

FLOAT GLASS | THIN GLASS | PATTERNED GLASS
SAFETY GLASS | COATED GLASS | DISPLAY GLASS | SOLAR GLASS



Glass Technology

Grenzebach – the name for high-tech solutions



Worldwide the name Grenzebach stands for intelligent handling, processing and automation. At locations in Europe, America and Asia more than 1,500 Grenzebach employees develop and realize individual high-tech solutions for the complex manufacturing and automation tasks of our customers.

Back in 1960 Rudolf Grenzebach founded the Grenzebach Maschinenbau GmbH in the Bavarian village Hamlar and started off with a team of seven employees.

Now, Grenzebach is an internationally operating, expanding family-owned company focusing on plant engineering, construction and automation. The Grenzebach Group encompasses the three business units “Glass”, “Building Materials” and “General Industry” to serve glass makers, building mate-

rial producers, international logistics groups as well as the automotive, the aviation and the food industry. Other areas of expertise are mechanical and thermal process engineering.

For us at Grenzebach a cooperative partnership with our customer is of great importance. With production facilities in Germany, the USA and China and agencies all over the world, we are always close to our customers and provide support and service on-site.

A competent partner in the glass industry



Over 40 years' experience and about 300 implemented plants for the manufacturing of glass worldwide.

From the glass ribbon (Cold End) via large area PVD Coating towards the stacked glass sheets at the warehouse – Grenzebach stands for top quality and high performance and sets standards for the flat glass industry. The scope of supply includes state-of-the-art machinery and turnkey solutions for transporting, coating, process monitoring and quality inspection, cutting, stacking, data management and automation. Float glass, pattern and wire glass, thin glass, coated glass, laminated glass, mirror glass and other special products like LCD and TFT display glass are manufactured on Grenzebach

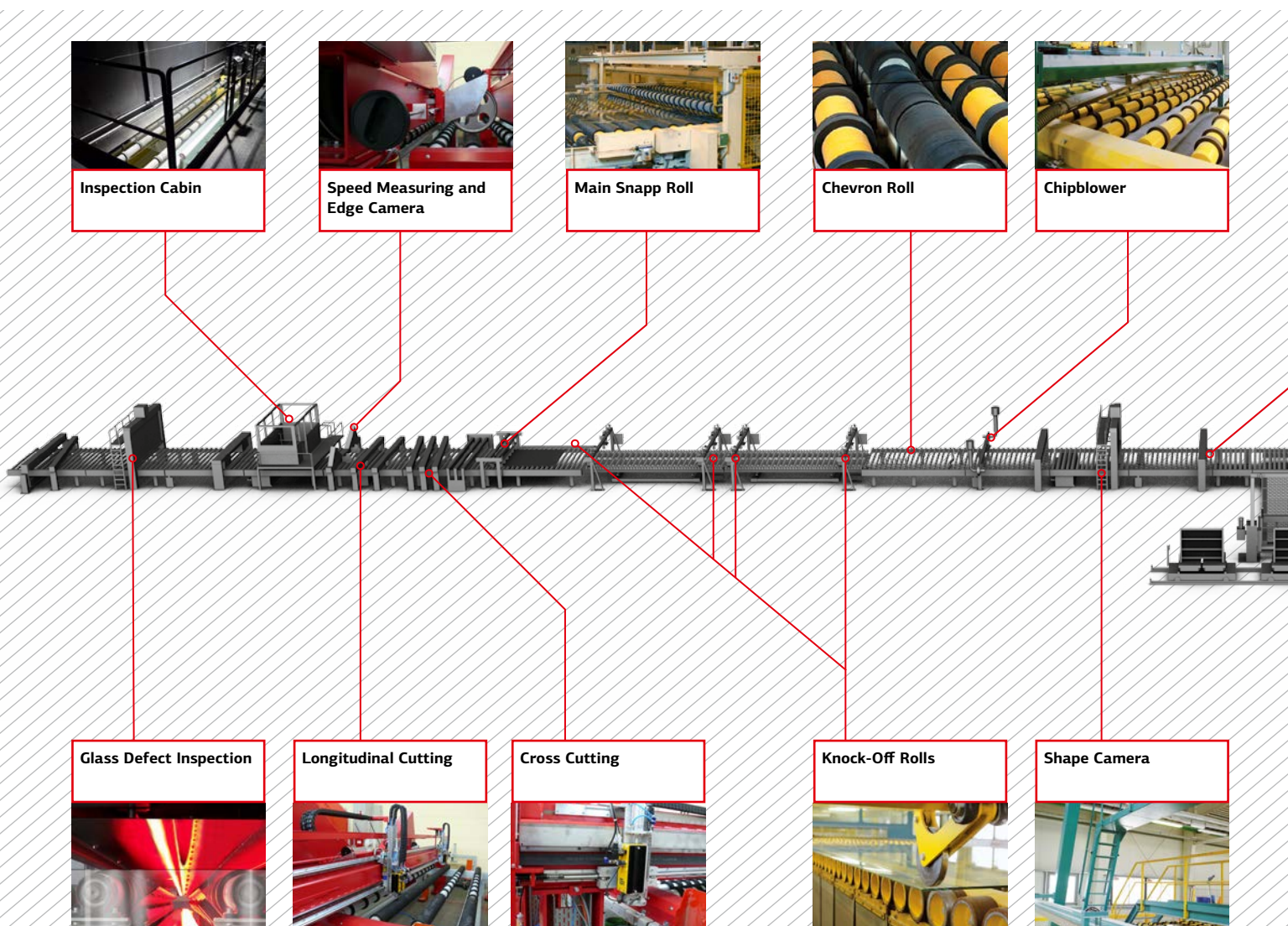
equipment. Furthermore Grenzebach provides solutions for crystalline, thin film photovoltaic and concentrator technology (CSP, CPV) applications.

