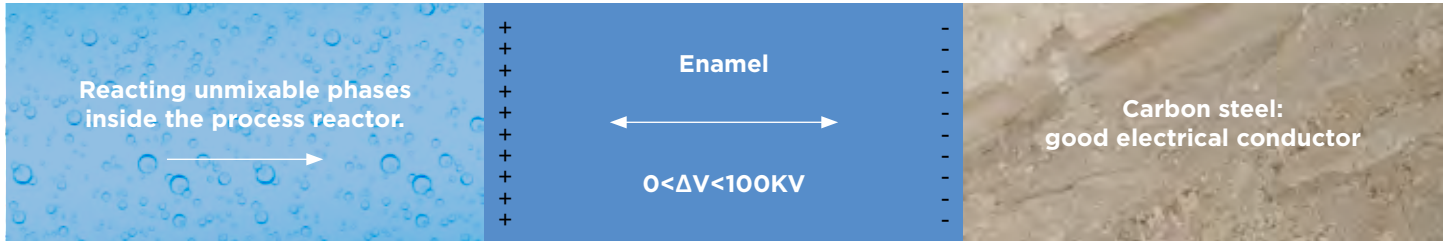


# Electrical conductive glass

## Electrical conductive glass

“Sigma Glass” is the GLASSCOAT enamel for chemical-pharmaceutical applications, where electrostatic currents, due to friction between unmixable fluids during the reaction, are present.

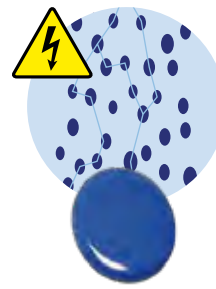


**Standard enamel G2208**  
There is no transfer of charge, so that it builds up till the breakdown of the dielectric.



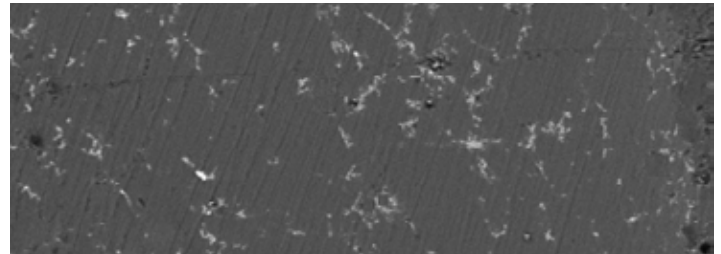
**“Sigma Glass”**

Thanks to the secondary phase inserted inside the glass matrix, there is a transfer and graded disposal of charge thru the thickness of the enamel: the enamel doesn't break.



## What is “Sigma Glass”?

The Glasscoat “Sigma Glass” is a composite glass matrix enamel, where the secondary phase is a material acting like an electronic carrier, permitting a suitable charge transfer inside the glassy dielectric coat. Contra, the G2208 standard enamel, submitted to a potential difference, in extreme conditions, up to 100 kV, couldn't stand it, having a dielectric rigidity of 30 kV/mm.

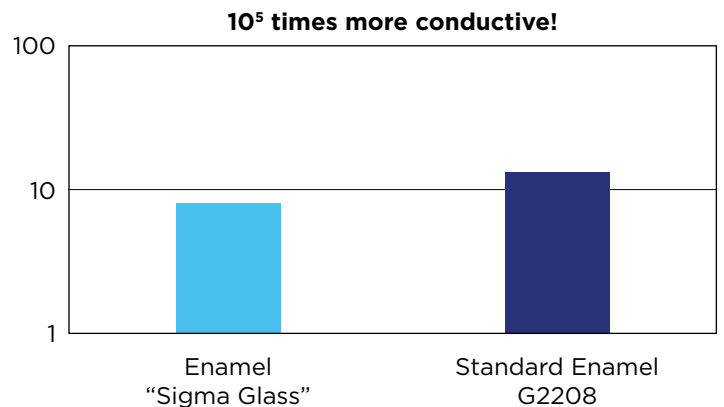


SEM image of a cross section of the “Sigma Glass” enamel, showing the conductive secondary phase.

## Volume electrical resistivity [Ω\*cm] - log scale

The resistivity of the “Sigma Glass” is about 5 orders of magnitude lower than the standard G2208.

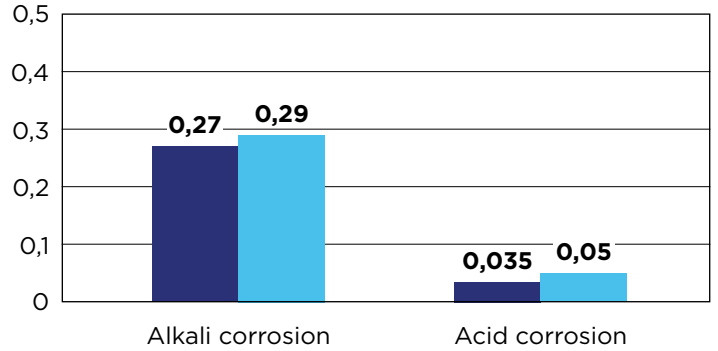
This allows an adequate charge flow thru the thickness of the enamel, keeping though the features of corrosion resistance to norm restriction.



