

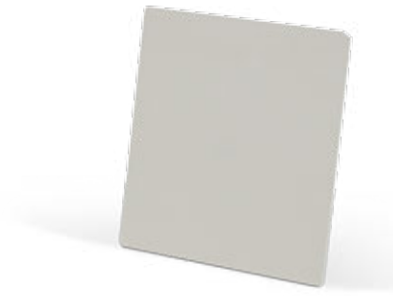
# Advanced Materials and Capabilities for High-Performance Sensors

## Ceramic Sensor Components Market Leader

CoorsTek manufactures millions of advanced ceramic sensor components every year, supplying critical parts to OEMs and suppliers in virtually every industry in the global marketplace from automotive to chemical and medical to semiconductor.

Sensor Component Types:

- Capacitive sensing
- Gas & oxygen sensing
- Pressure sensing
- Proximity sensing
- Temperature sensing
- Integrated membranes
- Custom applications



Tape cast temperature sensor component

## Advanced Materials for Long-Life, High-Performance

With over 300 proprietary ceramic formulations from high-purity alumina to advanced, zirconia-toughened blends and custom materials, CoorsTek experts help select materials suitable for specific applications. See chart below for a listing of some available materials and properties.

## Advanced Secondary Processing Services

As a vertically integrated manufacturer, CoorsTek provides customers with a singular source for design, manufacture, and finishing of sensor components to ensure the highest possible quality and precision. Secondary finishing options include:

- Pre/post-sintered machining
- Metallization services
- In-house analytical labs
- Laser machining/cutting
- Rapid prototyping
- RF Shielding
- Bonding & joining

## Design Expertise

To ensure optimal product performance for your sensor application, CoorsTek engineers offer expert assistance through each phase of manufacturing process, including component design, material selection, prototyping, and production validation.

## Numerous Manufacturing Options

CoorsTek offers a vast array of manufacturing options to meet the needs of customers based upon variable factors of design, time to market, and budgetary considerations, including dry pressing, tape casting, injection molding, roll casting, and more.

## Superior Quality Systems

Most CoorsTek facilities are registered and compliant with ISO 9001 and many to TS 16949 standards to meet customer requirements.

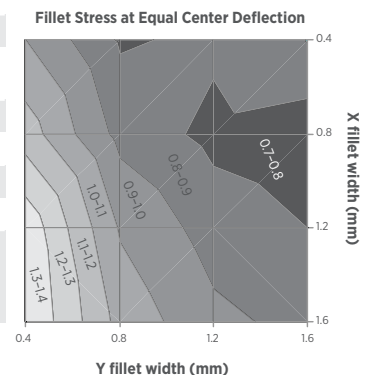
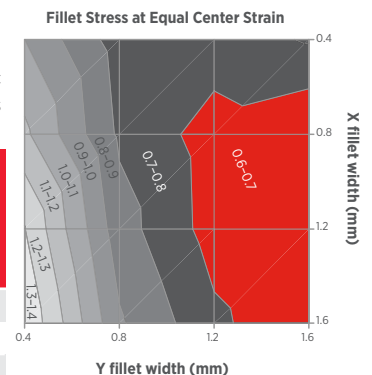
## Technical Ceramics Experts for more than 100 Years

With over 50 facilities across four continents, CoorsTek is a leading global manufacturer of engineered technical ceramics. Founded in 1910, CoorsTek combines vast materials and manufacturing capabilities with unparalleled technical expertise.

ADVANCED SENSOR MATERIALS								
PROPERTY	UNITS	TEST	AD-96 Nom. 96% Al <sub>2</sub> O <sub>3</sub>	SUPERSTRATE 996 Nom. 99.6% Al <sub>2</sub> O <sub>3</sub>	AD-995 Nom. 99.5% Al <sub>2</sub> O <sub>3</sub>	AD-999 Nom. 99.9% Al <sub>2</sub> O <sub>3</sub>	ZTA Zirconia-Toughened Alumina	
Density	gm/cc	ASTM-C20	3.72	3.87	3.90	3.94	4.05	
Crystal Size	microns	THIN-SECTION	6	< 1	6	3	2	
Flexural Strength (MOR)	MPa (psi x 10 <sup>3</sup> )	ASTM-F417	358 (52)	90	379 (55)	414 (60)	450 (65)	
Elastic Modulus	GPa (psi x 10 <sup>9</sup> )	ASTM-C848	303 (44)	54	370 (54)	386 (56)	360 (52)	
Compressive Strength	MPa (psi x 10 <sup>3</sup> )	ASTM-C773	2068 (300)	-	2600 (377)	2930 (425)	2900 (421)	
Hardness	GPa (kg/mm <sup>2</sup> )	KNOOP 1000g	11.5 (1175)	13.7 (1400)	14.1 (1440)	14.4 (1475)	14.4 (1475)	
		ROCKWELL 45 N	78	87	83	85	85	
Tensile Strength	MPa (psi x 10 <sup>3</sup> )	ACMA TEST #4	221 (32)	-	262 (38)	-	290 (42)	
Thermal Conductivity	W/m K	ASTM-C408	80.0	35	80.0	150-170	125.0	
Coefficient of Thermal Exp.	1 X 10 <sup>-6</sup> /°C	ASTM-C372	8.2	8.3	8.2	8.2	8.3	
Dielectric Constant	25° C	ASTM-D150	9.0	9.9	9.7	-	10.6	
Volume Resistivity	ohm-cm	ASTM-D1829	25° C	> 10 <sup>14</sup>	> 10 <sup>14</sup>	> 10 <sup>14</sup>	> 10 <sup>14</sup>	> 10 <sup>14</sup>
			500° C	4 x 10 <sup>9</sup>	> 10 <sup>10</sup>	2 x 10 <sup>10</sup>	3.3 x 10 <sup>12</sup>	2 x 10 <sup>9</sup>
			1000° C	1 x 10 <sup>6</sup>	-	2 x 10 <sup>6</sup>	1.1 x 10 <sup>7</sup>	3 x 10 <sup>6</sup>

The chart is intended to illustrate typical properties. Engineering data is representative. Property values vary somewhat with method of manufacture, size and shape of part. This data is not to be construed as absolute and does not constitute a warranty for which we assume legal responsibility. CoorsTek is a registered trademark of CoorsTek, Inc.

Stress Analysis on Ceramic Integrative Membranes



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