

t-ceramics

Advanced Technical Ceramics

Bisque Fired Machinable Ceramics

99.7% Alumina - Zirconia Toughened Alumina - Zirconia Silicate

Description.

Thermansys is producing a broad range of machinable refractory ceramics for applications requiring ultra-high processing temperature, corrosion resistance, electrical and thermal insulation and high wear resistance. Machining can be accomplished in standard machine shops with lathes, milling machines, drills, saws etc. using conventional tooling. Machinable ceramics are an excellent choice for construction of prototype ceramic components and many other applications.

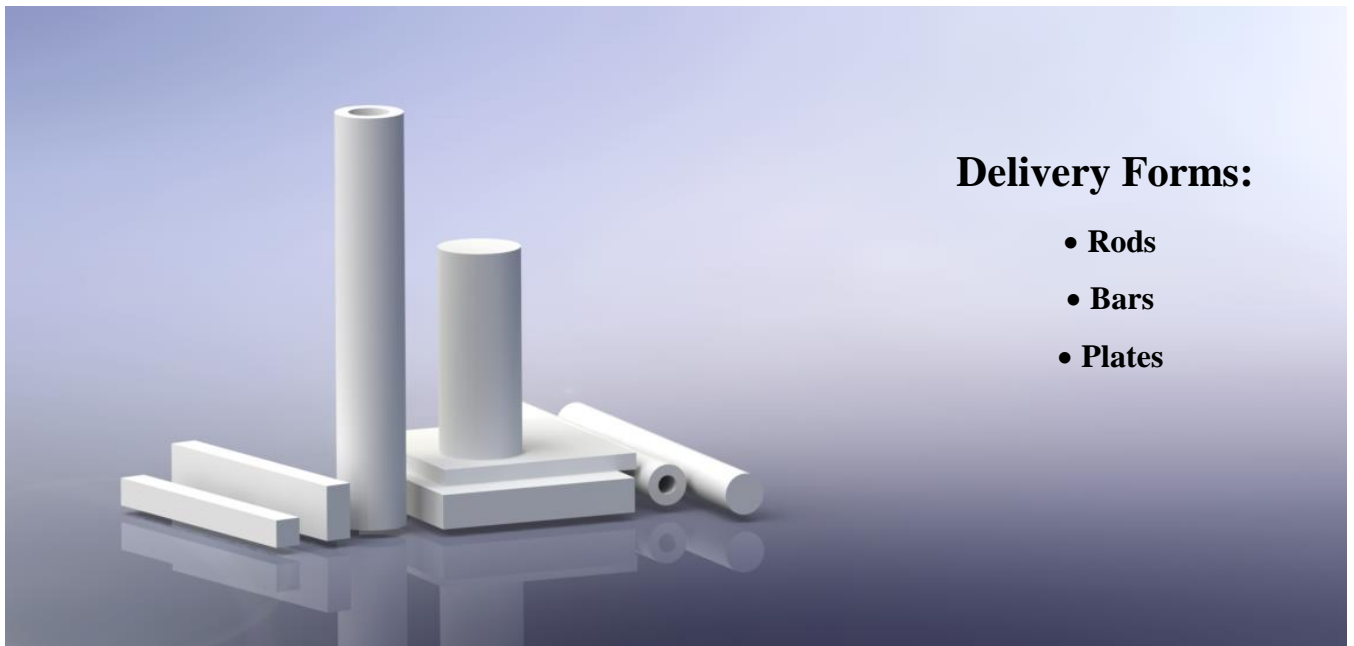
Available materials are High Purity 99.7% Alumina, Zirconia Toughened Alumina (ZTA) and Zirconia Silicate (Zircon). All our material are offered in rods, hollow rods, bars and plates.

The final product before delivery is fired up to a temperature allowing it to have good machinability but also adequate mechanical strength for handling and processing. After machining to final shape and dimension the material can be used as it is or fired to its fully firing temperature to acquire full mechanical, chemical and thermal properties. The materials as delivered have porosity, and a shrinkage, that is material and final firing temperature depended, should be expected after firing. Data and instructions for firing, and expected shrinkage are given below in this data sheet for each material. It should be noted that that all organic materials used during early stages of production are removed during bisque firing before delivery and thus further firing after machining to final shapes and dimensions does not produce organic residuals and odors.

All our material gallery are highly resistant to oxidizing and reducing atmospheres, molten metals, steam, corrosive gasses, most acids, chemicals and solvents.

Applications.

Furnace furniture, heater and resistor supports. High temperature corrosion and wear- resistant components. Catalyst support systems. Electrical insulators and stand offs. Welding fixtures. Thermocouple sheaths. Arc barriers, X-Ray equipment. Gas nozzles, turbine nozzles. microwave housings and components. Vacuum components and feedthrus. Thin film applications, R.F. heating fixtures, PVD,CVD Applications. Wafer chucks and substrates. Brazing/Carburizing fixtures, Induction heating Tubes, Hot forming dies for thermoplastic forming equipment. Molten metal crucibles, nozzles, molds and troughs. Furnace transfer rollers.



