



# informer

DECEMBER 2017 – THE CUSTOMER  
MAGAZINE OF KNORR-BREMSE GROUP  
RAIL VEHICLE SYSTEMS  
EDITION  
46

SPOTLIGHT

## APTA EXPO

All eyes on Atlanta

CUSTOMERS + PARTNERS

## Crossrail

Crossing London underground

PRODUCTS + SERVICES

## Distributor valve portfolio

Ready for the future  
with the new generation of  
KE distributor valves

**KNORR-BREMSE**



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Dr. Nicolas Lange,  
Member of the Executive Board  
Knorr-Bremse  
Systeme für Schienenfahrzeuge GmbH

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## Dear Reader,

Today, the UN climate change conference enjoys a high profile that the diplomats, politicians, and civil society representatives taking part in it could only have dreamed of in its early years. This prominence lent even more weight to the message that participants took back from Bonn to the rest of the world a few weeks ago, warning that climate change will soon become irreversible. What marked out this year's event was that it was the first time that the international climate negotiations took place under the presidency of a small island nation. As sea levels continue to rise, Fiji is experiencing the impact of climate change first-hand – and it is not alone. Some parts of the world are facing significantly higher rainfall levels and more extreme rainfall events, while other regions are threatened by drought.

For all the different points of view that were at times apparent in Bonn, there was unanimous agreement that everyone will need to work together if the undeniably ambitious climate goals are to be delivered. Government, civil society, and business must all demonstrate their commitment to genuine sustainability.

At Knorr-Bremse, this commitment is deeply embedded in our corporate culture. We put it into practice by reducing the quantity of raw materials we use and cutting our greenhouse gas emissions, by working hard to develop energy-efficient, low-emission and resource-saving products, and by producing them in as environmentally-friendly a manner as possible. To name but one example, the waste heat from the test rigs in our new Munich Development Center is used to power the climate control system in the Center and a nearby building.

From a global perspective, the energy we save by doing this is of course just one tiny step. Nevertheless, if everyone takes several tiny steps, together we will be taking one huge stride towards doing what the Bonn conference tells us we must. That is why we have set ourselves the target of achieving the same sustainability standards across all of the Knorr-Bremse Group's companies and sites. You can read about the details of this project in this issue of informer.

As usual, the magazine also provides a fascinating insight into the latest developments in the Knorr-Bremse world. These include our new systems strategy for the future of air supply, which will help to deliver installation space and cost savings for vehicle manufacturers and operators. Or the success story with Russian vehicle manufacturer Metrowagonmash. Not to mention the major door upgrade project for passenger trains in India. But don't let me tell you – you can read all about it yourself!

In a few days' time, another exciting year will have come to an end. I would like to take this opportunity to wish you a relaxing Christmas and a successful start to the New Year.

Best regards,

Dr. Nicolas Lange

# news



New passenger coaches for BART (Bay Area Rapid Transit), © Bombardier.



## New D and E passenger cars for BART

The Bay Area Rapid Transit (BART) is the main mass transit system in the densely populated San Francisco Bay Area, carrying more than 400,000 passengers every day and linking the cities of San Francisco, Oakland and San Jose as well as San Francisco and Oakland international airports. Last fall, the operator launched a major upgrade of its vehicle fleet: The 669 BART Type A/B and C vehicles are being replaced step-by-step by 775 Type D and E vehicles.

BART has thus remained faithful to vehicle builder Bombardier – and also to the American Knorr Brake Company, which is equipping the vehicles with hydraulic braking systems similar in many respects to those it already supplied for the Type A/B vehicles. However, the increased weight of the D and E cars means that certain important aspects – especially the friction materials – have had to be reconsidered. Following extensive testing at Knorr-Bremse's Development Center in Munich, the Knorr Brake Company decided to use Cosid 820 brake pads.

Delivery of the braking systems is currently scheduled to run until 2021, but may run even longer: BART has already secured options on 406 vehicles.

## Mark Cleobury welcomes Consul General Sugandh Rajaram

Sugandh Rajaram, the new Consul General of the Republic of India in Munich, received a warm welcome at a meeting with Mark Cleobury, Member of the Executive Board for Knorr-Bremse Rail Vehicle Systems. Mr. Cleobury pointed out that Knorr-Bremse has now been working successfully in India for more than 20 years and has been involved in key infrastructure projects such as the Madhepura locomotives and the Delhi metro. He emphasized that local talent had played an important role in these activities. In total, Knorr-Bremse's two divisions employ more than 1,200 people at the Palwal and Pune sites. They also have a joint Development Center in Pune.



Consul General of the Republic of India in Munich: Sugandh Rajaram (center); Knorr-Bremse: Dr. Jonathan Paddison (left), Mark Cleobury (right).



Kindergarten children in Phnom Penh (top).

Tanja Mohme (RailServices), Christoph Günter (Knorr-Bremse Global Care), Kathrin Moder (RailServices) (from left).

## RailServices makes donation to Global Care

For the third time, RailServices has combined its customer satisfaction survey with a donation of five euros to Global Care for each online questionnaire completed. By the end of the process a total of EUR 2,000 had been collected for the charity. At the end of the survey, participants were able to choose which project they would like to be supported: a kindergarten for children from waste-picker families in Phnom Penh, Cambodia or a project for street children in New Delhi, India.

**Phnom Penh:** Entire families live and work on the waste dumps in the city. The children often have to help out and therefore cannot attend kindergarten or school. At least some of these children are given relief in a preschool and kindergarten project that allows them to 'be children,' to laugh and to learn through play. In addition, care is taken to ensure that they are given a balanced diet and receive medical and hygienic care.

**New Delhi:** According to rough estimates, approximately 50,000 children live on the streets of this mega-city. The Don Bosco Ashalayam ('House of Hope') looks after some of these disadvantaged and particularly vulnerable children and young people. They are not only fed, but also receive medical care, education, shelter and above all, human affection. The idea is to restore the children's self-confidence and open up the prospect of a safe and independent life for them.

## IFE becomes first DB supplier to achieve highest maturity rating

At the 4th IFE technology conference "70 years of IFE – Innovation and Sound Technology for Sustainable Success," held from 31 May to 2 June 2017 in the Czech city of Brno, Knorr-Bremse's IFE division became the first Deutsche Bahn (DB) supplier to be awarded the company's highest Level 9 certificate of maturity. The certificate confirms that the Generation 4 entrance system has reached series maturity, having been tested and approved and found to be a high-quality product.

The certification process is driven by DB's new nine-level operational maturity model, which the rail operator uses to classify and document the fitness for purpose of new developments. This approach aims to prevent nasty surprises when new components or systems enter service by subjecting them to extensive field testing even before procurement. Early this summer the innovative IFE entrance system successfully completed a two-year field trial on a double-deck car belonging to DB Regio Elbe-Saale. Over this period, a total of 11 detailed inspections were carried out, with 56 parameters being recorded and evaluated on each occasion. "Not one single door fault was documented," says Carsten Kretschmar, specialist engineer for entrance systems and interior equipment at DB.

Dr. Matthias Müller, head of rolling stock technology service in the Rolling Stock Purchasing department at DB AG, (r.) presents the Certificate of Maturity to Oliver Schmidt, Chairman of the Executive Board of Knorr-Bremse GmbH Austria.





## Modernization solution featuring Knorr-Bremse wheel slide protection system wins UK award

Once a year, the entire British rail industry descends on London for the UK's annual Railway Industry Innovation Awards. This year, rolling stock leasing company Porterbrook was among the winners, carrying off the award in the Engineering and Safety category. Porterbrook won the award for its modernization of Class 156 vehicles from the 1980s and 1990s with new Knorr-Bremse wheel slide protection (WSP) systems.

Like the ABS on a car or truck, the WSP system controls brake slip at the point of contact between wheel and rail in order to make optimal use of the available friction. The installation of these systems on



Railway Industry Innovation Award.

old vehicles helps to prevent wheel flats that can be caused, for example, by braking when there are leaves on the line. Repairing wheel flats is a costly operation that requires the train to be taken out of service.



## Braking systems for SBB Prima H4 locomotives

Knorr-Bremse is developing and manufacturing the complete braking systems for 47 new Alstom Prima H4 locomotives destined for the SBB (Swiss Federal Railways) network. The locomotives will be used for track work on the rail network and shunting at the Lausanne-Triage and Limmattal shunting yards. The systems consist of a compressed-air supply system, the new ESRA Evo control system and the bogie equipment. The on-board auxiliary power converters are supplied by Knorr-Bremse PowerTech.

