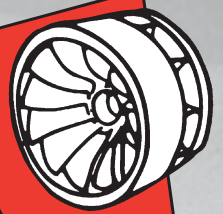


Gießereitechnik Heinrich Stadtmüller GmbH



INSPIRED BY NATURE

ACHIEVING COMPLEX FORM USING CERAMIC CORES



www.ceramcore-stadtmueller.com

our motivation



Markus Stadtmüller
(Managing Director)

Our philosophy

*„A customer is the important visitor to our premises.
They are not dependent on us. We are dependent on them.*

They are not an interruption on our work. They are the purpose behind it.

*We are not doing them a favour by serving them.
They are doing us a favour by giving us the opportunity to do so.”*

Mahatma Gandhi

Dear investment casting manufacturers and all others interested in casting technologies, welcome to our company!

Mahatma Gandhi describes in simple words what we stand for as a specialized company – our company’s philosophy and strategy. Our main target is living this philosophy every single day with real passion for our work, meeting the daily technical challenges and requirements of our customers.

You as a customer should and must have complete confidence in our product, our know-how and our technical support, because we always

see a successful business relationship as a long-term objective.

You can be confident in placing your trust in us, as a company committed to you!

We look forward to new common projects and a continued working partnership with you. Start your journey here, and be excited about all that you can expect from us.

With my best wishes

A handwritten signature in black ink, which appears to be 'M. Stadtmüller', written over a horizontal line.

Markus Stadtmüller



highest precision



Ø 105 mm / height 60 mm

We are manufacturers of ceramic core-solutions and over the past 25 years, have established ourselves as a reliable partner for the investment casting industry and other precision casting industries, continually developing our technology during this period.

Our worldwide customers appreciate the quality of our products along with our technical competence and support. Following our strong focus on international markets, our rate of export has increased beyond 70% in the meantime.

We produce ceramic cores which are adjusted to meet the individual needs and unique operating facilities of our customers. Our abilities mean that we have no limitations with regards to geometric requirements. Ceramic cores ranging from a few grams up to several kilograms in weight can be achieved with our machinery.

Smallest demands as well as high volumes can be realised in short time scales. The agile nature of our capacity allows us to guarantee each customer the highest level of flexibility and promptness, whatever the demand is.

Today, we do not just serve the so called "commercial markets" such as

- * **Automotive**
- * **Medical**
- * **Machining**
- * **Energy**
- * **Food / Nutrition**
- * **Pumps**
- * **Building / Architecture**

but increasingly meeting the demands of the "high-technology sectors" including

- * **Aerospace industries**
- * **Defense**
- * **Motorsport / Racing**
- * **Industrial Gas Turbine industries (IGT)**

The use of ceramic cores provide design engineers with much greater flexibility in helping them to find the best solutions. These benefits will be explained briefly in the following.

Advantages & possibilities



Complex internal shape, realized with plug-connection-techniques

Unforeseen design freedom

The designer is not subject to any restrictions within their planning of the interior shape of a casting by using ceramic cores. The most complicated interior form, undercut areas, deep bores, blind hole areas, narrow slots and even precise threads are no longer a major problem and can be achieved with high precision, repeatability and excellent surface finish to cost-effective conditions.

Complex thinner geometries of bores or channels can be realised with plug- and gluing-connections on ceramic cores. Wall thicknesses below 1 mm are achievable without any problems, depending on the geometry of the casting.

Increase of productivity

The time consuming process of drying ceramic shells can often be reduced with the use of ceramic cores as an alternative to filling these inner areas with shell material. The matrix of the ceramic cores allows a much faster removal from the castings compared to the shell material.



Connection on a Knee-prosthesis, realized by using a „thread core“

Costs savings

Ceramic cores can help to reduce the scrap rate for many applications significantly, therefore reducing the manufacturing costs of any casting project. These savings are also evident where additional mechanical operations can be avoided, especially when high-grade steel alloys are used for castings.

