FESTO

Highlights

Anniversary Edition 2025

From
one hundred successful years
to **a promising future.**

100 years

Automation for a world in motion.


FESTO
From
battery cell
to acceleration.
Festo products and solutions are setting the stage for flexible, intelligent and efficient automated manufacturing processes of nearly everything that moves us – cars, planes, trains, e-scooters. I 100.festo.com
100 years
Automation for a world in motion.

Dear Reader,

This will be a unique year, and we are delighted to be marking this occasion as **Festo turns 100!** One hundred years of success and innovation – that's what Festo stands for. Festo keeps the world moving with automation as well as technical basic and further training. With this anniversary edition of the "Highlights" brochure, we would like to reflect on the future by exploring topics that move you and us – and thank you. Thank you for shaping the industry of today – and above all of tomorrow – with us!

I am looking forward to a year full of highlights and especially to many personal anniversary moments with you – our customers, our partners, and all innovation enthusiasts.

"Automation for a world in motion" – Our customers in factory and process automation have many different requirements. Our aim is to meet these requirements as efficiently and sustainably as possible, regardless of the technology used. Festo is the first port of call for a broad and networked spectrum of automation technology, ranging from products and solutions for pneumatic and electric automation to digitalization and AI, rounded off by expertise in technical basic and further training.

In this issue, we show you exciting customer projects from various industries that underline our broad expertise and our partnership-based cooperation, not only in terms of technology, but in terms of training too. We will also be exploring the sustainable transformation of industrial production with trendsetting solutions by focusing on topics such as hydrogen, biotech automation, and the circular economy. A lot of knowledge from Festo as well as from renowned industry experts is awaiting you.

I hope you will be inspired by the ideas and will find plenty of food for thought!

Thomas Böck
Chairman of the Management Board, Festo

"By being open, curious, enthusiastic, and willing to learn. That is at the heart of our innovation, of being able to think beyond boundaries and daring to try something new".

Thomas Böck,
Chairman of the Management Board

In April 1925 Albert Fezer and Gottlieb Stoll founded “Fezer & Stoll”, focused on to the manufacture of woodworking machines. The brand name Festo is a combination of the surnames of the two founders and has stood for innovation ever since. After a few years, Gottlieb Stoll took over sole responsibility. His way of thinking and acting was shaped by wanting to make work easier for people.

The first company headquarters in Ulmer Straße in Esslingen am Neckar (see picture below) was built in 1939. It was home to modern production and office spaces. The foundation stone for further development had been laid and a place where ideas could be created had been opened.

„Festo – one mission, many hands.“
Gottlieb Stoll with his wife Berta

In the mid-1950s, the focus shifted to industrial automation when Festo set started developing pneumatic products and thus set new standards in automation. Festo grew and went global. The first national company was founded in Italy in 1956, followed by Switzerland, France, and Austria. The current headquarters were built back in 1962, at the first dedicated site for the Festo Pneumatics division in Esslingen-Berkheim; Administration and Production were now centralized. Six years later, Festo opened a production site in Rohrbach, Saarland; today, this site is its largest production and logistics center in the world.

Based on the firm conviction that innovative strength and competitiveness go hand in hand with learning and knowledge, the company set up Festo Didactic in the 1960s, with the specific aim of developing training courses for apprentices, employees and customers. It quickly became the leading provider of technical training and further education.

In motion for 100 years.
More impressions and information about our successful company history:

> www.festo.com/history

Wilfried Stoll, the second son of Berta and Gottlieb Stoll, pushed ahead with the international positioning and the founding of new Festo companies to strengthen the brand. He is pictured here during a trip to Southeast Asia in Singapore in 1973 in front of a Festo car.

In 1950, **Kurt Stoll**, the eldest son of Gottlieb and Berta Stoll, found out about pneumatics at a trade fair in Chicago and recognized its potential for automation. With his extraordinary, inventive spirit, he developed this topic further at his father's company. Kurt Stoll made a significant contribution to Festo becoming a pioneering solution provider in automation technology.

The first pneumatics catalog from 1956 comprised 166 items. Today's portfolio has about 33,000 catalog products in several hundred thousand variants.

Development of the first pneumatic products from **1955**. The picture shows the double-acting cylinder type DV.

The exhibition stand in 1967 at the Royal Exhibition Building in Melbourne, Australia. Right from the early days, Festo has been present at national and international trade fairs. Festo has been listed as an exhibitor at the Hannover Messe since 1949 and continues to demonstrate its innovative strength at the world's largest industrial trade fair.

A 100-year success story – This is only possible when innovative customers come together with a highly competent sales team. We would like to thank our customers around the world this year, for their trust, great inspiration, and a shared view of the future!

Frank Notz, Member of the Management Board Sales

2025 will be a year of innovation – of products, functionalities, methods, and the customer interface.

Dr. Ansgar Kriwet, Member of the Management Board Research and Development

Our success is based on our more than 20,000 employees worldwide. Our experts will continue to have their fingers on the pulse in the future because lifelong learning is part of Festo DNA!

Sebastian Beck, Member of the Management Board Finance and Human Resources

I am delighted to celebrate this special anniversary at our global production and logistics locations. Because we are active globally in the sense of “local for local”, close to our customers.

Dr. Jaroslav Patka, Member of the Management Board Operations

This year is all about “the future”. Electric automation, digitalization, and artificial intelligence will play a central role.

Gerhard Borho, Member of the Management Board Information Technology and Digitalization

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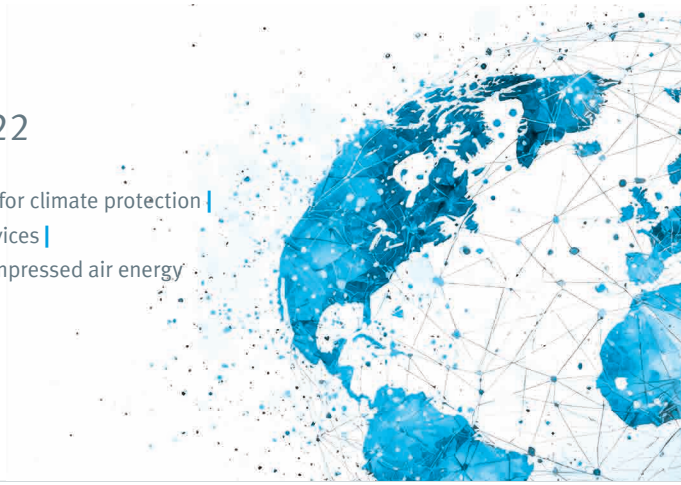


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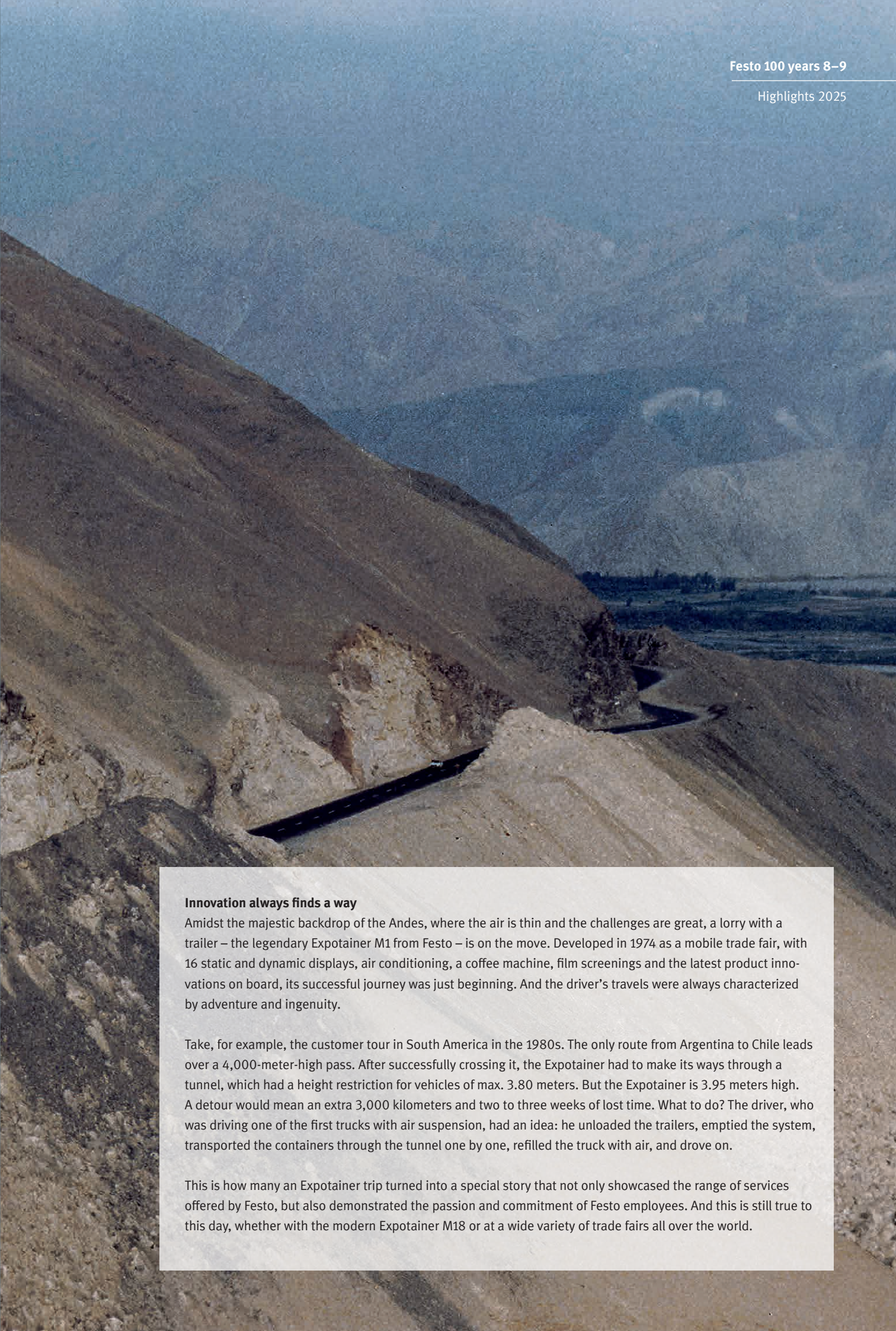


Innovation always finds a way

Amidst the majestic backdrop of the Andes, where the air is thin and the challenges are great, a lorry with a trailer – the legendary Expotainer M1 from Festo – is on the move. Developed in 1974 as a mobile trade fair, with 16 static and dynamic displays, air conditioning, a coffee machine, film screenings and the latest product innovations on board, its successful journey was just beginning. And the driver's travels were always characterized by adventure and ingenuity.

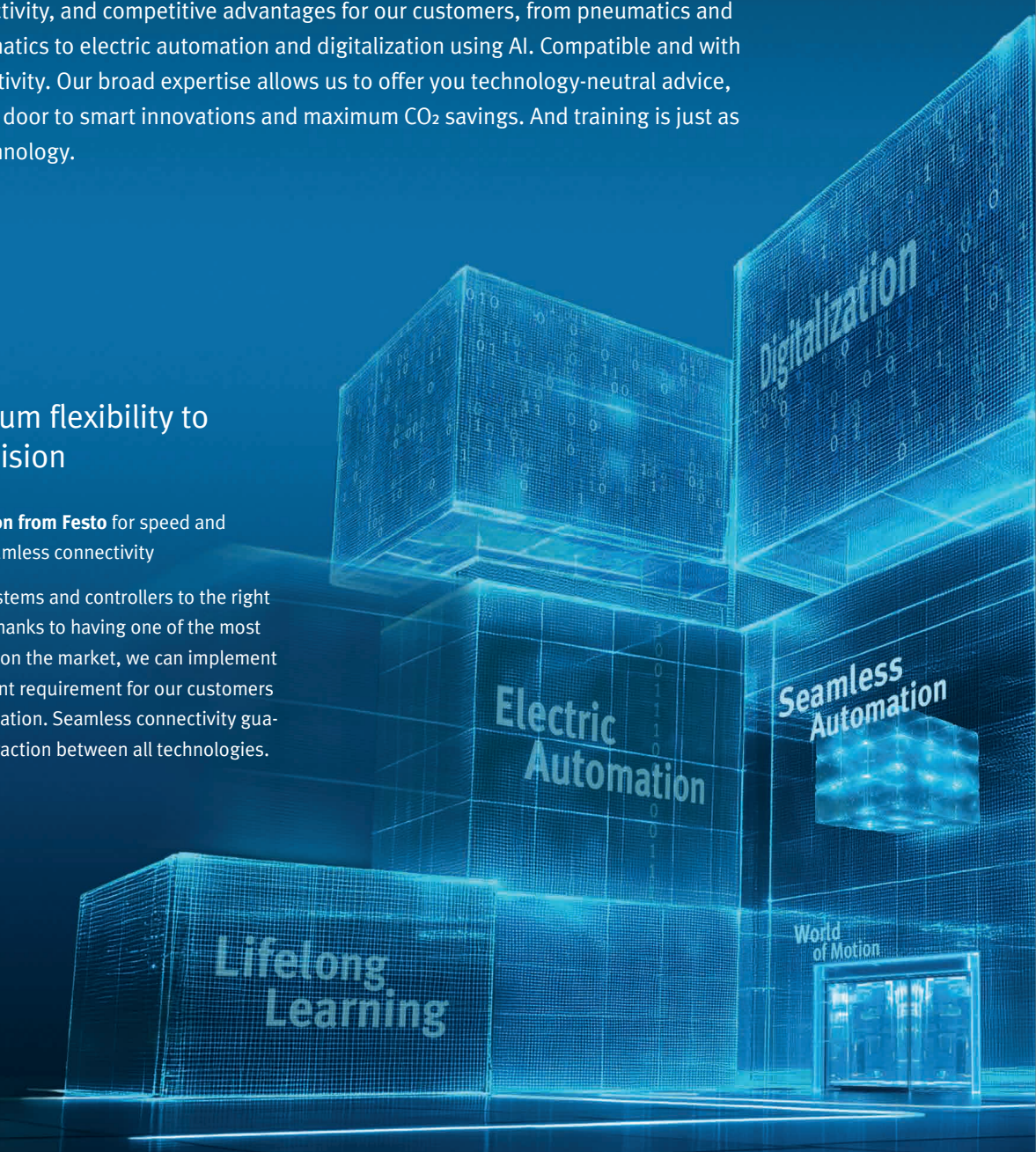
Take, for example, the customer tour in South America in the 1980s. The only route from Argentina to Chile leads over a 4,000-meter-high pass. After successfully crossing it, the Expotainer had to make its ways through a tunnel, which had a height restriction for vehicles of max. 3.80 meters. But the Expotainer is 3.95 meters high. A detour would mean an extra 3,000 kilometers and two to three weeks of lost time. What to do? The driver, who was driving one of the first trucks with air suspension, had an idea: he unloaded the trailers, emptied the system, transported the containers through the tunnel one by one, refilled the truck with air, and drove on.

This is how many an Expotainer trip turned into a special story that not only showcased the range of services offered by Festo, but also demonstrated the passion and commitment of Festo employees. And this is still true to this day, whether with the modern Expotainer M18 or at a wide variety of trade fairs all over the world.

World of Motion

From pioneering innovations to maximum productivity

We set the world in motion for our customers. By using innovations to simplify what is complex. Automation from Festo offers the right solutions for everything that ensures sustainable success, maximum productivity, and competitive advantages for our customers, from pneumatics and controlled pneumatics to electric automation and digitalization using AI. Compatible and with seamless connectivity. Our broad expertise allows us to offer you technology-neutral advice, thus opening the door to smart innovations and maximum CO_2 savings. And training is just as important as technology.



