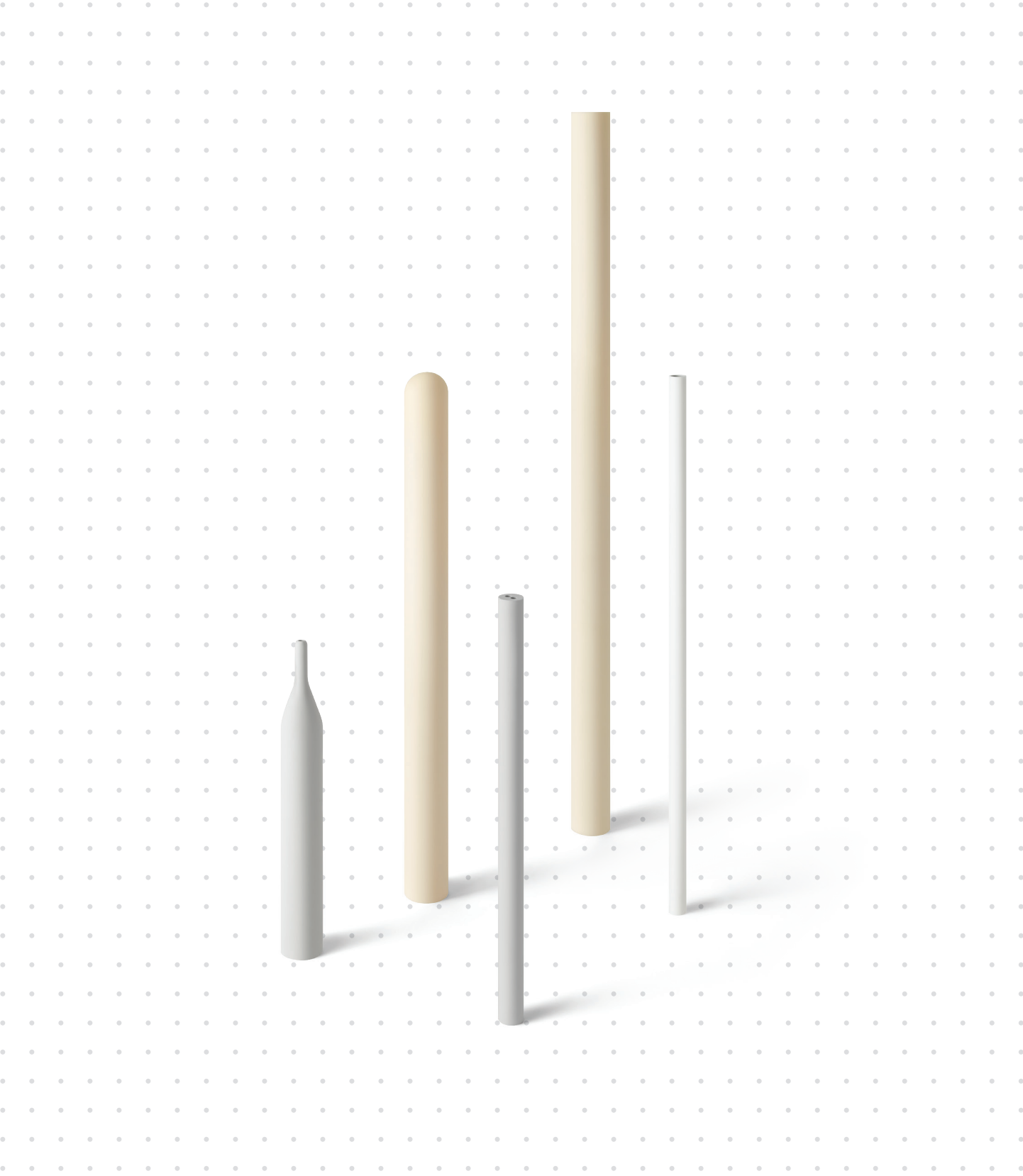




**Tubes and Rods Catalog**  
Extruded Ceramic Products



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With over 100 years of manufacturing experience, CoorsTek is a proven leader in engineered ceramic components. CoorsTek is the partner of choice for industry leaders in semiconductor manufacturing, medical, automotive, defense, medical, energy, and other critical-duty markets.

