

Edition 32 | May 2012

INFORMER

The customer magazine of Knorr-Bremse
Rail Vehicle Systems

Cover story

Knorr-Bremse in Poland

Projects

Orders from Germany for PESA

Product

Braking systems for GOST-
standard locomotives

Quality

Materials Laboratory



CONTENTS

Editorial

Rolf Härdi, 3
Member of the Executive Board, Knorr-Bremse
Systeme für Schienenfahrzeuge GmbH

News in brief

The latest information 4

Project

Orders from Germany for PESA 6

Cover story

Knorr-Bremse in Poland 7
Background story
Interview with Jacek Bilas, 10
Managing Director of Knorr-Bremse Poland

Product

Braking systems for 12
GOST-standard locomotives
Piston compressors 14
Monorail brake technology 18

Location

Technology Center for India 16

Service

Service projects in Poland 20

Quality

Materials laboratory 22



E-NEWS-0032-DE
This publication may be subject to alteration without prior notice. A printed copy of this document may not be the latest revision. Please contact your local Knorr-Bremse representative or check our website www.knorr-bremse.com for the latest update. The figurative mark "K" and the trademarks KNORR and KNORR-BREMSE are registered in the name of Knorr-Bremse AG. Copyright 2012 © Knorr-Bremse AG – all rights reserved, including industrial property rights applications. Knorr-Bremse AG retains any power of disposal, such as for copying and transferring.

Imprint:

Publisher:
Knorr-Bremse Systeme für
Schienenfahrzeuge GmbH
May 2012

Information for Knorr-Bremse's worldwide customers and business partners

Central Editorial Office:
Knorr-Bremse Systeme für
Schienenfahrzeuge GmbH
Marketing
Tanja Mohme
Moosacher Strasse 80
80809 Munich
Germany
Tel. +49 (0)89 3547 0
Fax. +49 (0)89 3547 2767
www.knorr-bremse.com

Conception, text and design by:
Knorr-Bremse Systeme für
Schienenfahrzeuge GmbH

Text: Thorsten Rienth

Realisation: KB Media GmbH,
Silvia Reichert

Layout, graphics: Cathrin Huber

Printed by: Weber-Offset GmbH

EDITORIAL

This summer, the eyes of the world will be on Poland and Ukraine. Hundreds of thousands of fans will be attending the European Soccer Championship and will have an opportunity to get to know the backbone of Poland's transport infrastructure - its railroad system. Knorr-Bremse Poland has made an important contribution towards modernizing the country's railroads, by combining the extensive experience of the parent company with an in-depth understanding of the local market.

In this edition we use the opportunity to take a closer look at Poland: A background report and an interview examine the particular features and history of the Polish rail market and describe how Knorr-Bremse has succeeded in establishing such a strong presence in the country. And two current examples from Poland demonstrate what makes Knorr-Bremse ideally suited for modernizing braking systems. We also report on the first exports of PESA multiple units from Poland to Germany.

This edition then looks at braking systems for locomotives, for which Knorr-Bremse has received orders from Belarus and Kazakhstan, as well as the successful development of oil-free piston compressors and the results of their nine years of field-testing. Another article looks at current monorail projects in which Knorr-Bremse is involved.

But we also want to tell you about the background to two major investment programs. You can read about the essential part that our Central Materials Laboratory in Munich now plays in the product development process and why we are setting up a technology center in Pune, India in conjunction with Knorr-Bremse Commercial Vehicle Systems.

I am also delighted to be able to provide you with a rough summary of our business results for 2011. Suffice it to say it was an extremely successful year!

As a new member of the Knorr-Bremse Executive Board I look forward to building on this success and working with you to implement a wide range of interesting projects around the globe.

I hope you enjoy reading this edition of the Informer.

Kind regards



Rolf Härdi



*Rolf Härdi,
Member of the Executive Board, Knorr-Bremse
Systeme für Schienenfahrzeuge GmbH*

News in brief

KNORR-BREMSE AMONG BRAZILIAN EXPORT PRIZE WINNERS

Knorr-Bremse is one of the winners of "Prêmio Exporta São Paulo – 2011". São Paulo's Export Prize was created in 2005 in order to encourage producers in São Paulo to engage in export operations and to recognize the work performed by them in foreign markets. São Paulo Commercial Association (ACSP), which distributes the award in cooperation with the Secretary of Development of the State of São Paulo and São Paulo State Federation of Trade Associations, presented it to Wilson Junior (Planning and Logistics Manager of Knorr-Bremse Brazil), representing Sales Director Everton Pereira during a ceremony held on December 12, 2011 at their headquarters.



SALES EXCEED EUR 4 BILLION

During the fiscal year 2011, significant growth in both divisions enabled Knorr-Bremse to break through the EUR 4 billion threshold, with Group sales rising more than EUR 500 million to EUR 4.24 billion – an increase of 14 percent.

The Rail Vehicle Systems division saw sales increase by 8 percent to EUR 2.19 billion, with a recovery in the freight market, particularly in North America and Europe, contributing to this result. Parallel to the rise in sales, the number of employees in the Group also increased. Whereas at the end of 2010 the company had employed a global workforce of 18,053, a year later the figure was 20,050.