Grenzebach places great emphasis on maintaining cooperative partnership with its customers and business partners. While taking full advantage of modern communications technology, the direct and personal contact is especially important to us. With our affiliates and representation offices throughout the world we are always close to your vicinity. The service expertise includes upgrades, spare parts, on-site production and maintenance support for the installed base.

Innovative float glass production from cold end to warehouse

Since the introduction of float glass technology to the market, the name of Grenzebach has been inseparably associated with handling and processing of flat glass.

- Takeover of the glass ribbon coming from the lehr with a synchronized conveyor system
- Quality inspection
- Quality and capacity optimized cutting of the glass ribbon into sheets in relation to order requirements
- Snapping and size control
- Rejection of faulty glass sheets
- Sorting according to size and quality
- Stacking onto glass racks of various design
- Rack storage and administration of quality data
- Removal and reinsertion to off-line handling



Float cutting technology

Extreme cutting accuracy and high availability are only two of the many standards that have to be met. The longitudinal and the cross cutter are equipped with the field-proven Grenzebach cutter heads and electromagnetic cutting force generator. A resistive wire strain is precisely regulating the required cutting force even for thin glass. The speed of the glass ribbon determines the positioning of the cutter heads and the cutter head controller enables a smooth lowering of the cutting wheel. The cutting equipment reaches its highest level of functionality in combination with the Grenzebach supervision and optimization system.

Stacking technology – the perfect device for each glass

For feeding of glass into a production line and for precise stacking Grenzebach offers economical technology – from simple manual take-off up to fully automated stacking for small and middle sizes and for jumbo formats weighing more than 3,000 kg. Grenzebach swing arm stackers are using crank gear drives for a controlled, smooth motion at each end of the stroke. Our direct driven tin-side/air-side stackers offers the option to take off glass sheets alternatively from top or bottom side and in certain applications, robots create a useful alternative for take-off or feeding. The direct drive stackers are available in three model series: small, medium and jumbo.



Tilting Conveyor



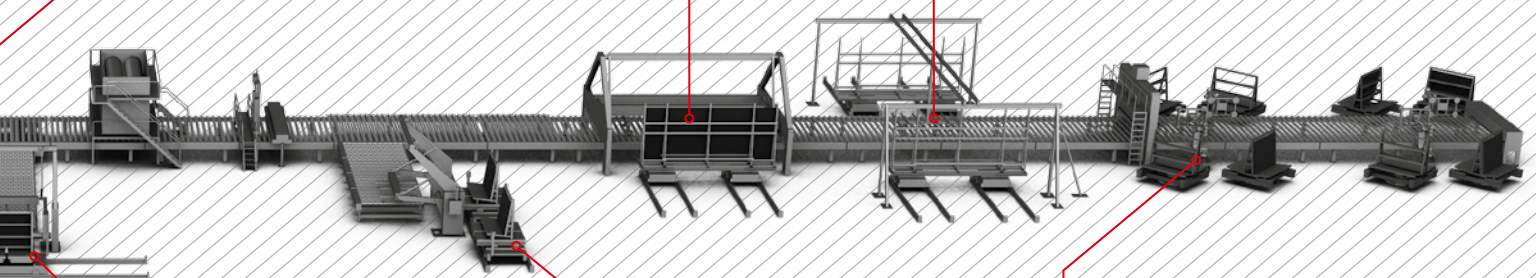
Large Size Stacker



Large Size Gantry Stacker



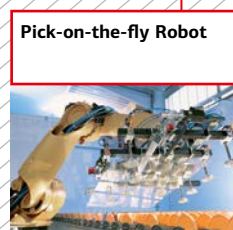
XXL Tin/Air Stacker



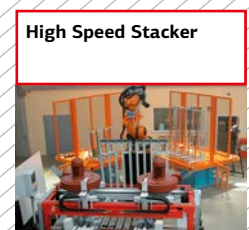
Small Size Stacker



Medium Size Stacker



Pick-on-the-fly Robot



High Speed Stacker

Customized solutions for Quality & Output



Thin glass production using float process

Thin glass handling requires a broad knowledge of glass with all its peculiarities, properties and processing requirements. The material is delicate but at the same time tough. Today, as manufacturing processes become more and more ingenious, the yield of fabrication lines depends more and more on appropriate material flow handling and product data collection. With the extended capabilities in layout planning and simulating material flows Grenzebach has proven to be a highly reliable partner for top global players in the thin glass and display industry.



