informer

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EDITION 45

NEWS

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VV-T 2.0 oil-free compressor

KNORR-BREMSE

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Dr. Peter Radina,
Member of the Executive Board
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Systeme für Schienenfahrzeuge GmbH

INFORMATION FOR
KNORR-BREMSE'S CUSTOMERS
AND BUSINESS PARTNERS

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Westinghouse platform screen doors
ZELISKO
RAILSERVICES

Dear Reader,

UNIFE, the European rail industry association, has estimated that annual growth in the global railroad market to the year 2021 will be 2.6%. The forecast for Western Europe is even higher, at 3.1% – the fastest growth rate in any of the major regions of the world. The reason for this is that manufacturers and suppliers in the sector are not satisfied with the status quo and are determined to push out the boundaries of what is technologically feasible, paving the way for further strong growth.

This determination is what lies behind the European technology initiative 'Shift2Rail'. In September, the initiative's next work program, entitled 'PIVOT', is due to be launched. Vehicle builders and system suppliers – but also railroad infrastructure companies and centers of competence – will be contributing their specific areas of expertise to this program. Knorr-Bremse is proud to be part of such a high-powered team once again, and will be in charge of the 'Technology Demonstrator Brakes'. In this edition of the Informer you can read about what the engineers and development experts have in mind.

The fact that Knorr-Bremse is able to take part in such a high-profile initiative is due partly to the extensive investment the company has made in its development infrastructure. The latest lighthouse project in this field is the new Development Center in Munich, which went into operation about a year ago. The Center's activities range from basic development to final testing and homologation of specific developments – but you can read about this for yourself.

There are other high-profile projects described in this edition. One is iCOM, which monitors the condition of rail vehicles and enables operators to take a proactive approach to maintenance that helps keep costs down. While this app platform is proving itself in several European contexts, Knorr-Bremse is already working on the next step, taking additional sub-system suppliers on board in order to offer fleet operators even greater benefits.

An important contribution to safety is made by the E-EDT3 derailment detector, which is currently undergoing validation by Knorr-Bremse. The background to this development is the increasing use of slab tracks with no – or only low-profile – cross-ties. Existing detectors are of limited use on such tracks, which is why Knorr-Bremse is helping by developing an additional algorithm.

I hope you enjoy reading this edition of the Informer.

Best regards

Dr. Peter Radina

news

Fast cornering

Avelia Liberty © Alstom.

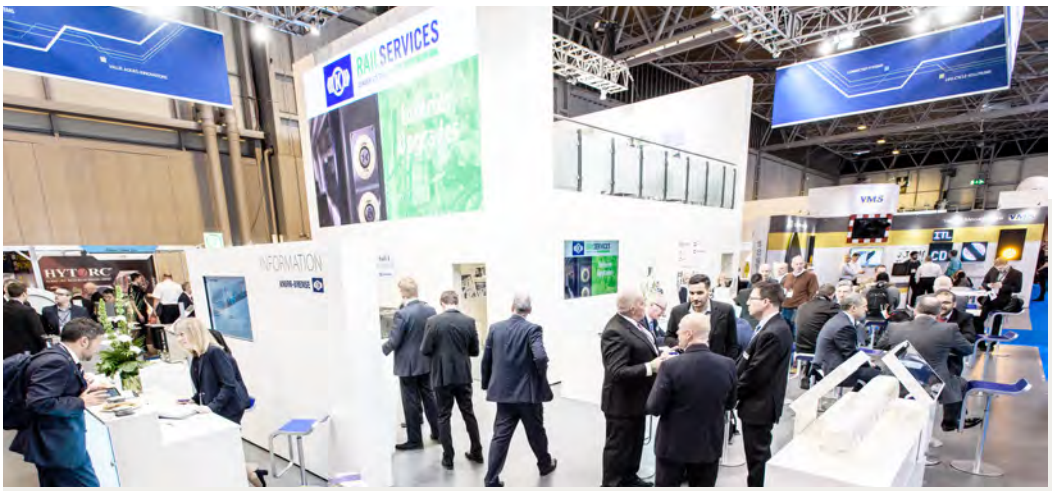
Knorr-Bremse is developing the braking systems for Alstom's first high-speed project in the USA. Operator AMTRAK has ordered 28 trains with 11 car sets per train from the Avelia Liberty platform to replace its current high-speed fleet on the Northeast Corridor (NEC) between Washington D.C. and Boston.

Knorr-Bremse teams on both sides of the Atlantic have been involved in designing the new braking systems. Approval of the final specifications is imminent, and parallel to this, Knorr Brake Company in Westminster, Maryland is developing the manufacturing equipment. The current schedule is for prototype delivery in 2018, followed by a rapid launch of volume production in 2020 and full completion within a year. The systems will be manufactured by Knorr-Bremse in Westminster and delivered directly to the Alstom plant some 300 km away in Hornell, New York. Included in the contract is a maintenance agreement for at least fifteen years, and a supply of spare parts and special tools.

The Avelia Liberty is currently designed to have a top speed of 320 km/h (200 mph) but will start revenue service with 257 km/h (160 mph) – already 17 km/h faster than its predecessor. Journey times will be cut further, thanks to the new train's ability to tilt by 7 degree, reducing the need to brake around curves.

"Acela Express" – a high-speed success story

Back in 2002, when the Acela Express first went into service, it carried some 2.5 million passengers per year. By 2015, this had increased to 3.5 million. According to AMTRAK, a third of jobs in the region are within a radius of 8 km (5 miles) of an NEC station, with multiple connections to regional and local trains. In other words, the Acela Express has long since become an integral part of the East Coast transport network.



Impressions of the Railtex trade fair.

RAILTEX

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EuroBrake 2017

Successful trade fairs

'Railtex', the leading British trade fair for railroad equipment, products and services, is held every two years in Birmingham and brings together decision-makers, engineers and purchasing managers from the industry. This year (May 9-11), Knorr-Bremse was one of the biggest exhibitors. The motto under which the Knorr-Bremse portfolio was presented was 'Connected Systems' – sub-systems that are networked with each other and the resultant customer benefits. The main advantages are top safety and reliability combined with low life cycle costs. The Knorr-Bremse booth also featured virtual reality displays illustrating the potential offered by vehicle modernization. Other important events for Knorr-Bremse during the first six months of 2017 have been: Eurasia Rail in early March in Istanbul, and in May, the Eurobrake exhibition in Dresden and the UITP Summit in Montreal.

Vladimir V. Rutkas receives RZD award for outstanding cooperation.

Three RZD awards from Russia

It started with the JSC Russian Railways selecting the KAB60 control valve made by Knorr-Bremse's Russian subsidiary 'Knorr-Bremse 1520' as 'Best in Quality, Components for Rolling Stock and Infrastructure'. Specially designed to meet the GOST standard, the valve was chosen for its performance and its contribution towards reducing life cycle costs. This was followed by the 'Red Star Award' for the excellent quality of the products and services supplied by the St Petersburg site. And to complete the hat-trick, Vladimir V. Rutkas, President of Knorr-Bremse CIS Holding, received the RZD award for outstanding cooperation.

Modernization: RailServices aims for full interoperability vehicle homologation for the first time

Knorr-Bremse RailServices is currently fitting a new braking system in a Desiro Classic vehicle belonging to DB Regio. In itself that is nothing unusual – but for the first time RailServices is also aiming to manage the homologation process according to the Trans-European Rail Interoperability Order.

This means that in addition to taking on responsibility for the modernization concept, design and required modifications, RailServices Engineering Munich and Krakow will also be managing the entire homologation process for the modernized vehicle. In other words, DB will receive the full modernization package from a single source. Track and type approval testing is currently under way and will be followed by the actual homologation process. Final homologation certification is expected to be forthcoming by the fourth quarter of 2017.

Benjamin Kumpfe and Dr. Matthias Stein from RailServices in front of the Federal Railway Authority.

Order for Stuttgart's networks.

