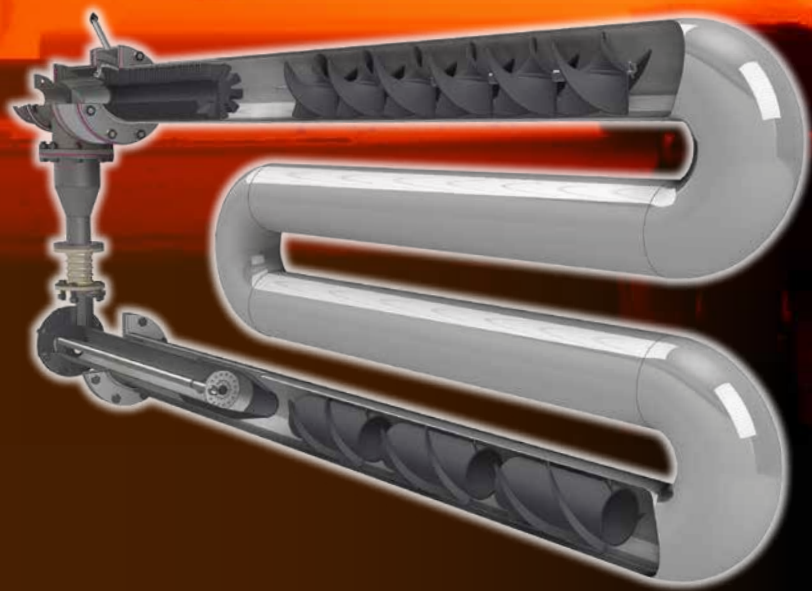


SAINT-GOBAIN PERFORMANCE CERAMICS & REFRACTORIES

# TOTAL BURNER SOLUTIONS

CERAMIC SYSTEMS



  
SAINT-GOBAIN

# SAINT-GOBAIN 2023

Derwent  
Top 100  
Global Innovator  
2023

Clarivate  
Analytics



1 IN 4

**PRODUCTS**  
did not exist 5 years ago



160,000

**EMPLOYEES**



47.9 BILLION

**SALES IN 2023**



REPRESENTED IN 76

**COUNTRIES**



-34 %

**CARBON EMISSIONS  
REDUCTION**  
(vs. 2017 on scope 1+2)



**MAIN R&D CENTRES**

## OUR PURPOSE

# MAKING THE WORLD A BETTER HOME.

## OUR MISSION

Saint-Gobain designs, manufactures and distributes materials and solutions which are key ingredients in the well-being of each of us and the future of all.

**WE ARE COMMITTED TO  
ACHIEVING NET ZERO  
CARBON EMISSIONS BY 2050**

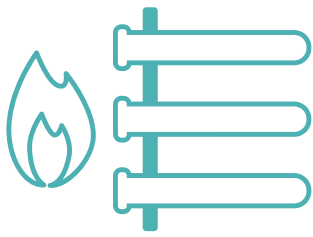
## SAINT-GOBAIN

### PERFORMANCE CERAMICS & REFRACTORIES

## OUR MISSION

To design, develop and supply solutions and services for extreme operating industrial conditions. Our engineered ceramics and refractory products are manufactured to the highest industrial standards and deliver enhanced performance while minimizing environmental impact.

