Kera-Coat Ceramic Coatings are Special Ceramic Coating defined as a substantially vitreous or glassy inorganic coating bonded to metal by fusion at a temperature above 800°F.
Below you can see other important Special Ceramic Coating proprieties, ***but less known that the ones in the main description:***

MECHANICAL AND PHYSICAL PROPRIETIES

LUBRICITY

Lubricity of conventional glossy porcelain enamels is perhaps the highest of any known finish except the "no stick" fluorocarbons. Lubricity of Special's Ceramic Coatings is particularly important in low friction applications. Examples include water lubricated bearings where the enamel mates with rubber, chutes and pipes conveying coal and other materials at low angles of inclination and pipe linings used in waste disposal systems. Similarly, a very low coefficient of friction and extremely wear-resistant Kera-Coat's Ceramic Coating finish can be produced for such applications as package chutes, screw conveyors and food processing equipment. Test reference: Inclined plane tests are sometimes devised to quantify the lubricity property. With application of a "standard load" on a coated test panel, the angle of inclination is observed when sliding begins. From this data, a coefficient of friction can be calculated.

BONDING

Bonding may be viewed as (1) resistance to mechanical damage by impact, torsion, bending or heat shock; (2) "attraction" of enamel and metal; and (3) a relationship to substrate design. Good bonding is produced by reaction and fusion of the Special's Ceramic Coating with the base metal at relatively high temperatures that may fall within a broad 932 degree F to 1652 degree F (500 degree C to 900 degree C) range. Glass is very strong in compression. When the Special's Ceramic coating (glass) is applied to the metal substrate, the formulation of the coating is such that it has a lower coefficient of expansion than the substrate and thus is always in compression. The bond has many characteristics of a true chemical bond in combination with mechanical bond developed by fusion flow of the coating over the surface roughness of the substrate. Since moisture or rust cannot penetrate beneath the Special's Ceramic coating, it will not flake away from exposed edges or damaged areas. The coating does not tend to "creep" under service conditions as can be shown by salt spray testing. Ceramic coated metal will flex with the metal providing resistance to stresses that cannot be obtained in solid glass.

IMPACT RESISTANCE

Like glass, Special's Ceramic Coating will fracture when abused. It is difficult to predict the impact resistance of a specific Special's Ceramic Coating since it depends as much or more on the design of the part as on the properties of the Special's Ceramic Coating. However, a Special's Ceramic Coating can be very strong and flexible if applied to a properly designed part. As a general rule, Special's Ceramic Coating will not fracture due to impact unless the base metal is permanently deformed. Because of its high compressive strength, the enamel is rarely crushed at the point of impact. Special's Ceramic Coating's compressive strength is in the range of 20,000 psi.

FLEXIBILITY

Thin Special's Ceramic coatings have very good flexibility and adhesion when applied to thin metal substrates. For example, a 10 mil (0.254 mm) commercial steel sheet with two Special's Ceramic coatings 5 mils (0.127mm) thick is so flexible it can be shipped in 12 inch (304.8 mm) diameter coils without damage. Experimental Special's Ceramics applied at a thickness of 1.5 mils (0.381mm) to steel sheet 4mils(0.102mm) thick have been deformed to a radius of 1.5 inches (38.1mm) without damage to the coating. Porcelain enameled coatings will flex with the base metal until the metal is permanently deformed. The modulus of elasticity is 10 x 10^6 for Special's Ceramic Coated steel. Tensile strength is approximately the yield point of the base metal. The brittleness and lack of flexibility stems from the fact that coatings applied to thick metal articles tend to fracture when lightly bent…above 1,2% elongation.

STIFFENING

Because of its low ductility and intimate bond, Special's Ceramic Coating increases base metal flexural strength. Thus, the stiffening effect of the coating can be used advantageously to reduce metal thickness in certain applications. The stiffening effect is more pronounced on lighter gages than on heavier gages of metal. Though thicker Special's Ceramic Coatings may be used to promote needed rigidity or offer added wear protection, thinner coatings are much less vulnerable to fracture and chipping. For instance, a 0.016 inch (0.406mm) under torsion test may be expected to show failure at 50-60 degree but 0.003 inch (0.076mm) coatings have been torsion tested to 200 degree and beyond before any fracture occurred. For metal Special's Ceramic Coated on one side only, the effect is greater when the Special's Ceramic coating is on the compression side. With equal coating thickness on opposite sides of a panel, the residual compressive stresses contribute a stiffening condition desirable for rigid designs.

