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BREAK THE LIMITS – RIDE THE FLOW

Knorr-Bremse at InnoTrans 2024

A BRIGHT FUTURE BECKONS

The latest generation of LED trackside signals

**A NEW GENERATION OF
AIR SUPPLY SYSTEMS**

Successful field trials in Japan

**EDITION
60**

September 2024 –
the customer magazine of
Knorr-Bremse Rail Vehicle Systems



KNORR-BREMSE

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Member of the Management Board,
Knorr-Bremse Systeme für
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As a company, Knorr-Bremse has been in existence for almost 120 years. We have evolved from a simple supplier of products into an experienced systems partner trusted by our customers. This has not always been smooth sailing. We succeeded because our vision was clear and our compass well calibrated: Our constant goal was to become a technology leader in key areas of innovation.

Now more than ever, we are combining this steady approach with sustainable action at every level. This is how we support our rail-industry customers as they deal with their day-to-day challenges – but also how we support their efforts to implement the ongoing mobility transition, so we can all build a world characterized by long-lasting quality of life.

The nature of this support is not always apparent at first glance. For instance, take the 13000 Series rail vehicles used by Tokyo Metro (see pages 30-31). A few months ago, they were fitted with the first 'AirSupply Smart' system to see regular passenger service. Invisible from outside the train, our next-generation air supply system adapts to load, speed, topography and other conditions. With this innovation, operators of new and existing rail vehicles can now manage the energy consumption and noise emissions of their air supply systems in fundamentally new, eco-friendly ways. In vehicles parked at night in residential areas or stations, for example, the control system is capable of reducing compressor operating speeds so that they run much more quietly.

We will be presenting our innovative solutions in Berlin from September 24-27, when the world's rail industry comes together at InnoTrans 2024 – the industry's biggest trade fair. So please make a note: Hall 1.2, Booth 250 is where you will find the main Knorr-Bremse Group presence.



MARIO BEINERT,
Member of the Management Board, Knorr-Bremse Systeme für Schienenfahrzeuge GmbH













On 1,000 square meters of exhibition space, full of experiential use cases for visitors to enjoy visually, haptically, and interactively, we will be presenting Knorr-Bremse innovations in multiple areas: Ecological Footprint, Traveling Comfort, Traffic Flow, Operations & Maintenance, and Digital Solutions. I need scarcely mention that we have made the trade fair this issue's Spotlight feature (see pages 10-21). The accompanying supplement provides a succinct overview of everything you can expect to see at our booth. As ever, we also enclose an entry ticket to InnoTrans in the form of a voucher code.

We very much look forward to seeing you there!

Warm regards,

Innovative technologies and systems competence from a single source

Knorr-Bremse Rail Vehicle Systems offers an impressive variety of customized solutions for braking and onboard systems.

 Braking Systems	 Entrance Systems	 Climate Control Systems	 Power Electrics	 Computing & Communication TCMS	 Digital Solutions	 Lifecycle Management
 Wiper / Wash Systems	 Driver Assistance	 Sanitary Systems	 Coupling Systems	 Signaling Systems		

Information for Knorr-Bremse's customers and business partners

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Making the whole product portfolio cybersecure

Due to become the most important internationally agreed standard for cybersecurity, the IEC 62443 series is about to impact the rail industry. Knorr-Bremse has already started the process of certifying all development projects.

It's fair to say that the SCPU 941-TW doesn't look like much: basically, a silver box with multiple inputs and outputs, together with a bunch of black fins for dissipating heat into the surrounding air while the device is running – because the controller's insides can get pretty hot. Optimized for computing power and ethernet communication, the controller combines several independent PLC controllers in a single appliance. But there's another reason why it's special: The SCPU 941-TW is the first product in Knorr-Bremse's Rail portfolio to feature an IEC 62443-4-1-certified development process, as well as IEC 62443-4-2 product certification (SL2).

The various certifications are all based on what will become the rail industry's most important internationally agreed cybersecurity standard. "It aims to ensure that train systems are provided with the best possible protection against cyberattacks," explains Andreas Meyer, who is responsible for, among other things, IEC 62443 certification in Knorr-Bremse's Rail division. In this context, "best possible" means that



SCPU 941-TW

"the IEC 62443 series doesn't start with the product itself. The '4-1' version lays down clear requirements for the entire development process." These requirements include, for example, security by design, testing and validation of security provisions, and the management of security updates.

Knorr-Bremse is making firm LOI commitments for upcoming tenders

By the end of the year, Knorr-Bremse will have certified all current product development projects under ISO 62442-4-1; this also applies to digital products developed in partnership with Nexiot. The next stage is ISO 62442-4-2 certification – certification of the actual products resulting from the certified development process. "For upcoming tenders, we're already telling customers we'll have both forms of certification, so we're making binding LOI commitments," emphasizes Meyer.

The series of IEC 62443 standards presupposes an even larger framework – an Information Security Management System (ISMS) that complies with the ISO 27001 standard. "We're also driving ahead with this certification at key points across our entire organization," reports Meyer. The ISO standard defines the criteria for developing, rolling out, operating, monitoring, and continuously improving the Group's information security management. "By obtaining this certification, we're showing that we've implemented a robust system capable of adequately protecting processed and stored information and data."

Groundbreaking ceremony for fully automated Surface Treatment Center

The groundbreaking ceremony for Knorr-Bremse's new Surface Treatment Center in Mödling was held on March 11, 2024.

