

High-Speed Trains



Source: Siemens

KNORR-BREMSE





Why do more and more high-speed train manufacturers and operators put their faith in Knorr-Bremse systems

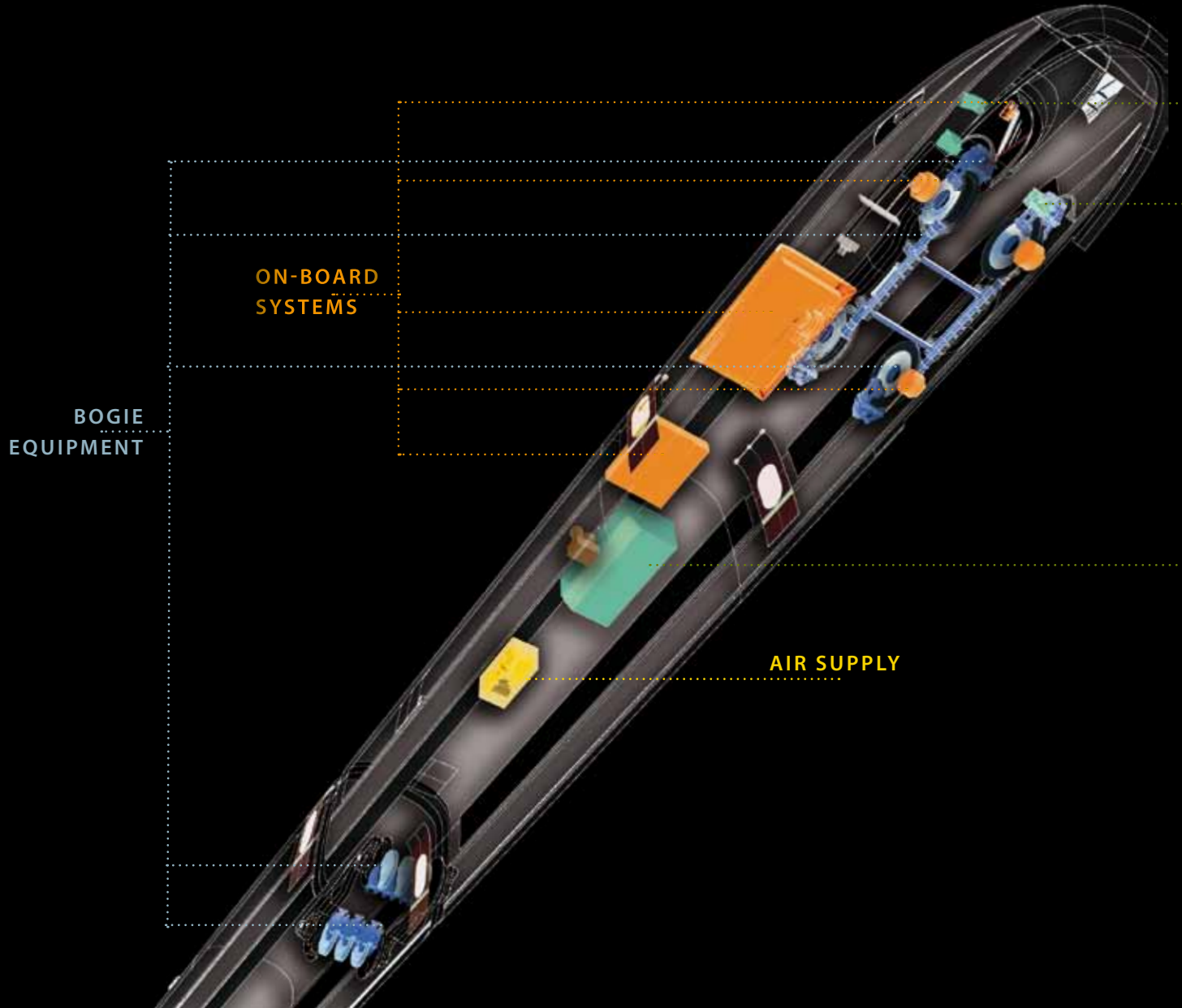




Knorr-Bremse systems are impressive even at extremely high speeds

At speeds of up to 400 km/h, enormous forces are generated. Trains that regularly travel long distances at high speeds require braking systems that can keep these forces under control – both safely and economically. As well as lightweight, compact systems that can be used worldwide, there is a need for intelligent control systems. Knorr-Bremse is regarded as an international pioneer in this field. On the basis of tried-and-tested technologies, we develop innovative solutions offering top levels of safety, reliability, and economy. The systems we have developed are so efficient that they also score top marks in terms of environmental friendliness. Customers enjoy full support from a single source – from the initial planning stage and commissioning right down to aftermarket services. Worldwide operator and customer audits regularly single out the consistent quality of our products and services for praise – and this is confirmed by our EN 50126 (RAMS and LCC) certification.

