

# Locomotives



Source: Bombardier



**Why do most locomotive manufacturers and operators put their trust in Knorr-Bremse systems**

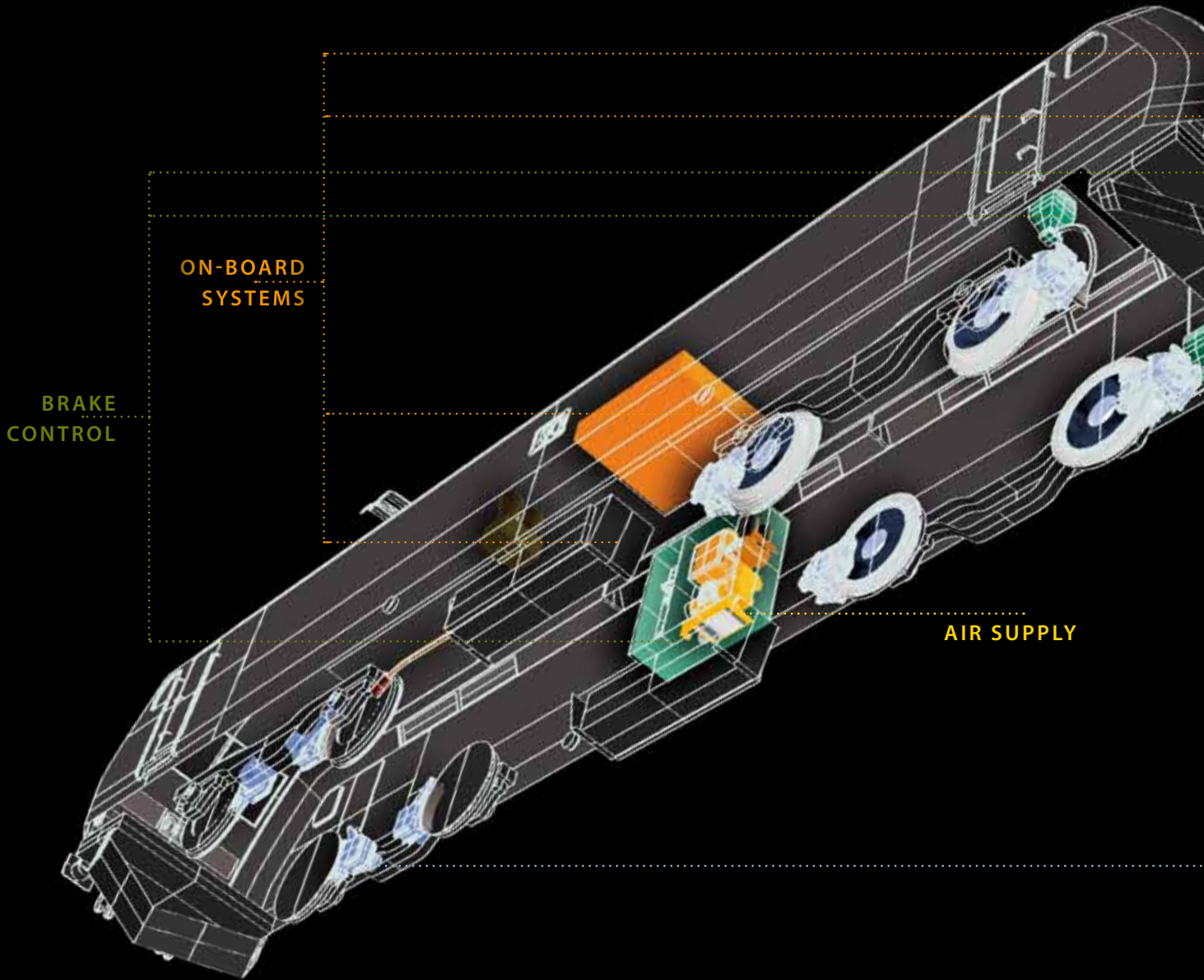




### **We simply find the right answers to complex challenges**

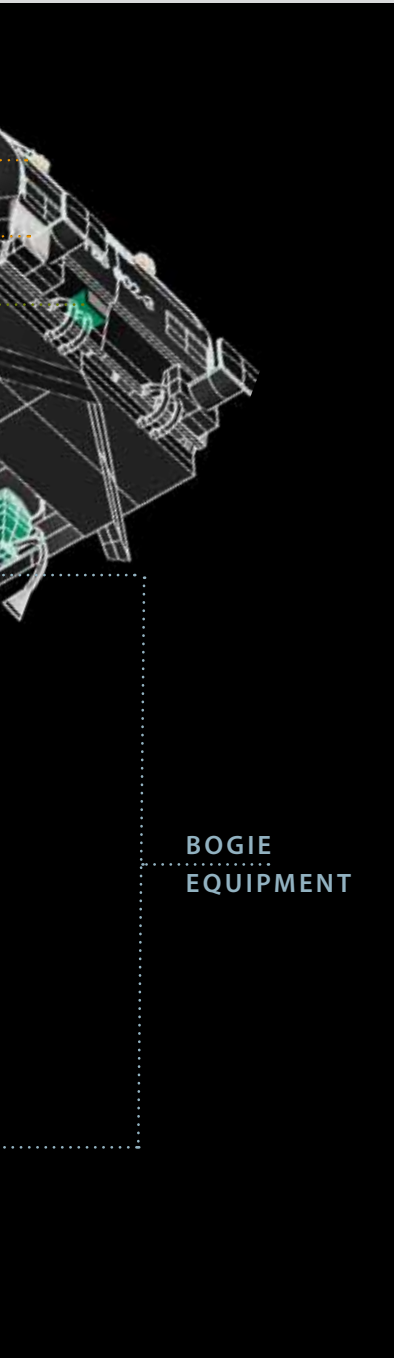
Locomotives have a key role to play in coping with increased demand for rail transportation worldwide. For high-speed passenger trains and heavy freight transportation, operators need economical vehicles that have been customized to their specific needs. Manufacturers therefore produce modular vehicle platforms that can be easily adapted to regional conditions but at the same time are suitable for cross-border operation. This is where Knorr-Bremse braking systems come in. On the basis of service proven technologies, we develop innovative solutions offering top levels of safety, reliability, and economy. The systems we have developed are so efficient they also score top marks for environmental friendliness. Customers enjoy full support from a single source – from the initial planning stage and commissioning right down to aftermarket services. Operator and customer audits worldwide 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 locomotives





**BOGIE  
EQUIPMENT**

### **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 economic oil-free piston compressors, low noise screw compressors, robust simple piston compressors, and auxiliary compressors, which can serve an air flow of 80 up to 5,000 l/min. as well as air dryers and condensate collectors. The oil-free compressor is a particularly economical solution, with significant reductions in life-cycle costs.

