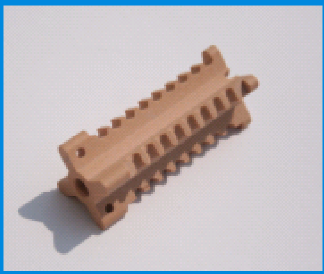
DATA SHEET
Rev. N° 0 - 05.06.2023



1AS.007
Alumina Silicate

Applications

- Machining of components and tooling
- Prototypes
- Manufacture of small production series in ceramics
- Winding cores
- Electrical insulation
- Assembly jigs
- Injectors, nozzles
- Components under vacuum
- Thermal insulators
- Induction insulators
- Brazing jigs
- Soldering jigs
- Sensors

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.

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Overview

Alumina silicate is a natural ceramic which is sourced from a pyrophyllite rock. Final Advanced Materials employs a mineral which is endowed with exceptional mechanical and thermal performance capabilities. After high-temperature treatment, this material acquires properties which are similar to those of known synthetic ceramics.

The remarkable flexibility of application of alumina silicate permits the resolution of issues raised by ceramics in laboratories and design offices.

Alumina silicate is frequently a key element of projects, because of its properties:

- Dielectric and thermal insulating capabilities
- Resistance to thermal impacts
- Resistance to abrasion
- Resistance to chemical agents
- Dimensional stability and accuracy
- Suitability for metal plating
- Heat-resistant up to 1,300 °C
- Non-combustible
- Low absorption of humidity
- Excellent under high-pressure vacuum (up to 10^{-8} torr)
- Limited production time
- Fusion compatibility with aluminium, zinc, lead, sodium or cast iron
- Absence of glass marking
- Compliance with food grade testing in accordance with NF EN ISO standard 10545-15

Alumina silicate shows very low shrinkage (≤ 1 %), and remains stable at high temperatures. It can be used at temperatures up to 1,300 °C, provided that a specific thermal treatment procedure is observed.

Final Advanced Materials can supply ceramic rods or plates for your own use, but it is also possible for us to undertake the complete execution of your project.

info@final-materials.com

Instructions of Implementation of the Ceramic

In its raw state, alumina silicate is machined like wood or brass, with the bandsaw, and for any traditional process: milling, turning, threading, boring, grooving, polishing, it is recommended to use tools in very hard metals, without cooling, and to clean carefully dusts of ceramic.

In the cooked form, note that parts should not exceed 12 mm of thickness if you want to avoid any crack; for higher thicknesses we shall drill holes.

During firing, the ceramic expands, from 1.9 % at 980 °C to 2 % at 1,040 °C. Beyond, variations are negligible and the precision can reach ± 0.05 mm.

We can finish grinding by softening. To bond this ceramic, we shall prefer the ceramic glue Cotronics® 919 from our catalogue.

Firing Procedure

To resist at more than 650 °C, the parts must be prepared in the furnace by sintering. The operation will start in cold oven and the heating levels will not exceed 260 °C per hour. Consider the expansion to obtain the final dimensions (approximately 2 %). These levels will have to go down to 150 °C per hour if the parts have a thickness of more than 12 mm. The maximum temperature will not exceed 1,010 °C to 1,100 °C, and will be held, from 30 min for a thickness of 6 mm to 45 min for a thickness of 20 mm (calculate the right value by extrapolation). We shall cool then gradually until the part will be taken out of the furnace at about 90 °C.

A cost-effective alternative to sintered ceramics

Alumina silicate provides a highly cost-effective alternative to sintered ceramics for applications at temperatures up to 1,300 °C.

For example, the production of a sintered ceramic component involves the machining of a material blank by the exclusive use of a diamond wheel. Accordingly, both the raw material and the machining process are highly expensive. Conversely, raw alumina silicate can be machined very easily using conventional tools. Machining costs are therefore low, as is the cost of the raw material.

Thereafter, thermal withstand is achieved by heat treatment at 940 °C, 1,100 °C or 1,300 °C. Where tolerances are highly restricted, finishing with a diamond wheel may be necessary.

Alumina silicate also provides a useful alternative to Macor®, depending upon the dimensions and the machining tolerances of the part to be produced.

For applications involving the contact of a mechanical component with glass, or for applications in the glass industry, alumina silicate delivers superior results to boron nitride at a substantially lower cost.

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Special Instructions

Action	Recommendations
Heating	Plan the expansion from 1.8 to 2 % during heating: a machined dimension of 9,8 mm will become a final dimension of 10 mm. Diameters also undergo this expansion.
Cleaning	Clean the machines thoroughly after work: alumina silicate is abrasive in powder form.
Remachining	Once cooked, ceramics can be remanufactured with water to a very high precision, when required by the application, by means of silicon carbide grinding wheels.
Lubricant and Coolant	NEVER use neither lubricants, nor cooling liquids.
Thickness	Maximum 12 mm, in order to avoid cracking. For thicknesses exceeding 12 mm, load-relief holes are required.
Rectification	This is possible, where a surface softening treatment is applied.
Adhesive Bonding	Resbond® 919 ceramic adhesive produced by Cotronics®, available from our catalogue.
In Case of Failure	Remember to check the causes most frequently observed: - Is the firing temperature adjusted? - Is there a miscalculation of the expansion? - Does the created model present sharp corners and «hard» transitions?

Composition

These values represent the quality of a product which has been heated at 1,300 °C.

Composition	%	Composition	%
SiO_2	60	Na_2O	< 0.2
Al_2O_3	35	P_2O_5	0.15
TiO_2	2	MgO	< 0.08
K_2O	1	CaO	0.03
Fe_2O_3	0.8	Na_2O	< 0.2

FINAL ADVANCED MATERIALS

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Technical Data

Property		Unit	Alumina Silicate, raw	Alumina Silicate, 940 °C	Alumina Silicate, 1,100 °C	Alumina Silicate, 1,300 °C
Item N°			080-0012	080-0021	080-0022	080-0023
Density		g/cm^3	2.9	2.9	-	2.65
Porosity		%	1.5 to 2	0 to 0.5	0 to 0.5	0.05
Water Absorption		%	-	3.7	3.1	0.8
Hardness on Mohs' scale			2.5	-	5.5	7.5
Compressive Strength at 20 °C		MPa	96	110	120	487
Flexural Strength		MPa	23	25	30	50
Max. Operating Temperature		°C	700	940	1,100	1,300
Specific Warmth	at 20 °C	$J\ K^{-1}\ kg^{-1}$	-	950	-	-
	at 1,000 °C		-	1,160	-	-
Thermal Conductivity at 20 °C		$W.m^{-1}.K^{-1}$	-	-	1.39	2.67
Expansion Coeff. at 20 °C	at 200 °C	%	-	-	0.07	-
	at 400 °C		-	-	0.156	-
	at 600 °C		-	-	0.23	-
	at 800 °C		-	-	0.312	-
	at 1,000 °C		-	-	0.399	-
Electrical Resistivity at 20 °C		Ω.m	-	-	$5.2x10^{11}$	$5.8x10^{11}$
Dielectric Constant at 20 °C at 1 MHz			-	-	6.5	5.9
Loss Tangent at 1 kHz		%	-	-	0.2	0.2
Dielectric Strength at 20 °C		kV/mm	8 to 10	-	6 to 7	12 to 17
Corrosion Resistance at 20 °C			good			
Alkali Resistance at 20 °C			good			