**PIONEERING CERAMIC SOLUTIONS FOR EXTREME INDUSTRIAL APPLICATIONS AND A GREENER WORLD.**

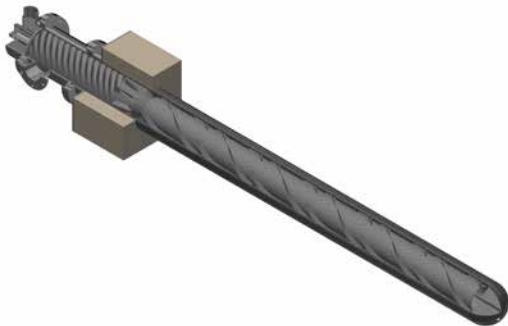


# BURNER SOLUTIONS TECHNOLOGIES

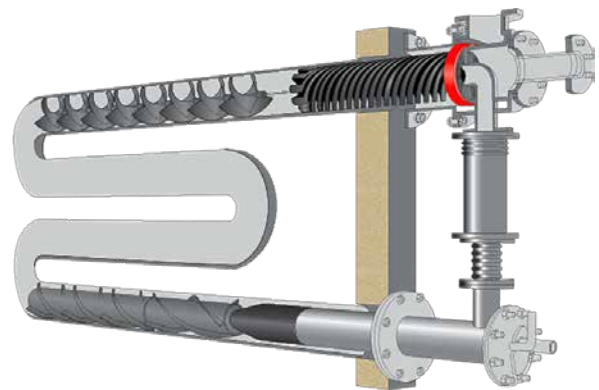
Our engineered ceramic products are custom designed, co-developed and manufactured for industrial heating applications. They deliver value in your toughest challenges related to efficiency, throughput, emissions and maintenance.



## SINGLE ENDED RADIANT TUBE (SERT) SOLUTIONS



## PERFORMANCE ENHANCING THERMAL DESIGNS FOR U- AND W-TUBES



## KEY MARKETS & APPLICATIONS



### NON FERROUS

Aluminium, Zinc, Copper



### CHEMICAL

High temperature processing



### AUTOMOTIVE

Metal heat treatment



### STEEL

Continuous annealing/Continuous galvanizing



### CERAMIC

Direct & indirect heating

# CERAMIC RADIANT TUBE

The foundation for our Burner Solutions is the silicon carbide radiant tube, that offers higher productivity at lower energy consumption. Our largest ceramic single ended radiant tube is 3.5 m long and withstands application temperatures up to 1,380°C / 2,500°F and can input up to twice as much energy as alloy radiant tubes into the furnaces. Available for straight and single-ended applications.



## BENEFITS

By comparing a ceramic radiant tube to a metal alloy system, you benefit on:



Increased service-life



Reduced maintenance costs



Lower energy consumption



Optimum efficiency



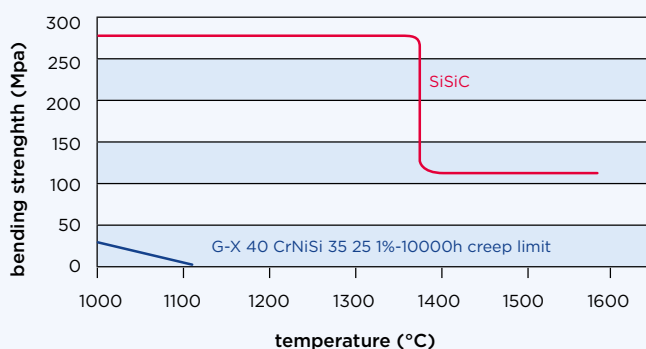
Excellent creep resistance up to max. application of T = 1,870°C

## CERAMIC VS. METAL ALLOYS

High temperature properties of Silit® SKD radiant tubes are superior in comparison to metal alloys. Strength of Silit® SKD is appr. 10 times higher and max. application temperature of 1,350°C compared to 1,100°C.

### MORE POWER

- For both horizontally and vertically installed tubes, Silit® SKD can resist net heat outputs of appr. 50kW/m<sup>2</sup> (up to 1,050°C) whereas steel reach only 50% = 25kW/m<sup>2</sup>.



### LOW MAINTENANCE AND WEAR

- Strength of Silit® SKD is very good, no support for horizontal installation is necessary. Significantly higher resistance to bending rotation.
- No scaling on the ceramic tube. Therefore no wear and no cleaning of the tubes.

## RECUPERATORS

Our recuperators that are integrated into burner systems for both direct and indirect-heating applications. Recuperator serves to recycle energy. Traditional ceramic recuperators allow for efficiencies of up to 75% in more sophisticated burner systems.



## FLAME TUBES / DIFFUSERS

Flame tubes (diffusers) act as a guide for the flow of combustion and combustion gas in single-ended radiant tube applications.



## BURNER NOZZLES

We provide a wide range of industrial, domestic oil or wood pellet boiler burners for direct heating. Amasic-3D® Additive Manufacturing, 3D printing capabilities enable us to offer burner nozzle designs of novel configurations and innovative designs to enhance performance.