From maximum flexibility to highest precision

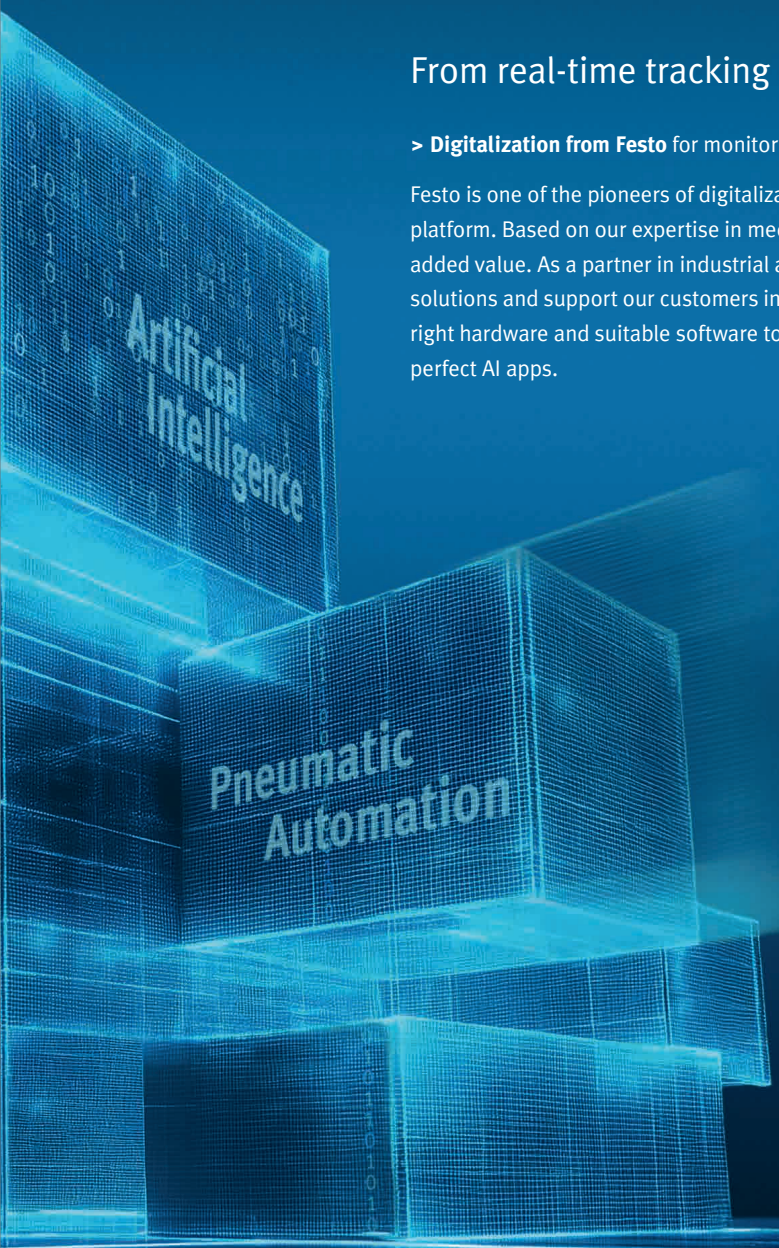
> **Electric automation from Festo** for speed and efficiency with seamless connectivity

From mechanical systems and controllers to the right cloud application: Thanks to having one of the most extensive portfolios on the market, we can implement almost any movement requirement for our customers using electric automation. Seamless connectivity guarantees perfect interaction between all technologies.

From comprehensive expertise to lifelong learning

> **Festo Didactic** for learning solutions and developing technical skills

As the global market leader in technical basic and further training, we create real added value for our customers on their journey to industrial transformation – and thus the basis for productivity, innovation, and sustainable growth. We systematically pass on our knowledge to the experts of tomorrow. Everything is from a single source, from simple software solutions and individual learning packages to digital learning platforms and comprehensive training centers.



From real-time tracking to looking into the future

> **Digitalization from Festo** for monitoring and digital tools to AI solutions

Festo is one of the pioneers of digitalization and a founding member of the Industry 4.0 platform. Based on our expertise in mechatronics, automation, and AI, we generate real added value. As a partner in industrial automation, we offer individual, comprehensive solutions and support our customers in increasing overall system efficiency with the right hardware and suitable software tools, from design to commissioning, as well as perfect AI apps.

From pure power to smart control

> **Pneumatics from Festo** for reliable and innovative automation solutions in all industries

Pneumatics often offers the simplest and most efficient solution. Regardless of the challenge, customers benefit from pneumatic solutions that are based on application knowledge gained over a hundred years of automation experience.

Our latest innovation, controlled pneumatics, provides intelligent solutions for more complex tasks. Together with comprehensive design software, digitized pneumatics opens up new possibilities, from precise positioning to fast and flexible control.

“Seamless automation allows us to combine the best of different technologies.”

Frank Notz, Member of the Management Board Sales

Together we move the world.
Welcome to the World of Motion:

> **www.festo.com/worldofmotion**

Electric Automation

Sustainable and efficient packaging

Real-life application

Perfectly shaped packaging: Stepper motor EMMS-ST on the hood forming module.

“The stepper motors reduce the energy consumption of the entire machine.”

Wolfgang Konrad, Vice President Marketing & Communication, IWK

With the new blister packaging machine from IWK, sustainability is not just lip service. Thanks to the use of recyclable packaging material, its low energy consumption, high speed and ergonomic design, the CABLIblue 870 proves to be a real trendsetter. And with electric automation technology from Festo sustainability and efficiency are significantly increased in this application.

IWK Verpackungstechnik GmbH, based in Stutensee near Karlsruhe, Germany, is part of the ATS Group and has more than 7,500 employees at 65 international production sites. It is one of the world’s leading manufacturers of packaging machines, focusing on tube fillers and cartoning systems. With the CABLIblue 870 card-to-card blister system, the company supports its customers on their journey towards a circular economy. The high volumes of sturdy packaging it processes are all made from recyclable cardboard, completely without plastic, and destined for medical technology, pharmaceuticals, cosmetics, DIY articles, and non-food.

Faster with stepper motors

When it comes to efficiency, no competitor can beat CABLIblue 870. With a packaging output of 22 cycles per minute, it is 10% faster than the industry average. The machine also achieves this output by consistently using stepper motors EMMS-ST from Festo, which enable overlapping movements.

The stepper motors not only reduce the noise level to below 72 dbA, they also lower the energy consumption of the entire machine. They thus guarantee a greater energy efficiency and reduce the carbon footprint.

The vacuum generators OVEM from Festo also contribute to greater efficiency as they integrate an air-saving and monitoring function for the complete vacuum system in order to reduce down-times (condition monitoring). The vacuum grippers for ejecting the finished blister packs are part of a handling system equipped with electric axes ECC and ELGC from Festo. The magazines for the packaging materials are easily accessible and can be refilled quickly during operation. Here, too, the stepper motors EMMS-ST from Festo provide support as the magazine in the gripping and loading area is moved towards the machine operator for filling. This improves ergonomics and relieves the strain on machine operators.

International cooperation in Thailand

"A large part of the CABLIblue 870 was developed and assembled in our factory in Thailand. What was impressive about the cooperation with Festo was the uncomplicated procurement of the necessary parts," explains Wolfgang Konrad, Vice President Marketing & Communication at IWK.

"The digital engineering tools were just as readily available for use for our in Thailand as they were in Germany and contact with the Festo project engineers in Thailand went smoothly," says Konrad. Even if a Festo component was not immediately available in Thailand, all it took was a phone call and the component was ready for delivery in Thailand in no time.

Konrad compares the cooperation with Festo with the relationship with IWK customers, the major brand manufacturers: "Brand manufacturers involve us early on in the development of packaging ideas so that we can work together on designing machine-compatible packaging. Such a basis of trust also characterizes our relationship with our development partner Festo."

You can find more information at:

> **www.festo.com/ea**
> www.festo.com/catalogue/emmt-st
> www.festo.com/ovem
> **www.festo.com/egc**
> **www.festo.com/elcc**
> www.festo.com/engineeringtools

Stepper motors on the cover card magazine shortly before sealing.

A handling system with electric axes EGC and ELCC ensures the finished blister packs are reliably transported.

> www.iwk.de

Decentralized Automation

Innovative window production in Canada

Real-life application

Complex things made simple: Automation solutions from Pro-Line for window and door production, optimized with innovative Festo technology.

Festo was on site with its video team:
> **www.festo.com/proline-video**

A machine builder from Ontario is countering the shortage of skilled workers with new, decentralized automation solutions from Festo. Modern machines for the flexible production of windows are equipped with innovative technology to save time and effort in design, construction, and commissioning. Maintenance, fault detection and troubleshooting are also made easier and cycle times are shortened.

For Pro-Line, one of Canada's leading OEMs of CNC and large-scale manufacturing systems in window and door production, expertise and automation are equally important. The company uses innovative automation solutions to compensate for the nationwide shortage of qualified workers for sawing, drilling, and joining PVC and aluminum. A simplified machine design combined with easier maintenance requires fewer skilled workers.

"Decentralized automation with CPX-AP-I simplifies installation and assembly"

Vinode Ramnauth, President and CEO of Pro-Line
> www.prolineautomation.com

Innovation partner Festo

"We want to take our machines to the next level of performance and efficiency, and Festo offers us the opportunity to do so. All our engineering work was developed together with Festo," says Vinode Ramnauth, President and CEO of Pro-Line. Decentralized automation with the remote I/O system CPX-AP-I is used in the latest window production system. The electronic proximity switch SDBT-MSX with automatic teach-in saves valuable time when building the nearly 20-meter-long machine – as much as two hours without the need for fine-tuning and readjustment during commissioning. It has a detection range of 20 mm and is easy and safe to install, especially when mounting is more difficult. "The innovative strength that Festo constantly demonstrates with new technologies enables us to go further," explains Ramnauth.

Efficient I/O networking

The new remote I/O system allows powerful input/output modules and existing valve manifold (terminal) interfaces to be integrated into the most important host systems. End-to-end connectivity and extended diagnostic options increase machine availability and productivity. In addition, integrating it into different control systems with PROFINET, EtherCAT, Ethernet/IP or ModbusTCP is really easy.

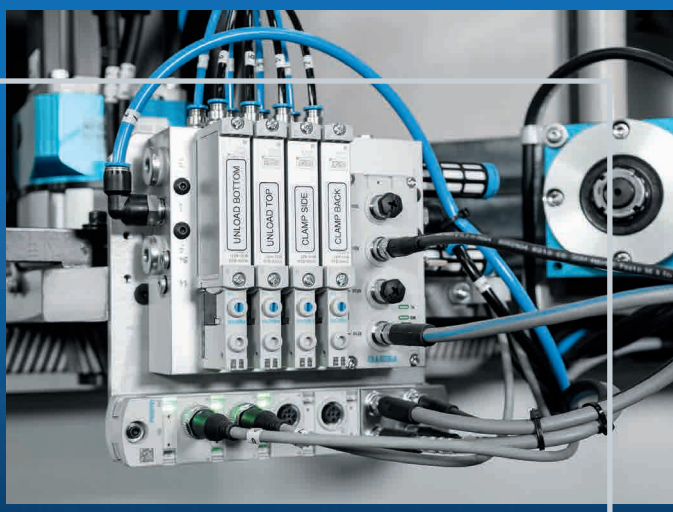
The Festo remote I/O system CPX-AP-I was initially tested on a parallel welding machine for plastic profile parts used in the manufacture of window and patio door frames. And with great success.

Only five hours instead of 40

The advantages of the decentralized automation solution are its short, energy-saving tubing and low cabling requirements. “While an electrician normally spends about 40 hours wiring one of our machines, they only need around five hours with a decentralized I/O design,” says Ramnauth. The decentralized system also reduces the training requirements for employees and thus compensates for the shortage of skilled workers in the long term. Key components such as the valve terminal VTUG and the electronic proximity switches SDBT-MSX are connected to the PLC via the CPX-AP-I system and do not need to be connected directly to the bus system.

Valve terminals placed at the point of operation

By switching to decentralized automation solutions, valuable space could be saved and the workload was reduced too. “We can now position valve terminals and I/O modules directly at the point of operation and don’t have to concentrate them in a central place. Until now, the centralized design usually necessitated larger dimensions,” says the Pro-Line CEO. “It is a great advantage for us that we can now install the valve terminal and the I/O modules exactly where we need them. This means we need fewer tubing and electrical cables and achieve shorter cycle times.”



Decentralized automation with the Festo remote I/O system CPX-AP-I simplifies installation and assembly and saves valuable time.

Festo modules are integrated directly at the point of operation thanks to excellent connectivity, which also reduces cabling costs.

Anniversary in Canada

Festo Canada is celebrating 50 years of success! Since its founding, the company based in Ontario has established itself as the market leader in pneumatics in Canada, continuously supporting the local industry. Over the years, Festo introduced local cylinder production, which evolved to meet changing needs, as well as a Customer Interaction Center to deliver dedicated support and tailored solutions. Recently, Festo Canada launched the Certified System Integrator Program. This program connects end users with skilled partners for automation projects. As Festo Canada approaches its 50th anniversary in 2025, it celebrates a legacy of innovation and market leadership.

> www.festo.com/cpx-api
> www.festo.com/catalogue/sdbt

Automation with VTUX

Fast processing of roses in the Netherlands

Real-life application

In the Netherlands, the land of cut and potted flowers, the machine building experts at Aventec are setting new standards. Speed and precision in processing rose cuttings have been significantly increased with modern, decentralized Festo automation technology.

When looking at potted roses, few people think of highly automated processes. But with quantities in the millions, short planting times are a must. The Dutch company Aventec, founded by John van de Ven, opens the door to extremely fast yet sensitive automation in horticulture. With a new design that was originally planned as an automation upgrade at a breeding company, Van de Ven was able to increase the output of a complete machine with four cutting stations to up to 5,200 cuttings per hour. The system was equipped with modern servo technology, controlled by the Festo automation platform CPX-E.

The perfect pattern

The Aventec system trims the rose cuttings to size and plants them in pots in a matter of seconds. At the start of the line, the rose twigs are first hooked into a transport system by hand; all subsequent steps are fully automated. Once in the processing cells, the cuttings are positioned in front of an image processing system and rotated 180 degrees to create a 3D scan.

The machine software then determines the optimum cutting pattern for the cultivated plants; this is carried out extremely quickly and precisely by a multi-axis robot. Finally, the robot inserts the cuttings into pots filled with soil after which the potted roses begin their journey into the greenhouse.

To find out how the turning and cutting processes could be realized with components from Festo, Van de Ven and his team sent rose twigs and their holders to the Festo development center in Delft. A week later, they received a video from the Festo team with the results.

Fully automated filigree work: The new machine from Aventec cuts and plants up to 5,200 rose cuttings per hour using Festo components.

Advantage of decentralized control

A key component for the high speed of the machine is the compact valve terminal VTUX. It allows both a decentralized and a centralized machine design. Van de Ven opted for the decentralized design variant for the new machine. “With VTUX, I can position the connection points closer to the sensors,” explains Van de Ven. “We only need one supply connection for air, electricity, and communication to the terminal. And where we used to need two control cabinets to accommodate everything, now one cabinet is enough. Thanks to the decentralized control system, everything can be operated independently.”

Reliable and fast diagnostics

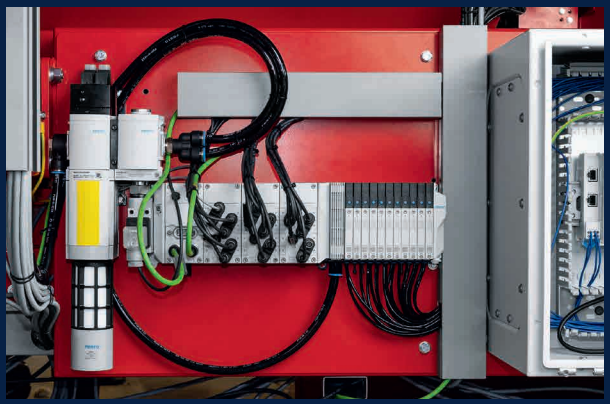
The Festo automation platform CPX-AP-A makes a valuable contribution to fast and error-free IO control between components. Extended diagnostic functions enable fast response times in the event of a malfunction. For example, a cable break in one of the sensors on the machine can be reliably localized in no time at all. To do this, all tags are read in and assigned in the VTUX. For each rose cutting module, there is one terminal in the upper and one in the lower section of the machine, as well as a valve terminal VTUX on the main unit – a total of nine per machine.

