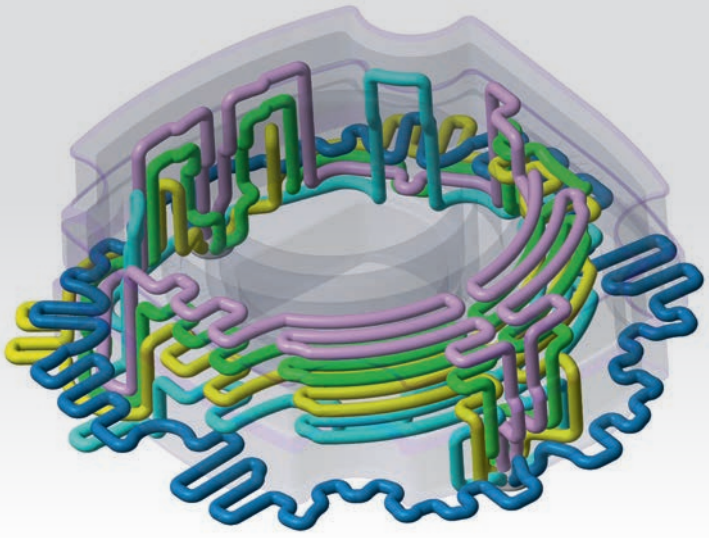
In the powder bed method metal powder is applied to a base plate in coats of 0.04 - 0.06 mm using a recoater and is homogeneously welded using a laser. During this process, components are produced by melting layer by layer. For the manufacturing process we have the materials 1.2709, Böhler M789 (corrosion-resistant) and Böhler W360 available to us.

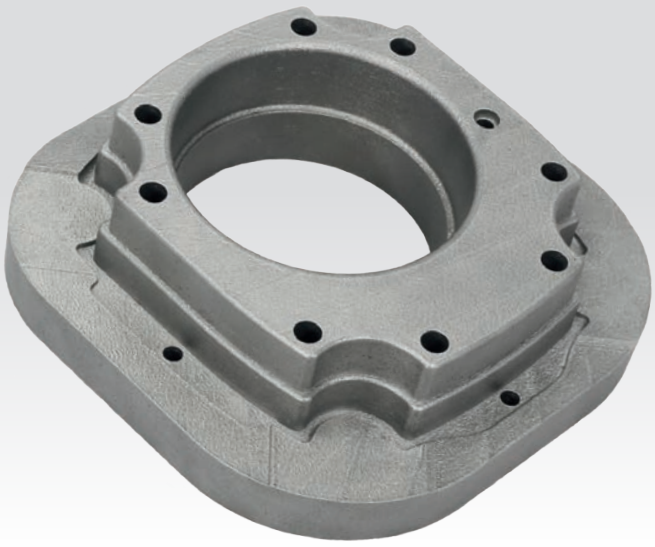
The components are shipped with the hardness and machining allowance specified by the client.

Large and voluminous mould inserts are for reasons of cost often made in hybrid technology. Here the contour area is built up layer by layer on the hybrid blank made conventionally of the original material. These hybrid blank are made by the client to design data supplied by iQtemp. If desired, we can take on this hybrid production for you.

ADDITIVE MANUFACTURING







10 cooling channels Ø3 mm, leading off from a common inlet and outlet. Balanced in terms of flow mechanics (identical flow conditions in every channel), as a result completely homogeneous temperature control.

Cooling time reduction of 60%.

MANUFACTURING PROCESS

BETTER COMPONENT QUALITY WITH SIMULTANEOUS REDUCTION OF PRODUCTION CYCLE TIMES

Vacuum brazing is a jointing technology proven over many decades that, with atmosphere excluded, facilitates at high temperatures extremely high-strength bonding of homogenous and heterogeneous materials. This occurs with the aid of a piece o brazing metal - for steels used in mould making on the basis of a nickel alloy. This brazing metal has the ability when smelted to create a whole-area, metallurgic diffusion bond with the base material. This joint is extremely strong and impervious to fluids and gases.

