

Let us be your guide
through the world of glass



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Enthusiasm
starts with excitement.

Glass lets us gaze way out onto the horizon or view the world and what it has in store under a microscope. The material is thousands of years old and reveals new facets of itself each and every day. It fascinates and empowers us to work tirelessly on technological innovations so that we can help you exploit its full potential.

Experts from many disciplines push boundaries because glass is in their DNA. They also understand the bigger picture. Architects use glass to create eye-catching buildings. Manufacturers produce this glass in exceptional quality and repeatedly break new ground in the process. They are backed up by a whole team of developers, engineers and programmers whose day-to-day mission is to discover what further potential glass can unlock.

We're delighted to be part of the journey that glass takes us on. Our approach is optimistic but we cast a critical eye when required. We're a partner who thrives on bringing our expertise to the table, kick-starting innovations and improving overall experience from start to finish.

At the same time, we also want to team up with you to ensure that future generations can fully enjoy the appeal of glass. Glass can play a key role in combating climate change and making the transition to green energy happen. For example, building modules that produce electricity from solar power.

Today, waste heat from the manufacturing process can already be used as a source of energy. Hydrogen or electricity from renewable resources could run production lines in tomorrow's world. Glass is naturally planet friendly. It can be recycled and melted down repeatedly while retaining all of its unique characteristics.

This material has been around for thousands of years and is now encountering the digital revolution. The digital opportunities available today inspire us to help you make your business grow. We want to place all added value at the center stage for you. Let's continue to embark on this journey together. Let us be your guide through the world of glass.



We look to the future with years of experience.

|| Glass is one of the world's oldest materials and has achieved a quantum leap thanks to float glass technology. We provide end-to-end support to float glass manufacturers and I'm always impressed each time I walk down a production line. And that really motivates us as a team to break the mold and make the technology even better for our customers. ||

Markus Gruber
Senior Vice President Business Unit Glass
Grenzebach Maschinenbau GmbH

Anyone glancing through a wrought-iron window in a historic building, castle or church will immediately notice what a difference float glass technology has made. You can look right through the glass without any optical distortion. Grenzebach and CNUD EFCO have been shaping the story of float glass technology from the outset. Our wealth of experience benefits our customers all around the world.

Sand, lime, dolomite and soda are all used to make the exceptional material that is glass. The ingredients melt at a temperature of 1,400 degrees Celsius, or 2,552 Fahrenheit and turn into glass. The basis is a liquid that remains transparent when it solidifies and is very stable. The float glass method is the most successful in the history of flat glass production, which goes back thousands of years.

Grenzebach and CNUD EFCO have been supplying production and processing machinery for industrial float glass from the very beginning. Since the 1990s, we've been technology pioneers in this sector. Today, way more than half the panels of glass fitted in buildings are based on Grenzebach technology and/or produced by CNUD EFCO.

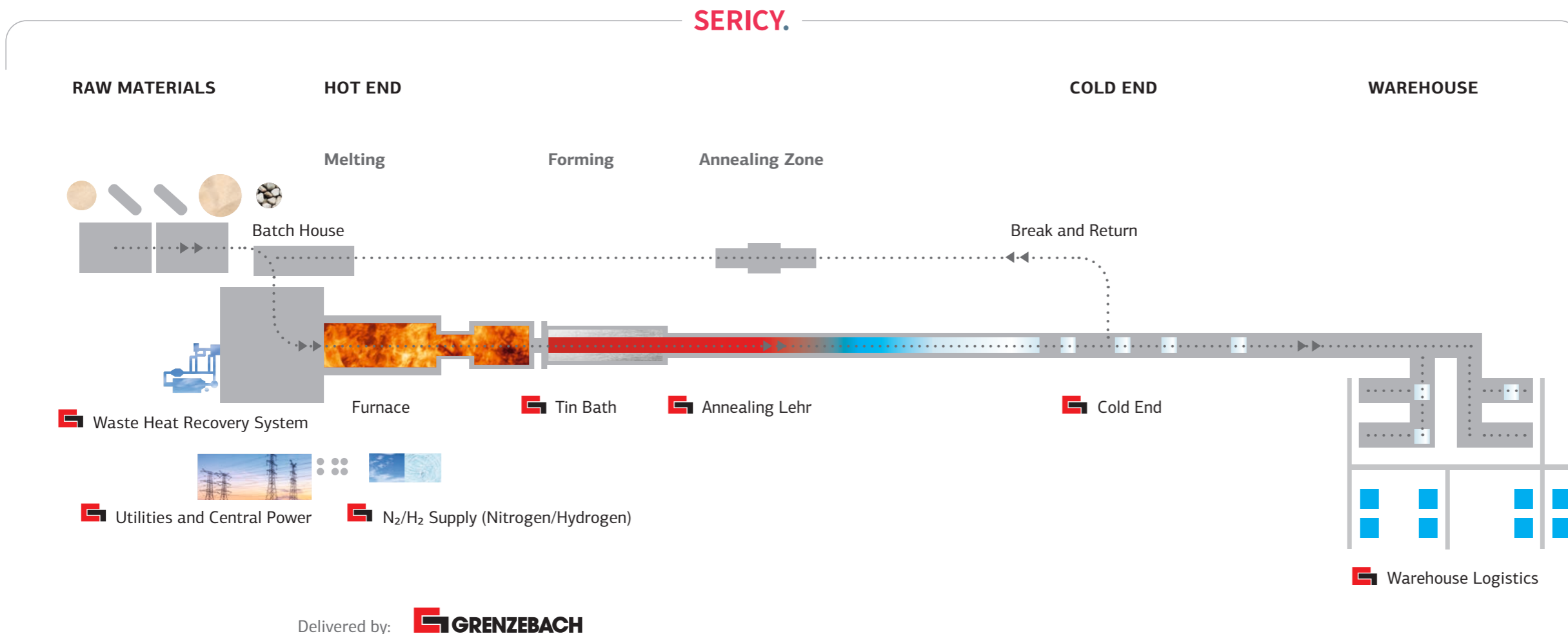
There's no end to the variety of ways glass is used. But regardless of whether it's architectural glass, automobile glass, patterned glass, thin glass, wired glass or customized glass, special machinery is required to make, fabricate and convey it. With over 300 systems installed internationally, Grenzebach and CNUD EFCO are hugely experienced in the sector.

Our experts are the people you bounce ideas off with and vice versa. They've been in the business for many years, know all equipment and technology involved and on-site collaboration builds trust.

To harness the power of technological progress in your interests, we are anticipating future challenges and asking critical questions above and beyond the project we're currently working on.

With production sites in four time zones and service centers in many countries, we're never far away and can be contacted remotely or locally.

Grenzebach and CNUD EFCO offer a seamless glass engineering **experience**.



Grenzebach's mission is to cover the journey glass takes from hot to cold. Together, we offer a one-stop solution that encompasses the tin bath to the annealing Lehr all the way to the cold end to conveying the finished product to the warehouse. Why not make use of this unique factor?

We view all parts of the float glass production line as one. This approach is beneficial in terms of technology and makes communication easier because there is one single point of contact. Data from all the sections are pooled and help create the added value digitalization offers.

Today, more than 300 flat glass production lines worldwide use Grenzebach cold-end machinery. As a market leader renowned for providing solutions for annealing lehrs, float baths and accessories, CNUD EFCO has been also involved in fitting out over 300 production lines.