The substitution of water soluble wax cores with ceramic cores brings several technical advantages which show clear results on the cost aspects of the casting application. The main disadvantages of water soluble wax cores like

- * **low stability during storage and difficult production**
- * **low dimensional stability during the casting process**
- * **difficult filling of complex internal shapes with the shell material**
- * **time consuming drying of the internal shell material**
- * **difficulty with removal of the shell materials out of the castings**
- * **lower surface values on castings**

can be eliminated with the use of ceramic cores instead. Evaluating customer feedback, the main advantage of a substitution with ceramic cores is however the lower scrap rate for the corresponding casting projects, compared to water soluble wax cores. It is our target to continue highlighting these advantages to engineers and let them appreciate the benefits they will have by using ceramic cores instead.

Environmental aspects

A major step forward in our technological development was the introduction of our special feedstock type V 209. We improve the removal of the ceramic cores significantly through the composition of this feedstock. This ceramic was specially developed for aluminium applications, but is also used more and more for steel applications.

The particular advantage: the investment caster will have the benefit of being able to avoid any harmful environmental and expensive disposal of wastes by using chemical leaching methods. The ceramic cores can be “shot out” of the castings by using high water pressure systems or other blasting techniques in short time scales. The usage of this special feedstock for steel applications must be discussed for each individual project with the responsible technician.

Standard feedstocks

Material type	Casting application	Operating range	Leeching recommendation	Standard lead time
V 144	Steel alloys	up to 1680°C	NaOH 500°C - 700°C	2-3 weeks
V 207	Steel alloys	up to 1680°C	NaOH up to 200°C or blasting techniques	2-3 weeks
V 02	Steel alloys	up to 1620°C	NaOH up to 200°C very good leaching behavior	2-3 weeks
V 209	Aluminium alloys (partly used for steel alloys)	up to 900°C	-water blasting >200 bar -mechanical removal	3 weeks (impregna- ted)

* Special feedstocks can be achieved at any time, depending on our customer's requirements. We also have the ability to impregnate our cores to attain greater strength if required. As well as providing support and advice on all critical ceramic leaching operations, we are happy to recommend specialists who are able to perform these operations on a sub contract level.

Complex ceramic cores for aerospace applications.
Ø big core 160 mm, Ø small core 75 mm

Steel applications

The following pictures give some impressions of interesting investment castings in steel alloys which had been realized by using our ceramic cores. There are almost no limitations for engineers fantasies. When do we get your enquiry?



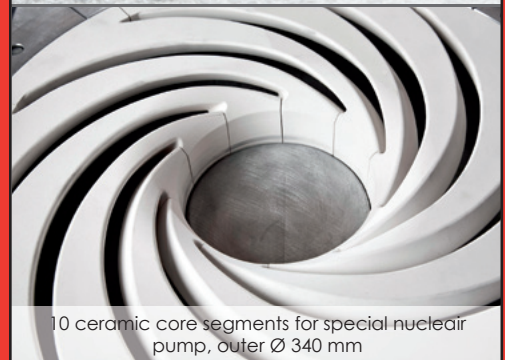
Ceramic core for Valve-body
height 120 mm



Ceramic core for automotive, Ø 80 mm,
thickness of blade 3 mm



Stator for Voith-Retarder Ø 200 mm
slot-thickness from ceramic core 2.5 mm



Aluminium applications

The following pictures give some impressions of interesting investment castings in aluminium alloys which had been realized by using our ceramic cores. There are almost no limitations for engineers fantasies. When do we get your enquiry?



Complex ceramic cores for aerospace applications,
Ø big core 160 mm, Ø small core 75 mm



Ceramic core for aerospace application,
smallest Ø 3.80 mm



Complex core for internal shape of a high pressure pistol,
core dimensions app. 70 x 45 mm





On top: Digital storage of the firing cycle via Jumo Logoscreen nt

Middle: Universal testing machine Zwick BDO-FBO.5TS

We decided to fully approve our well-established quality system in the spring of 2008, officially conforming to DIN ISO 9001. All steps of our organisation and process parameters are fully supervised and documented. We pay particular attention to the incoming inspection of our raw materials and their various production steps.