Our high-performance components and assemblies enable our customers to overcome technological barriers and improve performance — especially in demanding or severe-service environments.

CoorsTek has a highly qualified staff to assist with providing accurate material information and product design. For assistance with extruded ceramic products, please contact us or call:  
 +1 303 271 7100  
 +1 855 929 7100 (toll free in USA)

# GENERAL ORDERING INFORMATION

## Terms of Sale

- In stock items will typically ship in three to five working days.
- Expedited shipment available for a nominal fee.
- Terms: Net 30 days (with approved credit). MasterCard, Visa, and American Express accepted.
- Minimum order requirement of \$500.00 is applicable.

- CoorsTek standard terms and conditions apply.
- CoorsTek reserves the right to add or discontinue items at any time without notice.
- **Order online** 24-hours-a-day, seven-days-a-week at **coorstek.com**.

## Standard Extruded Products:

Please specify the following when ordering:

- Quantity (pieces or feet)
- Outside diameter, inside diameter, and length
- Extrusion configuration
  - Round single bore (RSB)
  - Round double bore (RDB)
  - Round 4 bore (R4B)
  - Oval double bore (ODB)
- Material Designation

## Custom Extruded Products:

Please specify the following when ordering:

- Quantity
- Dimensional specifications
- Material designation
- Application environment
  - Physical
  - Mechanical
  - Thermal
  - Electrical
  - Chemical

# COORSTEK MATERIAL DESIGNATION

**Mullite:**  $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$

**AD-998:** 99.8% Dense Alumina ( $\text{Al}_2\text{O}_3$ )

**AD-94:** 94.0% Dense Alumina ( $\text{Al}_2\text{O}_3$ )

**TTZ:** Magnesia partially stabilized Zirconia ( $\text{ZrO}_2$ )

**YTZP:** Yttria partially stabilized Zirconia ( $\text{ZrO}_2$ )

**ZDY:** Yttria fully stabilized Zirconia ( $\text{ZrO}_2$ )

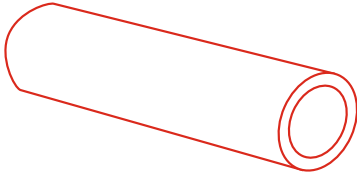
## TO ORDER

+1 303 271 7100

info@coorstek.com

www.coorstek.com

# ALUMINA EXTRUDED TUBING

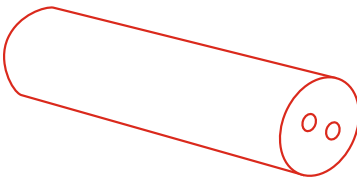


**AD-998**  
**ROUND SINGLE BORE TUBING**  
 Diameter tolerance  $\pm 3\%$  or  $\pm 0.003''$  (0.076 mm), whichever is greater.  
 Straightness:  $\leq 0.003''/1.000''$  cumulative

OD In.	ID In.	OD mm	ID mm	Part #
0.050	0.020	1.27	0.51	65650
0.063	0.031	1.60	0.79	65651
0.094	0.040	2.39	1.02	65652
0.094	0.063	2.39	1.60	65682
0.100	0.050	2.54	1.27	65653
0.125	0.063	3.18	1.60	65654
0.156	0.094	3.96	2.39	65655
0.188	0.094	4.78	2.39	65665
0.188	0.125	4.78	3.18	65656
0.219	0.156	5.56	3.96	65657
0.250	0.125	6.35	3.18	65663
0.250	0.156	6.35	3.96	65666
0.250	0.188	6.35	4.78	65658
0.313	0.188	7.95	4.78	65667
0.313	0.219	7.95	5.56	65659
0.375	0.250	9.53	6.35	65660
0.438	0.313	11.13	7.95	65661
0.500	0.250	12.70	6.35	65669
0.500	0.375	12.70	9.53	65664
0.590	0.394	14.98	10.00	65810
0.590	0.433	14.98	11.00	65811