KNORR-BREMSE SUPPLIES 500 KM/H CRH380AL

Knorr-Bremse provided the bogie equipment of a CSR Corp Ltd. test train which the company unveiled in late December. The train is able to attain speeds of more than 500 kilometers per hour. To build the new train, CSR modified a high-speed CRH380A railcar. The six-car CRH380AL features an extremely tapered nose, similar to Japanese Shinkansen trains, to minimize air resistance. The launch is a part of China's ambitious trillion dollar project to build over 13,000 kilometers of high-speed rail by 2012.

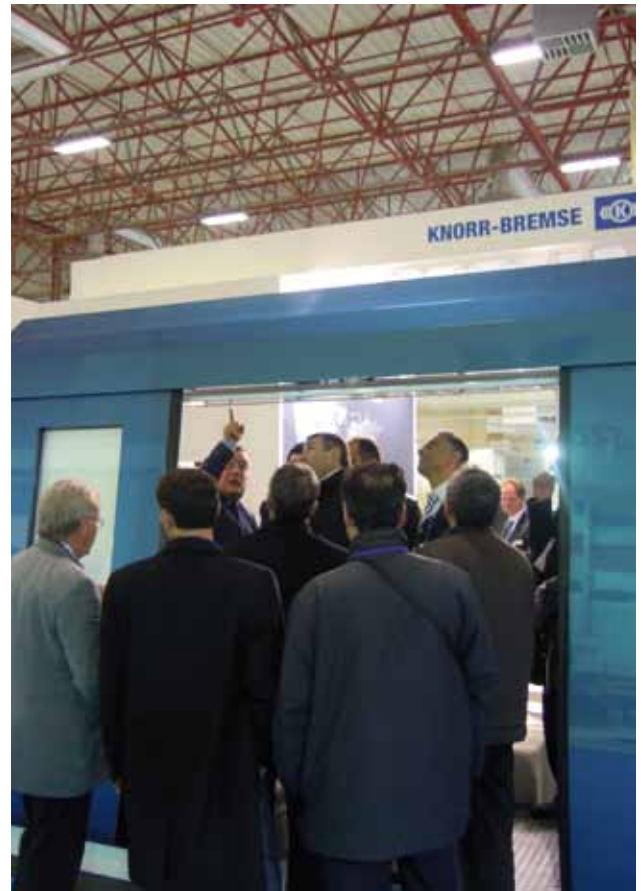
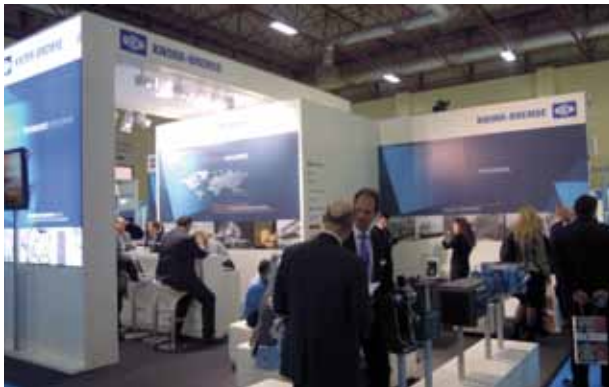


KNORR-BREMSE AT EURASIA RAIL

Knorr-Bremse participated in the second edition of the Eurasia Rolling Stock, Infrastructure and Logistics Exhibition in Turkey. From March 8th till March 10th, the trade show opened its doors to national and international public and private corporations at the Istanbul Expo Center.

The second edition of the fair hosted a total number of 187 exhibitor companies and 5,488 visitors.

The Knorr-Bremse booth was visited by many local and international customers as well as by Turkey's current Minister of Transport Binali Yildirim.



WESTINGHOUSE PLATFORM SCREEN DOORS (WPSD) WIN AWARD FOR DUBAI METRO

Dubai Metro is now the longest fully driverless rail system in the world, operating with some 75 kilometers of track. Following a construction period of almost four years, passengers on over 100 platforms are now protected and served by the WPSD platform screen door system. The contract for the design, manufacture, and installation of over 1,400 platform screen door sets, initially for the first two lines, Red and Green, is one of the largest in the history of WPSD.

On December 4, 2011 an award ceremony was organized by Mitsubishi Heavy Industries (MHI) in the world's tallest building, Burj Khalifa, to recognize the contribution of strategic partners involved in the successful execution of the project. MHI head the major Dubai Rapid Link Consortium. During the event, the WPSD team was delighted to learn that they had been recognized with the presentation of a Certificate of Appreciation from MHI. The award was for the support provided to the customer especially during the commissioning stage of the platform screen door system. The award reads: "for deep appreciation and recognition of quality professional services and support."





Orders from Germany for PESA

Crossing borders

The new LINK DMUs from Polish rail vehicle manufacturer PESA set new standards, particularly in terms of passenger comfort. Building on a major order from the Czech Republic, PESA has now also managed to access the German market. The braking systems for this new generation of diesel multiple units are manufactured by Knorr-Bremse.