“Where we used to need two control cabinets, now one is enough.”

John van de Ven, Managing Director Aventec

> www.aventec.nl

> www.festo.com/vtux
> www.festo.com/cpx-e
> www.festo.com/cpx-ap-a



The special feature of the valve terminal VTUX: It is suitable for both decentralized and centralized machine installation. At Aventec, they opted for decentralized control.

Digitalization in Tunnel Construction

Festo AX Smartenance optimizes maintenance management

Real-life application

Festo was on site with its video team:
> www.festo.com/herrenknecht-video

With lengths of up to 150 meters and diameters of up to 17 meters, Herrenknecht tunnel boring machines are true giants. They are used in many infrastructure projects all over the world to excavate tunnels quickly and efficiently. At Europe's largest infrastructure construction site in London, a rail link, High Speed Two (HS2), is being constructed between the north of England and London for trains traveling at up to 360 km/h. Two Herrenknecht tunneling machines are being used, whose reliability is based, among other things, on the digital maintenance manager AX Smartenance from Festo. The Festo software is integrated into the Herrenknecht.Connected digital system.

Transparent monitoring, intuitive operation: Festo AX Smartenance, the digital maintenance management solution, in use on the HS2 tunnel construction project in London.

Focus on maintenance

To ensure complex systems such as a tunneling machine can function without interruption, having a deep insight into the internal condition of the machines and seamless maintenance are crucial. In the past, necessary maintenance work often resulted in excessively long and expensive downtimes, while documentation on paper was slow, laborious, and complex.

With the digital customer portal Herrenknecht.Connected, Herrenknecht customers receive insights into and data from almost all systems on the construction site, from a tunneling machine in operation to wastewater treatment. The family-owned company also wanted to integrate a modern and user-friendly maintenance management system into this platform.

Everything at a glance

While researching the market, the IT specialists at Herrenknecht came across AX Smartenance from Festo. The maintenance software, also known as CMMS (Computerized Maintenance Management System), allows production managers and plant operators to carry out digital maintenance and servicing. Maintenance tasks and plans can be flexibly created, duplicated, and then evaluated, while intelligent user management improves fast teamwork and boosts the efficiency of maintenance management.

Integrated into Herrenknecht's customer portal, the CMMS AX Smartenance is responsible for the maintenance management of tunnel boring machines and all other maintenance-relevant machines and systems on a large construction site. It provides automated analysis functions, clear dashboards, and detailed evaluations of sensor data. This, in turn, reduces downtimes, minimizes the time required for maintenance and thus significantly reduces costs, all while increasing efficiency.

Maintenance staff and mechanics working on the machine also benefit from AX Smartenance. This is because the teams on site can now process, report and track routine tasks and incidents directly via the CMMS software. All maintenance-relevant documents such as circuit diagrams and drawings are available in one central location. As a result, the work of the maintenance teams becomes much easier and productivity increases.

> www.herrenknecht.com

> www.festo.com/ax

Lifelong Learning

Festo Didactic – partner for the development of technical expertise

Megatrends such as digitalization and the challenges of climate change are influencing many areas of life, including technical education. This helps to actively shape future changes and drive innovation.

At Festo, lifelong learning is firmly embedded in our corporate culture. As early as 1965, an independent division was established, tasked with the worldwide sales of learning systems and the organization of courses. Today, Festo Didactic is a global leader in technical basic and further training.

Used by customers from vocational colleges, universities, research centers, educational instituties and industrial companies all over the world, technical education becomes a driving force for innovation. The specialists of today and tomorrow are empowered to master the challenges of the future. They make a significant contribution to the competitiveness of companies and to boosting the economy by driving innovation with their new skills and ideas. Well-trained employees will enable industrial companies to react more quickly to market changes and position themselves more successfully globally.

> **www.festo.com/didactic**

Customized training solutions

Existing professions are constantly changing and new job profiles are emerging. Festo Didactic grasps new technologies and offers educational institutes customized training solutions and reliable partnerships. Together, young people are optimally prepared for the world of work and trained to contribute to a sustainable economy.

With its comprehensive portfolio, Festo Didactic offers companies and their specialists many innovative solutions for lifelong learning. These are tailored to the training requirements of industry and cover technologies such as factory and process automation, fluid technology, electrical engineering, as well as new topics such as electromobility (see also page 49). Current trends are thus also included in further technical training.

“Lifelong learning is the way to meet global challenges with knowledge and innovation.”

Dr. Oliver Niese, Member of the Board Festo Didactic

Digital learning solutions

Teaching theoretical knowledge, applying it directly in practice and consolidating it are inseparable parts of technical basic and further training. The targeted combination of digital courses and practical exercises enables learners to remain competitive in highly technological industries.

At the heart of the learning solutions is the digital learning portal “Festo Learning Experience” (Festo LX) with a comprehensive learning environment that is tailored to the individual requirements of customers. During their basic and further training, learners can study the theory and practice of a wide range of topics, from factory automation and fluid technology, the Industrial Internet of Things (IIoT) and Industry 4.0 to electrical engineering, process automation, renewable energies, and STEM.

For example, Festo LX can provide support with the design of environmental management. Sustainability-related topics such as energy, water and material consumption or CO_2 reduction, and compliance with environmental legislation can be integrated into the training, too.

Festo LX is already used by over 1700 customers with more than 75,000 active learners and access to over 740 courses.

> www.festo.com/lx

In focus: Sustainability

Green skills are environmentally friendly skills that contribute to sustainable development. These include technologies such as renewable energies (solar, wind and hydropower), energy efficiency, sustainable mobility, and building technology. Festo Didactic promotes green skills as a way of teaching sustainable business practices and supporting the transition to a climate-friendly industry. By training customers, partners, and its own employees in relevant sustainability topics, Festo Didactic helps them to better understand the environmental impacts and make sustainable decisions.

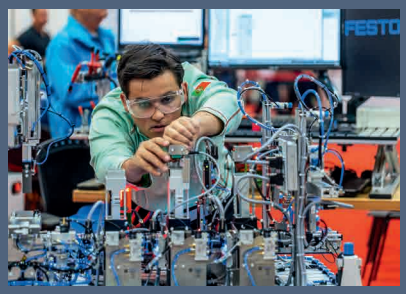
The water industry is a prime example of a high-tech sector in which employees require an increasingly broad range of skills. Festo Didactic offers effective learning methods using training systems and simulations that recreate real conditions in the water industry. Virtual experiments with complex water management systems can thus be carried out safely and realistically.

> www.festo.com/greenskills

Learning through competing

The international WorldSkills vocational competitions aim to nurture prospective skilled workers and strengthen cooperation between representatives from education, business, and politics. Festo Didactic has been involved in the world’s largest education trade fair for over three decades, both as a global industry partner and official supplier of competition equipment.

In addition to established professions, new job profiles are also showcased as future professions. Festo Didactic was able to help integrate the disciplines of Water Technology, Industry 4.0 (IIoT), and Renewable Energies into the competitions.



> www.festo.com/worldskills

1 Sustainability

Sustainability is already firmly integrated in many companies and sectors and forms the basis for responsible industrial development. This responsibility begins on the shop floor and extends along the entire value chain.

Automation plays a crucial role in increasing the efficiency of processes and contributes significantly to reducing the carbon footprint of companies. Festo supports its customers with CO_2-optimized products, energy efficiency modules, and TÜV-certified Energy Saving Services, such as compressed air energy efficiency audits. They can significantly reduce energy consumption.

Sustainability

Reducing carbon emissions to combat climate change

As a family-owned company, Festo stands for clear values, the highest quality, and customer-oriented innovations. This means that Festo as a company needs to make a contribution to sustainable development in the areas of environment, social affairs and governance (ESG). This is how sustainable decisions are made – responsibly and in the long term – for customers, for the company and for future generations.

The sustainability goals from Festo are bundled into four areas of action.

The continuous reduction of the carbon footprint, both for customers and for Festo, is a key focus of sustainable decisions. Festo offers its customers efficient and productive solutions in industrial production. The climate friendly transformation of production along the entire value chain is one of the main tasks for the company.

At Festo, the focus is on people. After all, a healthy, motivated and high-performing workforce is a key guarantee of success for us. In order to achieve the Sustainable Development Goals, it is important to set and adhere to binding ethical and governance standards worldwide.

More information on the **Areas of action** can be found here:

> **www.festo.com/sustainability**
> **www.festo.com/peopleatfesto**
> **www.festo.com/sustainableeducation**
> **www.festo.com/ethics-and-governance**

On the way to carbon neutrality
For Festo, climate protection means actively contributing to the reduction of greenhouse gas emissions. Innovative production technologies and recycling strategies reduce the consumption of resources and extend the service life of products.

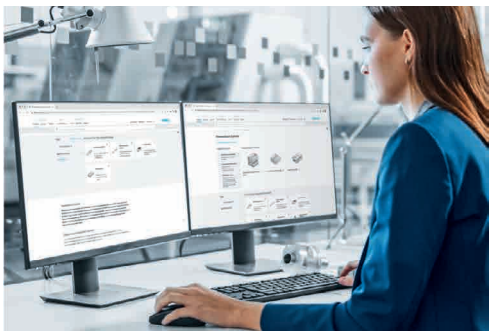
Festo will massively reduce its carbon footprint over the next few years. Since 2024 – two years earlier than planned – the entire Festo Group has been CO_2-compensated in Scope 1. Since 2024, the Festo Group has already been carbon-neutral in Scope 2 and 3.8. The plan is to reduce Scope 1 emissions by about 30% by 2030 and to achieve the net zero target by 2040.

"By integrating sustainable technologies and processes into our products, we help our customers achieve their own sustainability goals and therefore boost their competitiveness."

Marcus Stemler, Head of Corporate Sustainability, Festo

Festo ensures its products are manufactured sustainably and supports its customers on the way to the CO_2-neutral factory.

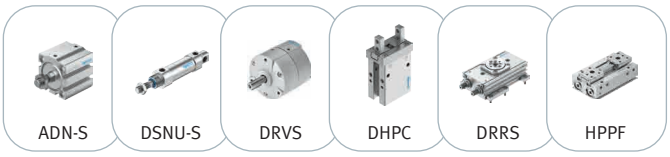
With its expertise in pneumatics and electrics, as well as software and AI, Festo can provide technology-neutral advice and maximize CO_2 savings through smart innovations. Thanks to a uniquely broad portfolio, Festo offers CO_2-optimized products and provides customers with services throughout the entire utilization phase. By using the right technology and optimally sized components, customers can save up to 70% on energy.



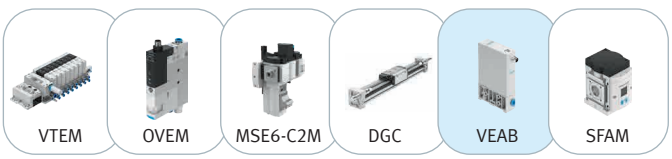
Product shopping cart for CO_2 reduction: You can find the product selection in the Online Shop.

Examples of...

... lighter weight products



... products with energy-saving function



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Sustainability

Festo Energy Saving Services

Greater energy efficiency, fewer carbon emissions

The Festo Energy Saving Services, certified according to DIN EN ISO 11011, offer a customized service that provides up-to-date information on the condition of compressed air systems and installations. Based on this independent and objective assessment, a detailed overview of the savings potential and valuable recommendations for action are provided so that this potential can be used to the full.

More information about the **Festo Energy Saving Services** can be found here:
> **www.festo.com/ess**

Compressed air energy efficiency audit

The compressed air energy efficiency audit is part of the Festo Energy Saving Services and offers an independent, comprehensive analysis of compressed air systems. The condition of all components, from the compressor to the pneumatic application, is inspected completely objectively. Specific potential savings are then identified, and targeted measures proposed to optimize systems and installations. The result: Lower energy costs, lower carbon emissions, and fewer unplanned machine downtimes for greater production stability.

Benefits:
- Independent and comprehensive analysis of the entire compressed air system
- Recommendations for action and prioritization of measures to optimize energy efficiency
- TÜV-certified in accordance with ISO 11011
- Savings potential of up to 60% for pneumatic systems
- Support with DIN EN ISO 50001 compliance
- Greater productivity and process reliability

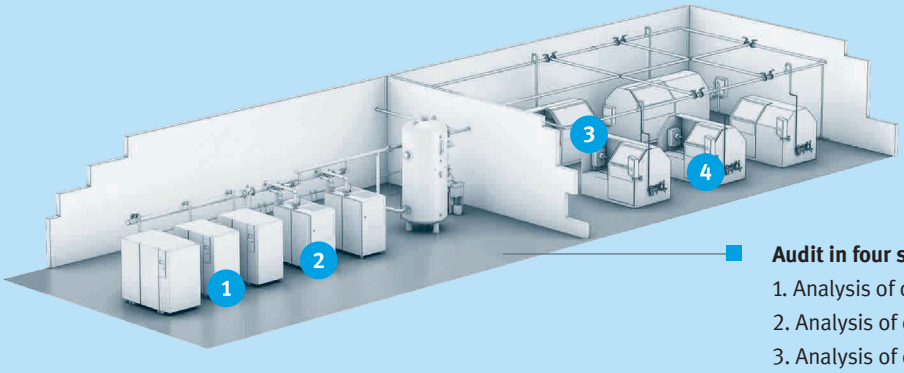
Pneumatics Sustainability Check

The Pneumatics Sustainability Check is an innovative service that is part of the Festo Energy Saving Services. During the check, we systematically inspect the pneumatic components and locate any leaks in your compressed air systems. These leaks are then evaluated in terms of energy loss, costs, and carbon emissions. The check provides a concrete calculation of potential savings, as well as a detailed list of necessary repairs, including the required spare parts.

Benefits:
- Transparent information about energy losses caused by leaks
- Analysis of potential savings on compressed air, costs, and carbon emissions
- Detailed list of necessary repairs, plus recommended spare parts
- Clear documentation of all results in the Festo Energy Saving Services Portal
- It is also possible to do it yourself. On request, Festo experts will provide training in advance.

“Only a comprehensive approach guarantees a compressed air system is optimally energy efficient.” *

Heiko Fleischhacker, Certified Energy Efficiency Auditor at Festo



Audit in four steps:

1. Analysis of compressed air generation
2. Analysis of compressed air preparation
3. Analysis of compressed air distribution
4. Analysis of pneumatic applications

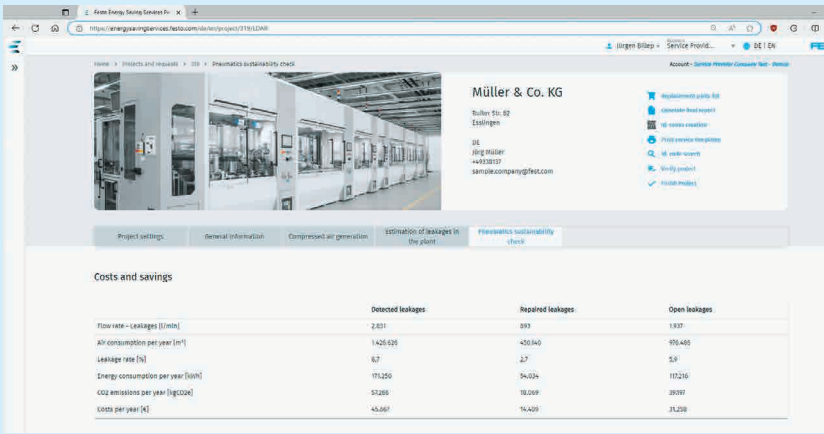
* On the next page, you can follow Heiko Fleischhacker as he visits a customer.