## THERMAL DESIGNS



## HEATCOR™ RECUPERATOR

Saint-Gobain also possesses a heat exchanger technology, enabled by its Amasic-3D® manufacturing platform that allows recuperators and burner systems to exceed 80% efficiencies. Known as HeatCor™, the unique twisted-channel design enables surface areas of up to 3x more than traditional recuperators that fit the same footprint.

### FEATURES

- Thin-Wall Silicon Carbide
- Variable Twist / Channel Cross-Section
- 3D Printed End-Sets
- Novel Metal-Ceramic Interface

### BENEFITS



Excellent thermal conductivity



3x higher rates of heat transfer



Custom designs for optimizing application variability



Minimizes long-term failures



Low pressure drop



Working temperature up to 1,350°C

### 3D PRINTED END-SETS

for unlimited entrance and exit conditions maximize retrofit possibilities. It allows us to customize HeatCor™ recuperators for each application.

### CASE STUDY

Continuous annealing line,  
U-type Radiant Tube w/metal recuperator

9% to 16% energy savings  
39% NO<sub>x</sub> REDUCTION

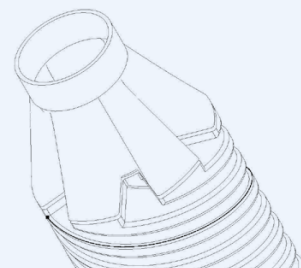
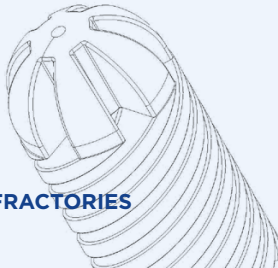
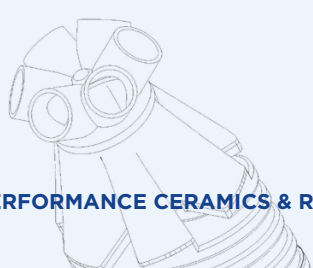
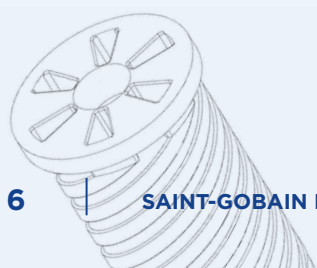
|                   |                         |            |
|-------------------|-------------------------|------------|
| Metal recuperator | Efficiency              | 70 - 72%   |
|                   | NO <sub>x</sub>         | 320 ppm    |
| HeatCor™-140      | After with HeatCor™-140 | 79% to 83% |
|                   | NO <sub>x</sub>         | 195 ppm    |

FLANGE

DIRECTIONAL NOZZLE

ROUND

INTEGRAL BURNER NOZZLE



# SPYROCOR® RADIANT TUBE INSERTS

These inserts can be easily retrofitted into existing radiant tubes to improve efficiency and bolster the amount of heat that the radiant tube is re-radiating into the furnace chamber. By implementing these inserts, users can experience energy savings of up to 15% or throughput improvements of up to 5%. Available for simple installation in straight, U-type, W-type, and tri-type radiant tubes. Also applicable in P-type and double-P-type radiant tubes.

## FEATURES

- Patented twist fin design
- Absorbs heat energy
- Re-radiates heat back into the furnace
- 2 - 6 % throughput improvements

