



THERMAL SYSTEMS

Innovative equipment for solar production



Solar series
Solar equipment

www.rehm-group.com



Solar Equipment

Optimal process performance
for best cell results

Outstanding metallization process for high volume cell production

Renewable energies use the natural energy flows on the earth in small parts. The inexhaustible power of the sun is ready for regeneration of these. All life on earth takes its energy from the power of the sun. Solar energy can also be used directly. Solar cells in photovoltaic plants, solar thermal power plants and solar collectors use solar radiation without detours and convert the radiation energy into electricity or heat.

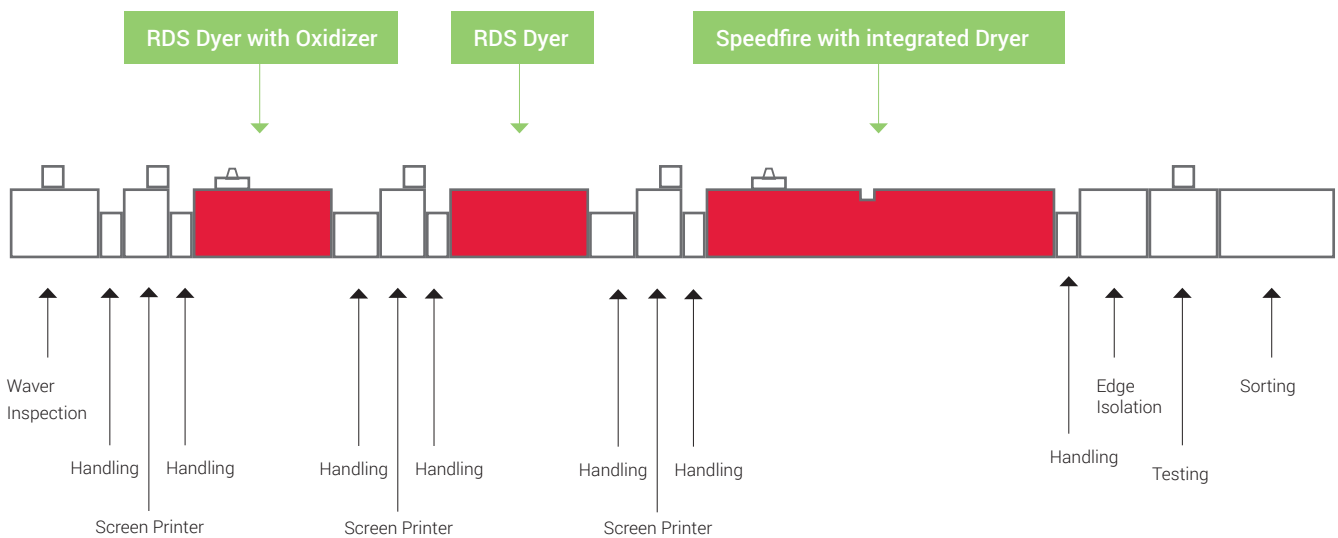
In the fast-paced world of solar cell manufacturing, Rehm is continuously developing new equipment to match the demands of our customers. Rehm has provided dryers and firing furnaces to the metallization lines for over 10 years. Since 2005 we have dedicated ourselves to the design and manufacturing of dryers for print lines. Drying the paste and handling the VOC's of the solar pastes is an extremely important part of the metallization and contributes largely to a good efficiency. For a sustainable handling of the VOC's, Rehm has developed a Thermal Oxidizer, operating at a 99,5 % oxidization efficiency. Our Firing Furnaces have a very good reputation in the market place. Apart from an increasing and loyal customer base, Rehm Firing Furnaces are used in famous institutions such as the Fraunhofer ISE in Freiburg, Germany. The Rehm Firing Furnaces provide a large process window for the optimization of the firing profile, while allowing an increased wafer throughput of up to 5300 wafers/hour. The Rehm LID system gives our customers the chance to expose PERC cells with an individually controlled laser solution to reduce LID to a minimum. With more than 750 solar units installed and operated all over the world, Rehm has the experience and insight necessary to develop equipment and processes to meet the highest requirements.