Short cullet strip

A novel technical achievement (patent pending) strikes a new path to a significant yield increase in the float glass production business. The assessment and qualification of non-conformities in the glass ribbon inevitably forces glass makers to score strips of faulty glass for elimination as cullet. The Grenzebach innovation now allows to produce and eliminate a very short cullet sheet directly at the main snap roll and, subject to the detected defects, to minimize the glass loss by up to 70%. Grenzebach's latest snapping station provides a movable roller section that can open and close within a short time to create a discharge opening.



XXL stacker

Architecture faces new ways in terms of designing facades: higher, bigger and self-supporting, spreading several floors. This brings up new challenges to the glass producers for production, handling and also for transportation.

During handling, it is essential that the sheets can be stacked without scratches onto special racks. With a new stacker generation Grenzebach is once more setting standards – significantly higher plate weights and safe handling of plates with a length of up to 24 m.

Professional Process Perfection

With the experience of dr. schwab Inspection Technology in the areas of optical inspection and optical measurement techniques, Grenzebach is strengthening their portfolio in all divisions. Glass producers are facing permanently increasing demands, requiring an absolutely stable production process. This is only possible, using advanced quality and process control methods.

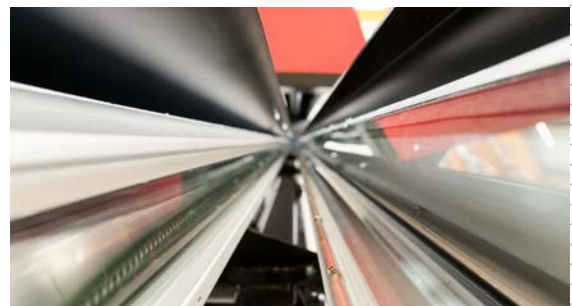
FPI^{float st & th}

High-speed glass stress and thickness measurement system for the cold end of float glass production. The basic features are measurement of glass stress, thickness, width and temperature. The FPI^{float st & th} supplies a substantial contribution to improve process uniformity and stability. High density of measurement points in both directions, based on high traverse speed and sampling rate.



FPI^{float vision}

The in-line inspection system FPI^{float vision} is the adequate solution for process control, enabling high resolution and full surface analysis. High-resolution camera inspection revealing all kind of glass defects, especially the critical defects like inclusions and optical distortions. Powerful data analysis tools supply the essential information to effectively improve the production process and increase the lines yield.



FSP^{G10}

FSP^{G10} is an optical system assessing the contour and size of sheets as well as defects and edge imperfections as a result of scoring and snapping. It excels with durable camera calibration, homogeneous assessment through scan line shading, complete high pixel resolution defect images, and with a simple menu-driven operator interface.

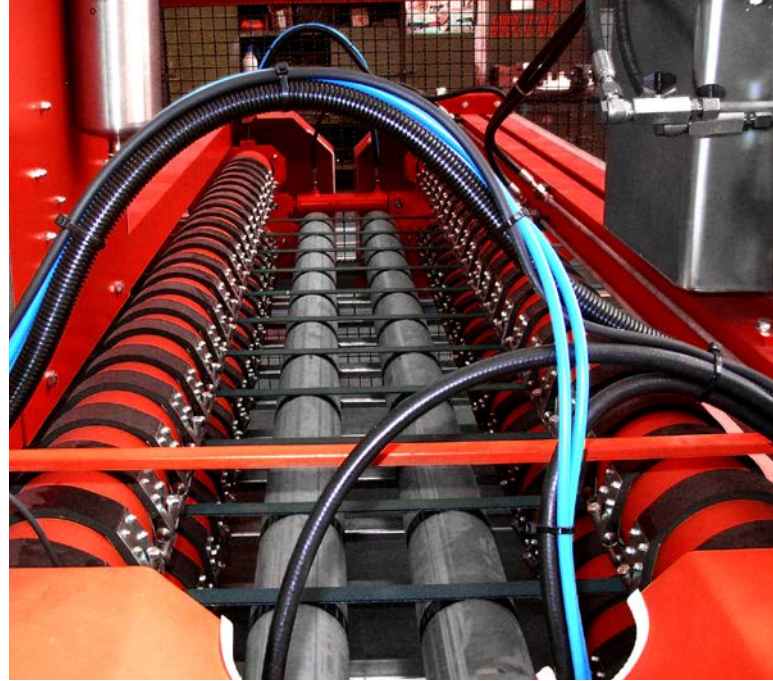


FPI^{coat in-situ}

A specific multi-channel line-scan camera solution based on wavelength multiplexing: the signal from several channels is inspected simultaneously, which allows high local resolution compared to other available systems. The FPI^{coat in-situ} supplies a substantial contribution to improve process uniformity and stability. In-situ coating process analysis minimizes downtime by improving target life cycle management.



