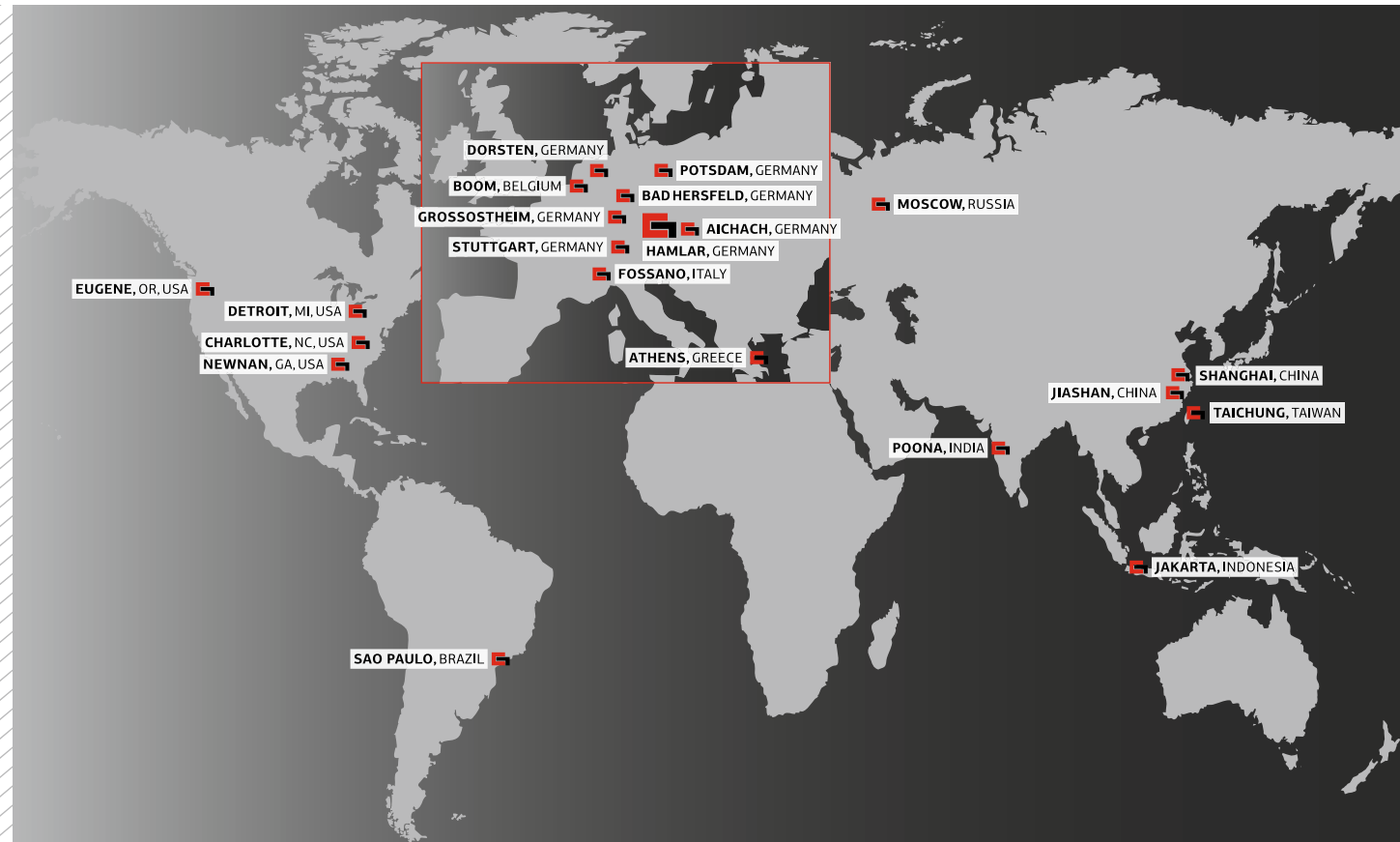


VACUUM COATING SYSTEMS | TURN-KEY COATING LINES |
ARCHITECTURAL GLASS COATINGS | LOW-E



Coating Technology

High tech solutions have a name – Grenzebach



World-wide, the name Grenzebach stands for intelligent handling, processing and automation focused on quality and performance.

