THERMANSYS®

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.

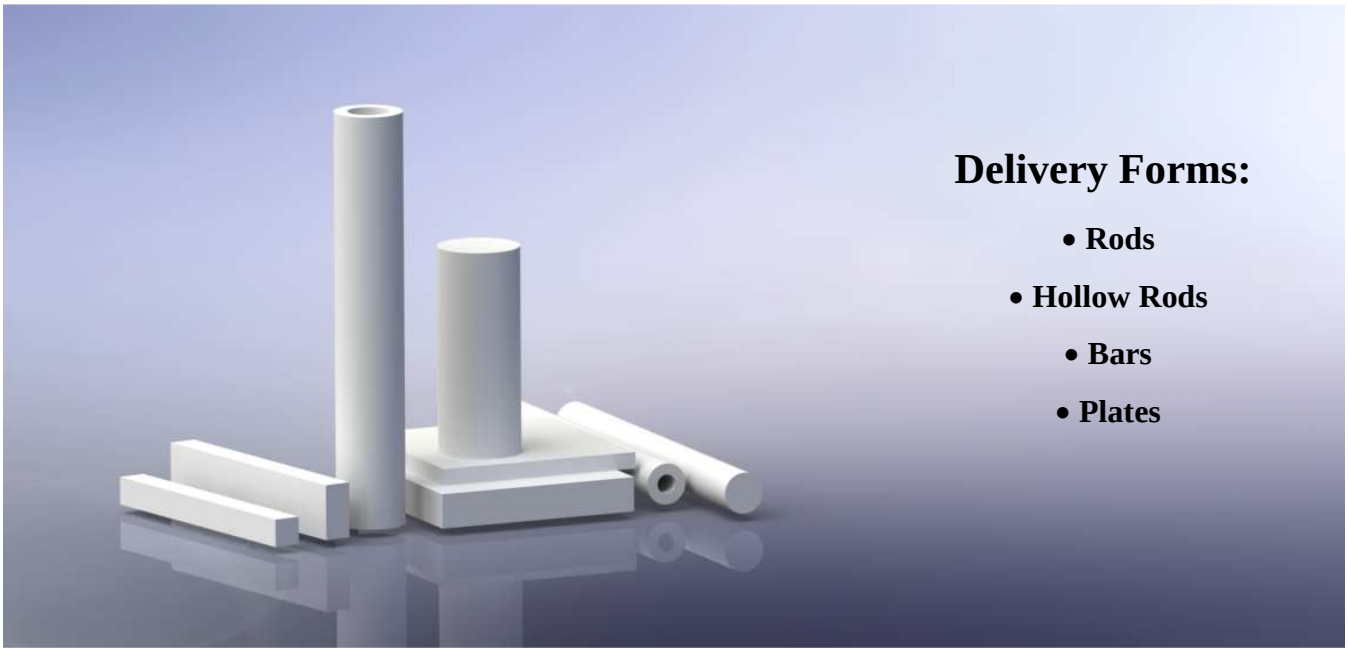
Available materials are High Purity 99.7% Alumina, Zirconia Toughened Alumina (ZTA) and Zirconia Silicate (Zircon). All our material are offered in rods, hollow rods, bars and plates.

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.



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Health and Safety.

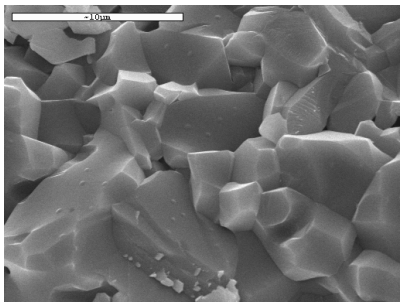
Our ceramic machinable materials, as it is delivered, do not contain substances dangerous to health, or create them during use. They are produced using natural inert raw materials. Any organic binder or other substances used during manufacturing are burned through production firing. Thermansys however 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 our 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 thermodielectric refractory and is transparent to microwave radio frequencies.

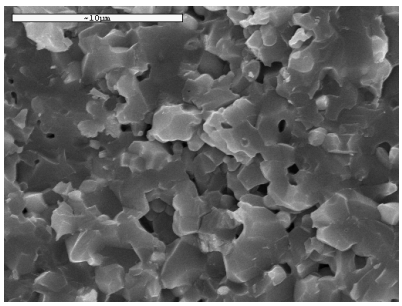


Thermansys t-ceramics machinable Alumina after full firing to 1700°C will became a dense material with all mechanical, chemical and electrical properties of high purity recrystallized Alumina.

