FINAL ADVANCED MATERIALS

TECHNICAL DATA SHEET

Rev. N° 0 - 25.04.2023

15MG.001
Crucibles

Summary

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Overview

Crucibles are the privileged tools of the metallurgist. They must resist to melting temperatures from treated alloys, without contaminating the molten metal.

In some cases, the crucible is used directly for cast pieces. Its movement, while heated to very high temperature, involves an extreme resistance.

Finals Advanced Materials proposes crucibles in following materials:

- Sintered Alumina: up to 1,700 °C
- Porous zirconia: up to 1,800 °C
- Magnesia: up to 2,000 °C
- Glassy carbon: up to 3,000 °C (under vacuum or neutral gas)

Our team will help you to choose the perfect material for your project.

Selection criteria

- Max temperature
- Heating / cooling speed
- Type of furnace
- Heating mode
- Molten matter
- Atmosphere

Applications

- Calcination of various alloys
- Fusion of various alloys

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Products

Sintered alumina 99,7 %

Sintered alumina crucibles are a resistant ceramic solution up to 1,7000 °C. This material withstands wear and chemical attacks from most acids and alkaline solutions to hydrogen and other reductive gases very well, except for:

- Hydrofluoric acid in big concentration
- Boiling phosphoric acid
- Boiling potassium hydroxide solution
- Sodium hydroxide solution
- Melted alkali salt

Characteristics

- Maximal temperature of use: 1,700 °C
- Composition: Al_2O_3 99,7 % with small quantities of MgO and SiO_2
- Good thermal shocks resistance because of its high thermal conductivity
- High resistivity
- High mechanical strength
- Type C 799 according to DIN EN 60672

Applications

- Crucibles for chemical industry
  - Crystal's growth
  - Molten process
  - Curing
- Extreme wear conditions
  - Grinding support
  - Nozzles
  - Protection muff

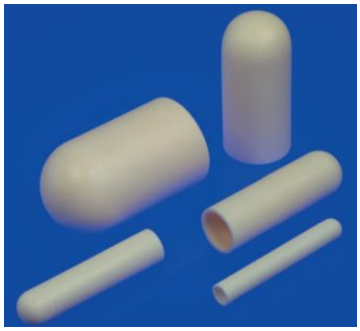
Range


Boat


Incinerating dish


Conical crucible

Crucibles


Tubular crucible


Cylindrical crucible

Glassy carbon

Glassy carbon crucibles don't have the disadvantages of ceramic products such as low thermal conductivity, noble meals adhesion and the use of melting salt. It resists up to 3,000 °C under inert gas or under vacuum. It is twice as resistant at 2,400 °C as at room temperature. The crucible doesn't become brittle at high temperature and tolerates thermal shocks extremely good. Temperature rises followed by repeated cool-downs are not a problem.

The high purity, low specific surface area and isotropic structure of the glassy carbon crucible cause a slight oxidation that generates a protecting gas on the molten metal. This slight oxidation prevents the formation of an oxide coat on the molten metal.

Characteristics

- High thermal strength in inert atmosphere or under vacuum
- High purity
- Good resistance to extreme corrosion
- No open porosity: impermeable to gases and liquids
- Not wet by molten metals
- High hardness
- Low density
- No dust formation on the surface
- Low thermal expansion
- Extreme thermal shocks resistance
- Isotropic structure
- Good electrical conductivity
- Biocompatible

Applications

- Suitable for melting palladium alloys and alloys containing a percentage of noble metals.
- Suitable for precious metals and titanium alloys.
- Not suitable for melting steel alloys or ferrous metals.

Range

- Cylindrical crucible
- Evaporation capsule
- Conical crucible (wide and narrow angle)

Crucibles

- Lid
- Crystal's growth crucibles
- Crucible with pouring spout
- Boat

Technical data

Properties	Unit	G Grade
Density	**g/cm³**	1.42
Open porosity	%	0
Peak temperature (under vacuum or inert gas)	**°C**	3,000
Electrical strength	**Ω.µm**	45
Young modulus	**GPa**	35
Flexural strength (4 points)	**MPa**	260
Compressive strength	**MPa**	480
Vickers hardness	**HV**	230
Linear dilatation (20/200 °C)	**$10^{-6}.K^{-1}$**	2.6
Thermal conductivity	**$W.m^{-1}.K^{-1}$**	6.3
Permeability coefficient	%	1.10^{-9}

K Grade available on request.