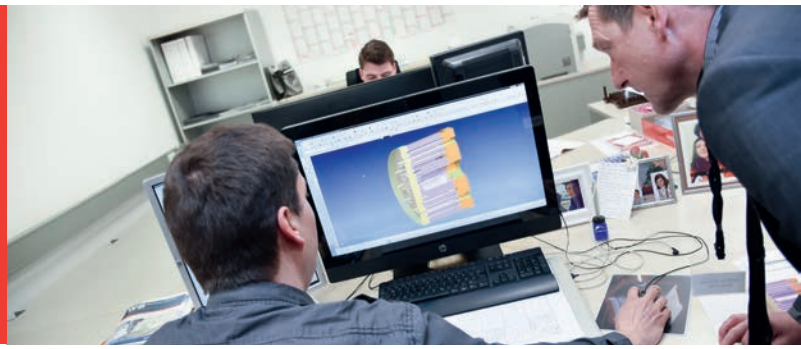
The brazing temperature for mould inserts corresponds with the hardening temperature of the standard hot-work and cold-work steels used in mould making. Hardening is thus integrated into the vacuum brazing process. The most commonly used steel grades for vacuum brazing include 1.2343, 1.2344, 1.2083, Böhler W360, Böhler W302, STM Fastcool 50; 1.2379. Other steels on request. We would be happy to check other materials for you.

For vacuum brazing the mould inserts can be systematically split up into components. This is done in discs or using the core/sleeve prinicple (See illustrations below)

This enables the cooling channels to be very simply made mechanically and the components to again be joined together to form an impervious insert through vacuum brazing.

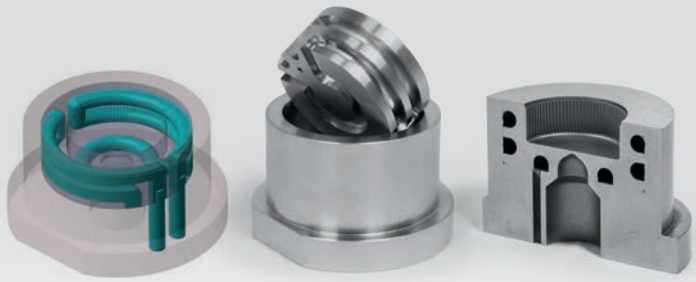
The brazing blanks for the vacuum brazing process are made by the client to design data supplied by iQtemp. If desired, we can take on this production for you.

VACUUM BRAZING

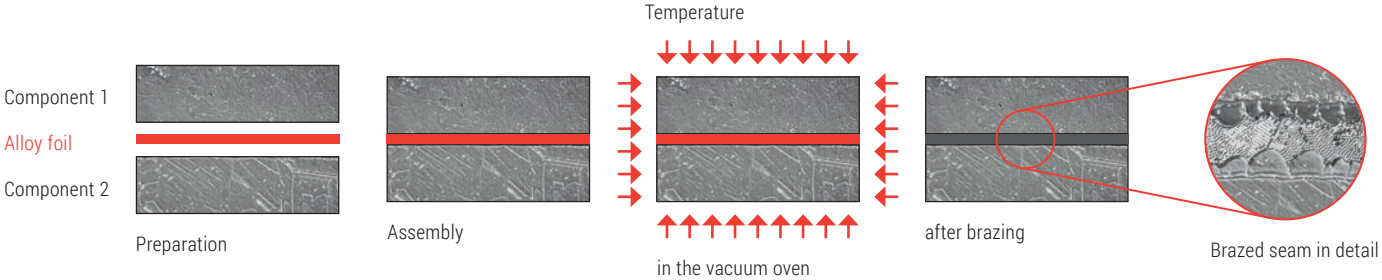


3 discs, 6 cooling channels Ø3 mm, leading off from a common inlet and outlet. Balanced in terms of flow mechanics (identical flow conditions in every channel), as a result completely homogeneous temperature control.

Cooling time reduction of 55%.



Core/sleeve prinicple. Cooling channel Ø6 mm, optimum embedding of the mould contour into the cooling.