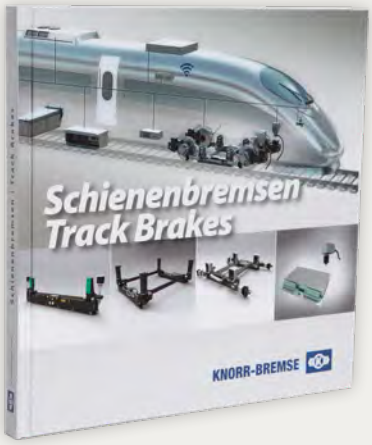
LRV in Chemnitz.

Systems for new Talent 3 trains

The new Bombardier Talent 3 regional multiple units that will carry passengers through the Neckar Valley from Stuttgart to Mannheim and Heilbronn from 2019/2020 onwards will have Knorr-Bremse systems on board. In February, the two companies signed a framework agreement covering brake control systems, bogie equipment including electromagnetic track brakes, sanding systems and air supply units with VV120-T oil-free compressors for the new vehicle generation. Furthermore, Bombardier will be ensuring a clear view of the track at all times, with innovative windshield wiper and wash systems from Knorr-Bremse.

An initial call-off order has already been received for 43 three- and five-section trains for the Stuttgart regional network operated by Abellio, and Bombardier has also received an order from operator vlexx for the Saar region's electric rail network, which will use the latest generation VV120-T 2.0.

Order for E Netz Saar.



New publication 'Schienenbremsen – Track Brakes'.

New publication: 'Track Brakes'

The second edition of Knorr-Bremse's book 'Schienenbremsen – Track Brakes' has just been published. This invaluable reference work from 2004 has now been thoroughly revised and updated. Available in German and English, it can be ordered on the website: http://www.knorr-bremse.de/en/railvehicles/downloadservices/libary/libary_railvehicles.jsp

Management Board of Kiepe Electric GmbH (from left): Ulrich Lauel, Dr. Rainer Besold and Jürgen Völkner.

Electrical traction systems added to portfolio

Kiepe Electric GmbH is a globally operating supplier of electrical traction equipment to leading rail vehicle and bus manufacturers – and since January has been a member of the Knorr-Bremse Group. "With this acquisition, we are taking the logical next step in the successful development of our business," said Klaus Deller, Chairman of the Executive Board of Knorr-Bremse AG and responsible for the Rail Vehicle Systems division. "For our customers, the main focus is on the technological benefits generated by greater sub-system connectivity." Along with eco-friendly traction technology for light rail vehicles, metros and regional railways, Kiepe Electric also specializes in rail vehicle modernization.

The acquisition has also enabled Knorr-Bremse to expand its offer in the field of commercial vehicle systems, as Kiepe produces environmentally-friendly traction equipment for battery-, hybrid-, hydrogen-, trolley- and in-motion-charging (IMC) buses. Kiepe Electric's efficient solutions and environmentally sustainable concepts for low-emission public transport have brought the company an international customer base that includes the world's leading rail vehicle and bus manufacturers.

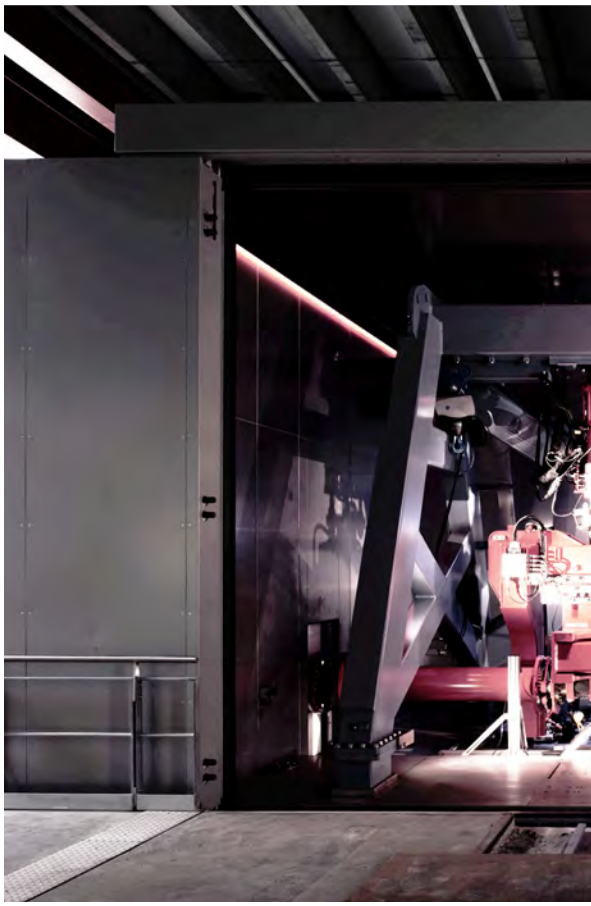
Wheel Slide Protection for older rolling stock

Leaves on the tracks create a serious problem for train operators, especially those with older rolling stock. Fleet owners Porterbrook were determined to tackle the issue on its older train fleets of Class 156, 150/2, 155 and 153 units, which are all from the 80s and 90s and were not originally fitted with any type of Wheel Slide Protection (WSP) system. During the autumn leaf fall they often suffered wheel flats that were costly to repair. Knorr-Bremse installed a new WSP system on a Class 156 train, which then entered service in November 2016. Rollouts are now planned across the fleets before the leaf fall season of 2017.

Rails with autumn leaves.

spotlight

Shaping the future of technology



The Development Center, which opened a year ago in Munich, represents the Knorr-Bremse Group's biggest single investment in its history. Above all it is the customers who stand to benefit.

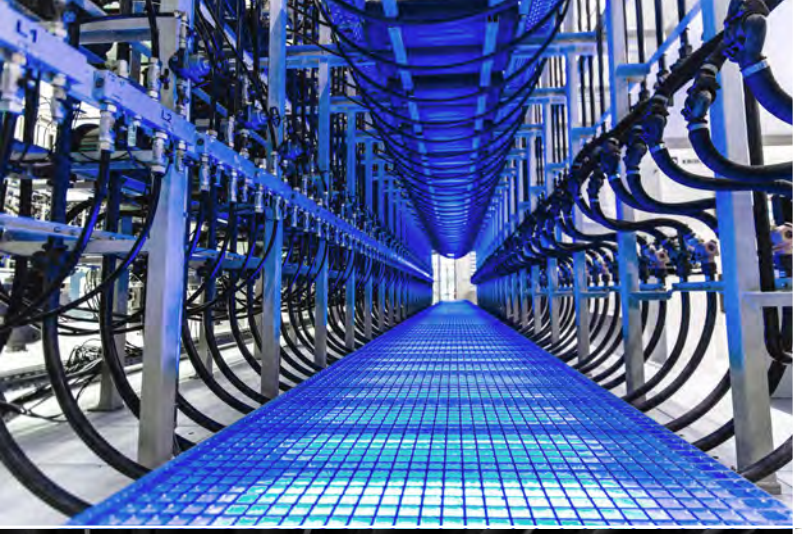
It stands five stories high, with almost 17,000 square meters of space providing 350 workplaces for engineers and technicians. The new Development Center is now as much an iconic feature of Knorr-Bremse's Munich site as the historic old building that houses the Knorr-Bremse AG headquarters. Between the laying of the foundation stone in April 2014 and the opening of the Center just under a year ago, this interdisciplinary cradle for new ideas and platform for Knorr-Bremse's systems expertise gradually took shape step by step. Engineers and technicians from both divisions – Rail Vehicle Systems and Commercial Vehicle Systems – work here side by side. Such a concentration of brake-related expertise generates synergies and adds value for our customers. Knorr-Bremse has invested a total of € 90 million in the Development Center, which was described as "a core investment for Bavaria" by Bavarian Minister President Horst Seehofer at its official opening ceremony just under a year ago.

Assessments such as this apply above all to the 100 state-of-the-art test rigs and equipment that Knorr-Bremse has brought together at the Center for the purpose of trials and quality assurance. They cover a huge range of functions, from basic research to final testing and homologation of specific developments. With these test rigs, Knorr-Bremse has created a long-term basis for supporting customers with regard to product safety, operational reliability and compliance with strict statutory regulations.