Efficient technology for patterned and wired glass



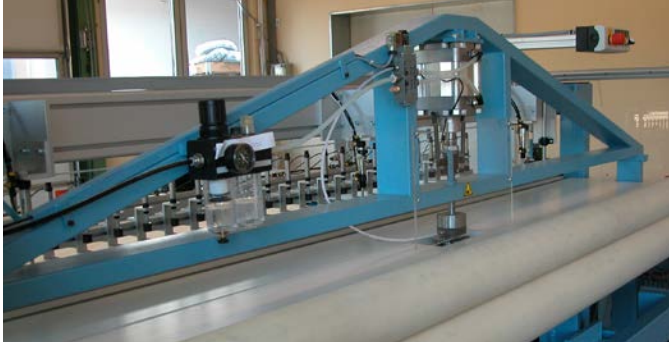
Grenzebach machinery for these glass products offers a concept of **high operational safety and efficient production.**

Advantage is taken of our know-how gained in many years of manufacturing float glass technology – especially cutting machinery – to securing high quality of this valuable end product, optimum yield from the material and cost-saving operation, thus contributing largely to our customers' success. The endless glass ribbon flows onto the Grenzebach line in various widths, thickness and production speeds. Our cold end equipment will accommodate all conventional patterns. In the cutting area, cross and longitudinal cutting bridges divide the glass ribbon. An electromagnetic system determines the cutting strength and proven Grenzebach cutting heads guarantee precise cuts.

When operating machinery with wire inlay it is possible to integrate a wire-shearing device after snapping of the cross cut. Following this operation, trimming and disposal of the glass edge is effected on a conveyor that can be varied in width. After trimming, the glass panel is conveyed to the stacking device and taken off. Grenzebach offers a complete range of equipment for stacking various glass sizes. Customers can choose from a simple manual take-off to fully automated stacking. Robots are increasingly used, due to their extreme flexibility. Stacking can be made on all conventional racks, in boxes and also in end caps. Highly automated devices can even be equipped with automatic end cap packing.



Flexible systems for safety glass



In modern architecture, glass is getting more and more important as an element of design as well as a functional building material. Consequently the need for laminated and strengthened glass is constantly rising and its application determines the type of glass.

Laminated glass is used as a standard for many applications like overhead installations, bullet proof glass, as sound proof glass and in many other variations. As flexible as its scope of use are the solutions for its production, according to the specific requirements. Grenzebach meets these needs by offering functional technology for laminating production lines.

The components of a Grenzebach laminated glass line are

- Loaders to bring the glass into the production line
- Glass transport
- Washing machine
- Clean room with foil application
- Application of cover plate and edge trim
- Pre Lamination and transport of glass sheets to a stacker
- Stacking of sheets onto autoclav racks
- Autoclav
- Integrated space frame handling
- Repacking on transport racks
- Optical inspection