L to R: Plant Manager Herwig Hinterreiter, Architect Andreas Hawlik, Building Inspector Werner Deringer, Deputy Mayor Silvia Drechsler, Building Manager Christian Diemling (at back), Knorr-Bremse Managing Director Jörg Branschädel, Rail Brakes Production Manager Selfet Yilmaz



Knorr-Bremse GmbH is building a new, fully automated center on the company's Mödling site that will specialize in the cleaning, shot-peening and painting of magnetic track brakes – part of the largest expansion and modernization project in the history of Knorr-Bremse in Austria. According to Managing Director Jörg Branschädel, the investment is based on four key considerations: "We're aiming to significantly reduce throughput times and increase our capacity while ensuring consistently high product quality – and taking some of the pressure off our colleagues in production." The energy-efficient plant meets high environmental protection standards, features state-of-the-art exhaust-air purification technology, and is scheduled for completion by early 2025.

Knorr-Bremse GmbH is one of the largest national companies in the Group. The head office in Lower Austria acts as Knorr-Bremse's global center of development and excellence for magnetic track and eddy current brakes, as well as sanding and wiper systems. Along with brake distributor valves, the plant manufactures all these products locally for the international market.

Handing over the symbolic baton

In Switzerland, DAC DAY is an opportunity for politicians, government agencies, operators, associations, and industry players to discuss everything to do with the Digital Automatic Coupler.

The DAC takes center stage in Switzerland! In late June, Knorr-Bremse Rail Systems Schweiz AG and PROSE AG jointly hosted DAC DAY 2024 in the company's hometown of Wallisellen. Switzerland is one of the pioneers in adopting the Digital Automatic Coupler (DAC): The country's politicians, government agencies, rail operators, rail associations, and rail industry all have an interest in positioning Swiss rail freight systems as modern, efficient, and highly competitive under Europe's Green Deal.

Here, Switzerland plays a special role. Because the country is not an EU member state, it has joined the Europe's Rail innovation program as an associated partner. And Switzerland would also like to become involved as a major driving force behind the technology used to

KNORR-BREMSE AND PROSE HAND OVER THE SYMBOLIC BATON, complete with the contents of DAC DAY's workshop outcomes, to the rail industry association for further implementation of the DAC migration. L to R: Andreas Hefti (Knorr-Bremse), Andreas Haas (Swissrail), Dr. Bernhard Frei (Prose).



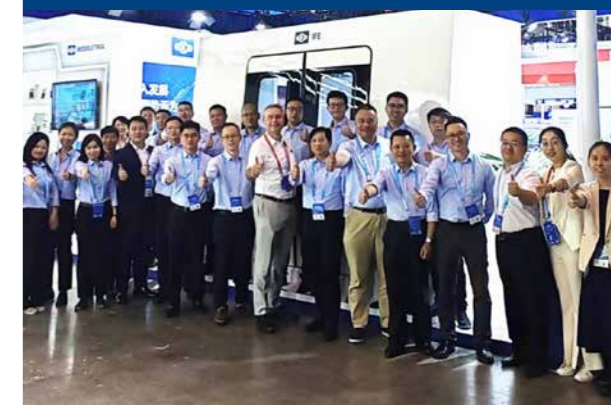
develop the DAC. Hence the importance of establishing a well-coordinated strategy for rolling out the new system, with clear conditions of use based on European policy, plus a program for individually preparing all the different parties involved for the DAC migration.

An afternoon of dialogue

In the morning, after opening addresses by hosts Andreas Hefti (Knorr-Bremse Rail Systems Schweiz AG) and Dr. Bernhard Frei (PROSE AG), a series of short presentations updated the audience on the current status of the DAC rollout from the viewpoints of politicians, operators, associations, and industry players in Switzerland. Jochen Helmlinger (PROSE AG) spoke, for example, on the topic of "DAC integration – how do we do it right?", while Michael Gutemann (Knorr-Bremse Systeme für Schienenfahrzeuge GmbH) talked about "Europe – leveraging DAC's potential together". In the afternoon, participants were able to choose from a wide selection of deep-dive discussion sessions, where they could also contribute their own personal expertise.

At the event, the symbolic DAC baton was handed over by the organizers of the industry initiative to Switzerland's rail industry association, Swissrail. Now Swissrail and the VAP Association of Shippers are working closely with the Federal Office of Transport (FOT) and the country's rail operators to coordinate the various activities required to roll out the DAC across Switzerland.

Knorr-Bremse at MetroTrans in Nanjing



CELEBRATING SUCCESS AT THE METROTRANS 2024 TRADE FAIR

Around 720,000 square meters of exhibition area, more than 400 international exhibitors, and over 40,000 trade visitors – those are the key stats for MetroTrans 2024 (June 13-15) in the Nanjing International Expo Center in the eastern Chinese province of Jiangsu. And for the first time, the "China Summit of Metro Operators" was held there too, alongside the exhibition.

"Of course we presented a selection of products, systems, and services targeting the Chinese and Asian rail markets at this largest and most influential of trade fairs for China's urban rail sector," states Eric Bi, who sits on the Management Board of Knorr-Bremse Rail Vehicle Systems China. Among the eye-catching exhibits were a life-size mockup of the IC 160 entrance system produced by Knorr-Bremse company IFE, with its cutting-edge sealing technology for comfortable rail travel. Plus the innovative 'AirSupply Smart' system – a low-noise, energy-efficient solution for supplying air to train braking systems.