THICKNESS

Special Ceramic Coating can be applied in a wide range of thickness, from 1mil (0.025mm) or less on steel or aluminum substrates to 125mils (1/8 inch – 3,175mm) or more on cast iron or heavy gage steel or plate. Optimum thickness depends on compositions of the Special Ceramic Coating and the base metal and -particularly- on the expected service conditions. In general, thinner Special Ceramic coatings are more flexible and have greater resistance to fracture. Thicker coatings have better electrical properties; they also withstand and chemical attack for longer periods. The thickness of the Special Ceramic Coating can be a factor in the mechanical strength of the product or component adding stiffness to it. For applications on steel, a base or ground coat of Special Ceramic Coating 2 to 5mils (0.051 to 0.127 mm) thick is commonly applied and followed with one or more finish coats. However, with modified pretreatment of steel substrates and decarburized steel quality, a one-coat Special Ceramic Coating finish coat of 3 to 5mils (0.076 to 0.127mm) may be applied directly to the steel. If more than one cover coat is applied, each may be 2 to 10mils (0.051 to 0.254mm) thick. Multiple coats can be applied that interfuse to form a single heavy layer. Normally, a white cover coat (titania opacified) should be at least 3mils (0.076mm) thick to provide adequate opacity to hide light scratches in the metal. Other white cover coats, not titania opacified, require thicker coatings to produce satisfactory appearance and color. Certain colors and textural effects can be obtained with relatively thick coatings. However, purely functional coatings such as those for high temperature protection are usually applied quite thin (as thin as 1mil - 0.025mm) using special base metals. Thickness over 15mils (0.381mm) is not generally recommended for sheet metal parts because of warpage or chip page problems. Normally, heavier coatings are used on cast iron or steel plate where rigidity of the substrate resists deformation and reduces the danger of fracture. Such coatings are sometimes desirable to hide rough spots on the metal or to provide longer service life.

THERMAL EXPANSION

Coefficient of thermal expansion is largely determined by chemical composition. Coefficient of expansion is 8-14 X 10^-6 cm./cm./ºC formulated so glass is always in compression. Being glass-like, Special Ceramic Coating is much stronger in compression than in tension. Hence, it is important to have the coefficient of expansion of the Special Ceramic coating lower than that of the metal substrate so that in cooling the coating will be in compression, not tension. The amount of compressive stress allowed to develop must be controlled carefully. If it becomes too high, fracture can occur at sharp radii. Excessive compressive stress can increase warpage tendencies, particularly with the metal substrate coated on one side only, or having unequal coating thickness on the two sides. Thus, residual compressive should be low in such applications as appliance parts and architectural panels. On the other hand, residual coating stresses should be kept high on parts subject to failures by thermal shock or bending.

THERMAL CONDUCTIVITY

Special Ceramic Coating is not a thermal insulator, but it is a relatively good heat conductor when applied in thin coats. Its emissivity characteristics are particularly good. Normally, Special Ceramic Coatings are applied so thin there is only a very small temperature gradient through them. Thermal Conductivity Range range ≈ 5-8 W/mK - Average (reference) ≈ 6 W/mK.

CORROSION RESISTANCE PROPRIETIES

WEATHER RESISTANCE

The weather ability of Special Ceramic Coating is usually measured by the degree to which the coating retains its original gloss and color. In general, acid resistance Special Ceramic Coatings have better weather resistance than those that are non-acid resistant. Thus, those Special Ceramic Coatings to be exposed to weathering should be specified to have no less than a Class A acid resistance rating.

ACID RESISTANCE

The acid resistance of Special Ceramic Coatings can vary widely depending on composition and, to some extent, the processing used. Special formulations can provide Special Ceramic Coatings with excellent corrosion protection against aqueous solutions of alkalis, salts and most acids except hydrofluoric. The highest degree of acid resistance is obtained by sacrificing other desirable properties such as alkali resistance. To achieve maximum service conditions, a proper balance of acid resistance, alkali resistance and other properties is necessary.

ALKALI RESISTANCE

Special chemical resistant coatings provide alkali resistance to solutions with a maximum pH of 12 at temperatures to 212 degree F (100 degree C).
Alkali resistant Special Ceramic Coatings are not necessarily acid resistant and vice versa. For Special Ceramic Coatings that resist both acids and alkalis, a balance between maximum acid resistance and maximum alkali resistance needs to be achieved in the formulation.

HIGH TEMPERATURE PROPRIETIES

Abrupt and severe temperature changes do not affect Special Ceramic Coatings applied at normal thicknesses. Special Ceramic Coating's thermal properties are excellent in the range of temperature from below freezing to high heats. Because of this thermal stability and thermal shock resistance, Special Ceramic Coating is a suitable coating for many heat-related applications. The thermal properties of Special Ceramic Coating provide a coating that readily withstands the expansion and contraction of the base metal under changing temperature conditions.

RESISTANCE TO OXIDATION AND CORROSION

Special Ceramic Coatings and ceramic coatings-glass coatings for metal used for applications above 1000 degree F (538º C) are noted for their ability to appreciably reduce the oxidation of base metals. As a result, they lower costs and improve performance in one or more of the following ways: (1) permit the use of less costly metal alloys without loss of performance; (2) extend base metal life; (3) increase the metal's maximum operating temperature, thereby improving the efficiency of operation. The ability of Special Ceramic Coatings and ceramic coatings to protect against oxidation is largely due to the fact that the coatings themselves are fully oxidized and do not undergo further oxidation at elevated temperatures. They also form an effective barrier to diffusion of oxygen. The protective ability of a Special Ceramic Coating depends on the temperature at which it starts to soften and become more fluid (ordinarily at about 400º F- 204º C below firing temperature). However, special ceramic coatings designed to be effective above the firing temperature can protect metals from oxidation up to 2000 degree F (1093 degree C). Specially formulated Special Ceramic coatings resist the corrosive effects of acid and alkali solutions at the elevated temperatures required for many industrial processes and reactions. These coatings provide both protection of the metal and ease of cleaning. The smooth, abrasion resistant surfaces also allow for more efficient flow of fluids over the surfaces.