Systems Solutions For Every Market



What is Knorr-Bremse's
complete "one-stop
solution" for
high-speed trains



**BRAKE
CONTROL**

Air Supply

Combined compressor and air treatment system

Knorr-Bremse's ready-to-install air supply equipment has been adapted in line with the trend towards increasingly compact, lightweight systems. Our product portfolio includes low-vibration and low-noise screw compressors with an output of between 600 and 2,500 l/min. as well as air dryers and condensate collectors. A particularly economic solution is the first ever oil-free compressor, with life-cycle costs that are up to 50% lower than those of conventional compressors.

Bogie Equipment

Innovative design minimizes assembly and maintenance requirements

Knorr-Bremse offers a wide range of compact, lightweight bogie equipment including low-maintenance compact brake calipers, low-wear brake discs, and innovative high-performance brake pads. Sinter pads reduce the life-cycle costs of electromagnetic track brakes by up to 40%. The eddy current brake is completely free of wear components.

Brake Control

Ensuring the intelligent interaction of all brake functions

With brake control systems, Knorr-Bremse ensures optimum functioning of all systems involved in the braking process and allow reliable stopping of the train in all operating conditions. The highly flexible and configurable brake control system EP Compact, together with the modular electronic platform ESRA, manages the pressure control, anti-skid, wheel-slide monitoring and diagnostics, as well as further highly complex brake control functions.

On-Board Systems

Doors, air-conditioning units, and more

It is not just Knorr-Bremse braking systems that ensure greater safety and comfort in rail vehicles. Our on-board product portfolio covers a wide range of innovative products and solutions including vehicle and platform doors and air-conditioning units. We also produce state-of-the-art electronic diagnostic systems and windscreen wiper and wash systems.

Rail-Services

A partner for all requirements throughout the entire product life-cycle

Knorr-Bremse offers a wide range of rail-services ranging from individual consultancy and collaborative product development to homologation, commissioning, training, maintenance, repair, upgrading, and overhaul of all components – as well as a reliable supply of OEM parts. Whether you opt for individual services or the full package, everything is provided locally, either on-site or in one of our global service centers.

Testing

Test benches for all products – worldwide

Knorr-Bremse supplies test benches for all products and systems, customized and tailored to the customer's requirements, to supplement long-term overhaul services with tools and products for daily maintenance. Several hundreds of test benches and test installations are in operational service with our customers worldwide – for example, as train brake tests, test benches for brake control products, compressors, air dryers, tread brakes, brake calipers, and more.

A perfect balance of high-quality systems and services

Knorr-Bremse's expertise in the field has gone into every single component and system. Top-quality components operate smoothly together to guarantee optimum functionality, high reliability, and maximum safety. Complex electronic control systems such as blending and brake management reduce wear to a minimum by ensuring balanced operation of all systems. The system can be configured either to use the vehicle bus system or a separate bus exclusive to the braking system. For each project, customers are closely consulted at the design stage. It goes without saying that Knorr-Bremse offers support during the homologation process as well as all the necessary on-site services across the entire product life-cycle.

Cutting-Edge Technologies

Compressors

Oil-free compressor

Knorr-Bremse was the first company in the rail vehicle industry to develop a compressor that operates without any oil. Lubrication is replaced by a special coating, and the unit is cooled by air taken in via the crankcase. This innovative product is a winner in both environmental and economic terms. Expenses for oil changes, oil separation, and condensate disposal are avoided, and energy consumption, weight, and installation space are significantly reduced.



Compact Brake Calipers

Easy to install, maintenance-free, unusually lightweight

The compact brake caliper unit has a completely redesigned mechanism for applying braking force that allows for considerable transverse axle movement and tilt without generating any internal stresses. Requiring only a standard interface, it is easy to install, and sealed joints mean low maintenance. Its weight has also been reduced by up to an impressive 100 kg per bogie.



Modular Brake Control

EP Compact and ESRA – modular brake control

With EP Compact, Knorr-Bremse has developed a flexible and powerful brake control system with central and distributed control coming from one family. Core functions can be expanded by adding a wide range of options offered by various modules of the EP Compact product family. Especially for high-speed trains, Knorr-Bremse has developed innovative ESRA modules for new functions as defined in the TSI. Knorr-Bremse is the only brake supplier to offer an integrated solution for bogie monitoring and diagnostics comprising detection of non-rotating axles, derailment detection and additional diagnostic functions to improve service and maintenance.



