



Made by Drache.
Casthouse Technology –
worldwide.



English version

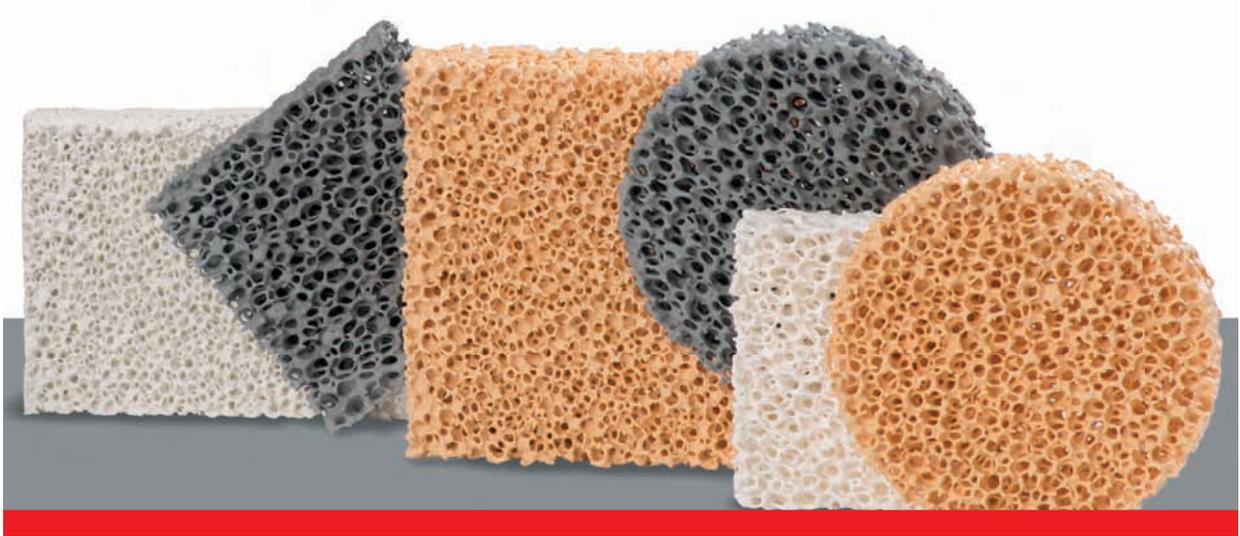


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In excellent shape all over the world: innovative foundry technology.

As a valuable raw material, metals are becoming increasingly important for the environment in terms of quality and cost aspects. Drache GmbH offers customers innovative solutions for foundry technology all around the world.



Due to the high quality demands on our products and our innovative strength, customers value us as a service-oriented, innovative problem solver; as a partner who responds to current market demands and meets the production requirements of tomorrow – today. That's why we are very active for suppliers to the aerospace industry.

What sets us apart is our consulting expertise, based on many years of experience around the world and continuous development. When providing advice on engineering, customers can expect tailor-made solutions for their specific requirements prior to awarding us with the contract – in terms of material selection, cost and energy efficiency, temperature and flow, as well as environmental compatibility and safety.

As a market leader, we strive to assist you in a responsible and long-term manner. Our service naturally includes the start-up and inspection of the systems on-site. In the rare case of an emergency, a service team will be with you quickly so that production can continue.

**Take advantage of Drache's services and products –
all in excellent shape.**



■ A burning desire for quality made in Germany.

Since its founding by Frank Drache in 1984, Drache GmbH, with satisfied customers worldwide, offers a wide range of innovative products and equipment for foundry technology.



Starting with the first ceramic foam filters, which are still an active constituent of our product focus. Today, Drache GmbH provides its satisfied customers around the world with the whole range of innovative products for the foundry industry. We also focus on providing a solution in line with customer-specific requirements, the quick and uncomplicated execution of projects, as well as reliable long-term partnerships in order to meet all the criteria needed for quality that is made in Germany.

Therefore, production capacities at the sites in Diez, Germany, have increased continuously since the company was founded, with new investments made in modern machinery and furnaces, along with constant optimisation of existing systems and internal processes. In order to satisfy customers around the world with solutions from a single source, all the components are planned, designed and implemented for the innovative casting technology here in what has now become two manufacturing facilities.