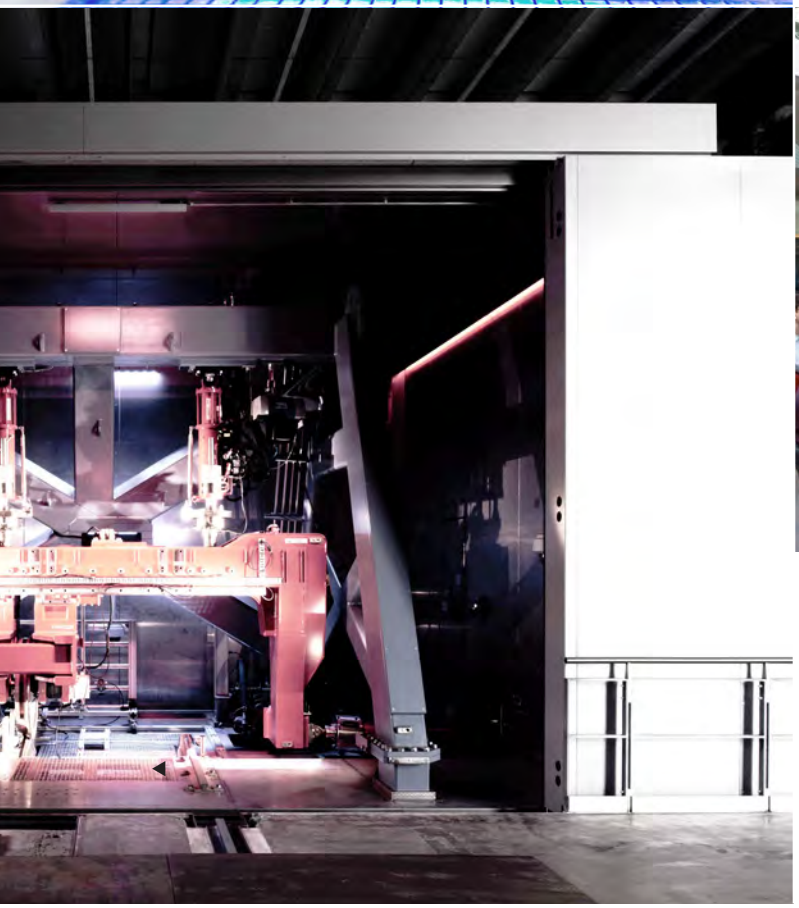
Testing, developing, validating, approving

The technical highlight of the Center is the 15-meter high, 760-ton ATLAS test rig (Advanced Test Laboratory for Adhesion-based Systems), which simulates real-life track operation of wheels, wheelsets and bogies at speeds up to 350 km/h. It caters for all gauges and standards and a wide range of different environmental conditions including extreme temperature ranges, rain and potential contamination. Similarly exacting testing is carried out on the Universal Train Test Rig. With its brake pipe configured in a giant spiral, it is capable of simulating the braking of entire passenger and freight trains with up to 208 cars and measuring more than 3 km in length. The Modular Electro-hydraulic Test Area simulates multidimensional loads on individual components in order to ensure that they are not prone to cracking or fracture. Climate chambers also enable temperature testing in a range between -70° and +90° Celsius to be carried out.

This infrastructure enables even the most complex concepts to be rapidly validated. Rig testing also reduces the requirement for testing on complete vehicles. Both these factors make a huge



The Universal Train Test Rig (UZP).



Test Rig ATLAS (Advanced Test Laboratory for Adhesion based Systems).

Atrium: A place to meet, talk and exchange ideas.

contribution towards reducing the total cost of vehicle ownership and cutting time to market, even where increasingly sophisticated technologies are involved. One example is the precise braking of trains whatever the load or weather conditions: This offers added value in terms of improved punctuality and shorter headways. Another example is friction materials: Knorr-Bremse aims to improve these in order to reduce wear and tear and noise emissions even further. In this way, the Development Centre also represents a direct, long-term investment for vehicle builders, operators, passengers and residents in the vicinity of railroad tracks.

The building itself has also been designed for maximum sustainability, with waste heat from the test rigs being used directly for the HVAC system.

The Universal Train Test Rig can simulate the braking of entire passenger and freight trains.

customers + partners

Learning from the market leader

Krakow, Poland

Training session at Knorr-Bremse (above). | Training module at IFE (below).

Technical customer training session at Knorr-Bremse.

Flexible training offering real value-added

The basic purpose remains the same: to improve service standards and increase vehicle availability by enhancing participants' knowledge of products and systems. But because the railroad sector is constantly changing, Knorr-Bremse also continuously develops its training program.

A comprehensive customer survey carried out in collaboration with Knorr-Bremse's global sales organization established that the main demand from fleet operators is for training measures to be flexible and have a long-term impact.

Customer training has to be based on the needs of the individual customer. But these can change as time goes by – which is why Knorr-Bremse has completely revised its training concept. In Krakow, Poland, the first local initiative to take this new approach has just been launched: 'Knorr-Bremse RailServices Training Academy'.

When it comes to Knorr-Bremse training, the same first-class quality and flexibility associated with its products is applied to the provisions on offer to customers. Common training standards and processes are designed and implemented at Knorr-Bremse Rail by the Supply Chain & Service Operations department in order to ensure the high Knorr-Bremse quality standards worldwide. Highly-qualified Knorr-Bremse trainers with international experience and local competence ensure state-of-the-art OEM product and systems training. The modular structure of the courses means they can be adapted to the specific needs of operators and manufacturers. A well-balanced mixture of modern e-learning and classic task-based training, including practical exercises on original systems and vehicles, ensures a lasting transfer of knowledge.

In response to this, Knorr-Bremse continues to fine-tune and modularize its training offer. At the same time, the range of methodologies is being extended, with the addition of virtual reality elements, simulations, e-learning modules and explanatory videos. The end result – exemplified by the new generation of braking technology training – is a realistic and continuously accessible source of knowledge transfer for participants.

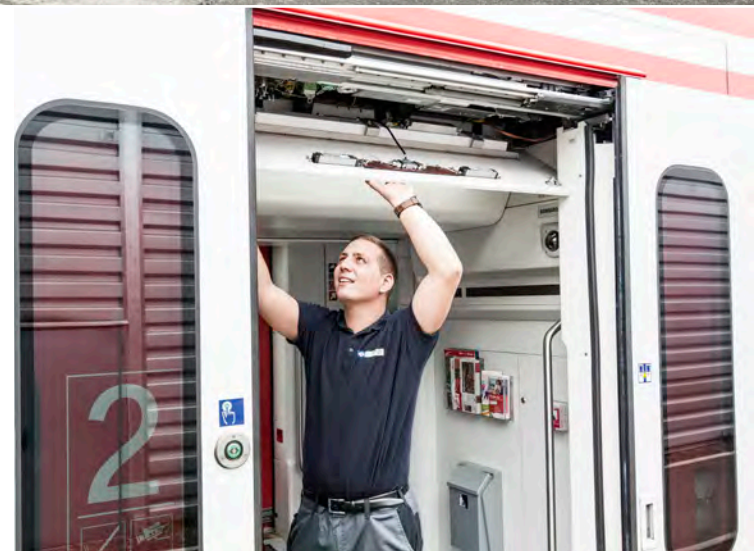
In order to maximize customer benefits, Knorr-Bremse is also networking with other training providers. "We regard our training program as a qualification platform that ensures an effective transfer of expertise between the various players in the railroad sector and generates genuine added-value for operators," explains project leader Tobias Zorn. "Our declared aim is to ensure that RailServices is also partner of choice when it comes to customer training."

Training Academy Krakow

A first step at local level was the opening of the 'Knorr-Bremse RailServices Training Academy' in Krakow, Poland, offering a program of open qualification measures. Four specially designed compact training sessions on rail vehicle braking systems are currently on offer: pneumatic brakes, electro-pneumatic brakes, air supply units and brake control units. Further modules, for example on brake pipe control, bogie equipment and hydraulic brakes, are under preparation and will shortly be added to the portfolio.