At locations in Europe, America and Asia more than 1500 Grenzebach employees develop and realize individual, high-tech solutions for complex manufacturing and automation tasks. Within our discrete business units, „Building Materials“, „General Industries“ and „Glass“ we continue to focus our many years of experience and competence on the needs of our customers. Thus we create solutions that enable our customers to achieve their goals.

Business Unit Glass

Since the early seventies, Grenzebach has accomplished a great deal in the glass market – all beginning with windows, mirrors and facades. Our varied applications of today's equipment are built upon the experience and numerous technical innovations of years past. Our innovative and intelligent solutions can be found in all areas of modern glass production. World-wide, we are one

of a very few companies today that offer a portfolio covering the complete range of glass manufacturing: from the thinnest glass for mobile phones, to solar modules and up to the biggest architectural glass sheets, 24m long.

Architectural coatings on glass contribute significantly to meet the high demanding, energy saving requirements of today's strict regulatory codes. One cannot imagine today's modern window and facade architecture without the use of high-quality Low-E and Solar Control coatings on expansive glass surfaces. At Grenzebach, execution of innovative machine technologies and forward thinking PVD process technologies provide our customers with the highest yields and superior product quality. The continuous improvement of existing systems and processes, coupled with the development of new technologies, guarantee coated glass products that are aligned with the future.

Grenzebach – Your partner for coating technology



Flat glass producers place their trust in Grenzebach technology. Now including coating technology to become the sole supplier of completely integrated production solutions.

With the extension of its product portfolio towards coating systems Grenzebach becomes the sole supplier covering the entire manufacturing chain from the cold end to the finished and processed product.

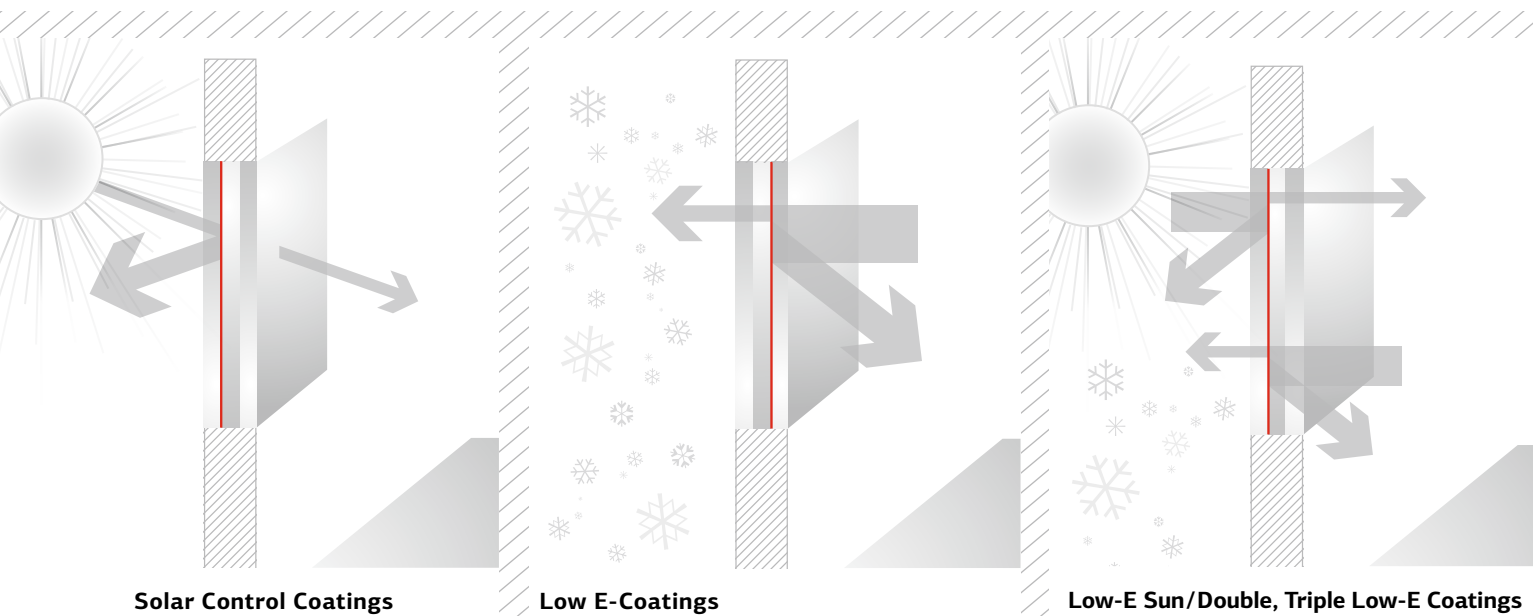
Including our expertise in float glass handling equipment and knowledge in automation of complex production lines (such as solar panel production and logistics) Grenzebach can provide solutions beyond sheer automation.