All ceramic materials are exclusively purchased in a very clean and pure form, and include the equivalent certificates of the supplier, to ensure an uncompromising casting quality to our customers. Additionally, all raw materials are subject to a thorough incoming inspection which undergo the following fundamental steps of analysis:

- 1. Physical – Chemical analysis**
- 2. Grain size analysis***
- 3. Tensile strength checking**
- 4. Checking of thermal expansion behavior***

(*also available as an independent chargeable service for customers.)

All determined values are documented and after their careful evaluation and comparison with our house-standard, the raw materials can be released for production feedstocks. In the next step the larger formulas for production go through exactly the same checking procedures, before they will be released for ceramic core production.

Furthermore we pay a great deal of attention to all our process parameters associated to the production of our cores. The best performance on all technical values will be determined by our technicians and constantly controlled and supervised by our experienced team. More detailed information about our quality procedures can be discussed personally at any time. We also welcome you to come and visit us for a comprehensive review of all our quality control methods.



On top: Dilatometer Netzsch DIL 402 PC
Below: Cilas Granulometer 1064L

During recent years, we have not only invested in new, state-of-the-art kiln facilities but also in modern equipment for the digital documentation of all our kiln processes. Burning cycles of all our kilns are steadily documented and securely archived around the clock on our server and external hard drive. This guarantees we give ourselves the possibility to review the history of each individual ceramic core and the security in the control on our process.

Certificate

Standard **ISO 9001:2008**

Certificate Registr. No. 01 100 070753

TÜV Rheinland Cert GmbH certifies:

Certificate Holder: **Heinrich Stadtmüller GmbH**
Gießertechnik
Ulrichstraße 106
D - 72116 Mössingen

Scope: Manufacturing and sales of ceramic cores for investment casting applications in steel and aluminium

An audit was performed, Report No. 070753. Proof has been furnished that the requirements according to ISO 9001:2008 are fulfilled.
The due date for all future audits is 17-04 (dd.mm).

Validity: The certificate is valid from 2010-05-19 until 2011-04-23.

Cologne, 2010-05-19

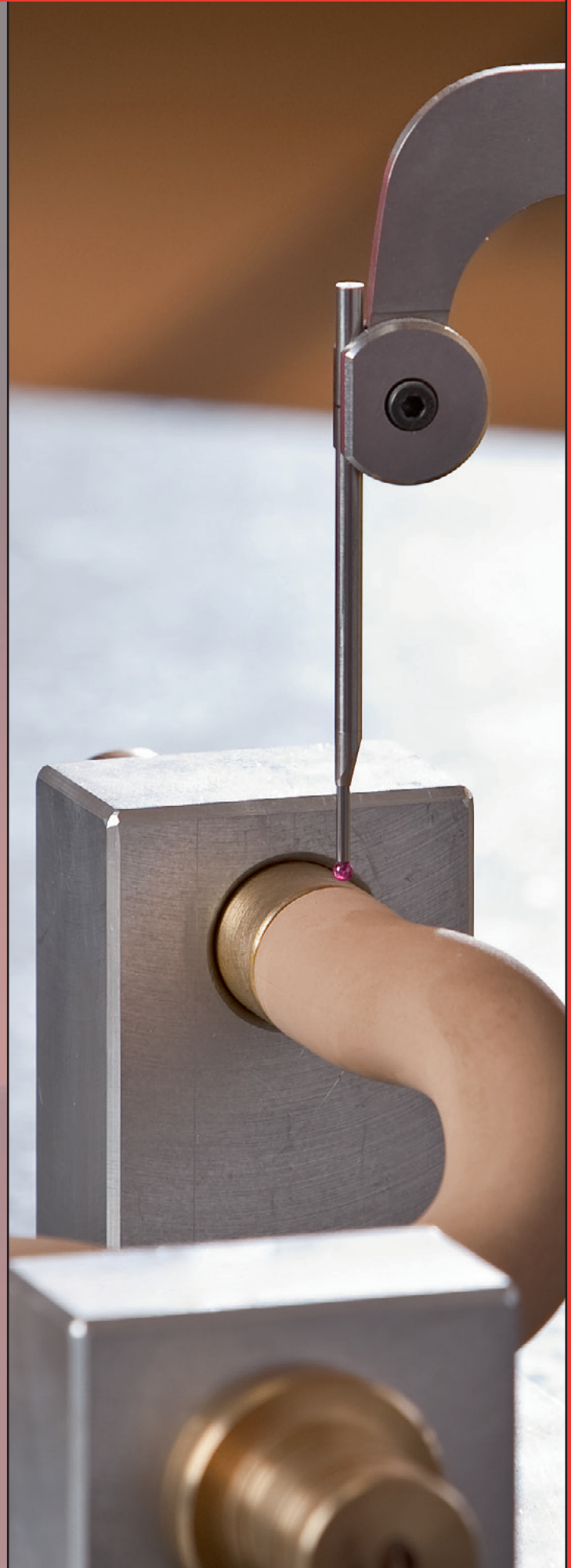
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TÜV Rheinland Cert GmbH
Am Grauen Stein 51105 Köln