DB Regio double-decker passenger car.

Predicting maintenance requirements



Installation of iCOM into a DB Region double-decker passenger car.

The iCOM Monitor app is currently keeping an eye on the condition of 24 E3 electric sliding plug doors in double-decker cars operated by DB Regio AG. The data gathered from this pilot installation will be used to develop algorithms for predicting cost-efficient maintenance measures.

Some systems are subjected to such extreme stresses that they threaten to fail relatively quickly; others are routinely replaced even before they have reached the end of their operating life as a precautionary measure. Now a joint development project by Knorr-Bremse, IFE and DB Regio AG is aiming to reliably identify the systems' actual condition.

In the past, merely deriving algorithms from the door opening and closing times had proved inadequate – which is why a number of additional parameters are now being taken into account for predicting maintenance requirements.

The partners in this project have pooled their expertise, with Knorr-Bremse and IFE contributing their detailed knowledge of the products and systems involved, and DB Regio AG adding its extensive experience as an operator. A combination of both is required to establish the causality of the recorded data and identify the condition of the components and systems involved. This is the central purpose of iCOM Monitor, which monitors the condition of the system and provides advance warning of maintenance requirements, enabling the operator to proactively take the necessary measures.

Generation X04 Citadis in Toulouse (France).

Palatial architecture of a Moscow metro station (top).
Interior view of a Moscow Metro car with IFE entrance system (bottom).

Milestones for entrance systems

Deliveries of IFE entrance systems to Moscow Metro recently surpassed the 10,000 mark. And in the last 15 years or so, more than 25,000 entrance systems have been sold for 2,000 Citadis light rail vehicles.

The older metro stations in the center of Moscow are decorated like underground cathedrals. On a network of some 350 kilometers, many rush-hour trains operate at 90-second intervals – so absolute reliability is essential when it comes to their entrance systems. The IFE systems clearly meet these high standards, as vehicle builders and operators regularly turn to the company when new vehicles are ordered, and the 10,000th door system was recently delivered.

Production for vehicle builder Metrowagonmash, part of the Transmashholding Company, is partly localized, with IFE supplying the basic door leaves to partner company PTS/CIT in Mytishchi, northeast Moscow. Here the doors are painted, glazed and assembled – and now also the delivery logistics for the completed systems are handled. This year also sees the first deliveries of entrance systems for the new 765 series metro trains, which are equipped with the electric RLS door drive and an optical LED status display strip in the door leaf.

Four vehicle generations, more than 70 projects

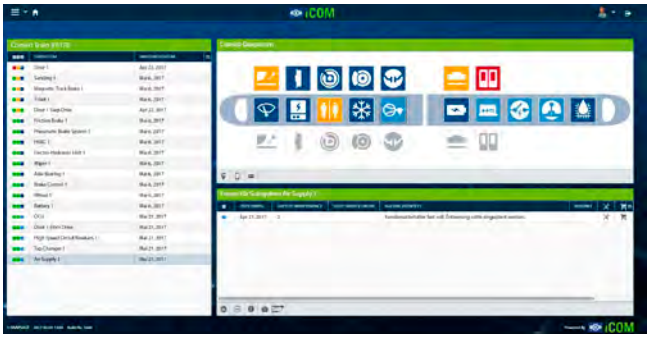
The door systems for Alstom Citadis light rail vehicles are a similar success story. An order received last January means that IFE has now been involved in four generations of Citadis vehicles and more than 70 projects. Including outstanding orders, this adds up to door systems for 2,000 LRVs.

From the very outset, IFE has supplied the Citadis family with its best-selling RLS family of door systems ranging from the original classic door to the RL2, as well as the relevant control systems, from the PMC and the MDC right down to future FLEX systems.

App platform for the rail sector

Use of iCOM Monitor on location.

All relevant information on the dashboard at a glance.



Overview of sub-systems in the back office.

The more sub-systems are monitored by the iCOM app, the greater the benefits for fleet operators – which is why Knorr-Bremse is bringing further rail vehicle sub-system suppliers on board.

Netherlands rail operator NedTrain is already using the iCOM Monitor app to check the condition of its compressors; in Germany, DB Regio AG has installed it to keep an eye on the E3 electric sliding plug doors in its double-decker passenger cars; and in Berlin, mass-transit operator Berliner Verkehrsbetriebe (BVG) is piloting its use for monitoring the hydraulic braking system in one of its light rail vehicles. These are only three examples of several current uses of iCOM by European rail operators.

"But our aim is to extend the use of iCOM beyond these routine areas of use," says Dirk Seckler, Head of Sales at Knorr-Bremse RailServices. "As part of an across-the-board approach to condition-based maintenance we want to involve further sub-system suppliers." In other words, iCOM is taking the next step towards becoming the app platform for the rail sector.

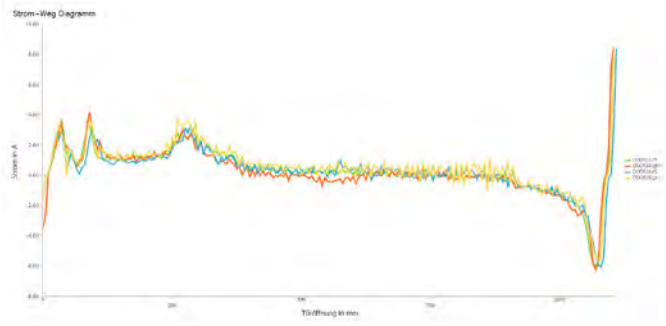
New strategic development partnerships

The first step was already taken with the design of the iCOM architecture: It is the first system of its kind in the rail sector to use an open standard, which means that as well as being extendable to cover specific customer requirements it can also integrate systems from manufacturers other than Knorr-Bremse. "We are actively contacting manufacturers that we think are of interest for us," reports Seckler. "And at the same time we are open to approaches from sub-system suppliers who see Knorr-Bremse as an attractive partner for the industrialization of condition-based monitoring for their products."

Against this background Knorr-Bremse recently launched a number of strategic development partnerships: Strategic partnerships have either already been concluded or are currently being negotiated with leading producers of fire protection, clutch and ball bearing systems. As far as the operator is concerned, the more sub-systems they can monitor with a single system, the greater the benefits.

Making profitable use of the generated data

When product and operational data are generated, manufacturers are naturally concerned about ownership of the information. "Our aim is to share these data in order to maximize the benefits for the customer," says Dirk Seckler.



Motor current characteristic curve for an average door-opening operation.

High-speed mountain link

In January the Turkish state railway company TCDD started to operate its new VELARO TR high-speed trains. When there is a short timeframe for R&D, the advantages of platform projects come to the fore.

Seven 8-car VELARO electrical multiple units were ordered from Siemens by the Turkish state railway company TCDD (Türkiye Cumhuriyeti Devlet Demiryolları). This project – the third European order from the VELARO platform – goes under the series of HT 80000 and HT 80100 in Turkey, and the VELARO TR trains have been operating on the Ankara-Konya and Ankara-Eskişehir lines since the start of this year. Knorr-Bremse supplied the entire braking system, including brake control, air supply and bogie equipment, as well as entrance systems from its subsidiary IFE and roof-mounted OVL resistors from Microelettrica.

Straightforward processes using proven technologies

"In cases like this, where the entire process has to be as rapid as possible – from receipt of the order to final commissioning – platform-based projects are an advantage," explains Michail Gecht, Senior Project Manager High Speed Trains at Knorr-Bremse Rail Vehicle Systems. "The structures are already in place and contractual modalities have already been agreed." It is easy to establish the stages of the process; designs have already been approved and interfaces aligned. "Put simply, the vehicle builder is able to place the orders and schedule the entire manufacturing process on the basis of the existing supply chain."

This was especially true in the case of projects like the Turkish one, for which proven tools and processes based on earlier VELARO projects were already in place. In addition, a first train from the VELARO platform had already been delivered to Turkey in 2015, and test runs, references and operating experience (over a million kilometers) had awoken interest and raised levels of acceptance for the new technology. For Siemens and Knorr-Bremse, years of expe-

Siemens VELARO TR high-speed train, Turkey.

rience with the VELARO meant they could draw on a wide range of solutions and use a high proportion of proven technologies.