Delivery Forms:

- **Rods**
- **Bars**
- **Plates**

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Health and Safety.

Our ceramic machinable materials, as it is delivered, do not contain substances dangerous to health, or create them during use. They are produced using natural inert raw materials. Any organic binder or other substances used during manufacturing are burned through production firing. Thermansys however cannot guarantee that ceramic fixtures exposed to conditions that could produce residual material or create material transformations retain its health and safety properties upon reuse. During machining process like cutting, drilling, turning and milling inert dust will be created. Operation should be performed in a well-ventilated area with suitable dust absorbers installed. Workers should be provided with suitable dust protection equipment.

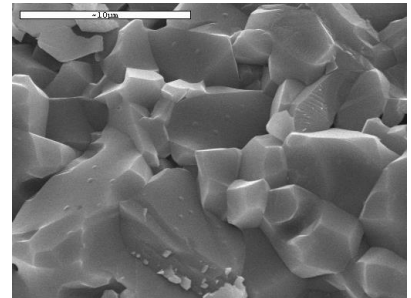
Machining Instructions.

Please see out technical bulletin “*t-ceramics machinables-machining Instructions-January 2017*”

Alumina 99.7%

Alumina is the material of choice for a wide range of general purpose laboratory and industrial applications. Alumina has wide application as a structural ceramic due to its high hardness value, high abrasion (wear) resistance, high corrosion resistance and low cost compared with other refractories. It has high compressive strength which provides good thermal shock resistance. High purity Alumina is one the best electrical insulations at high temperatures making it excellent choice as a thermoelectric refractory and is transparent to microwave radio frequencies.

Thermansys t-ceramics machinable Alumina after full firing to 1700°C will became a dense material with all mechanical, chemical and electrical properties of high purity recrystallized Alumina.

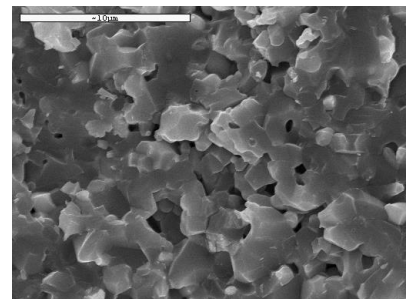


Firing – Shrinkage: For full firing raise the temperature to 1100°C with a heating rate of 4°C/min and then to 1650-1700°C with 2°C/min. Soak at this temperature for 6 to 12 hours. Cool down the furnace gradually with a rate of 4°C/min. The thicker the parts sections the longer the soak time. Typically for wall thickness 4-8mm 6 hours soaking time will be enough. Parts with cross sectional thickness higher than 25mm will need 12 hours soaking time. A shrinkage of 20-21% must be expected. An almost proportionally lower degree of shrinkage should be expected with lower soaking temperature.

Zirconia Toughened Alumina (ZTA)

Zirconia Toughened Alumina (ZTA) is essentially much similar material with Alumina. Their difference lies to the addition of a specific blend of Zirconia to the main Alumina matrix before sintering. The main advantages of Zirconia Toughened Alumina (ZTA) are that provides additional strength and toughness over Alumina for temperatures below 1500 C, and has fairly improved thermal shock resistance. Thermansys t-ceramics ZTA machinable forms are offered without significant additional cost compared to pure Alumina.

Thermansys t-ceramics machinable ZTA after full firing to 1600°C will became a totally dense material with all mechanical, chemical and electrical properties of commercial available ZTA.



Firing – Shrinkage: For full firing raise the temperature to 1100°C with a heating rate of 4°C/min and then to 1600°C with 2°C/min. Soak at this temperature for 6 to 12 hours. Cool down the furnace gradually with a rate of 5°C/min. The thicker the parts sections the longer the soak time. Typically for wall thickness 4-8mm 6 hours soaking time will be enough. Parts with cross sectional thickness higher than 25mm will need 12 hours soaking time. A shrinkage of 18-19% must be expected. An almost proportionally lower degree of shrinkage should be expected with lower soaking temperature.

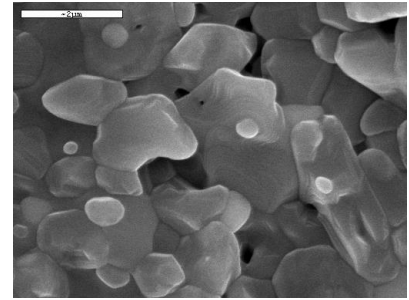
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Zirconia Silicate (Zircon)

Zirconia Silicate ($ZrSiO_4$) or Zircon has unique and outstanding properties as a refractory material. It has no definite melting point and dissociation into zirconia and silica begins at 1550°C with little physical change apparent until 1700°C. Its favorably low thermal expansion properties and lack of crystalline inversion give it a higher thermal shock resistance than other ceramic refractory materials. Zircon have severely lower cost compared to alternative refractories. A notable property of Zircon is also the low thermal conductivity making it a material with high insulation value.