### **Bogie Equipment**

#### **Innovative design minimizes assembly and maintenance requirements**

Knorr-Bremse offers a wide range of compact, lightweight bogie equipment including low-wear brake discs, and innovative, high-performance brake pads. Compact, low-maintenance brake calipers with sealed joints and a standardized interface reduce installation and maintenance costs.

### **Brake Control**

#### **Knorr-Bremse brake control systems ensure efficient and safe braking all over the world**

Knorr-Bremse offers brake control solutions for locomotives worldwide, which allow complete functional customizing to the regional requirements and for all climatic and environmental conditions. As with the CCBI in AAR regions, the modular design of the MBS brake system and the new generation of modular brake control BP and BC Compact (brake pipe and brake cylinder pressure control) offer both economical and flexible operation for UIC regions.

### **On-Board Systems**

#### **Driver assistance systems, sanding, windscreen wiper and wash systems, and much 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 efficient and innovative products and solutions including state-of-the-art driver assistance as well as electronic diagnostic 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**


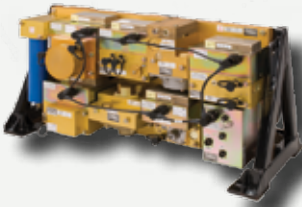


Knorr-Bremse supplies test benches for all products and systems, customized and tailored to the customer, requirements in order to supplement long-term overhaul services with tools and products for daily maintenance. Several hundreds of test benches and test installations are in operational service with 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