Ankara – rail hub of the future

Each train has 16 electric motors generating 8,000 kW of traction – enough to achieve a top operating speed of 300 km/h compared with current speeds of up to 250 km/h.

The example of the link between Ankara and Istanbul impressively demonstrates what this speed means in terms of traveling time: Whereas the timetable currently indicates a journey of more than six hours' duration, the good 500-kilometer stretch between these two industrial and political centers of the country will soon be covered within just three and a half hours in the VELARO TR.

Turkey plans to develop the new high-speed train station in the capital of Ankara into an important rail hub. According to TCDD it can serve 20,000 passengers per day in the first building stage, and as many as 50,000 are planned for the future. This underlines the fact that Turkey's high-speed plans go well beyond the link to Istanbul. The next stage will be to establish a route from Ankara to Sivas and Izmir – and the TCDD has already issued a call to tender for a further 80 high-speed trains for the country.

‘Central nervous system’ for the GOST market

Selectron has now been part of the Knorr-Bremse Group for about two years. The advantages for customers can be seen in the Russian GOST market amongst other places: The company produces components that are flexible, perfectly matched and easy to integrate.

A TCMS (Train Control and Monitoring System) only accounts for around 2% of the total cost of a rail vehicle, but its importance for the vehicle’s availability is much greater than that would suggest. The system uses a smart combination of networking technology and user software to integrate sub-systems such as traction, brakes, doors, HVAC, lighting, wet cells and other elements into the overall train control system. Any malfunction can quickly bring the entire train to a halt. In many ways the TCMS plays a role similar to that of the human central nervous system, connecting up the individual elements to form a carefully matched, well-functioning whole

Coping with heat and cold

Knorr-Bremse’s recent sales successes in the GOST market can be attributed partly to the speed with which it has responded to the requirements involved. A TCMS has to work perfectly under extreme environmental conditions such as wide temperature fluctuations, lengthy, intense vibration or violent shocks. Knorr-Bremse Selectron engineers rapidly met any additional requirements from the Russian market for the relevant TCMS components, and demonstrated their systems’ ability to function in extremely cold conditions. In so doing they were able to build on technical experience gathered with the Stadler FLIRTs exported to Finland, Norway and Estonia a few years earlier.

Where necessary, Knorr-Bremse Selectron also went to the other end of the temperature scale: Components installed in the engine room have demonstrated their ability to cope with temperatures of up to +70 °C. Selectron’s first foray into the Russian market took place some years ago when it supplied components for the Moscow Aeroexpress, the rapid transit link between the three airports and the city center. They soon achieved a reputation in Russia for their reliability, even under the harshest conditions. And now the Selectron TCMS is also increasingly setting standards in the GOST market, thanks to its flexibility, ease of integration and perfectly matched components.

Stadler EMU ‘ESCH2’ for the operator ‘Aeroexpress’.

Systems for Moscow, Kaliningrad and St. Petersburg

In the metro segment, Selectron recently received an order for Train Control and Monitoring Systems for new 81-765/766/767 trains for Moscow Metro. The contract, with delivery running until the year 2020, covers 768 vehicles and includes the latest Ethernet switch technology. Another contract involves an ongoing modernization project by manufacturer Metrowagonmash for which Selectron is supplying a flexibly configurable wheel slide protection system. And for the diesel-electric DP3 being exported by Polish manufacturer PESA to Belarus, Selectron has been chosen to supply the TCMS. The same goes for the PESA contract to supply Swing light rail vehicles to Kaliningrad and Foxtrot LRVs to Moscow. Finally, the 71-623-03 LRVs being manufactured by Ust-Katav Carriage Works for St. Petersburg will be equipped with the TCMS solution including CAN-powerline for the vehicles’ multiple traction system.

Stadler EMUs for Belarus Railways.

Joint action

The European technology initiative 'Shift2Rail' forms part of the 'Horizon2020' research program and aims to develop innovative ideas for the rail industry. Knorr-Bremse is heading up the 'Technology Demonstrator Brakes' that forms part of the 'PIVOT' program scheduled to start in September.

The 'Shift2Rail' joint technology initiative is intended to massively reduce life cycle costs for both rolling stock and infrastructure in European rail operations. It also aims to increase railroad capacity, improve reliability and punctuality and boost competitiveness. Environmental and social aspects such as energy consumption and noise levels also play a central role.

In the field of passenger vehicles (IP1, Innovation Program 1) the focus of the many research and development projects making up this technology initiative is on traction systems, train control and management systems, car body shells, running gear, braking systems, doors and train interiors. 16 participants, including major vehicle manufacturers, system suppliers such as Knorr-Bremse, and also rail infrastructure companies and centers of competence, are bundling their particular expertise as so-called "Members" of 'Shift2Rail'. They are supplemented by some 400 smaller firms and organizations that respond to so-called 'Open Calls'. In addition to IP1, 'Shift2Rail' involves four further IPs that are focusing on infrastructure and rail freight systems. The costs are being jointly met by the European Rail industry (approx. € 390 million) and the European Union (approx. € 610 million).

"'Shift2Rail' is a classic example of how joint action can result in genuinely European solutions" says Dr. Gert Fregien, Head of Support Operators and Technology at Knorr-Bremse Rail Vehicle Systems and responsible for coordinating the Technology Demonstrator Brakes within "Shift2Rail". 'TD Brakes' is nothing less than an attempt to lay the foundation for the next generation of rail vehicle braking systems. Knorr-Bremse's subsidiary IFE is also playing a minor role in the similarly structured 'TD Entrance Systems'. Knorr-Bremse's input to the PIVOT project amounts to some € 2.2 million.

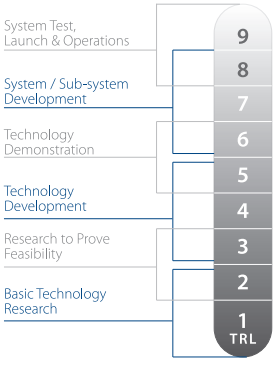
The "Shift2Rail" team (left) | Fast train with motion blur (above).

TRLs 3 and 4 in sight

The five projects under the title of 'TD Brakes' involve developing enhanced safety levels for electronic hardware and software, innovative friction materials, a new eddy current brake, new electro-mechanical brake solutions (EM brakes) and establishing standards and processes for virtual homologation in the rail vehicle sector.

The latter could help slash the cost of certifying new products and systems by introducing computer simulation to replace some of the certification runs required, thereby reducing the amount of time that has to be set aside for this purpose. The approach to developing new braking solutions – in response to market requirements – sets out to improve braking force transfer and make maintenance cheaper and more eco-friendly. The project for the next generation of eddy current brakes envisages extending the field of use from the high-speed sector to also include other vehicle types. And in the case of the new friction pairings, the aim is to improve braking performance and reduce wear and tear, thus cutting life cycle costs. Finally, the new hardware and software architecture for brake control is designed to reproduce in an electronic system the safety-critical functions that hitherto have been realized pneumatically.

Although the Technology Readiness Levels (on a scale of 1 to 9) of the current solutions at the start of 'PIVOT' are 1 and 2, the aim is to reach TRLs 3 and 4 by the time the project ends in two years' time. Further member calls planned for the years to follow should eventually bring the laboratory models up to TRL 6 (prototype demonstration) and above by 2020 and 2021.



Technology Readiness Level

products + services

Precise sensors

The increasing use of slab track with low-profile sleepers – or none at all – means that existing derailment detectors are often inadequate or unsuitable. Knorr-Bremse and the Technical University of Berlin are helping to solve this problem by developing a new algorithm.

A combination of automated railroad operations and the use of new vehicles on old tracks means that rapid, reliable derailment detection is becoming increasingly important. The current technology uses a pneumatic or an electronic system to detect irregular oscillation: In case of derailment, the jolting caused by the wheels running over the sleepers triggers a warning or automatic emergency braking. Both types of system – pneumatic EDT and E-EDT integrated into the electronic brake control – are found in Knorr-Bremse's portfolio for a range of vehicle types. In Brazil, for example, more than 1,000 E-EDTs have been in operation for over ten years.