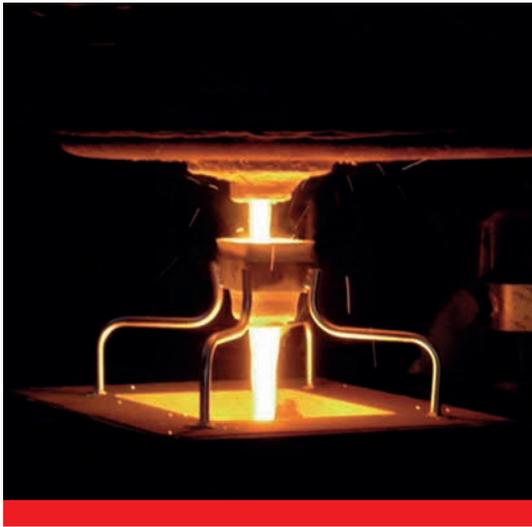
As a global company, we offer additional services:

- Complete relining of filter boxes, launders, deep-bed filters, degassers and transport crucibles on-site or at Drache
- Design and optimisation of filter boxes and launder systems for Aluminium casthouses
- Implementation for purity measurements of liquid Aluminium using the Prefil test unit
- Metallurgical analysis for Aluminium
- Implementation of solidification and mould filling for die casting using the SolidCast simulation software

If you have a burning desire for quality that is made in Germany, please contact us.

No hot metal for us: permanent innovation.

Many claim to be innovative. We are innovative. We do not stop with our own developments, but also constantly seek to take everything we have developed further to an optimum level, in collaboration with renowned institutes and research facilities.



Ceramics and metals are constantly changing. We adapt everything we have developed again and again according to changing requirements.

New developments in metals are repeatedly tested and alloys are further developed, with our own specially created pilot projects.

There are three ceramic R&D engineers as well as a laboratory assistant in our company employed.

We have already demonstrated innovation in many areas. Thus, a large number of materials, which are in use today and established in the global market, have been developed in our own R&D department. We continuously optimise existing products in order to achieve the best application properties.

As early as 1989, we introduced the Original Duplex Filter, which still combines two porosities in one filter. Other established in-house developments include the Ceralu[®] Al₂O₃ filter, the Cerazirk[®] ZrO₂ filter, the Cerazirk LD filter, the Cerapor[®] LD filter and the Cerasic[®] SiC filter. In the area of ceramics, the Drache Fused Silica, the Fused Silica Fine and Fused Silica LD are some of our proven solutions.

However, our innovations are not limited to ceramic components and filters. Drache also offers innovations in engineering for filter boxes and launder systems, which are characterised by a long service life, minimal heat loss and highly efficient, robust, pre-heating systems. For the Aluminium foundries, we have developed a crucible furnace with a more future-oriented energy efficiency when compared to conventional solutions.

If innovations for you are not hot metal, we can work together!

■ For us, responsibility is more than a mere formality.

As a future-oriented company, we are happy to take responsibility for the welfare of our customers and employees. Also, the respectful, environmentally-friendly approach and use of resources are important for us.



As a global company, we naturally meet all of the German and EU Directives. Emission and volume measurements take place at regular intervals in order to protect the health of our employees. Occupational safety and ease of use are a given for us. Thus, all machines in our production sites are tested internally and externally by the professional association in annual audits.

The systems and products we develop on behalf of our customers are also taken under examination in this respect. For example, the fact that our filter boxes stay cooler on the outside is a side effect that affects not only the safety, but also the improved quality and durability of the product. Energy efficiency is not only an issue in the systems and products of our customers, but also in our production halls themselves. Therefore, we use the excess heat of the furnaces in an energy efficient manner.

If responsibility is more than a mere formality for you, get to know us!

Solutions that work together toward one aim: your success.

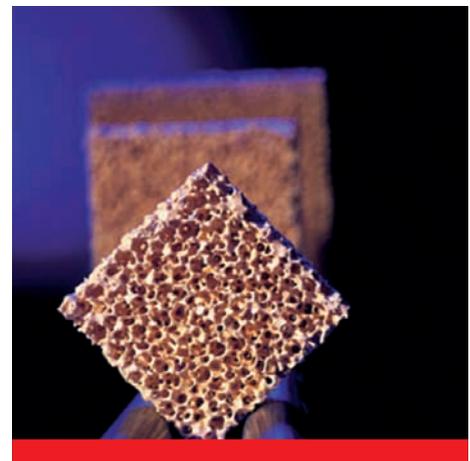
Drache is one of the world's leading suppliers of products for Aluminium DC and continuous casting. With our services and our expertise in engineering, we can meet your individual requirements.



Drache offers a comprehensive product range for Aluminium DC and continuous casting. This includes the Ceralu® Al₂O₃ ceramic foam filter, DBN Boron Nitride coating, DKS Calcium Silicate components as well as a wide selection of services.

In addition, Drache also manufactures fully engineered in-house systems, such as filter boxes, launder systems, pre-heating systems and offers relining for degassers and deep bed filters. Customised designs are also possible on request.