Meanwhile, trade-fair season continues for Eric Bi and his colleagues: "Now we're very much looking forward to welcoming our customers from China and Asia to our booth at InnoTrans in Berlin in just a few weeks' time," he confirms.

Short – but sweet!

Aachen Rail Shuttle (Project: FlexSBus-LR ARS)

The FlexSBus-LR ARS is about to start field trials. The braking system for this autonomous, battery-powered rail bus for use in rural areas has a number of unusual features.



THE AACHEN RAIL SHUTTLE will appear at InnoTrans, accompanied by the consortium partners.

Contrary to what you might expect, the “LR” part of the FlexSBus-LR name does not stand for “Long Range”, because the rail shuttle doesn’t need an especially long range. The two-letter abbreviation actually stands for “Ländlicher Raum” (German for “rural areas”), while the first part of the name, FlexSBus, stands for “flexible rail bus”. Together, they describe the Aachen Rail Shuttle (ARS) – a lightweight, flexible vehicle that’s intended to make local public transit services more economical to run, even in areas that are not served by major rail networks. Designed to function as an autonomous vehicle, the FlexSBus-LR draws the power needed to achieve its maximum range of around 100 kilometers from an on-board 150 kWh battery. Trials are due to start this year.

The two-axle vehicle, which is 12 meters long and has a maximum gross weight of 28 tons, is being developed by a consortium headed by RWTH Aachen University and the Laser Processing and Consulting Center (LBBZ). The comprehensive braking equipment supplied by Knorr-Bremse is largely invisible from the outside.

Carrying passengers in the morning, transporting a freight container at lunchtime

“It’s got a number of special features – in particular, a guaranteed ability to achieve the high deceleration rates specified, so anything up to 2.8 m/s²,” explains braking system specialist Volker Zudse. Each of the four 24-volt magnetic track brakes is a very short but powerful articulated electromagnet. This configuration is normally used in special-purpose vehicles or on special bogies where high braking force is required but installation space is limited. Brake control, monitoring and diagnostics are taken care of by the MagnetControl (iRCB) system using Ethernet Control Switches (ECS). In turn, the ECS are an integral part of the TCMS (Train Control & Management System) architecture supplied by Selectron – they handle communication between vehicle subsystems and connect them to the higher-level vehicle control system.

The air supply is also well worth a look: “The system is so efficient that it only needs a small, electrically powered auxiliary air compressor to generate compressed air,” explains Zudse. Even more impressive when you consider that the FlexSBus runs on comfy air suspension. “For the compressor, we picked a component that’s normally used to raise freight locomotive pantographs up to overhead power lines.”

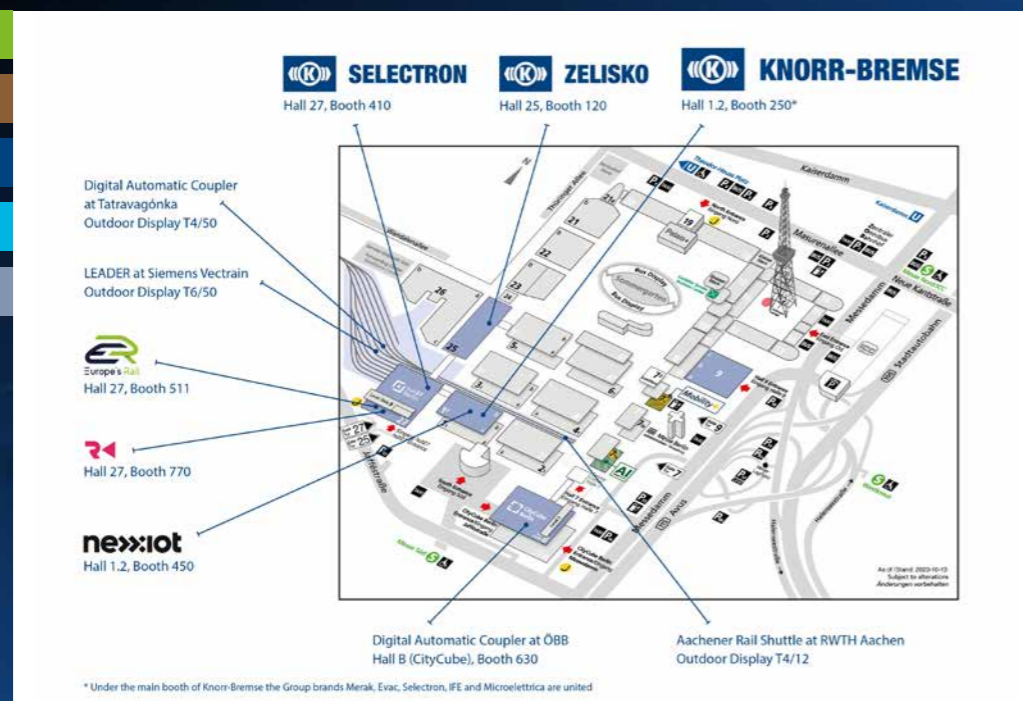
While “flexible” could refer to a lot of things, in this case it’s less about the various routes for which the FlexSBus-LR will be such an ideal solution, and more about the fact that “it’s easy to separate the passenger module from the chassis, so outside peak times, the vehicle could also be used to transport a freight container.”

INTERIOR DESIGN OF THE AACHEN RAIL SHUTTLE
© Benno Schiefer



Knorr-Bremse at InnoTrans 2024

From September 24-27, the world's rail industry will come together in Germany's capital city for the largest trade fair of its kind. All 42 halls in Berlin Expo-Center City (formerly Berlin Messegelände) are sold out – and Knorr-Bremse is right at the heart of it all.