The experts from Grenzebach and CNUD EFCO have worked together on many projects – united under one roof, they share the passion for innovation and a high quality standards.

We want to make your processes easier, less complex and minimize risk to you. Reap the following benefits that the global player provides:

- » One stop shop
- » Technology integration across the board
- » Focused, precision engineering
- » Less project management required by customers
- » A standardized control concept, fewer interfaces
- » Plant and equipment design in 3D and via simulations
- » Intuitive glass plant operation
- » Digital solutions for better output, quality and efficient resource use
- » Focus on energy efficiency and a better carbon footprint

Flawless glass manufacturing starts here – in the hot end.



We developed a shorter tin bath that delivers the following benefits:

- » Lower investment costs, due to the requirement for a smaller building, fewer steel structures and less tin.
- » Lower running costs as fewer resources, like energy and inert gas, are needed.
- » The tonnage of the existing glass plants can therefore be increased.

THE TIN BATH – ENDLESS FASCINATION

The float process is based on a revolutionary idea by Sir Alastair Pilkington where molten glass is poured onto a bed of molten tin. This method is the basis of industrial flat glass manufacturing up until today.

The molten glass is fed into the tin bath, which contains molten tin in an inert gas atmosphere. The glass mass spreads over the molten tin and forms a continuous ribbon. The underside of the glass floats onto tin in the tin bath and is heated from above to achieve a distortion-free and exceptionally high-quality glass ribbon and planarity on both sides.

In the tin bath, the temperature of the glass drops from around 1,000 degrees Celsius or 1,832 Fahrenheit at the inlet to around 600 degrees Celsius or 1,112 degrees Fahrenheit at the outlet and the glass ribbon leaves the tin bath in a formed and pre-hardened condition.

Grenzbach supplies the complete tin bath, including among other things:

- » **Suspended tin bath roof, roof casing, heating elements**
- » **Top rollers including a camera system**
- » **Nitrogen curtain**
- » **Optimized coolers**
- » **Venting system**
- » **De-drossing pocket**

A 3D design simulation makes a better variant possible. The dependencies of atmosphere, tin, glass and temperature in the whole tin bath can be simulated and analyzed first via a 3D design. The findings pay dividends because float bath technology is enhanced even further.



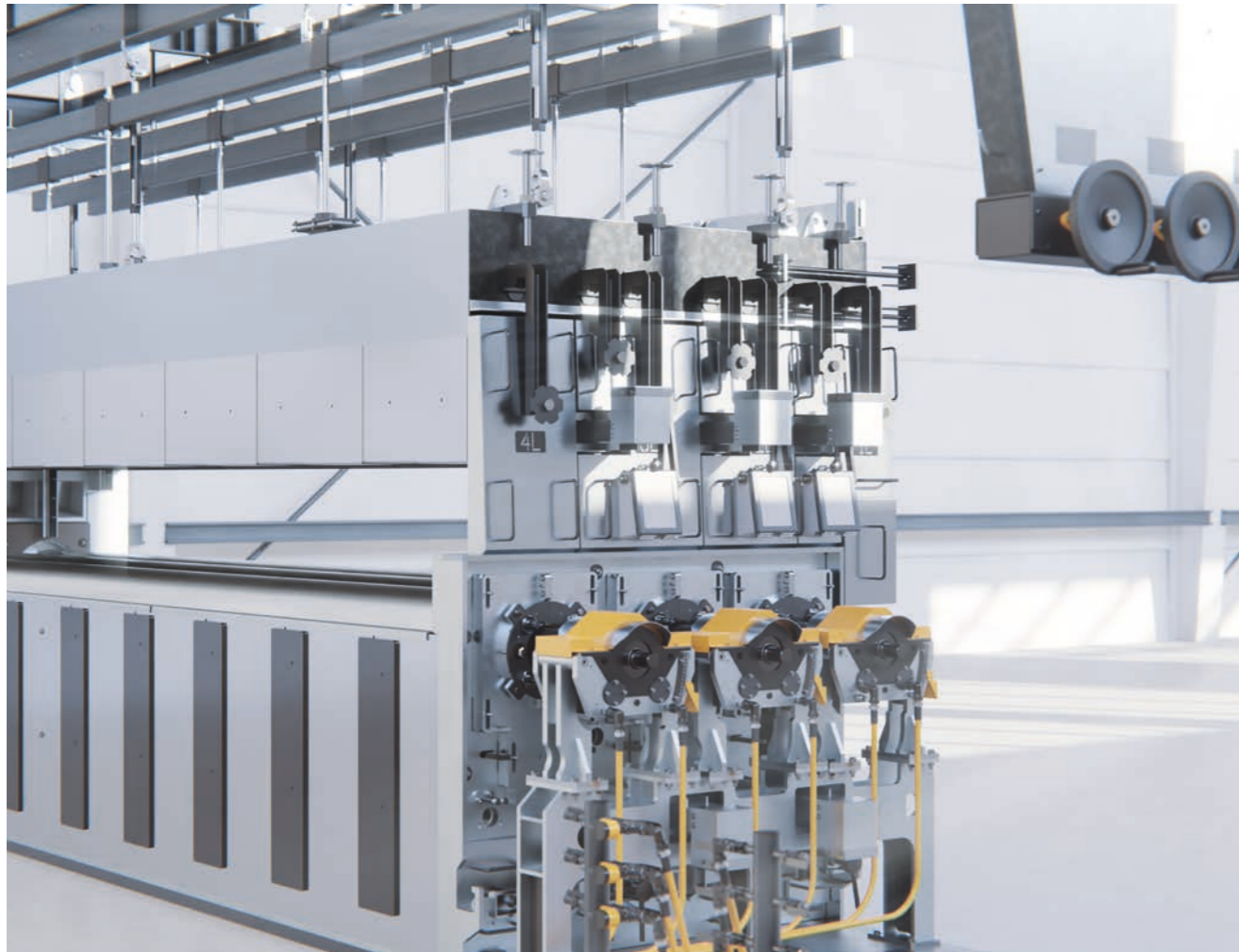
|| Reducing the energy consumption in production and lowering CO₂ emissions: These are key challenges for the glass industry. The glass production – a complex process, which we are improving on a daily basis, together with and also for you, so that you will reach your set climate goals and thereby secure your operating licenses for the future. ||

Egbert Wenninger
Chief Commercial Officer
Grenzbach Group

UTILITIES AND CENTRAL POWER SUPPLY – AN ECO-FRIENDLY FEEDSTOCK SOLUTION

For a glass plant to operate reliably and at peak performance, it needs a steady supply of energy and other media like natural gas, electricity, inert gas, tin and much more. Grenzbach can offer a one-stop solution in this respect. From the start, we liaise with you to plan the supply of energy and media in new plants, extensions or replacements. As a system solution provider, we have in-depth expertise and experience in delivering energy and media to a whole host of plants. Our objective is to provide a turnkey solution with all the infrastructure, supply lines, sensors and control technology.

We're equally familiar with open and closed loop cooling water systems and supplying technical gases. To provide H₂ and N₂ inert gas, we'll find the solution to match your float glass plant. We combine the high product quality you target with a sparing use of media too. Grenzbach is all about green engineering and cost-optimized operation of the plant.



DROSS BOX – THE SLUICE BETWEEN TIN BATH AND ANNEALING LEHR

In float glass production, the dross box is the interface and sluice between the tin bath and annealing lehr. This point in the production process presents particular challenges, because the glass ribbon, which is still very fragile, requires the utmost precision in handling under extreme ambient conditions. The trick is to transfer the glass ribbon from a liquid and full-surface support to a roller conveyor. The dross box also has the important task of sealing the tin bath atmospherically.