THERMAL STABILITY

Special Ceramic Coatings have the ability to withstand intermittent or prolonged heat without changing physical, chemical or appearance properties. The maximum temperature which a coating will withstand for extended periods is related to its firing temperature and its formulation. In general, the coating remains inert to a temperature about 400º F (204º C) below its firing temperature. The conventional firing temperatures using a steel substrate are from 1450º F to 1750º F (788º C to 954º C). Thus, the thermal stability of these coatings vary from 1050º F to 1150º F (566º C to 621º C). Of course, special formulations designed to fire at higher temperatures up to 1700º F (927º C) on steel can withstand proportionately higher temperatures for long service periods.

THERMAL SHOCK RESISTANCE

Thermal shock resistance of a Special Ceramic Coating varies inversely with its thickness. Thermal shock failure is caused by the rapid chilling of the surface. It manifests itself in a crack and occurs when the thermal gradient perpendicular to the surface is large enough to cause excessive differential shrinkage and tensile stress. Important considerations are the Special Ceramic Coating's thickness and its coefficient of thermal expansion. Thermal shock resistance is also affected by the design and thickness of the part. Flexing of the metal due to localized thermal gradients parallel to the surface can produce bending and tensile stresses in the coating. Thus, any increase in the strength or rigidity of a part helps increase the coatings resistance to thermal shock. Most Special Ceramic Coatings applied at conventional thickness can be expected to take abrupt temperature drops of 200º F to 300º F (93º C to 149º C) without damage. Thinner coatings have a proportionately higher thermal shock resistance. Other things being equal, the best thermal shock resistance is achieved with coatings of 5mils (0.127mm) or less. Special ceramic coatings will successfully undergo repeated tests of heating to 1700º F (927º C) and quenching in water.

EMISSIVITY

Emissivity is defined as the power of a surface to release heat by radiation. Special Ceramic Coatings have high total emittance at high temperatures. The color of a Special Ceramic Coating has practically no effect on total emittance at room temperature, but will have an effect at high temperatures. White Special Ceramic Coatings, for example, generally have lower emittance than black at high temperatures. A typical white Special Ceramic Coating has low spectral emittance at short wavelengths of about 0.2 to 0.5 u. Spectral emittance increases as wavelength increases to about 5 u and remains high at all longer wavelengths. A black Special Ceramic Coating has appreciably higher spectral emittance than a white one at short wavelengths; they are about the same at wavelengths longer than about 5 u.

ELECTRICAL PROPRIETIES

The inert, impermeable qualities of glass make a Special Ceramic coating a good electrical insulator. Using steel as the base metal, some selected areas of the metal may be left uncoated for electrical connections. Both electrical resistance and electrical conductivity may be achieved in Special Ceramic coating systems. The electrical resistance per unit area is a function of the thickness and the composition of the Special Ceramic Coatings. In addition to resistance, usually expressed as resistivity, other electrical properties of interest are dielectric strength, dielectric constant, and dissipation factor. These properties vary with temperature. In general, as the temperature increases, the resistivity and dielectric strength decrease, while the dielectric constant and dissipation factor increase. The dielectric constant and the dissipation factor also vary with frequency.

DIELECTRIC STRENGTH

The dielectric strength of a Special Ceramic coating will vary from point to point due to surface variations and internal bubble structure of the coating. Dielectric strength of ordinary Special Ceramic Coatings will range from 200 to 500 volts per mil with an average of 4-6mils (0.102-0.152mm) total thickness. Increase and decrease due to total thickness are not directly proportional to that thickness. However, Special Ceramic coatings with reduced bubble structure can be produced which have uniformly high voltage breakdown resistance. This strength can be greatly increased by changes in frit composition and alterations in the microstructure of the coating. While the bubble structure of a Special Ceramic coating can be greatly reduced, it cannot be eliminated. The best dielectric strength is obtained with a minimum of three thin coats of extremely dense "altered" Special Ceramic Coating.

VOLUME RESISTIVITY

Volume resistivity varies from 10^{13} to 10^{16} ohm-cm at room temperature. Volume resistivity will decrease rapidly with an increase in temperature. In fact, ordinary Special Ceramic Coating actually becomes a fairly good electrical conductor at or above its firing temperature.

DIELECTRIC CONSTANT

At 400-cycles per second and at room temperature, the dielectric constant is in the range of 6 to 12. A sharp increase in values can be expected at temperatures above 250º F to 300º F (121º C to 149º C).

DISSIPATION FACTOR

At 400-cycles per second and room temperature, the dissipation factor is about 1 or 2 %. Much higher values occur at temperatures above about 200 degree F (93 degree C) but decrease with increased frequency