The H4 is a dual-mode platform powered by an electric traction system and two diesel generators. The two power generators are coupled with an automatic start-stop system, providing a 20-percent reduction in fuel consumption compared with a single-engine diesel locomotive. Despite being designed for shunting and track work, the H4 runs at speeds of up to 120 km/h, allowing it to be integrated easily into mainline traffic flow. The locomotives are being manufactured at Alstom's site in Belfort, France. The first vehicles are scheduled to enter service with SBB in 2018.

## Q-RAIL

### Munich Brake Control Testing Laboratory Gains ISO 17025 Certification

The brake control testing laboratory is the first testing department at Knorr-Bremse's Munich site to validate its competence by attaining the ISO 17025 standard. The laboratory was awarded this globally recognized independent quality mark by Germany's national accreditation body DAkkS. As a result of this accreditation, the laboratory's test reports now benefit from international comparability and recognition, facilitating the procurement process for customers and licensing authorities. The same applies to the inclusion of measurement results in their reports. While all of Knorr-Bremse's testing laboratories have always worked to the highest standards, it is becoming increasingly important for measurements to be carried out according to international standards.

Knorr-Bremse's next major accreditation project is also now up and running. While its production facilities around the world have already been IRIS-certified for many years, the Group is currently in the process of upgrading them to meet the ISO TS 22163 standard. ISO TS 22163 sets the quality management system standards for the rail industry and applies across the entire supply chain, from development to maintenance. The aim is to complete this process by September 2018.



Exhibition booth at Tech Day.

## Innovation update for our partners at Alstom and Knorr-Bremse Tech Day

Knorr-Bremse subsystems are widely used in Alstom's vehicle platforms – the two companies have a long-standing partnership. The Tech Day at Alstom's Paris headquarters in November, 2017 sought to further strengthen this partnership. The day's theme of "networking" applied on two different levels. Firstly, it emphasized the relationship of close cooperation and trust between the two companies. Secondly, it alluded to the subsystems' technological design – after all, subsystem networking will be a critical aspect in the rail vehicles of the future.

Face-to-face meetings at various different levels (Management, Executive Board, Divisional and Departmental) allowed Knorr-Bremse to present its systems and solutions and explain how they can benefit Alstom's business in the future. Examples included the Group's new e-bus expertise following the acquisition of Kiepe Electric and the transfer of technology from the truck to the rail division, such as the collision warning systems for urban mass transit.



Dr. Jonathan Paddison, Knorr-Bremse (left), Alistair Dormer, Hitachi Rail Europe (right).

## Knorr-Bremse wins Hitachi Supplier Award

The Hitachi Awards recognize suppliers' contributions to the success of Hitachi Rail projects in Japan, the UK and Italy through outstanding performance in customer support, technology, delivery and quality. This year, the 'Hitachi Rail Best Contribution to Value Generation Award' went to Knorr-Bremse, one of the leading systems suppliers for the new Hitachi trains being built in Europe – Rock double-decker trains in Italy and new InterCity fleets in the UK. Dr. Jonathan Paddison, Senior Vice President Sales and Systems, received the award on behalf of Knorr-Bremse Rail from Alistair Dormer, Vice President and Executive Officer in charge of the Rail Business and Executive Chairman and CEO of the Board, Hitachi Rail Europe, at the Hitachi Rail Partners' Day held in London in June.





TRACTION INVERTER



Roberto Pecchioli, VP Program Management, Hitachi, Nuonno Giampaolo, President and CEO Hitachi Rail, USA, Rich Bowie (KBC), Mark Cleobury (Knorr-Bremse), Hans Gold (IFE) (from l.), exhibition booth (center), traction inverter (below), door presentation (r).



# spotlight

## All eyes on Atlanta



The APTA EXPO is the North American public transportation market's premier trade exhibition. At this year's event in October, it was once again apparent that public transportation is taking on an increasingly important role in North America.

The American Public Transportation Association (APTA) is the leading US nonprofit organization for the advancement of public transportation. It represents the interests of more than 1,500 transportation organizations, from small bus and streetcar companies through to the large metropolitan transportation authorities.

The Association holds the APTA EXPO just once every three years. The venue for this year's event was the Georgia World Congress Center in Atlanta. The fact that it is held so infrequently makes it an even more important date on the North American rail industry's calendar. After all, this is the North American public transportation market's premier trade exhibition, with more than 800 exhibitors, some 12,000 industry peers and a wide range of new technologies offering something to suit every business model. The record-breaking numbers of exhibitors and trade visitors at this year's event demonstrate the growing importance of public transportation in North America.

### Life-size door actuator mock-up

Understandably, Knorr-Bremse showcased a considerable number of products and systems in Atlanta. These included the iCOM system, an innovative platform for the digital railroad world that, for example, provides operators with immediate information about the status of any sub-system, regardless of whether it is a Knorr-Bremse system or one from another supplier. Also featured was the EP2002 brake control system, a decentralized system that adjusts metro and multiple unit braking to the current operating situation for each individual bogie, taking into account a wide range of variables such as passenger weight distribution.

There was also a life-size mock-up of the new linear door actuator for sliding pocket doors. Depending on the specific installation, this new actuator from Knorr-Bremse company Technologies Lanka can reduce the installation space by up to 40 percent thanks to the integrated design of the actuator and door hanger. The system's modular design means that it is nevertheless extremely easy to maintain. And this approach has a further advantage for vehicle construction: The two components are installed in one go.

Other exhibits included a hydraulic leveling cylinder that allows easy adjustment of vehicle height to platform height, the SDO2-1-B sanding system and a range of products from Kiepe Electric, Microelettrica Scientifica and Selectron. Meanwhile, Knorr-Bremse's service business presented its Original Parts Kits (OPKs). These ensure efficient overhaul processes and low logistics costs for operators by providing all the original parts required for maintenance in a compact, simple and standardized package.

# The same standards for everyone

We know that growth and long-term responsibility are mutually stimulating. That is why sustainability forms an integral part of Knorr-Bremse's corporate strategy. Consequently, we aim to achieve the same Corporate Responsibility (CR) standards across all of the Group's companies and sites.

Running more than 100 facilities in 30 different countries is a huge responsibility, not least towards society and the environment. Knorr-Bremse endeavors to meet this responsibility not only by developing energy-efficient, low-emission, and resource-saving systems and products, but also by producing them in as environmentally friendly a manner as possible. No less important is the Group's responsibility towards its employees, suppliers and customers. "Today, the challenges associated with sustainability are extremely complex and are affected by a wide range of interactions, regardless of the CR priority in question," says Stefan Bräuherr, Head of Corporate Responsibility at Knorr-Bremse. Moreover, the CR standards demanded by the law, the public, and particularly customers are constantly rising all around the world. That is why "One CR Voice to the Customers" is one of the core principles of Knorr-Bremse's CR strategy.

In keeping with this principle, the Group is working to bring all its companies and sites up to the same high sustainability standards. "Knorr-Bremse has also started implementing these CR standards in the supply chain," says Bräuherr. The result is that for customers around the world, Knorr-Bremse is a reliable partner that also delivers value-added mobility solutions in the field of sustainable products and systems. Knorr-Bremse does not leave the sustainability of its innovations to chance. It systematically integrates CR into every stage of the product life cycle – from the vision and development stages through to manufacturing, operation (including maintenance), and end of life.

## Sharing best practices

The Group has introduced binding CR standards in order to ensure the necessary coordination and cooperation between the relevant parts of the business. These also establish the key CR themes for post-merger integration (PMI) of new companies, as illustrated by the recent example of Kiepe Electric GmbH. "On the one hand, we inform the new companies about our standard CR requirements such as the Code of Conduct," says Bräuherr. "At the same time, we also actively try to identify any best practices that the 'newcomers' may already have in place." Igor Nowak, Head of Integrated Management Systems at Kiepe Electric, describes the



Kiepe Electric site in Düsseldorf.

process as follows: "Sustainability and social engagement have been on Kiepe's agenda for many years. As suppliers of electrical systems for local public transportation, we attach great importance to energy efficiency and the avoidance of CO<sub>2</sub> emissions. Our products and solutions enable our customers to achieve a sustainable reduction in their CO<sub>2</sub> emissions. We will continue to drive progress on sustainability going forward. Our integration into a global Group like Knorr-Bremse opens up completely new possibilities for us in this area."