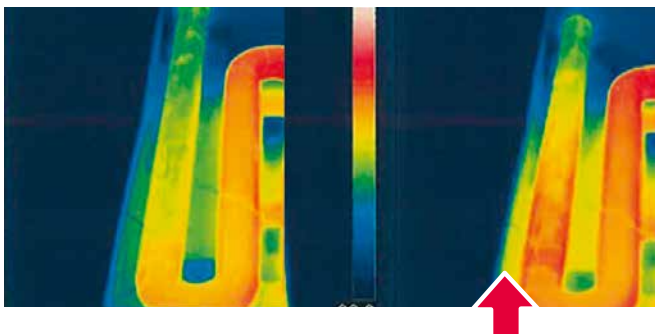
## BENEFITS



Reduction of exhaust temperature

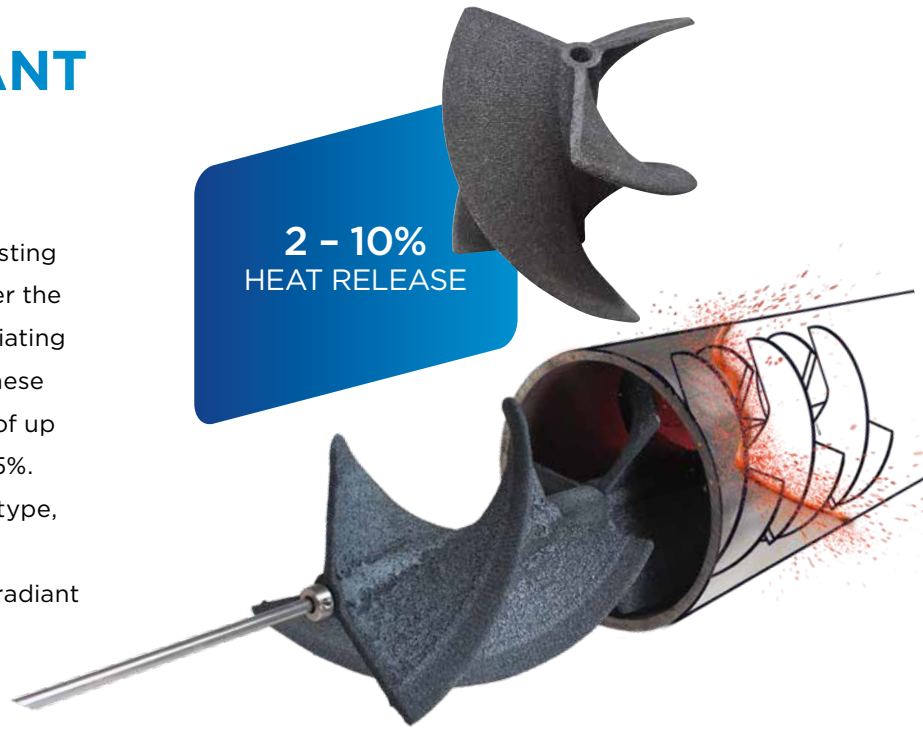
Improved energy efficiency

Reduction of polluting emissions



More heat into the furnace allows operators to reach YOUR desired temperature faster and boost throughput.

2 - 10%  
HEAT RELEASE

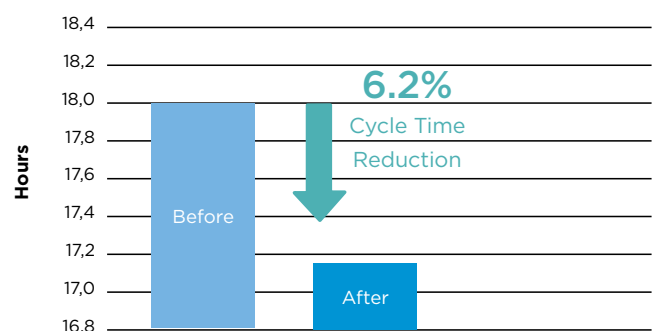
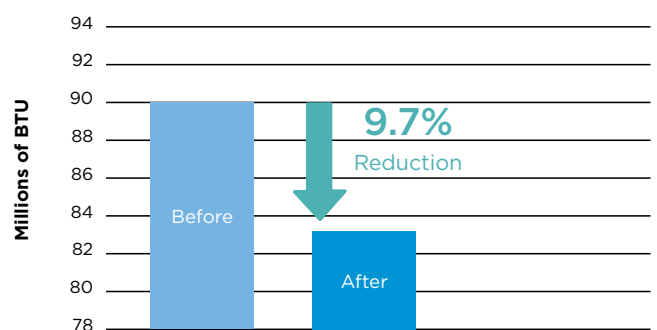