Full power for your metallization line

Highest throughput and best results

Would you like to combine optimal firing solutions and reliable drying methods in your metallization process? Our metallization line concept, which consists of the RDS Dryer with Oxidizer, the Speedfire Firing Furnace and the LID Unit based on customer specification, is an important part within the production line of solar cells. The Speedfire Firing Systems for the metallization of crystalline silicon solar cells excel because of the high quality design. The modularity is

the key feature that allows these systems to perfectly fit into any solar cell manufacturing environment. Nowadays more and more manufacturers tend to consider the huge quality contribution that the drying process has in the crystalline silicon solar cell production. Good drying means excellent adhesion of the printing pastes to the wafer. The RDS Drying Systems meet these requirements at its best and guarantee reliable drying results.



- › Flexible, modular construction
- › Versatile production layout
- › Low energy consumption, sustainable and efficient
- › High throughput for diverse applications up to 5300 wafers/hour
- › Intelligent software solutions
- › Minimal maintenance

RDS Dryer

Ready for complex pastes

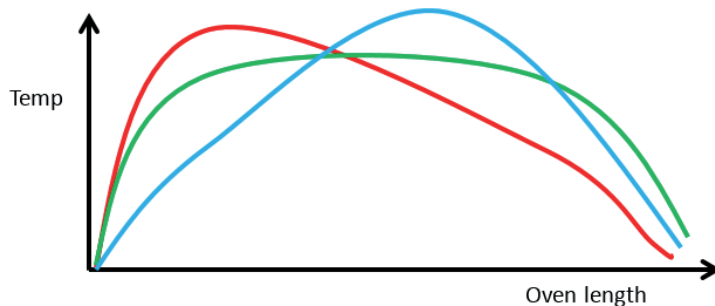
Drying the large variety of ever evolving solar pastes is ever more challenging in the silicon solar cell production. Complex pastes for PERC to HJT cell architectures require a modular drying system which provides a large process window for the customer.

While maintaining a short footprint, the RDS can process 5300 wafers/hour at speeds of up to 10 m/min. The system will easily meet any cycle time requirements called for in this fast-paced market. It is the chosen dryer of one of the industry's top print line manufacturer.



Dual heating concept for best profiling

Temperature profile flexibility



Flexible profiling due to separately controlled IR

Rehm dryers are designed to handle a variety of drying profiles from fast ramp up to temperatures of over 300 °C to a slow increase in temperature for a very stable heat intake of the cells. The innovative hybrid heat transfer combines separately controllable IR and convective heating technology. This technology provides the customer with a maximum degree of flexibility when setting up a profile.

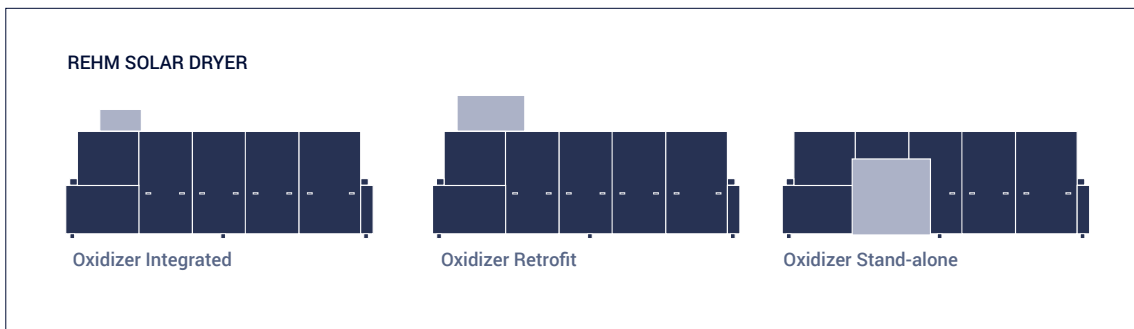
- › **High profile flexibility**
- › **Fast temperature ramp-up**
- › **High throughput**
- › **High energy efficiency**
- › **Modular design for integration in HJT lines**
- › **Lane pitch capability of 210 mm – 280 mm**



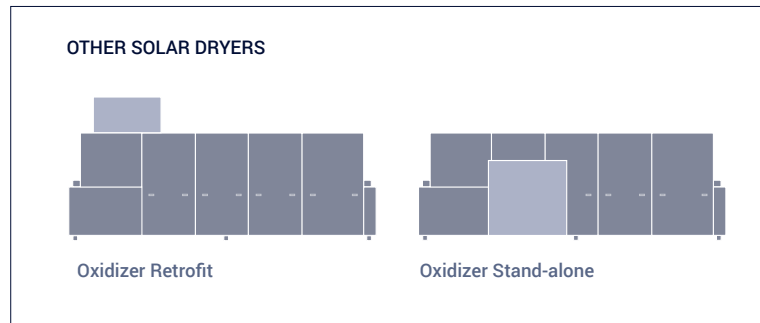
VOC Thermal Oxidizer for a clean process

Drying solar pastes produces up to 30 % of the weight of the printed paste in volatile organic compounds (VOC). The VOC's have to be removed from the process chamber via exhaust to avoid contamination of the process chamber, VOC's condensation damage on the solar cell and obstruction due to odor development in the vicinity of the dryer.