Diameter tolerance  $\pm 5\%$ .  
 Straightness:  $\leq 0.003''/1.000''$  cumulative

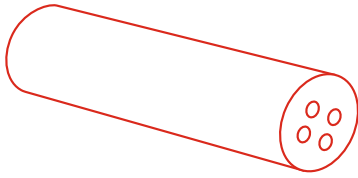
OD In.	ID In.	OD mm	ID mm	Part #
0.625	0.500	15.88	12.70	65677
0.688	0.500	17.48	12.70	65679
0.750	0.500	19.05	12.70	65662
0.750	0.563	19.05	14.30	65680
0.875	0.625	22.23	15.88	65668
1.000	0.750	25.40	19.05	65825



**AD-998**  
**ROUND DOUBLE BORE TUBING**  
 Diameter tolerance  $\pm 3\%$  or  $\pm 0.003''$  (0.076 mm), whichever is greater.  
 Straightness:  $\leq 0.003''/1.000''$  cumulative

OD In.	ID In.	OD mm	ID mm	Part #
0.063	0.016	1.60	0.41	65670
0.094	0.025	2.39	0.64	65671
0.109	0.031	2.77	0.79	65672
0.125	0.031	3.18	0.79	65678
0.125	0.040	3.18	1.02	65673
0.156	0.052	3.96	1.32	65674
0.188	0.040	4.78	1.02	65835
0.188	0.047	4.78	1.19	65836
0.188	0.063	4.78	1.60	65675
0.200	0.052	5.08	1.32	65676
0.240	0.078	6.10	1.98	65693
0.250	0.063	6.35	1.60	65690
0.335	0.059	8.51	1.50	65699

# ALUMINA EXTRUDED TUBING

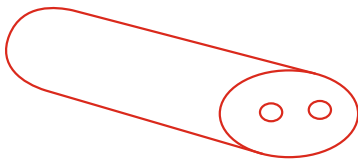


**AD-998**  
**ROUND FOUR BORE TUBING**

Diameter tolerance  $\pm 3\%$  or  $\pm 0.003''$  (0.076 mm), whichever is greater.

Straightness:  $\leq 0.003''/1.000''$  cumulative

OD In.	ID In.	OD mm	ID mm	Part #
0.063	0.016	1.60	0.41	65684
0.085	0.024	2.13	0.60	65692
0.094	0.020	2.39	0.51	65683
0.109	0.020	2.77	0.51	65687
0.188	0.031	4.78	0.79	65685
0.188	0.047	4.75	1.19	65698
0.219	0.050	5.56	1.27	65686
0.258	0.078	6.55	1.98	65689



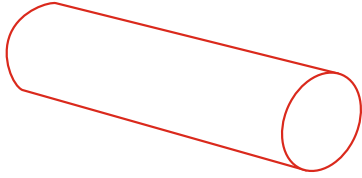
**AD-998**  
**OVAL DOUBLE BORE TUBING**

Diameter tolerance  $\pm 3\%$  or  $\pm 0.003''$  (0.076 mm), whichever is greater.

Straightness:  $\leq 0.003''/1.000''$  cumulative

OD In. (major)	OD In. (minor)	ID in.	OD mm (major)	OD mm (minor)	ID mm	Part #
0.077	0.051	0.014	1.96	1.30	0.36	65695
0.120	0.070	0.031	3.05	1.78	0.79	65697
0.163	0.112	0.040	4.14	2.84	1.02	65696

# ALUMINA RODS



## AD-998

### AS-FIRED RODS

Diameter tolerance  $\pm 3\%$  or  $\pm 0.003''$  (0.076 mm), whichever is greater.