## Brake Control

MBS for Europe	CCB II for America	MBS for GUS	CCB II for India
<p>The modular design of the European equivalent to CCB II in America – MBS and the new generation of brake control modules, BP Compact for brake pipe pressure control and BC Compact for brake cylinder pressure control, reduces the number of components required.</p> 	<p>CCBII is the standard brake control system for the AAR market and therefore for North America as well. Recently CCB also became a great market success in China, where MBS and CCB technologies came together and were integrated into a combined product.</p> 	<p>Starting with a successful market introduction in Lithuania, Knorr-Bremse is also strengthening their footprint in the countries of the former Soviet Union with GOST requirements. The brake control system based on MBS is compatible to the local distributor valve and operates under extreme temperatures.</p> 	<p>For India, Knorr-Bremse is homologating the North American CCB system. To meet the special requirements of Indian operations, experiences gained by MBS were adapted to suit CCB technologies.</p> 

All Knorr-Bremse brake control systems for locomotives are characterized by their modularity. Each of the line replaceable units is capable of self-diagnosis. Faults can be quickly identified and defective modules rapidly replaced. This also simplifies the brake panel layout and considerably reduces the cost of installation, commissioning, maintenance and repair, while at the same time improving vehicle availability. Emergency brake control remains completely functional even in the case of power failure.

### 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 Flexpad 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 require 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.

Air Supply

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. The expense of oil changes, oil separation, and condensate disposal is avoided, and energy consumption, weight, and installation space are significantly reduced.



**Fritz Königsbauer**  
*Teamleader*  
*Sales Locomotives Germany*

"The ability to carry out cross-border freight operations without having to change locomotives at frontiers is becoming increasingly important. This is where our flexible solutions come in."



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



# Satisfied Customers ...



## The safest and most economical solutions always win in the end

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 locomotives.

Examples for equipped locomotives worldwide:

- 1 Gravita 2 HXD3 3 ALP46 4 WAG-9 5 Euro 4000 6 ER20CF 7 G6 8 Evolution 9 Maxima

# ... 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
- Nearly pulsation-free, compressed-air delivery



## Brake Control

### MBS – modular brake system

- For UIC and GOST market
- High availability through back-up levels
- Reduced overhaul time by automatic self-diagnostics
- Functionalities combined into line replaceable units
- Optimized maintenance



### CCBII

- Modular design
- For AAR market



## Bogie Equipment

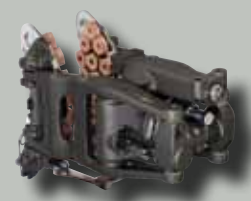
### Wheel-mounted brake disc

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



### Compact brake caliper

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



**Piston compressor**

- Great reliability, long life and extraordinary ruggedness
- Self-supporting, flange-mounted-motor compressor set



**Air dryer**

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



**KE distributor valve**

- Standard distributor valve
- Conventional and approved design
- More than 50 years of experience



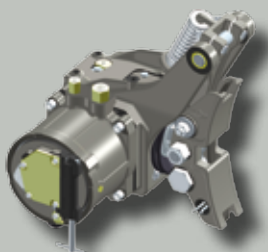
**Modular motion controller kit**

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



**Tread-brake unit**

- Fixation modular design
- Flexible mounting
- High output forces



**Cleaning-block unit**

- Wheel surface conditioning to improve friction
- Flexible mounting in bogie
- Robust and service-proven design





Where have Knorr-Bremse solutions already been tried and tested



# The Future



Source: Siemens

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



Secure Operation | Secure Investment | Secure Future



### Technology for the future

Few areas have as many different regulations as cross-border rail transportation. As a manufacturer of innovative systems with more than 100 years of experience, Knorr-Bremse has the necessary expertise. Constant improvements to processes and high levels of R & D investment guarantee the high quality of our products. Wherever it is to the customer's advantage, Knorr-Bremse further standardizes its products. And where wear and tear is unavoidable, we reduce it to a minimum. New maintenance concepts increasingly require only the replacement of easy-access, cost-optimized modules, thereby further improving vehicle availability. And with its railservices, Knorr-Bremse promises to keep all braking and on-board systems running for the next 30 years.

## Rail Vehicle Systems

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