## CASE STUDY

Aluminum slab reheating furnace with W-type Radiant Tube & 567,000BTU/Hr burner

Energy saving: 9.7%  
Additional capacity: +28 cycles / year  
ROI\*: 4 months

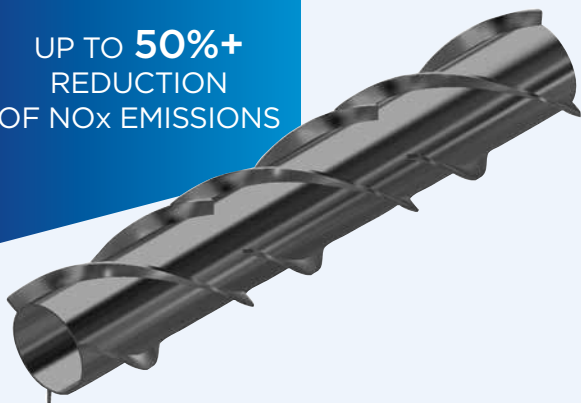
## Natural gas consumed per furnace cycle



\*Energy savings represents an average at gas cost of \$4.00/MMBZU.

## THERMAL DESIGNS

UP TO **50%+**  
REDUCTION  
OF NO<sub>x</sub> EMISSIONS



### BENEFITS



Significant energy and maintenance savings via hot-spot elimination

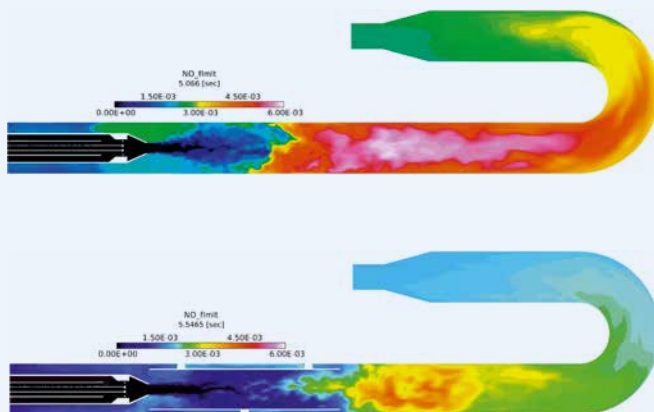


Combined with SpyroCor®, achieve temperature uniformity up to 150°F / 83°C

## NOXBUSTER®

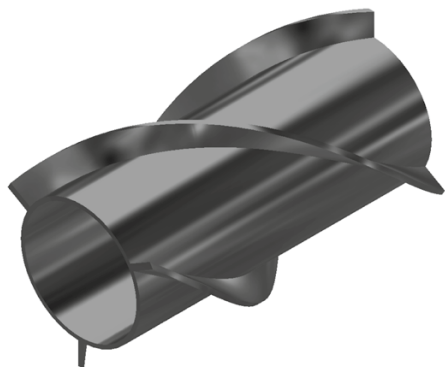
### RADIANT TUBE INSERT

NOxBuster® patented design permits the recirculation of flue gases within the radiant tube. With the NOxBuster® shape, you can significantly reduce flame temperature and lower NO<sub>x</sub> emissions by up to 50%!

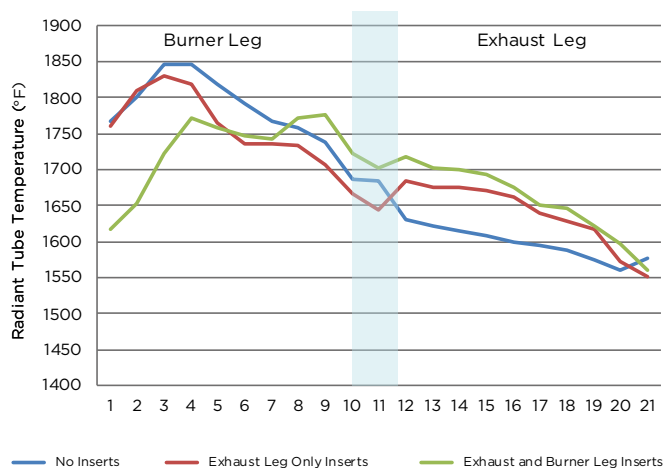


## PYROCOR™ FLAME TUBE

An uniquely designed flame tube, modified and developed for use in U-tubes and W-tubes, that protects the radiant tubes by eliminating hot spots caused by direct flame impingement and increases the life of the radiant tube. The spiral shape can be custom engineered to promote excellent temperature uniformity.



