flox.com

FLOX® INSIDE

GREEN GAS READY®

German Environmental Award 2011

PRODUCT OVERVIEW

WS Industrial Burners and Radiant Tubes

FLOX®

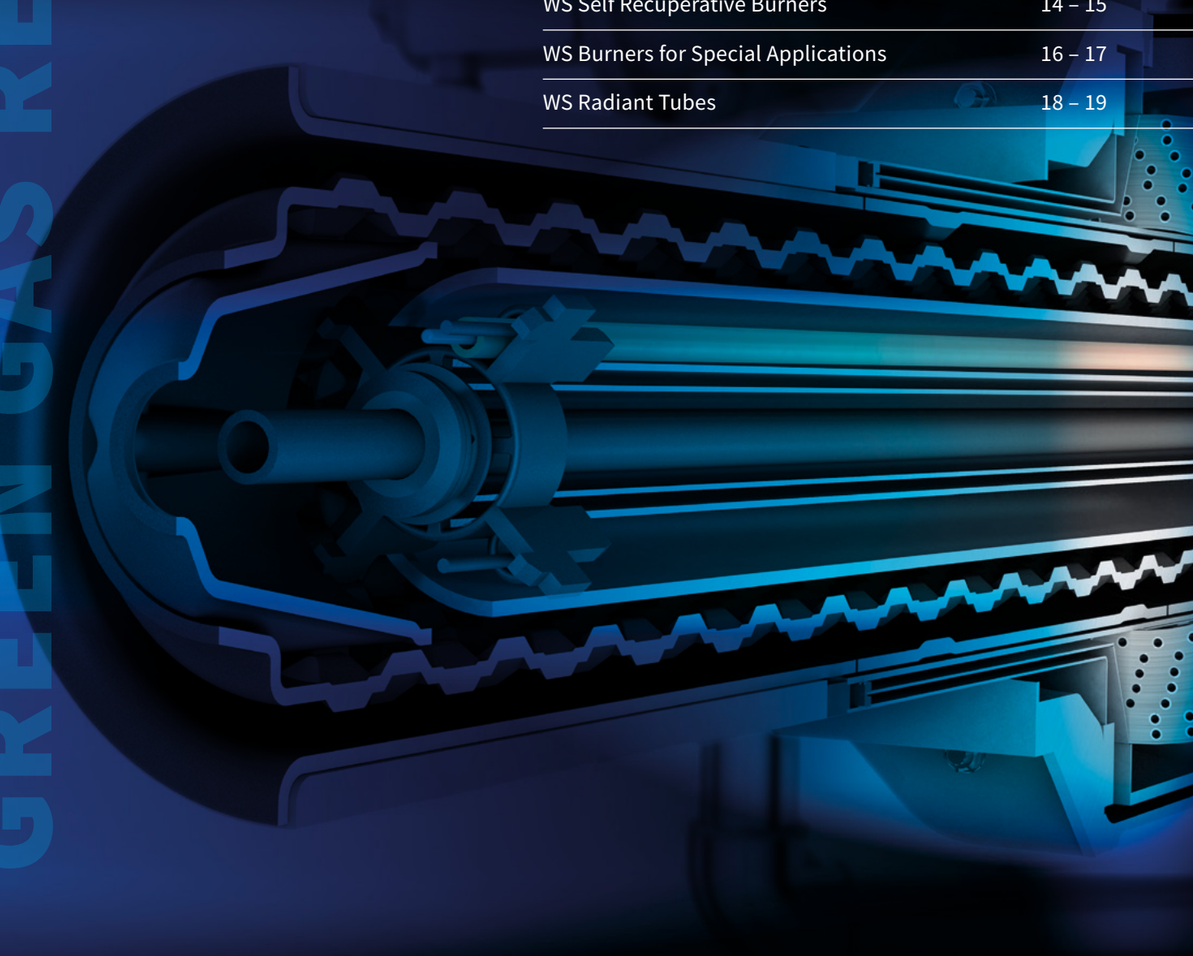
GREEN GAS READY®

Your High Quality Gas Heating System:

Future-Proof
Efficient
Low-Emission
Flexible

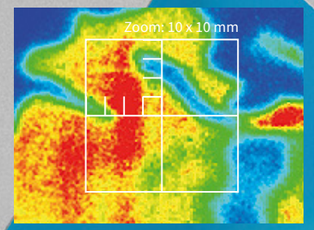
Secure your competitive advantage with innovative gas heating solutions based on decades of experience.
As an owner-operated company, WS is independent from corporate strategies and concentrates on one thing only:
The best possible heating solution for your application.