“The portal calculates the savings and classifies the leaks so that you can immediately identify the highest optimization potential.”

Jürgen Billep, Certified Energy Efficiency Auditor at Festo

Festo Energy Saving Services Portal

The Festo Energy Saving Services Portal provides the necessary transparency for optimizing compressed air systems. Leakage detection results and findings about the inspected pneumatic components are easily and clearly documented. The mobile app enables users to collect data directly at the production system and reliably synchronize it on the portal. With the free trial license, new functions can be tried out.



Sustainability Automation

Compressed air energy efficiency audit

Real-life application

Rising energy costs and environmental regulations make energy efficiency indispensable. Gessner has sustainably increased energy efficiency in its own company thanks to Festo Energy Saving Services. All processes, from the compressor to the pneumatic applications, were analyzed on site by Festo experts and successfully optimized.

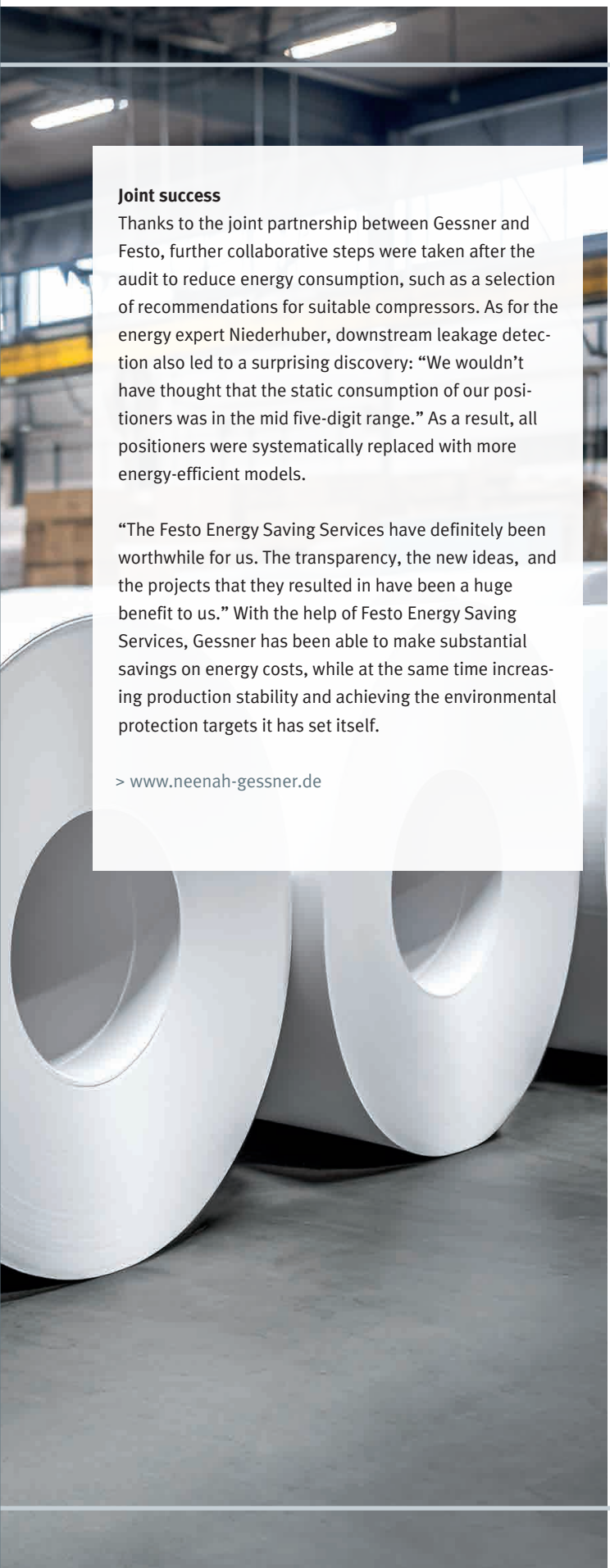
According to the German Federal Statistical Office, the production of paper, cardboard and goods made from them is one of the five most energy-intensive industries. Gessner, part of the Mativ Group, is the European market leader in the technical specialty papers and synthetic materials sector. It manufactures filtration products for the automotive industry at its site in Feldkirchen-Westerham, Germany, and is constantly developing new solutions. “It is easy to become blind to existing production processes and operations,” says Armin Niederhuber, responsible for Energy Management at Gessner. “That’s why we brought in the expertise from Festo in the person of Heiko Fleischhacker, to help us see and improve things that we don’t have an eye for ourselves.” The energy efficiency expert and certified auditor at Festo is used to not only taking a close look, but also to determine exactly where energy is not being used efficiently.

Efficiency and transparency

According to Heiko Fleischhacker, an audit always makes sense if a company wants to obtain an objective assessment and a precise picture of the current condition of its compressed air system. The aim is to identify inefficient areas and opportunities to save energy.

During his audit, Heiko Fleischhacker analyzed the entire compressed air system at Gessner and quickly identified shortcoming that, once remedied, led to sustainable energy savings. “We were also advised to install a higher-level compressor control system. With the same result,” states Armin Niederhuber. Thanks to the retrofit, the operating times of the compressors were adapted much more precisely to the actual air requirements.

All information and data obtained from the audit were processed by Festo and made available to all employees on the web-based Festo Energy Saving Services Portal, including open points on potential savings. “Everyone, from energy management employees to on-site workers and mechanics, can access it and see what needs to be done where.”



Joint success
Thanks to the joint partnership between Gessner and Festo, further collaborative steps were taken after the audit to reduce energy consumption, such as a selection of recommendations for suitable compressors. As for the energy expert Niederhuber, downstream leakage detection also led to a surprising discovery: “We wouldn’t have thought that the static consumption of our positioners was in the mid five-digit range.” As a result, all positioners were systematically replaced with more energy-efficient models.

“The Festo Energy Saving Services have definitely been worthwhile for us. The transparency, the new ideas, and the projects that they resulted in have been a huge benefit to us.” With the help of Festo Energy Saving Services, Gessner has been able to make substantial savings on energy costs, while at the same time increasing production stability and achieving the environmental protection targets it has set itself.

> www.neenah-gessner.de

As part of a leakage detection program from Festo that took several days and during which the problem was systematically rectified, Gessner was able to save 30,000 euros per year in compressed air costs at its plant.

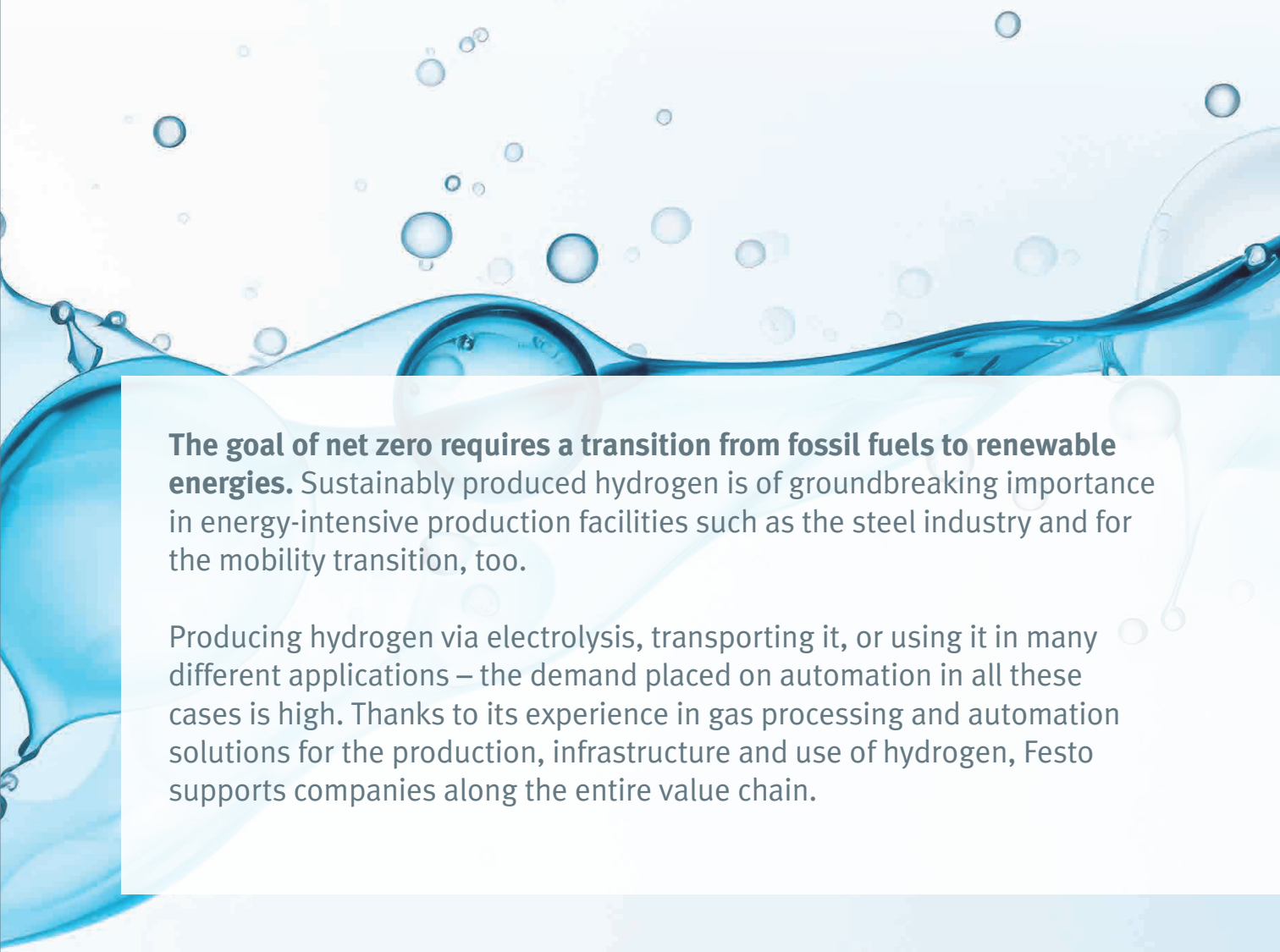
Working in partnership: From the joint inspection of the systems to the analysis and evaluation. (Armin Niederhuber, Energy Management Expert at Gessner, left, and Heiko Fleischhacker, Certified Auditor from Festo).

Maximum transparency: The Festo Energy Saving Services Portal provides a clear overview of all data for optimizing compressed air systems.

> www.festo.com/ess/audit

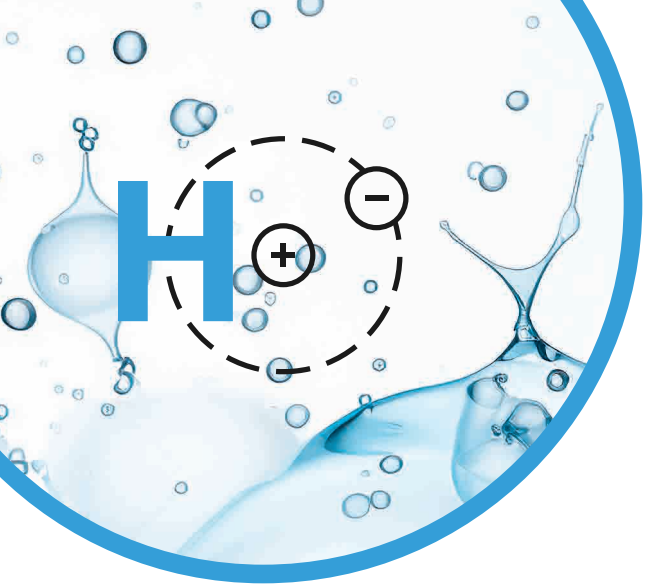
2 Hydrogen

“Tomorrow’s energy is water that has been broken down by electric current. The elements of water thus decomposed, hydrogen and oxygen, will secure the earth’s energy supply for the unforeseeable future.” Jules Verne, 1875



The goal of net zero requires a transition from fossil fuels to renewable energies. Sustainably produced hydrogen is of groundbreaking importance in energy-intensive production facilities such as the steel industry and for the mobility transition, too.

Producing hydrogen via electrolysis, transporting it, or using it in many different applications – the demand placed on automation in all these cases is high. Thanks to its experience in gas processing and automation solutions for the production, infrastructure and use of hydrogen, Festo supports companies along the entire value chain.

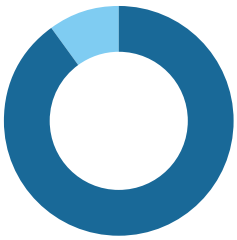


Hydrogen is ...

- 14 times lighter than air
- Colorless and odorless, non-toxic
- Non-flammable in pure form
- Highly flammable with oxygen

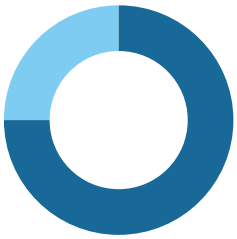
Gaseous up to -253 °C
Liquid at -252 °C
Solid at -259 °C

Hydrogen was described by its **discoverer Cavendish** (1731, Nice – 1810, London) as "flammable air".
Chemist de Lavoisier (1743, Paris – 1794, Paris) baptized the gas "hydrogène".



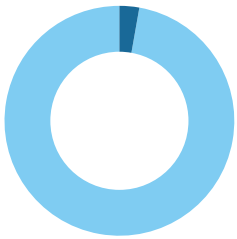
90%

of all atoms in the universe are hydrogen atoms.



75%

of the mass of our solar system is hydrogen.



2.9%

of the earth's crust consists of hydrogen.

Hydrogen occurs in nature only in bound form, including in water (H_2O), hydrocarbons such as natural gas, or crude oil, or in minerals.

Hydrogen is key for future energy systems and can be used directly as an energy source, e.g., as a component for aircraft fuels.

Green hydrogen
Origin: Obtained from water through electrolysis using electricity from renewable energy sources.
Carbon emissions: None

Blue hydrogen
Origin: Fossil natural gas
Carbon emissions: Up to 90% can be stored

Grey hydrogen
Origin: Fossil natural gas
Carbon emissions: About 10 t CO_2 per ton of H_2

Fuel of the solar system

600 million tons of hydrogen fuse into helium every second inside the sun and thus supply the solar system with energy.

Hydrogen is not freely available on earth and is produced using primary energy (e.g., wind or solar energy).

Element of extremes
Hydrogen is the lightest element and also has a high energy density:

Hydrogen 33.3 kWh per kg
Gasoline 12.0 kWh per kg
Natural gas 10.6 – 13.1 kWh per kg

1 ton of hydrogen

provides 33,330 kWh of energy and is enough to supply seven households with electricity for a year.

"Green hydrogen is the central building block of the energy transition; it is particularly essential for storing and transporting large quantities of energy."

Dr.-Ing. Max Ellerich, Solution Manager H2 Production, Neuman & Esser (manufacturer of PEM electrolyzers with over 100 years of experience in hydrogen plant construction)

Hydrogen energy storage: When hydrogen is produced using renewable energies, CO_2-neutral energy becomes available for e.g., chemical and steel production (sector coupling) or as fuel for transportation.

2030

> 40 gigawatts: That is the electrolysis capacity for producing green hydrogen that the EU hydrogen strategy is aiming for by 2030.

> 85 billion euros: The market volume of the hydrogen industry expected in the EU by 2030.

> 38 measures: The number of measures the German Ministry for Economic Affairs and Energy is planning to introduce by 2030 to make hydrogen usable as an energy source for the energy transition.

> 20%: The EU's goal for covering European energy consumption with hydrogen by 2050.

> 160 million tons of green hydrogen could be produced worldwide in 2050, according to forecasts.

2050

Hydrogen

Automation solution for green hydrogen production

Producing energy in an environmentally friendly way is one of the greatest challenges of our time, and this is where green hydrogen plays an important part. It will have a decisive role to play in the future supply of energy and the reduction of carbon emissions in energy-intensive industries.