The Rehm Thermal Oxidizer will expose the exhaust volume to over 750 °C in order to destroy all VOC's, such as alcohols, toluene and terpineol with an efficiency of up to 99,9 %. The side products of this process are water vapor and carbon dioxide and make this a sustainable environmentally friendly process in compliance with legal standards such as the TA Luft, Germany. Even with the higher throughput in modern cell production, the Rehm Thermal Oxidizer can handle the increased VOC content.



Rehm Thermal Oxidizer comes integrated into the Aluminum Back side Dryer or can be retrofitted as a top-mounted or stand-alone unit to a number of drying systems in the market.



Data and facts VOC destruction results

	Run No. 1	Run No. 2	Run No. 3
Oxidizer Inlet VOC Concentration (g/m ³)	1,64	1,71	2,07
Oxidizer Outlet VOC Concentration (g/m ³)	0,00273	0,00145	0,00305
VOC Destruction Rate (%)	99,8	99,9	99,8

measured during production at leading solar cell manufacturers

VOC Thermal Oxidizer/COMPACT	
Max. VOC destruction efficiency	99,9 %
Operating temperature	750 °C
Volumetric flow raw gas	110 Nm ³ / h
Residence time	1s
Dimensions	H: 1400 mm W: 1200 mm L: 1200 mm

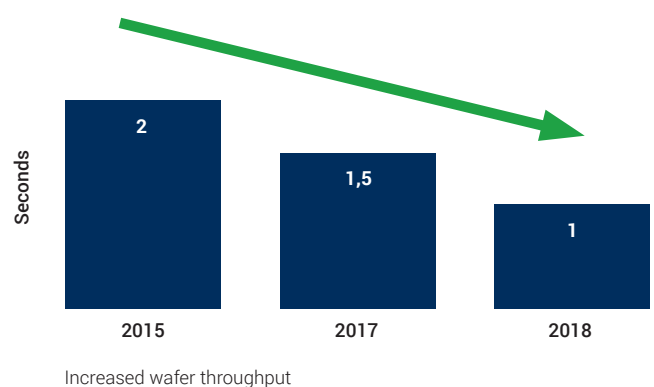
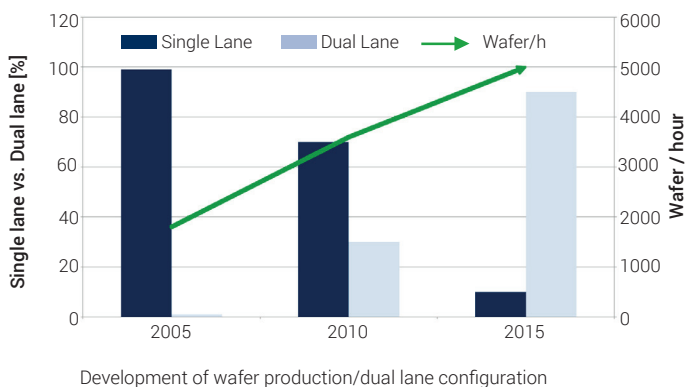


Speedfire Firing Furnace

Processing up to 5300 wafers/hour

Rehm Speedfire Firing Furnace offers a range of advanced process features and thermal control that enable PV manufacturers to move their processes to entirely new levels of efficiency and yield. The demand for high process flexibility, higher wafer throughput and decreasing cycle times has led to the latest innovation in the field of firing systems.

The modularity of the Speedfire zones allows the user to achieve full polymer binder burn off and fast firing at temperatures up to 900 °C while processing 5300 wafers/hour. Even at belt speeds of up to 10 m/min the Rehm Fast Firing Furnace offers a large process window in the peak zones, allowing for the most customized temperature profiles.