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Example of a project & toolshop

We would usually receive a new enquiry in the form of an E-Mail, including attachments such as cad-files (iges, step, stl) or drawings.

The enquiry should inform us about details like:

- * available leeching methods for ceramic cores
- * the casting alloy
- * expected lot sizes
- * required tolerances
- * desired lead times

We check the feasibility of the enquiry, respectively the construction of the ceramic core tools. We will then send our quotation for tooling, eventual control fixtures and unit prices of ceramic cores within 2-3 days or even on the same day if necessary!

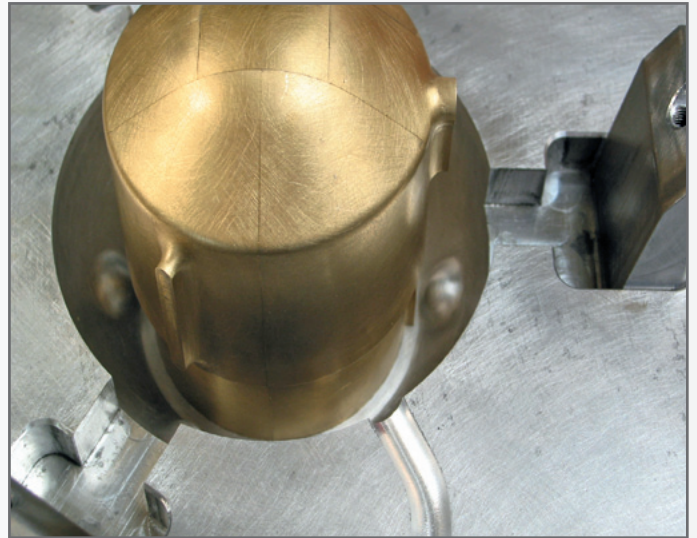
Core- / wax tools & control fixtures

We have recently initiated a close collaboration with a specialised toolmaking company, meaning we are able to react in a much shorter time scale to our customers by reducing the lead times for tooling and therefore the first ceramic core samples.

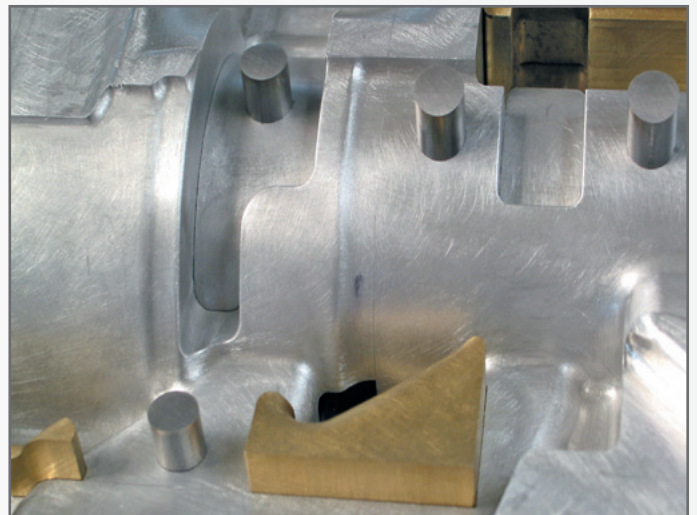
Our partner has over 20 years experience in the production of tooling and special fixtures for the investment casting industry.