Innovations that pay their way

Reducing wear and tear and maintenance costs is a good way of saving money. More than any other manufacturer, Knorr-Bremse has succeeded in finely coordinating the complex interplay of different braking systems. Brake components that are prone to wear are only used when the wear-free electro-dynamic braking cannot cope on its own. Even then, patented ISOBAR brake pads have proven longevity against conventional materials. Brake pads and discs require replacement less frequently, and their design enables them to be serviced rapidly. The brake calipers themselves are low maintenance. These examples demonstrate that if all the relevant factors are included in the calculation, the bottom line is savings for the customer.

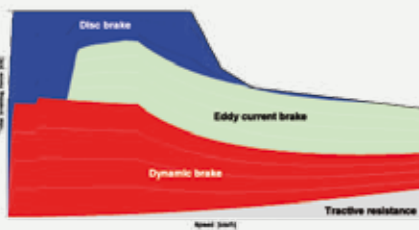
railservices

Customized service packages ensure that all Knorr-Bremse systems function smoothly for up to 30 years – anywhere in the world. The secret is our combination of OEM expertise and a highly efficient service infrastructure.

Brake Management

Intelligent braking

Economical braking is all about reducing the stress on wear components to a minimum. Knorr-Bremse ensures that friction brakes only come into operation when wear-free dynamic brakes are not enough. A brake management system for the entire train calculates brake force distribution based on different data: available brake effort of the individual brake systems, vehicle weights and adhesion limits, and thermal limits of the friction brake are taken into account to blend the different systems and achieve a balanced braking.



Stefan Aurich
*Team Leader,
 System Engineering
 High-Speed Trains*

"We produce utterly reliable systems for rail vehicles that are subject to heavy use. Our products offer everything: easy handling, low-cost, and uncompromising levels of safety."



Is it true that
 Knorr-Bremse's
 high-speed solutions
 are also the best in the
 world in terms of
 economy



Satisfied Customers ...



Wherever top quality is crucial for competitiveness

Knorr-Bremse's rail vehicle systems are not only cutting-edge technology – they are also market leaders. All over the world, when manufacturers and operators make purchasing decisions, they take a wide range of factors relating to safety and economics into consideration. They find that the best results are offered by Knorr-Bremse's unique combination of experience and innovation. Many customers opt for the full range of Knorr-Bremse systems and components for their high-speed trains. Examples for equipped high-speed trains worldwide:

1 BR 407 2 AVE S 103 3 AGV Pegase 4 CRH3 5 AVE S 102 6 KTX Korea

... Supplied With Excellent Products

Air Supply

Oil-free compressor

- Oil-free air (environmentally friendly, no downstream contamination)
- Less complex system / fewer interfaces (no oil filter, no condensate collector)
- Almost maintenance-free, very low LCC



Screw compressor

- Special design, related to tough railway operation conditions
- Low compressor noise level
- Virtually pulsation-free, delivery of compressed air



Brake Control

EP Compact

- Flexible brake control platform
- Central and distributed control
- Compact design
- Continuous pneumatic load correction
- Full set of auxiliary functions
- CENELEC- and TSI-compliant



Modular ESRA

- Intelligent combination of pneumatic and electronic control
- Intelligent blending and brake management
- Modular and suitable to the various customer requirements
- CENELEC- and TSI-compliant



Bogie Equipment

Wheel- and axle-mounted brake disc

- Standardized interface and fixation on wheel
- Resistant against thermal cracks due to movable friction disc
- Robust design with high safety against external shock and vibration



Compact brake caliper

- Only one interface to bogie
- Highly modular design
- Optimized design regarding weight, assembly, and costs
- Reduced maintenance



Compact units

- Compact, light, reliable
- Protected: developed especially for installation beneath the frame
- All components to be maintained can be reached through a maintenance port



Air dryer

- Dual-chamber regeneration dryer
- Lightweight aluminum design
- Integrated pre-filtration elements



COMORAN – Condition Monitoring for Railway Applications

- Condition monitoring and diagnosis
- Derailment detection
- Reducing life-cycle costs
- Fulfillment of TSI requirements



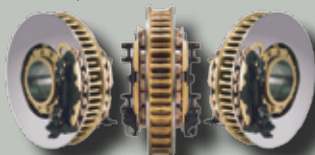
Modular motion controller kit

- Brake, traction, and master controller
- Compatible with UIC standard
- Small, flexible installation space
- Robust design, proven application