The DMUs (Diesel Multiple Units) easily bear comparison with vehicles produced elsewhere in the world. They are equipped with highly efficient engines that offer significantly lower energy consumption and operating costs than the current ATR220/219M models. Passengers with restricted mobility – including wheelchair users – can embark and alight with ease.

DOUBLE FLEXIBILITY

The LINKs are doubly flexible: They can be adapted for platform heights of between 230 and 760 mm above the track; and operators can also configure their trainsets to have one, two or three units. In the case of the two most recent orders, both customers opted for double units, with Czech operator Ceske Drahý ordering 31 trains, and the Eastern Bavarian Regentalbahn 12.

KNORR-BREMSE A KEY SUPPLIER

Knorr-Bremse is one of the key suppliers for both these projects, providing important elements of the braking systems such as air treatment, brake control and other bogie equipment. Knorr-Bremse also offers a magnetic track brake as an option for the LINK platform.

The bogie equipment has to be capable of operating reliably for years on end, even under harsh climatic conditions, and Knorr-Bremse has designed it to be extremely robust and shockproof as well as meeting the requirement for lightweight modules capable of installation in a restricted space. Knorr-Bremse will be delivering the systems for the 31 DMUs being built for Ceske Drahý during the course of this year and next year. The systems for the Regentalbahn are due to be supplied rather later, with the first of the new trains slated for delivery in early summer 2014. They will then go into operation in December of the same year on the "Oberpfalzbahn", which links Regensburg, Marktredwitz and Schirnding.



Knorr-Bremse in Poland

ON TRACK TO THE FUTURE

After many years of relatively low levels of investment in the Polish rail market, the situation has now been completely reversed. In particular Poland's accession to the EU gave a massive boost to the country's economy – and triggered a race to modernize its rail infrastructure. Dozens of new locomotives, passenger and freight cars – and in particular tramways – were purchased in recent years, and many older train types were modernized and upgraded. Throughout this process, Knorr-Bremse played an active role, thanks to its teams of highly trained experts, its extensive network of local service centers – and global backup from a world-class corporate group.



Background story Poland

Championships trigger expansion

Poland has been investing billions of euros in infrastructure programs as part of its preparations for the 2012 European Soccer Championship. As the big event draws closer, there are increasing signs that this investment is starting to bear fruit – especially in the rail sector.

Anyone who hasn't been in Poland for a few years and attends one of the games during the European Soccer Championship, being jointly hosted by Poland and the Ukraine this June, will find the place transformed – especially the cities. Over the last few years stadiums have been constructed, motorways resurfaced, modern tramways purchased, mass transit systems expanded, hotels built – and even the layout of entire streets redesigned.

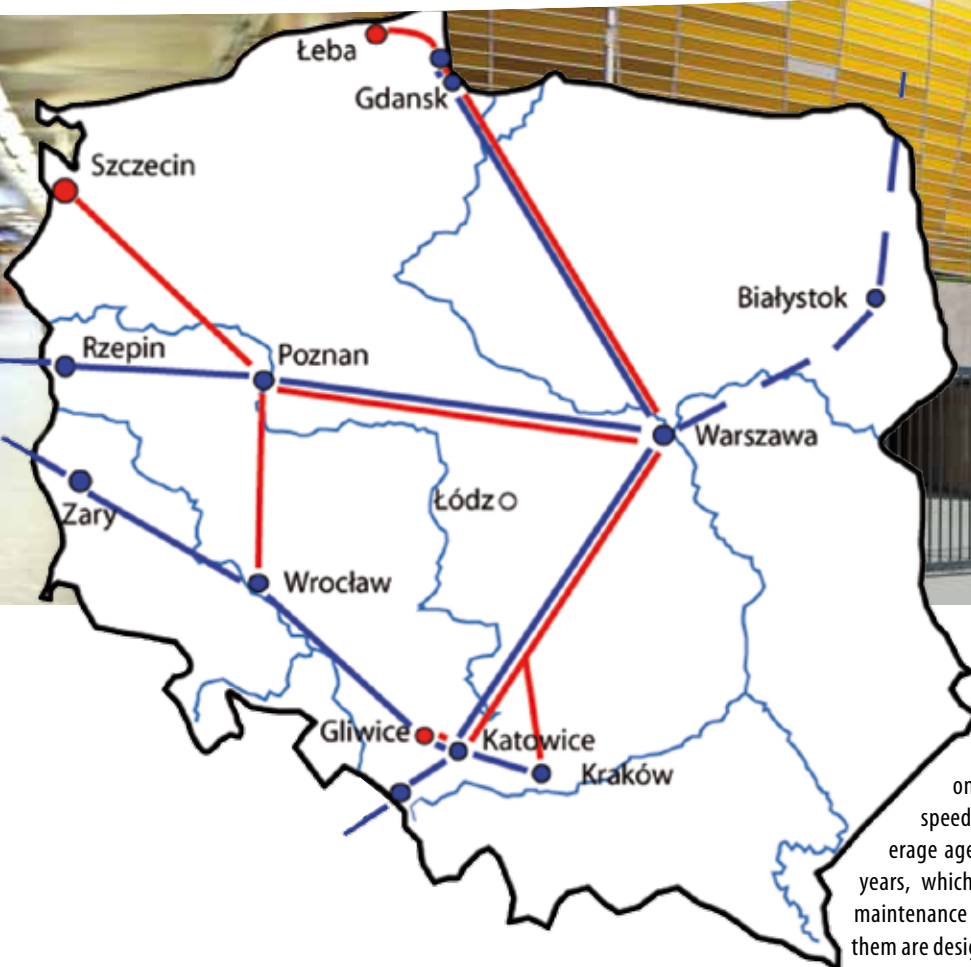
According to the Polish Minister for Sport and Tourism Adam Giersz, the government alone is investing around EUR 20 billion in the run-up to this major sporting event. And the Poles readily admit that it offers a welcome opportunity to tackle a legacy that has long been a source of irritation to the business community – the country's ailing infrastructure.

