

## Ceramic Cements Glossary

**ARCING** - A type of electrical conduction in gases or solids characterized by high current density. As current increases, the resistance decreases. Characterized by very high temperatures and very high concentrated thermal energy.

Layman's Terms: *Millions of watts may be dissipated in confined paths, producing temperatures that may reach thousands of degrees Celsius.*

**Application:** At these temperatures, most ceramics and metals melt quickly, thus increasing rate of conductance. Once a material has arced, the resistance along the arc path is lower than the surrounding matrix and subsequent electrical fields will tend to follow the same path.

**COEFFICIENT OF LINEAR THERMAL EXPANSION (CTE)** - The symbol of  $\alpha$  is defined as the unit change in length per degree change in temperature. CTE is a bulk characteristic of the material.

Layman's Terms: *A measure of expansion as a material is heated.*

**Application:** CTE stated in the Celsius scale will show a bigger number (the unit change of length will be greater because a 1°C change is more than a 1°F change).

**CONDUCTANCE** - The conductivity of a substance is defined as the reciprocal of the resistivity.

Layman's Terms: *Transference of an electric current through a solid or liquid.*

**Application:** In metallic or electronic conductors, the current is carried by a flow of electrons from atom to atom with the atomic nuclei remaining stationary. This type of conduction is common to all metals and alloys, carbon, graphite and certain solids. If the same material varies in density, the more dense substance will have higher conductance.

**DIELECTRIC CONSTANT** - Is a value that serves as an *index* of the ability of a substance to resist the transmission of an electrostatic force from one charged body to another. The lower the value, the greater the resistance. The standard is for a vacuum whose constant is 1.0. In reference to this, various materials interposed between the charged electrodes have the following values at 20°C (68°F).

Layman's terms: *An index of the ability of a substance to resist a charge in comparison to vacuum.*

Air 1.00058

Ammonia 15.5

Glass 3  
Benzene 2.3  
Acetic Acid 6.2

Ethanol 25  
Glycerol 56  
Water 81

**Application:** Most hydrocarbons (epoxies, furans, etc.) have high resistance and therefore low conductivity. Dielectric constant values decrease as temperature increases, i.e. Resistance increases with rising temperatures. (Atoms are close together when cold. When they are close, electrons can more easily discharge.)

**DIELECTRIC STRENGTH** - Also known as Dielectric Breakdown Strength, this is the maximum electric field that an insulator or dielectric can withstand without breakdown. It is usually measured in kilo volts/centimeter of thickness, kv/cm. At breakdown, a considerable current passes as an arc, usually accompanied with some degree of decomposition of the material along the current path.

Layman's Terms: *The amount of electricity a substance will withstand without "breaking down". What is "break-down"? A form of arcing that causes a change such as melting.*

**Application:** The dielectric strength of insulating cement should be higher than the dielectric strength of the wire that is insulated. This prevents charge from passing through cement.

**MAXIMUM SERVICE LIMITS** – The maximum exposure, typically indicated by temperature, that a material will withstand without breaking down in some way. This limit will change with changing environments.

Layman's Terms: *The maximum heat in a dry environment that a material will withstand on a continual basis.*

**Application:** Chemical, oxidizing, reducing, steam, and environments will all affect this limit – sometimes drastically.

**RESISTANCE** - That property of an electrically conductive material that causes a portion of the energy of a flowing electric current to be converted to heat.

Layman's Terms: *Opposite of conductivity.*

**Application:** All materials are conductive at some point. Heat is proportional to current being insulated. A wire that has a charge that is being insulated will give off heat.

**THERMAL CONDUCTIVITY** - Time rate of heat transfer by conduction, through unit thickness, across a unit area for unit temperature differential. For example, Btu-inches/hr/ft<sup>2</sup>/F° or Cal-cm/sec/cm<sup>2</sup>/C°. If the two opposite faces of a

rectangular solid are maintained at temperatures  $t_1$  and  $t_2$ , the heat conducted (Btu's) across the face area ( $\text{ft}^2$ ) of a given thickness (inches) in a time (hr.) is called the thermal conductivity,  $K$ .  $K$  is a bulk property of the material and is affected by the composition, density, specific heat, and heat storage capacity.

Layman's Terms: *The degree to which a material will transfer, or dissipate, heat.*

**Application:** Dense materials tend to be thermally conductive. Since air is a good insulator, more porous materials tend to be thermally insulating.

**THERMAL SHOCK** - Resistance of a material to deterioration by rapid changes in temperature.

Layman's Terms: *Stress caused by rapid heating and cooling.*

**Application:** Thermal shock resistance increases as strength and thermal conductivity increase and as CTE and modulus of elasticity decrease. A bigger mass will suffer more from thermal shock. If thermal shock is a concern, one should minimize the mass of an insulator. If thermal shock is extreme, suggest a cement with high thermal conductivity and low coefficient of thermal expansion.

**VOLUME RESISTIVITY** – A proportionality factor characteristic of different substances equal to the resistance that a cube of 1 cm on each side, offers the passage of electricity, the current being perpendicular to two parallel faces. Expressed in ohm-centimeters.

Layman's Terms: *Sometimes called "specific resistance", this bulk property quantifies the passage of electrical current directly through a material.*

**Application:** The higher the volume resistivity drops off dramatically. The thicker the material, the more resistant it is.