GREEN GAS READY

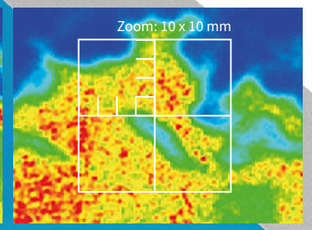


CONTENT

YEARS OF EXPERIENCE 30+ FLOX®



Temperature during flame operation

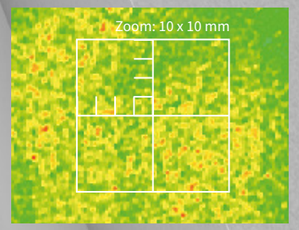


OH intensity during flame operation

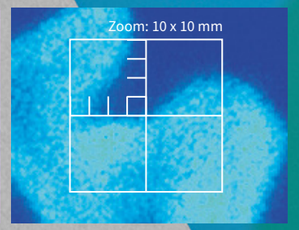
FLAME MODE
Burner firing into an open combustion chamber in flame mode
Visible high velocity flame
Red hot SiSiC combustion chamber
NO_X < 220ppm @ @850 °C (~ 1,550 °F) (typical values)
Temperature uniformity
Typical roaring associated with combustion

FLOX® MODE
Burner firing into an open combustion chamber in FLOX® mode.
No visible flame
Noticeably cooler burner nozzles
NO_X < 50ppm @ 1,100 °C (~ 2,150 °F) (typical values)
Superior temperature uniformity
No audible combustion noise

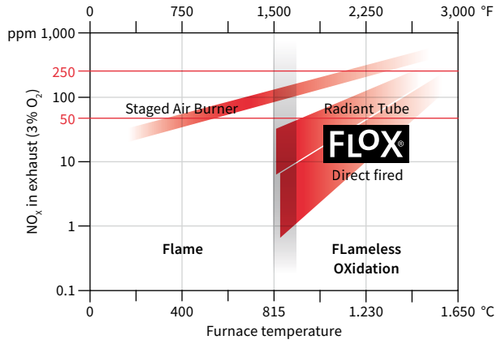
FLOX®



Temperature during FLOX® operation



OH intensity during FLOX® operation



The patented FLOX® Combustion Principle:

FLOX® is an acronym for »FLamless OXidation«, which describes a method of combustion occurring at high chamber temperatures, typically above 850 °F (1,550 °F).

Contrary to a classical flame, with one highly intensive reaction zone near the burner nozzle, the FLOX® reaction is homogeneous without flame fronts.

Ignition is achieved by recirculation of the hot waste gases. This method guarantees stable combustion over a wide load range even when using fuels with low calorific values.

Temperature peaks as seen in flame fronts are eliminated. Thus, NO_X emissions are substantially reduced, even at high air pre-heat temperatures.

YEARS OF EXPERIENCE
30+

Multiple patents by WS.

»FLOX® by WS: the original and best flameless combustion you will find.«

FLOX® INSIDE

	FLOX® = »FLameless OXidation«
Temperature range	Above 850 °C (1,550 °F) chamber temperature
Supervision	Fail safe temperature supervision in FLOX® mode
Emissions	Significant reduction of nitrogen oxides (NO_X)
Uniformity	More uniform combustion chamber temperatures
Equipment life	Reduced thermal stress results in longer equipment lifetime and reduced maintenance

YEARS OF EXPERIENCE 30+ FLOX®

WS COMPETENCE

»WS has been our reliable and professional partner for many years – we use over 500 WS burners. We particularly appreciate the in-depth exchange of experience with their well-trained employees.«

Joachim Baumeister, Burner Maintenance,
Erbacher Härtetechnik, Erbach, Germany

»The installation of WS burners is easy and can always be performed without delays. Moreover, they are very popular with our customers thanks to their well thought-out functions and ease of operation.«

Michael Scheffler, Project Management and Sales,
KOHNLE Wärmebehandlungsanlagen GmbH,
Birkenfeld, Germany

»»The support for our project in Canada was extraordinary. This proves how important an open and honest business relationship is. Something we certainly cultivated with WS over many years of collaboration.«

WMU Wärmebehandlungsanlagen für Industrie
und Umwelttechnik GmbH, Bönen, Germany
Project in Canada

»With only some degrees of freedom in the selection and design of the heating system, we are able to meet almost all of today's expectations in terms of efficiency and NOx emissions.