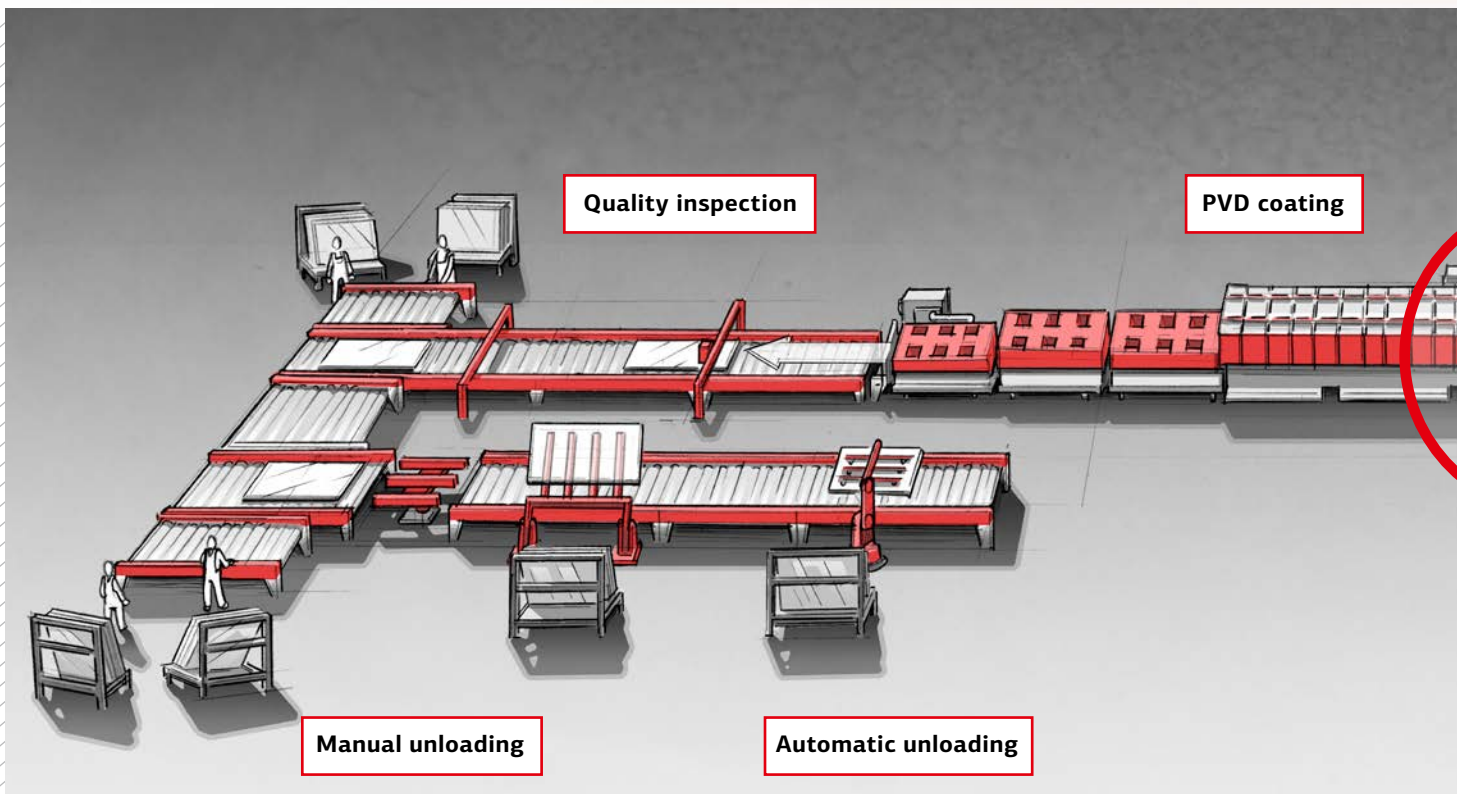
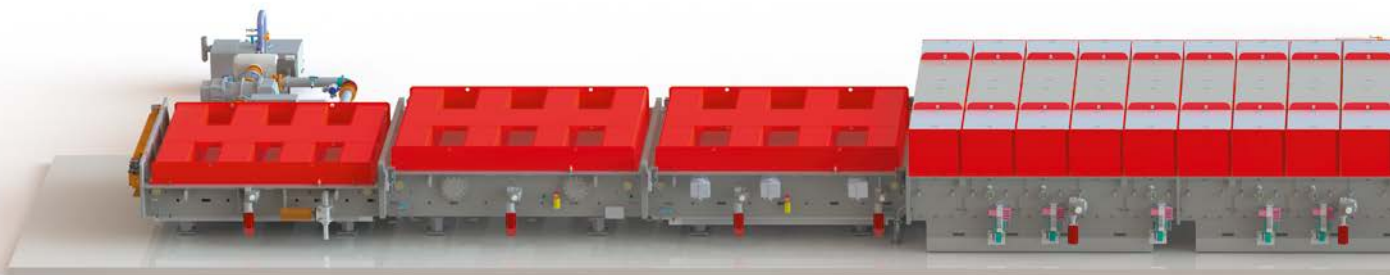


Coating technology

Grenzebach is uniquely positioned to **optimize a total production line solution** that meets the customer's market goals for year one, three, five and beyond.

Sophisticated glass processing

Built upon our long-standing experience in float glass handling, Grenzebach has designed dedicated loading, unloading and conveying equipment to perfectly partner with today's state of the art PVD coating machinery.