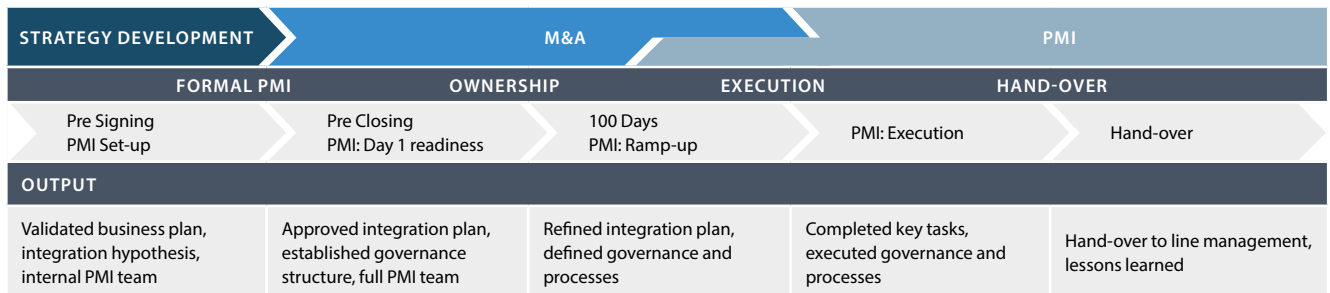
## Sustainability begins at home

Nowak adds that a credible sustainability strategy should be reflected not only in an organization's products but also in its specific actions. Tangible improvements are often the result of a number of small steps taken together. He cites the EV charging stations at Kiepe Electric in Düsseldorf and Knorr-Bremse in Munich. Or the fact that waste heat from the test rigs at the Group headquarters is fed straight into the building's heating system. Meanwhile, the solar PV system at Kiepe Electric generates 40,000 kilowatt-hours (kWh) a year, equivalent to the average annual consumption of eight four-person households in Germany. The site also recently optimized its server room cooling system, saving a further 8,400 kWh. "All of these measures help to bridge the frequently cited gap between ecology and economy," says Nowak.





Charging station at Kiepe Electric.



Outline of the Post Merger Integration process.



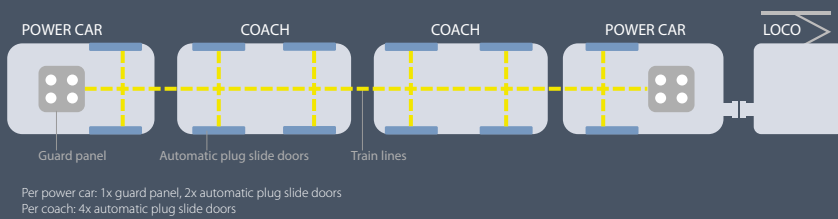
A clean and quiet trip  
across Lucerne by e-bus,  
powered by Kiepe Electric.



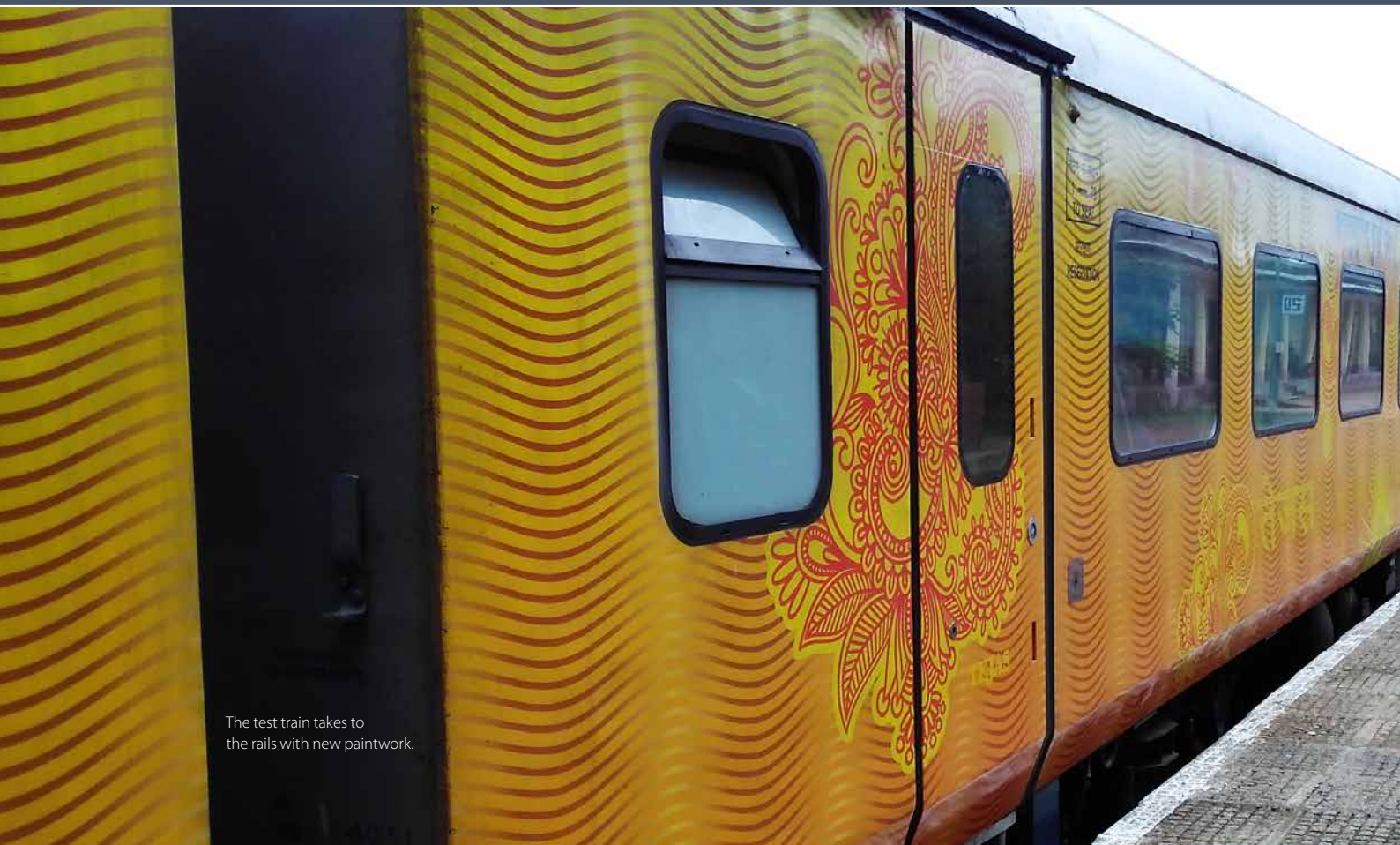
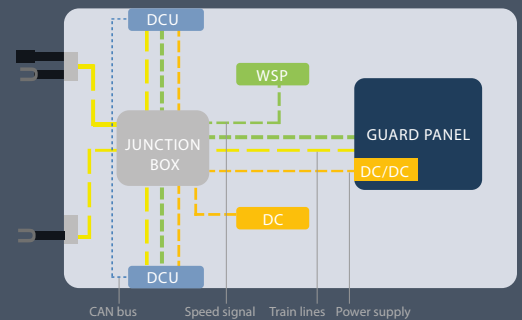
# customers + partners

## Bringing safer rail travel to India

### TRAIN SIDE DOOR CONTROL



### POWER CAR



The test train takes to the rails with new paintwork.





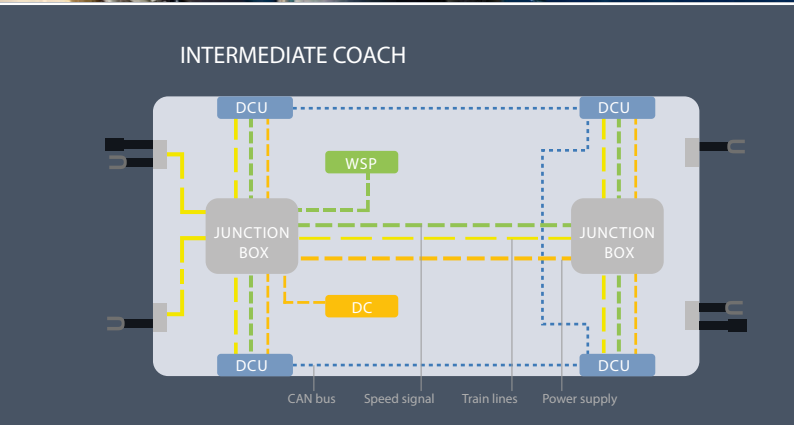
Door systems installed by Knorr-Bremse India.



In addition to 70 door systems (including doors, drives and control units), the call for tenders also required bidders to develop, produce and install a train side door control concept. Since India's long-distance trains are not equipped with either free train lines or a vehicle bus, the project also included all the on-board wiring, the individual signal cable links between cars, and guard panels to ultimately control the doors. An additional requirement was that the entire system must function independently of the locomotive used.