Reliable detection even on slab tracks

These systems now face a challenge as a result of the increasing use of slab tracks on new routes, metro lines and tunnel sections. "An extremely sensitive system is needed to detect derailment on a smooth track with no – or only low-profile – sleepers," explains Ulf Friesen, Development Project Manager, Bogie Diagnostics Knorr-Bremse Rail Vehicle Systems.

Knorr-Bremse and the Technical University of Berlin are currently validating an additional algorithm on the E-EDT3 that precisely meets these requirements – and they are using a new approach to the process: In the past, detection algorithms were always based on vehicle-related experimental data and therefore only provided type-specific information. In the case of the E-EDT3, in order to avoid the need for elaborate vehicle- and track-specific detection experiments, model-based validation is being used. "But for this we require realistic data derived from testing on slab tracks," says Friesen.

Validating an extended detection algorithm

Knorr-Bremse engineers and academics from the Technical University of Berlin ran an experimental vehicle over a smooth concrete track and a section with sleepers with one- and five-centimeter profiles. An array of sensors produced data that enabled a model of the vehicle-track contact to be parameterized and validated. "Integration into the original vehicle model enabled us to close the 'gap' in the simulation model," says Friesen.

This simulation model for the entire vehicle now enables universally valid datasets to be generated. Parameters such as speed and weight can be varied, and constellations derived that no longer just represent the marginal conditions of the vehicle's experimental run. The data from the various simulation runs, together with measurements already available from other test runs, are now being used to validate the actual detection algorithm on the test rig.

One after the other, the datasets are fed into the control unit with the detection algorithm. If the system always triggers – or does not trigger – the mechanism on the basis of the input data, the algorithm can be regarded as validated.

The process is due to be completed during the course of this year, and the new E-EDT3 is likely to be approved and ready for market launch by mid-2018.

Experimental vehicle (left).

Derailment test, various sleeper heights (top).

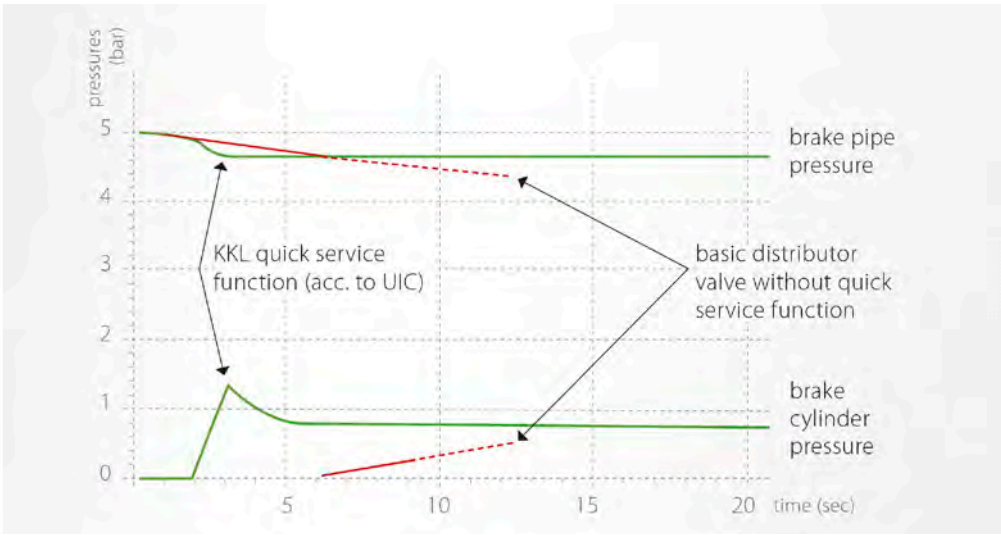
Derailment test on prepared track (center).

Derailment test, transition from 1 cm
to 5 cm sleeper height (bottom).

UIC homologation for KKLII

EP Compact with compact distributor valve.

Compact distributor valve on a pipe mounting.



Characteristic curve for first-stage braking with a compact distributor valve compared with an auxiliary distributor valve.

The KKLII – the successor to the KKL compact distributor valve – has achieved UIC certification. It is equally suited to passenger trains and multiple units as the KE valve, but saves more than 50% installation space and weight.

The first generation of compact distributor valve (KKL) has now been successfully operating in a wide range of regional trains for more than ten years. It is designed for applications that require the most important features of a UIC valve but for which a full UIC valve is too big and offers too many functions. These include full compatibility with the indirect braking system for the trains and locomotives, a rapid propagation rate (more than 250 m/s) irrespective of the regular operating pressure, and unlimited functionality at operating pressures between 4 and 6 bar.

Combinable with other designs of distributor control valve

Various options were used to reduce the installation size of the valve. This was possible because the valve was specially designed for dual pipe passenger operations and pre-control of relay valves. For these functions, the compact valve can offer full UIC-quality operation both as a pneumatic back-up for electronic braking systems and also for purely pneumatic operations. One advantageous feature is the fact that – as with the 'big' UIC valves – the valve speeds up the response of pneumatic brakes even in long trains.

Countless tests – including combinations with other designs of distributor valve and on trains with up to 26 cars – have demonstrated the KKLII's full suitability for mainline passenger trains and multiple units. Test results and a one-year pilot project have been validated by an accredited testing institute and experts from the UIC, and certification achieved on this basis.

Integrated solutions in EP Compact product family

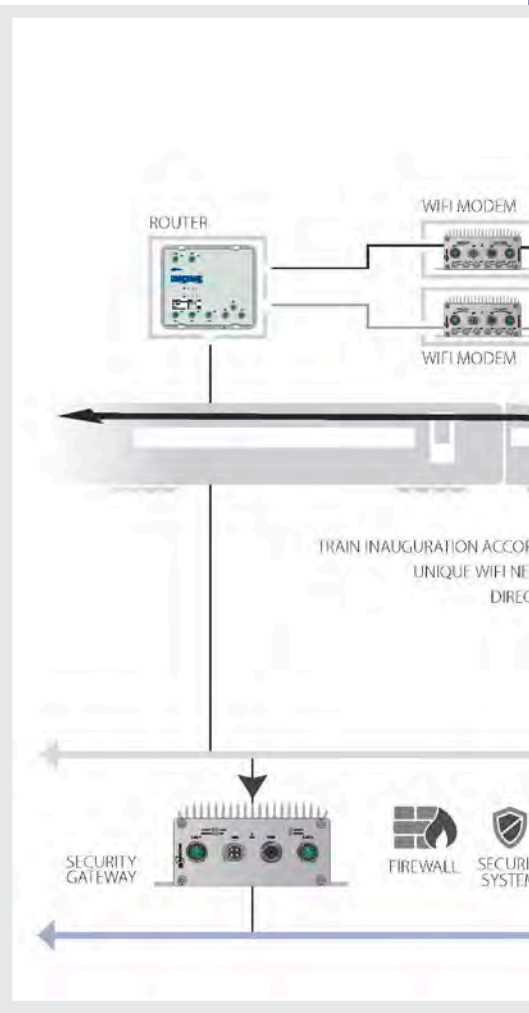
Both the KKL and the KKLII can be used in the same way as a KE-type UIC distributor valve. But the compact valve offers a significant (50%+) reduction in terms of installation envelope and weight. Knorr-Bremse uses these advantages for its integrated solutions from the EP Compact brake control product family, with a pneumatic load brake valve and a computer-controlled electro-pneumatic brake. This approach ensures the correct interaction of the EDP braking system and the air brake with the help of mechanical and pneumatic components. As a result, transition between the different types of brake is possible at all times without any impact on the braking effect.

Wireless control

Selectron Train Control and Monitoring Systems provide the foundation for rail vehicle digitalization. A technology that used to rely on cabling is now increasingly supplemented by wireless communication channels.

