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.
What is Knorr-Bremse’s complete “one-stop solution” for high-speed trains?
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.
## Compressors

<table>
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<tr>
<th>Oil-free compressor</th>
<th>Easy to install, maintenance-free, unusually lightweight</th>
<th>EP Compact and ESRA – modular brake control</th>
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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

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

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.

## Cutting-Edge Technologies

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.

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**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.”

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Is it true that Knorr-Bremse’s high-speed solutions are also the best in the world in terms of economy?
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
### 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?
What prospects for the future can Knorr-Bremse offer in the high-speed segment?
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.