Grenzebach turnkey coating lines – one supplier for the entire production line

Small – Fast – Neat

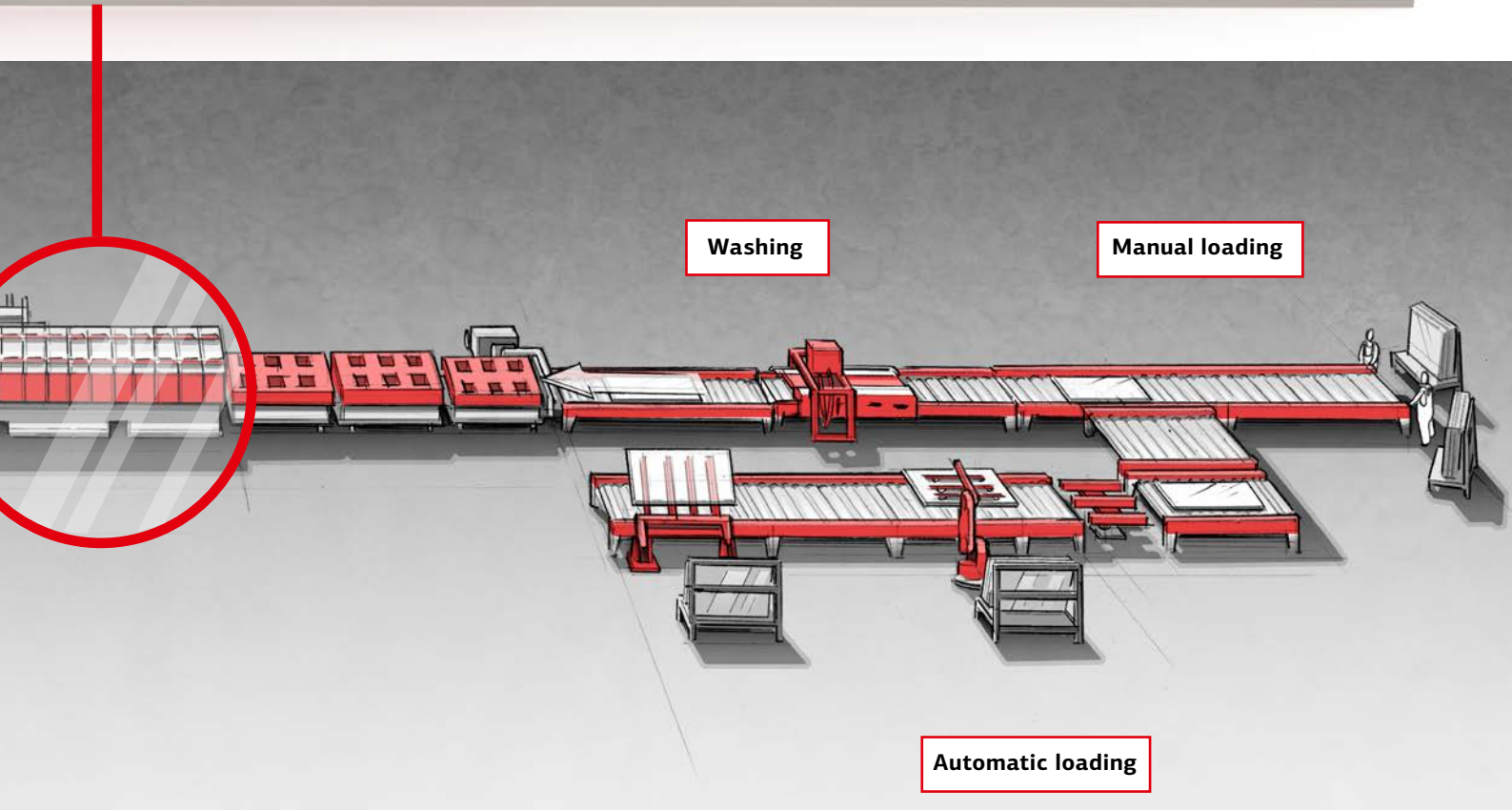
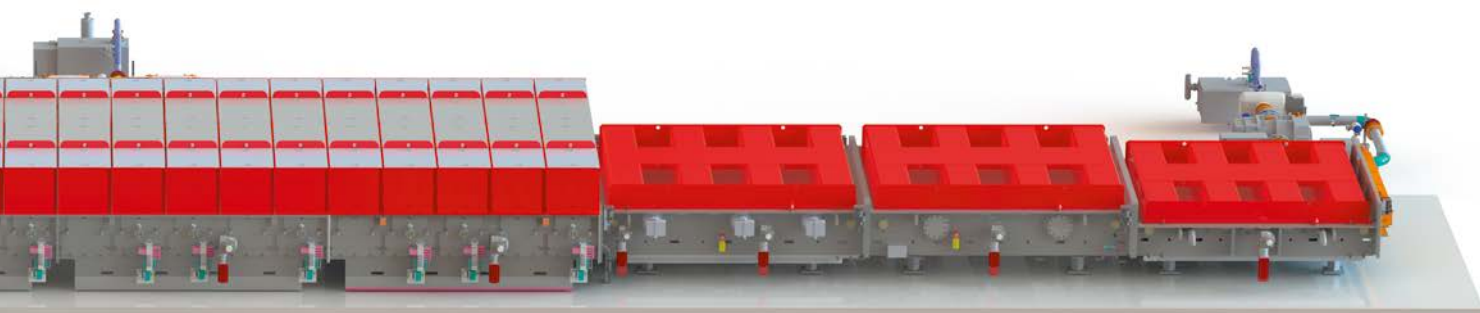
Optimized for smaller scale production requirements but readily prepared for throughput upgrades at any time, this system is set up for 2–5 Mio m² per annum initially, at a cycle time of 60 s per load.

Medium

Down to 45 s per load cycle time, these systems are optimized for 5–8 Mio m² per annum for given customer tailored product mix requirements.

High Productivity

This high end, turnkey coating system targets mass production of a well established product portfolio at cycle times down to 20–30 s, yielding an annual production of up to 18 Mio m².