Plan

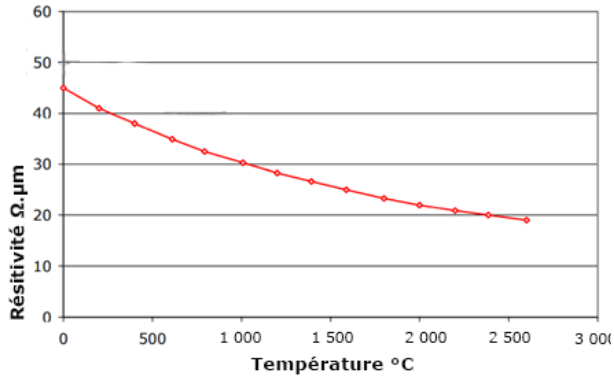


Figure 1: resistivity / temperature

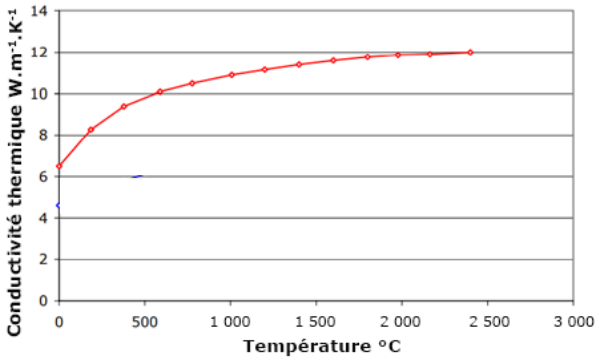


Figure 2: thermal conductivity / temperature

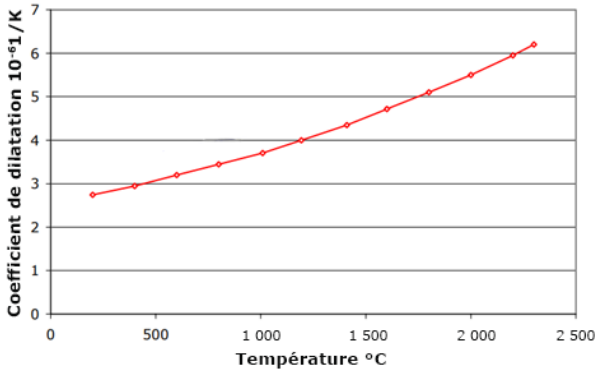


Figure 3: linear dilatation coefficient / temperature

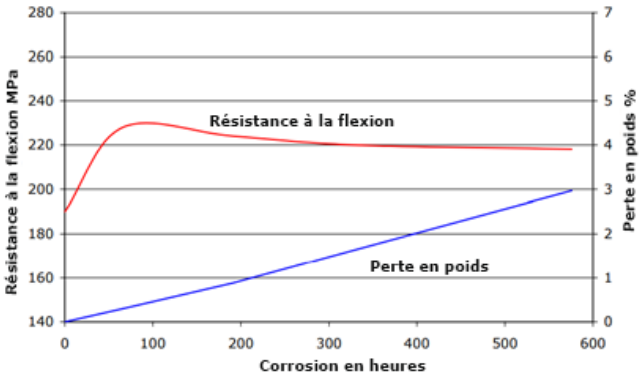


Figure 4: flexural strength and weight loss / corrosion hardness in nitric acid 65 % at 120 °C Test in 4 points; geometry of the specimen: molding in pearl, Ø 5 mm, L 60 mm

Magnesia

Magnesia crucibles, MgO, have a structure with thin grains and a slight open porosity. They offer a good mechanical and thermal strength (up to 2,000 °C), however they are less resistant to thermal shocks then other crucibles suggested. Homogeneous heating and cooling are necessary to preserve the product.

The composition of the crucibles includes 2 % of yttrium oxide (Y_2O_3). This addition enables to ease the magnesia sintering. Yttrium oxide is completely inert and behaves as the similarly as magnesia in every application.

Characteristics

- Thermal resistance
- Open porosity
- High purity
- Good mechanical strength
- Sensitive to thermal shock
    - Maximal heating or cooling speed: 200 °C/h
- Better chemical strength then alumina in some applications
- Perovskite structure
- Resistant to lead

Applications

- Alloys with nickel
- Plutonium and uranium refining
- Ceramic materials supraconductor
- Treatment of piezoelectric materials

Technical data

Properties		Unit	Magnesia
Density		**g/cm³**	3,40 – 3,45
Open porosity		**%**	<1
Peak temperature		**°C**	2,200
Composition	**$MgO + Y_2O_3$**	**%**	98.5
	CaO		0.5
	SiO_2		0.1
	Al_2O_3		0.55
	Fe_2O_3		0.06
	B_2O_3		< 0.002

Range

- Cylindrical crucible
- Rectangular incinerating dish
- Squared incinerating dish
- Circular incinerating dish

- Flange cover

Porous zirconia

Zirconium oxide crucibles are perfect for a use up to 1,800 °C. Zirconia is partially stabilized with magnesia and is obtained by isostatic pressing.