The European Championship is said to have advanced the expansion and upgrading of the infrastructure by between two and five years. And all this investment might support the fact that Poland is the only country in the European Union showing continuous growth even during the recent crisis.

TESTING TIMES FOR THE RAIL NETWORK

Poland is expecting up to one and a half million additional visitors during the European Championship – and most of them will be traveling to more than one city. So the Polish rail network will face a considerable challenge in June and July.

The organizers have an ambitious plan to ensure that the various venues, which are up to 300 kilometers apart, are



It is also impossible to find locomotives that travel faster than 160 km/h in Poland – indeed only a small number can achieve speeds above 140 km/h. And the average age of the country's tramways is 26 years, which makes for high operating and maintenance costs. Moreover only very few of them are designed to transport passengers with restricted mobility, despite increasing calls from the public for them to have this capability.

reachable within four hours – as was the case four years ago at the European Championship in Austria and Switzerland.

It goes without saying that this will only be possible if the rail network is expanded – and that is precisely what is happening. But even the most up-to-date rail network reaches the limits of its capacity when up to one and a half million extra visitors flood into the country – so Poland will also be operating a special timetable using additional rolling stock borrowed from its neighbors in the Czech Republic.

YET MORE SCOPE

Poland currently has more than 80,000 freight cars, some 1,200 local trains, 4,500 passenger cars, 3,400 locomotives, and a good 7,500 tramways. But although the Polish rail market is the third biggest in Europe in terms of numbers of vehicles, there is still further scope for improving the rail infrastructure.

Despite all the improvements brought about by the recent investment, the relative poor state of some tracks remains a major problem, with many trains having to operate at reduced speeds.

INVESTMENTS TO CONTINUE AFTER 2012

Over the last five years, Polish operators have ordered over 300 tramways – more than any other country in Europe. Contracts have also been signed for around 100 urban train-sets – the first major order in this sector for decades.

Many of these investments are, of course, linked to the Euro 2012, but the growing Polish economy – and also, of course, European Union subsidies – are likely to ensure that levels of investment in the rail network will remain high even after the Championship is over.

There are certainly signs that this is the case: The city of Warsaw has placed an order for urban trains with maximum speeds of 160 km/h – clearly with an eye to the long term rather than just the temporary needs created by Euro 2012. And in 2012, Polish investment in the rail market is due to double compared with the previous year. Under a government-funded program, a further 2,300 kilometers of rail network are also due to be upgraded or reopened in the near future.



Interview

“We combine global expertise with an understanding of the Polish market”



The Informer spoke to Jacek Bilas, Managing Director of Knorr-Bremse Poland, about Knorr-Bremse's activities in the Polish market.

Mr. Bilas, since its founding in 1999, Knorr-Bremse Poland has been highly successful. What is this success based on?

Mr. Bilas: We have to consider the development of the Polish rail market: Almost two decades of market stagnation and a lack of infrastructure and rolling stock investment following the collapse of communism created a railway market that was hungry for projects. Accession to the European Union and rapid economic development created an important foundation for future growth in the rail industry.

As far as Knorr-Bremse's success is concerned, the answer is quite simple: Thinking globally and acting locally! Of course, there are many other factors in our success as well as our global expertise and understanding of the local Polish market. A close relationship with local vehicle builders and the main fleet operators is one of them, as is local system engineering skills, the development of local service centers and, finally, a highly motivated and professional local KB Poland team. This is how we became the strongest brake suppliers in Poland, with an extremely high market share. We know our customers and deliver what they need.

With that in mind, what are your plans for future business development?

Mr. Bilas: The Polish rail market is on a growth path. Of course, the pace is likely to slow somewhat once the 2012 European Soccer Championship is over, but our long-term strategy is based on an expectation of further market expansion. In our medium-term planning we are focusing on strengthening our organization and personnel. We recently implemented some organizational changes and are investing in upgrading the professional knowledge and skills of our staff.