“With our global presence and world-leading expertise, we’re a powerful partner for our customers. Each Knorr-Bremse brand and location acts with an excellent understanding of the product and market and is geared to take optimal account of the system concept of our portfolio.”

Ulisses Camilo,
President and CEO, New York Air Brake LLC
& Knorr Brake Company LLC

Hall 1.2, Booth 250 – that’s where visitors will find Knorr-Bremse’s main Group presence. Knorr-Bremse has become a global driving force behind tomorrow’s mobility, and this is reflected in many other parts of the exhibition center. Group subsidiaries **Selectron** (Hall 27, Booth 410) and **Zelisko** (Hall 25, Booth 120) will be showcasing their own specialist areas of activity in the appropriate contexts. Hall 27 will also host **Rail Vision** (Booth 770), while **Nexxiot** will appear in Hall 1.2 (Booth 450). Knorr-Bremse has a stake in both companies.

Knorr-Bremse will also appear as a guest: with **LEADER** in the Siemens Vectrain flexible vehicle solution on show in the Expo-Center’s outdoor area (T6/50); with the **“FreightLink” Digital Automatic Coupler** on the Austrian Railways (ÖBB) stand (Hall B, Booth 630); in the European Village’s “hub27” under Flagship Projects 1, 4, and 5 (Hall 27, Booth 511); and as the supplier of numerous subsystems for the Aachen Rail Shuttle (Project: **FlexSBus-LR**), also in the outdoor area (T4/12).

DR. NICOLAS LANGE sits on Knorr-Bremse AG's Executive Board and assumed global responsibility for the Rail Vehicle Systems division last year. With a doctorate in mechanical engineering, he started his career at Knorr-Bremse in 2000 as Team Lead Technology and Development Brake Mechanics.



An interview with Dr. Nicolas Lange

How Knorr-Bremse's products, systems, and solutions are shaping the future of mobility – and how the company is inspiring new ideas in the process.

Dr. Lange, product cycles in the rail industry traditionally tend to be lengthy. So why is it worth visiting InnoTrans even though the last event was just two years ago?

Nowadays, InnoTrans is much more than just a "product showcase" – it also performs an important role as a global platform for discussing two key questions about the future. First, how can rail services meet people's growing mobility needs around the world? And second, how do we shift as much freight transportation as possible to rail – the most sustainable solution? This debate between customers and suppliers is a great source of inspiration for the rail industry as a whole, but especially for product and system developments at Knorr-Bremse. So our presence at the trade fair is also an invitation to join us in taking this process forward. In short, it's high time we all got together again!

What are Knorr-Bremse's priorities for this year?

The burning issues that currently concern rail vehicle manufacturers and operators alike are ecological foot-

print, traffic flow, lifecycle management and passenger comfort. We systematically develop all our technologies in response to these challenges and needs. With our digital electromechanical braking system, for example, we're bringing yet another advanced technology to market that uses electrification and brake-by-wire features to improve eco-efficiency, reliability, and performance. But brakes aren't just one of the most safety-critical systems aboard trains. They can also be used to improve traffic flow and increase rail network capacity – because the distances between trains are largely dependent on braking performance. These synergies need to be explained, which is another reason why this trade fair is so worthwhile.

"How will humans stay mobile in the future? And how do we shift as much freight transportation as possible to rail – the sustainable solution?"



But Knorr-Bremse isn't just a supplier of braking systems.

Brakes are still our core business and here, we're the global market leader. But Knorr-Bremse is made up of numerous Group companies and brands. With their solutions, we're fulfilling our mission: to become a major mover in the positive transformation of the rail system as a whole. Our premise is simple: We offer every customer the optimum, perfectly customized solution for their needs with respect to, for example, specific regional features, climate impacts or regulatory requirements. We're like a modular toolbox that enables manufacturers and operators to assemble their own, optimized solutions from our ecosystem of products, systems, and services. Wherever we can and wherever it makes sense, we focus on modularity. Anyone who's building or operating a train needs solutions on board that are highly reliable and absolutely safe.

Major digitalization initiatives were already under way at InnoTrans two years ago. How is Knorr-Bremse positioned with respect to digitalization today?

The important thing is that the whole industry is now aware of the benefits of digitalization. As far as Knorr-Bremse is concerned, we've achieved key milestones in developing our technologies over the last couple of years – most of our systems can be upgraded to smart systems. So now we're focusing on translating the resulting data into real-world improvements in reliability, punctuality, and efficiency. The way we're thinking here is illustrated by, among other things, customer projects that are already delivering added value in the field. For the partners involved, things like data insights, smart recommendations for action, and remote diagnostics are raising their operational and maintenance activities to new heights of efficiency – right now. And over the next few years, our innovations relating to the digital freight train, Digital Automatic Coupler and

“Brakes are our core business and here, we're the global market leader. But Knorr-Bremse is made up of numerous Group companies and brands.”



“The whole rail industry is now aware of the benefits of digitalization.”

other automation technologies will help to ensure that rail freight finally, once and for all, moves out of the analog and into the digital age. In terms of technology, we're one of the pacesetters driving this paradigm shift.

What's it like working with customers on digital products?