And such systems are already prepared for the immediate or future use of green hydrogen.«

Dr.-Ing. Joachim G. Wünning,
Technical Director of
WS Wärmeprozesstechnik GmbH

Together we will find the best possible solution.

You require a future-proof heating system with maximum energy efficiency and lowest possible emissions?

Name your expectations. Together, we will find a solution that suits your needs.

WS burners cover all relevant technological aspects and allow us to master the challenges of your application.

Definition of Goals for Efficiency and NO_X → **Joint Analysis of required Furnace Design Aspects** → **Burner Selection by experienced WS Engineers** → **Optimal Solution for your Application**

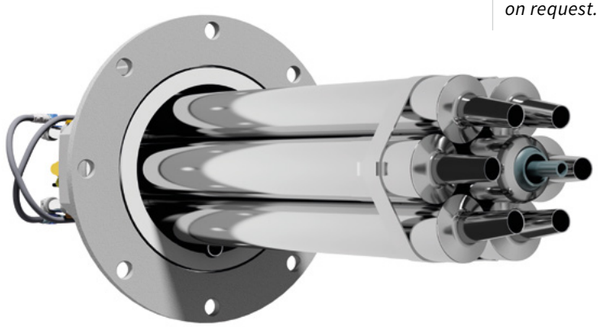
YEARS OF EXPERIENCE 30+

FLOX®

WS REGEMAT® 250

FLOX® INSIDE GREEN GAS READY®

	WS REGEMAT® 250
Typical input	120 - 140 kW 400,000 - 475,000 BTU/hr
Typical operating temperature	800 - 1,000 °C 1,450 - 1,850 °F
Application examples	Direct and indirect heating of continuous galvanizing lines, annealing lines, belt furnaces, box furnaces, ... *Special solutions are possible on request.*



»It‘s the best technology available on the market, and we‘re putting it in to really future-proof the plant and still safely stay below emission limits many, many years from now.«

Dr. Clemens Trachternach, Team Leader of FBA10, thyssenkrupp Steel on the use of WS regenerative burners at the FBA10 in Dortmund, Germany

The FLOX® burner REGEMAT® 250 immediately revolutionized the world of continuous galvanizing lines. With unprecedented efficiency and NO_X emissions, which make downstream exhaust gas treatment obsolete.

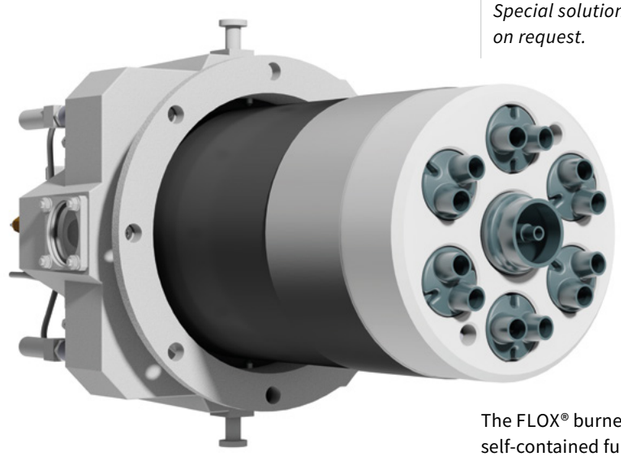
Customers who rely on the REGEMAT® 250 are optimally equipped for all possible future developments. Especially since the burner meets all the »Green Gas Ready« criteria with flying colors. So your plant is well prepared for the future of alternative fuels such as green hydrogen.

With well over 10 years of experience and thousands of burners in operation, the REGEMAT® 250 is the proven reference technology for all customers who are seeking a future-proof and highly efficient plant.

WS REGEMAT® 350

FLOX® INSIDE GREEN GAS READY®

	WS REGEMAT® 350
Typical input	200 kW FLOX® + 200 kW Boost
Typical operating temperature	850 - 1,250 °C 1,550 - 2,300 °F
Application examples	Direct heating of forge furnaces, stainless steel APL, car bottom furnaces, ... *Special solutions are possible on request.*



The FLOX® burner REGEMAT® 350 is a self-contained functional unit and eliminates the need for operation in burner pairs, which is common with many other regenerative burners. All switching mechanisms are already integrated in the compact unit, so that each burner can operate autonomously.

With a typical operating range of up to 1,250 °C (2,300 °F), the REGEMAT® 350 is perfectly suited for direct heating of high-temperature processes such as forging furnaces or stainless steel lines.