If you are interested in holistic solutions, come and work together with us!



■ We have the best equipment for your smooth processes.



Engineering for the Aluminium DC and continuous casting is performed entirely in-house. From the initial conception and creation of 3D drawings, to the manufacture of parts and their assembly, to their installation and commissioning on-site, we offer you engineering of filter boxes, launder systems and major components.

Want to have systems for smooth processes? Talk to us!

■ Filter Boxes

Drache manufactures filter box systems, which are used in Aluminium DC and continuous Aluminium casting. Drache covers the complete range of services, from the first design, to the complete engineering and manufacturing in-house to the installation, commissioning and operator training all over the world.



- Fully engineered and built by Drache
- Installation, commissioning and training on-site
- Highly efficient heating systems, either gas-fired or electrical
- Easy and user-friendly interfaces
- Optional temperature measurement of the filter tile
- Fully customised solutions can be realised

Laundry Systems



Laundry systems for Aluminium DC casting are also available from Drache as a complete package:

- Fully engineered and built by Drache
- Optimised for a minimised temperature loss, low shell temperature and homogenous flow
- Installation and commission on-site
- Optional lids and heating systems are available

Large Precast Shapes

In addition to 'standard components' such as filter boxes, launders, casting spouts, hot top rings, etc., Drache also manufactures large components for applications in Aluminium casting.

This product group comprises, for example, liners for deep bed filters, degasser inserts and transport crucibles. All components are integrally moulded, dried and fired at our production site so that they can be delivered ready-to-use.

Drache offers the installation of the parts as a complete 'all-inclusive' package of services, with delivery made either at Drache itself or on-site in the foundry:

- Relining services for deep-bed filters (including grid plates), degassers and transport crucibles
- Service can be performed either on-site or at Drache's workshop
- All liners are precast, fired and ready-to-use
- Installation of highly efficient insulation material to minimise the heat loss



■ Ceralu[®] Al₂O₃ Filter



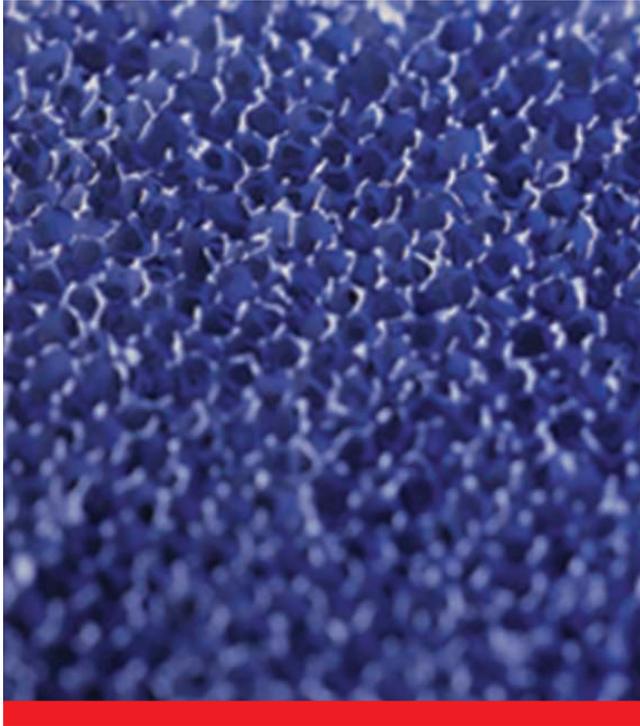
Ceralu[®] Al₂O₃ ceramic foam filters have been used successfully for more than three decades in Aluminium DC casting as well as continuous casting of Aluminium alloys.

Take advantage of Drache Ceralu[®] Al₂O₃ Filters:

- Ceramic foam filters for Aluminium DC and continuous casting
- All common filter sizes and porosities
- Excellent chemical resistance for all alloys, including 5xxx and 7xxx alloys
- Suitable for Al-Li alloys
- Duplex filters
- HF filters



Ceralu[®] HF Filter



The variant of the Ceralu[®] HF filter is always used when very high metal flow rates are required, which cannot be achieved or are difficult to achieve with the common ceramic foam filters.

Duplex Filter

The Ceralu[®] duplex filter combines two different porosities in a single filter, with the coarser pores of the filter on the upper side and the finer pores on the underside of the filter.

This kind of filter was developed by Drache in 1986 and has been used successfully in casthouses ever since.

Duplex filters are available in all standard sizes from 9" to 23". Common porosity combinations include PPI 30/50 and PPI 40/60; other combinations are also possible.