The glass ribbon, which is still flexible, is lifted out of the tin bath by three individually driven rollers (LOR = lift-out rollers) and conveyed to the annealing lehr. Thereby, the lift-out rollers form a curve geometry, which can be adapted to the respective production requirements by individually adjusting the height of each roller. This also enables an equal distribution of the load on all rollers. The result is a flexibly adjustable lift-out curve with settings that can be saved for the respective glass thicknesses.

The special roller sealing contributes to a particularly high level of insulation of the Grenzebach dross box. This results in less heat loss and a more homogeneous temperature distribution across the entire width of the glass. The ambient temperature at the edge no longer substantially deviates from the temperature in the center of the glass ribbon. This provides better glass quality and reduces the risk of a cross breakage.



|| Building on the expertise of CNUD EFCO, Grenzebach has completely redesigned the annealing lehr and now offers a flexible annealing point, improved process control, more precise simulations, and significantly reduced energy consumption. ||

Florian Nagler
Vice President Sales Business Unit Glass
Grenzebach Maschinenbau GmbH

THE ANNEALING LEHR FOR QUALITY GLASS

Once it leaves the tin bath, the glass ribbon enters an up to 200 meter, or approx. 656 foot annealing lehr. This is a kind of long kiln in which the glass is cooled slowly from about 600 degrees Celsius or 1,112 degrees Fahrenheit to 60 degrees Celsius or 140 degrees Fahrenheit. This controlled cooling process minimizes stresses in the glass, which is vital when processing the glass afterwards. Therefore, the annealing lehr has a very important role to play. A Grenzebach annealing lehr will contribute to a stable glass. In the closed part of the annealing lehr, heat exchangers are used to prevent cooling with ambient air, which prevents contamination during the process and, in turn, ensures better quality glass. We draw on a customized calculation program with a good, decades-long track record and our expertise from 40 years of annealing lehr technology.

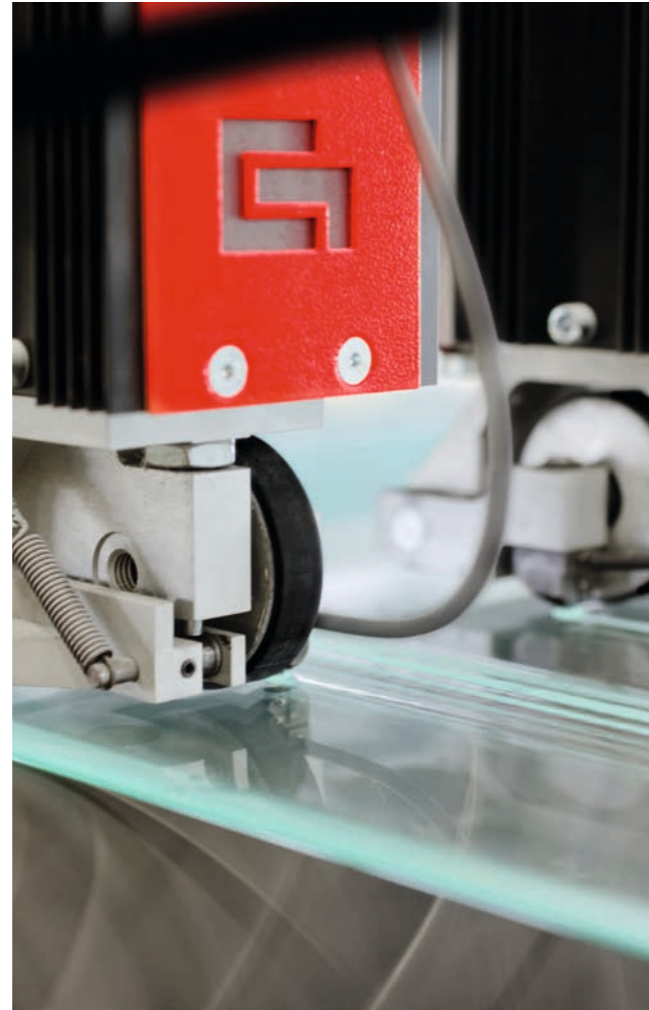
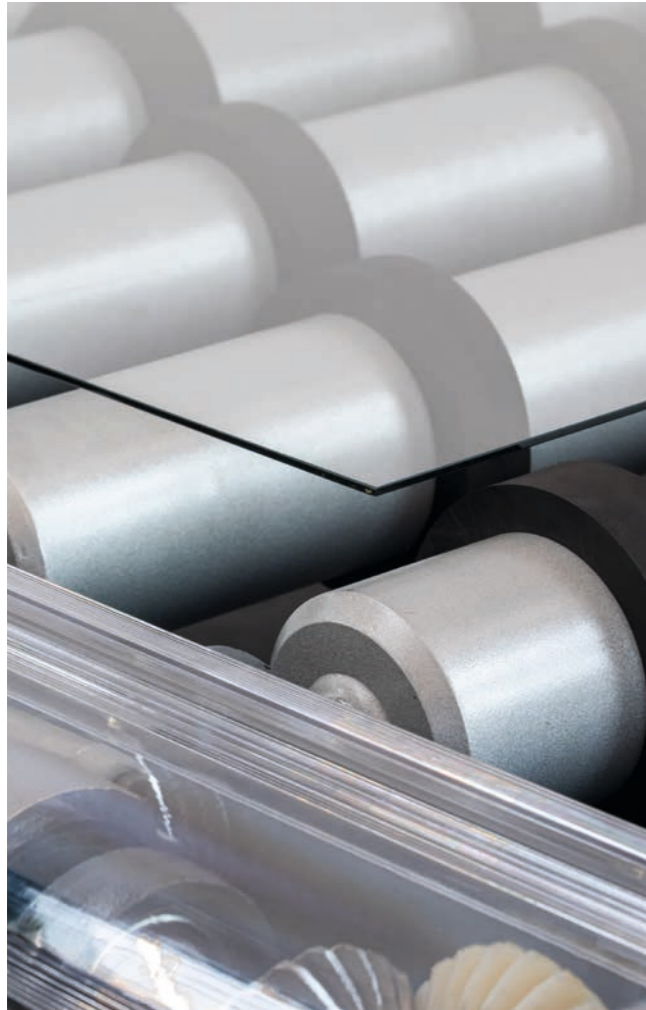
With the new generation of annealing lehrs, Grenzebach increases the flexibility at the annealing point and thus offers customers new possibilities to achieve the perfect glass tension for all kinds of production scenarios.

Overview of the benefits:

- » Higher flexibility at the annealing point during production regarding tonnage and glass thickness
- » A modular construction of the annealing lehr with improved process control
- » Improved possibilities for simulations to optimize the annealing lehr during the project engineering phase
- » Reduced energy consumption and emissions through highly efficient cooling and lower heat losses

The innovative drive design makes maintenance of the annealing lehr much easier and also offers increased protection of personnel during maintenance thanks to innovative protective covers - also during operation.

The cold end, destined for **flexibility** and **reliability**.



SEAMLESS CONVEYING

Our broad portfolio of conveying solutions connects each step in the production line to form a sophisticated and continuous system.