Straightness:  $\leq 0.003''/1.000''$  cumulative

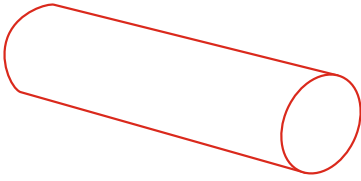
Diameter tolerance  $\pm 5\%$ .

Straightness:  $\leq 0.003''/1.000''$  cumulative

OD In.	OD mm.	Part #
0.011	0.28	65987
0.020	0.51	65983
0.022	0.56	65988
0.024	0.61	65981
0.029	0.74	65980
0.30	0.76	65985
0.35	0.89	65974
0.040	1.02	65982
0.041	1.04	65984
0.043	1.09	65993
0.048	1.22	65975
0.056	1.42	65976
0.063	1.60	65967
0.072	1.83	65950
0.096	2.44	65951
0.125	3.18	65968
0.137	3.48	65953
0.188	4.78	65969
0.197	5.00	65954
0.212	5.38	65991
0.250	6.35	65970
0.264	6.71	65955
0.313	7.95	65971
0.375	9.53	65972
0.388	9.86	65952
0.400	10.16	65956
0.440	11.18	65973
0.500	12.70	65958

OD In.	OD mm.	Part #
0.518	13.16	65977
0.625	15.88	65959
0.640	16.26	65978
0.750	19.05	65960
0.775	16.69	65979

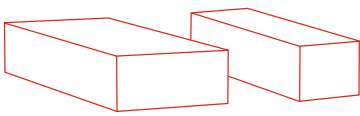
## ALUMINA RODS



### AD-998 GROUND RODS

Diameter tolerance  $\pm 0.001''$  or  $\pm 0.025$  mm.  
Straightness:  $\leq 0.001''/1.000''$  cumulative

OD In.	OD mm	Part #
0.060	1.52	65961
0.080	2.03	65962
0.125	3.18	65963
0.188	4.78	65964
0.250	6.35	65965
0.375	9.53	65966
0.500	12.70	65957

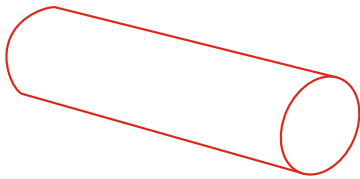


### AD-998 SQUARE/RECTANGULAR RODS

Diameter tolerance  $\pm 3\%$ .  
Straightness:  $\leq 0.003''/1.000''$  cumulative  
Maximum twist  $2^\circ$  per foot.

Width/Thickness in.	Width/Thickness mm	Part #
0.125/0.125	3.18/3.18	65995
0.156/0.156	4.0/4.0	65997
0.250/0.250	6.35/6.35	65996
0.500/0.250	12.70/6.35	65999

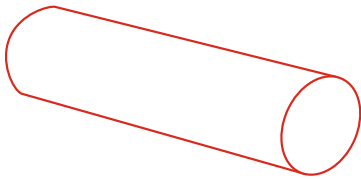
## ALUMINA & ZIRCONIA RODS



### YTZP AS-FIRED RODS

Diameter tolerance  $\pm 3\%$  or  $\pm 0.003''$  (0.076 mm), whichever is greater.  
Straightness:  $\leq 0.003''/1.000''$  cumulative

OD In.	OD mm.	Part #
0.072	1.83	66900
0.137	3.48	66901
0.197	5.00	66902
0.264	6.71	66903

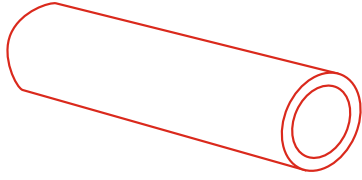


### TTZ AS-FIRED RODS

Diameter tolerance  $\pm 3\%$  or  $\pm 0.003''$  (0.076 mm), whichever is greater.  
Straightness:  $\leq 0.003''/1.000''$  cumulative

