

Metros



Air Supply | Brake Control | Bogie Equipment | Rail-Services | On-Board



**Why do more and more metro manufacturers and operators put their trust in Knorr-Bremse systems**

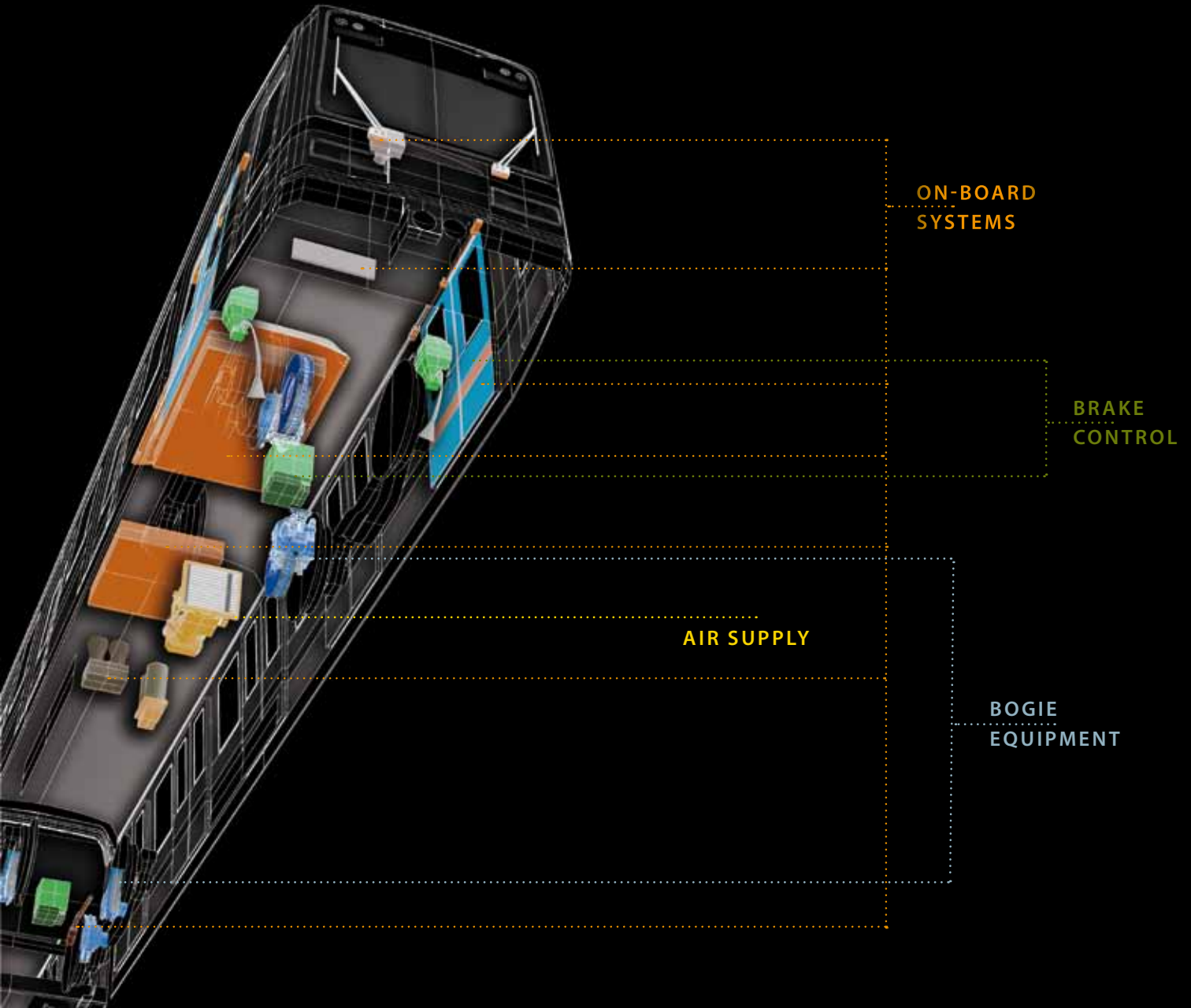




**We simply find the right answers to complex challenges**

With major conurbations growing worldwide, public transport systems are becoming increasingly important. Major cities are depending on attractive metro systems to take the pressure off overcrowded streets. Especially in Asia, massive investment is currently taking place to develop the necessary infrastructure and purchase new, improved vehicles. Knorr-Bremse is a leading player in this growth market. 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 metros



### Air Supply

#### Combined compressor and air treatment system

The space available in modern metro vehicle platforms is increasingly limited, and installation is becoming more and more complex. When it comes to air supply, the trend is towards distributed systems using increasingly lightweight, compact units. Knorr-Bremse's high-performance systems have been designed to meet these requirements. Intelligent compressor management means that the compressor only operates until the required quantity of air has been produced. In addition, reduced installation and maintenance times increase vehicle availability.

### Bogie Equipment

#### Innovative design minimizes assembly and maintenance requirements

Knorr-Bremse offers a wide range of compact, lightweight bogie equipment including block brakes, low-wear brake discs, and innovative high-performance brake pads. For individual projects, precise calculations are made, and testing is carried out on the basis of the customer's data. New systems are subjected to extreme loads on the test bench before they are put into operation.

