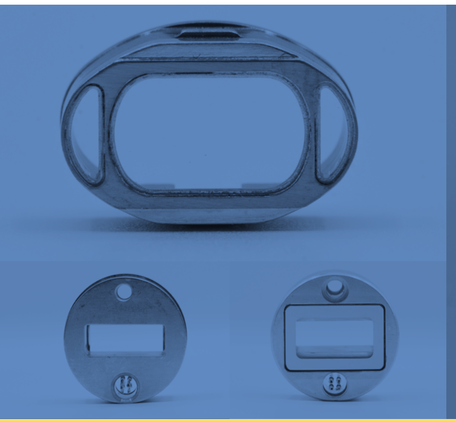
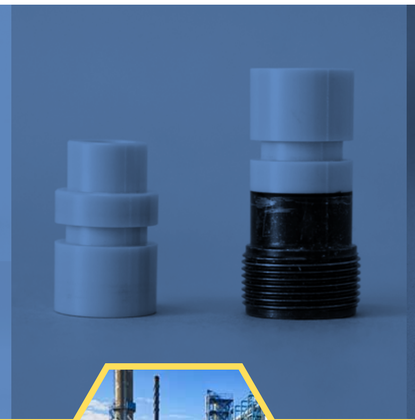
Material Solutions

Providing highly engineered advanced material solutions for over 120 years.





Superior engineering. Trusted solutions. Customized materials.

A Broad Spectrum of Ceramic Material Solutions

We have developed deep experience in working with technical ceramics materials, including Zirconia (YTZP, MSZ), Zirconia Toughened Alumina (ZTA), Alumina (74-99.8%) and Silicon Nitride (Si3N4). The unique attributes of each material allow our engineers to solve individual industry challenges, all while providing cost effective solutions.

Alumina Provides Durability and Cost Effectiveness

Alumina materials are a cost effective alternative to other materials where hardness is required for wear and corrosion resistance. Alumina also provides high compressive strength and is an excellent electrical insulator. Alumina is often used in rupture discs, wear liners, pump plungers, hydrocyclones and electrical insulators.

Silicon Nitride Provides Added Thermal Advantages

Silicon Nitride offers superior strength and thermal performance for applications that require thermal shock resistance combined with overall material strength. At a lower density than the Zirconia materials, it is a lighter weight alternative while still providing excellent strength, corrosion and wear resistance.

Zirconia Toughened Alumina for Greater Strength & Durability

Zirconia Toughened Alumina is an excellent choice for applications requiring greater toughness and higher strength than Alumina alone, while maintaining the corrosion resistance of Alumina. This material is used in similar applications as Alumina, but where the pressures and well conditions demand greater material strength and durability. ZTA can also be metalized and brazed, similar to Alumina, to offer companies unique possibilities when designing tooling components.

Other Zirconia Materials Provide Extended Life Performance

The Zirconia family of materials provides impact and toughness in extreme environments that often require extended life performance. YTZP offers superior strength, MSZ excellent toughness. Zirconia is often used in MWD/LWD tooling components, artificial lift components, and frac plug buttons.

Providing highly engineered material solutions for over 120 years.

We specialize in providing highly technical, custom solutions for Energy Industry equipment applications. We are able to offer our customers deep expertise in the specific material properties of given ceramic materials, and matching them to specific use cases. Please contact us to discuss your unique challenges.

Ceramic Engineering Insight

We bring 120 years of ceramics engineering experience to our customers. Our engineers' expertise provides guidance in material selection, design-to-manufacture geometry and cost effective production.

Proven Experience in Quality Documentation Assurance

The performance of a ceramic component is dependent on the consistency and quality of its material properties. That's why we control every aspect of manufacturing; from raw material through to finished component. Powder preparation, forming, green machining, sintering and diamond grinding are all governed by the same principles of total quality management.

Responsive Service Culture

In the larger world of ceramics, we're a mid-sized firm located in Vermont. We pride ourselves on providing direct access to our key team members and quick response times for our customers.

Contact STC Material Solutions:

STC Material Solutions
600 Industrial Park Road.
St. Albans, VT 05478
(802) 527-7726

ITAR REGISTERED

AS9100 & ISO 9001

DFARS CYBER COMPLIANT

REACH COMPLIANT

RoHS COMPLIANT

Material Solutions

Providing highly engineered advanced material solutions for over 120 years.

Advanced Ceramic Solutions for the Oil & Gas Industry

STC Material Solutions offers the oil and gas industry a variety of ceramic and hermetic material solutions to meet the increasingly severe service requirements for petroleum and gas upstream processing. As conventional and unconventional wells become more extreme operating environments, with higher pressures, temperatures and extreme pH, our engineers continue to collaborate with you to find the best material solutions for your specific challenges.

Proven Performance in Extreme Operating Environments

Technical Ceramics are well suited for challenging operating conditions due to their unique properties, which include:

- **High Temperature Resistance** – important in oil field settings as temperatures continue to rise downhole and thermal shock can be an issue.
- **Toughness** – including impact and vibration resistance
- **Hardness** – providing wear and erosion resistance
- **Chemical Resistance** – to both acidic and basic environments.