Numerous safety regulations must be observed when expanding hydrogen production capacities and the necessary infrastructure. Depending on the specific requirements and characteristics of production, different solutions are possible, such as centralized or decentralized automation solutions, compact control cabinet systems or flexible, modular concepts.

> **www.festo.com/hydrogen**

Ready-to-install control cabinet: Complete with explosion protection and functional safety (SIL).

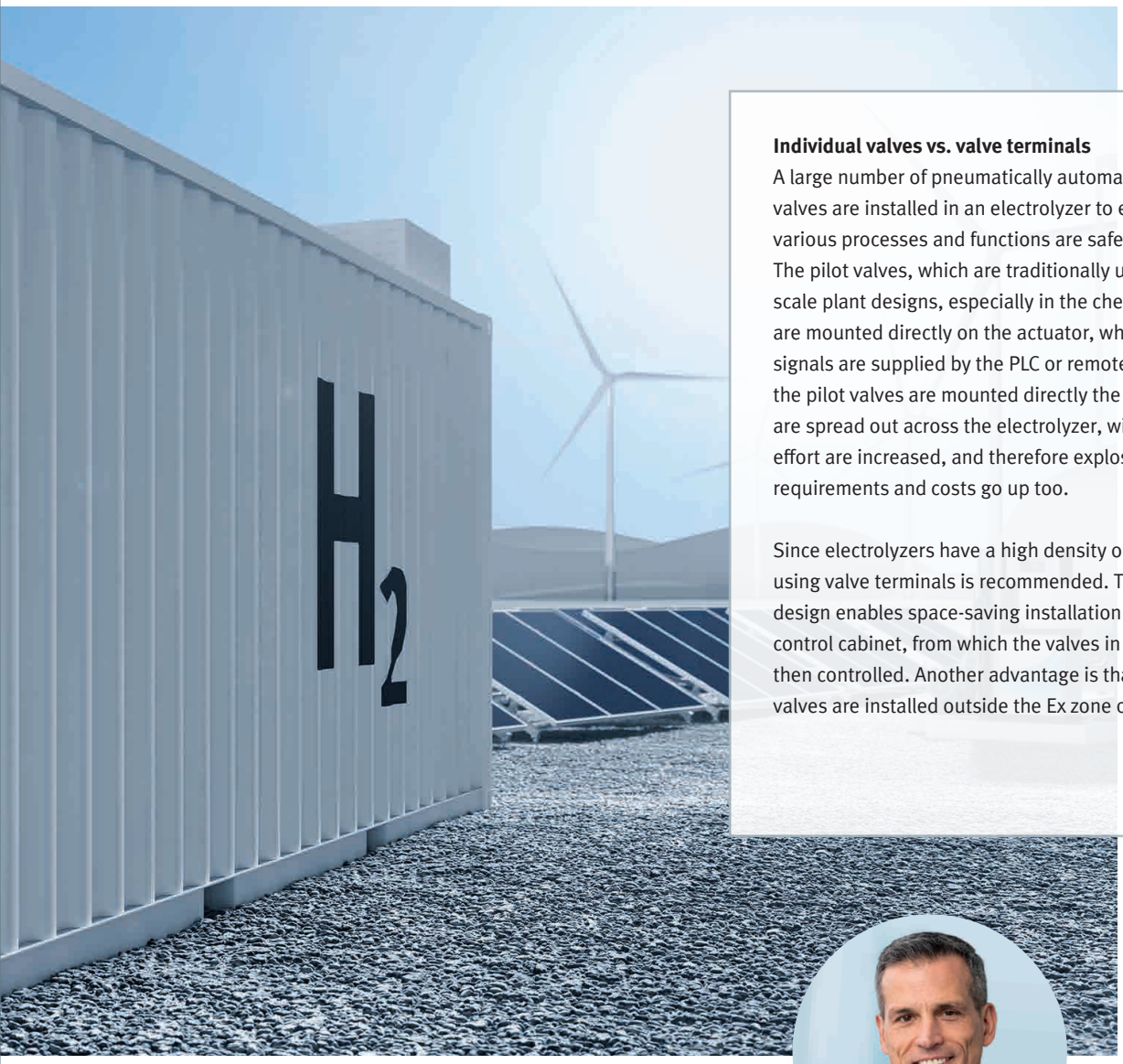
Electrolyzers are the central element along the hydrogen value chain. The systems that split water into hydrogen and oxygen are key components in numerous industries. Complying with the required functional safety (SIL) and limiting risks are therefore crucial. This can be achieved by using suitable products and solutions.

An automation concept that precisely matches the electrolyzer is therefore decisive for efficient, safe, and long-term operation. Festo offers a wide range of components that meet these requirements.

Safety as the top priority

Hydrogen is a colorless, volatile and non-toxic gas, but it is very flammable and is processed at high pressure. Electrolyzers therefore pose several challenges in terms of safety. To get the green hydrogen produced to a point where it can be used, it has to be made transportable, for example by compressing it in a compressor station.

The safety of a system is also important in the event of malfunctions or faults. Festo offers numerous products that are specially certified for use in potentially explosive atmospheres and in accordance with the SIL standard to IEC 61508, such as the sturdy and corrosion-resistant solenoid valves type VOFC and VOFD. The functional safety of electrolyzers is therefore essential to make industrial processes safe, efficient, and environmentally friendly.



Individual valves vs. valve terminals
A large number of pneumatically automated process valves are installed in an electrolyzer to ensure the various processes and functions are safe and reliable. The pilot valves, which are traditionally used in large-scale plant designs, especially in the chemical industry, are mounted directly on the actuator, while the control signals are supplied by the PLC or remote I/O. When the pilot valves are mounted directly the actuators and are spread out across the electrolyzer, wiring time and effort are increased, and therefore explosion protection requirements and costs go up too.

Since electrolyzers have a high density of pilot valves, using valve terminals is recommended. The compact design enables space-saving installation in the existing control cabinet, from which the valves in the field are then controlled. Another advantage is that the solenoid valves are installed outside the Ex zone or in Zone 2.

Customized and ready to install
Festo offers control cabinet solutions for a wide range of applications. They protect components against environmental influences and foreign bodies. Regardless of whether pneumatic, electric or electro-pneumatic components are used, the end result is a fully configured control cabinet.

For applications in potentially explosive atmospheres, the control cabinets can be planned, assembled and certified in accordance with regional and international regulations, with components for functional safety (SIL) available on request.

“An automation concept that is perfectly matched to the electrolyzer is the key to its efficient, safe, and long-term operation.”

Alexander Vargas, Head of Global KAM and ISM Process Industries, Festo

Hydrogen

H_2 trailer control with valve terminal solution

Real-life application

Hydrogen makes sustainable energy mobile. With the intelligent trailer control system HY.Runner from GP JOULE, transporting H_2 is more efficient, safer, and more environmentally friendly. The Festo valve terminal VTUG and the solenoid valve VOFC provide a space-saving design on the trailer chassis, as well as additional safety.

From generating to using renewable energy, GP JOULE as an integrated energy supplier is active along the entire energy value chain. The newly developed trailer control system HY.Runner won the German Renewables Award as “Hydrogen Innovation of the Year” in November 2024. It is the second project of GP JOULE to receive this prestigious award. HY.Runner is already being used in HY.CITY.Brermerhaven, a model region for the production and use of hydrogen.

Smart controlled sectors

The intelligent trailer control system ensures that the hydrogen produced in electrolyzers is delivered to hydrogen filling stations or industrial customers as efficiently as possible. The advantages of this innovative solution are the optimum utilization of the hydrogen quantities in the trailer and the networked communication between the electrolyzers, filling stations, and mobile H_2 reservoirs. The central component of the innovative solution is the process control system running directly via the trailer as the hydrogen is being filled and removed. The hydrogen storage sectors are smartly controlled so that as much hydrogen as possible can flow to the filling stations as quickly as possible.

The hydrogen supply can be drawn off remotely at any time, resulting in greater flexibility and high precision in hydrogen distribution. In addition, a standardized interface makes the trailer independent of the stationary remote station. By monitoring all the operating conditions, safety is increased and integration into the safety concepts of filling and extraction points is simplified.

Green energy from wind farm to hydrogen filling station:
Hydrogen production site of the eFarm project in North Frisia, Germany, initiated by GP JOULE.

“HY.Runner enables green hydrogen to be transported safely and efficiently.”

André Steinau, Head of Business Relations GP JOULE and Managing Director HY.City.Bremerhaven

Photos: GP Joule

Pneumatically functional and safe

The intelligent control system is housed in the lower frame area of the trailer chassis. This means that a pneumatic solution that was both sturdy and space-saving was required. The choice was made for the valve terminal VTUG from Festo. With its high pneumatic functionality and electrical modularity, it can be quickly integrated into various automation solutions and can be easily configured, too. Thanks to its compact dimensions, it is perfect for use in the HY.Runner. To meet the high SIL safety standards, the valve terminal VTUG is actuated using the Festo solenoid valve VOFC. The indirectly controlled pilot valve is designed for particularly demanding operating conditions and is suitable for safety-related systems up to SIL3.

Green H_2-Bremerhaven ecosystem

HY.Runner is showcasing its strengths for the first time in the regional energy transition project HY.CITY.Bremerhaven, which was initiated by GP JOULE Hydrogen GmbH and Green Fuels GmbH. The project uses renewable energy from local wind turbines to operate a 2-megawatt electrolyzer. The hydrogen extracted is stored directly in a trailer with an intelligent control system and delivered to a publicly accessible H_2 filling station. With the electrolysis capacity, up to 34 buses and more than 190 cars can be refueled every day.

> www.gp-joule.com

Electricity from wind is converted to hydrogen in electrolyzers and, smartly controlled by the Festo valve terminal VTUG and solenoid valve VOFC, is fed directly into the mobile H_2 trailer.

> www.festo.com/catalogue/vtug **> www.festo.com/vofc**

3 Life Sciences

Growing and aging populations, increasing risk of illness, and global mobility call for cost-effective healthcare solutions. The demand for new health and diagnostic procedures, both for use with people and in laboratory automation, is constantly growing.

Technical developments such as miniaturization, integration or dispensing of ever smaller fluid volumes are opening up new opportunities in the life sciences. Festo promotes this development in the LifeTech sector and supports it with innovative, more compact components, highly integrated modules, and a special focus on microfluidic products for controlling gases and liquids.

Life Sciences

Microfluidics: Focus on miniaturization

Interview//Life sciences such as medicine, pharmacology, and biochemistry are becoming increasingly important worldwide. The demand for analytical and diagnostic processes in the life sciences is growing. Thanks to major advances in microsystem technology and microfluidics, tests can now be carried out quickly and easily on patients at the point of care. Lab-on-a-chip solutions optimize processes in laboratory automation. **Prof. Dr. Roland Zengerle,** one of the leading experts in microsystem technology and microfluidics, explains why these small systems are on the rise.

Photo: W. Sperl

About the person

Prof. Dr. Roland Zengerle is a physicist and one of the leading experts in microfluidics, a branch of microsystem technology. He conducts research at the Institute for Microsystems Engineering (IMTEK) at the University of Freiburg, Germany. www.imtek.de

» You are one of the scientists at the forefront of research into microsystems and microfluidics. What was it that fascinated you about this back in the early 1990s?

Prof. Dr. Roland Zengerle: My generation watched Star Trek when we were young. There was the tricorder, a device the size of a smartphone today, with which you could analyze what was wrong with a patient in seconds. Ideas like that inspired me and many of my colleagues and spurred us on to carry out research into microsystem technology. In those early years – the 1990s – the vision that emerged has almost become reality now, apart from a few compromises in terms of the size of today's analyzers and the scope of possible diagnostics. We currently have mobile test devices that perform complex analyses on body fluids.

» How far has the miniaturization of laboratory technology already progressed?

Zengerle: We are able to carry out diagnostics during a point-of-care test with a machine that fits on a DIN A4 sheet of paper. Years ago, a large-scale laboratory needed a machine measuring around two by five meters to do this. Instead of two tons, today's lab-on-a-chip solution weighs only five to ten kilograms. And the trend is towards further miniaturization. However, there will still be limits to what is feasible in the future. A minimum amount of liquid is required for analysis and therefore the test cartridges need to be a certain basic size, because nowadays we detect analytes which only have a few molecules in 1 cm^3 of sample.

» Microsystem technology and microfluidics only really gained in importance with the coronavirus pandemic, didn't they?

Zengerle: Yes and no. During the pandemic, new diagnostic procedures and devices were developed at full speed and brought to market, such as PCR test devices that can detect pathogens extremely sensitively and reliably in 15 to 30 minutes. That saved us time, since we were able to shorten the traditional route via a large laboratory. But what hardly anyone remembers these days is that the infamous moose test in the automotive industry in 1997 was a real accelerator for microsystem technology. At the time, a relatively new model from a well-known German car manufacturer flipped onto its roof during a skid test. Microsystem technology in the form of modern acceleration and angular rate sensors has made a significant contribution to solving this problem.

» Where are products from your research area used today?

Zengerle: There are around 100 or more sensors installed as components in a car, several dozen sensors in smartphones, and even fitness wristbands contain microsystem technology. Today, the smallest systems have established themselves in our everyday lives across the board and across all industries, usually without us being aware of it.

Microfluidics has also produced many products, although they are less common in everyday applications. One example is the chips that make it possible to sequence a human genome within just one day and at a cost of a few hundred euros. 25 years ago, that would have cost three billion euros and would have taken several years. Nowadays, there are hardly and modern technologies in life sciences that are developed without knowledge of microfluidics. The volumes to be analyzed are getting ever smaller, the requirements for precision are getting ever more demanding, and this automatically leads to phenomena that have been researched using microfluidics.

» What trends do you see and how much room for improvement is there for further developments?

Zengerle: Genome sequencing will become one of the dominant technologies in diagnostics. In the past, individual biomarkers were tested, but in the future, it will be possible to sequence the entire genome, allowing us to examine a health disorder in much greater depth. Nowadays, the individual cells of a tumor tissue are already sequenced for cancer therapy.

In addition, patient-specific cell therapies will increasingly gain ground. CAR T-cell therapy, for example, uses the body's own immune system to fight cancer. To do this, white blood cells are taken from the patient's blood and genetically modified in the laboratory so that they can recognize and specifically destroy cancer cells. I see a great opportunity for the development of bioreactors to produce these patient-specific cells in the future.

> "Point-of-care technologies and laboratory automation can benefit from each other, for example by combining classic laboratory robots with microfluidic chips."
>
> Prof. Dr. Roland Zengerle

» What about taking a look into the future?

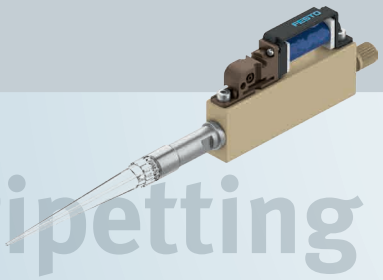
Zengerle: Then I would like to return to our initial topic: In the past 60 years, we have come much closer to the tricorder than to beaming from the same science fiction series. In another 60 years we will perhaps have fully developed the tricorder, although I don't think it will work contactlessly like in Star Trek. You will certainly need a little body fluid. And you are definitely going to need microfluidics!

LifeTech

Smart solutions for laboratory and medical devices

The changing fluid properties of different media requires that very small quantities of liquids, down to the microliter range, have to be handled with great precision, flexibility, and process reliability. Pressure-controlled liquid handling systems enable precise, scalable liquid handling. Festo has suitable solutions for these systems, whether for pipetting, dispensing or aspirating. From handling and positioning sample containers to the precise dispensing of liquids in microtiter plates, Festo offers a wide range of components in various sizes.

> www.festo.com/lifetech



Pipetting

Precise and powerful pipetting head DHOE

The open pipetting system for the easy transport of liquids allows you to configure and flexibly extend the most important pipetting functions in line with your needs. The system is also compatible with a range of tip sizes. Thanks to its outstanding chemical resistance, it can handle a wide range of liquids with varying viscosities. Even minute volumes as small as 5 µl can be pipetted with the greatest precision.