Our long-term strategy is no different from what we do all over the world: We offer our customers innovative products that meet the highest standards of safety, quality and comfort, and represent great value for money. Beyond that, we aim to introduce new Knorr-Bremse products that meet the specific needs of the Polish market and to further develop our network of local service centers.

As you say, market success comes from meeting customer needs. Can you give us a current example?

Mr. Bilas: Close contact with the customer is the key. Poland is in some ways an “emerging market”. We do not have a strong record of railway and rolling stock investment over the last thirty years. And when it comes to the braking systems, we are the specialists! We know how to develop the perfect system for specific customer requirements.



Knorr-Bremse Poland's site in Krakow

To give you a current example: PESA, the main Polish vehicle builder, has just developed the new EMU platform ELF – a product that is customized to the specific requirements of a wide array of different Polish regions. KB Poland's native-speaker system engineers built up an efficient communication channel with our customer's development engineers. Efficient engineering work carried out rapidly and professionally in response to customer requirements has resulted in a braking system that fully meets the needs of the Polish market. And the system was developed with a remarkably short lead time. Efficient testing and homologation processes carried out by the Polish authorities confirmed the high quality of our performance.

In general, what makes Knorr-Bremse's products so special?

Mr. Bilas: What makes Knorr-Bremse attractive for the market is its ability to develop braking systems of the highest quality that meet Polish technical requirements. We also work closely with vehicle builders and operators to offer excellent levels of support during the warranty period. That makes for a high degree of customer satisfaction.

It's not enough just to deliver the required products on time. It is vital to take an across-the-board approach that includes commissioning support, staff training, fulfillment of warranty obligations, spare parts delivery, and maintenance support. The crucial thing is that we offer a complete service package. And we are getting better and better by the day.

How does having a local Knorr-Bremse presence in Poland benefit day-to-day business?

Mr. Bilas: The complexity of the Polish market and its rapid development means we are confronted with a wide range of different types of project. We have a strong presence in various different market segments from freight, light rail vehicles, commuter trains and passenger coaches to locomotives. We offer braking systems and on-board products, and meet after-market demand with classic spares delivery, maintenance contracts and modernization projects.

The obvious advantage of working with us is our fast response, our excellent understanding of customers' needs, and our local service centers. And we are a young, ambitious team that is eager to tackle sophisticated and complex challenges!

Braking systems for GOST-standard locomotives

Securely established in new markets

Knorr-Bremse recently received three important orders from Kazakhstan and Belarus for braking systems. This shows the company is gaining a reputation as a supplier of equipment for GOST-standard locomotives.



KZ8A freight locomotive for Kazakhstan

Knorr-Bremse is already well established as a supplier of braking systems for metros, passenger cars and high-speed trains like the VELARO Russia. But more recently the company has also managed to expand its activities in the field of GOST locomotives. In addition to supplying systems for 12 e-locomotives for Belarus (DELC), the company also recently received two substantial orders for braking systems for freight and passenger train locomotives for Kazakhstan (from Alstom). This marks the first use of the KAB 60 control valve for a locomotive in the GUS market. A major factor in Knorr-Bremse winning the order was the fact that the company could supply entire GOST braking systems from a single source – manufactured to its usual high quality standards.

DESIGNED FOR EXTREME TEMPERATURES

Delivery of the system modules was preceded by a lengthy development phase during which the usual UIC brake control, air supply and bogie equipment had to be adapted to GOST standards. In particular the systems had to be redesigned to cope with extreme temperatures: -40° Celsius for Belarus, and in the case of Kazakhstan, -50° for air supply, and even -55° for bogie equipment.

In the case of the air-supply components and bogie equipment, however, fundamental changes were required to make sure they could function at -50° Celsius and -55° Celsius respectively. New elastomers and greases had to be used that offered better elasticity and viscosity than traditional materials but otherwise retained their existing characteristics. This was the only way the compressed air components could be made sufficiently robust and airtight to operate at such extreme temperatures.

BOGIE CHALLENGES

When it came to the bogie equipment, various design modifications were required to adapt it to the kinematics of operating at such low temperatures. High-performance lubricants and elastomers were used to ensure the right levels of internal friction even at extreme temperatures. For example, the spring actuator had to be reliably released in an emergency, even at -55° Celsius.



Brake control system for the Belarus project

For a project like this it is essential to carry out extensive testing – not just of the components themselves but also of the metals and bolted connections. Finally the entire units have to be exhaustively examined for functionality and subjected to endurance testing before they can be approved for delivery.

Piston compressors

Tried and tested

After eight years of field-testing, it was time for a final assessment. Following detailed inspection of the system, Deutsche Bahn AG has officially approved the oil-free VV180T piston compressor for rail applications.



Condition of air supply unit following installation in October 2002



Condition of air supply unit following almost nine years of trial operation

There was real tension in the air as the engineers from Knorr-Bremse and Deutsche Bahn AG removed the compressor from the VT610 multiple unit after 9,811 hours of operation and 496,343 power cycles. A combination of performance and component measurements and photographic evidence had documented the condition of the VV180T throughout the testing process, but even so, looking into the heart of a compressor is always a special moment.