### Knorr-Bremse assumes overall responsibility for implementation

Train side door control is usually the vehicle manufacturer's responsibility – in this type of project, Knorr-Bremse's role would typically be as a sub-contractor. Since its reorganization, however, the RailServices division has also assumed overall responsibility for modernization projects within the provisions of agreements with the respective customers, and buys in any necessary additional competencies from external sources. Hand in hand with Knorr-Bremse India and the personal support of Mr. AP Garg (Managing Director Knorr-Bremse India Private Limited) Indian Railways equipped the first test trains in May 2017.



Since it was not possible to install the control system in the locomotive, the decision was taken to locate it in the train's two power cars. Each power car supplies electricity using a diesel generator and contains a compartment for the guard. It was decided that one guard panel should be installed in each of these two guard's compartments. In order to prevent operating command conflicts, Knorr-Bremse designed the guard panel logic in such a way that the two guard panels negotiate which one should control the train at any given time. In order to keep costs to a minimum, it was decided that a new vehicle bus would not be specially developed. Instead, the signals are transmitted via conventional train lines.

Open doors on moving passenger trains are an everyday sight in India. Accidents occur almost daily. As a result, Indian Railways (IR) is investigating ways of upgrading its existing broad-gauge fleet. With the support of RailServices, Knorr-Bremse India has developed a solution to put automatic doors on the trains.

The manual door systems used in India allow anyone to open the doors on moving trains. The doors can only be operated manually – there is no automatic locking. This poses a huge safety hazard on trains that can run at speeds of up to 130 km/h. It is said that open doors are responsible for between two and three thousand deaths every year. Indian Railways has decided that it is time to do something about this problem.

### Locomotive-independent train-wide control

There are two key issues that the state railroad company wants to investigate with the test train. First, the extent to which Indian passengers are prepared to accept automatic door systems. And second, how well the systems perform when faced with the badly overcrowded platforms often found under typical operating conditions.

The project organization for the complete turnkey system was extremely complex. Knorr-Bremse India was in charge of both overall project management and the installation of the door systems, including the control system and the train lines. The door systems were engineered and manufactured by IFE-Victall in China, while IFE's facility in Kematen, Austria, coordinated the safety aspects and Knorr-Bremse RailServices in Munich produced the concept for implementation without a bus connection.

### EMUs also in line for an upgrade

The test train has been running on the Mumbai-Goa route since May 2017. "Our initial experiences and the customer feedback have both been extremely positive," reports RailServices project coordinator Reinhard Rauscher.

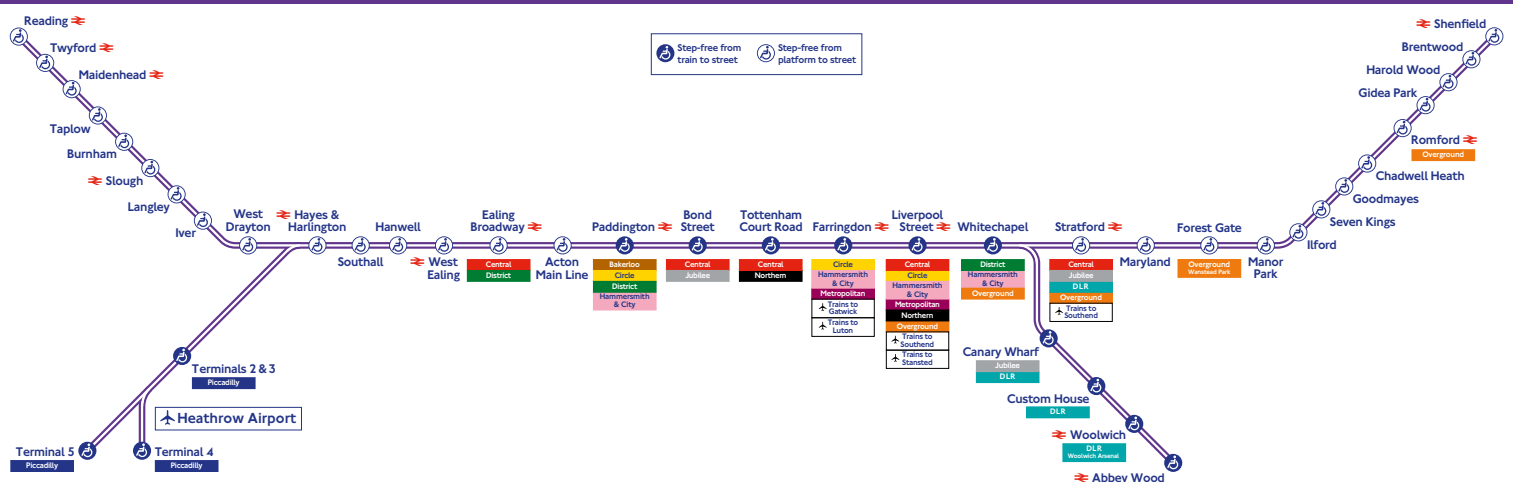
IR's Western Railway and Central Railway zones, which together operate around 10,000 EMUs, have now launched a similar upgrade project. Once again, Knorr-Bremse India won the contract for the first trial. The first upgraded EMU is scheduled to start running at the beginning of 2018.

# Crossing London underground

## ELIZABETH LINE

The new BT Aventura regional express on the Elizabeth Line at Shenfield Station heading for London Liverpool Street, July 7, 2017.

### Elizabeth line - December 2019



DRAFT July 2017





New station design: Canary Wharf, exterior and interior, © Crossrail UK.

London's "Elizabeth Line" is one of the largest current rail infrastructure projects in Europe. With a number of the line's new trains having entered service on a recently completed section of the line this summer, British passengers are now using the first of more than 3,500 new Generation 4 IFE entrance systems.

21 kilometers of tunnels have been bored beneath central London, almost unnoticed by the public. Once they emerge from below the ground, the new tracks continue to Shenfield in the east, while in the west they will ultimately extend to Reading and Heathrow Airport Terminal 4. The first trains started running between Liverpool Street Main Line and Shenfield in June.

The opening of the final section of the line in 2019 will mark the culmination of a plan that in essence dates back to an idea from the 1940s – a supplementary mass transit network for London, linking the city's suburbs from east to west. Today, of course, the project also addresses the urgent need to relieve the pressure on a rapidly growing city's creaking traffic arteries and deliver attractive rail transportation for the future. Over the next 13 years, London's population is forecast to soar by 1.4 million to a total of around 10 million. The Elizabeth Line's 118 kilometers will be able to carry some 500,000 passengers a day, increasing central London's current rail capacity by ten percent.

#### **65 200-meter nine-car trains**

A new fleet built by Bombardier Transportation (BT) will operate on the 25 kV, 50 Hz electrified line. Although the fleet is based on the Avenra platform, its design has been tailored to meet Crossrail's specific requirements. The first vehicles to enter service are 160-meter seven-car trains. Eventually, a further two cars will be

added, bringing them up to a total length of 200 meters. Each train will then be able to carry up to 1,500 passengers. Nevertheless, the station platforms will be 240 meters long so that the number of cars can be increased to 12 as and when passenger numbers rise. The automatic Communications-Based Train Control (CBTC) signaling system will eventually be capable of 30 train per hour operation in each direction.

#### **3,510 IFE entrance systems**

The operator chose IFE to install three double-leaved sliding plug doors with Generation 4 drives on each side of the cars. The door systems allow quick and easy boarding and alighting, keeping station stop times to a minimum. IFE has also signed a 29-year maintenance contract for the 3,510 entrance systems. Featuring proven technology and a compact design with 44 percent fewer components, the systems are impressively easy to install and maintain.

Their low weight is also important, since the trains have been designed to be as light as possible. With the energy regenerated back into the power supply when braking, they will use up to 30 percent less electricity than the old trains. The cars have dedicated wheelchair zones and spaces where seating can be tipped up to accommodate baby carriages or luggage. Passenger information systems display onward travel connections in real time, while the trains also feature intelligent lighting and temperature control. "These new trains will transform the way people travel across London and beyond," enthused Britain's rail minister Paul Maynard when the first trains entered service on a newly completed section of the future line.

# Targeted learning

Knorr-Bremse RailServices has been chosen as the official brake inspection training partner for DB Cargo locomotives for the next three years. A new measuring instrument kit is also being used increasingly widely in DB Cargo workshops.