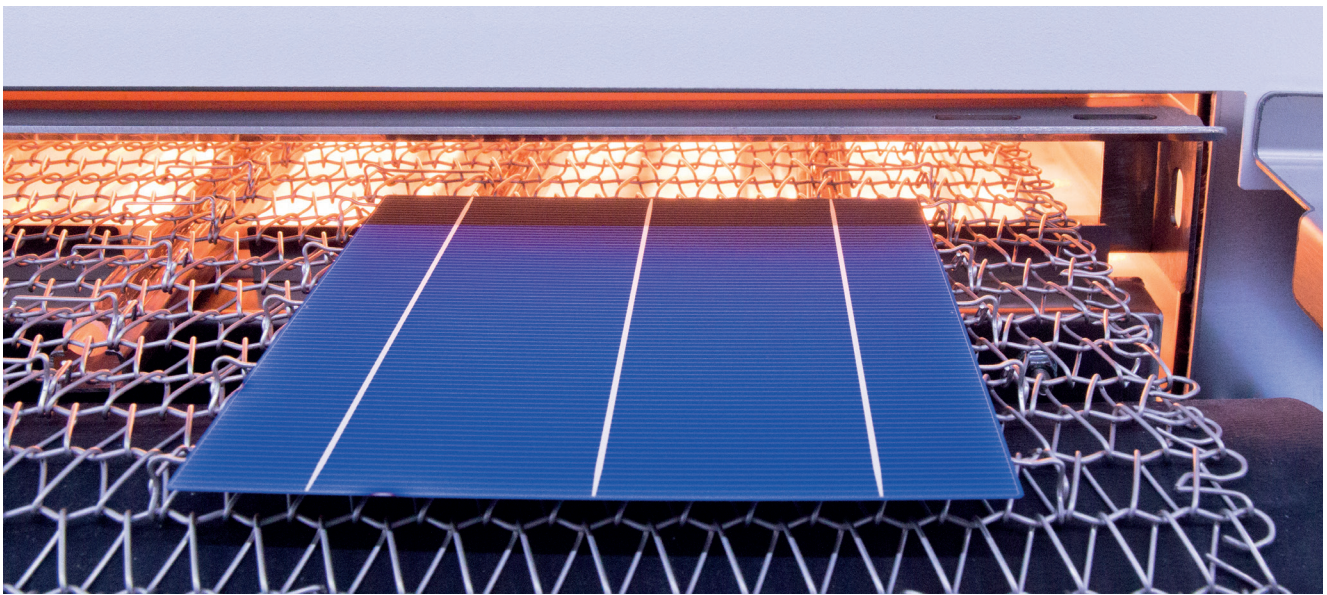


From drying to firing

Safe, vibration-free, reliable

Your solar cells will run through various sections of the system during the drying and firing process. Secure transportation is a key entity when it comes to continuous processes.

The highest assembly skills, the top quality materials and the advanced designed concepts of our transport system guarantee low-vibration transport of the wafers. The horizontal throughput ovens guarantee a safe transport through the oven. The mesh belt is equipped with stand offs for secure transport of the wafers.



