

# Trams



Source: MVG



Source: Bombardier Transportation

Why are more and more tram manufacturers and operators putting their faith in Knorr-Bremse systems



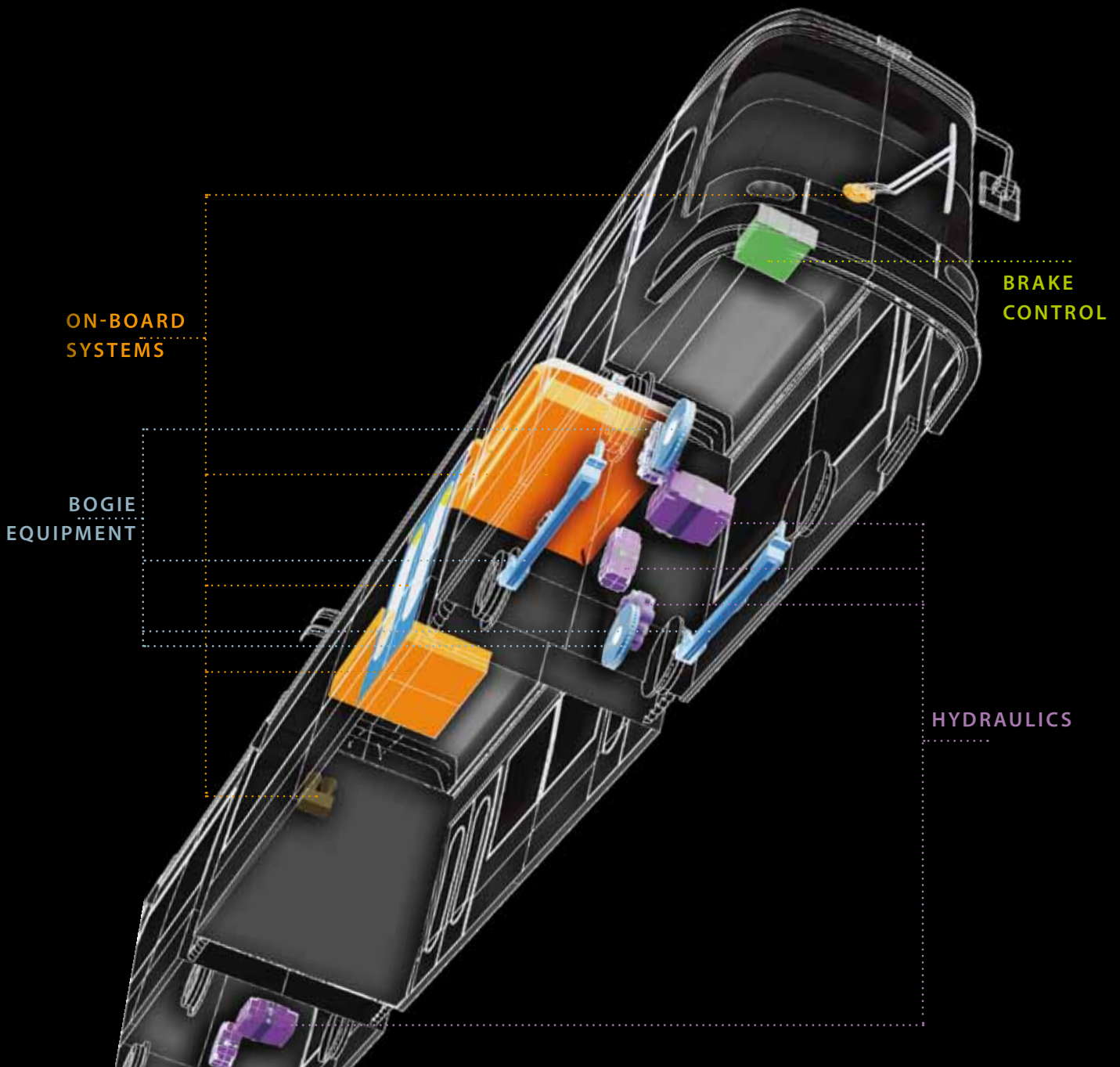


**Because we simply find the right answers to complex challenges.**

Trams and light railway systems are once again in demand. In particular, medium-sized cities that wish to avoid the expense of creating a metro network are opting for this environmentally-friendly alternative. The range of vehicle types is particularly wide, but Knorr-Bremse's consistent platform strategy means it can offer the necessary flexibility at affordable prices. Our hydraulic systems offer top performance in a confined space and are indispensable for low-floor vehicles that only have limited room available.