Now Grenzebach has once more extended its innovative power towards new frontiers covering coating technology with the same passion and dedication to fulfil our customer's demands.

The yield of today's fabrication lines depend more and more on appropriate material handling flow and product data collection solutions as manufacturing processes become increasingly sophisticated. Hence the integration of coating technology is the logical step towards higher outputs at even higher quality levels.

With its extended capabilities in layout planning and material flow simulation, Grenzebach has proved a highly reliable partner for top global players in the thin glass and display industries.

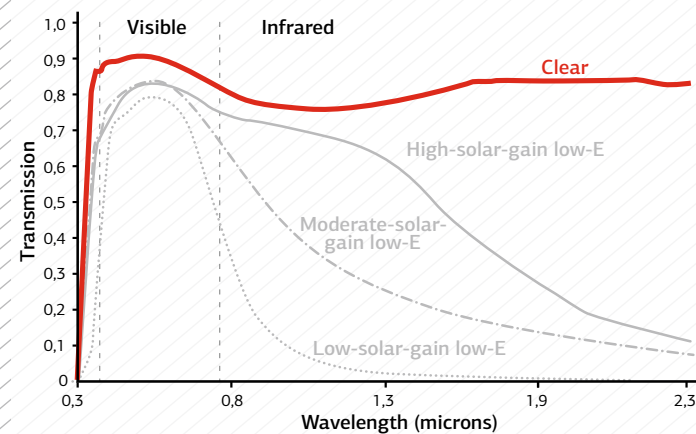
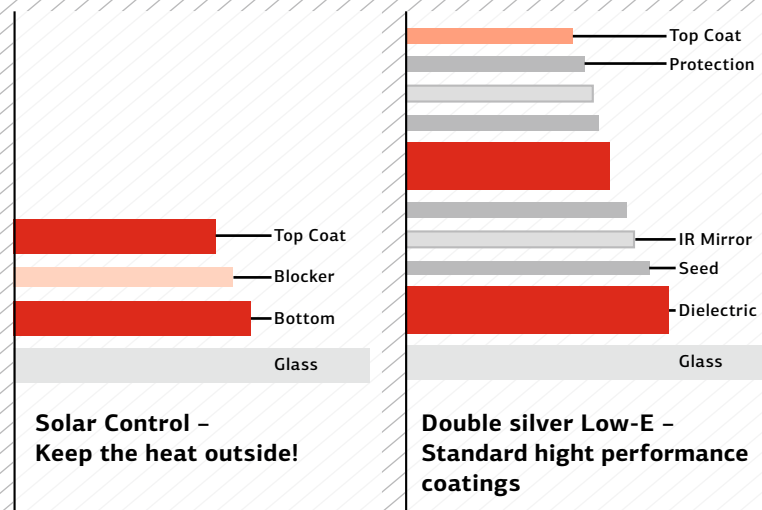
Applied nanotechnology