Display technology



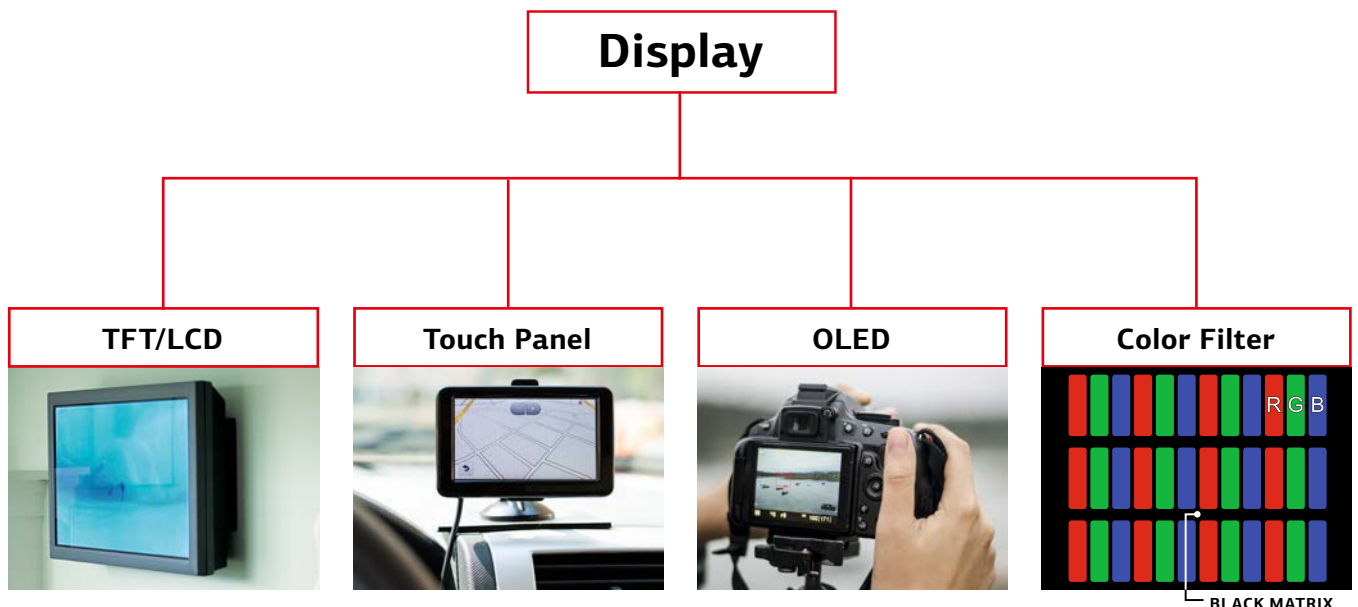
Demanding requirements to the quality of thin glass products require **a high degree of process accuracy and stability.**

Grenzbach offers a multitude of production and handling solutions to satisfy the ever increasing demands of our customer's yield, quality and manufacturing cost related to thin glass products.

Key Facts:

- Small to big sizes between 300 x 400 mm and 3,300 x 3,140 mm
- Thin and thick between 0.3 mm and 1.1 mm
- Fraunhofer certified clean room class 100

Our portfolio:



Solar technology

We at Grenzebach design, manufacture, and deliver **complete lines as well as stand-alone solutions for the production of CPV, CSP and PV modules.**

Our solutions focus on cost reduction, increased efficiency and throughput. With these targets in mind, Grenzebach has developed cutting edge automation and process equipment to provide maximum yield, uptime and quality.

We take this responsibility seriously and have organized our company according to these needs. With our global foot-

print and local experts we support you through all operating phases of your plants. This is why Grenzebach is your perfect partner for automated systems.

Starting from individual line concepts to the supply of specialized technologies, we provide solutions that assure maximum module performance and guarantee your success.

Our business areas in solar are:

Thin Film



Grenzebach provides manufacturing solutions for crystalline and thin film solar modules. Machinery delivered to date allows an annual manufacture capacity of about 2.5 GW.

CPV



Grenzebach is the first automation specialist realizing fully automated CPV module manufacturing lines.

With the experience of two fully automated module assembly lines an annual output capacity of about 250 MW Grenzebach takes the lead in this segment.

CSP



Grenzebach market activities focus on equipment, solutions and concepts for all major CSP technologies