Our pneumatic systems are the preferred solution for high-floor vehicles. Tried-and-tested technologies form a basis for developing innovative solutions offering top levels of safety, reliability and economy. Customers enjoy full support from a single source – from the initial planning stage via commissioning right down to aftermarket services.

# Systems solutions for every market



What is Knorr-Bremse's complete "one-stop solution" for trams



### Hydraulics

#### Top performance in a small space

The company has a large portfolio of hydraulic components and systems for low-floor trams, ranging from conventional parking brakes to combined active/passive braking systems for trams and people-movers. Our suspension and leveling systems facilitate disabled access and enhance passenger comfort.

### 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 with a diameter from 260 mm, on brake caliper units, pneumatic brakes for high-floor street cars and track brakes with extremely lightweight articulated electromagnets. Deposit-free pole shoes made of sintered materials improve braking performance while at the same time reducing servicing costs and vehicle downtimes.

### Brake Control

#### Not just for hydraulic systems

Intelligent systems such as ESRA are equally capable of controlling both hydraulic and pneumatic systems. Knorr-Bremse also has a range of electronic control and interface modules especially designed for hydraulic systems. The HCM hydraulic control module transfers the signals to the braking system.

### Services

#### A partner for all requirements throughout the entire product lifecycle

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 worldwide network of service centers.

### 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 that includes vehicle and platform doors and air-conditioning units. We also produce state-of-the-art electronic diagnostic systems and passenger information systems.

### A perfect balance of high-quality systems and services.

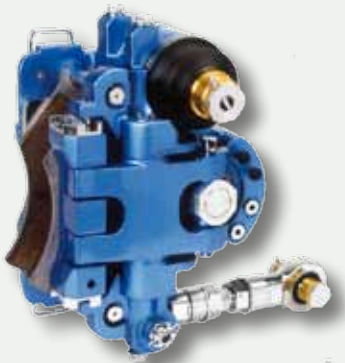
Knorr-Bremse's expertise means that the complete braking systems it produces offer a combination maximum functionality, reliability and safety. Top-quality elements operate in perfect harmony: low-maintenance brake Caliper units offering top performance even in a restricted space; brake discs whose thermal characteristics are precisely tailored to operating conditions; hydraulic units that incorporate all functions in a small space; electromagnetic track brakes with sintered pole shoes for deposit-free operation; and electronic control and interface modules for the hydraulic system. Every system is designed according to the requirements of the particular project. And Knorr-Bremse also offers support during the homologation process as well as all the necessary on-site services across the entire product lifecycle.

# State-of-the-art technologies

## Bogie Equipment

### Brake caliper units for all types of installation

Knorr-Bremse brake caliper units are ideally suited for tram platforms, especially the low-floor segment, where installation space is at a premium. These high-performance modules can be installed even in the most confined spaces and operate with low maintenance requirements. The universally installable basic units can be easily modified to take special interfaces.

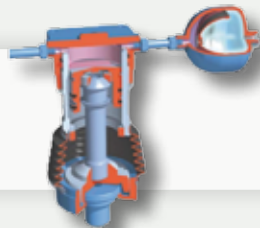


### Hydro-pneumatic suspension and hydraulic self-leveling systems

## Hydraulics

### Electro-hydraulic supply and control units

The energy consumption and performance characteristics of Knorr-Bremse electro-hydraulic supply and control units make them ideally suited for use in low-floor trams. Products available range from units for simple braking systems to ones for operating hydro-pneumatic suspension and/or self-leveling systems using wearless drive systems. The pressure supply and control units are available with functionality covering a wide variety of different situations.



## Pneumatics

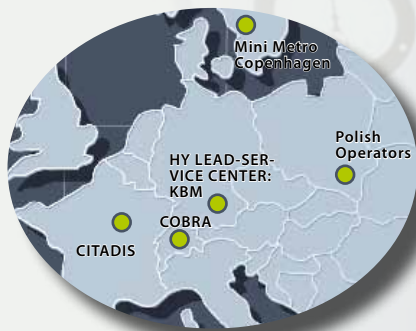
### Everything for the pneumatic system

Knorr-Bremse pneumatic braking systems are a product of the company's combined expertise in a variety of different areas air supply, brake control and bogie equipment. They include complete air-supply systems as well as maintenance-free brake calipers and control units that can be operated purely pneumatically in case of failure of the electronics.



*railservices*

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



**Stefan Osslander**  
*Team Leader – Sales Hydraulic*

Customer requirements – for example for high levels of reliability – are the important factors in our product development.

**Martin Waldstein**  
*Team Leader Development Hydraulic*

“Development engineers and sales staff collaborate closely to create efficient, economical braking systems for our customers.”