### Radiant Tube Temperature Profile

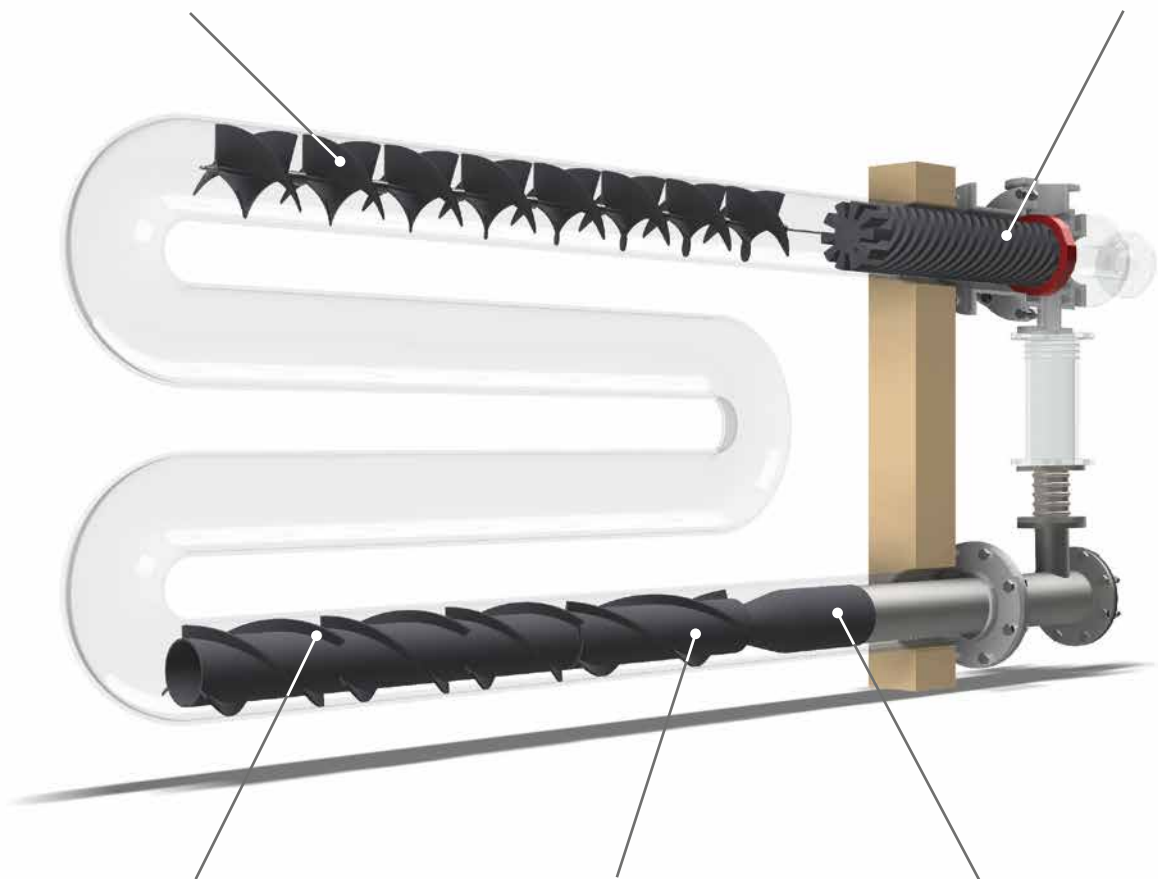


# PERFORMANCE ENHANCING THERMAL DESIGNS

The combined benefits of Saint-Gobain's Thermal Designs make them the best total sustainable solution for you. Apply them to your system to help achieve your performance objectives.