■ DBN Drache Boron Nitride



Drache Boron Nitride (DBN) is a coating for use in aluminium casthouse applications. DBN is highly efficient and has been successfully applied to casting tables, filter boxes, launder systems and other refractory components.

DBN is characterised by excellent non-wettability and excellent chemical resistance to all aluminium alloys. Even very thin coating layers of only 100 microns only already ensure a very efficient separation.

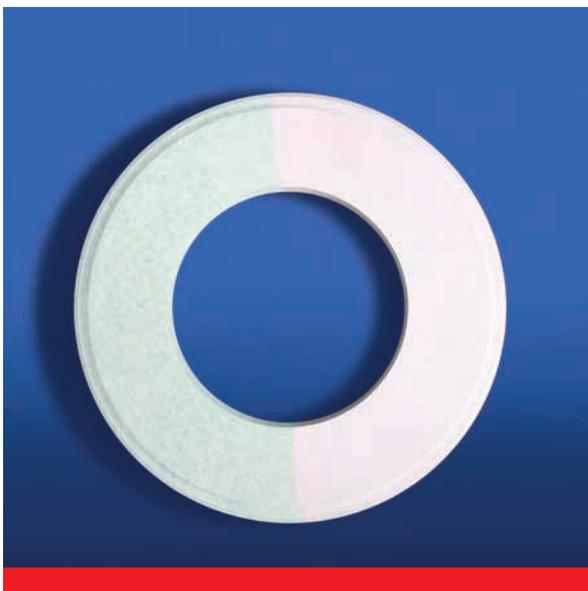
DBN 25 i and DBN 15 i are concentrated coatings, that are diluted with water to the required grade prior to use. DBN 10 i RTU is a pre-thinned and ready-to-use coating. DBN can be applied by brushing, spraying or dipping to refractory materials and metal surfaces.

DBN was developed by Drache and is produced in-house at Drache's own manufacturing facilities. The coating is mixed using the latest technology assuring an excellent and consistent quality. Even supplying larger quantities of DBN with short lead times is no problem at all.

DBN Drache Boron Nitride

The coating is available in three versions, which differ in their boron nitride content: DBN 25 i, DBN 15 i and DBN 10 i RTU.

We will manufacture all variants in colour on request, and only use organic, non-toxic pigments.



In addition to the familiar standard grades DBN 25 i, DBN 15 i and DBN 10 i RTU customised grades are also possible. These customised solutions ensure optimum results even for special applications.

DBN Technical Data

	DBN 25 i	DBN 15 i	DBN 10 i RTU
Colour	Various: white, red, blue	Various: white, red, blue	Various: white, red, blue
Ceramic Constituent:	Boron Nitride	Boron Nitride	Boron Nitride
Binder	Aluminium Oxide	Aluminium Oxide	Aluminium Oxide
Solid Content:	25 % (Boron Nitride)	15 % (Boron Nitride)	10 % (Boron Nitride)
Density	1,24 g/cm ³	1,14 g/cm ³	1,10 g/cm ³
pH value	3-4	3-4	3-4
Max Application Temperature	1000 °C (at air)	1000 °C (at air)	1000 °C (at air)

The above-mentioned values are indicative and not to be understood as assured characteristics.

DKS Drache Calcium Silicate



Numerous components made of Drache calcium silicate (DKS) are used in Aluminium continuous casting and mould casting.

Depending on the specific application, you can choose from two optimised material grades.

These are the grades DKS 150 and DKS 200, which differ by individual strengths.

DKS 200 is reinforced with carbon fibre, making it the perfect choice for transition plates and header plates.

Parts made from DKS are successfully used, for example, as transition plates for Wagstaff billet casting tables, mould rings for Hycast casting tables and mould plates for Hertwich horizontal casting machines. All DKS parts are manufactured according to the customer's specifications and demands.

The components can also be coated with Boron Nitride at Drache.



