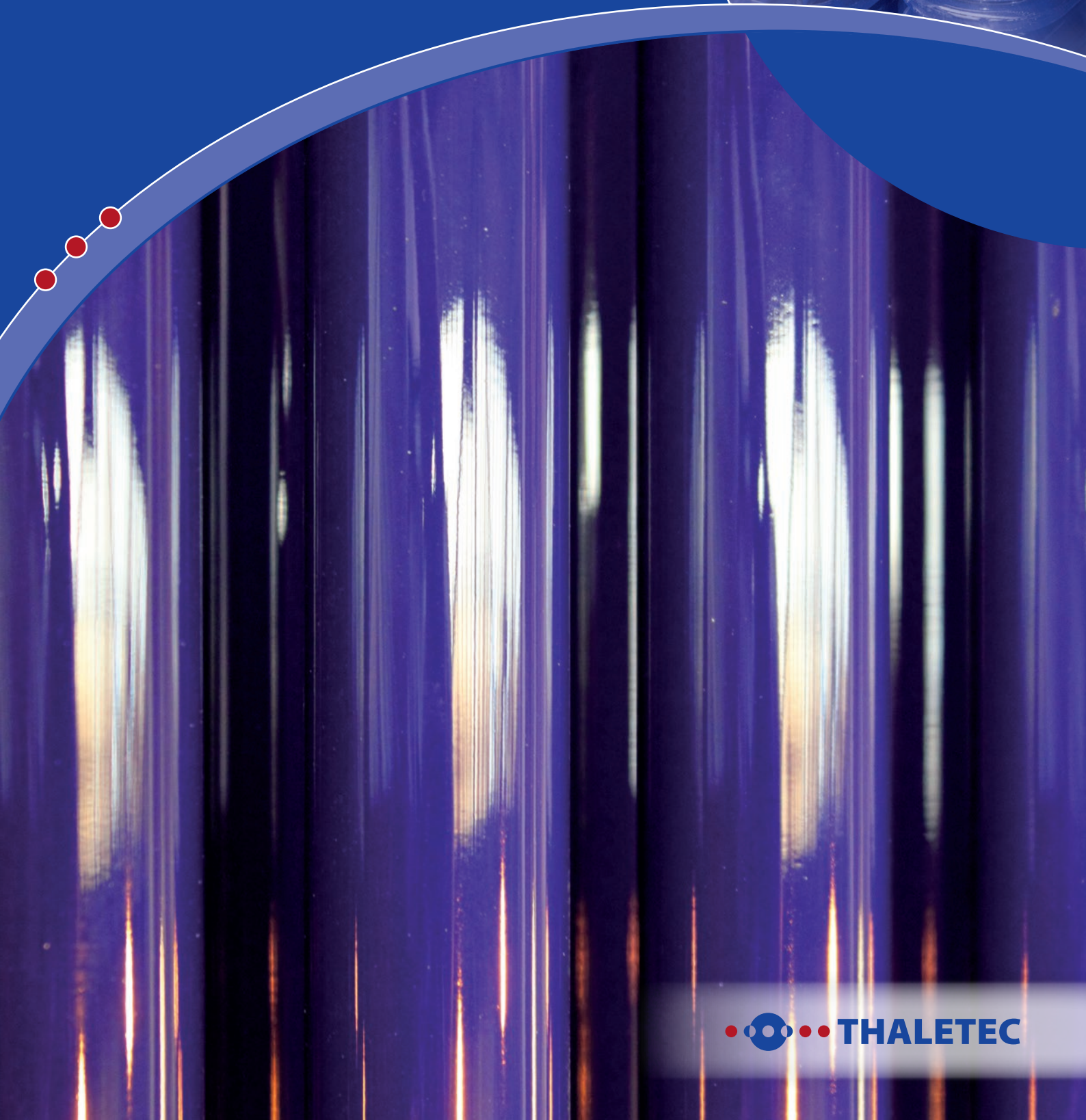
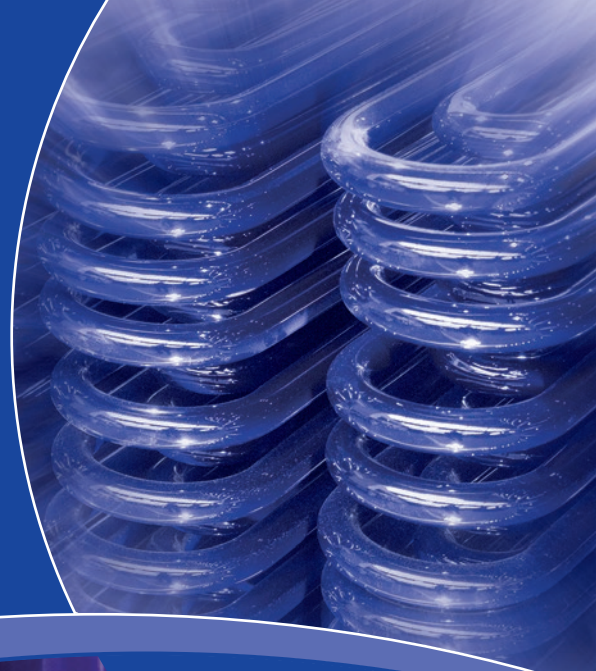
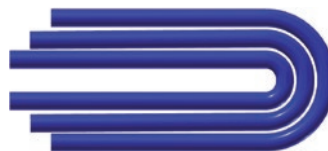