Furthermore we are able to offer the service of manufacturing complex wax tools, even if there is no demand for ceramic coring. This service is used more and more from our customers and we can assure the best quality and competitive conditions at all times.

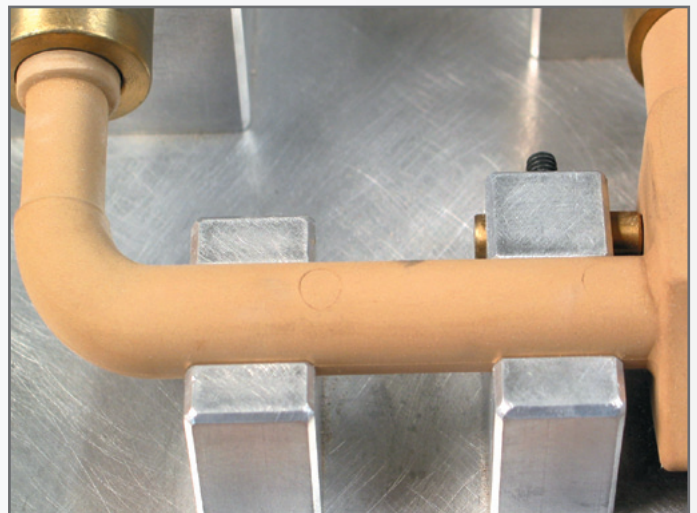
On the following pictures we show you some examples of tools made by our toolmakers.



Example of tool-section for an aerospace application with inserts producing the „windows“ and undercut-areas.



Example of tool-section for a F1 application with slides and inserts producing the undercut-areas



Example of a control fixture-section with several slides to determine the exact position of all core prints

Impressions & capacities



View on kiln capacities



Modern „lean-lift“ stock system for tools



Packing and shipping area

Tolerances

Table 2 a: Tolerances of shape and position
(in mm)

Straightness, linear shape

Nominal- dimension range	D1 Feld	D2 Feld	D3 Feld	A1 Feld	A2 Feld	A3 Feld
up to 6	0,15	0,12	0,10	0,20	0,18	0,15
over 6 to 10	0,18	0,14	0,12	0,20	0,18	0,15
over 10 to 18	0,25	0,20	0,15	0,20	0,18	0,15
over 18 to 30	0,30	0,25	0,20	0,20	0,18	0,15
over 30 to 50	0,40	0,35	0,25	0,30	0,25	0,20
over 50 to 80	0,60	0,45	0,30	0,35	0,30	0,25
over 80 to 120	0,80	0,60	0,45	0,50	0,40	0,30
over 120 to 180	1,10	0,80	0,60	0,70	0,50	0,40
over 180 to 250	1,50	1,15	0,90	0,90	0,70	0,55
over 250 to 315	1,90	1,40	1,20	1,10	0,90	0,70
over 315 to 400	2,40	1,80	1,50	1,35	1,10	0,90
over 400 to 500	3,00	2,20	1,80	1,60	1,30	1,10
over 500 to 630				1,80	1,50	1,30
over 630 to 800				2,00	1,70	1,50
over 800 to 1000				2,20	1,90	1,70

Table 2 b: Tolerances of shape and position
(in mm)