We've transferred the modular principle we apply to our physical products over to the digital world, from individual solutions through to software platforms. Once again, it's our customers who decide what they want, based on their individual needs. For example, do they want to process the data from their Knorr-Bremse subsystems themselves? In which case we'll make it available to them. Would a software-as-a-service (SaaS) solution or a cloud application be a better fit for their ideas? Whichever it is, we'll provide it. Would they prefer a platform with a graphical user interface tailored to their specific needs? Yes, Knorr-Bremse can do that too.

But as data flows from – for example – trains into the cloud, the risk of cyberthreats intensifies.

Our commitment to safety doesn't end with braking distance. Security is an integral part of safety, and all our developments are based on a systematic “secure-by-design” approach. In operation, we use layers of security to protect our systems against unauthorized external access, following the defense-in-depth principle.

A few weeks ago, Knorr-Bremse further expanded the Group by acquiring Alstom Signaling's conventional trackside signaling business in North America. What was the reasoning?

We've never viewed acquisitions as an end in themselves. Among our customers, the shift to digitalization and networking has focused a lot of interest on the signaling technology sector – so of course we're interested too. Brakes and signaling technology exert a major influence on the safety and capacity of rail networks, so considering all these elements together is an attractive approach. To put this in a larger context: We have no interest in competing with our customers. But we do aim to become a Tier 1 platform partner in signaling technology that can offer products, systems and services that will benefit the established manufacturers.

And what are you personally most looking forward to at InnoTrans?

I'm someone who thrives on personal contact. That's why I'm looking forward to the in-depth discussions I'll be having with our customers and partners. I want to know what's driving them, and I'd love to join them in looking ahead to the rail mobility of tomorrow!



RENDERING OF THE KNORR-BREMSE BOOTH AT INNOTRANS 2024

Knorr-Bremse's trade fair presence

Knorr-Bremse first stepped into "the flow" two years ago, with the slogan "Get into the Flow". Now, as InnoTrans 2024 prepares to showcase the rail industry's latest innovative developments, Knorr-Bremse is urging visitors to "Break the Limits – RIDE THE FLOW" – to ride the vigorous flow of an ever more interconnected mobility sector.

The industry is in full flow – and Knorr-Bremse is playing a key role. With our solutions, we optimize **ecological footprints** and dynamize **traffic flows**; we synchronize **operations and maintenance**; we raise **traveling comfort** to new levels. Acting as a digital hub, we interconnect, interweave, and merge together our **digital solutions** – a combination of smart products, functions, and services – by applying our advanced Data2Action approach.

Welcome to 1,000 square meters of exhibition space, full of use cases that can be experienced visually, haptically, and interactively – and anticipate tomorrow's mobility on today's rail networks!

Break the Limits – RIDE THE FLOW. Visit Knorr-Bremse in Hall 1.2 at Booth 250.

IN OUR INNOTRANS SUPPLEMENT, YOU WILL FIND SUCCINCT EXPLANATIONS OF THE MAIN PRODUCTS, SYSTEMS, AND SERVICES ON SHOW AT KNORR-BREMSE'S TRADE FAIR BOOTH.



Ecological Footprint

Only by systematically reducing emissions will the rail sector be able to further expand its role in the mobility mix. This is why Knorr-Bremse is focusing its efforts on developing eco-friendly technologies at key points in the transportation chain – by designing demand-driven air supply systems and eco-friendly climate control systems, by optimizing energy efficiency, and by ensuring sustainable friction pairing.

Traveling Comfort

To entice passengers onto trains, operators must ensure that they enjoy all the benefits of smooth, comfortable rail travel. The wealth of comfort-enhancing solutions devised by Knorr-Bremse makes the whole process of boarding and traveling on a train easier and more enjoyable. Among the many solutions are pressure-tight and barrier-free boarding systems and fresh, clean air supplied by innovative climate control systems.

Traffic Flow

The key prerequisite for an efficient, high-capacity traffic flow? Excellent braking systems. With them, trains can travel faster and closer together (with less safety margin), and can reach their destinations sooner. Also essential to traffic flow is our “Future Rail Freight Transportation” approach and its key enabler, the Digital Automatic Coupler (DAC), combined with proactive troubleshooting.

Operations & Maintenance

As a strategic, independent full-service partner at component level, RailServices makes rail vehicles more available by intelligently optimizing processes and extending vehicle lifecycles – thanks, for example, to attractive service models featuring automated remote diagnostics and predictive maintenance.

Digital Solutions

By developing technologies for the Internet of Things, (AI-driven) automation, data generation, and profitable data utilization (Data2Action), Knorr-Bremse has become a major mover in today's rail industry. Data sharing will also play a key role, as reflected by the company's sophisticated solutions for cybersecurity, Rail Computing & Communication, and the Rail Data Space – the secure data hub required for the rail sector's end-to-end digitalization.

Making green mobility possible – together



Knorr-Bremse is helping customers to improve their ecological footprint by prioritizing the sustainability of both products and business processes. Knorr-Bremse has also set clear goals for active climate protection.

Knorr-Bremse – a member of the rail industry’s “Railponsible” initiative – is systematically embedding sustainability criteria in all its processes. The company’s development programs incorporate EcoDesign and circular economy principles right from the start. The aim is to optimize products and systems by applying environmental criteria, thereby reducing energy consumption, noise emissions, and product weight – all areas in which Knorr-Bremse, as a strategic partner, helps customers to improve their own eco-footprint.

Knorr-Bremse’s commitment to climate neutrality is readily quantifiable. At present, for example, over 95 percent of the energy purchased by the company comes from renewable sources. To date, Knorr-Bremse has successfully reduced production-related carbon emissions by some 70 percent (relative to baseline year 2018).