THALETEC PowerTubes

**Glass-lined tubes for
power plants, energy- and
environmental technologies**



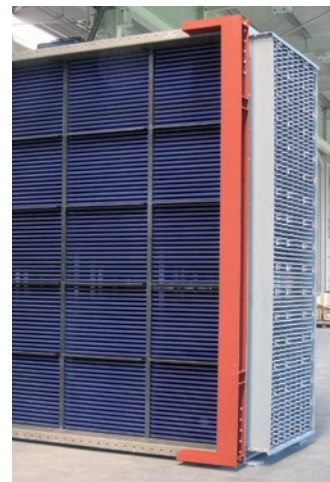
Corrosion protection in industrial combustion plants through the composite material glass-lined steel



U-tube (hairpin)



Straight tube, closed on one side



For almost three decades, glass-lined tubes have been used as the basis for highly corrosion-resistant heat exchangers in the field of fossil combustion plant technology, energy technology and environmental technology. Compared with conventional heat exchangers with tubes made of metallic materials or plastics, they are a particularly cost-effective and long-lasting alternative.

The coating can be stressed until reaching the yield strength of the support material.

The glass-lining is highly resistant to corrosive attack by acids, such as may occur in combustion processes.

In addition, the glass-lining has an excellent surface finish, which helps to prevent caking and significantly simplifies cleaning.

The special precision glass-lining ensures consistent quality and high heat transfer performance compared with other materials.

Precision glass-lined heat exchanger tubes

- are universally chemically resistant, especially against aggressive acids and alkalis
- are mechanically stable and able to absorb and dissipate forces
- can be pressurised
- do not age and wear under normal operating conditions
- are diffusion-tight against all media

For certain applications, the glass-lined PowerTubes can be coated with resistant plastics (e.g. PFA). This further improves the chemical and mechanical properties.

Production of precision glass-lined heat exchanger tubes

Precision glass-lined PowerTubes are manufactured using a fully automatic production facility. Here, the steel tubes are first given a surface treatment which ensures optimum adhesion of the glass-

lining. The tubes are then glass-lined in a continuously operated installation in two steps. For this purpose, the application of a glass-lining powder is dry/electrostatic. The quality of glass-lining is continuously monitored and recorded quality parameters are used to control and regulate the installation. Finally, post-processing and further concluding test steps take place.

Application

- Flue gas cleaning
- Thermal recycling (waste incineration)
- Flue gas cooling
- Clean gas preheating

Type programme

- glass-lined straight tubes, open on both sides
- glass-lined U-tubes (hairpin tubes)
- glass-lined tubes sealed on one side
- Special designs on request

Materials

Steel tube

- Material certificate EN 10204 3.1.B
- Diameter: 25 mm
- Wall thickness: 1.5 mm
- Maximum (straight) length: 12,000 mm
- In the case of U-tubes: Bending radius according to customer requirements

Glass-lining

- 2 firings with a total thickness of 0.45 +/- 0.05 mm
- Bent section of U-tubes locally up to 0.8 mm
- Special designs possible