- Parabolic Trough
- Tower with Heliostats
- Fresnel

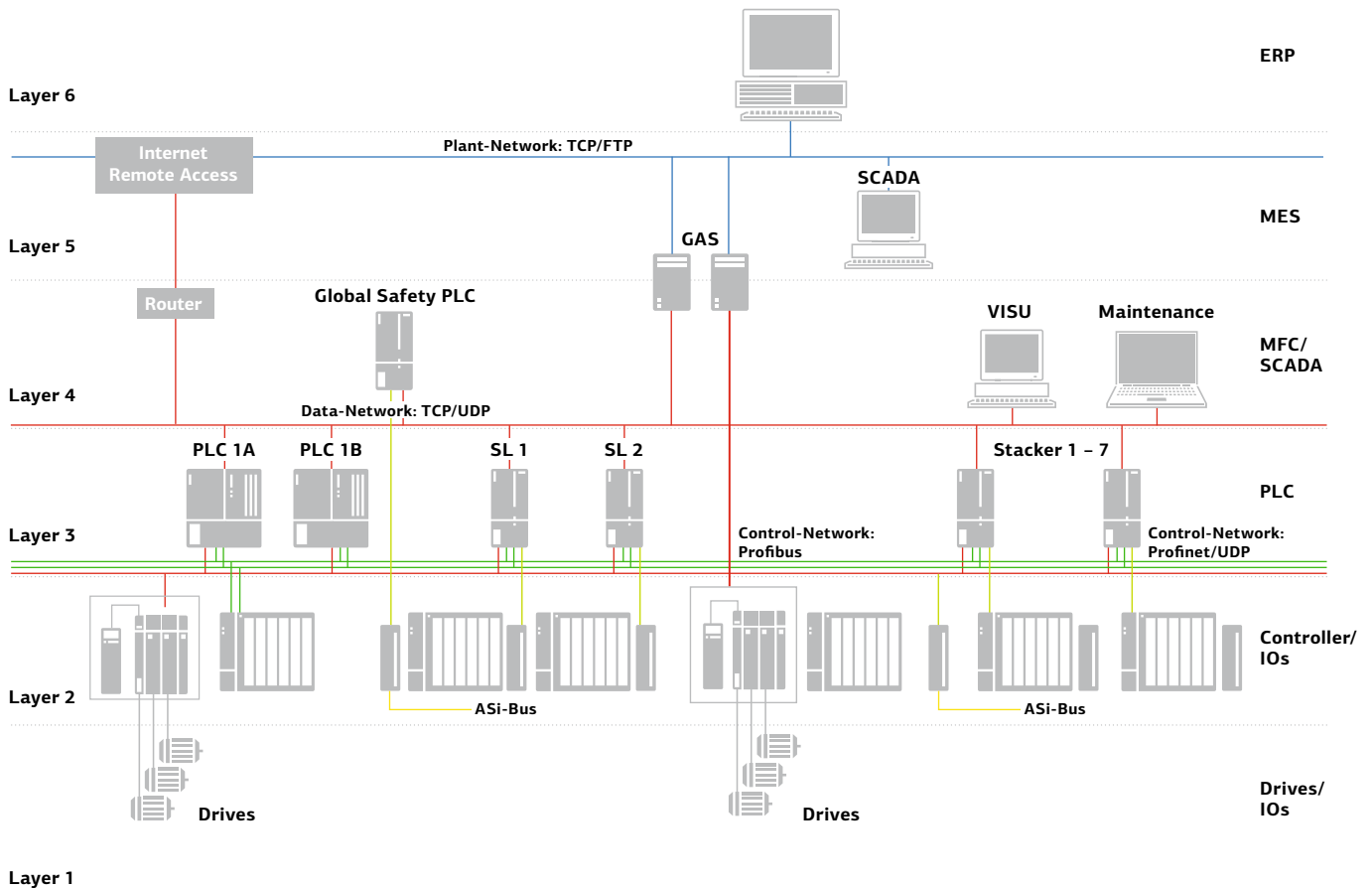
The Grenzebach portfolio includes stationary and mobile equipment.

Grenzebach Application Server (GAS) & Secure Plant

Grenzebach Application Server (GAS) is the answer to the **integration of customer-owned components and processes into Grenzebach equipment.**

GAS interconnects various computers, control and visualization systems to one another without the necessity of big changes in the respective modules. The adaptation to data structures and protocols is done in the adapters on

the GAS Server. This option is also available for cold tank repairs where the communication of new and old automation systems is simplified.



Grenzebach Secure Plant

Without communication nothing will ever get done in processing plants. Plant availability is directly dependent on industrial networks. Everything must fit together to ensure high availability: from the first IP address configuration through remote access services. The “Grenzebach Secure Plant

concept” brings the solution. This holistic approach of intelligently combined IT standards provides high-level security and robustness. We implement VLAN, firewall, encryption, backup, system ruggedization and other technologies such as virtualization in a scalable response to customer requirements. Our customers may thus strike the balance between security, price and functionality.

Service at Grenzebach



Round the clock. Round the globe.
The 24/7 principle applies – availability.
24 hours a day, 7 days a week.

After all, the entire Group is focused on its customers' requirements. We know that smoothly running plants and machinery form the basis for success. Reliability, expertise, rapid actions are Grenzebach key maxims.

General Customer Service

Keeping the plant in top-notch condition

- Maintenance
- One-stop service
- Health checks
- Genuine spare parts
- Plant repair

Enhanced Service Concepts

Optimizing plant operation beyond maintenance

- For maximum availability:
24/7 hotline: Phone service/
remote support
Grenzebach College to train
maintenance teams
Grenzebach on-site service
team
- For predictable costs:
Extended warranty
Supply contracts for parts
subject to wear
Outsourcing models
- For maximum efficiency:
Upgrades
Process optimization
Component refurbishment

Life Cycle Support

Extending the operational phase of plant

- For extending the operational phase:
Retrofit solutions for automa-
tion technology
Service engineering: Funda-
mental mechanical refurbish-
ment and modification
- Other alternatives versus
new investment:
Second hand/used plants
and components
Relocating plants

GLASS | BUILDING MATERIALS | GENERAL INDUSTRY | SERVICE



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