Our technology conveys glass gently and precisely – even over distances greater than 100 meters or 110 yards. What’s more, our conveying solutions operate smoothly and have long service lives, too.

- » **Conveying systems with specific functions**
- » **Robust, durable, efficient, low on maintenance and emissions**
- » **Ideal, steady material flows**

We also have experience with handling of extremely thin glass or customized glass widths of up to six meters or approx. 19.7 foot. We’ll do everything needed to convey glass without any scratches or residues left behind.

DYNAMIC CUTTING TECHNOLOGY

Grenzebach’s cutting and breaking technology transforms the continuous glass ribbon into the sizes required. It allows you to cut glass to size with very minimal product loss.

Longitudinal and cross cutters with force-controlled cutting heads, which are adapted to handle thin, regular or thick glass, score the glass. Cutting pressure is applied precisely based on glass thickness and stress in the glass and by using closed-loop control.

The multi-longitudinal and cross cutters can make various formats, even with very small sheets of glass. By changing dynamically to different cutting bridges, formats are produced continuously without any interruptions.

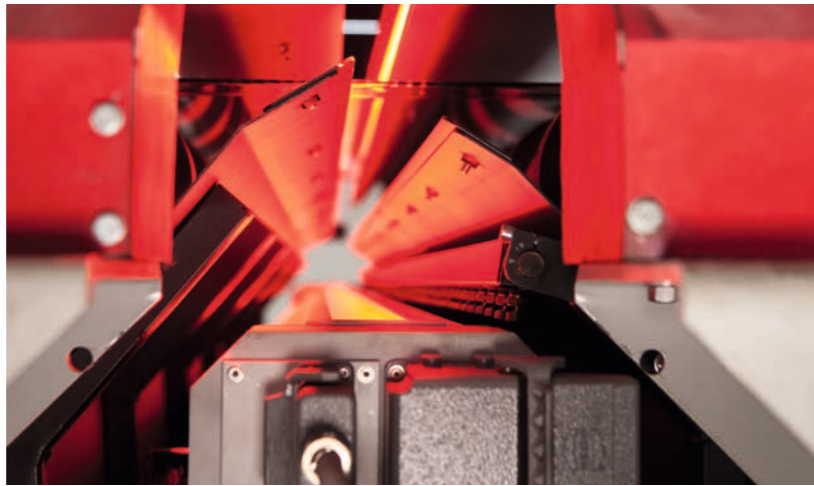
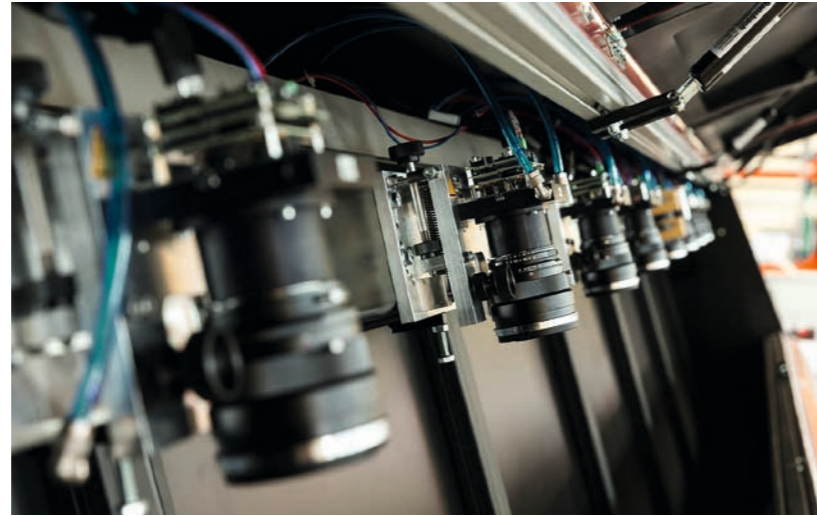
We have a broad portfolio of solutions for cross, center or lengthwise breaks so that the edges are the best possible quality.

Combined with our digital float scan edge camera and look ahead cutting optimization system, we can offer function-rich cutting technology. All in the interests of superior precision, quality and yield.

Defects in the glass ribbon, such as inclusions, bubbles or stones, force glass manufacturers to dispose of the cullet (waste glass) in a cullet bin. Depending on the roller pitch, the shortest cullet plate was 500 mm or 19 11/16 inches long. Thanks to Grenzebach’s short cullet plate system, this figure can be cut to 170 mm or 6 11/16 inches. This is possible because the cullet is disposed of directly after the snap roller.

|| **Cutting technology lies at the heart of the cold end of a float glass production line. Combined with the breaking system, the cutting heads, force-regulated controls and an intelligent optimization system form a superbly efficient unit.** ||

James Shang
Managing Director
Grenzebach Machinery (Jiashan) Ltd.



METROLOGY – GOOD DATA MEANS BETTER RESULTS

As a glass manufacturer, a stable production process is more important than ever these days. Grenzebach's inspection and measurement procedures stand for advanced control methods and top product quality. The following aspects are measured in real time:

- » **Contours and sizes**
- » **Edges**
- » **Position of the glass ribbon**
- » **Thickness of glass and layers**
- » **Stresses**
- » **Temperature**
- » **Quality**
- » **Surface quality**

duction process is fully transparent and full complete product analysis is possible.

Grenzebach's integrated approach permits analyses to be made and conclusions drawn about the whole production process. And customers have the benefit of faster response times with minimal use of resources.

All the relevant production parameters during a period of time or for a single sheet of glass can be captured, analyzed and archived all along the line for any subsequent tracking.

The data captured are fed back into the production process. They help spot deviations from processes at an early stage and trend analyses of recurring problems reduce losses. The pro-

STACKING TECHNOLOGY – GOOD STACKING MEANS BETTER GLASS

For the glass line's stacking process to work well, it relies on a good sorting process. We can develop a smart system for you so that conveying and stacking are a class act. What's required are the right number of stackers at maximum capacity to deliver a highly accurate and scratch-free result.

Grenzebach offers best-in-class technologies to support precise stacking at the end of the glass lines as well as for feeding the further processing lines. Sheets of glass can be simply removed by hand or by using a fully automatic stacker for small, mid-size, large and extra-extra-large glass sheets of up to 24 meters or 26 yards and weighing up to 3 tons or 6,613 pounds.

The sheets of glass can be removed from the tin or air side, statically or picked on the fly. Single or dual pick options enable greater efficiency. The smart combination of two stackers, which can be used singly or as a pair for extra-long sheets, allows fully flexible production.

The Grenzebach portfolio has a large variety of handling equipment, ranging from portal stackers, swing stackers, direct stackers, under-table stackers and robot technology. At the same time, a range of different combinations of handling equipment and platforms are possible. And all this is adapted to the subsequent material flow

Smart, connected and transparent processes all along the line.



INTEGRATED PRODUCTION LOGISTICS

Want to interconnect stations on the glass production line, create links from the cold end to the warehouse or from the production line to temporary storage space? As far as we're concerned, the sky's the limit.

The factory of the future will revolve around automation concepts that learn as they go along. Traditional conveying technology will grow to increasingly embrace modern robotics and automatic guided vehicles (AGVs), which are autonomous and boast a high level of availability. Automatic guided vehicles enable sustainable flexibility of processes. For example, our software also allows route planning of forklifts and AGVs.

Grenzbach increases efficiency by guaranteeing that the right products are in the right place at the right time.