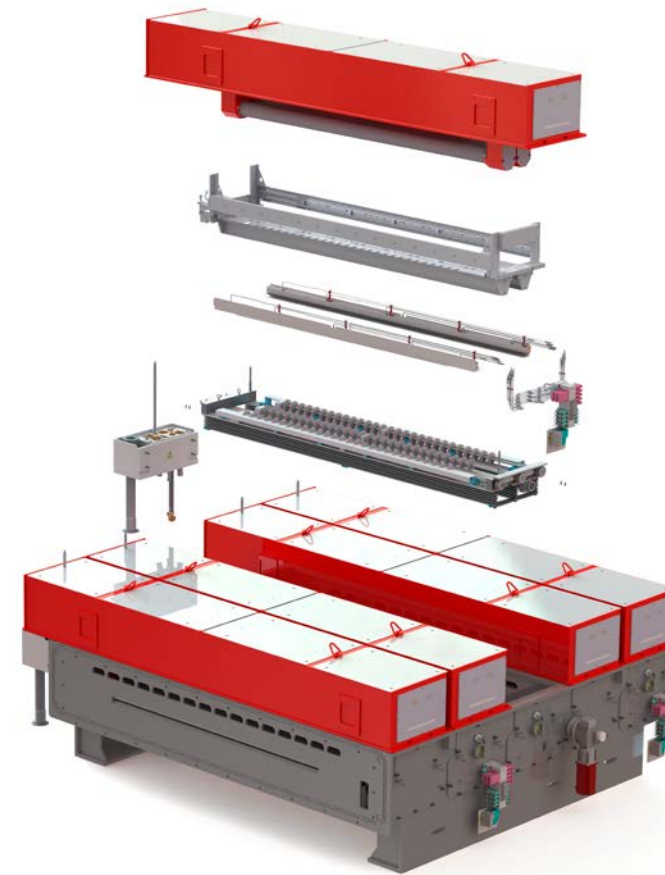
Solar Control Coatings

Low E-Coatings

Low-E Sun/Double, Triple Low-E Coatings



Low-E Spectra Comparison



Nanotechnology today.

Sophisticated coatings help to keep our future bright.

Energy efficiency becomes more and more important hence sophisticated layer stacks for coatings have been developed. But it is of similar importance for our comfort that objects have colors which we are used to – green grass, blue sky, yellow sun and white snow.

- **Transmittance & lightening** – living comfort is kept on a maximum level
- **Energy efficiency** – heat transfer is limited to keep our planet green
- **Neutral appearance** – colors can be adjusted to please any given demand

The Grenzebach coating platform allows producing these cutting edge coatings on a single machine with consistent quality and output.

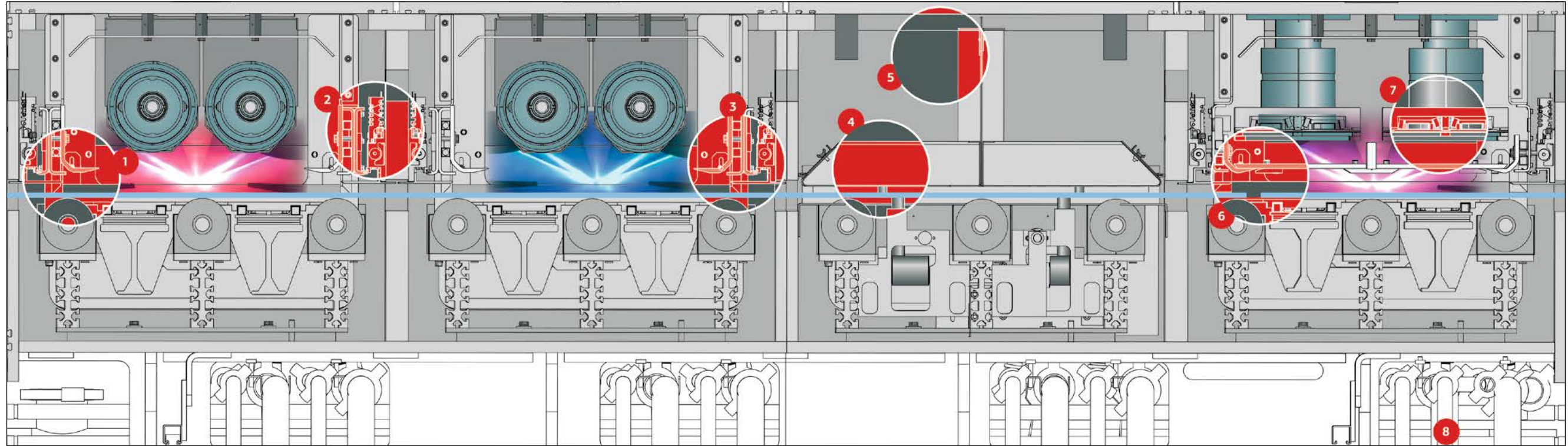
Industrialization of Nanotechnology.

Enable the technology of tomorrow today.