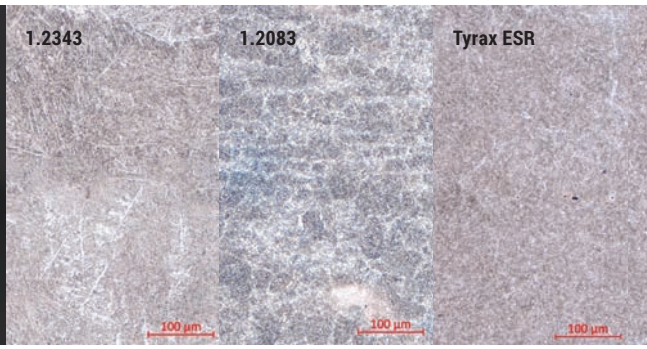
Diffusion welding is a materially bonded jointing method, in which no filler material needs to be used. The welded joint is, even when polished, visually unnoticeable. The welded joints have identical characteristics to the base material.

The components to be joined are pressed together under a high vacuum, at high temperatures and at a high level of pressure. This results when solid in a material exchange and thus to a high-strength welded joint. As no filler materials are used, there is also no noticeable joint zone.
Diffusion welding can be used both for joining materials of the same kind (steels, aluminum, copper, titanium and nickel alloys) and for combinations of materials.

THE AREAS OF APPLICATION FOR THIS PRODUCTION TECHNOLOGY ARE DIVERSE, INCLUDING:

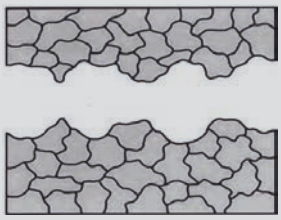
- **Temperature-controlled injection moulds and heat channel distributors**
- **Temperature-controlled die casting moulds**
- **Cooling plates for semi-conductor technology**
- **Plate heat exchanger for power electronics**

DIFFUSION WELDING

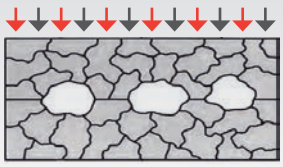


CUSTOMER BENEFITS:

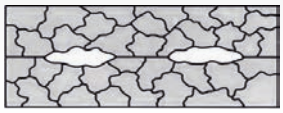
- **Materially bonded and thus highly resilient and temperature-resistant joints.**
- **Low-pore and low-warpage joints.**
- **Components can be highly polished, as there is no noticeable joint zone. Therefore also suitable for plastic spraying of transparent parts.**
- **No oxidation of the components, as the process takes place in a high vacuum.**
- **Diverse combinations of different materials possible.**



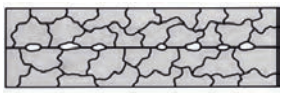
Component surfaces prior to welding



Pressure and temperature



Smoothing out the pores



Closing the pores

Components welded together

OUR PERFORMANCE RANGE:

- **Advice on the choice of material and on design**
- **Performing test welds**
- **Diffusion welding of full-production components**
- **Heat treatment of the welded components to client specifications**

One of the biggest problems in use is the blocking of the cooling channels by rust or contaminated water. In order to avoid such disruptions, iQtemp has developed stainless steel filters and coatings that provide protection against corrosion.

CORROSION PROTECTION

ANOXPRO

The revolution in corrosion protection for conformal cooling channels

Uncoated channels after 230 hours of salt spray testing (NaCl solution as per DIN EN ISO 9227) with heavy corrosion

Coated channels after 230 hours of salt spray testing with minimal corrosion

Up until now there were no effective treatments to guarantee corrosion protection for additively manufactured, conformal cooling channels available. The new AnoxPro coating finally offers a solution:

- Optimum protection for channels with extremely small diameters and long channel lengths
- Treatment does not affect the advantageous heat exchange effect due to typical surface roughness of additively manufactured surface structures
- Additional active corrosion protection due to metallic particles in lacquer coating
- Suitable for variothermal processes with cooling media temperatures up to 180°C