# Electrical conductive glass

## Corrosion rate (mm/year)

■ G2208    ■ è glass



## Physical properties

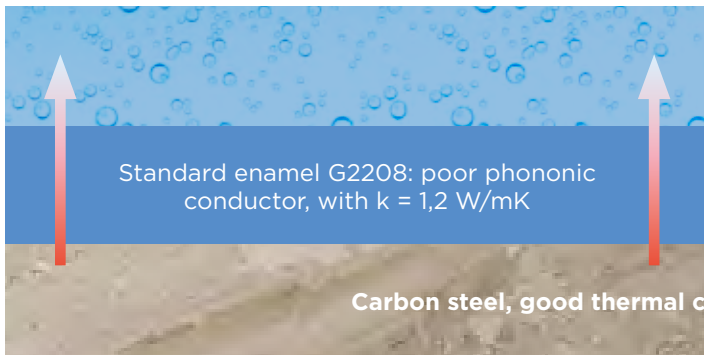
Moreover, as for the G2208 standard enamel, there is no tendency to chipping and the surface appears smooth, shiny, easy to clean and wear resistant.

Hardness HV → 700 - 750  
 Thermal Conductivity (W/mK) → ≈ 1,2  
 Thermal Shock Resistance  $\Delta T$  (°C) → > 200

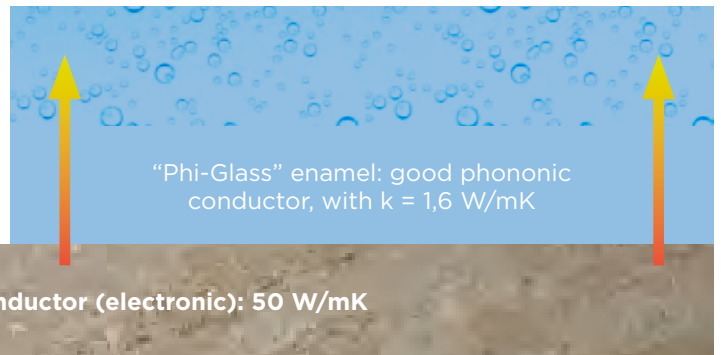
## Thermal Conductive Glass

The first worldwide enamel for chemical pharmaceutical devices with improved thermal conductivity to save up to 30% the heating/cooling time in the plants.

Standard glass lining G2208



“Phi-Glass” glass lining



## What is “Phi-Glass”?

The “Phi-Glass” is a glass-matrix composite enamel, into which a ceramic crystalline secondary phase is embedded, allowing an improved thermal conductivity thanks to the ordered oscillatory movements of the atomic structure inside the secondary crystalline phase.

On the other hand the standard enamel G2208, having a disordered amorphous monophasic structure, suitable to maximize the acid corrosion resistance, does not permit the vibrational movements to be transmitted.

# Electrical conductive glass

**Mathematical model** used for the study of the thermal conductivity of a composite glass-matrix material with a secondary ceramic phase (NGG model).

$$\lambda_c = f(\varphi) = \frac{(1 + 1,41\varphi)}{(1 - 0,94\varphi - 0,34\varphi^2)}$$



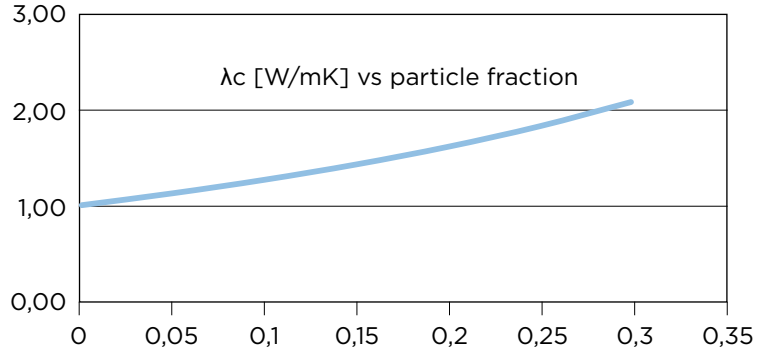
“Phi-Glass”



G2208

Particles volume ratio $\Phi$	Conductivity [W/mK]
0	1,00(*)
0,05	1,12
0,1	1,26
0,15	1,42
0,2	1,61
0,25	1,82
0,3	2,07

(\*) Assuming  $k = 1 \text{ W/mK}$  as a reference value.