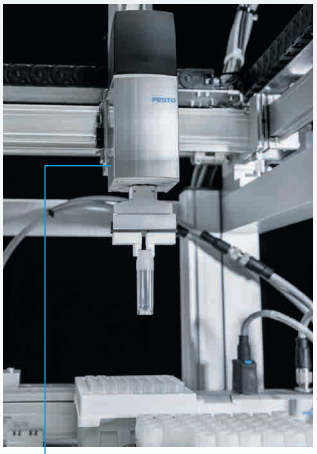
> www.festo.com/liquidhandling

Decapping

Gripping and decapping sample vials with rotary gripper module EHMD

Opening and closing sample vials is one of the core processes in sample preparation. Combined rotary gripper modules perform two process steps at once: gripping and decapping or recapping. The special feature of the rotary gripping module EHMD is its suitability for a wide range of vial sizes and heights with different lid types. It can be used universally and opens the screw cap of the vial regardless of its thread pitch.

www.festo.com/catalogue/ehmd



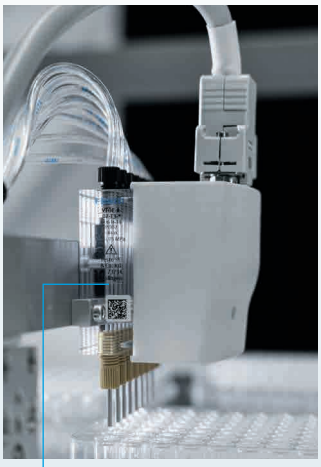
The **rotary gripper module EHMD** reliably carries out all tasks assigned to it, whether for in vitro diagnostics, cell or genome research, or quality inspections in the biotech and pharmaceutical industries.

Dispensing

Contactless dispensing of the smallest volumes with dispense head VTOE

The high-precision dispense head VTOE is a complete modular solution consisting of a manifold duct plate, dosing valves, and nozzles. Media-separated valves prevent cross-contamination and ensure optimum flushability. It enables contactless dispensing and a minimum dosing volume of 1 µl and is also suitable for sensitive and aggressive liquids.

> www.festo.com/catalogue/vtoe



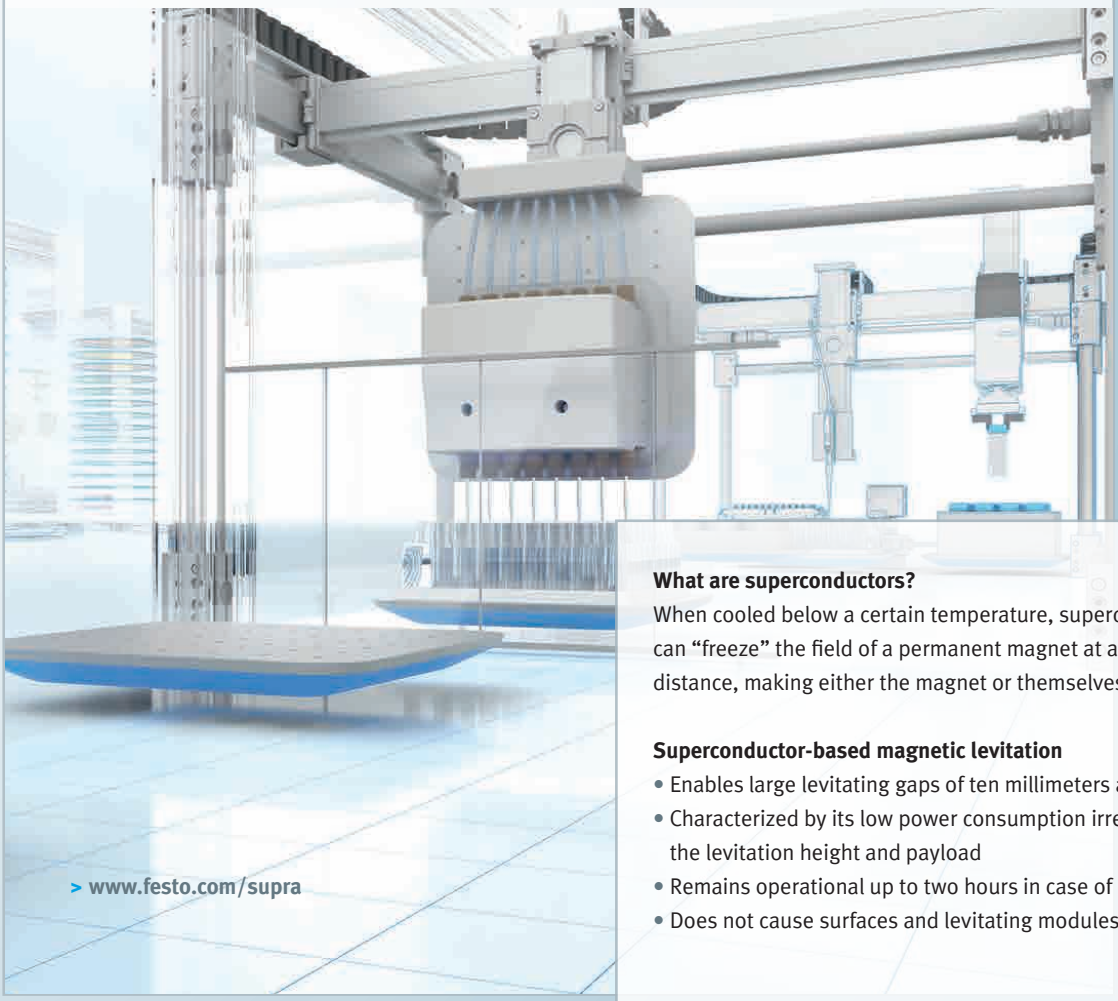
With its wide range of possible applications, the **dispense head VTOE** can dispense various liquids and filling quantities.

Innovation and research

Research and development for life science applications
The goals in the different areas of life science are different, but innovation is crucial for companies across the entire industry sector. For example, automation and digitalization, the use of artificial intelligence (AI), robotics and microfluidics, as well as personalized medicine, will shape the laboratory of the future, as will innovative material technologies such as nanomaterials, smart materials, and superconductors.

Contactless working with superconductor technology
Superconductors enable objects and fluids to be moved and handled without any contact. This makes them ideal for sterile and safe working practices in laboratories and biotechnology. With SupraMotion levitating modules and products from our automation portfolio for laboratory applications, the highest standards of cleaning and cleanliness can be met.

The magnetic forces between the superconductor and the carrier on which the containers are transported enable levitation heights of ten millimeters and more. This leaves plenty of space for partition walls that enclose sterile working environments. It is possible to move the carrier through walls and to check its weight using standard laboratory scales. This means that most of the technology remains outside the cleanroom.



> www.festo.com/supra

What are superconductors?
When cooled below a certain temperature, superconductors can “freeze” the field of a permanent magnet at a specific distance, making either the magnet or themselves levitate.

Superconductor-based magnetic levitation
- Enables large levitating gaps of ten millimeters and more
- Characterized by its low power consumption irrespective of the levitation height and payload
- Remains operational up to two hours in case of power failure
- Does not cause surfaces and levitating modules to heat up

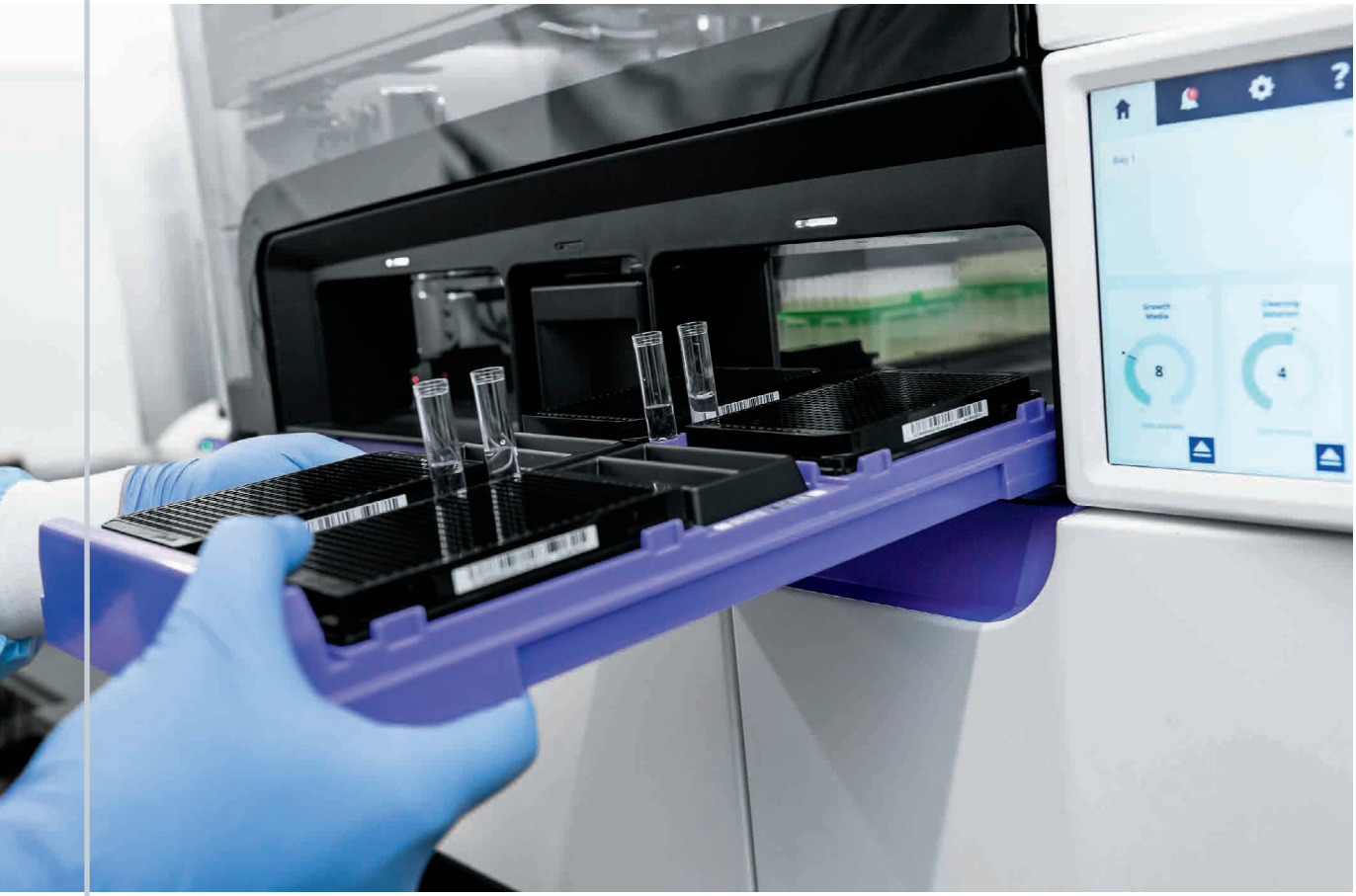
LifeTech

Rapid antibiotic diagnostics

Real-life application

One of the greatest discoveries in modern medicine was made by the British doctor and bacteriologist Alexander Fleming in 1928: penicillin. The development of the manufacturing process in 1943 paved the way for the global fight against diseases. But that was only a partial success. Since then, there has been a race between microbes with antimicrobial resistance and research into new active ingredients.

Personalized antibiotic therapy can help solve this problem. Before medication is administered, it determines which antibiotic in which dosage promises the best therapeutic outcome for a patient. To support this process, U.S. company Selux Diagnostics has developed an automated process, supported by the Technology Engineering Center (TEC) from Festo.

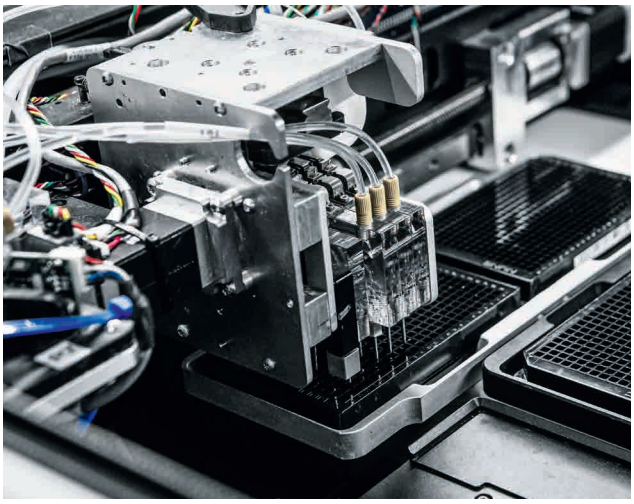


Selux NGP determines to which antibiotics the pathogen reacts and to which it is resistant. After inoculating the microtiter plates, the laboratory staff place the sample carriers in the analyzer and the system takes care of the rest.

> www.festo.com/excm
> www.festo.com/catalogue/vtoi

The Selux Analyzer is the heart of the Selux NGP system and provides rapid phenotypic AST results in an average of 5.5 hours.

Maximum functionality in the smallest installation space: the planar surface gantry EXCM-30 is perfect for use in laboratory processes such as the dosing application shown here.



Fast and precise dosing thanks to the pressure-controlled dosing system of Festo.

Personalized therapy

"One solution to the growing challenge of antibiotic resistance is personalized antibiotic therapy," says Aleksandar Vacic, President and co-founder of Selux Diagnostics. "Today, patients usually receive a broad-spectrum antibiotic at the start of an infection. Whereas targeted treatment is only administered once the results of an antimicrobial susceptibility test (AST) are available. This takes one to four days. With our new Selux platform, we can reduce this time to just a few hours."
The innovative precision diagnostics provides doctors with valuable information for quickly selecting the right antibiotic for a patient.

TEC supports innovation

Repeat accuracy and speed are crucial factors in automated and individualized ASTs. Festo TEC, Boston, Massachusetts, took on the challenge to find a suitable solution. The team of on-site experts supported the development of a precise pipetting system for liquids. "The Festo Technology Engineering Center played a key role in the development of the Selux platform," explains Christopher Duchesneau, Industry Segment Sales Specialist, Life Science at Festo.

"The Festo experts were heavily involved in the implementation of Selux-specific tests and the validation of Festo life science products. This led to the development of customized products and the modification of standard Festo products." This is why the latest dispense heads VTOE and VTOI and valve control module VAEM were integrated in the innovative medical technology solution from Selux. The compact planar surface gantry EXCM-30 together with the rotary gripper module EHMD, which is ideal for gripping, rotating, and aligning small objects such as blood samples in laboratory automation, ensures the microplates are handled quickly and safely.