To transfer the latest technology into production requires sophisticated and up to date coating equipment which is simultaneously future proof and ultimately dedicated to maximized uptime and lowest running cost. As coating systems for architectural, solar and display applications become more and more complex the coating platform allows also to choose complementary technologies such large area PECVD, ion cleaning and treatment, heating, etc., which truly protects our customer's investment in a Grenzebach coating system. Grenzebach coating systems – a perfect fit to pair maximum flexibility with highest reliability.

The heart of coating technology – Grenzebach vacuum coating machinery

GRENZEBACH COATING TECHNOLOGY



- 1 MODULAR DROP-IN SHIELD & DRIVE SYSTEM**
Rapid removal drop-in shield and transport roll system = increased uptime due to shorter maintenance time = highest productivity
- 2 ADJUSTABLE GAS BAR SEGMENTATION**
Gas bar segmentation easily adoptable to process requirements = superior process control maintenance time = highest productivity

- 3 PROCESS GAS MANAGEMENT**
Process gas inlet at pass line and top pumping = highest process stability and reproducibility at lowest gas cost
- 4 ADJUSTABLE GAS SEPARATION TUNNELS**
Fixed gas separation at varying glass thicknesses = improved process stability and shorter coater

- 5 PROCESS ZONE HEATING**
Integrated process heating devices allow for substrate temperatures up to 225 °C = greater product line flexibility
- 6 GLASS GAP**
Stable and reliable ≤30 mm glass gap = higher productivity and lower maintenance requirements = longer campaign lengths

- 7 DOUBLE PLANAR CATHODES**
Two planar cathodes in one process compartment = longer campaign time and shorter coater length
- 8 LOWEST FLOORLOAD**
Minimal floor reinforcements and no special foundation requirements = reduced total CAPEX

Coating technology of tomorrow. Using latest coating technology allows for maximum profitability.

The versatile compartment concept includes features like a robust transport system for the process zones, remote adjustable gas isolation tunnels, tub design for aperture shields, multi couplers for main media and many others.

The top pump capability for the coating positions helps to reduce footprint costs to a minimum.

The coating tools and related environments as offered are designed in a way to easily match layer uniformities of ± 1% for all common processes

The technology compartment with 870 mm of width offers:

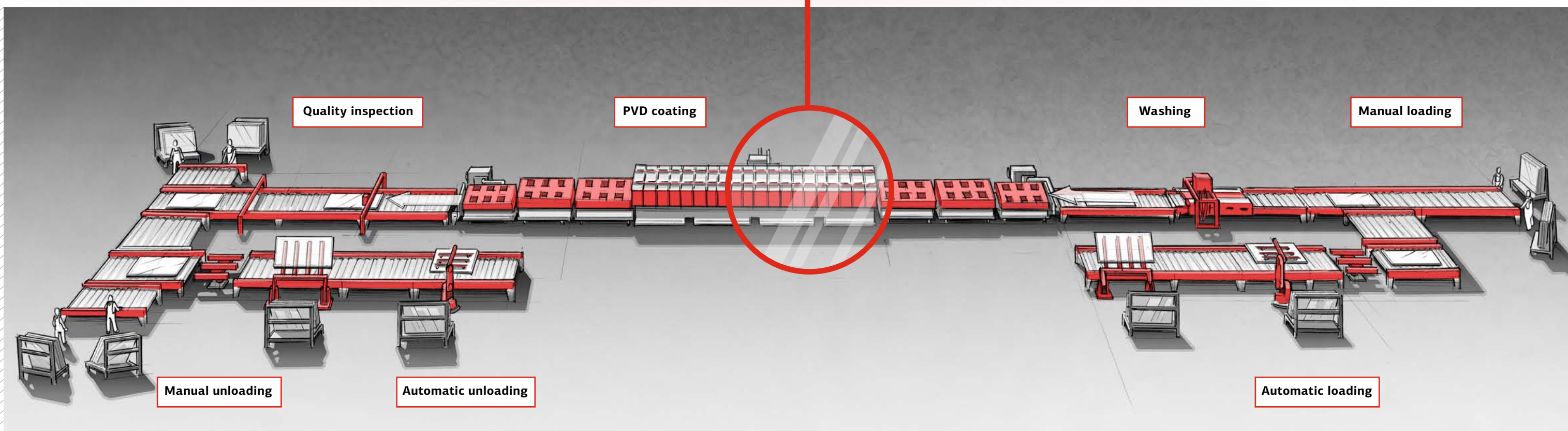
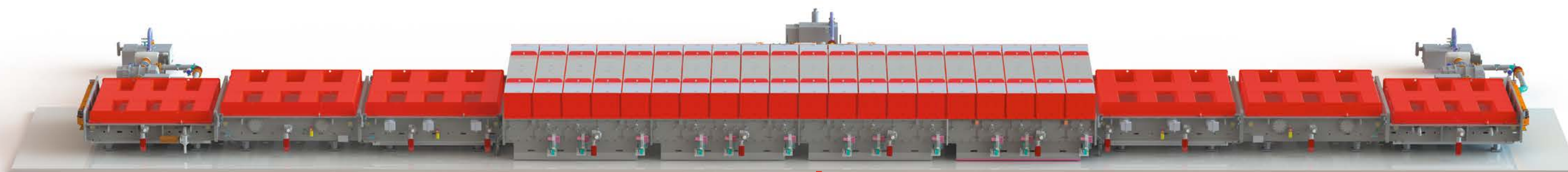
- Highest process stability with process gas feed in close proximity to the substrate surface
- Capability of running two standard planar cathodes side by side
- Easy access during maintenance cycles plus simplified exchange of shielding assemblies in a single frame.