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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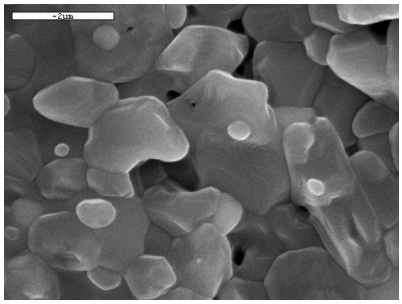
Zirconia Silicate (Zircon)

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 has 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 for all standard shapes and sizes that are available from Thermansys. All data quoted are nominal values. Dimensional tolerances in the order of ±3% apply to all our products. Prices listed are in Euro.

Rods

O.D. mm	Length mm	Alumina		ZTA		Zirconia Silicate	
		Part No.	Price	Part No.	Price	Part No.	Price
6	150	MA-R 4	23	MZTA-R 4	25	MZRC-R 4	20
6	300	MA-R 8	31	MZTA-R 8	34	MZRC-R 8	26
12	150	MA-R 17	42	MZTA-R 17	46	MZRC-R 17	36
12	300	MA-R 34	57	MZTA-R 34	63	MZRC-R 34	49
20	150	MA-R 47	66	MZTA-R 47	73	MZRC-R 47	56
20	300	MA-R 94	90	MZTA-R 94	99	MZRC-R 94	76
30	150	MA-R 106	95	MZTA-R 106	104	MZRC-R 106	80
30	300	MA-R 212	128	MZTA-R 212	141	MZRC-R 212	109
40	150	MA-R 188	122	MZTA-R 188	134	MZRC-R 188	104
40	300	MA-R 377	165	MZTA-R 377	182	MZRC-R 377	141
50	150	MA-R 294	148	MZTA-R 294	163	MZRC-R 294	126
50	300	MA-R 589	201	MZTA-R 589	221	MZRC-R 589	171
60	150	MA-R 424	174	MZTA-R 424	192	MZRC-R 424	148
60	300	MA-R 848	236	MZTA-R 848	260	MZRC-R 848	201

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Hollow Rods

O.D. mm	I.D. mm	Length mm	Alumina Part No.	Alumina Price	ZTA Part No.	ZTA Price	Zirconia Silicate Part No.	Zirconia Silicate Price
12	6	150	MA-HR 13	37	MZTA-HR 13	41	MZRC-HR 13	32
12	6	300	MA-HR 25	51	MZTA-HR 25	56	MZRC-HR 25	43
20	10	150	MA-HR 35	58	MZTA-HR 35	64	MZRC-HR 35	50
20	10	300	MA-HR 71	79	MZTA-HR 71	87	MZRC-HR 71	67
30	14	150	MA-HR 83	85	MZTA-HR 83	93	MZRC-HR 83	72
30	14	300	MA-HR 166	115	MZTA-HR 166	127	MZRC-HR 166	98
40	24	150	MA-HR 121	100	MZTA-HR 121	110	MZRC-HR 121	85
40	24	300	MA-HR 241	136	MZTA-HR 241	149	MZRC-HR 241	116
50	30	150	MA-HR 188	122	MZTA-HR 188	134	MZRC-HR 188	104
50	30	300	MA-HR 377	165	MZTA-HR 377	182	MZRC-HR 377	141
60	34	150	MA-HR 288	147	MZTA-HR 288	162	MZRC-HR 288	125
60	34	300	MA-HR 576	199	MZTA-HR 576	219	MZRC-HR 576	169

Bars

Height mm	Width mm	Length mm	Alumina Part No.	Alumina Price	ZTA Part No.	ZTA Price	Zirconia Silicate Part No.	Zirconia Silicate Price
12	12	200	MA-B 29	68	MZTA-B 29	75	MZRC-B 29	58
12	20	200	MA-B 48	87	MZTA-B 48	96	MZRC-B 48	74
12	40	200	MA-B 96	121	MZTA-B 96	133	MZRC-B 96	103
20	20	200	MA-B 80	111	MZTA-B 80	122	MZRC-B 80	94
20	40	200	MA-B 160	155	MZTA-B 160	170	MZRC-B 160	132
20	60	200	MA-B 240	188	MZTA-B 240	207	MZRC-B 240	160
25	40	200	MA-B 200	172	MZTA-B 200	190	MZRC-B 200	147
25	60	200	MA-B 300	209	MZTA-B 300	230	MZRC-B 300	178

Plates

Height mm	Width mm	Length mm	Alumina Part No.	Alumina Price	ZTA Part No.	ZTA Price	Zirconia Silicate Part No.	Zirconia Silicate Price
6	150	150	MA-P 135	143	MZTA-P 135	157	MZRC-P 135	121
12	150	150	MA-P 270	199	MZTA-P 270	219	MZRC-P 270	169
20	150	150	MA-P 450	254	MZTA-P 450	280	MZRC-P 450	216
25	150	150	MA-P 563	283	MZTA-P 563	312	MZRC-P 563	241

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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