2% - 10% heat release with SpyroCor®

Up to 70% - 85% efficiency improvement with HeatCor™



Improvements of uniformity with PyroCor™

Up to 50% NOx reduction with NOxBuster®

Advanced combustion with 3D Printed Burners

SERT



U-TUBE



W-TUBE

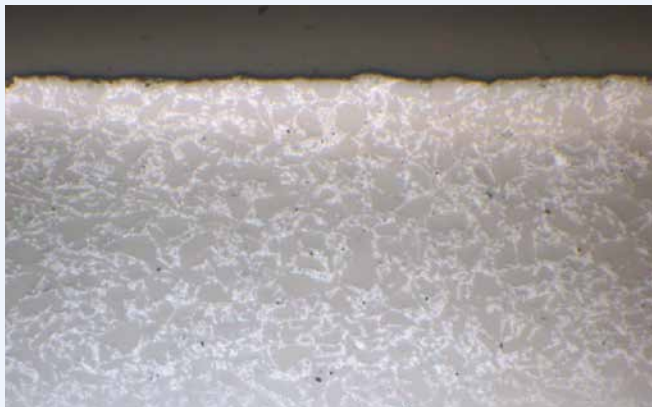


### SILIT® SKD / AMASIC-3D®

Silit® SKD and Amasic-3D® are a reaction-bonded, siliconinfiltrated silicon carbide (SiSiC).

#### FEATURES & BENEFITS

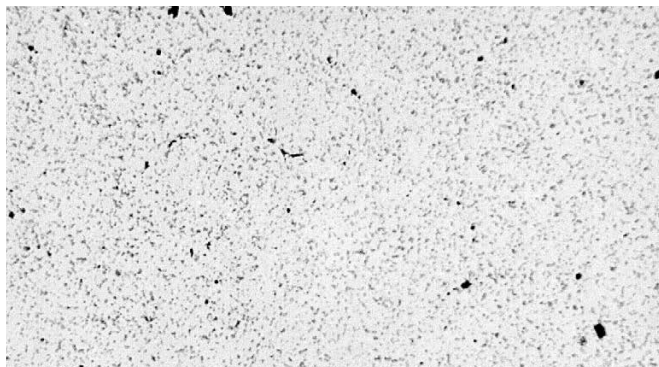
- Gastightness
- Very high thermalshock resistance
- Dimensional stability till maximum application temperature
- Very high thermal conductivity
- Low mass
- High efficiency
- High operational reliability and operating efficiency
- Amasic-3D®: 3D-printable SiSiC



Photomicrograph of Silit® SKD (100x)

### HEXOLOY® SA SiC

Hexoloy® SA SiC is a pressureless, sintered form of alpha silicon carbide, with a density greater than 98% theoretical. It has a very fine grain structure (4 - 10 microns) for excellent wear resistance and contains no free silicon, which makes it highly chemically resistant in both oxidizing and reducing environments.



Photomicrograph of Hexoloy® SA SiC (200x)

#### FEATURES & BENEFITS

- Near universal corrosion resistance
- Excellent resistance to wear
- Exceptional strength at high temperature
- High oxidation resistance, up to 1,650°C in air
- Low thermal expansion
- High thermal conductivity



## PROPERTIES OVERVIEW

Saint-Gobain's application engineers are available to assist you with your technical project in designing cost effective high performing products that will meet your need now and in the future.

|                                                             | Test specification | Unit                | Silit® SKD  | Amasic-3D®  | Hexoloy®    |
|-------------------------------------------------------------|--------------------|---------------------|-------------|-------------|-------------|
| Main components                                             | SiC                | %                   | 85          | 60          | > 99        |
|                                                             | Si                 |                     | 15          | 40          |             |
| Maximum application temperature <sup>1)</sup>               |                    | °F / °C             | 2510 / 1380 | 2460 / 1350 | 3450 / 1900 |
| Bulk density                                                | EN 993-1           | g/cm <sup>3</sup>   | 3,0         | 2,8         | 3,1         |
| Apparent porosity                                           | EN 993-1           | Vol. %              | 0           | 0           | 0           |
| Young's modulus RT <sup>2)</sup>                            | EN 843-2           | Gpa                 | 340         | 155         | 430         |
| Modulus of rupture RT <sup>2)</sup>                         | EN 993-6           | Mpa                 | 260         |             | 380         |
| Coefficient of thermal expansion $\alpha$<br>RT ... 1.300°C | EN 993-10          | 10 <sup>-5</sup> /K | 4,5         | 4,8         | 4,0         |
| Thermal conductivity 1.000°C                                | EN 993-15          | W/(m*K)             | 35          | 40          | 126         |