DETAILED MEASUREMENTS CONFIRM VISUAL IMPRESSION

Externally the compressor – which had operated smoothly throughout – was covered with the usual patina, though

free of excessive amounts of dirt. This initial positive impression was confirmed after detailed measurements and examination of the components: The state of the compressor was completely in line with expectations, or indeed exceeded them. Both the crank drive and the non-moving elements in the air supply system were in perfect condition. Thomas von Behren, compressor expert at Deutsche Bahn, was delighted: “Even the cylinder and pistons are in a remarkably good state,” he commented.

The compressor also passed with flying colors on three further counts. Both at ambient temperature and also at its upper limit of 50 °C it started up without any problems, and its running noise was perfectly normal. Electrical data



also showed that at the end of the testing the compressor showed virtually no signs of wear. The interplay of oil-free compressor and air dryer functioned perfectly.

WIRELESS MONITORING

The compressor had been tested on winding sections of non-electrified line, mainly between Nuremberg and Bayreuth and Nuremberg and Hof. The VT610 diesel electric multiple unit reached speeds of around 160 km/h and was equipped with an active tilting system.

A wireless system installed in the train ensured continuous monitoring of the compressors, relaying the data from the

measuring equipment directly to computers in Munich via a GSM wireless modem. This system also functioned reliably and without problems.

Following the tests, Deutsche Bahn issued the VV180T with a coveted certificate of approval for rail applications, confirming that the compressor had been tried and tested under real operating conditions. The significance of certification should not be underestimated, as it is a requirement for all new purchases made by Deutsche Bahn. The German rail operator also signed a statement of recommendation for the VV180T.

Technology Center for India

Knorr-Bremse's policy of making effective use of resources

In the western Indian high-tech metropolis of Pune the company is currently constructing a Technology Center India (TCI), which is destined to be jointly used by the Group's rail and truck divisions.

More than a billion people live in India, around half of them under the age of 25. The country also has a steadily growing middle class with a thirst for mobility and consumption levels that are boosting transportation of goods – which is why India has one of the world's most rapidly expanding rail markets.

STEADY GROWTH

The healthy state of Knorr-Bremse India's order books in recent years reflects the relatively steady economic growth on the subcontinent. And the signs are that the country is set to continue recording high levels of growth in the medium and long terms.

An important factor in this is the planned expansion of India's transport infrastructure – of which the rail network is a crucial element. Existing vehicles are being upgraded and new ones ordered – both areas in which Knorr-Bremse has been active in India for many years.

LOCALLY DEVELOPING LOCAL PRODUCTS

In this context, the creation of a technology center in which Knorr-Bremse can focus its development is a logical step. The truck division had in any case started to build a new production facility in Pune last year, so it made sense to create a joint technology center for braking systems for rail and commercial vehicles instead of two separate ones. The construction process was launched at the end of November 2011 with the turning of the first sod and a traditional Pooja ceremony.

JOBS FOR 200 DEVELOPMENT ENGINEERS

The technology center will enable Knorr-Bremse to react flexibly to global trends in the fields of electronics and software development. It will not only provide the company with the necessary resources to cope with the increasing complexity and variety of electronics projects but also ensure a local supply of highly qualified engineers and resources to enable the company to respond flexibly to global developments.

For some time now, a team of 35 software and electronic component specialists from Knorr-Bremse Rail Vehicle Systems based in Pune has helped the Knorr-Bremse Brake Control Center of Competence carry out development and testing. And earlier this year, work also started for various Knorr-Bremse subsidiaries.

Relocation to the new TCI is scheduled for 2013. Once development work commences in 2015, the two divisions will employ a total of around 200 development engineers at the site.

The charitable organization Knorr-Bremse Global Care runs projects aimed at providing carefully targeted and effective aid to people in need all over the world. It has already funded several projects in India and is currently supporting a training workshop for brake servicing in Pune, in collaboration with Knorr-Bremse India. The idea is that disadvantaged young people will learn a trade and thus become more self-sufficient.





The Kuala Lumpur Monorail has an oil-free air compressor and microprocessor brake control system developed by the rail division, with a brake disc from the truck division.

Monorail brake technology

One train, one rail

As well as existing metro networks, there is another type of rail system that is becoming increasingly important for urban public transport systems, particularly in the cities of Asia: the monorail. Unsurprisingly, many operators are relying on Knorr-Bremse to supply the subsystems.



Courtesy of Bombardier Transportation

The King Abdullah Financial District Monorail in Riyadh has brake discs designed for rail vehicles and a hydraulic braking system normally used for tramways.

Monorails often look so futuristic you might imagine them to be a 21st-century invention, but that is not the case. In fact, their history goes back almost 200 years to 1821, when British inventor Henry Robinson Palmer took out a patent on a vehicle that traveled on a single rail. Four years later it went into operation, transporting bricks in the English town of Cheshunt. The cars were suspended below an elevated single rail supported by pillars, and the train had a one horsepower engine — literally!