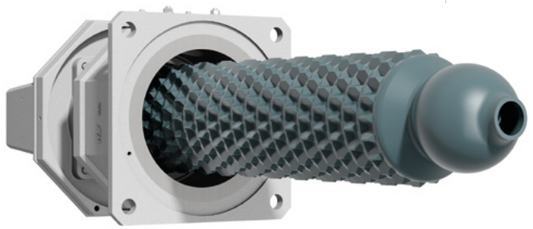
Due to the extremely high air preheat, the burner achieves maximum energy efficiency with unbeatably low NO_X emissions thanks to the FLOX® technology. And of course, this burner is already equipped for operation with green hydrogen.

YEARS OF EXPERIENCE 30+ FLOX®

WS REKUMAT® C

FLOX® INSIDE GREEN GAS READY®

	WS REKUMAT® C
Typical input	10 - 100 kW 35,000 - 350,000 BTU/hr
Typical operating temperature	700 - 1,250 °C 1,300 - 2,300 °F
Application examples	Direct and indirect heating of belt furnaces, hardening lines, silicon strip lines, ... *Special solutions are possible on request.*



The FLOX® burners of the REKUMAT® C series are characterized by an integrated ceramic high-performance heat exchanger for typical operating temperatures of between 700 and 1,250 °C (1,300 - 2,300 °F).

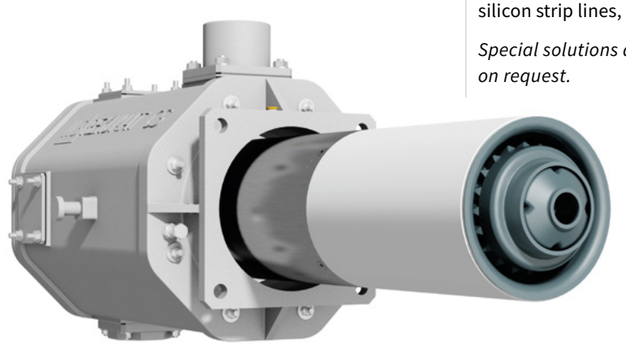
Minimal wear due to the FLOX® technology as well as decades of experience from tens of thousands of burners in operation make the REKUMAT® C the most successful recuperative burner in the world.

The REKUMAT® C series enables extremely low NO_X emissions with both direct and indirect heating and is excellently suited for operation with hydrogen.

WS REKUMAT® CS

FLOX® INSIDE GREEN GAS READY®

	WS REKUMAT® CS
Typical input	20 - 100 kW 70,000 - 350,000 BTU/hr
Typical operating temperature	700 - 1,250 °C 1,300 - 2,300 °F
Application examples	Direct and indirect heating of belt furnaces, hardening lines, silicon strip lines, ... *Special solutions are possible on request.*



The FLOX® burner series REKUMAT® CS combines highly efficient gap flow recuperators with the temperature resistance of SiSiC high-performance ceramics.

Superior efficiency even at the highest temperatures for maximum energy savings. This burner is cutting-edge technology paired with FLOX® and guarantees lowest NO_X emissions and maximum fuel flexibility.

Of course, the REKUMAT® CS is also »Green Gas Ready« and thus prepared for the operation on green hydrogen.

YEARS OF EXPERIENCE 30+ FLOX®

WS REKUMAT® M

	WS REKUMAT® M
Typical input	20 - 300 kW 70,000 - 1,000,000 BTU/hr
Typical operating temperature	700 - 1,100 °C 1,300 - 2,000 °F
Application examples	Direct and indircet heating of belt furnaces, hardening furnaces, galvanizing and annealing lines, enameling furnaces, ... *Special solutions are possible on request.*

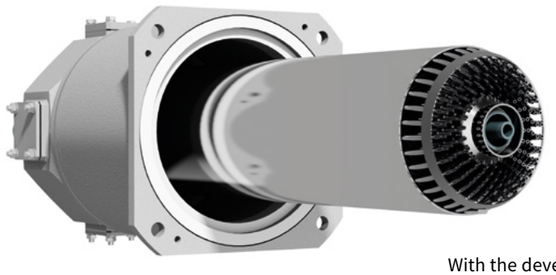
The REKUMAT® M series offers proven technology paired with state-of-the-art features such as FLOX® and fuel flexibility.

With the experience of tens of thousands of burners in use, the REKUMAT® M is a perfect burner for anyone looking for a long-proven, extremely robust and always reliable product with high efficiency and low emissions.