The desks of Jens Blaufuß and Josef Lohmaier are more than 300 kilometers apart as the crow flies. Blaufuß is head of training for Technical Management at DB Cargo AG's headquarters in Mainz, while Lohmaier is in charge of the Knorr-Bremse RailServices customer training department in Munich. But the speed-dial keys on their phones keep them in close contact. "Hardly a day goes by without us being in touch," says Lohmaier.

The reason is a new framework agreement between DB Cargo and Knorr-Bremse RailServices under which the Munich customer training department is now responsible for all the brake inspection training provided to Blaufuß's colleagues. "We send about 100 members of staff to them every year for training so that they can carry out the inspections by themselves when they are back on site," explains Blaufuß. According to Lohmaier, "The trainers have been working in training for 15 years and they really know each one of the different locomotives inside out. There is virtually zero staff turnover among our trainers."

The resulting high training quality was the first major reason for DB Cargo's decision to sign a framework agreement. The second reason was flexibility. "On the operational side of the business, we sometimes need to be able to respond very rapidly to new situations," says Blaufuß. "This means that we need a training partner with whom training can be arranged easily and sometimes at short notice."

## New measuring instrument kit not restricted to Knorr-Bremse equipment

The DB Cargo training courses also resulted in the operator starting to make widespread use of the new Knorr-Bremse measuring instrument kit in the field. "The kit covers the full spectrum of inspection applications, from manual testing of individual parts to complex braking system testing," explains Lohmaier. This includes fault detection and diagnosis, all the testing operations for the different brake inspection steps, receiving inspections, adjustments, and ECM-compliant measurement recording and storage.

The kit is clearly laid out and designed to cope with the rugged working environment inside a workshop. It contains all the nec-

essary tools such as quick couplings, adapters, pressure sensors, and digital manometers, plus the measuring instrument and all the corresponding cables. A USB connection to the ST03A Service Terminal software for PCs enables universal measurement recording and processing. This means that the measuring instrument kit is not restricted to Knorr-Bremse equipment and can also be used for pneumatic braking equipment made by other manufacturers.

Periodic maintenance of the kits is also included in the DB Cargo package. RailServices will recalibrate or, if necessary, repair the equipment at the appropriate service intervals. A replacement kit is supplied while the kit is being serviced.







# At the cutting edge

Knorr-Bremse first started supplying braking equipment to Russia in the 1960s – at the height of the Cold War. Today, the company is well established as a major player in the Russian rail market.

Moscow Metro is getting used to organizing underground celebrations – at least 15 new stations are scheduled to be opened before the end of the year. Many of them are on the second circle line, which is due to expand further over the next two years and, with completion of the southern section, will add up to 60 kilometers of track. Careful planning has ensured that the line is linked with the Central Circle urban train line that opened last year, as well as having rapid interchanges with most of the other metro lines.

New metro lines for Moscow, but also for St. Petersburg (the country's second-largest metro network) and Kazan, require new rolling stock – and this is where the manufacturer Metrowagonmash comes in.

## **Knorr-Bremse's biggest metro customer in Russia: Metrowagonmash**

Knorr-Bremse's sizeable share of the Russian market is largely due to the fact that Metrowagonmash regularly turns to the company when major metro operators place orders for rolling stock. This has enhanced Knorr-Bremse's reputation for outstanding quality, as Moscow Metro is considered to be the world's most punctual metro system. The latest generation of Type 81-765/766/767 trains is fitted with Knorr-Bremse bogie equipment, air supply systems, doors, high-voltage electronics and control and management systems; and the company is also supplying a wide range of equipment for Type 81-722/723/724 metro cars.

This is only the latest chapter in a story that dates back to the 1960s, when the former Knorr-Bremse parent plant in East Berlin began to supply braking equipment for Soviet passenger trains. The first important step after the collapse of the Iron Curtain was the opening of Knorr-Bremse's Moscow office in 2004. This was followed, three years later, by the establishment of Knorr-Bremse Systems for Rail Vehicles LCC to coordinate the Group's rail vehicle activities in Russia and the CIS states.



Type 81 – 760 / 761 metro cars for Moscow Metro.





New type 81 – 765 / 766 / 767 metro cars for the Moscow metro.

### Meeting the GOST standard

In 2010, Knorr-Bremse opened its first Russian production facility in Voronezh, where disc brakes and calipers for mainline passenger trains are assembled and various service activities provided. Then, in 2013, Knorr-Bremse set up a joint venture with the Federal Cargo Company entitled 'Knorr-Bremse 1520' – the name being derived from the Russian track gauge of 1,520 millimeters.

Parallel to this development, the KAB60 distributor valve and AKB1 load-dependent brake valve went into volume production. Specially designed to meet the GOST standard, they are now widely installed in new vehicles developed for the Russian rail network and manufactured by Russian car builders. Almost 30 per cent of new Russian freight cars are already equipped with these systems. Many Knorr-Bremse systems have also been chosen for installation in the 'Sapsan' and 'Allegro SM6' high-speed trains. And orders are also frequently received for new intercity and mass-transit trains and locomotive projects. As a result, it made sense for Knorr-Bremse to concentrate its rail vehicle activities in a single, newly-constructed facility in St. Petersburg – the northern cornerstone of the Russian high-speed network.



Russian high-speed train "Sapsan".

### Registration as a Russian company

The latest development in Russia came last year, when Knorr-Bremse bought out the FGK's share of the 'Knorr-Bremse 1520' joint venture. This move was a demonstration of the company's long-term commitment to the Russian market, but at the same time was a logical development, as it meant that Knorr-Bremse was now officially registered as a Russian company. In an era of localization quotas, Knorr-Bremse can gain from being involved in Russian vehicle projects supplied by foreign manufacturers – a recent example being the Lastochka commuter train from Ural Locomotives, a Joint Venture between Sinara Group and Siemens. LRVs will fill the gaps that remain despite the expansion of metro systems: Capable of operating in places that metros cannot reach or where they are not financially viable, they can transport passengers virtually from their doorstep to the nearest metro station.



EoT devices (left to right): Italy, France/Benelux, Germany

## Way up in the far north

Fret SNCF has been using Knorr-Bremse's new End-of-train devices (EoTs). Soon, they should also enter service on trains belonging to Swedish operator Green Cargo.

One of the slightly paradoxical aspects of rail transportation is that although the industry has made huge strides in terms of introducing digital technology and now uses a wide range of electronic safety systems, there are still some instances where robust mechanical systems remain the only solution. End-of-train devices (EoTs), the main function of which is to improve the efficiency of the braking of freight trains, are one such case. Because freight cars are not equipped with a power supply or radio technology, a fully mechanical pneumatical implementation is the most simple option open for freight.

"The fact that EoTs are directly connected to the main brake pipe means that they also benefit braking performance," explains engineer Rudy Melchior (Knorr-Bremse Systèmes Ferroviaires France). Provided that the relevant regulations are complied with, they thus make it possible to operate longer, heavier or faster trains. "This brake support system operates via an integrated pneumatic module, providing entirely redundant functionality over and above that of the standard electro-pneumatic modules. This gives you vastly more reliable operation without needing to do anything else to the train, or to the locomotive."

### **Trials completed without a single fault**

Knorr-Bremse's EoT system was trialed by French operator Fret SNCF between 2012 and 2015 and eventually adopted after it obtained the desired approval for use on trains of up to 850 meters in length. In 2016, Scandinavia's largest rail freight operator Green Cargo finally started field testing the system. The tests began during the summer on trains running in the southern part of Sweden, between Gothenburg and Storvik. One interesting discovery noted favorably by the operator during this phase of the trial was that the EoT reduced the braking distance by around 25 percent.

As a result, Green Cargo and Knorr-Bremse Rail France decided to run a further test program that same winter. This time, the goal was to test the EoTs' suitability for operation in the tough winter conditions of northern Sweden. After all, the system had not been specifically designed with these conditions in mind. The system racked up more than 15,000 braking maneuvers during the trial – once again without a single fault. Green Cargo therefore decided to make wider use of the EoT. As a result of the cooperation between Knorr-Bremse Nordic Rail Services and Knorr-Bremse Systèmes Ferroviaires France, a leasing agreement is planned to be signed soon that also includes the yearly systems' maintenance.





The project team.