Mesh belt with stand offs

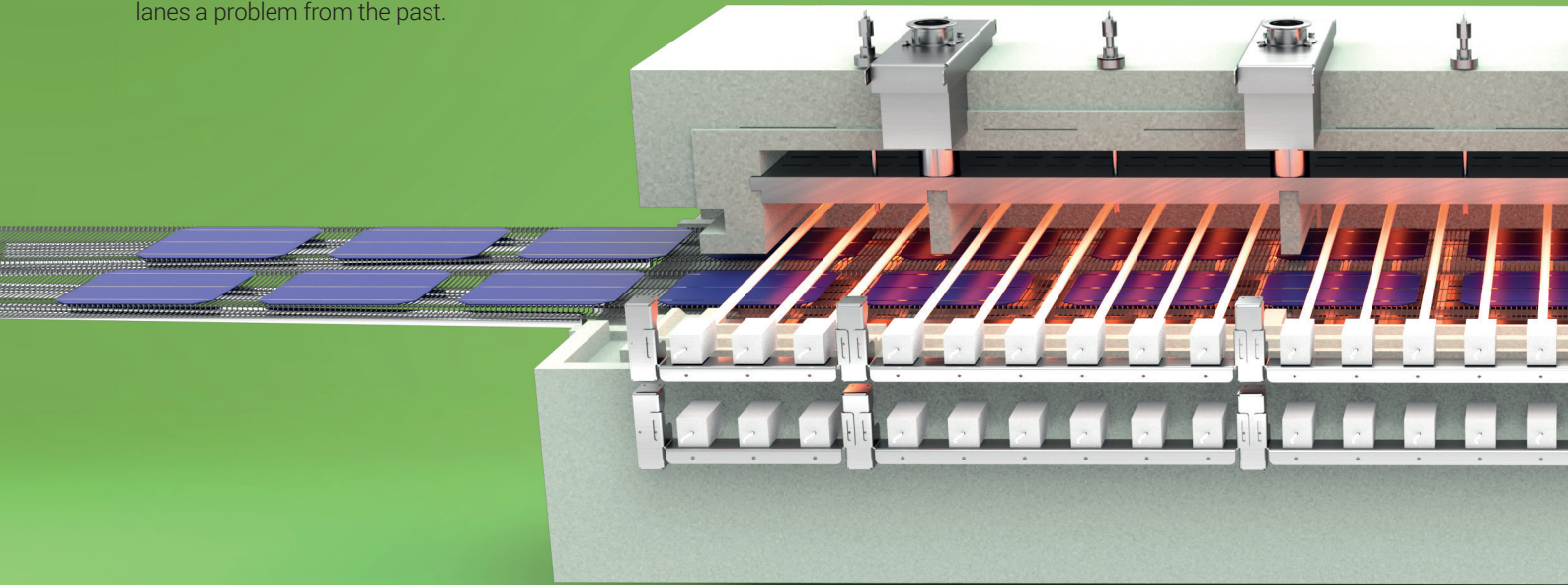
- > **Reliable, failure-free production guaranteed by absolutely safe transport**
- > **Precise and repeatable adjustment of the transport speed**
- > **Reduced maintenance, transport drive mechanism is outside of the process chamber**
- > **Low-vibration transport of the wafers guaranteed**

low 
maintenance
expenses

Dual Chamber Design

for precise profiling of each lane

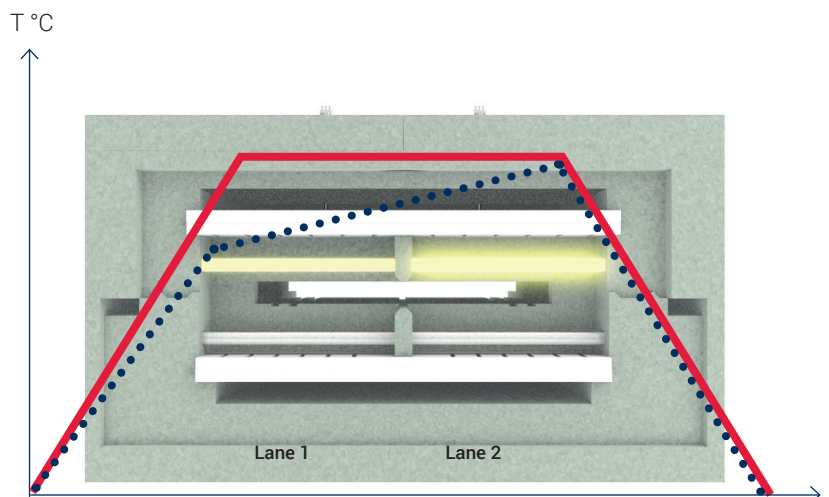
With the new dual chamber design, the Speedfire can control the temperature of each lane separately, making temperature fluctuations due to unevenly loaded lanes a problem from the past.