Nowadays, passengers take it for granted that they can use their smartphone to read their emails or surf the Internet from a moving train – or simply consult an on-board monitor for the latest arrival times and connections. But there are a lot of additional functions that most travelers are unaware of – for example the capture, collection and transmission of diagnostic data from virtually all the train's electronic facilities. Such data is processed by the TCMS (Train Control and Monitoring System) before being passed to the so-called On-Board Communication Unit (OCU) and transmitted wirelessly to the fleet operator's infrastructure facility, where it is evaluated by iCOM – an innovative platform for the digital rail world – and used to improve vehicle availability and keep down maintenance costs.

Such applications require traditional cable-connected Ethernet technology to be supplemented by secure wireless technology. While the train is in motion, data can be transmitted by GSM or LTE, and when it is stationary in a depot or station, WiFi technology can also be used. Both are referred to as Train2Ground Communication.



Overview of Ethernet wireless modules.

Proven solutions from the field of avionics

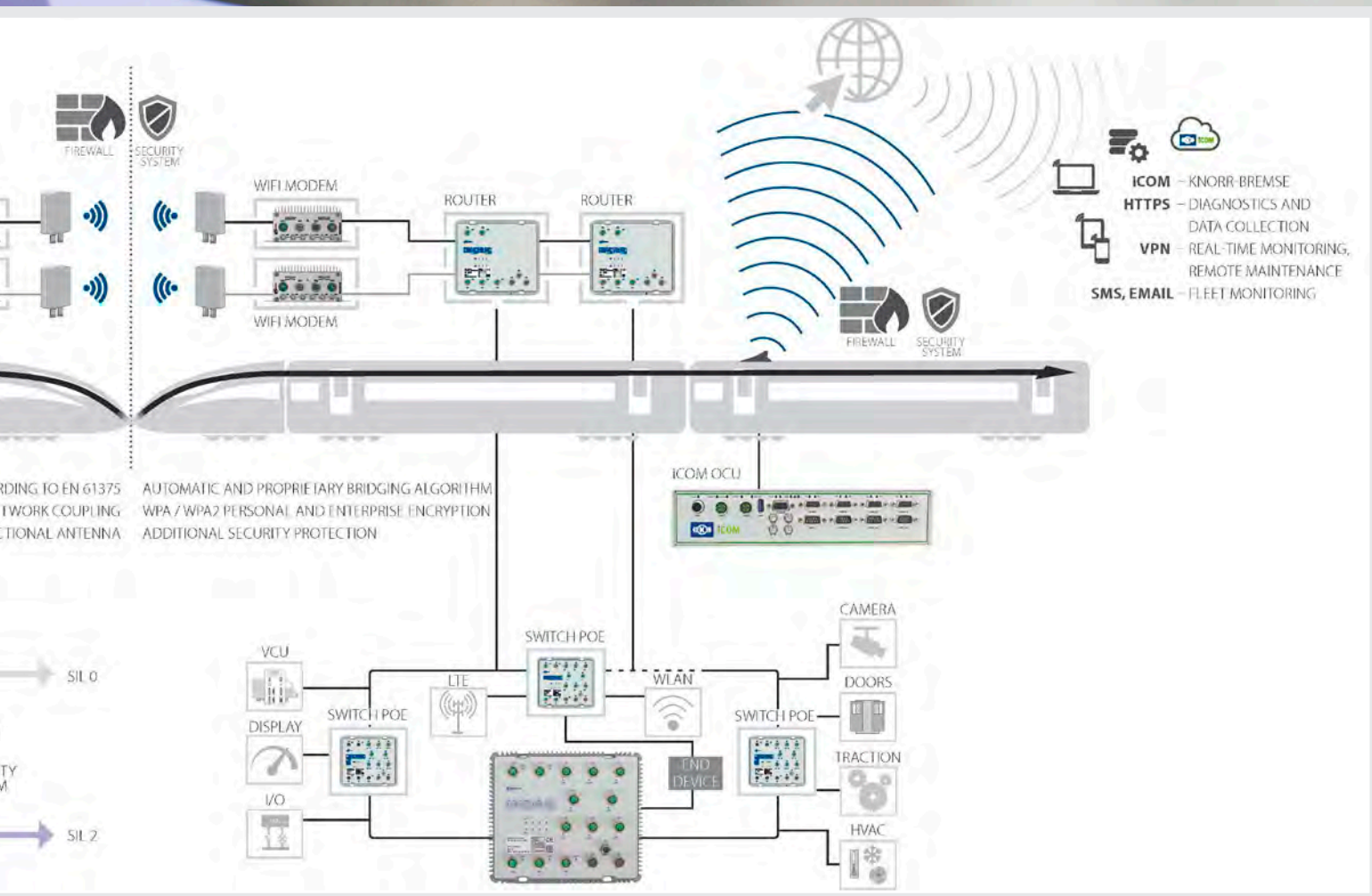
Today's technologies can ensure the stability of data connections without any problems, but a key question arises in connection with improper access to vehicle functions or data. With this in mind, Selectron is working closely with specialists in the field of avionics – a sector that has years of experience in preventing misuse of wireless systems.

All devices supplied by Selectron such as wireless/GSM modems or on-board communication units are equipped with appropriate safeguards. And it goes without saying that this also applies to the new Security Gateway "SGW" series, which separates network architectures from safety levels SIL 0 to SIL 2, and ensures that they are technically secure.

Patented process for secure data transfer

A typical example is the wireless data link, even between coupled vehicles. As well as automatically setting up the wireless data channel, the system includes automated train setup for correct configuration of a whole trainset. This is crucial, for example, for electronic control of the door system throughout the entire train – ensuring that the doors open on the correct side according to the direction of travel.

Wireless train coupling is nearly always essential in the context of modernization projects. When trains are retrofitted with state-of-the-art multi-media technology, the number of contacts of the wire-bound data-coupling or the bandwidth of the existing data connection are often no longer sufficient. In other cases, mechanical conversion and installation of new cabling is simply too expensive. Here the best solution is to send the additional data via a parallel WLAN radio data channel or to replace similarly essential parts of the cable-connected data coupling with a WLAN connection. A patented process from Selectron – including protocol and security algorithms – ensures correct device connectivity. Secure and stable data transmission is guaranteed.



OCU-iCOM.

Safety gateway SGW-901-TW.

WLAN gateway EWM-902-TW.

The next generation

Some 22,000 units, 61 different countries, over 600 projects – impressive statistics for the oil-free compressors that Knorr-Bremse first introduced back in 2002. Drawing on 15 years of field experience, the company is now launching an improved second-generation VV-T 2.0.

As part of its ongoing improvement process, Knorr-Bremse has optimized numerous components of its oil-free compressors. The main focus for this 'second generation' has been on four areas:

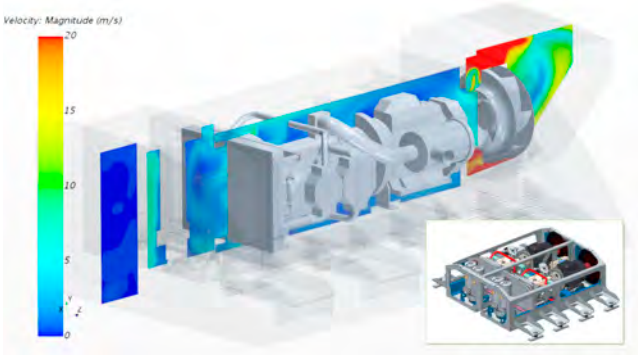
- The cylinders have been produced using an improved coating and machining process, and the piston rings have a new geometry.
- The new generation uses the intermediate cooler to remove condensate in order to achieve optimum protection of the secondary stage. This principle offers an unrivaled level of condensate removal in the pulsating air stream between the compression stages.
- The new air intake filters out fine particles more efficiently, and at the same time has a safety function in the form of a second, downstream filter level which comes into its own if the first filter fails to fulfill its task completely.
- A patent for a new cooling concept with a smart design for the air stream has also been applied for.