Isobar sinter brake pad

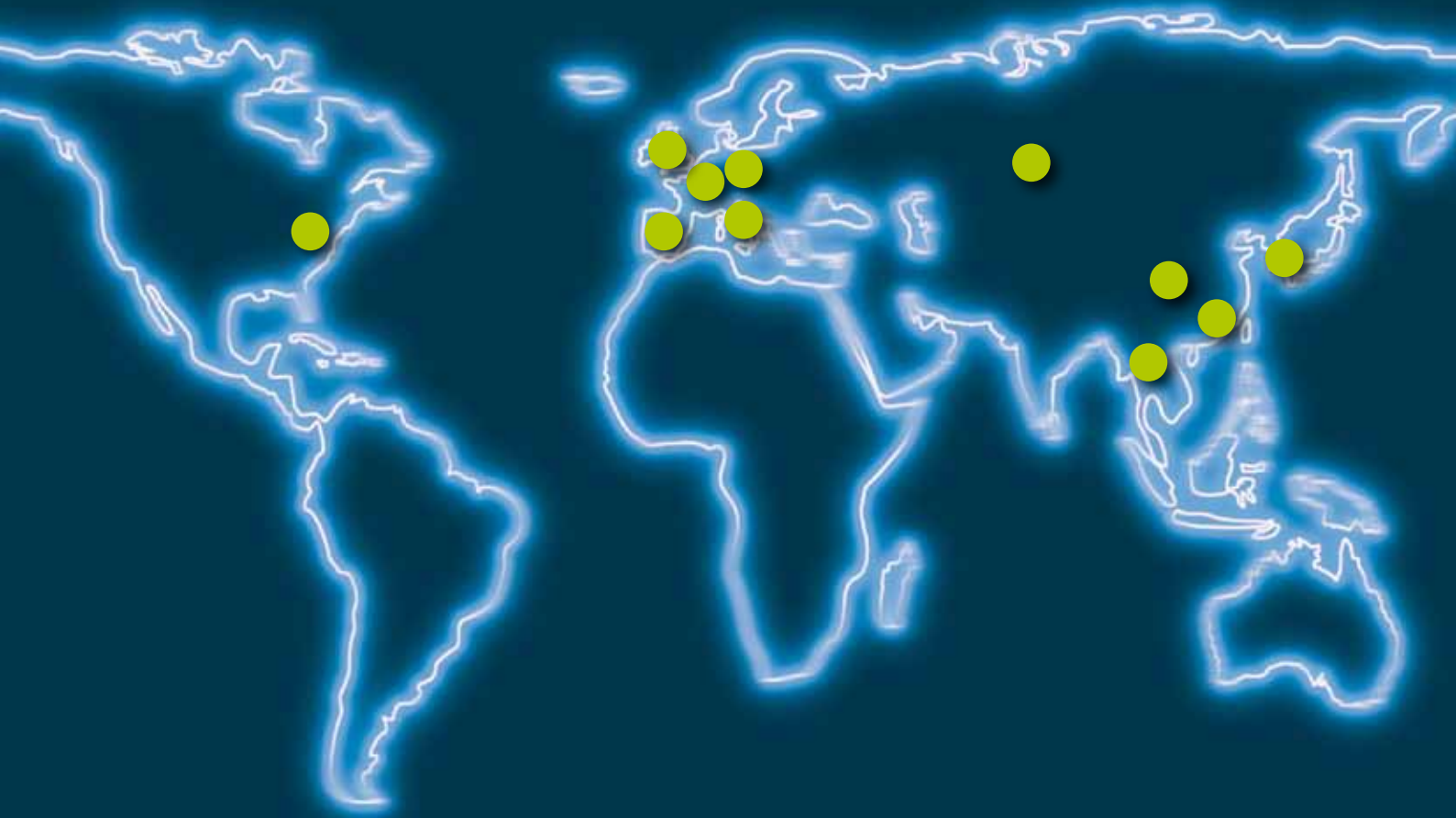
- Flexible sinter brake pad with highest brake performance
- Temperature resistant with constant friction behavior
- Long disc and pad life due to even temperature distribution on brake disc
- For overhaul, only replacement of friction elements necessary



Eddy current brake

- No mechanical contact between brake and rail
- No wear and tear and low maintenance
- Noiseless braking
- Brake force does not depend on friction coefficient
- Constant brake force even at high-speed applications





Where have Knorr-Bremse solutions already been tried and tested



The Future



What prospects for the future can Knorr-Bremse offer in the high-speed segment



Secure Operation | Secure Investment | Secure Future



The future belongs to technology leaders

The extreme stress to which high-speed trains are subjected call for unusually high-performance, top-quality, and safe braking technologies. We offer to adapt every system to the specific operating conditions involved, thereby minimizing wear and tear and achieving top levels of economy and vehicle availability. As a manufacturer of braking systems with more than 100 years' experience, Knorr-Bremse has the necessary expertise to achieve this. High levels of R & D investment ensure that our systems remain cutting-edge around the world. With railservices Knorr-Bremse offers a high-quality portfolio of maintenance and aftermarket services ranging from original spare parts and maintenance agreements right down to responsibility for complete systems during the entire life-cycle. Customers also benefit from a comprehensive network of service centers for all braking and on-board systems.

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