VERSATILITY

The basic principles of the monorail have hardly changed, despite almost 200 years of technical progress. Although monorails could theoretically operate at ground level or in tunnels, most use an elevated rail, avoiding the danger of accidents involving other vehicles in crowded city centers from the outset.

Thanks to their flexible design, with the track usually assembled from prefabricated elements, monorails are easy to install in densely populated areas, and can even be incorporated into large buildings. Compared with conventional railroads, monorail systems are better protected from the weather and their (usually) pneumatic tires offer impressive acceleration and braking.

EXPERTISE FROM BOTH DIVISIONS

It is no coincidence that Knorr-Bremse is currently involved in a range of monorail projects around the world. Given that these vehicles combine the braking systems of rail and commercial vehicles, Knorr-Bremse, with its expertise in both fields, is an ideal supplier.

The company is currently working with Bombardier Transportation in São Paulo and Riyadh, and is also involved in projects with Intamin in Bologna and Port Harcourt. In Mumbai and Kuala Lumpur, it is cooperating with transport solutions provider Scomi Engineering.

The systems supplied by Knorr-Bremse vary as much as the applications for which they are designed. For the new monorails in São Paulo, they include disc brakes and hydraulic calipers, whereas in the case of the Intamin and Scomi Engineering projects, Knorr-Bremse is not only supplying conventional pneumatic brake control systems but also EP2002 brake control and oil-free compressors.

INCORPORATING INNOVATIONS

At the same time the company is adapting existing safety functions. A good example of this is the TPMS Tire Pressure Monitoring System produced by Bendix, the North American subsidiary of Knorr-Bremse Commercial Vehicle Systems.

The wireless sensor system is already being used by some monorails in the ongoing monitoring of tire pressures and temperatures as well as the charge status of the sensor battery. TPMS alerts the driver as soon as values exceed or fall below preset levels.

The component configuration in Nigeria is similar to that for Kuala Lumpur, but uses a purely electropneumatic braking system.





Service projects in Poland

Specialist brake modernizations

Modernizations are an integral part of product life cycles in many industries and are now becoming increasingly common in the rail sector. Knorr-Bremse recently carried out two major modernization projects in Poland.

Fleet operators always have to keep an eye on costs and usually try to run their vehicles for as long as possible – in good technical condition and maintaining high levels of comfort. But after a vehicle has been in service for some decades, a decision has to be made: Is it time to invest in new rolling stock, or would it perhaps be more cost-effective to modernize the existing fleet?

CUSTOMER BENEFITS

Modernizations have three main advantages: They significantly prolong service life, reduce life cycle costs (LCC), and enable additional or new functionalities such as diagnostics to be added. In the case of the braking system, the central requirement is that the modernized brake system has to fulfill the high safety standards given in the railway industry.

With its long history as a global systems supplier, Knorr-Bremse is the ideal partner for carrying out brake modernization. Modernizing rolling stock – especially carrying out a brake upgrade – calls for excellent project management, system design, production, and long-term service – and of course, the highest levels of product quality.

SUCCESSFUL MODERNIZATION

Knorr-Bremse Poland's service organization recently delivered two modernization projects. The first one involved the EN57 – a three-car EMU designed to cope with low platforms. Between 1961 and 1993, the Polish manufacturer Pafawag produced more than 1,000 vehicles with various interior options, and the EN57s rapidly became the biggest and most important regional EMU fleet in Poland.

For this upgrade the Knorr-Bremse engineers used their comprehensive expertise to come up with a customized solution for the customer: an ESRA-based EP Compact brake control system with integrated parking brake control and distributor valve. In the case of the air supply system, Knorr-Bremse supplied SL20 compressors with dual chamber air dryers.

The SM42 locomotive upgrade was a similar success. The SM42 diesel locomotive was produced by the Polish manufacturer Malady Fablok between 1965 and 1992, and 867 of them still form the backbone of rail company PKP's freight operations. The contract involved brake panels with EP Compact, distributor valves, ESRA electronic brake control, SL20 compressors, and dual chamber air dryers.

Here, too, the complexity of the vehicle's design meant the brake upgrade required the development of a customized concept. As well as involving its own experts, Knorr-Bremse Poland drew on the Knorr-Bremse Group's worldwide systems engineering network to bring in additional locomotive specialists and software experts from Germany and Austria.





Materials laboratory

Moving with the times

In recent years, Knorr-Bremse has invested more than a million euros in its Central Materials Laboratory in Munich. The work of the lab used to focus mainly on inward goods inspection, but now it increasingly carries out essential activities in product development and failure analysis.

The demands made on the cleanliness of components are becoming increasingly rigorous. Depending on the application involved, even minuscule contamination on a scale of less than 10 µm can cause problems. This is where the Knorr-Bremse materials laboratory has an important role to play in further improving the technical cleanliness of the company's products. It is currently developing new, more effective cleaning processes designed to remove manufacturing residues – for example, from soldering or welding – from oil-free compressors.