The company’s targets leading up to 2030 – all validated by the Science Based Targets initiative (SBTi) – are correspondingly ambitious. By 2030, Knorr-Bremse aims to reduce the Group’s global production-related carbon emissions by 75 percent relative to baseline year 2018. Also by 2030, the company intends to reduce absolute emissions from purchased goods and services, upstream transportation, and sold products during their service lives by 25 percent relative to baseline year 2021.

Knorr-Bremse awarded gold status by EcoVadis, an A- rating by CDP

External agencies regularly recognize Knorr-Bremse’s commitment to sustainability by awarding above-average ratings and rankings. The most recent success? After languishing at silver status for two years, the company has once again been awarded a gold medal by EcoVadis. This means that Knorr-Bremse is now among the top five percent of its peers in the Environment, Labor & Human Rights, Ethics, and Sustainable Procurement categories. Previously, CDP (which ranks corporate climate protection efforts on a descending scale from A to D-) had awarded Knorr-Bremse another improved rating (A-), elevating the company above the European average (B) and global sector average (C) to CDP’s Leadership level.

Innovation leadership

Questioning the old, creating the new – by focusing intensively on key areas of innovation, Knorr-Bremse is boosting transportation performance and availability, delivering sustainable mobility by enabling the smart management of rail vehicles throughout their service lives.

Entrepreneurship, technological excellence, reliability, passion, and responsibility – these are the five values that have both inspired and characterized Knorr-Bremse for almost 120 years. As a global driving force behind the transition to efficient, eco-friendly mobility for this and subsequent generations, Knorr-Bremse is making the transportation of people and freight by rail more dependable, more connected, safer, and cleaner, as well as more comfortable and efficient.

Knorr-Bremse is a technology leader in key areas of innovation, generating genuine added value for the company’s customers:

Efficient Automation: Rail transportation is full of opportunities to upgrade functions by automating them. And Knorr-Bremse is exploiting this potential – for example in the form of ATO solutions, the Digital Automatic Coupler, and smart environment detection.



Consistent Green Priorities: Reduced emissions are vital for green rail travel and transportation. Knorr-Bremse is using every possible lever to reduce emissions – from finding new ways to manufacture onboard products and systems through to devising integrated energy management solutions for entire trains.

Smart Control: Increasingly, Knorr-Bremse’s solutions can collect and evaluate status and operating data in the cloud. An advanced Data2Action concept translates the raw data into real-world benefits by improving reliability, punctuality, and efficiency.

Secure Data-driven Services: As the mobility sector becomes increasingly digitalized and networked, the potential risks of cyberattacks on trains and vehicle fleets are also multiplying. Knorr-Bremse is working to counter these risks by deploying sophisticated cybersecurity services, as well as secure products and processes.

Optimized System Lifecycles: Everything required to extend vehicles’ service lives – from product upgrades to refurbishments, from connectivity enhancements to the modernization of entire vehicles through to the implementation of ATO solutions – is available right now.

Convenient Comfort & Care: For passengers to switch from road to rail, they must be convinced of the advantages of a comfortable train journey. Knorr-Bremse has responded by removing barriers to boarding and by devising innovative solutions for keeping the air in train compartments fresh, clean, and safe.

A bright future beckons

Knorr-Bremse brand Zelisko is installing its latest generation of LED trackside signals for the first time. A brilliant idea has significantly reduced the installation space required. Even better, the system is flexible enough to fit different types of mountings.



A NEW GENERATION OF LED TRACKSIDE SIGNALS

Wherever public transit services dominate the transportation mix so that more and more freight is carried by train rather than truck, rail traffic becomes denser – which is why it is so important to ensure that it is precisely and safely organized. Digitally, this is all done in the background by computerized control systems. Optically, trackside signals are the key to traffic flow.

At the turn of the millennium, Zelisko was one of the very first companies in the world with the expertise to install trackside signals based on LED technology – still a novelty at the time. 2006 saw the birth of a second generation: Over 100,000 units of the modified LED Signal EU are currently in operation. Now the company is preparing to make the first delivery of its third-generation product to an infrastructure project in Switzerland.

Flat design thanks to a new electronics layout

The first thing that strikes you about the new generation is how much its design has been slimmed down – the product name, “Compact”, suits it perfectly. While the previous model measured 356 millimeters in depth, the new generation is more than 42 percent slimmer at just 205 millimeters. “The change is down to a fundamental redesign of the electronics,” explains Robert Freissl, Head of Sales at the Zelisko plant in Mödling, Austria.

“We managed to fit three previously separate PCBs onto a single, exceptionally compact control board,” explains the engineer. This eliminated the main reason for the system’s previous depth. “So now it consists of just two assemblies: the PCB and the central LED, which has already proven itself in action.” Best of all, almost the entire system is recyclable.

Despite this, the way the system works and its electrical interfaces with the signaling infrastructure remain unchanged. Meaning that the new – and, for the first time, IP65-certified – generation is flexible enough to be mixed with the previous generation.

Flexible enough for all kinds of applications

Flexibility is one of the key features of the new “Compact” signals: The control unit is compatible with most of the signaling interfaces commonly used in Europe. The front bezel is interchangeable, so it can be adapted to various types of mountings. Similarly, infrastructure operators can select from a wide range of connector layouts.

And if, at a later stage in the product’s lifecycle, the control hardware needs to be replaced (to accommodate new functions, for instance), this would be straightforward even if large numbers of signals were involved. “We’ve designed it so you don’t necessarily have to upgrade the optics at the same time,” explains Freissl.