86 tests in just a few hours

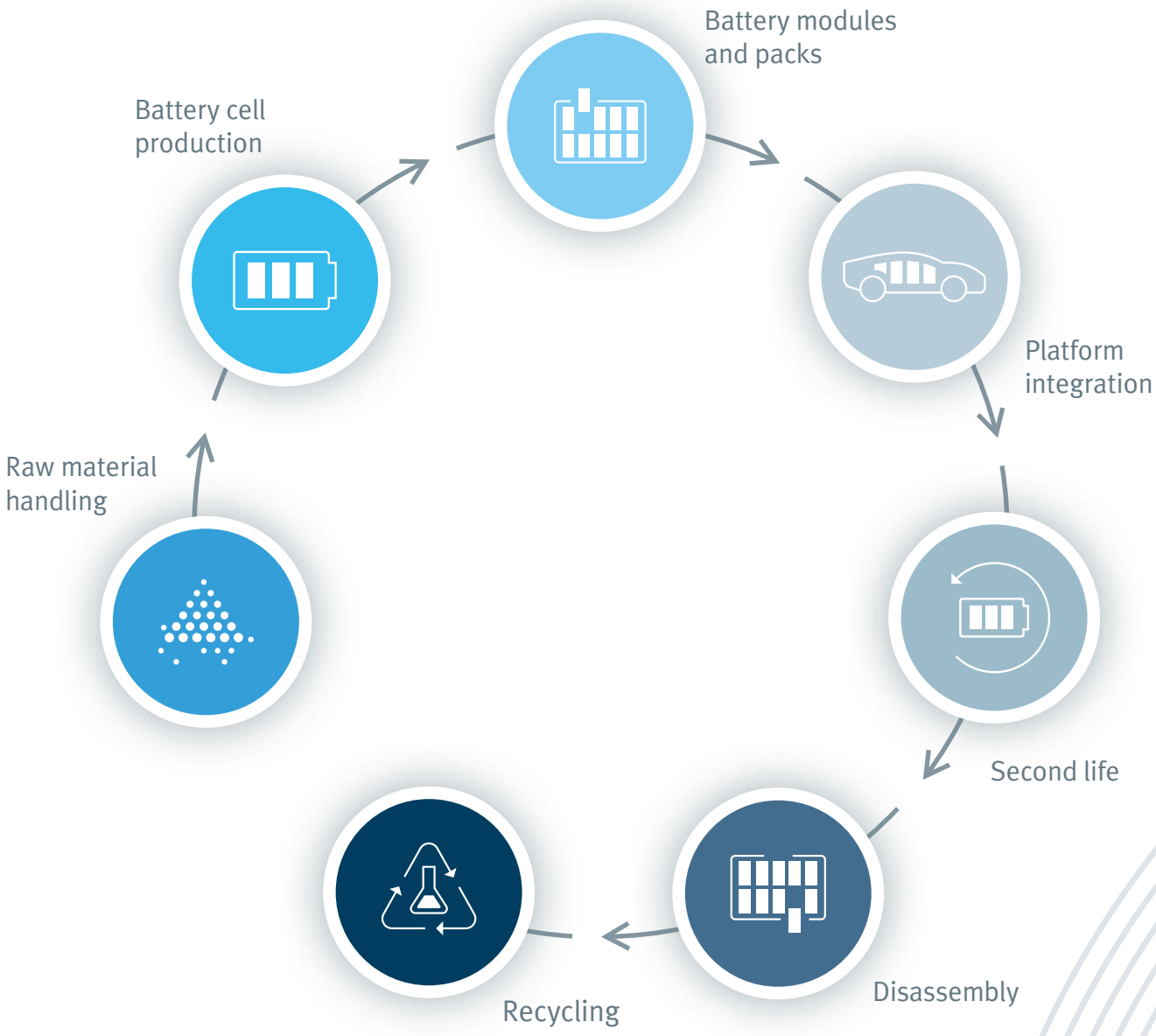
With a capacity of 86 plates, the Selux platform is able to test 86 patient samples simultaneously. To increase the flexibility of the processes, the samples are picked up randomly. The expandable system can incorporate new antibiotics coming onto the market into the analysis process and can therefore be adapted to pharmaceutical changes. The high degree of automation reduces the workload of laboratory staff, who simply need to insert sample carriers into the analyzer. The Selux platform takes care of all further steps.

> www.seluxdx.com

Electromobility

Increasing battery capacity will play a vital role in the coming years. The focus is on clean energy technologies, especially batteries, which are regarded as an important source of energy for a sustainable energy future. In this context, the transformation to a circular battery economy is particularly important, since it efficiently closes the material cycle from production to recycling.

Automation technology is hugely significant for electromobility. Automated processes in battery production increase efficiency, improve quality and scalability, and help reduce manufacturing costs.



Festo offers its customers a product portfolio that completely covers the seven phases of sustainable production and recycling in battery life cycle management.

Electromobility

Partner in battery production

According to a study by Porsche Consulting and VDMA, over 200 battery factories will be built worldwide in the next 10 years, mainly in Europe. The market for energy storage systems will grow from 20 billion euros to 550 billion euros per year by 2030.

Thinking in cycles
Automation is the key to safe and efficient production processes and to achieving the required large quantities.

Automation not only enables battery cells to be economically produced, but also enables the recycling processes to be precisely monitored and controlled. By using automated systems, valuable materials can be efficiently recovered from the batteries and reused. This guarantees a more sustainable and environmentally friendly value chain.

> **www.festo.com/battery**
> **www.festo.com/electromobility**

Battery cell production

Battery cell production is a central part for the development of modern energy storage solutions, especially for electric vehicles. This market offers enormous potential since the demand for efficient and environmentally friendly batteries is constantly growing.

> **Process optimization**
An optimized production process is crucial in order to remain competitive. This includes the careful planning and monitoring of all production steps, from raw material preparation to cell assembly and end-of-line testing. Continuous process improvements reduce production costs while the quality of the battery cells remains high.

> **Regulations and standards**
Compliance with legal regulations and standards is a must for battery cell production. This includes safety and environmental standards as well as specific requirements for lithium-ion cells. By complying with these regulations, companies minimize legal risks and gain the trust of customers and partners.

> **Quality control**
Quality control is essential to guarantee the safety and reliability of products. Automated testing systems ensure the accuracy and consistency of the tests. Thorough quality control not only contributes to product safety, but also enhances efficient operation as it reduces rejects and rework.

"Choosing the right automation solutions is the first step towards successful battery cell production."

Jochen Luik, Product Management Electromechanics, Festo

Products for battery cell production

With the specially developed non-ferrous metal-free product portfolio from Festo, the reject rate of faulty batteries can be significantly reduced while the quality and speed can be increased. It ensures compliance with environmental regulations and avoids potential pollutants.

Festo greatly values quality and environmental protection. The company is therefore ISO 9001 certified for quality and ISO 14001 certified for the environment. Products from Festo are also suitable for use in clean-room and dry room environments. These tested products ensure reliable and precise performance, even under demanding conditions.

Extracting forming gases
When battery cells are initially charged, so-called forming gases are produced, and these must be extracted in a controlled manner. Precise vacuum control is essential for the safety of the process. With media valve VZQA, piezo valve VEAB and pressure sensor SPAW, Festo offers an economical and safe solution.

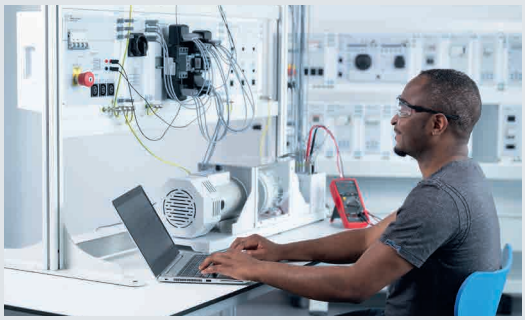
Media valve and pressure sensor: Maximum resistance to forming gases thanks to the use of special materials.

Pressure sensor SPAW
- Extremely sturdy
- For liquid and gaseous media
- Optimal legibility: Display housing rotatable 320°, display at an angle of 45°

Flow regulator VEAD
- Modular design
- Quick and easy replacement of the diaphragm
- For critical, abrasive and viscous media
- Flow direction can be freely selected

Proportional pressure regulator VEAB
With the piezo valve the VZQA can be dynamically and precisely controlled.

- Up to 6 bar
- Extremely precise and durable
- Fast control behavior
- Silent operation
- Low energy consumption



Further training concepts for battery production
The technological development towards electromobility is creating more and more jobs – in new gigafactories, as well as at suppliers and integrators around the world. The demand for qualified workers in battery production is on the increase.

Festo Didactic offers a wide range of learning formats, from live online introductory seminars on battery life cycle management to onboarding training in battery production.

> **www.festo.com/didactic**

Electromobility

Automation in the battery life cycle

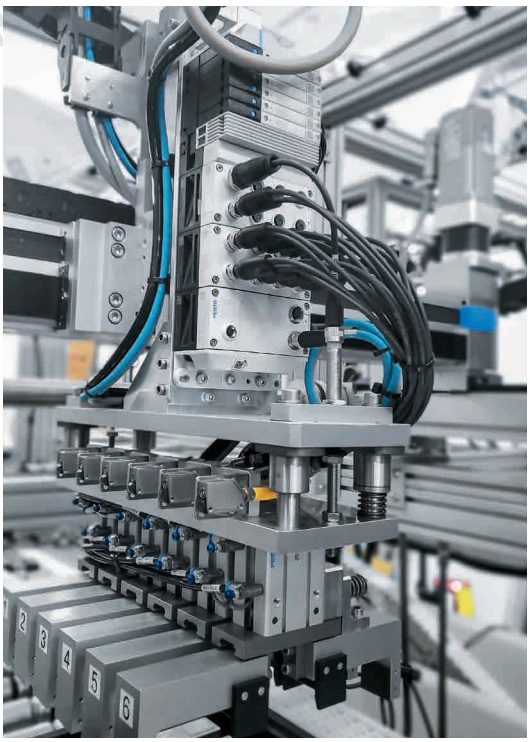
Real-life application

Inspection of battery cells

Electric vehicles require high-quality batteries to operate reliably. A new automatic handling system from Harris Hill Automation now enables individual charged battery cells to be inspected safely, thoroughly, and quickly. The seamless integration of Festo servo drives, motors and actuators has contributed to a twenty-fold increase in product throughput. The engineering tool HGO ensured that the innovative system was designed and commissioned quickly. The new Festo valve terminal VTUX sustainably increases flexiblilty.

OEM successfully breaks new ground

With its innovative solution, Harris Hill Automation has successfully ventured into new territory for an OEM customer. Until now, this company did not have an automated process for handling battery cells during the inspection process. Now, individual cells are seamlessly tracked and documented as they enter and exit the new inspection system.



Flexible solution: Valve terminal VTUX is suitable for almost any machine concept, whether centralized or decentralized. The modules are compact, lightweight, and can be arranged as required. You save time, space and weight in the machine.

The new handling system uses a pick-and-place solution to remove incoming battery cells from a tray via a conveyor belt and transfers them to the inspection system. An end-of-arm tool with six pneumatic grippers from Festo is used for this task. The individual battery cells are then tested. The results of the quality inspection are fed digitally into the Manufacturing Execution System (MES) of the plant for complete traceability. Once the cells have been inspected, the handling system transports them to the dispensing point, where they are placed back into trays for onward transportation.

Simple sizing and commissioning

The key to the successful development of the new machine was maximum precision when handling the charged battery cells. Harris Hill Automation achieved the customized specification of the gantries using the Handling Guide Online (HGO) from Festo. The engineering tool supported the U.S. automation experts in sizing and selecting the components and provided 2D CAD files, a parts list, the delivery date and the price for the entire system at the end of the design process. The handling system was commissioned quickly and efficiently using the free PC-based software tool Festo Automation Suite and the digital commissioning file supplied by Festo Handling Guide Online.

Festo VTUX works directly at the front end

The flexibility of the machine design was increased by the modular valve terminal VTUX from Festo. Introduced in 2024, Harris Hill Automation was one of the first companies in North America to use it. And with success. When mounted directly on the end-of-arm tool, the VTUX terminal shortens the length of the compressed air tubes while its lightweight design optimizes handling movements. The VTUX terminal offers advantages for centralized and decentralized machine concepts thanks to integrated electric and pneumatic valves. The comprehensive connectivity, which ranges from multi-pin or IO-Link interfaces to fieldbus integration, ensures easy and efficient integration into different communication environments.

> www.harrishillautomation.com

> www.festo.com/engineeringtools
> www.festo.com/vtux

Dismantling battery packs

Modern batteries are not only the powerhouses of electromobility, they also are as a source of raw materials for producing new energy storage systems. At the end of their first life, they can be dismantled, reprocessed, and given a second life. Italian company Comau, supported by Festo technology, has now developed the Flexible Dismantling (Flex-BD) robot cell precisely for this purpose. With the robot-assisted battery disassembly cell, different types of batteries with a low state of charge can be flexibly managed, and safety for operators and equipment in the recycling process is also increased.

Excellent processing flexibility

The Flex-BD from Comau uses a flexible, repeatable and standardized process to automate all the steps for dismantling used batteries from electric cars. The robot cell was designed with the simplest possible processes in mind. Flex-BD feeds battery packs one by one into the disassembly room, where a heavy-duty industrial robot adapts the handling and machining process to the requirements of the different battery types. In a typical recycling application, for example, the robot unscrews the battery cover, changes the grippers to remove the cover, attaches a suitable screwdriver to loosen the modules and then transports the parts to the storage area using grippers. From there, the separated components can be sent for reprocessing.

Easier conversion

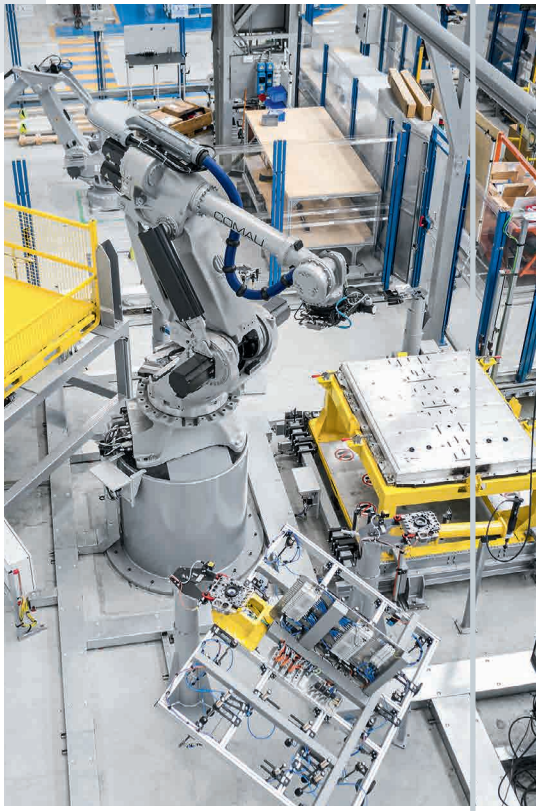
A key advantage of Flex-BD is its amazing flexibility to process different types of battery packs from different manufacturers. In addition, simple yet innovative solutions reduce implementation and setup costs, as well as cycle times. Festo components are instrumental in ensuring the excellent performance and reliability.
They range from electromechanical components to soft start/quick exhaust valves of type MS6-SV, which de-energize critical parts in the event of an emergency stop. Festo solutions also make it easier to modify the system and help to automatically adjust the positioning of the battery packs. The Festo remote I/O system CPX-AP-I ensures a high degree of flexibility and self-learning capability.

Precise positioning of different modules

The technologies and solutions used by Festo also include the compact and lightweight valve terminal VTUG with fast switching times, low power consumption and high flow rates – ideal for use in robotic applications. Toothed belt axis ELGG and spindle axis EGC have also been integrated, making sure the different-sized modules are precisely positioned and processed. Festo electric motors enable the module grippers to be reconfigured so that parts which have different dimensions as a result of mechanical or thermal deformation, can also be processed during battery disassembly.

> www.comau.com

> www.festo.com/cpx-ap-i
> www.festo.com/ms6-sv



The Flex-BD robot cell from Comau dismantles battery packs quickly, safely, and flexibly. Equipped with Festo solutions, it ensures the battery packs are optimally handled and increases the efficiency of the entire process. (Photo: Comau)

5 Semicon

For companies in the semiconductor industry, specific innovations and rapid developments are hugely important.
The systems that are used to manufacture modern semiconductors have stringent requirements when it comes to process reliability and repeatability. That is the only way structures of just a few nanometers in size can be produced with consistent precision.

Festo offers innovative and energy-efficient solutions, including for the precise dosing of nitrogen, as well as a broad product portfolio and the use of new technologies such as piezo technology.

160 is the number of **chips** in a modern smartphone

A hybrid car currently contains approximately **3,500 chips**, with luxury cars having up to 5,000 chips.

50,000,000,000
Modern microprocessors can contain billions of transistors on a single chip. The record is over 50 billion transistors on a single chip.

Nanometer
1 nm = 1/1,000,000,000 m
One nanometer corresponds to the size of about ten water molecules arranged in a row.

Angstrom
A unit of length in the order of an atomic diameter that is widely used in the field of atoms and molecules, as well as in spectroscopy. One angstrom corresponds to one ten-billionth of a meter or 0.1 nanometers.