MAXIMUM TRANSPARENCY TO MAKE COMPLEX THINGS CLEARER

A glass element in the facade of a skyscraper has to be replaced? Then the data transparency of the product is key! All information and data created within the value chain can be collected and used. Assigning this information to basic glass sheets and the processed follow-up products enables all members of the glass ecosystem to track and understand the entire process from the manufacturing to the warehouse and, eventually, to the consumer. This is the basis for continuous improvement.

Grenzbach makes complex processes as transparent and easy to understand as possible for plant operators and operating personnel. We have been linking production data as digital information, or the so-called Asset Administration Shell (AAS), with the physical product for many years, for instance, using the product ID, and thereby sustainably increasing the value of the product.

Glass production has always been and still is a highly complex process. Today, intelligent systems help to maximize the yield and product quality and, at the same time, minimize the resources required. Grenzbach supplies these systems and is a pioneer in many new areas. This also applies to the acquisition and central storage of data – a valuable asset for the continuous optimization of a glass production plant.



Using glass to harness the power of the sun.

Working at a comfortable room temperature and enjoying time with the family. Driving from point A to B in a climate-friendly way. Producing goods for industry and our daily needs. Solar power is already playing a significant role in many countries and is booming worldwide. Grenzebach contributes a wide range of technology that harnesses the powerful natural force of the sun for present and future generations using glass as a material.

In many countries, the focus of politics, business, and society is on the rapid and vigorous expansion of renewable energies. The goals for renewable energy are ambitious and the global political situation is also speeding up the process of becoming independent of fossil fuels. The sun has a special role in the energy mix, being the most powerful energy source of all. Photovoltaics generate electricity; solar thermal heat.

For years, Grenzebach has been putting a lot of innovative energy into production technologies that harness the power of the sun. Production lines for manufacturing patterned glass for PV modules are an integral part of our portfolio.

We also support producers of thin-film solar modules worldwide with our expertise in the overall automation of manufacturing plants. The sensitive substrates must be handled with high

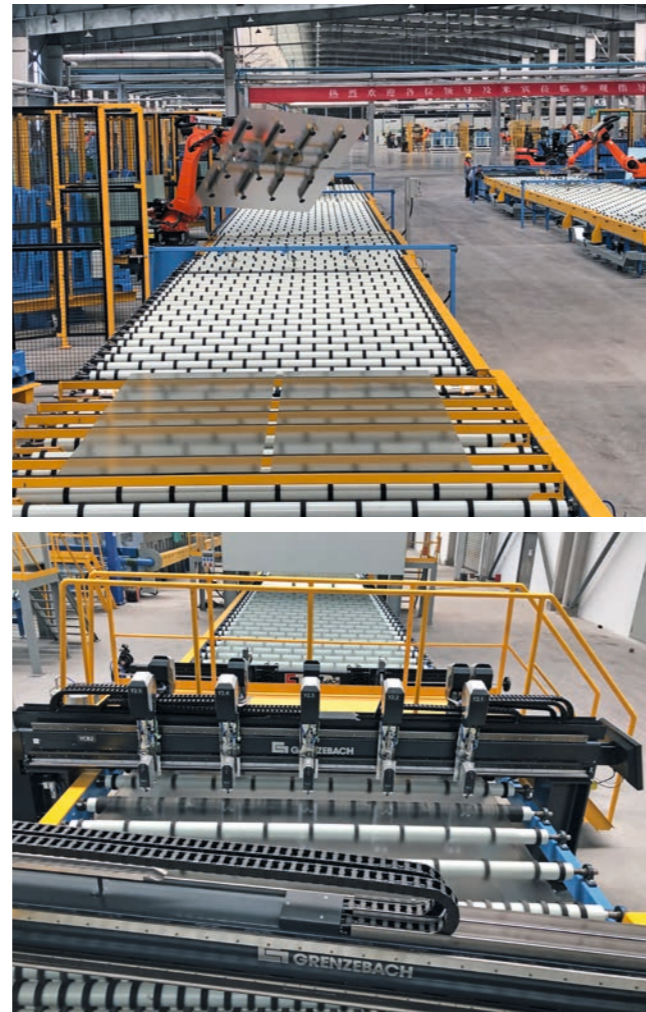
precision and care. Thereby, we focus on conveyor equipment and the back end.

Especially in urban areas, however, the use of solar energy is still marginal and is mainly limited to photovoltaic systems on roofs. But what about facades? At present, they are hardly used for solar energy, but they could make a significant contribution, far greater than roof surfaces.

Solar-active building envelopes are an integral part of architecture for us, maximizing decentralized energy production and reducing the CO₂ footprint of buildings – up to energy-plus standards. Grenzebach Envelon GmbH offers an architecturally advanced and aesthetically pleasing building facade “Made in Germany” that enables the sustainable and efficient supply of energy to commercial and residential real estate as well as

public buildings. A new type of color technology in the front glass allows for completely new design options. The technology meets the high aesthetic requirements of a glass facade by using invisible solar cells and combining them with the generation of electrical energy in activated building envelopes – all in color.

Ideal structure for energy transition



PATTERNED GLASS IS THE PERFECT BASIS FOR SOLAR MODULES.

Drawing glass. Rolled glass. Patterned glass. These terms describe glass with a special surface structure. Due to its light-focusing structure, high light transmission, and low reflection, this material is ideal as front glass in PV modules. Grenzebach supplies the optimal production technology for float glass and has decades of experience.

Thickness and structure of drawing glass are controlled in production through a roller pair. The molten glass flows out of the furnace and accumulates in front of the pair of rollers. The distance between the two rollers determines the thickness of the glass. One of the two rollers may have a structured surface – hence the term patterned glass. A special structure is used for PV modules so that the incident sunlight is concentrated towards the solar cell, ensuring that the solar module is as efficient as possible.

Today, melting furnaces for drawing glass provide up to 1,200 tons of melting glass per day. Each furnace supplies several side legs. Grenzebach provides hot-end as well as cold-end technology. We are your partner along the entire production line, from the annealing lehr to the cold end with cutting, stacking, and conveyor equipment. One line produces between 150 and 300 tons of glass per day, which is perfectly adapted to the solar panels in terms of thickness and size.

The next step in the value chain is the further processing of the raw glass. The edges are polished, and the glass is prepared for later use in the solar module. This is where the precise Grenzebach cutting technology pays off, increasing the efficiency and cycle time of the grinding, while reducing the need for expensive grinding material. Grenzebach also provides equipment for further processing.



|| With solar-active building envelopes, we and our customers from all over the globe can make a significant contribution to the energy transition. ||

Hans-Peter Merklein
CEO
Grenzebach Envelon GmbH



ENERGY TRANSITION WITH TURNKEY SOLAR-ACTIVE FAÇADE SYSTEMS – MADE IN GERMANY

In order to achieve the climate targets, enormous areas of land are needed for PV systems. However, especially in urban areas, the use of solar energy is still marginal and is mainly limited to photovoltaic systems on roofs. At present, façades in particular are hardly used for solar energy, but they could make a significant contribution, far greater than roof surfaces.

It is just as possible to produce green electricity decentrally at your own property for commercial and residential buildings as it is for public buildings. A new type of color technology in the front glass, installed in extremely powerful PV modules, creates completely new possibilities for the sustainable operation of buildings – sustainable, climate-friendly, and aesthetically pleasing. The electricity generated can be used directly in the building for IT systems, air-conditioning, or for charging electric cars. In order to meet the high standards of architects and builders, the ENVELON module facades consist of frameless,

high-quality glass elements, which are available in different colors. This allows businesses to design the exterior of their buildings aesthetically – and at the same time play their part in protecting the climate.