Teaching by objective, not by curriculum

The Customer Training Portal is just one area in which the RailServices Training Academy is moving with the times. Educational priorities are shifting to solutions-focused knowledge transfer – and now apply to all Knorr-Bremse sites across Europe.



Ultimately, customers have a clear outcome in mind: They want their employees to be capable of responding swiftly and effectively to, for example, those rare occasions when a given rail vehicle's braking system needs troubleshooting. "Previously," explains Jens Blaufuss, Director of the Berlin-based RailServices Training Academy, "we used to give them in-depth training on the relevant braking system." But what operators really want their teams to be able to do is more straightforward: "Everyone needs to know what steps to take, and in which order, to put things right."

In most cases, Training Academy courses focus on the functionality and maintenance of braking systems. But they also focus on specific objectives, as in the above example: rapid, systematic troubleshooting of the braking system affected. "We don't just see ourselves as a training provider, but as a service provider supplying our customers with all-in-one packages," adds Blaufuss.

What he means becomes clear upon taking a closer look at the Training Academy's Customer Training Portal (<https://training-railservices.knorr-bremse.com>). Take, for example, the course entitled "Maintenance on the Eurodual BR159 Basic Module", which begins – quite conventionally – by describing the functions of the Eurodual locomotive's braking system and its components. But the second of the three training modules – "Learning how to execute servicing, adjustment, maintenance, and testing activities in accordance with the Knorr-Bremse or customer documentation" – already relates directly to actual practice. And the third module focuses on the immediate objective: "Detection and correction of malfunctions and faulty functions."

Cross-border training for cross-border train services

Faults or malfunctions that rarely occur are precisely the ones that drive up maintenance time and costs. This is why the Academy's technical coaching sessions by professionals are so important – in helping employees to avoid, for example, common misinterpretations when drawing up and implementing BR protocols. The portfolio also includes a whole series of courses on the latest aspects of digitalization and automation. But what if a customer has training needs that do not appear in the portal? As Blaufuss says: "Just contact us! As a rule, our training courses are modular, so we'll happily tailor a course to your needs".

Starting this year, this applies to all Knorr-Bremse's European locations. "We've recently taken big steps toward standardizing our processes," confirms Agata Waclawek, responsible for the interfaces between the Training Academy and the various Group companies based in Europe. "We've standardized the descriptions and delivery of our services across the board, as well as our participant certification for everyone who completes a course, plus our feedback forms." Cross-border training services follow hot on the heels of cross-border train services.

Another new feature is the use of AR glasses combined with the "Oculavis Share" app. The Training Academy uses this application – originally designed so that mechanical and process engineers could deliver customer services in augmented reality – as an efficient tool for customer training.

The RailServices Training Academy

The instructors who deliver the theoretical and practical training courses at the Academy have international experience, teacher-training qualifications, and are certified under Deutsche Bahn's brake training guideline 046.9015. "Many of them have decades of active training experience and know the products and systems inside out," confirms Jens Blaufuss, Training Academy Team Lead. In addition to German and English, the Customer Training Portal is now available in seven other languages. Almost all theoretical training courses can be delivered remotely via the Academy's "virtual classroom" if required.



"We don't just see ourselves as a training provider, but as a service provider supplying our customers with all-in-one packages."

Jens Blaufuss,
Team Lead, RailServices Training Academy

Following the gold line

Just a few months ago, Knorr-Bremse and Alstom announced their collaboration on new metro trains for Bhopal and Indore. Now they are also working on trains for the Delhi Metro which include a unique brake control system.



DELHI METRO

Commissioned by Madhya Pradesh Metro Rail Corporation Limited (MPMRCL), the metro trains destined for Bhopal and Indore are based on Alstom's Movia platform. But the latest order from Delhi Metro Rail Corporation (DMRC) for the Indian capital's metro system includes 52 six-car trains – a total of 312 passenger cars – based on Alstom's Metropolis platform. The vehicles are designed to travel at speeds of up to 95 kilometers per hour. The operator intends to run the new trains on three metro lines: Delhi's Pink, Magenta, and Silver Lines.

"The city is expanding its metro network yet again," reports Sanjib Chakraborty, Senior Sales Manager for Knorr-Bremse India, who works at the company's Palwal facility in the state of Haryana in northwestern India. On the Pink Line, the new vehicles will boost train frequency and other aspects of the service. The Magenta Line is being extended, and the Silver Line is brand new.

"The long-term planning for the lines is very strategic; they'll act as links between residential areas in particular and the rest of the city," explains Chakraborty. The new metro stations also act as local mini-hubs. "If you live further out in the suburbs and drive a car, you can park at the stations and travel into the city by metro."

Just ten months from LOI to the first system deliveries

A strong urbanization trend and associated investments in infrastructure make India one of the rail vehicle sector's most attractive future markets. Alstom is manufacturing the trains at its Indian plant in SriCity, Andhra Pradesh. Knorr-Bremse is fulfilling the project's high localization requirements by producing the braking and entrance systems in Palwal.

Thanks to this geographical proximity, Knorr-Bremse has already begun delivering the first project consign-

ments, even though the initial Letter of Intent (LOI) was only received in July 2023. Despite accommodating multiple new developments during the design phase, it took the company just ten months or so from receipt of the LOI to start delivering the first systems to Alstom.