Thermansys t-ceramics machinable Zircon after full firing to 1550°C is remarkably hard and wear resistant, can withstand extremely corrosive environments.

Firing – Shrinkage: For full firing raise the temperature to 1100°C with a heating rate of 4°C/min and then to 1550°C with 2°C/min. Soak at this temperature for 4 to 8 hours. Cool down the furnace gradually with a rate of 5°C/min. The thicker the parts sections the longer the soak time. Typically for wall thickness 4-8mm 4 hours soaking time will be enough. Parts with cross sectional thickness higher than 25mm will need 8 hours soaking time. A shrinkage of 16-18% must be expected. An almost proportionally lower degree of shrinkage should be expected with lower soaking temperature.

Standard Delivery Forms and Dimensions Tables.

Tables below are listing dimensions and capacity data for all standard shapes and sizes that are available from Thermansys. All data quoted are nominal values. Dimensional tolerances in the order of $\pm 3\%$ are apply to all our products. Prices listed are in Euro.

Special shape or size Alumina engineering ceramics are available upon request. Thermansys can provide a detailed quote even for low volume order. Please send as a detailed drawing of the desired product and we will provide you with a quote.

Rods

O.D. mm	Length mm	Alumina			ZTA			Zirconia Silicate		
		Part No.		Price (euro)	Part No.	Price (euro)	Part No.	Price (euro)		
6	150	MA-R	6/15	30	MZTA-R	6/15	32	MZRC-R	6/15	30
6	250	MA-R	6/25	50	MZTA-R	6/25	55	MZRC-R	6/25	50
12	150	MA-R	12/15	40	MZTA-R	12/15	44	MZRC-R	12/15	40
12	250	MA-R	12/25	60	MZTA-R	12/25	66	MZRC-R	12/25	60
20	150	MA-R	20/15	70	MZTA-R	20/15	76	MZRC-R	20/15	70
20	250	MA-R	20/25	100	MZTA-R	20/25	110	MZRC-R	20/25	100
30	150	MA-R	30/15	100	MZTA-R	30/15	110	MZRC-R	30/15	100
30	250	MA-R	30/25	150	MZTA-R	30/25	165	MZRC-R	30/25	150
40	150	MA-R	40/15	120	MZTA-R	40/15	132	MZRC-R	40/15	120
40	250	MA-R	40/25	180	MZTA-R	40/25	198	MZRC-R	40/25	180
50	150	MA-R	50/15	150	MZTA-R	50/15	165	MZRC-R	50/15	150
50	250	MA-R	50/25	200	MZTA-R	50/25	220	MZRC-R	50/25	200
60	150	MA-R	60/15	180	MZTA-R	60/15	198	MZRC-R	60/15	180
60	250	MA-R	60/25	260	MZTA-R	60/25	286	MZRC-R	60/25	260

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Bars

Height mm	Width mm	Length mm	Alumina		ZTA		Zirconia Silicate	
			Part No.	Price (euro)	Part No.	Price (euro)	Part No.	Price (euro)
12	12	200	MA-B 12/12	70	MZTA-B 12/12	76	MZRC-B 12/12	70
12	20	200	MA-B 12/20	90	MZTA-B 12/20	100	MZRC-B 12/20	90
12	40	200	MA-B 12/40	120	MZTA-B 12/40	132	MZRC-B 12/40	120
20	20	200	MA-B 20/20	110	MZTA-B 20/20	120	MZRC-B 20/20	110
20	40	200	MA-B 20/40	160	MZTA-B 20/40	176	MZRC-B 20/40	160
20	60	200	MA-B 20/60	190	MZTA-B 20/60	210	MZRC-B 20/60	190
25	40	200	MA-B 25/40	180	MZTA-B 25/40	198	MZRC-B 25/40	180
25	60	200	MA-B 25/60	210	MZTA-B 25/60	222	MZRC-B 25/60	210

Plates

Height mm	Width mm	Length mm	Alumina		ZTA		Zirconia Silicate	
			Part No.	Price (euro)	Part No.	Price (euro)	Part No.	Price (euro)
6	150	150	MA-P 6/15	150	MZTA-P 6/15	165	MZRC-P 6/15	150
12	150	150	MA-P 12/15	210	MZTA-P 12/15	230	MZRC-P 12/15	120
20	150	150	MA-P 20/15	260	MZTA-P 20/15	285	MZRC-P 20/15	260
25	150	150	MA-P 25/15	290	MZTA-P 25/15	320	MZRC-P 25/15	290

t-ceramics is the brand name of refractory technical ceramics produced by
THERMANSYS
www.thermansys.com

Thermansys is a producer of High Temperature Electrical Furnaces, Vacuum Ovens, Precision Vacuum Hot Plates and Refractory Technical Ceramics.

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