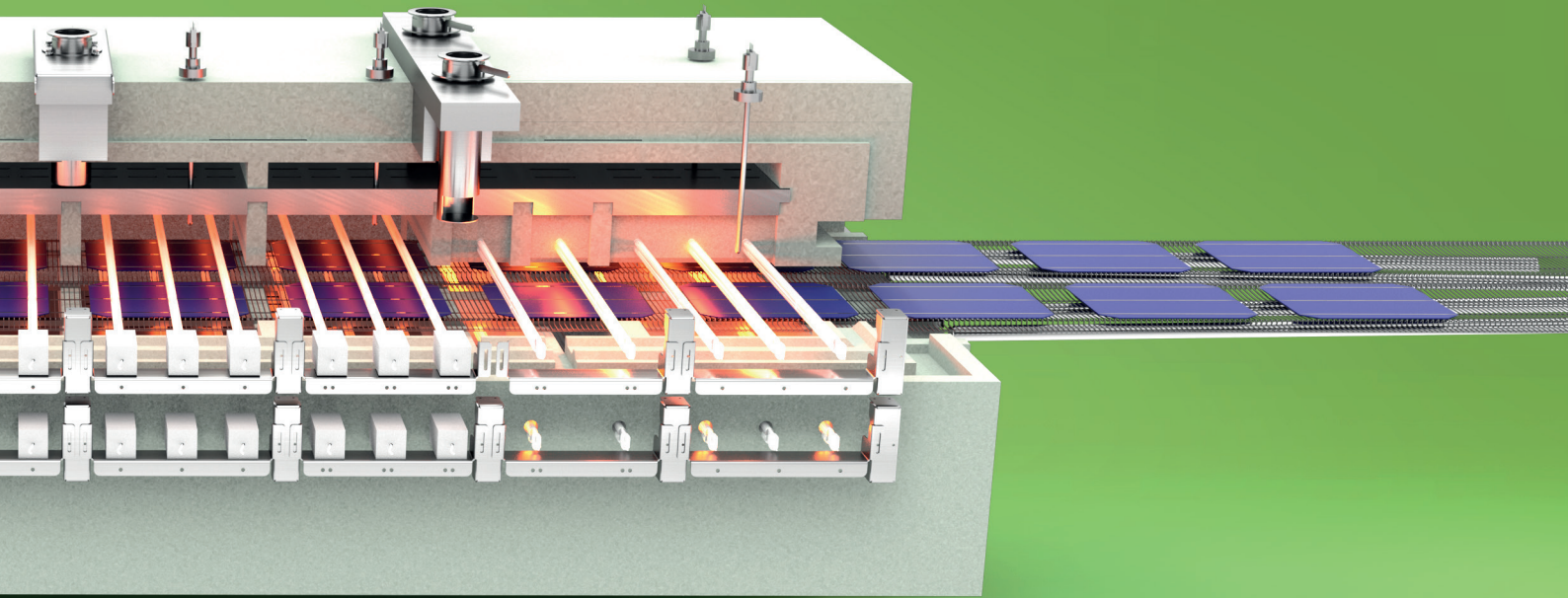
Flexible profiling

for precise process control

An insulating wall separating the lanes just above the belt divides the chamber into two separately controllable process chambers. Each chamber has its own sets of specially designed IR lamps and thermocouples providing the possibility to run completely different profiles independently from each other.

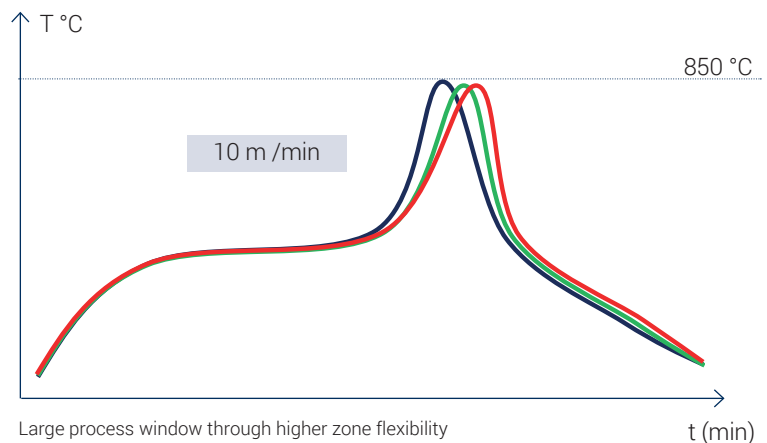


Dual chamber design with cross profile



Large process window at 5300 w/h due to modularity of zones

The modularity of the Speedfire zones allows the user to achieve full polymer binder burn off and fast firing at temperatures up to 900 °C while processing 5300 wafers/hour. Even at belt speeds of up to 10 m/min the Rehm Fast firing furnace offers a large process window in the peak zones, allowing for the most customized temperature profiles.



Rehm Fader Function

for optimized front- and backside firing

The Fader function had first been introduced in 2009. Top and bottom IR lamps are controlled separately and thus enhancing the profile flexibility.

By achieving up to 30 °C difference between the top side and the bottom side of the wafer, the Speedfire enables the user to fire the wafer sides at different temperatures. These temperatures are close loop controlled and easily managed in the furnace software.