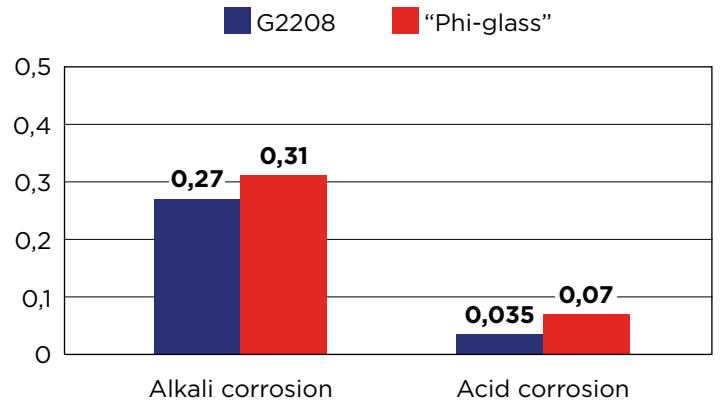


## Corrosion rate (mm/year)

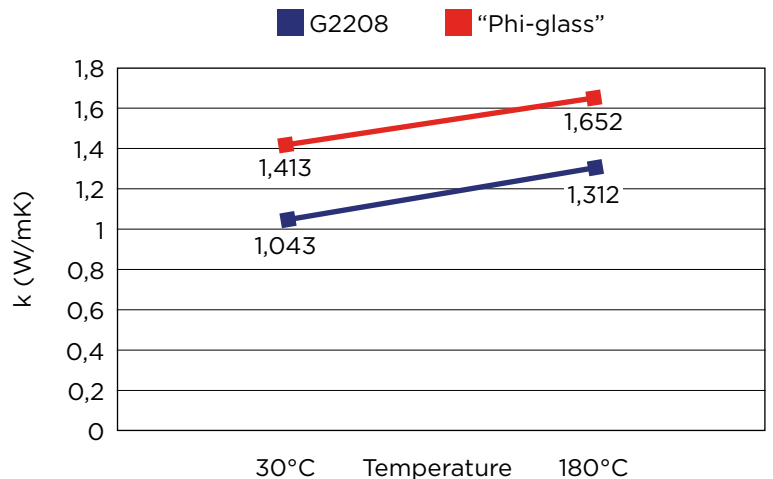
Despite the biphasic structure, “Phi-Glass” shows an excellent corrosion resistance behaviour, complying with the ISO DIN norm restrictions.

The thermal conductivity coefficient of “Phi-Glass” is about 30% higher than the standard G2208 one.

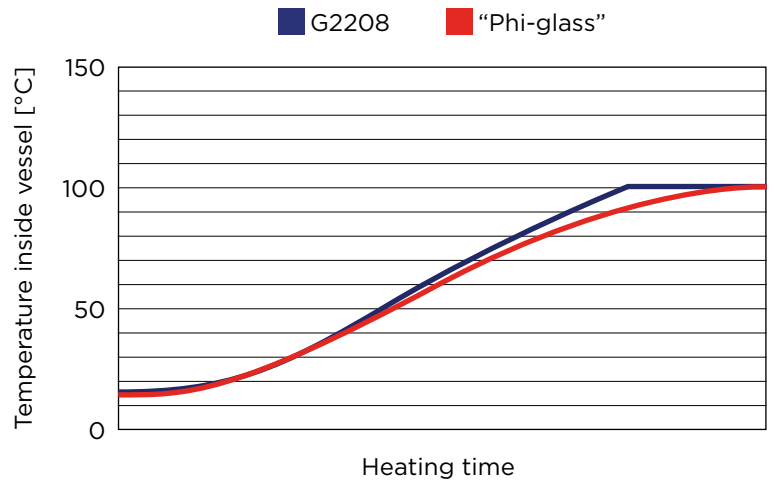
This means that, considering the same thickness of enamel and the same temperature difference between the fluids inside the jacket and the reactor, the heat transfer is 30% higher.



## Thermal conductivity coefficient



## Temperature vs time



## Physical properties

Hardness HV	750 - 800
Dielectric strength (KV/mm)	30
Thermal Shock Resitance T (°C)	> 200



**Glasscoat** is determined to maintain its leading position over time in the anticorrosive coating industry.

Technical experts in glass-ceramic linings, in close collaboration with external laboratories, university institutions and experts in nanotechnology, have developed innovative formulations:

- A conductive glass lining that improves thermal and electrical conductivity, with evident benefits in terms of production.
- A surface coating that ensures low wettability of the glass lining with a consequent reduction in deposits on the walls of the vessel and less crevice corrosion.
- Glass linings that are resistant to strong alkaline processes.
- The “GPO9 Light Blue” glass lining, which, in combination with a special base glass lining, is particularly suitable for stainless steel.

This fundamental department of 3V Glasscoat organises all activities requiring technical assistance, from the selection of the most suitable equipment and components to the repair of damaged vessels. With offices in Europe, the United States and the Far East, 3V Glasscoat guarantees the highest level of technical assistance.

Our service is guaranteed 24 hours a day, including Sunday and public holidays, for the entire life of the equipment and plants. The warehouse, equipped with a considerable range of parts and accessories, ensures continuous availability for the service of repair and reglazing.