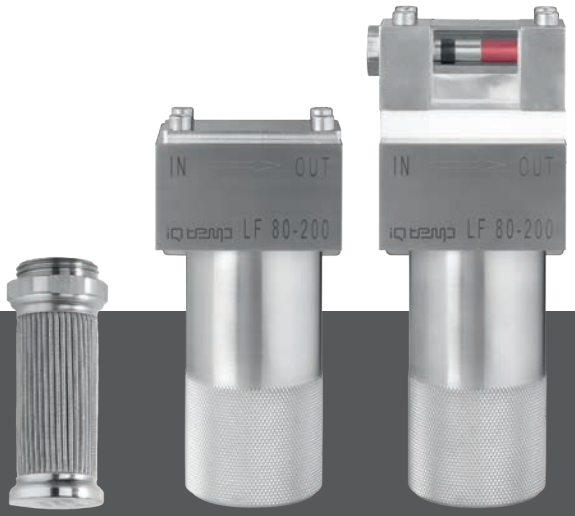
Innovative lacquer coating with active protection mechanism

The special coating mechanism of AnoxPro offers the advantage that the geometry of the cooling channels does not affect the coating thickness. The average coating thickness is 10 µm. Therefore AnoxPro can be used universally for a wide range of cooling/heating channel geometries.

Whereas up to now only passive layers had been available, the new innovative AnoxPro lacquer system contains metallic particles. These act as a sacrificial anode and hence maintain a persistent, active protection against corrosion even in the case of small defects in the coating layer.

Is also offered for other products as a service

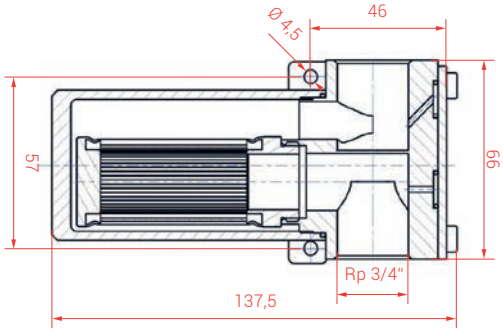
STAINLESS IN-LINE FILTER



LF 80-200

Reliable protection of your cooling/heating channels

Dirt particles in coolants often result in clogging the small cooling channels, which render the mould inserts unusable. The low-maintenance LF80-200 stainless steel in-line filter provides inexpensive, excellent protection against foreign particles, especially for conformal cooling channels of injection moulds. The filter can be flange-mounted to the mould or operated directly with temperature control units.
The high filtering performance is based on a star-shaped pleated stainless steel screen, which prevents any particles > 200 µm penetrating into the cooling channels.



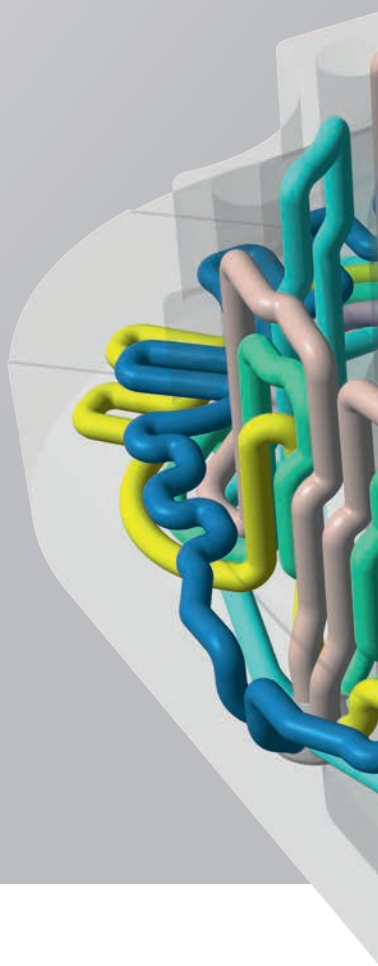
Very versatile
The filter is suitable for water-based or oil-based coolants with a flow rate of up to 80 l/min and offers diverse possible uses within a temperature range of -10 to +260°C and a pressure level of 16 bar.

Easy maintenance
Thanks to its low-maintenance concept, the filter insert can easily be taken out and cleaned using compressed air, an ultrasound bath or a high-pressure cleaner. The filter housing remains in the system circuit.

The LF80-200 is optionally supplied with a maintenance indicator.

ALL BENEFITS AT A GLANCE:

1. **Inexpensive with high filter performance**
2. **Easy maintenance and cleaning**
3. **Suitable for high flow rates**
4. **Large temperature range**



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