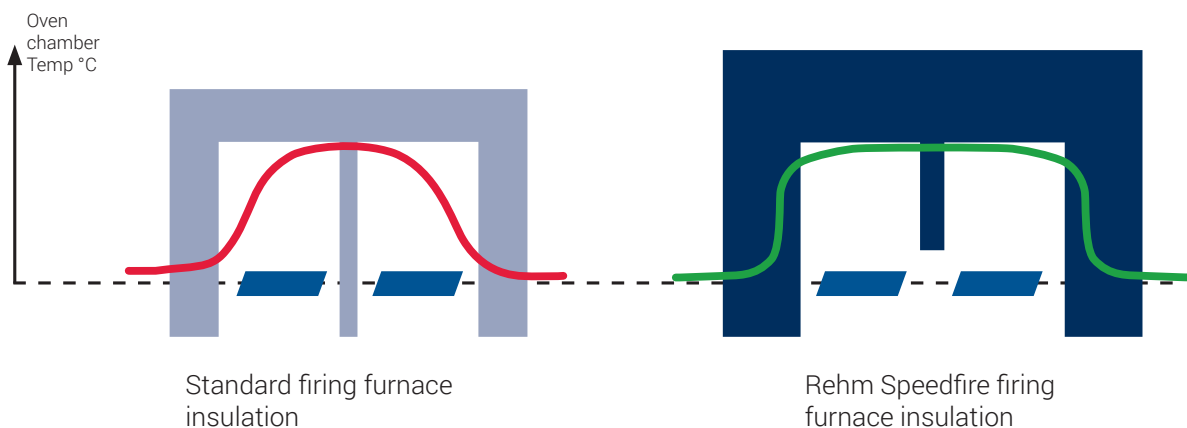


Multi-layer insulation

for stable process temperature

The Rehm Speedfire chamber insulation design, based on 25 years of oven building experience, is the best in the industry. The well insulated chamber guarantees an extremely homogenous heat distribution inside the process chamber, resulting in a stable process temperature at the wafer.

A lower housing temperature and the better electrical efficiency of the oven are favorable side effects of the multi-layer Insulation.



Comparison of the heat distribution inside the process chamber



Regenerate your cells by reducing the LID effect

Mono crystalline solar cells experience a loss in efficiency of more than 1 % within the first hour of their exposure to sun rays. It depends on the wafer material and the cell architecture. This effect is called Light-Induced-Degradation (LID). Because the prices for solar cells and modules are linked to their absolute efficiency, a cancellation of the LID effect bears a large economical potential.

Rehm Thermal Systems has developed an equipment which will reduce the LID by exposing the metallized cell to a light source for a defined period of time under a defined light intensity. The LID tool convinces with a very short and compact layout. The large light density of the laser modules create a notably higher control flexibility than standard LED light sources.

The laser modules have a higher life cycle and don't deteriorate in infrequent of high frequent utilization.

The emitted laser radiation can be controlled exactly to the requirements of the customers. Partially enhanced energy transfer can be realized in order to create a perfect homogeneous result throughout the cell surface, even on and around the cell edges.

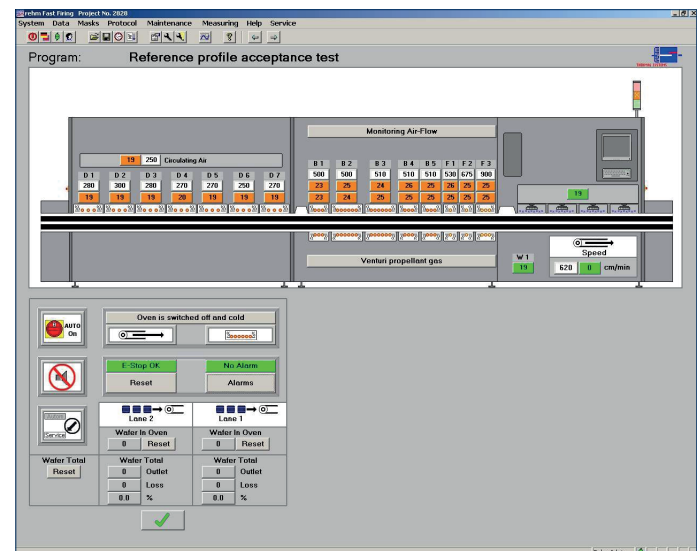




Innovative software tools for easy programming

The Speedfire Firing Furnace and RDS Dryer are operated via intuitively controlled, user-friendly software. It has numerous software features including programming, language selection, rights management, MES connection and uncomplicated operator guidance. This means you can not only adapt all your work steps flexibly to your product requirements and process flow, but you can at any time track and document all procedures transparently as well.

For optimum and reproducible process results!