The air supply system in overview

Even this second generation of compressor should not be viewed in isolation. Extensive interaction within the air supply system and with the vehicle itself calls for an approach based on the system as a whole. Like other Knorr-Bremse compressors, the new generation of VV-T compressor can also be used with a smart compressor management system that distributes the load as evenly as possible among the various air-supply systems in a network and keeps each compressor at its ideal operating point.

In the early stages of product development Knorr-Bremse can also carry out thermal simulation of specific installation examples so that customers can be certain that all components will receive optimum cooling. Acoustic configuration of the systems takes place in a special sound-insulated chamber, using acoustic cameras to develop and test acoustic optimization measures for the units, compressors and air dryers.

New-generation VV120-T 2.0 oil-free compressor.



Thermal simulation of a roof-mounted unit with two compressors.

Three questions for Dr. Gert Assmann – Vice-President, Center of Competence Air Supply at Knorr-Bremse Systeme für Schienenfahrzeuge GmbH

Knorr-Bremse's oil-free compressors have been highly successful in the market. Why did you feel the need to develop a second generation?
With the first generation, Knorr-Bremse pioneered oil-free compressor units in the rail market. By working with our customers we have been able collect invaluable field data, which has now flowed into the development of a second generation.

Where precisely does Knorr-Bremse's expertise lie?
Knorr-Bremse's expertise lies in knowing the correct layout and adaptation of the components in relation to each other and to the vehicle itself. This means that 'Knorr-Bremse Air Supply' means much more than just the oil-free compressor itself. Our air supply units have a complex thermal design and are carefully acoustically matched. And with our years of worldwide experience we can help our customers choose the right components and integrate them into the vehicle:

For example, we can use suitable converters to adapt the compressor's delivery according to the vehicle's requirements at any one time. This means we can also reduce noise levels or do without additional auxiliary compressors, saving costs and reducing noise emissions for nearby residents.

Why do vehicles require a huge compressor if its capacity is only needed a few times a year when the reservoirs are completely empty? We have to start questioning current solutions. It is time to sit down with vehicle manufacturers and operators and rewrite the requirements we make of air supply equipment. Knorr-Bremse has the right technology for this purpose.

Can new compressors replace the 'old' ones on a one-to-one basis?
Even better: The current compressors can be 'upgraded'– for example during servicing. We are, as it were, 'downward compatible'.

Sustainable, efficient and reliable

IFE has added a state-of-the art painting facility to its production plant in Brno, thereby ensuring the company's high quality standards and cutting production time for door leaves.

"The entire system is designed to meet our customers' requirement for efficient provision of a high-quality paint finish for door leaves," explains Markus Rechling-Greimel, Managing Director of IFE Czech Republic in Brno. Investment in the facility has also slashed throughput times: Whereas the paint process previously required some 15 days' work, it now takes a mere four to five. "We have achieved this mainly by reducing the logistics involved, such as shipping and transportation to and from the supplier."

Fully-automated transportation of door leaves largely avoids the risk of damage (right).

The paint chambers have state-of-the-art equipment for efficient manual painting.

Perfect results

The painting process begins in the integrated chemical pre-treatment unit, using an oscillation spray system to ensure uniform preparation of the complex surfaces involved. Together with subsequent processes this ensures a high degree of corrosion protection against aggressive environmental influences such as high humidity, salt atmosphere and the cleaning chemicals used in vehicle washing facilities.

One crucial element in ensuring the quality of the surface finish is a rapid but gentle drying process. With a fully automated twin-chamber drying facility, IFE is able to monitor the entire drying process and control temperature differences in the two chambers.

To ensure the required high levels of quality, optical checking of the painted surfaces and measurement of the coat thickness, color and gloss levels is carried out throughout the process. The in-house validation center in Austria has also developed special methods for checking the required high levels of corrosion resistance to aggressive external influences. Customer-specific validation testing can also be carried out.

Optimum final hardening of the paint takes place in a special chamber in which a constant temperature is maintained whatever the time of year. This also reduces the throughput time for the door leaves. A fully automated system also takes care of transportation from the paint shop to the final assembly stage, so as to avoid damage to the surface of the door leaves during handling.

Sustainable production process

In order to ensure sustainability of the process, IFE uses no solvents during chemical pre-treatment. Furthermore, the use of adsorption zeolite filtration means that any solvents that have to be used during the later hardening process are retrieved and recycled. Waste air from the zeolite wheel is also used for controlling the temperature in the workshops and storage area.

To ensure the required high levels of quality, optical checking of the painted surfaces and measurement of the coat thickness, color and gloss levels and testing for durability is carried out throughout the process (left).

Numerous complex, carefully coordinated steps are required to ensure high quality application of the paint layers (above).

The full range

Optimum friction pairing for maximizing performance and operating life and minimizing costs can only be achieved in a perfectly balanced braking system. As a supplier of brakes and a full range of friction products, Knorr-Bremse is in an ideal position to design the best system.

"The secret is to find the right combination"
Markus Seidl is in charge of friction material development at Knorr-Bremse Rail Vehicle Systems

What has friction pairing to do with top-performance braking systems?
The friction materials carry out the physical work of any braking system by transforming most of the train's kinetic energy into thermal energy. But even though friction pairing is important, it shouldn't be seen in isolation: For a braking system to perform properly you need to look at the system in its entirety.

What does this approach mean for friction pairing?
For optimum results in terms of performance, operating life and cost, you have to have the right combination of braking system (including blending), and friction material. Knorr-Bremse is ideally placed to offer this: We are well-known as a systems supplier and also have all the current friction materials – including many low-noise products – in our portfolio.

Operators are mainly concerned with costs. Where do they come in?
An integrated approach to the issue – looking at the combination of friction material and braking system – has an impact on the total cost of ownership and life cycle costs. Interestingly, though, operators today are still very much focused on initial purchasing costs. If they were to look at friction material costs, for example in cents per kilometer, or wear and tear over the year, this would provide them with a more transparent basis for making decisions.

Locomotives / Freight Cars / Metros with brake block.

Light Rail Vehicle with hydraulic pad.

Train/Passenger Coaches with organic brake pad UIC 400.

Talgo 350 Harmamain with sinter brake pad for high-speed trains.

ISOBAR® 600.

Simply better

High-speed train.

Typical Metro installation.

The Linear drive features a simplified design with only five moving parts.

Fulfills APTA standards with an over-center lock mechanism for safety.

Door actuators are subject to considerable stresses during operation, and are often the weakest point in a door system. Now Technologies Lanka, the North American specialist for linear door technology within the Knorr-Bremse Group, has come up with a radically simplified drive system.

The best way to avoid failure of a component is not to use it in the first place – that was the approach taken by the engineers at Technologies Lanka, when it came to designing a new linear actuator for sliding pocket doors. Their priority was to reduce the number of moving parts subject to wear and tear. The result is a design in which the motor coils push directly on the door, and even the position sensor is completely contactless.

The new system weighs 20% less than a standard spindle drive, and moving parts have been reduced by 65% – consisting merely of the rollers that support the weight of the door. Depending on the specific installation involved, the system can save up to 40% space envelope, thanks to integration of the linear actuator and the door hanger, but its modular design still makes it extremely easy to maintain. And there is a further big advantage: the two components are installed at the same time. For additional robustness, the electrical motor coils and magnets are mounted in a protective plastic assembly. These innovations have no impact on the closing speed: A 35-kg, 70-cm door closes in one and a half seconds.

Testing with genuine metro dust

Before being released for production, the prototype was subjected to a battery of tests. To reproduce real conditions the engineers collected dust from a metro tunnel – a fine black powder composed of sand, carbon, rubber dust and fine steel particles. Even packed with this dirt, the linear actuator kept on going as if nothing had happened. There are two main reasons for this: Firstly, there are no tolerance requirements between coil and magnets; and secondly, no lubricant is used except in the – sealed – bearings, so dirt cannot clog the mechanism.

The linear actuator is equipped with a lock assembly that meets all current safety requirements, including US APTA standards. The lock principle is a field-proven, dead-over-center one, but the actual design is new: The parts that mate together when the lock is engaged join through bearings that are virtually silent.

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