The systems are well established and are already operating successfully on metro trains in Delhi and Mumbai. The braking systems in particular feature a partially redesigned brake control system. RailServices will be responsible for servicing and maintaining the Knorr-Bremse systems on 13 of the metros for the next 15 years.

Less than three hours



Knorr-Bremse is supplying braking and entrance systems for the Chinese high-speed trains that will run on the new line between Budapest and Belgrade.

In the first European rail vehicle project by a Chinese vehicle manufacturer to comply with Europe's Technical Specifications for Interoperability (TSI), rail vehicle builder CRRC Changchun Railway Vehicles Co., Ltd. (CRRC CRC) is supplying five high-speed trains for the new Hungary-Serbia rail link between the two countries' respective capitals.

Knorr-Bremse is supplying the braking and entrance systems for the four-car trains that will soon be carrying passengers between Budapest and Belgrade. Knorr-Bremse is manufacturing the majority of the braking system components at its R&D center in Suzhou, China, while the IFE-VICTALL joint venture in Qingdao is responsible for producing most of the entrance systems.

Validation and certification runs are already under way

The infrastructure project surrounding the new rail link is currently one of the largest in southeastern Europe. It is intended to reduce the time of rail journeys between the two cities from nearly eight hours to just two hours 40 minutes. The 183 kilometers of track in Serbia are designed to support a top speed of 200 km/h; the 159 or so kilometers of track in Hungary can handle speeds of up to 160 km/h. But the route is also interesting from a rail freight perspective, because it will improve the

connection between rail systems in Europe and Turkey – and from there with the rest of Asia.

The first two of the five high-speed trains have already been delivered and have been performing validation and certification runs since May. As soon as they have been certified, they will start operating on the section of track between the Serbian cities of Belgrade and Novi Sad. By 2025, the entire line should be ready for regular passenger traffic between the two capitals.

'AirSupply Smart' launches in Japan

'AirSupply Smart' is starting field trials on the Tokyo Metro network. The trials are already demonstrating the potential of this new generation of air supply systems, especially in solutions for modernizing existing vehicles.

In view of the country's sophisticated signaling, safety, and operating systems for up-to-the-second punctuality, plus a well-designed rail network that replaced many domestic flights long ago, as well as vehicles that are always exceptionally clean, comfortable, and serviced to an excellent standard, it is scarcely surprising that Japan's rail industry is regarded worldwide as the benchmark for efficiency and reliability.

Much of this is due to the country's reputed openness to new technologies – an openness espoused by Tokyo Metro, which launched the first 'AirSupply Smart' field trials in December, after installing the system aboard a vehicle in regular passenger service.

Exchange of detailed commands, feedback, and diagnostics

The metro operator, Tokyo Metro Co., Ltd., commissioned Knorr-Bremse to develop an air supply system that would not only replace an earlier system, but also integrate with the vehicle control system. One of the key features is a combined hardware and software interface designed by a cross-functional team in the RailServices Modernization department: "It's based on an electromechanically complex plug-and-play solution that's connected to the vehicle's CAN bus as well as the operating interface," explains Gregor Steinhäler, Team Lead System Test & Commissioning Mainline Systems HST & Loco, describing the concept. He was personally responsible for creating the solution while working on the RailServices Modernization team.

No longer limited to binary transmissions, the interface sets the scene for the second key feature: the exchange of detailed commands, feedback, and diagnostics between vehicle and 'AirSupply Smart'. The built-in data logger is also capable of collecting additional operating



TOKYO METRO CO., LTD.

data which could, in the future, be used to optimize the operation of the vehicle itself. The mechanical connections, as well as the positioning of the pneumatic and electrical interfaces, ensure that the system is fully interchangeable.

A single large compressor replaces four smaller ones

The 'AirSupply Smart's' soft-start feature offers additional benefits, by enabling a vehicle architecture that is as streamlined as possible. This can be explained as follows: Typically, four small compressors are installed aboard 13000 Series vehicles for generating compressed air. To avoid critically high power-on currents, the vehicle control system switches on the compressors sequentially, rather than simultaneously.

But now the four smaller compressors have been replaced by a single, larger PistonSupply Eco type VV180-T compressor offering comparable performance. "Thanks to the soft-start feature, we've been able to drop the big compressor's power-on current to the same level as the nominal current, meaning that it's actually lower than it was with the four smaller compressors, even when they were being switched on one after another," explains Martin Pröbstl (Team Lead Project Management, Air Supply Unit). In short, 'AirSupply Smart' has enabled a major step forward: "The vehicle simply isn't designed to cope with the higher power-on currents typical of large compressors."

'AirSupply Smart'

Unlike earlier systems based on a rigid on-off logic, this next-generation air supply system adapts its delivery of air to the vehicle's current operating conditions – based on load, speed, and route topography, for example. This adaptive control results in less wear and tear and, when combined with the integral condition-monitoring function, reduces lifecycle costs. The "intelligent" inverter also makes it easier to offer flexible functionality: In noise-sensitive areas, the compressor's Silent mode causes it to run more slowly and therefore more quietly. This flexible speed capability has another positive impact on vehicle hardware: Compressors can be powered directly from the vehicle's battery, meaning that the vehicle no longer needs the usual auxiliary air compressor running in what is known as Panto mode. Finally, the compressor's Boost mode can cover peak loads, making it easy to select the ideal compressor size.



L to R: Martin Pröbstl (Sub-Project Manager Air Supply), Gregor Steinhäler (Project Manager / Systems Engineer Modernization)

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