User-friendly software interface



Industry 4.0

Intelligent Software Solutions

Software solutions from Rehm allow the reliable control and monitoring of the solar equipment

The software components are consisting of monitoring tools and various modules, each of which completes its own individual task. Master software compiles the data and evaluates it, for instance in order to keep the specified parameters constant for the respective manufacturing profile. The modular system can be assembled into individualized packages and matched to the customer's respective requirements. Custom tailored master software is available for each system type.



Traceability and process interlocking

With over 25 years of experience in the SMT industry, Rehm has adapted its wafer tracking and traceability functions from their vast experience in reflow ovens for the electronics industry.

A variety of packages are possible for the Speedfire Firing Furnace and the RDS Dryer in the field of traceability and process interlocking:

- › **Traceability/Process traceability via hand-held scanner (order-specific)**
- › **Process interlocking via fixed position scanners**
- › **Process interlocking and traceability via fixed position scanners**

Wafer tracking and traceability is becoming ever more important to guarantee quality production and satisfy the end customers. The seamless traceability of every wafer, paired with the process and the actual production parameters should be ensured.

A data set containing the relevant process parameters during the process is generated in a file for each wafer. Means that batch or serial numbers, work orders, temperatures, belt speed, profiles and others in the oven software are stored.

Internal wafer tracking provides the customer with the possibility to match every incoming wafer with the oven process parameters, such as IR lamp output, temperature, etc. at any given position within the oven.



Data and facts:

Detail of Speedfire Firing Furnace | Throughput 5300 wph

Dimensions

DIMENSIONS

Length:	10700 mm	Footprint:	20 m ²
Width:	1870 mm	Weight:	5000 kg
Height:	2000 mm	Load per Base:	500 kg

Technical specifications

TRANSPORT SYSTEM

Transport lanes:	Dual lane
Belt system:	Continuous belt system
Conveyor width:	540 mm
Product clearance:	30 mm
Belt speed range:	1–10 m/min
Belt speed accuracy:	< 0,5 % max. speed
Belt type:	Mesh belt
Transport height:	930 +/-50 mm
Throughput direction:	Left to right/right to left

HEATING ZONES

Furnace max. temp. firing:	1000 °C
Furnace max. temp. drying:	450 °C
Typical heat up time:	40 min*
Typical ramp rate heating:	80 – 140 K/s
Surface temperature covers:	≤ 35°C
Temperature uniformity (unloaded):	+/- 1,0 °C
Temperature uniformity (loaded):	+/- 5,0 °C
Heating zones drying:	7
Heating zones burnout/firing:	5/3

* at 70 % heating output for prolonged heater life time

COOLING ZONE

Cooling type:	air/water
Cooling length:	2200 mm
Typical cooling rate:	40 – 120 k/s

WAFER TEMPERATURE AT EXIT

Water temperature 12 – 15 °C*:	≤ 35 °C
Water temperature 17– 20 °C:	≤ 50 °C

* recommended

Supply data

WATER

Water pressure:	min. 1,5 bar
Water temperature:	12 – 15 °C
Water flow rate:	min. 20 l/min

GAS/AIR

Exhaust air dryer/firing:	max. 700/2000 m ³ /h
Max. changeover rate:	~ 6/min
Flow rate CDA:	max. 50 ³ /h
Required CDA pressure:	6 bar

On-site service

We are there for you worldwide.

The quality levels of our systems are of the highest order. We aim to maintain this high level in our service activities as well. From Blaubeuren via Georgia and Příbor to Szendehely or from Dongguan to Guadalajara – we are there to help for all questions related to sales and service. Anywhere in the world!

Need special advice on our systems, something fitted or a spare part? Our responsibility does not end with the sale! We remain in close contact with our clients and suppliers after they have invested in a Rehm system and make every effort to keep our response times short. We make sure we keep to delivery deadlines, installations and service inspections. And we are also available at any time for questions about applications – ensuring that your production runs smoothly.



24 hours
a day available

Service 
from A to Z

in **24** countries
on site 

Your service contact person

Service-Center:

Mon - Thurs 07:00 – 16:30
Fri 07:00 – 12:15
service@rehm-group.com

24h-Service-Hotline:

Germany: +49 (0) 7344 - 9606 511
China: +86 769 8328 0260



Rehm Worldwide

As a leading manufacturer of innovative thermal system solutions, we have customers on every continent. With our own locations in Europe, the Americas and Asia as well as 27 agencies in 24 countries we are in position to serve the international markets quickly and to offer outstanding on-site service – worldwide and round the clock!