### Brake Control

#### All over the world, brake control systems ensure efficient and safe braking

Knorr-Bremse offers both centralized and distributed systems that are compatible with all types of vehicle bus systems. Combined with the ESRA electronic platform, brake control systems such as EP Compact lite ensure optimum interaction of all braking functions. The EP2002 intelligent brake control system combines mechatronic and electronic elements in a single, extremely compact unit.

### On-Board Systems

#### Doors, air-conditioning units, windscreen wiper and wash systems, 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 efficient and innovative products and solutions including vehicle and platform doors, air-conditioning units, windscreen wiper and wash systems and state-of-the-art 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 – worldwide

Knorr-Bremse supplies test benches for all products and systems, customized and tailored to the customer's 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 at 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 the balanced operation of all systems. Customers are closely consulted when the overall system is being designed. It goes without saying that Knorr-Bremse also offers support during the homologation process as well as all the necessary on-site services across the entire product life-cycle.

# Cutting-Edge Technologies

## Distributed Brake Control

### EP 2002 Cube

Growing passenger numbers call for greater availability of trains and shorter operating intervals on metro networks – which puts greater demands on brake reaction times. The EP2002 intelligent brake control system combines mechatronic and electronic elements in a single, extremely compact system with distributed control modules installed close to the bogie. The entire compressed air system has become even more compact with the latest development – the EP2002 Cube – which includes a wide range of additional functions in a single cube-shaped unit with integrated piping.



## Central Brake Control

### EP Compact lite

With EP Compact lite, Knorr-Bremse has developed a flexible and powerful brake control system with central control. The core functions can be expanded by the addition of a wide range of optional functions offered by the various different modules of the EP Compact product family. EP Compact lite offers electronic load correction and pneumatic load limitation and can also be installed beneath the floor, including electronics. Additional functions: control of parking brakes, wheel slide protection, air suspension, sanding, indirect brakes, brake management, BUS coupling, and further functions.



## 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. Expenses for oil changes, oil separation, and condensate disposal are avoided, and energy consumption, weight, and installation space are significantly reduced.



### 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 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

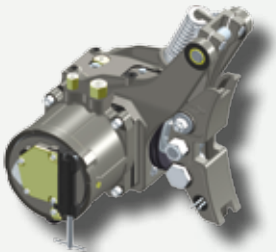
Customized service packages ensure that all Knorr-Bremse systems function smoothly for up to 30 years – anywhere in the world. The secret is our combination of OEM expertise and a highly efficient service infrastructure.

## Bogie Equipment

### Tread-brake unit – PEC7

The compact, space-saving design of the PEC7 tread-brake unit makes it ideally suited for vertical or horizontal installation in bogies with restricted space.

Depending on operating requirements, a number of different variants are available with or without spring parking brake. The robust design has been installed and tested in metro trains all over the world.



### **Ricardo Fortes**

*Manager Project Engineering*

*Metro*

“In today’s competitive global market, we need more than a worldwide presence – we must understand our customer’s expectations independently of language and culture. It is not unusual to have to design a brake system with a traction and bogie manufacturer located in Europe and a vehicle builder located in Asia delivering vehicles to South America. We manage the complexity to the advantage of our customers.”



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



# Satisfied Customers ...



source: Münchner Verkehrsgesellschaft mbH (MVG), Foto: Kerstin Göh



source: ALSTOM Transport, R. Parvez



## 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 metros.

Examples for equipped metros worldwide:

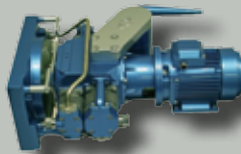
- 1 Munich
- 2 Algiers
- 3 Santiago de Chile
- 4 Guangzhou
- 5 Nanjing
- 6 London

# ... 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 2002 Cube

- Distributed control
- Compact design



### EP Compact lite

- Central control
- Compact design
- Modular and suitable to various customer requirements
- Optional electronics underfloor



## 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
- Aluminum friction rings



### Compact brake caliper

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



**Capsuled units**

- Compact, light, reliable
- Protected: developed especially for very low noise level
- 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



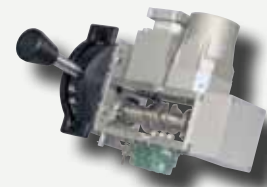
**COMORAN – Condition Monitoring for Railway Applications**

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



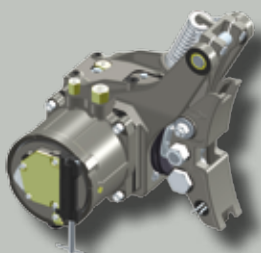
**Modular motion controller kit**

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



**Tread-brake unit**

- 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



# T h e F u t u r e



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



Secure Operation | Secure Investment | Secure Future



### **Technologies of the future**

Traffic levels in the world's cities continue to rise. To avoid gridlock, the proportion of passengers using rail transport has to be increased by developing attractive metro systems. What is required are compact, lightweight technologies offering greater economy. 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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