The technology of Grenzebach Envelon GmbH, which has operated under the brand of the internationally active Grenzebach Group since 2021, not only enhances the visual, ecological, and economic value of real estate, but also enables the sustainable generation of energy on previously unused surfaces – for present and future generations.



What will the future be like?
Be a part of the journey with our **digitalization solution** for tomorrow's glass production.

Digitalization has touched all areas of our lives, whether we're using smartwatch payment options, writing a digital journal, carpooling or living in automated smart homes. Digitalization is opening the door to a spectacular future of glass production. So why not come on board?

Our glass customers' key objectives are to raise product quality, increase output and improve resource efficiency.

Our technological developments and services are geared to achieving these goals in your company. We exploit the enormous potential of digitalization to boost the quality and efficiency that our equipment and automated processes have already achieved.

A DECISIVE IMPACT ON PROCESSES

We're offering glass manufacturers the opportunity to revolutionize their value creation processes. Industry 4.0 creates ecosystems where data-based solutions facilitate glass production in tomorrow's world.

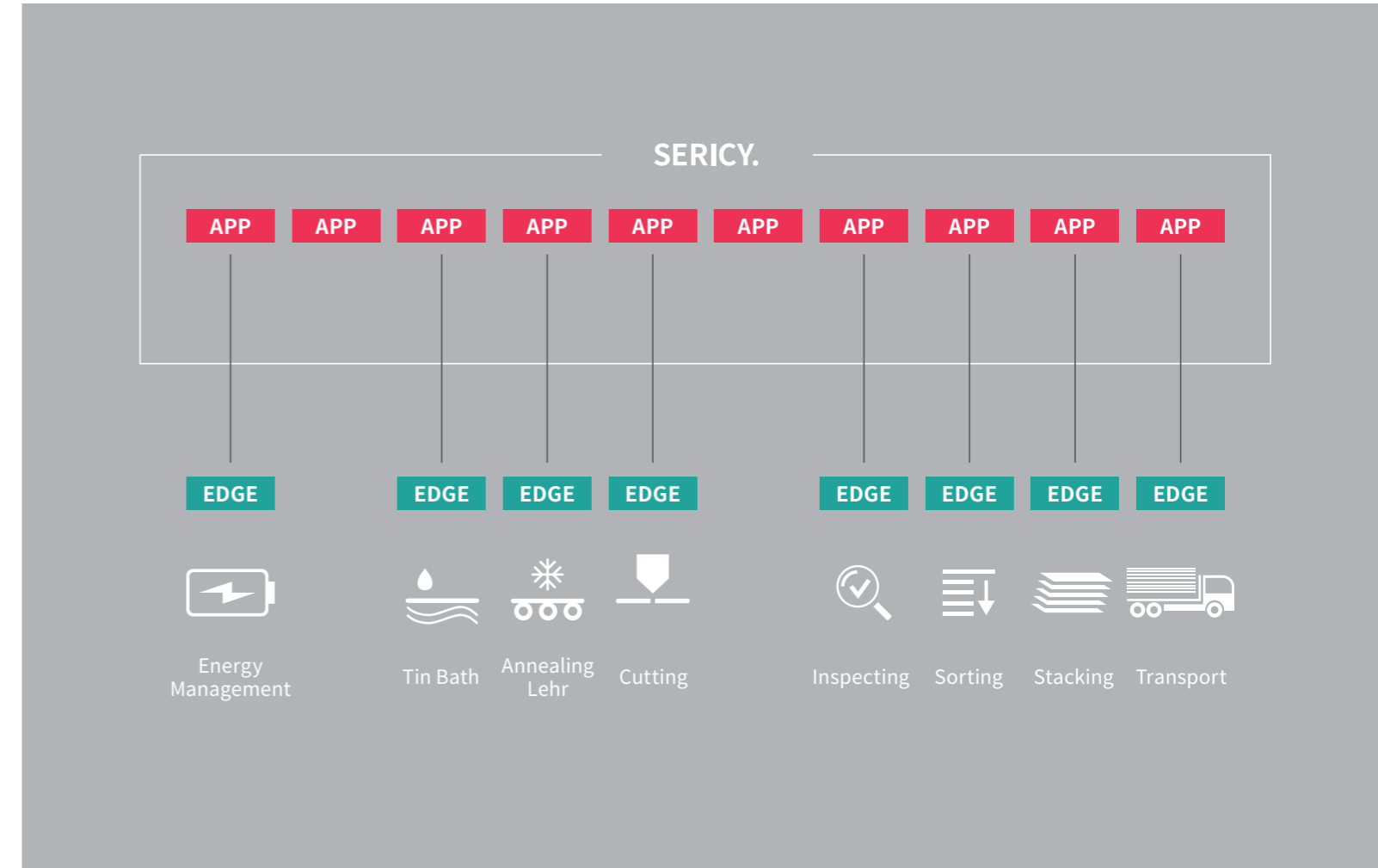
Digitalization can be used to retrieve a vast quantity of data and value is created by bundling and analyzing them. In the past, each of the phases in a process was treated separately in many cases, but there is significant room for improvement in applying the data across all disciplines.

USING POTENTIAL ACROSS DISCIPLINES

Grenzebach covers most of the disciplines in a flat glass line – an important step in exploiting the potential of Industry 4.0. Today, we can capture data on the majority of steps in the process. Actual use cases, based on the consolidation and analysis of large quantities of data, generate added value for customers and consumers.

SERICY.

A data powerhouse.



THE SERICY IIOT ECOSYSTEM LIES AT THE HEART OF DIGITAL GLASS PRODUCTION.

SERICY provides data on when, where and to what extent our machinery is required. Intelligent applications transform the raw data into valuable pieces of information, which are fed into the production process, or used for special tasks. In future, intelligent assistance systems will give recommendations to operatives on action that needs to be taken.

Based on the analyzed data, SERICY provides practical information to the head of production on how to change machinery settings to optimize the production process. This converts into even higher quality, more output and less consumption of resources.

Because it's scalable, modular and configurable, SERICY can be customized and you gain a tailor-made digitalization solution.

PRACTICAL ADDED VALUE

In the field, valuable data are generated, which were previously not made use of and can now be read and processed with our SERICY's platform's edge device. Edge translates the data so that they can be used by intelligent applications. Interfaces to any subordinate and overarching systems enable openness, which is a key condition for added value in digitalization.

Our intelligent data handling allows ideal integration from the field all the way to a control system to ERP systems and our own high-level SERICY solutions with machine learning and analytics applications.

An example from the real world: A predictive maintenance app tells your team, in time, when maintenance is required. Your staff is given practical help and our systems raise the availability of your machinery even further.

APP

- » Applications on SERICY or a stand-alone system to analyze data and control parts of machinery
- » Interface to your MES or ERP system
- » Interface to SERICY services

EDGE

- » Edge device as an OT (Operational Technology) adapter to the shop floor
- » Supports standard Ethernet protocols, Ethernet-based fieldbuses and digital inputs and outputs
- » Allows clustering and cascade concepts
- » Acts as a gateway to integrate third-party systems horizontally and vertically for specific automation solutions

Plant operation and control that's a breeze.



|| The goal we share is to take the pressure off your staff as much as possible and to make certain your plant is running at peak performance and maximum availability levels. ||

John Fluker
Managing Director
Grenzbach Corporation

THINKING PROCESSES AHEAD

Our new control and operating concept makes running your plant a breeze. To do so, the plant needs to run reliably and without any disruptions. In the process, all integrated systems can communicate in one language.