DKS Technical Data

	DKS 150 Calcium Silicate	DKS 200 Calcium Silicate															
Application	Transition plates, header plates, hot-top rings, launder dams, spouts and other parts for Aluminium casting	Transition plates, header plates, hot-top rings, launder dams, spouts and other parts for Aluminium casting															
Max. application temperature	1000 °C	1000 °C															
Service temperature	850 °C	850 °C															
Chemical composition	50-55 % SiO ₂ 40-45 % CaO approx. 2% others 1.0 – 1.5 % LOI	443-48 % SiO ₂ 38-42 % CaO approx. 2% others 7 – 10 % LOI															
Density	approx. 1040 kg/m ³	approx. 820 kg/m ³															
Mechanical strength	approx. 10 MPa flexural strength approx. 20 MPa compressive strength	approx. 10 MPa flexural strength approx. 16 MPa compressive strength															
Thermal expansion	approx. 5 * 10 ⁻⁶ K ⁻¹	approx. 3 * 10 ⁻⁶ K ⁻¹															
Thermal conductivity λ	<table border="1"> <thead> <tr> <th>Temperature [°C]</th> <th>λ [W/mK]</th> </tr> </thead> <tbody> <tr> <td>400</td> <td>0,25</td> </tr> <tr> <td>600</td> <td>0,27</td> </tr> <tr> <td>800</td> <td>0,29</td> </tr> </tbody> </table>	Temperature [°C]	λ [W/mK]	400	0,25	600	0,27	800	0,29	<table border="1"> <thead> <tr> <th>Temperature [°C]</th> <th>λ [W/mK]</th> </tr> </thead> <tbody> <tr> <td>600</td> <td>0,141</td> </tr> <tr> <td>800</td> <td>0,174</td> </tr> </tbody> </table>	Temperature [°C]	λ [W/mK]	600	0,141	800	0,174	
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Thermal shrinkage after 12 h	<table border="1"> <thead> <tr> <th>Temperature [°C]</th> <th>linear</th> <th>thickness</th> </tr> </thead> <tbody> <tr> <td>750</td> <td>0.05 %</td> <td>0.2 %</td> </tr> <tr> <td>1000</td> <td>0.12 %</td> <td>0.7 %</td> </tr> </tbody> </table>	Temperature [°C]	linear	thickness	750	0.05 %	0.2 %	1000	0.12 %	0.7 %	<table border="1"> <thead> <tr> <th>Temperature [°C]</th> <th>linear</th> </tr> </thead> <tbody> <tr> <td>750</td> <td>0.45 %</td> </tr> <tr> <td>850</td> <td>0.60 %</td> </tr> </tbody> </table>	Temperature [°C]	linear	750	0.45 %	850	0.60 %
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The above-mentioned values are indicative and not to be understood as assured characteristics.



■ Our refractory materials are made with Consistency and Quality.

All materials specially developed by Drache are characterised by excellent properties that – along with the customer-oriented and application-oriented manufacturing in-house – offer many advantages in the production processes.

All the materials we develop are characterised by their excellent properties. Whether this is thermal shock resistance, low thermal conductivity, excellent non-wettability, excellent resistance to alloys, strength or abrasion resistance, Drache Fused Silica (DFS), Drache Fused Silica Fine (FSF) and other refractory materials developed by us can offer you many advantages.

Our in-house production and flexibility in customer-specific and application-specific geometries offer the exact solution to meet your requirements.



If you rely on the quality of special materials, you will find it here!

■ Drache Fused Silica

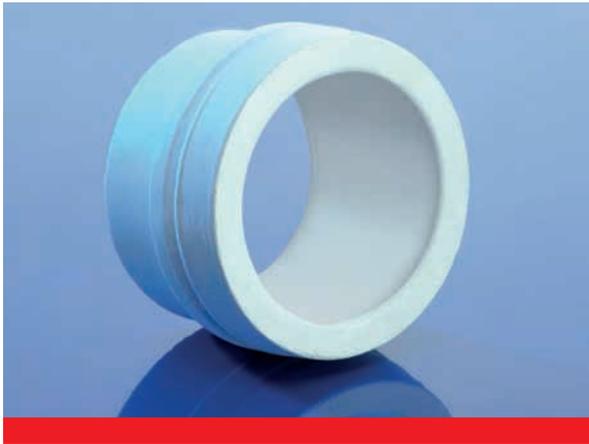
Drache Fused Silica (DFS) is a refractory material specially optimised for use in Aluminium casting. It was developed specifically for this purpose by Drache.



- In-house developed, optimized for Aluminium casthouses
- Excellent thermal shock resistance
- Very good non-wettability as well as chemical resistance against all Aluminium alloys, including Al-Li alloys
- Very good strength combined with a density $< 2 \text{ g/cm}^3$
- Customized shapes and parts
- „ready-to-use“

Drache Fused Silica Fine

Drache Fused Silica Fine (FSF) has, similar to Drache Fused Silica (DFS), an excellent thermal shock resistance, combined with very good non-wetting properties as well as a very good resistance against Aluminium alloys. FSF is optimized for smaller parts with thinner wall sections.



- Similar advantages as DFS
- Optimized for smaller and thin-walled parts (spouts, stoppers, hot-top rings)
- Parts can be pre-coated with Boron Nitride

Other Refractory Materials

In addition to the two in-house developments – Drache Fused Silica and Fused Silica Fine – Drache also utilises other more refractory materials. The resulting use of manufactured components is also primarily in the Aluminium casting.