The Cost Effective Choice

Experience in oil & gas settings has shown that technical ceramics often provide better performance than traditional materials in high temperature, corrosive, wear and chemical environments – resulting in overall cost savings for our customers.

Downhole Tool Components

- Poppets
- Wear Sleeves
- Seal Carriers
- Float Sleeve
- Gap Sub
- Rupture Discs
- Poppet Seats
- Electrode Insulators
- Guide Plug
- Retainer Ring
- Artificial Lift Components
- Directional Drilling Components

Wear-Resistant Product Applications

- Chokes and Valves
- Pump Impellers/Liners
- Hydrocyclone Liners
- Mechanical Seals
- Wearplates
- Downhole Wear Parts
- Hanger Bearings
- Desanders
- Separators
- Shaft Sleeves
- Downhole Sensor Parts
- Nozzles, Sandblast/Spray

Pump Applications

- Seal Components
- Sleeves
- Mechanical Seals
- Impellers
- Suction Side Plates
- Shafts
- Wear Plates
- Casings
- Casing Rings
- Suction Pipes
- Liners
- Impeller Rings
- Artificial Lift Components

Ceramic Plungers, Valves & Packing Applications

- Extension Rods
- Valve Seats
- Valve Seals

Technical Ceramic Solutions for the Oil & Gas Industry

	Property	ASTM Method	Units	Alumina AL74 74%	Alumina AL95 95%	Alumina AL96 96%	Alumina AL98 98%
General	Crystal Size (Average)	Thin Section	Microns	13	11	8	7
	Color	--	--	White	Ivory	White or Purple	White
	Gas Permeability	--	atms-cc/sec	gas tight <10-10	gas tight <10-10	gas tight <10-10	gas tight <10-10
	Water Absorption	C 20-97	%	0	0	0	0
Mechanical	Density	C 20-97	g/cc	3.03	3.65	3.71	3.78
	Hardness	Vickers 500 gm	GPa (kg/mm2)	10.5 (1075)	11.5 (1175)	12.7 (1300)	12.7 (1300)
	Hardness	--	R45N	78	79	81	81
	Fracture Toughness	Notched Beam	MPam1/2	2 - 5	3 - 4	4 - 5	4 - 5
	Flextrual Strength (MOR) (3 point) @ RT	F417-87	MPa (psi x 103)	241 (35)	310 (45)	358 (52)	393 (57)
	Tensile Strength @ RT	--	MPa (psi x 103)	117 (17)	151 (22)	200 (29)	221 (32)
	Compressive Strength @ RT	--	MPa (psi x 103)	1378 (200)	1827 (265)	2068 (300)	2241 (325)
	Elastic Modulus	C848	GPa (psi x 103)	172 (25)	303 (44)	310 (45)	345 (50)
	Poisson's Ratio	C848	--	0.22	0.22	0.22	0.23
Thermal	C.T.E. 25 - 100° C	C 372-96	x 10-6/C	5.5	6.1	6.0	6.2
	C.T.E. 25 - 300° C	C 372-96	x 10-6/C	5.8	7.0	6.8	6.8
	C.T.E. 25 - 600° C	C 372-96	x 10-6/C	6.3	7.7	7.5	7.6
	Thermal Conductivity @ RT	C 408	W/m K	4	19	23	29
	Max Use Temp	--	Farenheit (°F)	2800	3000	3100	3100
		--	Celcius (°C)	1540	1650	1700	1700
Electrical	Dielectric Strength (.125" Thick)	D 149-97A	V/mil	225	250	250	260
	Dielectric Constant @ 1 MHz	D 150-98	--	7.0	9.0	9.1	9.5
	Dielectric Constant	D 2520-95	--	--	9.2	9.1	9.4
	@ Gigahertz			--	11.0	10.9	9.8
	Dielectric Loss @ 1 MHz	D 150-98	--	0.0012	0.0006	0.0004	0.0006
	Dielectric Loss	D 2520-95	--	--	0.0009	0.0007	0.0005
	@ Gigahertz			--	12.5	10.9	9.8
	Volume Resistivity, 25° C	D 257	ohms-cm	< 1 x 1013	> 1 x 1014	> 1 x 1014	> 1 x 1014
	Volume Resistivity, 300° C	D 1829	ohms-cm	4 x 1010	5 x 1012	3 x 1012	8 x 1011
	Volume Resistivity, 500° C	D 1829	ohms-cm	3 x 107	3 x 109	7 x 109	2 x 109
	Volume Resistivity, 700° C	D 1829	ohms-cm	2 x 106	3 x 108	4 x 108	2 x 108
	Volume Resistivity, 1000° C	D 1829	ohms-cm	--	--	--	--