Our high-performance solution consisting of a master computer and control system can plan production, manage orders and guarantee that all processes are ones that are efficient and can be counted on.

INTUITIVE USER INTERFACES

Nevertheless, our software solutions always focus on the user. Intuitive user interfaces and intelligent navigation make life easy for everyone working on the production line.

Our operating concept delivers all the information users need. The head of production has configurable, customized dashboards to monitor and manage the production process. The shift supervisor benefits from user interfaces that allow easy order management in the control system. And operatives also have intuitive user interfaces to run the machinery. Your staff receive notifications in real time and are therefore always kept in touch. Both stationary and mobile equipment are supported, regardless of the operating system and hardware configuration.



We live Service.
Partnership and service that
go the extra mile.

|| It's a privilege to oversee a customer's operations throughout a plant's lifecycle. Production line availability is already excellent and our team competes to see if we can do even better. And of course, we don't hesitate to make full use of any technological improvements we identify. ||

Markus Gruber
Senior Vice President Business Unit Glass
Grenzbach Maschinenbau GmbH

Our mission is to maintain your production machinery at a high level of availability. We want you to benefit consistently from technological improvements and modernizations. View us as a sparring partner who offers service that goes that extra mile and enable added value for your plant.

You need powerful technology to match your requirements. Which is why we use robot simulations to reflect all operational aspects and give you confidence that you've made the right investment from the get-go. We develop tailor-made solutions for you. At the same time, we discuss any issues openly, include you from the moment the development phase starts and incorporate your feedback into the design. We'll move mountains to ensure you get the results you're seeking.

Our technology is state of the art and we're equally flexible when it comes to financing models. We'd be happy to find a payment plan that's right for you, too.

We focus on minimizing the risk to you and forging a good business relationship from day one.

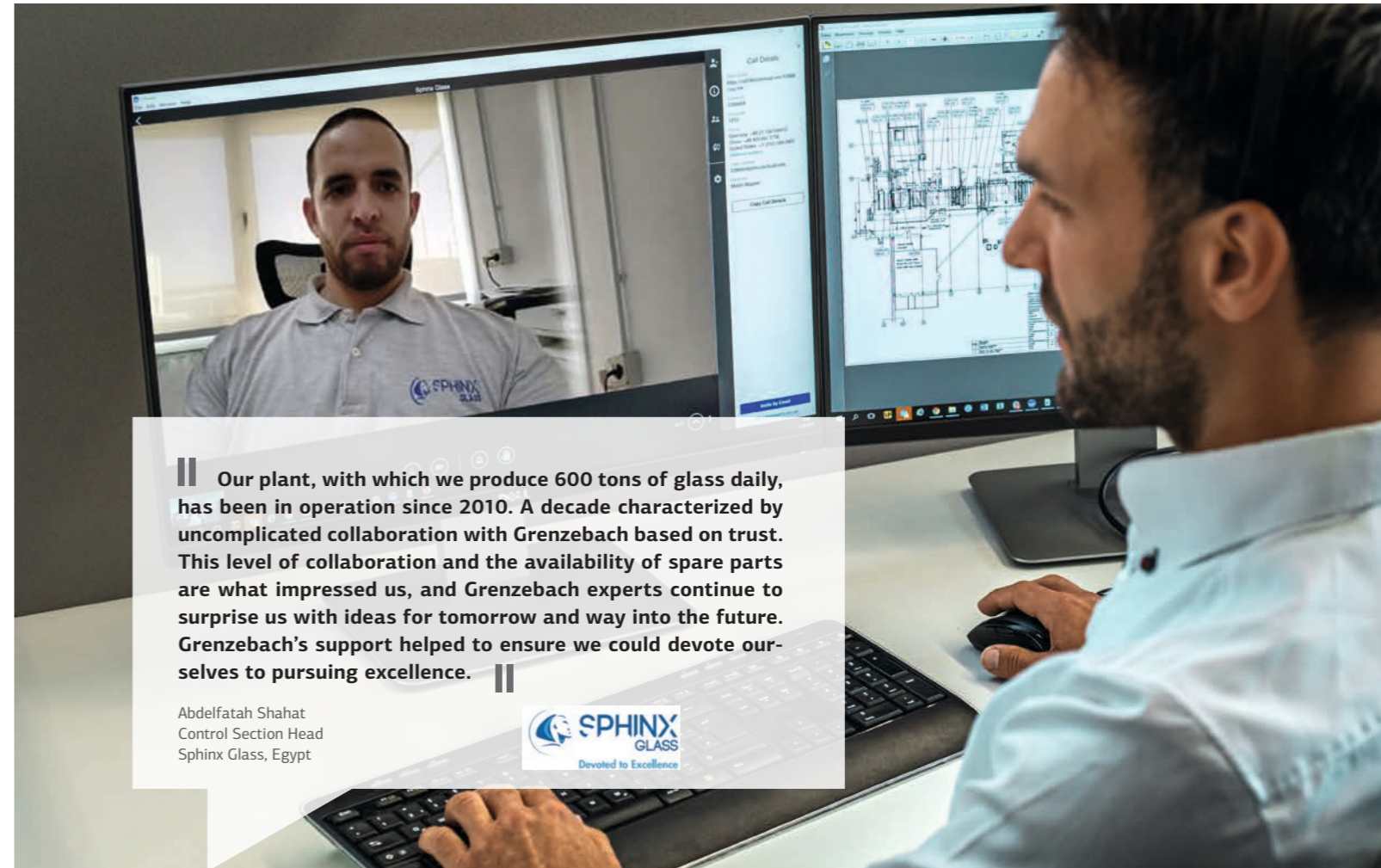
Grenzebach service promise: You can **rely on us**.



Grenzebach delivers results and rock-solid dependability for the whole of your plant's life. We can also offer tailor-made services and products as needed. During the operational phase, the after-sales team helps to make glass production happen or modernizes equipment to reflect new requirements.



GRENZEBACH GOES THAT EXTRA MILE, ANYTIME, ANYWHERE. WE LIVE SERVICE. 24/7. WORLDWIDE.



Our plant, with which we produce 600 tons of glass daily, has been in operation since 2010. A decade characterized by uncomplicated collaboration with Grenzebach based on trust. This level of collaboration and the availability of spare parts are what impressed us, and Grenzebach experts continue to surprise us with ideas for tomorrow and way into the future. Grenzebach's support helped to ensure we could devote ourselves to pursuing excellence.

Abdelfatah Shahat
Control Section Head
Sphinx Glass, Egypt



DEVELOPMENT
Innovativeness you can count on.

Grenzebach uses cutting-edge technologies to respond to your requirements in today's or tomorrow's world. We also give you the opportunity to have an impact on a machine's design at the developmental phase. The upshot is production technology that puts you in pole position to rise to global-market challenges. Reap the rewards of from world-class quality and output during the entire lifecycle.

- » Maximum benefit to customers
- » Intuitive usability
- » Added value generated
- » Customers' requirements fulfilled
- » Advanced technologies
- » Durable and future-proof solutions
- » Prototype creation and testing

PLANNING
Trust you can count on.