- SiC-based for parts which require a very high abrasion resistance
- Al₂O₃-base material for parts with very long contact times with liquid Aluminium, like e.g. deep-bed filter liners
- Other, custom-requested materials can be used on request



■ Precast Ceramic Shapes

Drache manufactures a wide range of refractory components for the Aluminium industry, from small components such as spouts and stoppers to large parts such as filter boxes, degasser inserts and deep bed filter modules.

All parts are characterised by:

- Supreme service time
- Very high abrasion resistance
- Very good resistance against liquid Aluminium

Drache produces these components using different materials, although Drache Fused Silica, which is created in-house, is most commonly used.



■ Special Components



In addition to standard components like filter boxes and launder segments, we also manufacture larger parts to customer order.

These include inserts for degassing units, pump well exits, modules for deep bed filters, furnace outlets, pump channel plates, transport crucibles for Aluminium foundries, etc. Like our standard components, if desired these special components can be made of Drache Fused Silica or other refractory materials.

Filter Box Liner

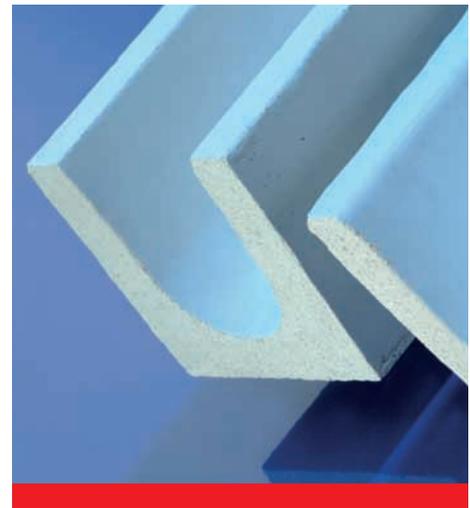
Drache's product range for filter box liners, mainly made from Drache Fused Silica, includes:

- All common filter box sizes starting from 7" and 9" up to 23" and 26"
- Double filter box liners
- Filter boxes with staged filter seats
- Fully customised design available
- For all filter box liners, the corresponding inlet launder, step-up troughs, etc. can be offered



Launder Segments

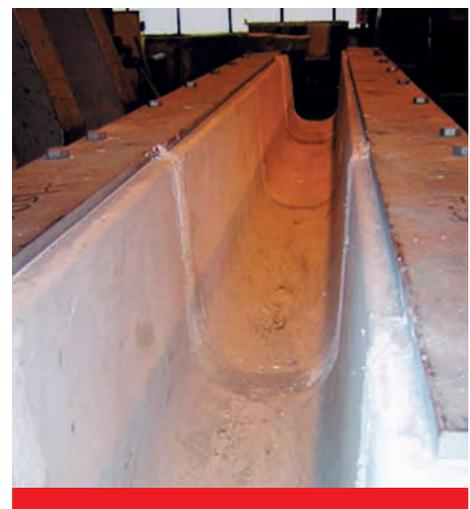
Drache manufactures a wide range of launder segments, ranging from small segments for continuous casting, to segments for billet and rolling ingot casting, to large segments for transfer launders. The right launder cross-section is chosen by taking the given casting speed into consideration. This ensures a turbulent-free flow of the metal combined with a minimised heat loss.



All launder segments are characterised by:

- Fully engineered and built by Drache
- Optimised for a minimised temperature loss, low shell temperature and homogenous flow
- Installation and commission on-site
- Optional lids and heating systems are available

The material of choice for launders is Drache Fused Silica. For transfer launders, a SiC-based material can be offered as well.



■ Casting Spouts and Stoppers



For the casting of rolling ingots, Drache can provide spouts and stoppers in a variety of geometries. Naturally, these are also available in customised sizes.

In addition to the spouts, suitable spout seats can also be delivered.



If requested, both the spout and the stopper can be coated with Drache Boron Nitride, further improving the non-wettability of the material.

Spouts, stoppers and spout seats are made from the material Fused Silica Fine.

For questions regarding the use of Drache's precast shapes, the Drache team will be happy to help at any time.

In excellent shape: our solutions for Aluminium foundries.



In the field of Aluminium casting, Drache provides numerous products for its customers, such as ceramic foam filters, special components for low-pressure die casting, as well as a crucible furnace developed in-house that is used all around the globe.

The filter of choice for Aluminium foundries is the Cerapor® LDNG ceramic foam filter, which can be used for sand casting and permanent mould casting.