	High Purity Alumina AL995 99.5%	High Purity Alumina AL9980 99.8%	High Purity Alumina AL9996 99.96%	Zirconia ZTA-14	Zirconia ZTA-20	Zirconia MSZ (Magnesia Stabilized)	Zirconia YTZP 2000 (Yttria Stabilized)
General	6	6	2	6	3	30	1
	Ivory - White	Ivory	Off White/Blush	White	White	Ivory or Yellow	Ivory
	gas tight <10-10	gas tight <10-10	gas tight <10-10	gas tight <10-10	gas tight <10-10	gas tight <10-10	gas tight <10-10
	0	0	0	0	0	0	0
Mechanical	3.88	3.91	3.93	4.17	4.30	5.72	6.02
	14.3 (1459)	15 (1530)	19.6 (2000)	14.5 (1478)	14.4 (1470)	11.7 (1200)	12.5 (1250)
	82	86	90	82	82	78	80
	4 - 5	3 - 4	5 - 6	6	6	12	10
	338 (49)	379 (55)	455 (66)	586 (85)	621 (90)	620 (90)	951 (138)
	172 (25)	200 (29)	275 (40)	344 (50)	350 (51)	310 (45)	550 (80)
	2137 (310)	2240 (325)	2413 (350)	2758 (400)	2758 (400)	1862 (270)	2485 (360)
	379 (55)	379 (55)	393 (57)	338 (49)	338 (49)	206 (29.8)	210 (30)
	0.23	0.23	0.23	0.23	0.23	0.28	0.30
Thermal	6.3	6.5	6.5	6.0	6.0	8.9	6.9
	6.9	7.9	7.9	7.0	7.0	9.7	8.1
	7.6	8.1	8.2	7.1	7.1	10	10.5
	30	30	35	24	24	3	2.2
	3047	3047	3100	2730	2730	2200	932
	1675	1675	1700	1500	1500	1200	500
Electrical	270	290	422	250	250	300	240
	9.8	9.8	9.9	12.5	12.5	22.7	30.0
	9.7	10	--	--	12.4	29.2	--
	9.8	9.6	--	--	9.4	6.2	--
	0.0002	< .0001	< .0001	0.0006	0.0006	0.0016	0.0010
	< .0001	< .0001	--	0.0005	0.0005	0.0018	--
	9.8	9.6	--	9.4	9.4	6.2	--
	> 1 x 1014	> 1 x 1014	> 1 x 1014	> 1 x 1014	> 1 x 1014	> 1 x1013	> 1 x1013
	1 x 1012	3 x 1012	1 x 1013	1 x 1010	1 x 1010	5 x107	1 x 1010
	5 x 1010	6 x 1010	5 x 1012	2 x 109	2 x 109	1 x 107	1 x 106
	2 x 109	6 x 109	1 x 1012	2 x 108	4 x 108	2 x 106	5 x 103
	--	--	--	--	--	--	--

	Nitride Silicon Nitride (Si_3N_4)	Silicates Steatite L-4	Steatite L-5	Corderite	Mullite	Lava Grade A Fired	Units
General	4	7	7	--	7	--	Microns
	Black	Tan	Gray-Green	Orange-Tan	Gray-Tan	Gray-Tan	--
	gas tight <10-10	--	--	Porous	--	Porous	atms-cc/sec
	0	0	0	10	0	3	%
Mechanical	3.25	2.65	2.75	2.00	3.00	2.30	g/cc
	15 (1529)	4.9 (500)	4.9 (500)	5.8 (590)	10 (1000)	4.4 (450)	GPa (kg/mm2)
	83	57	57	50	78	42	R45N
	6	--	--	--	3	--	MPam1/2
	900 (130)	117 (17)	138 (20)	66 (9.5)	206 (30)	69 (10)	MPa (psi x 103)
	537 (78)	103 (15)	103 (15)	19 (2.7)	138 (20)	21 (3)	MPa (psi x 103)
	2500 (362)	551 (80)	586 (85)	165 (24)	1034 (150)	172 (25)	MPa (psi x 103)
	300 (44)	103 (15)	103 (15)	103 (15)	179 (26)	--	GPa (psi x 106)
	0.28	0.24	0.24	0.31	0.24	--	--
Thermal	--	7.3	8.5	2.1	3.6	2.9	x 10-6/C
	--	7.4	8.6	2.5	4.1	3.3	x 10-6/C
	2.9	7.5	8.6	3.0	4.8	3.6	x 10-6/C
	29	3	3	3	4	2	W/m K
	2552	2350	2350	2350	3100	2000	Farenheit (°F)
	1400	1290	1290	1290	1700	1100	Celcius (°C)
Electrical	300	260	270	120	250	100	V/mil
	9.2	5.6	5.7	5.5	6.7	5.3	--
	--	5.6	5.8	--	6.7	--	--
	--	9.2	12.5	--	11.4	--	--
	--	0.003	0.0014	--	0.003	--	--
	--	0.005	0.0017	--	0.003	--	--
	--	9.2	12.5	--	11.4	--	--
	> 1 x 1014	> 1 x 1014	> 1 x 1014	> 1 x 1014	> 1 x 1014	--	ohms-cm
	--	2 x 1010	1 x 1011	--	4 x 1010	--	ohms-cm
	--	1 x 109	4 x 1010	--	1 x 109	--	ohms-cm
	--	2 x 108	1 x 109	--	--	--	ohms-cm
	--	--	--	--	--	--	ohms-cm

Revised: 4/4/2023