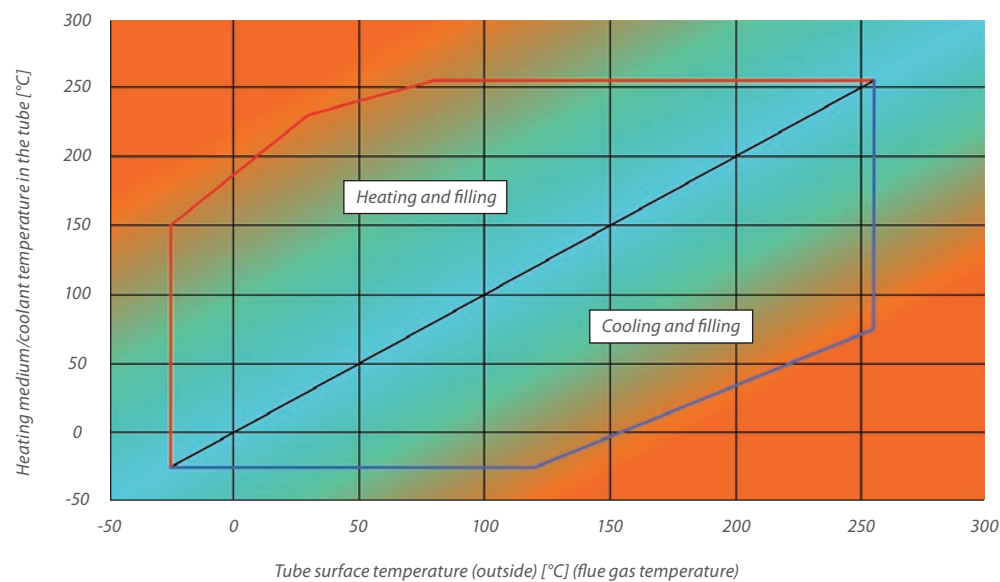
Selection of suitable precision glass-lining according to customer requirements on the basis of an use case analysis.

Material specifications
of the glass-lining

| Characteristic value | Size |
|----------------------------------|--|
| Tensile strength: | up to Rp 0.2 (yield strength) of the support material |
| Pressure resistance: | approx . 800 N/mm ² |
| Hardness (HV;H _{10μ}): | 600 HV |
| Special electrical resistance: | T = 20°C 10 ¹² – 10 ¹⁵ Ωcm T = 200°C 10 ⁹ – 2x 10 ⁹ Ωcm |
| Average roughness value Ra: | 0,2 μm |
| Thermal conductivity λ: | 1,163 W/mK |

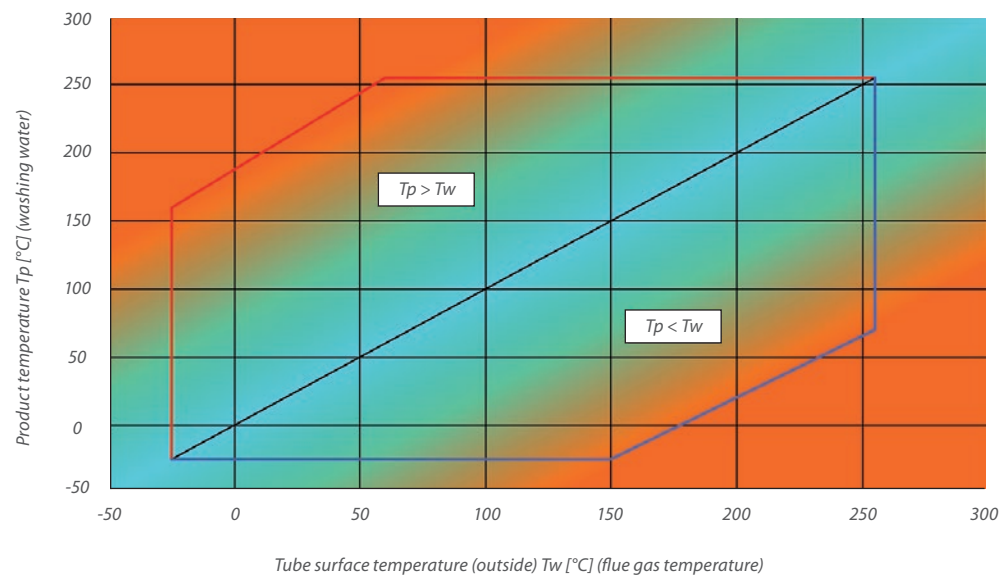
Operation diagram

Glass-lining thickness
0.45 +/- 0.05 mm, maximum 0.8 mm
Dimensions of the support tube:
25 x 1.5 mm
Diagram based on
ISO 28721-3