Two machine sizes for all demands. Customized configuration for virtually any product in glass coating.

The overall length of the machinery depends on the required production output and the individual product specifications. Due to its inherent flexibility, the machine configuration can be easily changed during maintenance cycles in order to adapt to any given product mix of the user.

		GB 3300	GB 2650
Glass dimension max. L × W [mm]	[L × W] mm	6,200 × 3,300	3,700 × 2,650
Glass thickness [mm]	mm	2 – 19	
Min. cycle time [sec]	sec	≤ 30	≤ 20
Annual productivity	Mio m ² /year	up to 18	up to 13
Typical factory footprint	[L × W] m	200 × 25	150 × 25

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



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.

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.

Highlights in coating technology @ Grenzebach

NEW SYSTEMS

Coater

The Grenzebach coater platform GB 2650/3300 is designed to push productivity, uptimes and final product performance towards the limits while flexibility and ease of maintenance are unbeaten.

Combining well established features with smart improvements and new ideas result in a unique coating platform which serves to satisfy the market needs of today and tomorrow.

Handling equipment

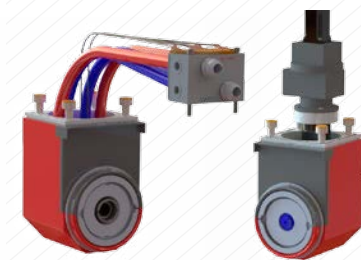
Based upon the long-standing experience in float glass handling Grenzebach has designed dedicated coater handling lines to serve the increasing demand in coated glass.

Typically working offline, these lines can process all sizes of glass. Taken from temporary glass rack storage, jumbo or mid-sized (LES) glass sheets are fed into the line by swing-arm stackers or gantry feeders. Robots are also used to handle LES sizes as well as small glass plates. Additionally, sheets of any size can also be loaded manually.

TECHNOLOGY

Cathodes

Inhouse made planar and rotary cathodes in combination with latest state of the art MF-, DC- and pulsed DC technology deliver reliable, consistent coating performance to meet the latest demands as well as face future challenges of the coating industry for architectural glazing.



SERVICES & DEVELOPMENT

Spare parts, upgrades and consulting

Spare parts

Component refurbishment

- Spare parts packages & services for the existing global installed PVD coater base
- Endblock refurbishment services for rotatable cathodes

Upgrades

Control retrofit

- Additional coating positions (sputter cathodes)
- Vacuum system optimization / cycle time reductions
- Retrofit of controls / drive systems
- Increase of production throughput
- Optimization of layer stacks & recipes

Reconfiguration

Process optimization

Technical consulting

- Development of new layer stacks as onsite support or as remote service at Grenzebach Coating Lab
- Technology support for ongoing production

Coating lab

Based in the Grenzebach headquarters, a full size lab coater equipped with multiple coating positions in different process zones serves as an R&D tool for new layers, a training system for customer projects and a qualification platform for new hardware technologies and components.