Is it true that Knorr-Bremse's tram solutions are also world-leaders in terms of economy



## Satisfied customers...



### Wherever top quality is crucial for competitiveness

Knorr-Bremse's rail vehicle systems are not only cutting-edge in terms of technology – they are also market leaders. All over the world, when manufacturers and operators are making purchasing decisions they take a wide range of safety- and economy-related factors into consideration. And again and again they find 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 tramway systems – from hydraulics and brake control right down to bogie equipment. Examples:

- 1 Citadis Tunis
- 2 Kinkisharyo for the US city of Seattle
- 3 Flexity Berlin
- 4 Sirio for Milan
- 5 Variobahn for Nuremberg
- 6 S70 for Portland

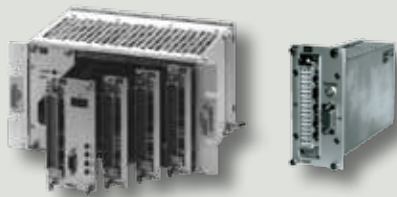
# ...supplied with excellent products

## Citadis platform

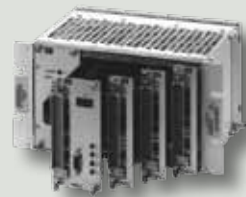
## Tram Train

### Brake Control

- KBGM-H electronic brake and wheel slide protection control
- HCM electronic control unit



- KBGM-H electronic brake and wheel slide protection control



### Hydraulic Unit

- HGE-28ANL hydraulic unit



- HGA-40ppn



### Bogie Equipment Actuators & Calipers

- SN100S-3 electromagnetic track brake
- F400B060MKUH flanged brake disc
- HS2P20N hydraulic floating caliper
- HF2A15 hydraulic fixed caliper

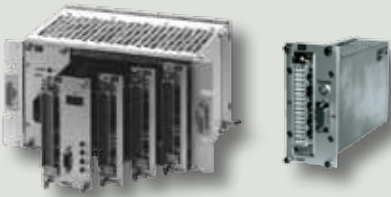


- MB58RS45 electromagnetic track brake with sintered pole shoe
- W360B058XGGH axle mounted brake disc
- HC1P28 hydraulic floating caliper



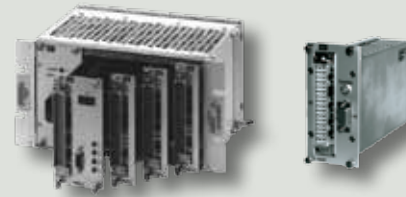
Sirio platform

- KBGM-H electronic brake and wheel slide protection control
- HCM electronic control unit



Variobahn

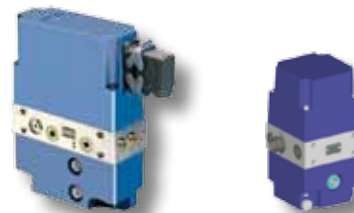
- KBGM-H electronic brake and wheel slide protection control
- HCM electronic control unit



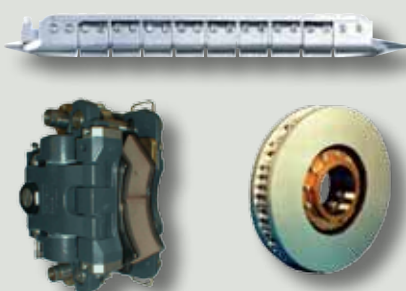
- HGE-28PNL hydraulic unit



- HGK-PN hydraulic unit
- EDHL 601 electrical auxiliary release unit



- MB54-R58 electromagnetic track brake
- W400B045PGUH axle-mounted brake disc
- HC1P28W compact hydraulic floating caliper



- MB54R66-25 electromagnetic track brake
- F440B032MKUH flanged brake disc
- HC1P28 (20) compact hydraulic floating caliper





Where are Knorr-Bremse solutions already successful in operation



## The future



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



| Secure Operation | Secure Investment | Secure Future |



Source: Stadler Rail

### Technologies of the future.

Trams are coming back as an environmentally-friendly alternative to costly extension of metro networks. For years, vehicle design has been undergoing further development in close collaboration with Knorr-Bremse. For the restricted installation space available in the low-floor segment we produce compact units with continually improving performance. 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 world-wide. And with **rail**services Knorr-Bremse offers a high-quality portfolio of maintenance and aftermarket services ranging from original spare parts via maintenance agreements right down to responsibility for complete systems during the entire lifecycle. Customers also benefit from a comprehensive network of service centers for all braking and on-board systems.

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