In addition, there are specific components made of the engineering Ceramics Silicon Nitride (SN) and Aluminum Titanate (ATi), which show their

advantages in particular in low-pressure die casting (LPDC). In addition, Drache manufactures its own crucible furnace for Aluminium foundries, which offers extremely high energy efficiency.

**Looking for solutions for Aluminium die-casting?
With us, you will find what you're looking for!**

Cerapor® LDNG Filter

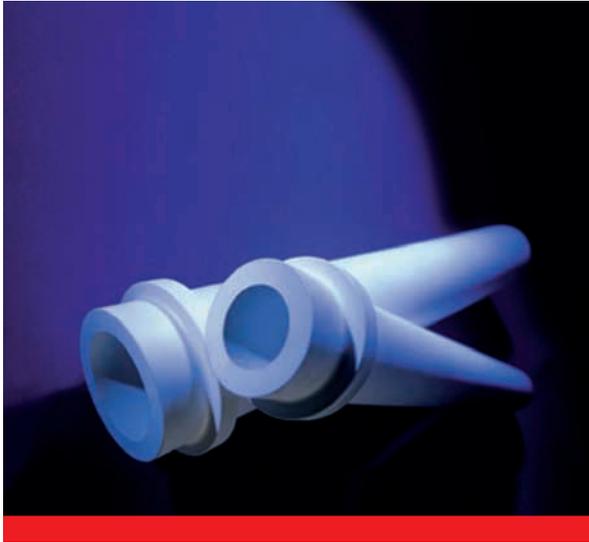
Cerapor® LDNG filters are ceramic foam filters that have been specifically designed and optimised for Aluminium casting.

- Optimised for Aluminium foundry applications
- Temperature resistance up to 1,000 °C
- Floats on top of liquid Aluminium
- Free from graphite and carbon
- Not hygroscopic



■ ATi-Aluminium Titanate

Aluminium Titanate (ATi) is a ceramic material that is primarily used in Aluminium casting. Two material properties worthy of special mention are the excellent thermal shock resistance and excellent non-wettability to liquid Aluminium.



- Advanced ceramic material for Aluminium applications
- Excellent thermal shock resistance and non-wettability
- Customised shapes like riser tubes, sprue bushes, breakings, dosing tubes, downspouts, etc.

■ SN-Silicon Nitride

Silicon Nitride (Si_3N_4) has, due to its excellent material properties, many advantages when applied for Aluminium and Magnesium casting:

- Advanced ceramic material for Aluminum and Magnesium casting
- Excellent chemical resistance against liquid Aluminium, foundry chemicals as well as caustic soda
- Very high strength and thermal conductivity
- Riser tubes can be ,polished' on request for an improved lifetime and easier cleaning



Crucible Furnace

Drache developed a modern and up-to-date holding crucible furnace for Aluminium foundries, which has a number of advantages:

- Energy-efficient crucible furnace for Aluminium foundries
- Up to two tonnes capacity
- Immersion heating elements in combination with a highly efficient insulation ensure a very homogenous temperature distribution ($\pm 2\text{ }^{\circ}\text{C}$)
- Easy cleaning (no corundum growth)
- Extended life times (>1.5 years)



Low-Pressure Die Casting

Drache offers a complete package for a casting system used in low-pressure die casting, including the corresponding services to achieve the maximum performance.

The services include the support of converting existing casting system, using cast iron riser tubes, to more modern and efficient system using riser tubes made from Silicon Nitride or Aluminium Titanate.

- Complete casting systems: riser tubes made from Silicon Nitride (SN) or Aluminium Titanate (ATi), intermediate tubes made from Drache Calcium Silicate (DKS), sprue bushes made from Aluminium Titanate, ceramic foam filters
- Technical support and service for converting and upgrading existing casting systems



■ The right Ceramic Foam Filters for Steel and Iron castings.



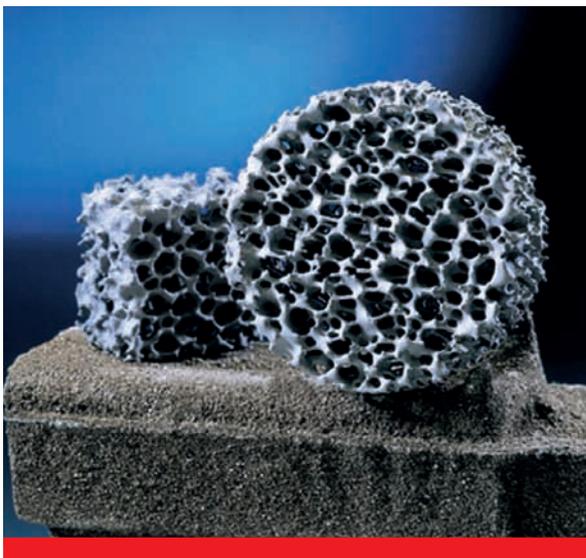
For foundries doing steel, super-alloy or iron casting – either for large components or small to mid-size pieces – Drache has the right ceramic foam filters to achieve optimum results.