A high-performance optical microscope enables the materials laboratory to classify such contamination according to size, type and origin. And if the particles also need to be examined for their chemical composition, the laboratory uses EDS – energy dispersive X-ray spectroscopy with a scanning electron microscope (SEM).

CLOSER ANALYSIS

At the same time Knorr-Bremse has also enhanced its ability to analyze polymers. The existing infrared spectroscopy has been supplemented by the acquisition of an infrared microscope for analyzing tiny sections and particles. Infrared spectroscopy is thus an important tool for examining the qualitative composition of organic and inorganic materials.

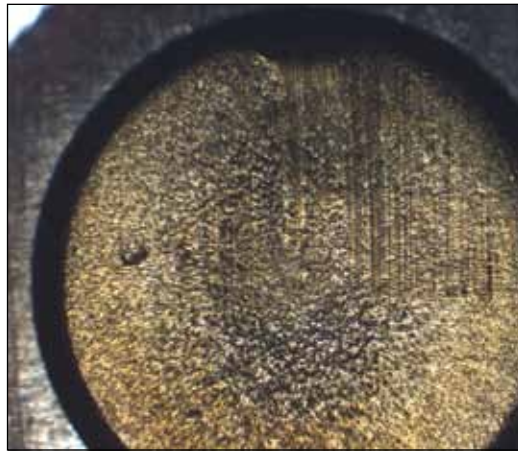
Analysis of production residues is only one example of the laboratory's work. Whether metals, castings, ceramics, coatings, elastomers, plastics, composite materials, or lubricants are involved – virtually all Knorr-Bremse sites worldwide benefit from the analysis service provided by the Munich-based specialists. In addition to upgrading the laboratory's equipment and fine-tuning its processes, the investment is primarily being used to expand its analysis portfolio to cover all current testing processes. In the field of coatings, the laboratory's facilities now also include a climatic test chamber for more realistic simulation of environmental conditions.

SURFACE STRUCTURES MAGNIFIED A HUNDRED THOUSAND TIMES

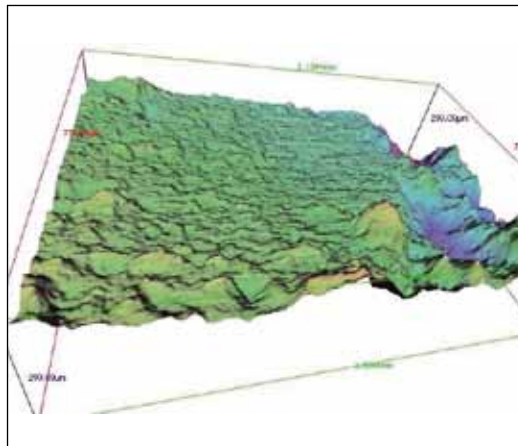
One special feature of the laboratory is the interface between optical and the scanning electron microscopes for materialography – the study of material structures. Tiny faults identified with the optical microscope can be transferred to the SEM with the click of a mouse and subjected to full analysis and evaluation.

But that is not the only reason why the SEM is an essential tool for the analysis of materials. It also enables the surface structures to be magnified up to a hundred thousand times with extremely high depth of focus – essential for assessing fractures, for example. And it is also required to determine chemical element content and processes. Using special software, the magnifications can be displayed three-dimensionally on the computer screen, enabling even tiny sections of a component to be reliably examined.

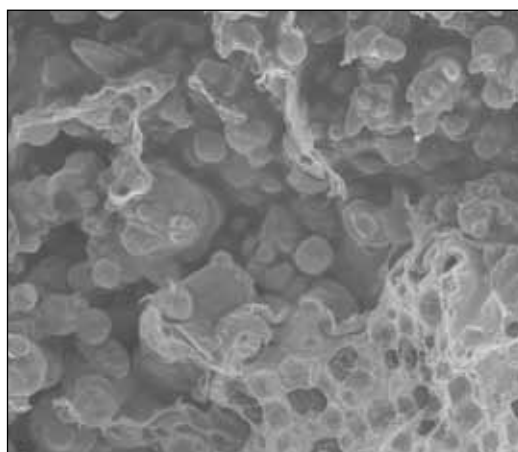
The laboratory has also added thermogravimetric analysis to its range of capabilities, enabling the experts to monitor changes in mass as a function of temperature. This means, amongst other things, that materials can be further categorized, for example, the glass fiber content in glass fiber reinforced plastics can be measured.



Microswitch contact with scoring



3D display of the scoring from Figure 1 in detail



Shrinkage cavity in tensile specimen of a rejected initial sample



K FOR CONFIDENCE.

By using genuine Knorr-Bremse quality parts you can be confident that your Knorr-Bremse rail systems retain their original integrity. With Knorr-Bremse guaranteed parts, you can also be confident that you are investing your budget wisely and ensuring that the original system design responsibility remains firmly with Knorr-Bremse. In the longer term, the cost of relying on non-genuine parts, with all the potential reliability, performance, and safety risks, will often be much higher! Confidence . . . with a K! | www.knorr-bremse.com |

KNORR-BREMSE