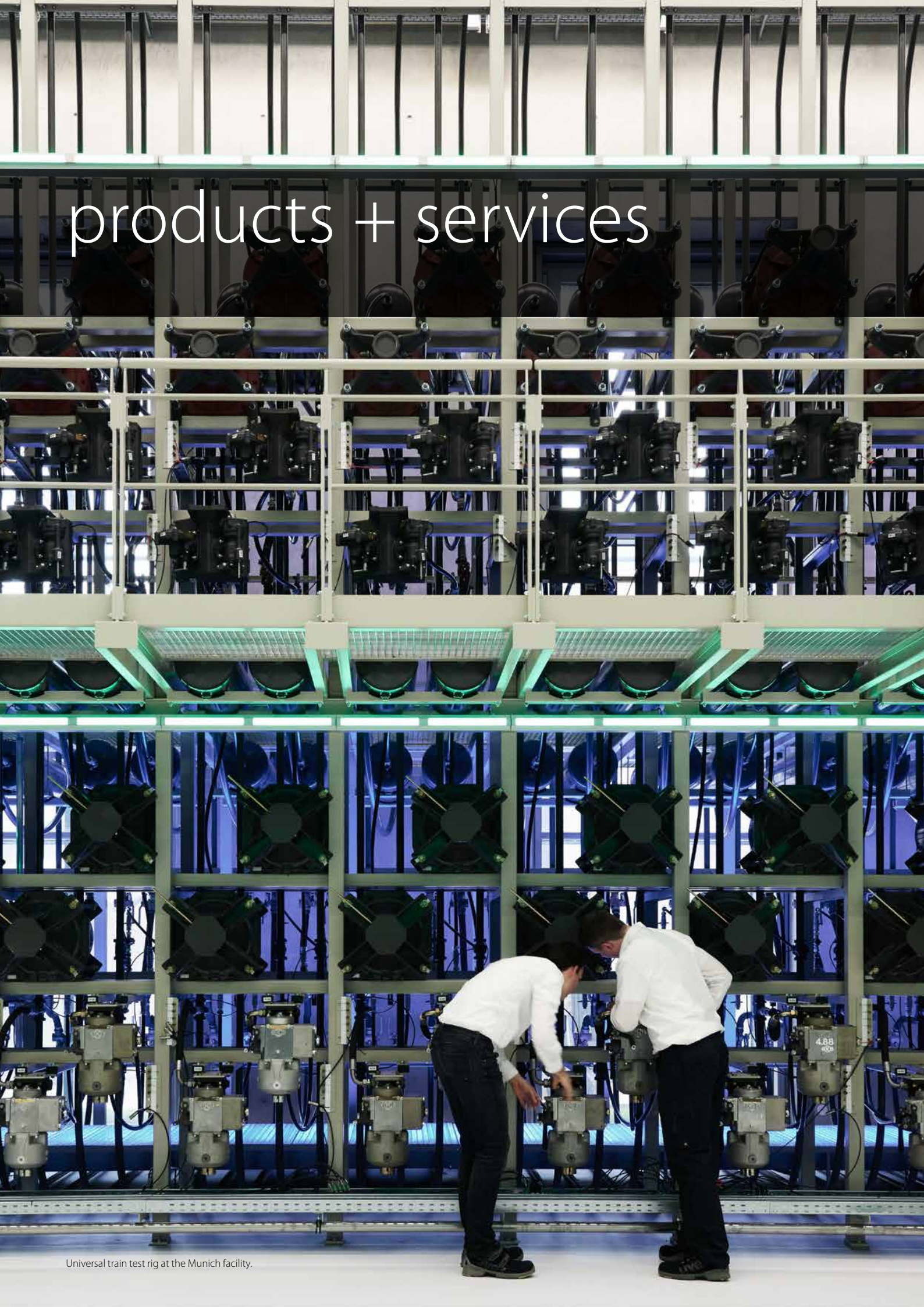
green  
cargo



EoT static test.

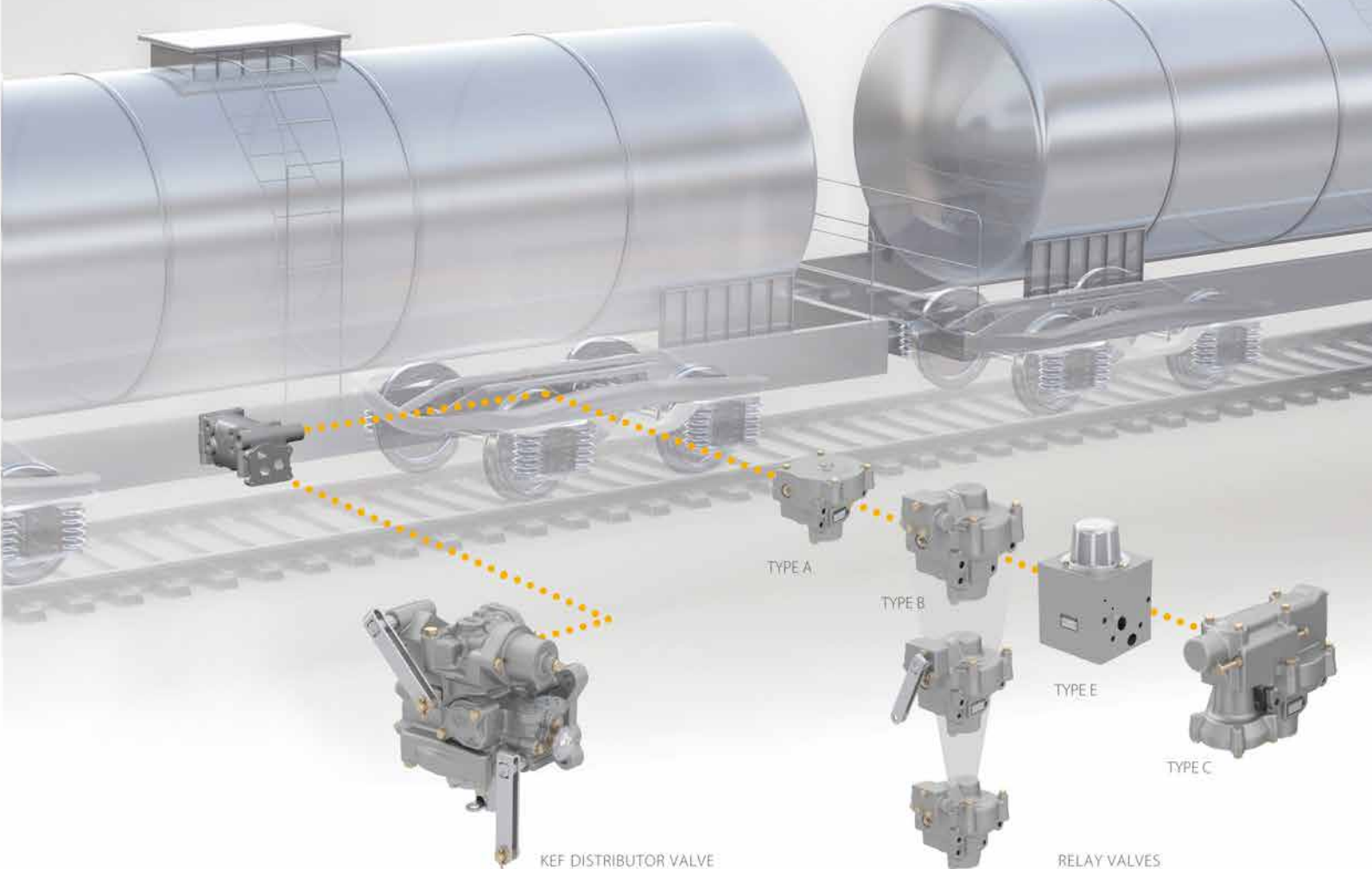


products + services



Universal train test rig at the Munich facility.





# Here's to several more decades!

After selling more than 1.5 million KE distributor valves, Knorr-Bremse has re-engineered its number one distributor valve from the ground up. Provisional UIC certification has been obtained and field testing of the new KEf generation has been underway since last spring.

When the first KE valve entered service in 1953, its engineers had written a new chapter in railroad history. The KEa was the first distributor valve capable of always filling the brake cylinder within the prescribed time, regardless of size and piston stroke. It replaced high-maintenance mechanical slide valves with reliable rubber membranes and seat valves. Furthermore, the entire design was based on a modular principle. The idea was to make the valve capable of adapting as flexibly as possible to potential requirements.

As a result of continuous development – and new technical standards – there are now approximately 500 versions of the KE valve, plus countless components. “All these different versions make overhauls more time-consuming and mean that further development of the valves is becoming more and more complex,” explains Dr. Christoph Heine, head of Brake Systems Qualifications at Knorr-Bremse Rail Vehicle Systems. “At the end of the day, everything still has to fit into the installation spaces that were specified almost 65 years ago.”