OD In.	OD mm.	Part #
0.063	1.60	66837
0.125	3.18	66838
0.150	3.81	66831
0.188	4.78	66839
0.250	6.35	66832
0.313	7.95	66833
0.375	9.53	66834
0.390	9.91	66840
0.438	11.13	66835
0.500	12.70	66836

# MULLITE EXTRUDED TUBING



## MULLITE ROUND SINGLE BORE TUBING

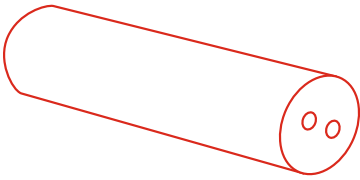
Diameter tolerance  $\pm 3\%$  or  $\pm 0.003''$  (0.076 mm), whichever is greater.

Straightness:  $\leq 0.003''/1.000''$  cumulative

Diameter tolerance  $\pm 5\%$ .  
Straightness:  $\leq 0.003''/1.000''$  cumulative

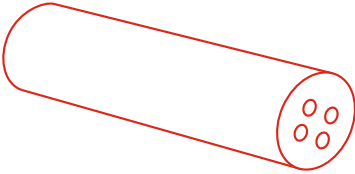
OD In.	ID Inch	OD mm	ID in.	Part #
0.078	0.047	1.98	1.19	66618
0.125	0.063	3.18	1.60	66620
0.125	0.094	3.18	2.39	66621
0.156	0.094	3.96	2.39	66623
0.188	0.125	4.78	3.18	66626
0.219	0.125	5.56	3.18	66627
0.250	0.063	6.35	1.60	66628
0.250	0.125	6.35	3.18	66630
0.250	0.188	6.35	4.78	66631
0.313	0.188	7.95	4.78	66632
0.313	0.250	7.95	6.35	66633
0.375	0.125	9.53	3.18	66634
0.375	0.188	9.53	4.78	66635
0.375	0.250	9.53	6.35	66636
0.438	0.313	11.13	7.95	66637
0.500	0.125	12.70	3.18	66638
0.500	0.250	12.70	6.35	66640
0.500	0.313	12.70	7.95	66641
0.500	0.375	12.70	9.53	66642
0.500	0.406	12.70	10.31	66643

OD In.	ID Inch	OD mm	ID in.	Part #
0.625	0.500	15.88	12.70	66603
0.688	0.500	17.48	12.70	66604
0.750	0.500	19.05	12.70	66601
0.750	0.563	19.05	14.30	66644
0.875	0.625	22.23	15.88	66602



**MULLITE**  
**ROUND DOUBLE BORE TUBING**  
 Diameter tolerance  $\pm 3\%$  or  $\pm 0.003''$  (0.076 mm), whichever is greater. Straightness:  $\leq 0.003''/1.000''$  cumulative

OD In.	ID Inch	OD mm	ID in.	Part #
0.063	0.016	1.60	0.41	66645
0.125	0.040	3.18	1.02	66648
0.188	0.063	4.78	1.60	66653
0.250	0.040	6.35	1.02	66655
0.250	0.063	6.35	1.60	66656



**MULLITE**  
**ROUND FOUR BORE TUBING**  
 Diameter tolerance  $\pm 3\%$  or  $\pm 0.003''$  (0.076 mm), whichever is greater. Straightness:  $\leq 0.003''/1.000''$  cumulative

OD In.	ID Inch	OD mm	ID in.	Part #
0.188	0.047	4.78	1.19	66667
0.250	0.063	6.35	1.60	66669

Ask for a quote for custom sizes.