In addition, REKUMAT® M burners can be excellently operated with green hydrogen in most applications.

WS REKUMAT® S

	WS REKUMAT® S
Typical input	10 - 140 kW 35,000 - 500,000 BTU/hr
Typical operating temperature	700 - 950 °C 1,300 - 1,750 °F
Application examples	Direct and indirect heating of enameling furnaces, belt furnaces, hardening furnaces, ... *Special solutions are possible on request.*



With the development of the FLOX® burner REKUMAT® S, WS succeeded in revolutionizing the class of recuperative burners.

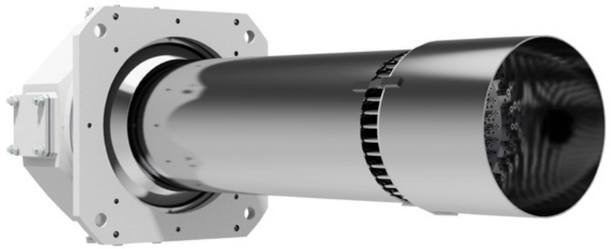
A tripling of the heat exchanger surface area due to the patented gap flow technology enables groundbreaking efficiency. Thanks to FLOX®, the burners achieve lowest NOx emissions even with extremely high air preheating.

Moreover, due to the scalability of the recuperator, the burner is always perfectly adapted to the respective application. With efficiencies >80 %, the REKUMAT® S achieves the efficiency of a regenerative burner even at lower outputs. In many cases, REKUMAT® S burners can also be operated with green hydrogen.

YEARS OF EXPERIENCE 30+ FLOX®

WS REKUMAT® S NT

	WS REKUMAT® S NT
Typical input	10 - 100 kW 35,000 - 350,000 BTU/hr
Typical operating temperature	<600 °C <1,100 °F
Application examples	Direct heating of low-temperature applications *Special solutions are possible on request.*



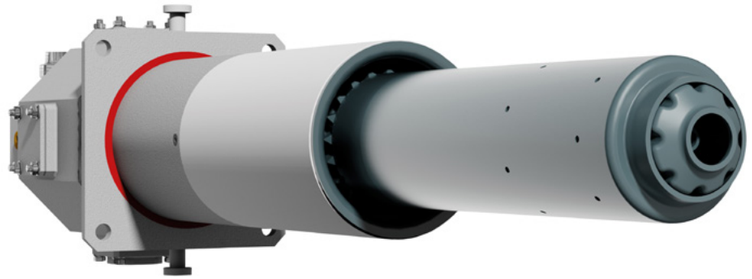
The REKUMAT® S NT enables the use of highly efficient gap-flow technology even at furnace chamber temperatures well below 600 °C (<1,100 °F).

Compared to conventional designs, the patented recuperator ensures a three times higher heat exchanger surface area and thus groundbreaking efficiency. The special design of the burner also enables particularly low-emission operation.

With rising energy prices, more and more customers are aiming at the highest possible efficiency, even in the low-temperature range. The REKUMAT® S NT opens up the potential of huge savings opportunities thanks to efficiencies of 90 % and more.

WS REKUMAT® CR

	WS REKUMAT® CR
Typical input	40 - 60 kW 135,000 - 200,000 BTU/hr
Typical operating temperature	700 - 1,250 °C 1,300 - 2,300 °F
Application examples	Direct understoichiometric heating *Special solutions are possible on request.*



The FLOX® burner REKUMAT® CR enables the substoichiometric operation of a recuperative burner by means of integrated post-combustion.

Increased efficiency even at the highest temperatures for maximum energy savings is thus made possible for many additional furnace types. Patented advanced technology coupled with FLOX® guarantees lowest NO_x emissions and high fuel flexibility.

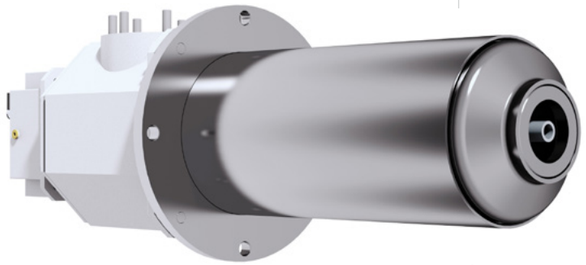
The REKUMAT® CR series is also »Green Gas Ready« and thus equipped for operation with green hydrogen.