1) Dependent on the corresponding operating conditions

2) Ambient temperature

## SAINT-GOBAIN'S TOTAL BURNER SOLUTIONS

The combined benefits of Saint-Gobain's Total Burner Solutions makes it the most sustainable solution for you. Apply them to your systems to help achieve up to



**10%**

THROUGHPUT



**50%**

REDUCE EMISSIONS



**30%**

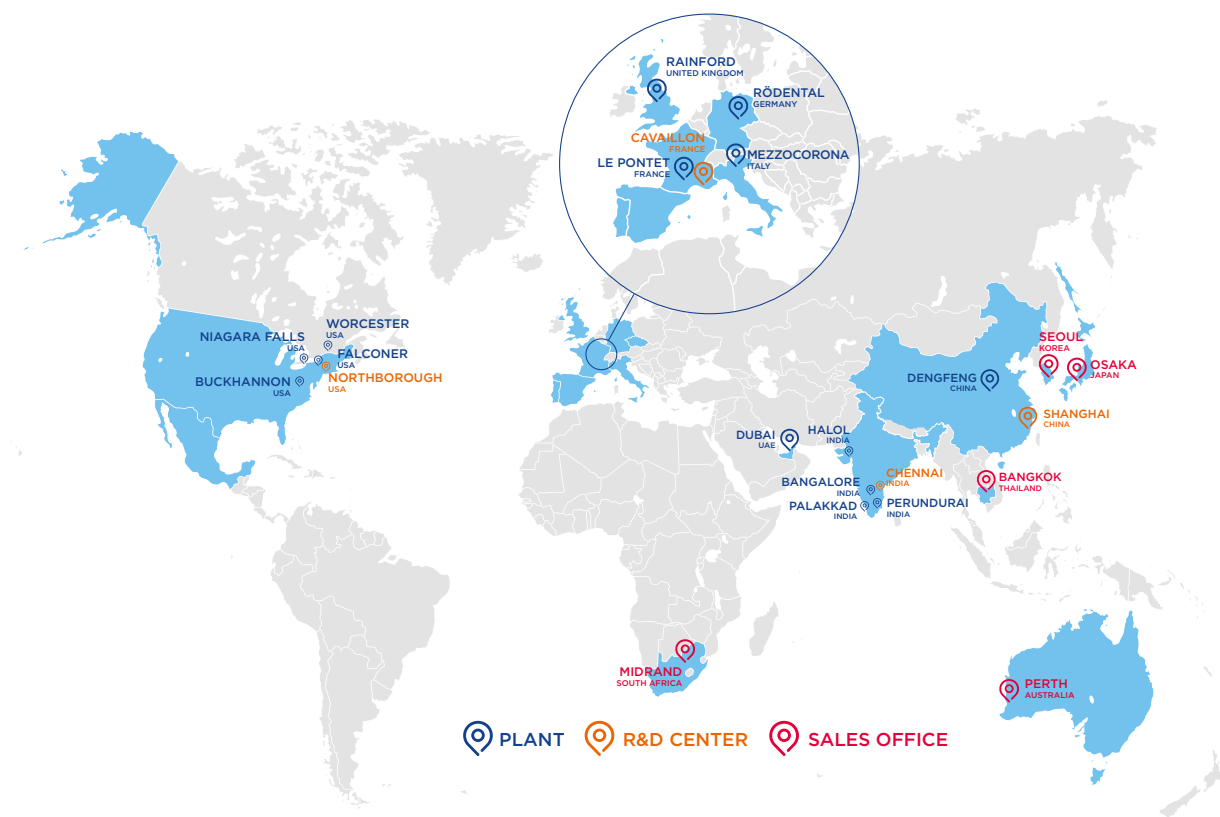
ENERGY SAVINGS



**3x**

LIFE

# OUR GLOBAL PRESENCE



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