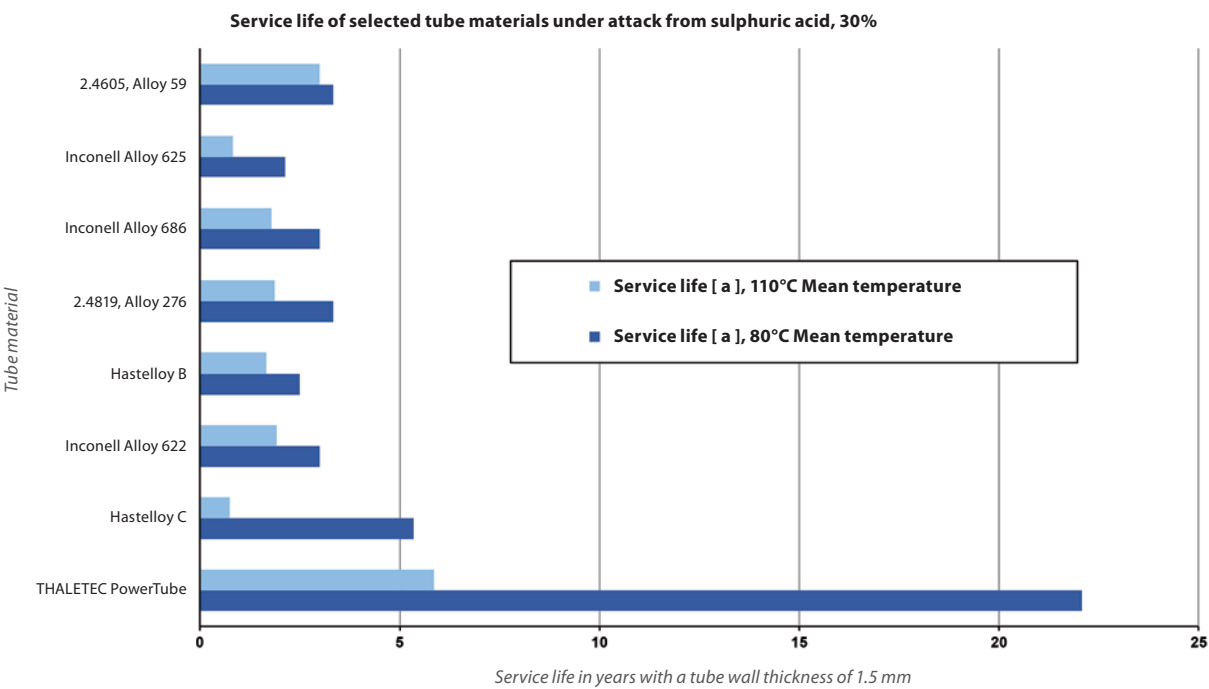


Thermal shock chart

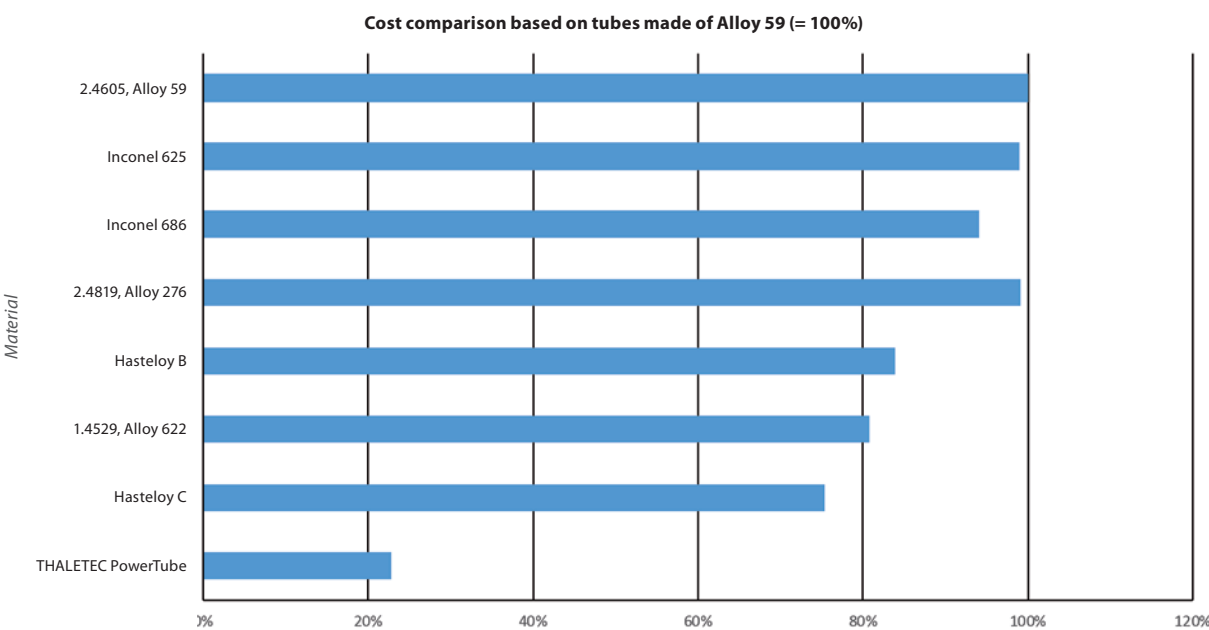
- Glass-lining thickness
0,45 mm +/- 0,05 mm
- Dimensions of the support tube
25 x 1.5 mm
- Sudden temperature shock on
glass-lining side in a liquid-filled
PowerTube



Theoretical service life of glass-lined PowerTubes when subject to external stress corrosion

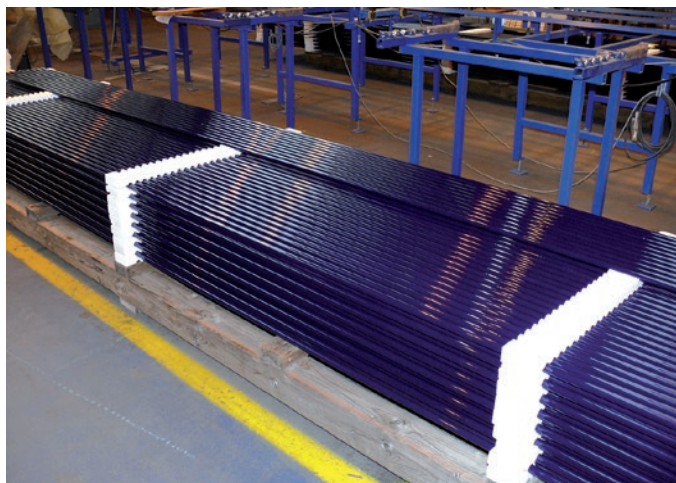


Comparison of costs between glass-lined PowerTubes and tubes made of other materials



Glass-lined PowerTubes – Technical specifications

| | |
|--|---|
| Heat exchanger type | Tube Bundle |
| Operation | waste heat recovery |
| Applications | industrial combustion plants: <ul style="list-style-type: none"> • Flue gas cleaning • Clean gas preheating • Thermal recycling • Flue gas cooling |
| Design of PowerTubes | <ul style="list-style-type: none"> • Straight tube, open at both ends • Straight tube, closed on one side • U-tube (hairpin) • Special designs on request |
| Support tube | 1.0348 (P 195 GH) Test certificate according to EN 10204/3.1 B Other materials (e.g. stainless steel) on request |
| Glass-lining thicknesses | 0,45 mm +/- 0,05 mm |
| Adhesiveness of the glass-lining EN 10209 | A1 |
| Acid resistance 30% sulphuric acid DIN EN ISO 28706-2 | requirements met |
| Acid resistance 20% hydrochloric acid (vapour phase) DIN EN ISO 28706-2 | requirements met |
| Steam resistance DIN EN ISO 28706-2 | requirements met |
| Alkali resistance caustic soda DIN EN ISO 28706-4 | requirements met |
| Pores test DIN EN 14430 | no defects and pores |
| Maximum quenching temperature DIN EN ISO 13807, 500 µm glass-lining thickness | 220°C |
| Thermal shock resistance | See thermal shock chart |
| Temperature change resistance in continuous operation | See operation diagram |



We would be pleased to assist you:

- Application Consulting
- Heat engineering design
- Mechanical design
- Performing corrosion tests
- Supporting your sales
- Optimisation considerations

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