YEARS OF EXPERIENCE 30+ FLOX®

WS LUVOMAT®

FLOX® INSIDE GREEN GAS READY®

	WS LUVOMAT®
Typical input	up to 500 kW up to 1,700,000 BTU/hr
Typical operating temperature	850 - 1,250 °C 1,550 - 2,300 °F
Application examples	Direct heating of furnaces using externally preheated air and/or substoichiometric operation *Special solutions are possible on request.*



The LUVOMAT® can be used if externally preheated air is already available, and low NO_X emissions by means of the FLOX® combustion principle is desired. This can be the case, for example, if the furnace atmosphere makes it difficult to operate classic recuperative or regenerative burners, such as in substoichiometric operation or dusty and aggressive furnace atmospheres.

The requirements for LUVOMAT® burners vary greatly due to often externally specified boundary conditions. A detailed burner design is always carried out in close coordination with the customer.

WS FLAT FLAME

FLOX® INSIDE GREEN GAS READY®

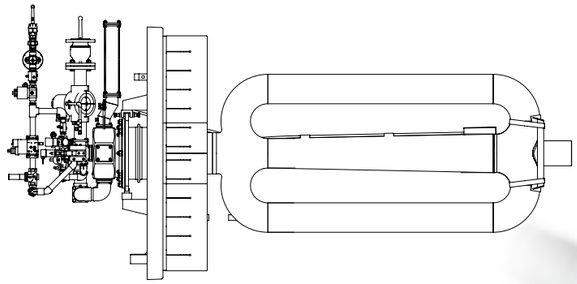
	WS FLAT FLAME
Type	FLOX® Burner in Flat Flame Configuration
Typical input	30 - 300 kW 30,000 - 1,000,000 BTU/hr
Typical operating temperature	700 - 1,250 °C 1,300 - 2,300 °F
Application examples	Direct heating of chamber furnaces, car bottom furnaces, and special applications *Special solutions are possible on request.*

Many WS burners are also available in special FLAT FLAME designs. In addition to recuperative burners, burners with a special nozzle design enable low-emission heating of various industrial applications or chemical reactors.

In FLAT FLAME applications, FLOX® is proving to be a key technology for meeting particularly demanding challenges. Since the requirements for each application are different, burner design is always carried out in close cooperation with the customer.

YEARS OF EXPERIENCE 30+ FLOX®

WS RADIANT TUBES



WS (DOUBLE-) P-RADIANT TUBES

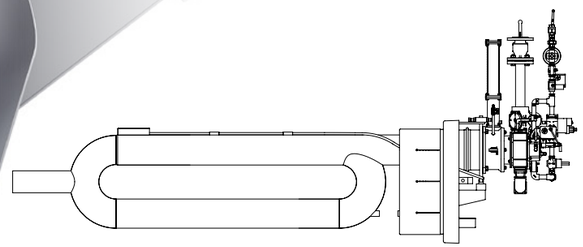
Application examples

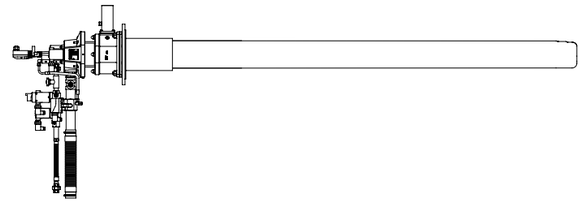
Modern continuous galvanizing lines, enameling furnaces, hardening furnaces, chamber furnaces, ...

For demanding applications in particular, WS relies on metallic P or double-P type radiant tubes.

Due to the superior temperature uniformity, compared with non-recirculating designs, WS radiant tubes obtain particularly long service life and enable minimal NO_X emissions with extremely high combustion efficiency.

Industry best efficiency in combination with lowest NOx emissions can only be achieved by high recirculation rates within the WS radiant tube burner system – even when operating with hydrogen.





WS SINGLE ENDED RADIANT TUBES

Application examples

Horizontal strip lines, hardening furnaces, chamber furnaces, ...

Metallic or ceramic single eneded radiant tubes offer particularly high temperature uniformity and, when properly designed, are ideal for heating the most demanding applications. The operation with green hydrogen is also possible due to the high rates of internal recirculation.

WS mastered the challenge of connecting a ceramic SiSiC tube to a metallic flange with flying colors early on and has relied on the patented connection ever since.

The high temperature resistance of our SiSiC radiant tubes allows extremely long service lives of the tubes. The technical properties also allow easy installation without counter bearing.

YEARS OF EXPERIENCE 30+ FLOX®

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