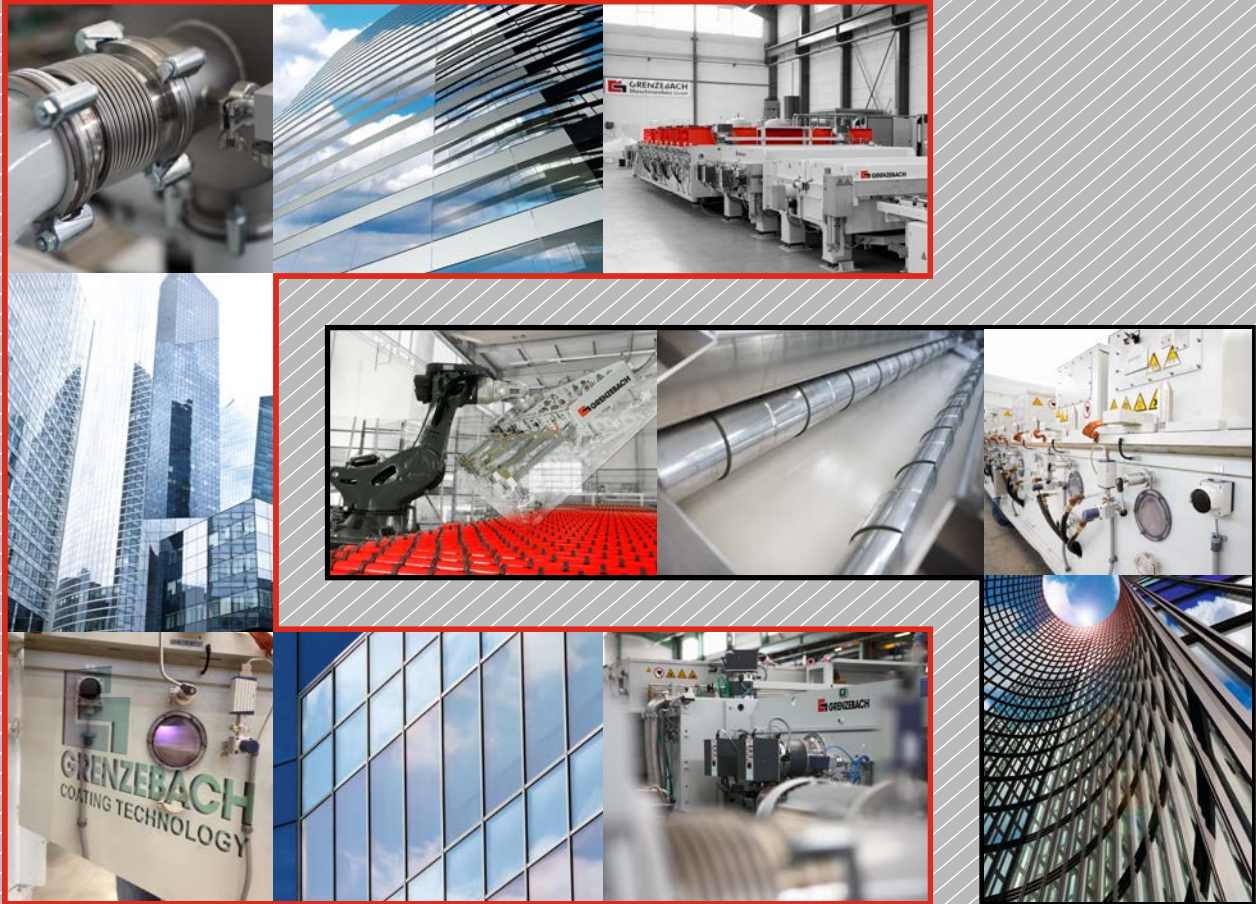
Grenzebach stays one step ahead in the industry through constant development of new hardware, components and processes as continuous duties.



Grenzebach supplies fully integrated, turn key systems with all required equipment for a complete coating production line from a single source.

Grenzebach is serving the existing installed coater base with service products from upgrades to spare parts and extensive on-site production or maintenance support.

GLASS | BUILDING MATERIALS | INTRALOGISTICS | SERVICE



www.grenzebach.com