## YTTRIA FULLY STABILIZED ZIRCONIA (ZDY)

CoorsTek ZDY zirconia system is specifically designed to work in applications where oxygen ionic conductivity or extreme temperature resistance is required. CoorsTek Oxygen Sensors and Carbon Probe electrolytes will be your choice when your application demands:

- High output (> 98% of theoretical by the Nernst equation)
- Low offset (< 0.5m V at 750° C)
- Low internal resistance (< 25 ohms at 750° C)
- Quick response times

CoorsTek can provide electrolyte cells from bare zirconia to platinum metallized — with or without platinum lead attachment.

Other typical applications include:

- High temperature thermocouple protection tubing
- RF induction elements

Whatever your application, CoorsTek will work with you to supply a ZDY material that will fit your needs.

## CUSTOM PRODUCTS

Advanced technical ceramics provide a broad variety of unique engineering properties to improve or extend the performance of your product.

When your application demands:

- Extreme temperature stability
- Excellent dielectric properties
- Hard and wear resistant surfaces
- Low coefficient of thermal expansion
- Corrosion resistance

CoorsTek can assist you with:

- A broad range of material selections
- Custom shapes and sizes
- Machining to precision tolerances
- Polished surfaces
- Intricate shape capability

Contact a CoorsTek sales representative at the earliest stage in your design process for information on our available materials and design considerations to achieve the optimum balance between performance and cost objectives.

MATERIAL COMPARISON CHART

			MULLITE	ALUMINA			ZIRCONIA			
PROPERTIES	UNITS	TEST	3AL <sub>2</sub> O <sub>3</sub> •2SiO <sub>2</sub>	AD-94	AD-998	AD-995	TTZ	YTZP	ZDY	
PHYSICAL	Density	grams/cc	ASTM C20	2.80	3.70	3.92	3.90	5.72	6.02	5.60
	Color			Tan	White	Ivory	Ivory	Ivory	Ivory	Ivory
	Permeability			Gas-Tight	Gas-Tight	Gas-Tight	Gas-Tight	Gas-Tight	Gas-Tight	Ionic
MECHANICAL	Elastic Modulus (Typical 20°C)	GPa(psi x 10 <sup>6</sup> )	ASTM C848	150 (22)	303 (44)	370 (54)	370 (54)	200 (29)	210 (30)	173 (25)
	Flexural Strength (MOR) 20° C	MPa (kpsi)	C1161-02	170 (25)	352 (51)	375 (54)	379 (55)	620 (90)	900 (130)	207 (30)
	Flexural Strength (MOR) 1000° C			151 (22)	138 (20)	210 (30)	—	—	—	—
	Compressive Strength Typical 20°C	MPa	ASTM C773	550	2103	2500	2600	1750	2500	—
		(kpsi)		(80)	(305)	(363)	(377)	(254)	(363)	—
	Facture Toughness Range	MPa x m <sup>1/2</sup>	NOTCHED BEAM	2	4 - 5	4 - 5	4 - 5	11	13	3
	Hardness	Newtons	Rockwell 45N	70	78	83	83	77	81	75
GPa(Kg/mm <sup>2</sup> )		Knoop 1000g	7.4 (750)	11.5 (1175)	14.1 (1440)	14.1 (1440)	11.8 (1200)	12.7 (1300)	—	
THERMAL	Thermal Conductivity 20°C	W/m°K	ASTM C408	3.5	22.4	30.0	30.0	2.2	2.2	2.2
	CTE 25 - 1000° C	10 <sup>-6</sup> /°C	ASTM C372	5.3	8.2	8.2	8.2	10.1	10.3	10.5
		(10 <sup>-6</sup> /°F)		(2.9)	(4.6)	(4.6)	(4.6)	(5.6)	(5.7)	(5.8)
	Specific Heat 100° C	j/kg°K	ASTM E1269	950	880	880	880	400	400	—
(cal/g/°C)		(0.23)		(0.21)	(0.21)	(0.21)	(0.14)	(0.10)	—	
Thermal Shock ①	D°C(D°F)	DTc	300 (570)	250 (480)	200 (392)	200 (392)	350 (660)	350 (660)	150 (300)	
ELECTRICAL	Dielectric Strength (6.25mm Thickness)	AC-kv/mm	ASTM D116	9.8	8.3	8.7	8.7	9.4	9.0	—
		(AC-volts/mil)		(248)	(210)	(220)	(220)	(240)	(228)	—
	Dielectric Loss	25° C @ 1MHz	ASTM D2520	0.002	0.0004	< 0.0001	< 0.0001	0.001	0.001	—
		25° C @ 5 GHz		—	0.0095	< 0.0001	< 0.0001	—	—	—
	Volume Resistivity 25° C			> 10 <sup>14</sup>	> 10 <sup>14</sup>	> 10 <sup>14</sup>	> 10 <sup>14</sup>	> 10 <sup>13</sup>	> 10 <sup>13</sup>	—
	Volume Resistivity 500° C	ohm-cm	ASTM D1829	5 x 10 <sup>12</sup>	4 x 10 <sup>9</sup>	2 x 10 <sup>10</sup>	2 x 10 <sup>10</sup>	2 x 10 <sup>5</sup>	2 x 10 <sup>4</sup>	—
Volume Resistivity 1000° C			3 x 10 <sup>5</sup>	5 x 10 <sup>5</sup>	5 x 10 <sup>7</sup>	2 x 10 <sup>6</sup>	< 10 <sup>3</sup>	< 10 <sup>3</sup>	—	
Dielectric Constant	25° C @ 1MHz		6.0	9.1	9.8	9.7	28.0	29.0	—	