Characteristics

- Use up to 1,800 °C
- Very good thermal shocks resistance
- Oxidizing resistant
- Very low thermal expansion
- Not wet by molten metals

Applications

- Crucibles for melting by induction
- Crucibles usable in oxidizing atmosphere or under vacuum
- Crucibles for precious metals or superalloys

Range

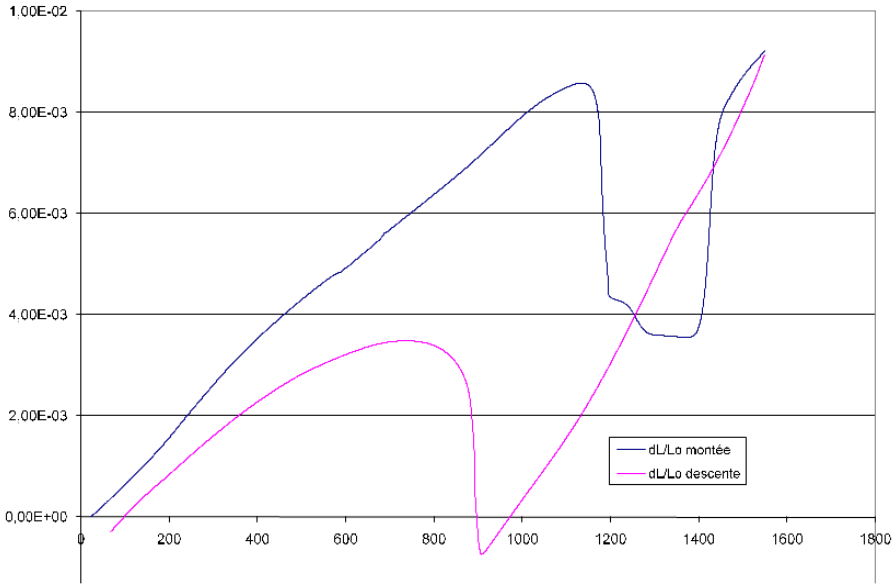
Only tailor-maid

Technical data

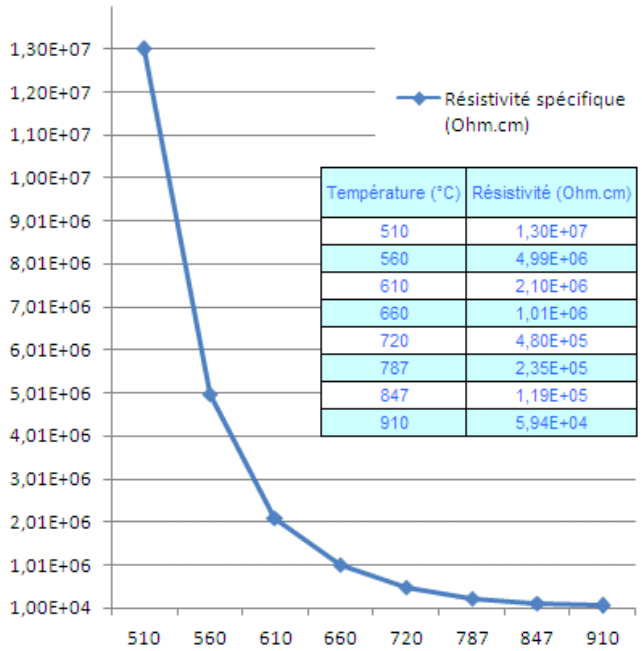
Properties		Unit	Zirconia
Composition	ZrO_2	%	95.3
	MgO		2.2
	SiO_2		1.2
	Al_2O_3		0.7
	CaO		0.2
	Fe_2O_3		0.2
	TiO_2		0.2
Density		g/cm^3	4.6
Open porosity		%	18
Breaking load		MPa	24.1
Peak temperature		°C	1,800
Thermal conductivity (at 800 °C)		$W.m^{-1}.K^{-1}$	1.4
Thermal expansion	at 600 °C	$10^{-6}K^{-1}$	6.6
	at 1,000 °C		6.2
	at 1,300 °C		2.3

Thermal expansion curve

- Duration of the test: 18 h
- Thermal cycle: 21 h, 1,550 °C, 67 MPa
- Maximal expansion: 9,22.10^{-3} mm



Specific resistivity curve

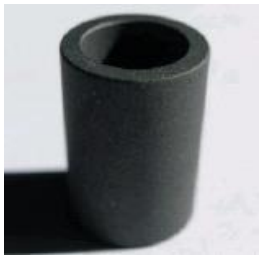


Température (°C)	Résistivité (Ohm.cm)
510	1,30E+07
560	4,99E+06
610	2,10E+06
660	1,01E+06
720	4,80E+05
787	2,35E+05
847	1,19E+05
910	5,94E+04

Tailor-made manufacturing

In addition to the standard references, we offer tailor-made products according to your needs. You can select the material from our range and entrust us with the machining of your crucibles.

Materials available for tailor-made projects



- Zirconia
- Boron nitride
- Silicon carbide
- Silicon nitride
- Graphite

Examples of tailor-made products

- Silicon carbide crucibles
  - $Ø_{ext}$ 24 mm – $Ø_{int}$ 20 mm – H 40 mm
- Zirconium oxide crucible
  - $Ø_{ext}$ 6 mm – $Ø_{int}$ 4 mm – H 10 mm

Physical variables included in this documentation are provided by way of indication only and do not, under any circumstances, constitute a contractual undertaking. Please contact our technical service if you require any additional information.