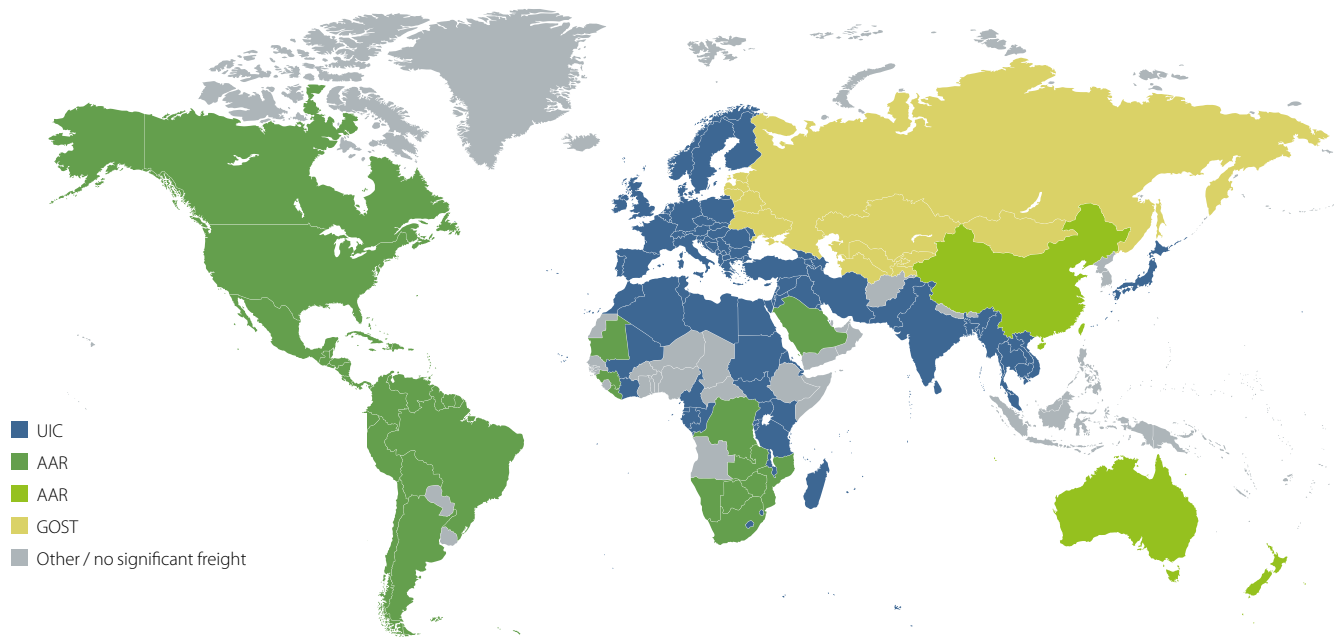
## “Ready-for-future” tag is no gimmick




As a result, Knorr-Bremse took the decision to develop the KEf, a completely new KE distributor valve generation. It will be comple-

mented by a newly developed kit featuring single-stage, two-stage and load-dependent relay valves. The engineers have opted to replace the solid sand-cast design with hot-pressed aluminum parts. Whereas formerly the pilot volumes of the distributor and relay valves used up a lot of space and material in cast housings, this installation space now elegantly disappears in the carrier. This makes the valves significantly lighter and more compact. Even the standard version now fits vehicles with limited installation space – such as low-floor cars – without any special modifications.

The ready-for-future tag is no gimmick – the valves have been designed to be ready for the digitalization of the freight car. The KEf modular distributor valve's interfaces are equipped to meet future requirements. This provides a convenient solution for operators that includes easier handling. When a valve needs overhauling, the carrier simply remains in the vehicle – all modules requiring maintenance can be removed from the carrier.

A carefully conceived, universal common parts strategy lies at the heart of this approach. The requirements of a wide range of vehicle types can be met extremely flexibly with just one distributor valve and a handful of relay valve variants.

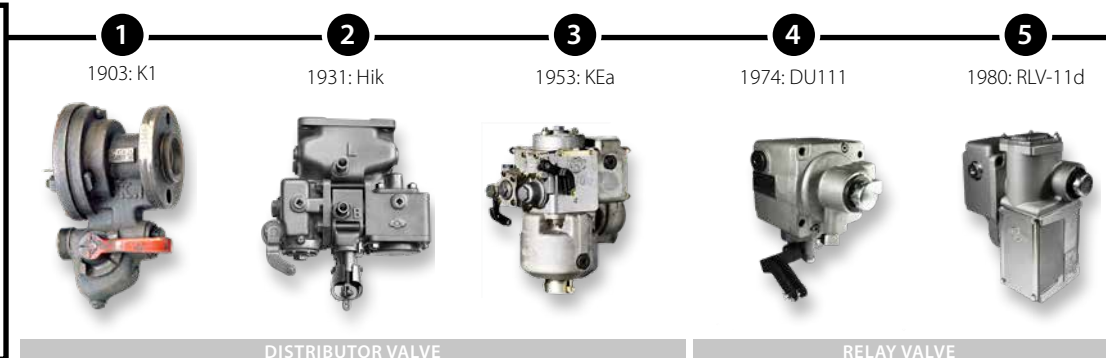


Feature	UIC	AAR	GOST
Brake control	Graduated release	Direct release	Switchable; level: direct release, gradient: graduated release
Normal operating pressure in main air line	5.0 bar	70–110 psi (4.8–7.6 bar)	Level: 5.3 bar, gradient: 6.3 bar
Maximum brake cylinder pressure	3.8 bar (full and emergency braking)	Standard 64 psi (4.4 bar) for full braking; 15% higher for emergency braking	4.2 bar
Maximum train length	750 m, trials up to max. 1500 m	Up to approx. 200 cars	Approx. 100 cars
Distributor valve (example)	KEf	DB60	KAB60
			

The braking systems and their key features.

## EVOLUTION

Following the launch of the K1 rapid-action brake for passenger trains, Georg Knorr founded Knorr-Bremse in 1905 in order to re-engineer the K1 for freight trains. Unveiled in 1931, the Hildebrand-Knorr brake was the benchmark in 17 countries. The KE valve gave Knorr-Bremse a new boost in the post-war years.







Cold chamber (left) and vibration test rig (right) at the Munich facility.

### Munich Development center provides extensive testing facilities

The new Development Center in Munich played a pivotal role in the development process. "We are able to carry out extensive type testing with over 500 individual tests within a relatively short space of time," says Knorr-Bremse test engineer Michael Krusche. "For example in the climatic chamber, on the shock and vibration test rig, or using special test set-ups for dusty environments and stone chipping." The engineers used the Universal Train Test Rig (German abbreviation: UZP) to test both traction mode with up to 100 KEf distributor valves and, of course, mixed operation with the existing distributor valves. Extensive endurance testing showed that compared to the previous generation, the KEf generation delivers significantly higher reliability and uptime with the same or longer overhaul intervals.

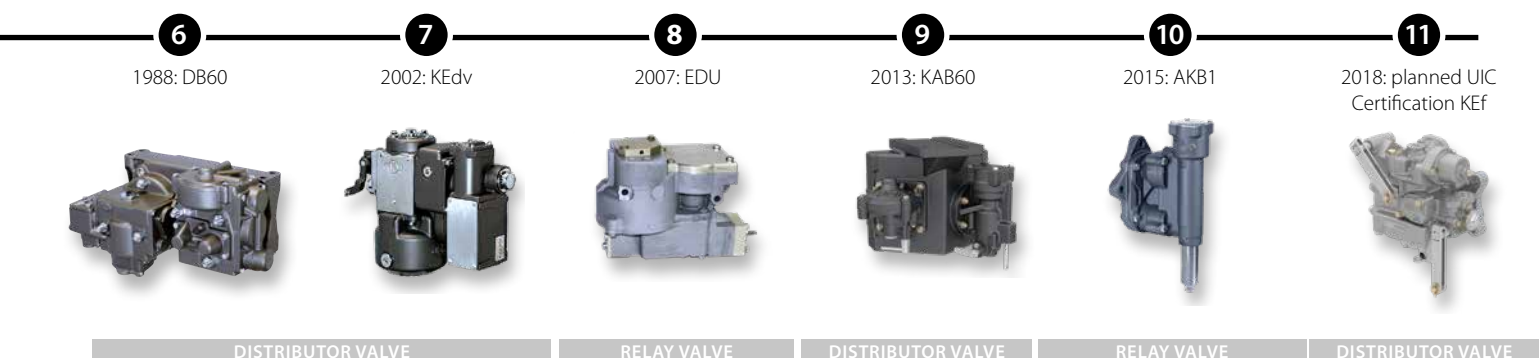
It is thus no coincidence that when they granted the KEf provisional certification, the UIC experts made special mention of the high testing equipment standard and confirmed that the results were fully reproducible. Once the provisional certification had been obtained, field testing under real operating conditions began in spring 2017. Since then, more than 30 distributor valves have been in service in three different types of vehicle. Full UIC certification is scheduled for June 2018. TSI certification was obtained from Germany's EU certification and inspection agency Eisenbahn-Cert in summer 2017.