Drache's focus for steel foundries is the Cerazirk LD filter for all types of steel casting as well as the Cerazirk ZrO₂ filter for steel castings, super-alloy castings and large iron castings.

If you are looking for the perfect solution for every cast, you've come to the right place!

■ Cerasic® NG Filter

Cerasic® NG filters are applied for many types of iron castings and iron alloys, as well as casting of copper-based and Aluminium alloys:



- For all types of iron casting, copper foundries and Aluminium foundries
- Temperature resistance up to 1,500 °C
- All common sizes, customised and larger filters are possible on request
- Suitable for copper DC casting as well

Cerazirk LD Filter

Cerazirk LD ceramic foam filters are applied in steel foundries for all types of steel casting: unalloyed and low-alloyed steels as well as high-alloyed steels.

- Lower density compared to regular ZrO_2 -based filters, Cerazirk LD filters can be applied at lower casting temperatures
- Improved filter capacity
- Suitable for all types of steel alloys
- Fully ceramic, free from any organics and carbon
- Temperature resistance up to 1,680 °C



Cerazirk[®] ZrO_2 Filter

Drache's proven Cerazirk[®] ZrO_2 filters are applied in a large number of foundries for various metals and alloys:

- Steel casting super alloy casting large iron casting, Magnesium casting
- Temperature resistance up to 1,700 °C
- All sizes, including filters larger than 200 mm
- Porosity up to PPI 50
- Excellent thermal and mechanical resistance, even for extended casting times



Simulation

Our company offers to perform simulations for the casting as a service. The simulation can be performed for all standard casting processes, such as sand casting, shell mould casting, investment casting, permanent mould casting and low-pressure die casting. In principle, the simulation can be performed for all common cast metals, such as cast steel, cast iron (GJS, GJL, CGI, GJX), Aluminium alloys and various copper, magnesium alloys and superalloys.

Drache uses SolidCast and FlowCast as simulation software, with the calculations performed using the finite difference method (FDM).

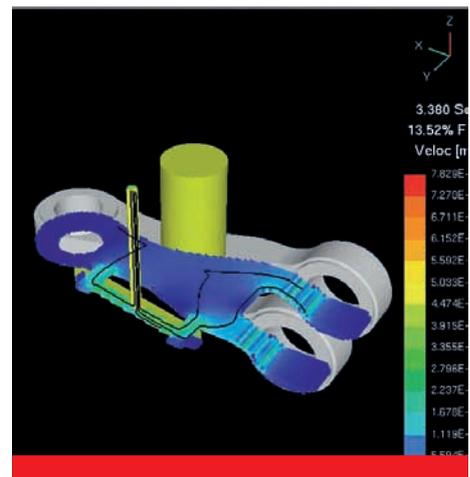


Solidification Simulation

In the simulation of solidification, the pure solidification process of the cast is simulated. The simulation produces the following results, among other things:

- Solidification time
- Solidification process
- Density distribution after solidification
- Display of porosity / blowholes
- Module distribution in the cast

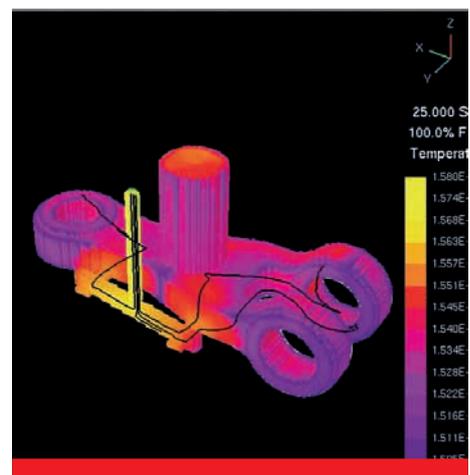
The solidification simulation can be carried out optionally preceded by a mould filling simulation. The solidification simulation can be used, for example, to optimise the size and placement of feeders.



Mould Filling Simulation

In the mould filling simulation, the flow of metal when filling the mould is simulated. Depending on the desired level of detail and necessity, various algorithms can be used to calculate the mould filling.

Based on the mould filling simulation and the resulting temperature distribution, a subsequent solidification simulation can be performed. If you have questions regarding the topic of simulation for mould casting, the Drache team is naturally at your disposal.





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