At Grenzebach our aspiration is to comprehensively understand your challenges during project planning to enable us to collectively reach the optimal solution. Our goal is to always meet and even exceed your technical as well as commercial expectations. The result is an excellent planning for the realization of your high-tech plant.

- » We listen, understand and act
- » Personal contact
- » A one-stop shop
- » Customized solutions
- » Requirements engineering
- » Pre-planning
- » Third-party equipment integrated
- » Financial planning
- » Cost-benefit planning
- » Results on budget

EXECUTION
Experience you can count on.

Our joint goal is to meet the agreed production launch date. Our skilled project management team ensures your plant operates at the quality and performance level specified, on time and on budget. We can adapt to any challenges and requirements presented to us.

- » Guaranteed production launch
- » Professional project management
- » On time and on budget
- » Professional training sessions
- » Performance
- » Seamless handling
- » Financial services
- » Certification
- » Safety management
- » Assembly and commissioning worldwide
- » Supplier management

UTILIZATION
Reliability you can count on.

We provide professional support and future-proof development of your plant during its entire lifecycle. This translates into less downtime, maintenance that can be scheduled and therefore, lower costs. Your dedicated and experienced service manager is on hand to provide support so you benefit from your investment to the max. As a result, you're ready for any new market requirements or modernizations if products are discontinued.

- » Peak plant availability and efficiency
- » Remote technical support 24/7
- » Guaranteed supply of spare parts
- » Innovative upgrades
- » On-site support
- » Personal service manager
- » Regional service worldwide

Grenzebach service to exceed expectations.

When every second of glass production counts, Grenzebach is the go-to option.

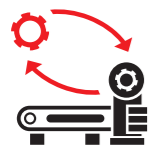
Service doesn't just start when a problem arises, but from the moment you partner with Grenzebach. Because we know that your glass production lines never sleep. Our skilled service team will pull out all the stops to solve a problem and get your plant up and running as quickly as possible. We speak your language and are available on call in your time zone – either locally or remote.

We live Service.

Our service goes that extra mile, worldwide, around the clock.



GRENZEBACH'S SERVICE MODULES FOR THE GLASS INDUSTRY. A ONE-STOP SOLUTION.



ORIGINAL PARTS

Ensure top performance, value due to durability, cut downtime:

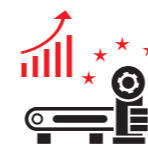
- » Excellent quality
- » A one-stop shop
- » Consistent production
- » High levels of availability
- » Quick lead times for spare parts
- » Professional customer support
- » Long service lives
- » Supplied worldwide



EXCELLENT SERVICES

Optimize technology availability, keep output constantly high, and make usage sustainable:

- » 24/7 hotline
- » Remote support online
- » Health checks
- » Preventative maintenance
- » Training for customers
- » On-site service
- » Flexible service agreements
- » Extended warranty



ROLLING UPGRADES

Increase output, raise plant productivity and extend lifecycle:

- » Process optimization
- » Plant overhaul
- » Modifications to hardware and software
- » Engineering consulting
- » Disassembly and reassembly of machinery and parts if company relocates
- » Customized, automated retrofits
- » Energy saved due to new technologies and machine applications
- » Plant audit and reassessment of the safety concept
- » Upgrading safety components to the start of the art



FUTURE SERVICES

Use Grenzebach's SERICY digitalization platform and benefit from smart, robust processes:

- » AR/VR support during maintenance
- » Predictive maintenance
- » Electronic parts catalog
- » Online documentation
- » Collaboration app
- » Clear reporting
- » Detailed statistics
- » Advanced analyses
- » Digital twin

YOUR WORLDWIDE CONTACT TEAM



John Fluker
Managing Director
Grenzebach Corporation



Robert Lamy
Sales Director Hot End
Grenzebach Belgium bv



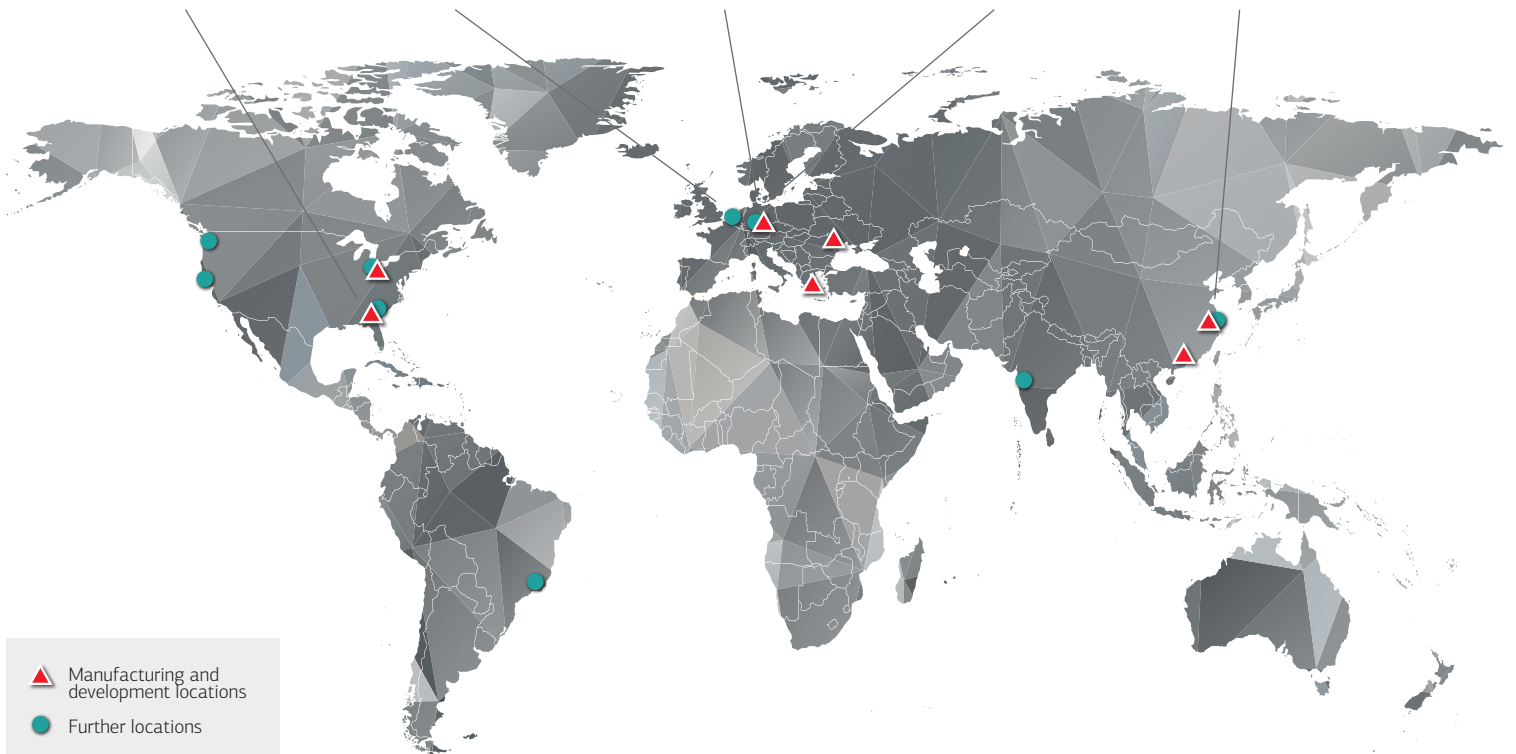
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