Flatness, surface shape, roundness

Nominal- dimension range	D1 Feld	D2 Feld	D3 Feld	A1 Feld	A2 Feld	A3 Feld
up to 6	0,20	0,15	0,12	0,20	0,18	0,15
over 6 to 10	0,25	0,20	0,15	0,20	0,18	0,15
over 10 to 18	0,40	0,30	0,20	0,25	0,22	0,18
over 18 to 30	0,50	0,40	0,30	0,30	0,25	0,20
over 30 to 50	0,60	0,50	0,40	0,40	0,30	0,25
over 50 to 80	0,80	0,65	0,50	0,50	0,40	0,30
over 80 to 120	1,00	0,80	0,65	0,65	0,50	0,40
over 120 to 180	1,30	1,10	0,85	0,90	0,70	0,55
over 180 to 250	1,80	1,50	1,20	1,15	0,90	0,75
over 250 to 315	2,30	1,80	1,50	1,35	1,10	0,90
over 315 to 400	2,90	2,30	1,85	1,60	1,35	1,10
over 400 to 500	3,40	2,80	2,20	1,80	1,55	1,30
over 500 to 630				2,00	1,80	1,50
over 630 to 800				2,25	2,00	1,70
over 800 to 1000				2,50	2,20	1,90

Table 2 c: Tolerances of shape and position
(in mm)

Parallelism, symmetry

Nominal- dimension range	D1 Feld	D2 Feld	D3 Feld	A1 Feld	A2 Feld	A3 Feld
up to 6	0,25	0,20	0,15	0,20	0,18	0,15
over 6 to 10	0,30	0,25	0,20	0,20	0,18	0,15
over 10 to 18	0,40	0,30	0,25	0,25	0,20	0,18
over 18 to 30	0,50	0,40	0,30	0,35	0,25	0,20
over 30 to 50	0,70	0,60	0,50	0,45	0,30	0,25
over 50 to 80	1,00	0,80	0,65	0,55	0,40	0,30
over 80 to 120	1,30	1,10	0,90	0,70	0,50	0,45
over 120 to 180	1,80	1,50	1,20	0,90	0,75	0,60
over 180 to 250	2,50	2,00	1,60	1,20	1,00	0,80
over 250 to 315	3,15	2,60	2,00	1,50	1,20	1,00
over 315 to 400	3,80	3,20	2,50	1,90	1,60	1,30
over 400 to 500	4,40	3,80	3,20	2,40	2,00	1,60
over 500 to 630				3,00	2,50	2,00
over 630 to 800				3,80	3,15	2,50
over 800 to 1000				4,80	4,00	3,20

Table 2 d: Tolerances of shape and position
(in mm)

Co-axiality, cylinder shape

Nominal- dimension range	D1 Feld	D2 Feld	D3 Feld	A1 Feld	A2 Feld	A3 Feld
up to 6	0,30	0,25	0,20	0,25	0,20	0,18
over 6 to 10	0,35	0,30	0,25	0,25	0,20	0,18
over 10 to 18	0,50	0,40	0,30	0,30	0,25	0,20
over 18 to 30	0,60	0,50	0,40	0,40	0,30	0,25
over 30 to 50	0,80	0,60	0,50	0,60	0,45	0,30
over 50 to 80	1,10	0,80	0,60	0,80	0,70	0,45
over 80 to 120	1,30	1,00	0,80	1,10	0,90	0,65
over 120 to 180	1,80	1,40	1,10	1,50	1,30	0,90
over 180 to 250	2,40	1,90	1,60	2,00	1,60	1,30
over 250 to 315	3,00	2,50	2,00	2,40	2,00	1,60
over 315 to 400	3,80	3,20	2,50	2,90	2,40	2,00
over 400 to 500	4,40	3,70	3,00	3,50	3,00	2,50
over 500 to 630						
over 630 to 800						
over 800 to 1000						

Page 4, VDG-Reference Sheet P690

*We manufacture corresponding to VDG-Norm DIN ISO P 690. The applied tolerances of our ceramic cores for steel applications correspond to column D3, respectively A3 for aluminium alloys. For smaller sizes or less complex geometries we are even able to guarantee the half of these values.

Casting surface

Photo front page:
Ceramic core for Turbomecca aerospace housing.
Diameter 6 mm, length 180 mm



Ceramic core for special pump
application, Ø 115 mm

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