### KEf for countries with UIC standard, KAB60 and AKB1 for GOST

The KEf continues Knorr-Bremse's strategy of supplying a modern valve generation for each of the world's railroad standards. This was already achieved some years ago for countries with the GOST standard 1,520 mm gauge, when certification was obtained for the KAB60 distributor valve and the AKB1 load-dependent brake valve – almost 20,000 of which are now in service.

While the focus for the graduated-release UIC brakes is on inexhaustibility and excellent speed regulation, the most important consideration in countries that use the GOST standard is suitability for use on exceptionally long and heavy freight trains, with train weights of up to 10,000 tons – and of course the ability to operate in extremely low temperatures.

The KAB60 and AKB1 valves operate in ambient temperatures down to -60 °C during the Russian winter. Before the frozen cargo can even be unloaded, the trains must first be driven into special thawing sheds where they are rapidly warmed to a temperature of +80 °C: "A huge amount of know-how has gone into many of the sealing elements, since the extreme operating temperature requirements could only be met by developing new component geometries and elastomer composites," says Knorr-Bremse's Thomas Petter, who was in charge of the KEf distributor valve's development. During the course of the development process, patents were even filed for the contours of ostensibly simple flange seals. "This know-how was incredibly valuable when we developed the KEf." Customers will be reaping the benefits of this work for decades to come.



# Reducing costs and noise levels

With its upgradable configurations, Intelligent Air Control (IAC) is the expandable strategy for the future of air treatment. The first configuration featuring a new power converter concept has been on sale for some time. And now, the second configuration is available, offering varispeed rather than simple “on/off” operation.

Multiple units usually have two main and two auxiliary compressors. They convert electrical energy into the pneumatic energy required to operate key vehicle systems such as the brakes and air springs. Operators generally define compressor capacity in terms of the time allowed for the first filling of the pneumatic system and reservoirs. Most compressors are therefore bigger than necessary for normal operation.

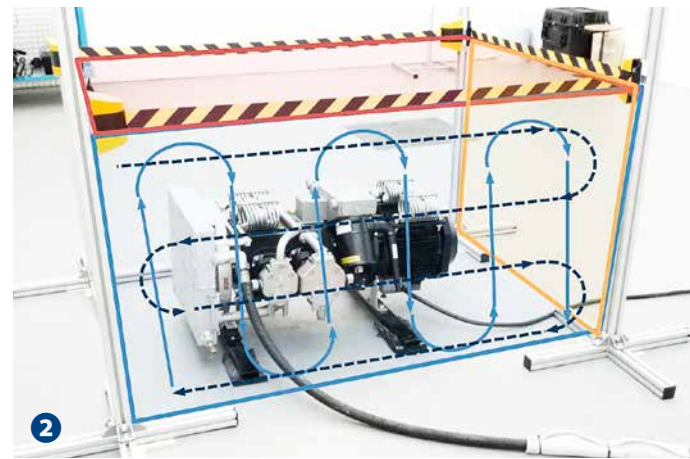
However, the overarching goal of any air supply solution should be to always supply the right volume of air at the right time for the current operating status, thereby ensuring optimal systems operation. Intelligent Air Control (IAC) is available for this purpose in different configurations.

## Less noise, lower costs

For historical reasons and also because of differences in vehicle construction, there is considerable variation in the compressor power supplies in old vehicles – they may be AC or DC and have different voltages and frequencies. The focus in the first IAC configuration is on using the existing compressor range and expanding its applications to all these different versions. For example, if a required compressor capacity can only be achieved with 60 Hz rather than 50 Hz, but a 60 Hz on-board power supply is not available, IAC uses the converter to modify the frequency.

Moreover, for DC applications, the system could be used to convert direct current to alternating current, allowing expensive and heavy DC motors to be replaced by AC motors. This would make the air supply system lighter, thus lowering the cost – as well as allowing the use of standardized technology. These options are primarily aimed at the aftermarket.

The second IAC configuration aims to provide a completely new type of compressor control in response to complaints from residents and noise abatement campaigners about vehicles that are parked in standby mode during the night. These complaints eventually led to the adoption of a new regulation by the Association of German Transport Companies (VDV) imposing strict limitations on the permitted noise levels. The second configuration adopts a new approach. Previously, the vehicle control system would switch

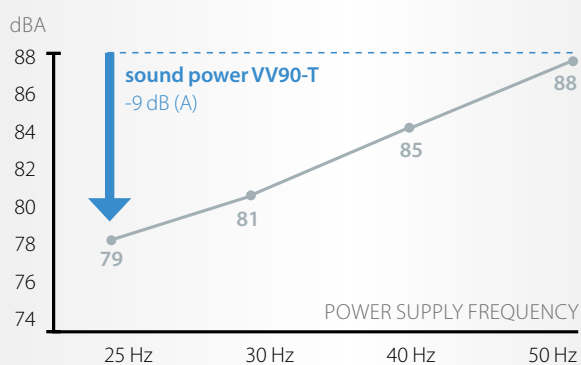


Lower noise level through compressor speed reduction, shown here with the VV90-T (measured acc. to ISO9614-2:1996) (Figs. 2 and 3).

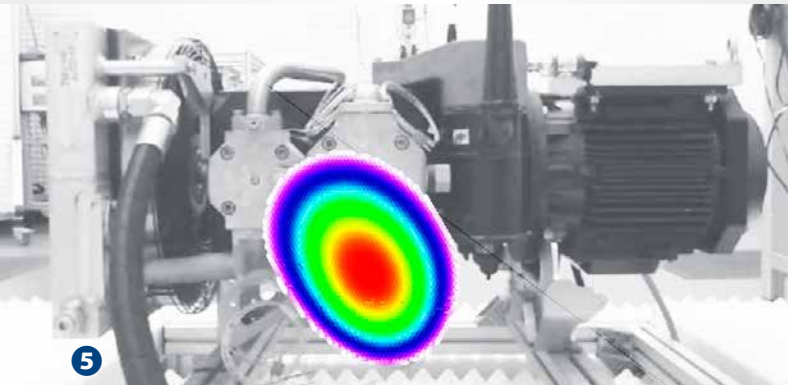
the compressor on whenever the pressure in the main air reservoir fell below a predefined threshold. Every time this happens, noise is generated. But not all operating modes require the full capacity of the compressor. Especially in the case of vehicles parked in standby mode overnight while they are out of service, occasional compensation of pressure loss due to leakage is perfectly adequate.

IAC provides the solution by halving the compressor's supply frequency from 50 to 25 Hz. This reduces the compressor speed from 1,450 rpm to 698 rpm. Although the lower output means that the compressor has to run longer to deliver a given volume of compressed air, the advantage is that it is significantly quieter. In the case of the VV90T oil-free compressor, this reduction in rpm translates into a 9 dB(A) reduction in the sound power level. This means that the compressor is only half as loud to the human ear. Until now, the only way to achieve noise reductions of this order was through heavy and costly full encapsulation.





Noise emission analysis of a VV120-T compressor (Figs. 4 and 5). in the acoustic chamber.



Commuter trains parked in standby mode near a residential area in France (Fig. 1).

### Simplified concept offers more flexible installation options

The more constant running speed has a number of economic benefits for operators and vehicle manufacturers. Firstly, the energy costs are consistently lower for a compressor that runs at a constant speed than for one that is either running at full speed or not at all. And secondly, the more constant operating temperature makes for less frequent heating and cooling phases, which minimizes condensation and thermoelectric voltages. Both of these factors contribute to a longer compressor lifespan and thus lower costs for operators.

The third factor is especially important for vehicle manufacturers. The flexibility of varied compressor speeds goes a long way towards resolving the intractable design problem of having to trade off compressor performance against soundproofing encapsulation, an adequate supply of cooling air and the formation of condensation. By reducing the encapsulation needed for soundproofing, it becomes possible to simplify the cooling concept. And a simplified cooling concept in turn reduces the system's complexity. With 60 Hz operation, it is possible in some cases to downsize the compressor, i.e. use a compressor that is one power level smaller. In the future, this will translate into smaller installation spaces and weight savings. This is a compelling benefit, especially for metro applications where installation space is often at a premium. All of this means that there are still plenty of avenues left to explore with IAC.