Source: Silicon Saxony

From Silicon Saxony ...

Interview// Chips are the driving force behind progress in all areas of life. They may be mostly invisible and hidden, but their computing power is huge. The Internet of Things and artificial intelligence are giving the semiconductor market an enormous growth spurt. In this interview, **Frank Bösenberg**, Managing Director of Silicon Saxony e.V., and **Ajit Manocha**, President and CEO of Semiconductor Equipment and Materials International, give an insight into the world of semiconductors and their outlook on groundbreaking developments. The role of automation cannot be underestimated.

» Mr. Bösenberg, semiconductors are master performers in all areas of life. What significance does the chip industry have for the global economy?
Frank Bösenberg: The chip industry is a strategic industry for many other sectors of the economy and their value creation. The ratio of the impact of chips on other industries and economic sectors is said to be one to fifty. This means that one euro in chip production generates up to 50 euros in further added value.

» The semiconductor market is very special. What makes it so special and what growth can be expected in the future?
Bösenberg: The special thing is that not all chips are the same. If you look at chips for smartphones, tablets and the like, their innovation development is subject to very short cycles. Chips for the automotive industry, on the other hand, must be designed to last for years and decades. The global chip market is currently expected to grow by six to eight percent annually across all segments. The global market volume is expected to double to up to one trillion dollars by the end of the decade.

» A few years ago, there were massive problems with the supply chains in the semiconductor industry. What were the causes and are we immune to them now?
Bösenberg: All chip plants worldwide run 24/7. Capacity fluctuations are very difficult to compensate for. The entire production period for processing the chip front end and back end takes about six months. Chip production also requires a large number of materials. We have a highly diversified and globalized value chain that is tightly intertwined. If there is a disruption in one area of the semiconductor value chain for geopolitical or geophysical reasons, this affects the entire network. This is still the case today.

Photo: Tommy Halfter

Frank Bösenberg is Managing Director of Silicon Saxony e.V., the largest microelectronics cluster in Europe.
www.silicon-saxony.de

“Chip production is extremely highly automated and requires innovative automation.”

Frank Bösenberg

Interview//Frank Bösenberg

» What significance does the chip industry have for industry as a whole and value creation worldwide?
Bösenberg: Chip manufacturing is extremely highly automated and requires innovative automation. Yet automation also constantly needs new and more powerful semiconductor products. The very high degree of automation in German fabs is one of the reasons why they are able to hold their own on the global market.

» What role does automation play in chip manufacturing?
Bösenberg: The focus on new developments on the one hand and modernization on the other is demanding. The ever-smaller chips are associated with ever-increasing investment costs for fabs. The scaling takes place at all levels and the sums involved are staggering. New fabs often require investments to the tune of many billions of euros with some machines for chip processing costing several hundred million euros. Thanks to technological advances in automation, however, existing plants can also be modernized and continue to operate for many years.

» Sustainability is one of the top issues. How important has the carbon footprint in the semiconductor industry become and how do semiconductors contribute to the energy transition?
Bösenberg: The chip industry is a driver of the energy transition and, at the same time, sustainability in chip manufacturing is a challenge. For reasons of cost efficiency alone, the chip industry has an intrinsic interest in operating as efficiently as possible. In many areas, digitalization and decarbonization can only be achieved on a large scale by semiconductors. The current carbon footprint of the semiconductor industry is offset by a major increase in sustainability in all the sectors in which chips contribute to reducing emissions.

… All the way to Silicon Valley

» Mr. Manocha, artificial intelligence is one of the defining topics right now. How will AI change the world of semiconductors?
Ajit Manocha: AI will usher in a great era of growth. We are still benefiting from the era of the Internet of Things – IoT. The IoT has led to major semiconductor growth thanks to its connectivity. This will continue and accelerate with AI. Artificial intelligence has been around for 50 to 60 years, and now people have realized how to take advantage of it. This is in part because it's only now that the hardware is making it possible. With AI, we will progress towards ever smaller chip sizes, such as five-nanometer technologies and below. AI will be the driver of semiconductor growth in the future.

» What are the industries and application areas that stand to gain the most from AI and will therefore continue to fuel semiconductor growth?
Manocha: One of the biggest winners was the automotive industry, as its demand for semiconductors was growing. This is closely followed by the life science sectors, and especially the medical industry, as the intersection of medicine and semiconductors is huge. Taken together, automotive and life sciences will create an enormous demand for semiconductors. This is especially true for advanced technologies that are being driven by AI. Though it is still difficult to say what future growth can be expected for legacy and advanced semiconductors.

» What dimensions will the semiconductor market reach in the future – keyword 1 trillion mark?
Manocha: It is clear to see that on the wafer fab side, around 50% of investment will go towards the development and production of AI-enabled chips or Gen-AI chips. I believe that what we have seen so far in the field of AI is just the tip of the iceberg; there is much more to come. With AI and the subsequent development of quantum computers, we will break through the 2 trillion dollar barrier in global sales in the semiconductor market by 2040 or 2045 at the latest.

» Growing market size contrasts with shrinking chip size. How much further can miniaturization go? Are there limits to what is possible?

Manocha: Miniaturization is an ongoing process. Since the dawn of the semiconductor industry, we have reached a point where the complexity of chips doubles every 18 months. This development has now slowed down, as it is becoming increasingly difficult to manufacture chips with a size of just two nanometers. Nevertheless, we will make further progress. Sooner or later, however, we will reach the physical limits of atomic size. Two nanometers correspond to 20 Angstroms, which is still a relatively large number. We may be able to get as far as 15 Angstroms and 10 Anstroms, but then the single-digit Angstrom range will be the absolute limit.

> "AI will be the driver of semiconductor growth in the future."
>
> Ajit Manocha

» Growth usually also means increasing complexity in supply chains, and these have proven to be vulnerable in the past. Can AI help to avoid semiconductor supply bottlenecks?

Manocha: At the moment, we are doing a lot of things physically. We have discussions with individual component manufacturers, distributors and PCB manufacturers and all the pieces of the puzzle begin to form a complete picture. I think that AI will help to automate this system too, so that everything is very well organized, and things run faster and better. When the chip shortage began, many of the suppliers and device manufacturers really had to think about where to get chips from. They didn't even know which company actually manufactured the chip. All this information was either unknown or protected. With the help of AI as part of the entire process, many things will become easier, the market will become more transparent, and the entire value chain will be democratized. This will significantly strengthen supply chains and make them more resilient.

» Do we need greater regionalization and a more even distribution of the global semiconductor industry?

Manocha: There are currently a limited number of semiconductor centers in the world. The COVID-19 pandemic and the climate and geopolitical issues have taught us that we are very vulnerable if we only produce semiconductors in a few regions of the world. I therefore believe – and I think that many of my colleagues in the industry would agree with me – that we would be better off opening up more regions in order to reach the targeted doubling of growth. That would result in global redundancies that make us less susceptible to risks.

Photo: SEMI

Ajit Manocha is President and CEO of SEMI (Semiconductor Equipment and Materials International), the global industry association for the electronics manufacturing and development supply chain, headquartered in Milpitas, California. Manocha has more than 40 years of experience in the semiconductor industry. www.semi.org

The interview took place at SEMI in Milpitas, California, on November 7, 2024 – and was led by Damon Turley, Head of Sales Industry Segment ELA, Festo USA.

Semicon

N_2 purge systems reduce nitrogen consumption

Machine and plant building in the semiconductor industry is incredibly complex. Automation components must guarantee high system availability, precision and reproducibility. The ongoing decarbonization of industry requires the use of resources to be minimized by reducing production energy.

Nitrogen is an important factor in increasing energy efficiency and reducing costs. With the N_2 purge system, Festo has developed a sustainable solution that helps to use this noble gas efficiently. Processes can be optimized in a targeted manner and the quality of the semiconductors ensured. At the same time, electricity consumption is reduced, costs are lowered, and CO_2 savings targets are achieved.

You can find more information on automation in the semiconductor industry here:
> **www.festo.com/semicon**

Recognizing the various factors that affect operating costs is crucial for semiconductor manufacturers. Even small factors can have a big impact. Optimized plant maintenance, improved and energy-efficient processes, effective environmental management and strategic material management in procurement, storage and production can significantly reduce your company's operating costs and thus maximize profitability and competitiveness. The key to success in the semiconductor industry is having a comprehensive view of all aspects that contribute to cost optimization and increasing yields throughout production.

Up to 50,000 cubic meters of nitrogen consumption
A semiconductor plant consumes large quantities of water, electricity, liquid chemicals and process gases. The most commonly used medium in the semiconductor manufacturing process is nitrogen (N_2). It is used, among other things, to rinse transport containers for wafers, knows as FOUPs (Front Opening Unified Pods). They create a controlled, contamination-free environment when transporting wafers between workstations. Large fabs can consume up to 50,000 cubic meters of nitrogen per hour. N_2 is produced in an on-site air separation plant using energy-intensive methods and supplied to the processes.

Advantage of piezo technology
By carefully analyzing the areas in which nitrogen is used, considerable savings can be achieved in a short space of time. Especially the dispensing of N_2 for flushing the FOUPs offers great potential if the previous standard valve systems are replaced by N_2 purge systems from Festo with closed-loop control and piezo technology. Compared to conventional valves, the features of piezoelectric purge valves are extremely precise dispensing, and at the same time extremely low power consumption. The nitrogen consumption of a large semiconductor plant and the associated energy consumption and carbon emissions can be significantly reduced with N_2 purge systems from Festo.

"Demand-based and precise dispensing of nitrogen offers a significant savings potential."

Tobias Glattbach, Global Industry Segment Manager Electronics, Festo

View of a semiconductor factory with Overhead Transport System (OHT), which automatically places FOUPs with the substrates/wafers on the production machines.

Reduce nitrogen consumption by up to 18%

Even a small saving per FOUP has a positive effect on the entire factory. The Festo experts calculate that, by using new technologies, the amount of nitrogen used can be reduced to the absolute minimum necessary.

The innovative solution from Festo reduces nitrogen consumption for the FOUPs by 75% by controlling the flushing process. The investment will pay for itself after just three months.

Verified sample calculation
Actual state: A plant with 10,000 FOUPs without an N_2 Purge system from Festo consumes up to 550,000 tons of nitrogen per year.

Amount of N_2 saved by the N_2 purge system
By using a regulated flow, the flow rate can be reduced from 20 SLPM to 5 SLPM (standard liters per minute) per FOUP. This results in a reduced, permanent flow rate of 15 SLPM in the system.

» By reducing the flow rate, up to 75% can be saved per FOUP, reducing the factory's total nitrogen consumption by up to 18%.

Flow regulator VEAD
The very affordable, pre-assembled flow controller for CDA and inert gases continuously supplies the wafer reservoir (FOUP) with inert nitrogen, thus preventing oxygen from oxidizing the wafers.

Mass flow controller VEFC
The compact flow regulator for inert gases has all the advantages of piezo valves: Maximum dynamic response, infinitely variable precision, low power consumption, and a stable flow without the need for manual adjustment.

Examples of Festo valves with piezo technology

BioTech Automation

Bioreactors for microorganisms from teaching and research to production
Bioprocesses are becoming increasingly important for industry as sustainable alternatives to conventionally manufactured products. Measuring, recording and controlling numerous variables ensure that the environmental conditions are precisely tailored to the needs of microorganisms, allowing bacteria, microalgae, and yeasts to optimally grow and achieve a high biomass.

Industrial bioprocesses can be operated efficiently in the long term thanks to the wide range of components and solutions from the Festo product portfolio. These include products for gas handling, liquid handling and control technology, as well as solutions right through to ready-to-install control cabinets. In addition, Festo offers customized software from the control system to the cloud. Seamless integration of the systems and the ability to analyze data in real time enable efficient and transparent process control. Festo is also involved in biologization as a learning field.

Example: Algae reactor
The application illustrates several ways in which Festo components and solutions can be used. The mass flow controller VEMD provides controlled gassing with air and CO_2. The food-safe pinch valve VZQA handles filling and emptying processes. Both are controlled by the innovative valve terminal VTUX. The automation system CPX-E automatically controls and regulates the pH value, temperature, gassing and light.

> **www.festo.com/biotechautomation**

Photosynthesis is a central metabolic process for the growth of microalgae. During this process, CO_2 is converted into sugar and oxygen is released.

Real-life application

The CM180 module from Subitec for the cultivation of microalgae combines biological findings with state-of-the-art technology. In the picture: Daniela Stadtmüller, Subitec, and Tobias Brucker, Process Industries, Festo.

Producing microalgae in large quantities is becoming increasingly important for the global production of pharmaceuticals, cosmetics, food supplements, and animal feed. By using CO_2 and producing valuable substances such as oxygen and omega-3 fatty acids, microalgae play a key role in the sustainable circular economy. As a leading supplier in the biotech industry, Subitec has developed a perfectly coordinated cultivation system for microalgae. At its heart is the CM180 module with 30 flat-panel airlift photobioreactors. Festo components and solutions make a valuable contribution to the development and manufacture of turnkey and cost-efficient microalgae production systems.

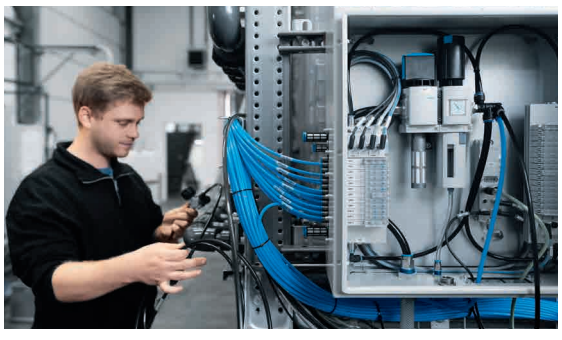
On a footprint of just 16 m², the space-saving design of the module creates a cultivation volume of 5.4 m³. This corresponds to a photosynthetic surface area of 270 m².

The CM180 module, with its large capacity, advanced technology and high-quality, contamination-free production environment, contributes greatly to large-scale industrial production of microalgae.

Festo automation solutions, mounted in control cabinets ready for connection, simplify and speed up design and commissioning, from the powerful remote I/O system CPX-AP-I and the space-saving valve terminal VTUG to the MS series of service unit components.

The collaboration on the cultivation module developed and produced by Subitec represents another important step for Festo towards the industrialization of biological transformation and thus an active contribution to climate protection.

> www.subitec.com



Final inspection of the ready-to-install control cabinet solution shortly before delivery to a Japanese customer.

From a **Small Impulse ...**
... to the **Entire World of Motion.**

A single flap of Festo's eMotionButterfly sets the Festo Incredible Machine in motion. This small impulse marks the beginning of a fascinating journey – the history of motion in automation technology, which Festo has significantly influenced. A project that demonstrates the pure joy of innovation. Because after all, inventiveness and a pioneering spirit have been in the company's DNA from the very beginning.

The Festo Incredible Machine is an example of our core expertise: Motion. It was created to mark the company's 100th anniversary and to demonstrate Festo's wide ranging skills and comprehensive expertise in the field of automation technology. At 14 meters, the unique exhibit seamlessly combines more than 1000 Festo components and over 1.8 km of tubes and cables.

Festo Incredible Machine

Join us on a journey through the fascinating world of motion – from the history of Festo, battery production for electric cars and laboratory automation in the field of life sciences, to intralogistics and the semiconductor industry.

„The ‘Incredible Machine’ represents a look back at Festo’s history, but it is primarily a forward-looking vision of the future and showcases the fascinating world of motion technologies – be they pneumatic,electric, digital, or a combination of the three.“

Dr. Ansgar Kriwet, Vorstand Research and Development, Festo

Discover the inspiring innovation journey here:
> **www.festo.com/incrediblemachine**

Notes

Imprint

Published by Festo SE & Co. KG, Ruiter Strasse 82, 73734 Esslingen, Germany, Phone +49 711 347-0. Creative Concept/Project Management: Silke Gartenmeier, CC-MC. All terms such as customer, user, specialist or technical consultant are gender neutral.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