① Thermal Shock Resistance - Tests are run by quenching samples into water from various elevated temperatures. The change in temperature where a sharp decrease in flexural strength is observed is listed as DTc.

General Characteristics

- Mullite Good thermal shock resistance, not recommended for high temperature vacuum application (low cost)
- Alumina AD-94 Easily metallized with good electrical properties
- Alumina AD-998 Hard, corrosion resistant, capable of withstanding use at high temperatures, low dielectric loss at microwave frequencies
- Zirconia TTZ Impact resistant, very tough, corrosion resistant
- Zirconia YTZP Impact resistant, high strength, polishes easily
- Zirconia ZDY Oxygen ionic conductive, extreme temperature resistant

## About CoorsTek

With manufacturing operations in over 30 locations across three continents, CoorsTek is the international partner of choice for companies requiring the unique, high-performance properties of engineered technical ceramics. For over 100 years, industry leaders have turned to CoorsTek for solutions to the world's most perplexing engineering and manufacturing challenges. We meet these challenges with unsurpassed expertise in materials engineering, broad research & development capabilities, operational excellence, and a commitment to building reliable, collaborative relationships.

Using over half the world's known elements in our 400+ proprietary ceramic formulations, CoorsTek manufactures complex, high-strength components for virtually every industry in the global marketplace. CoorsTek material offerings include aluminas, carbides, nitrides, quartz, silicates, yttrias, and zirconias. We also offer a broad selection of specialty materials to meet application-specific requirements. Combined with a vast range of manufacturing and finishing capabilities, immense manufacturing capacity, guaranteed quality, and localized service across the globe, CoorsTek delivers outstanding value with every product.

Visit [coorstek.com](http://coorstek.com) to learn more.



Charts intended to illustrate typical properties. Property values vary with method of manufacture, size, and shape of part. Data contained herein is not to be construed as absolute and does not constitute a representation or warranty for which CoorsTek assumes legal responsibility. CoorsTek is a registered trademark of CoorsTek, Inc.



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### China

+86 21 6232 1125  
[info\\_shanghai@coorstek.com](mailto:info_shanghai@coorstek.com)

### Korea

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[koreainfo@coorstek.com](mailto:koreainfo@coorstek.com)