

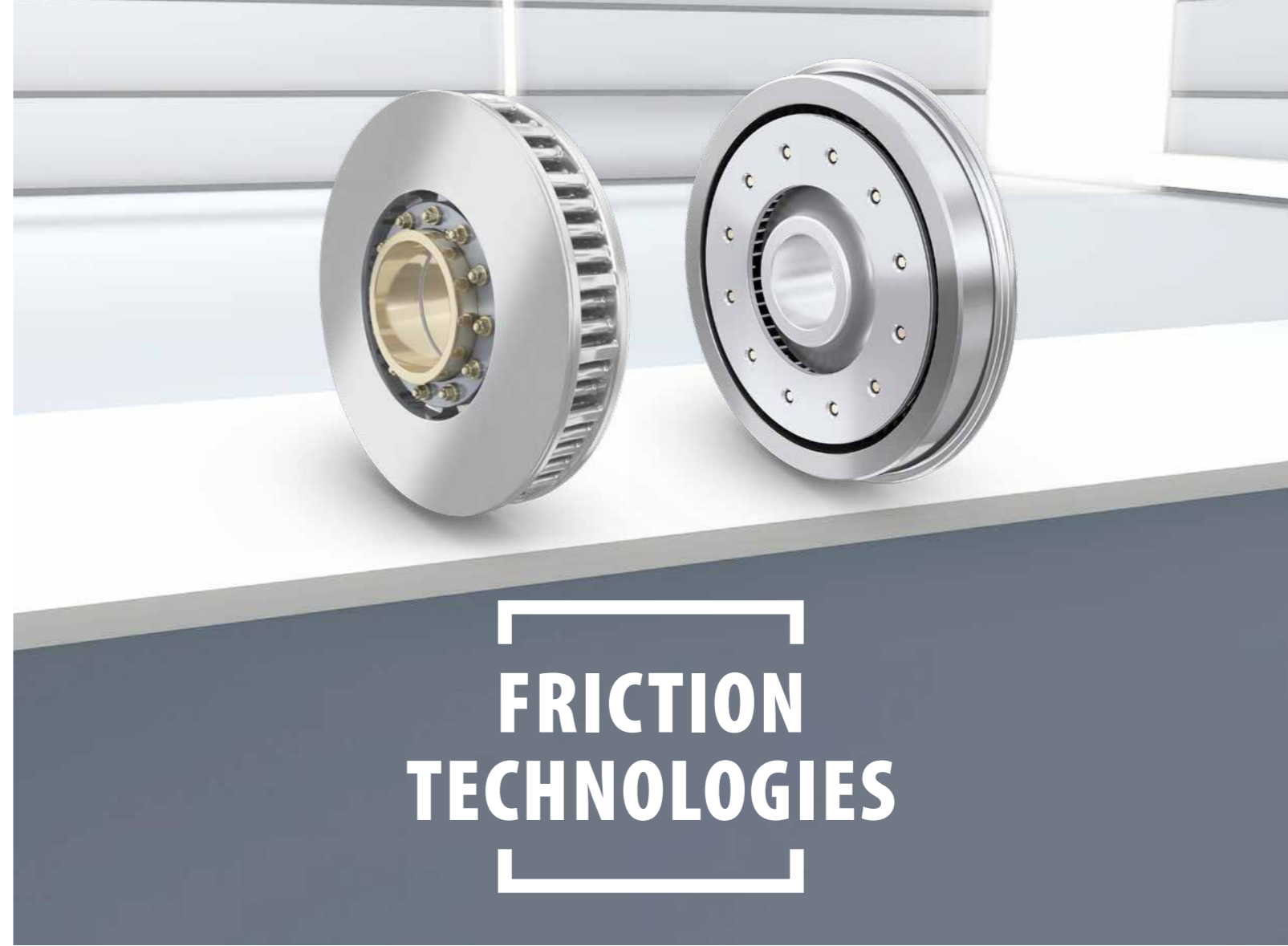
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-  **KNORR-BREMSE**
-  **NEW YORK AIR BRAKE**
-  **IFE**
-  **MERAK**
-  **MICROELETTRICA**
-  **SELECTRON**
-  **EVAC**
-  **ZELSKO**
-  **RAILSERVICES**

P-1264-EN 04.2024



**Brake Disc Excellence for all
train applications**





FRICION TECHNOLOGIES

PRODISC ULTRADISC LIGHTDISC

With the system competence and global know-how of Knorr-Bremse, Friction Technologies provide the most comprehensive, individual and suitable offer of friction products for all train applications.



Optimum friction pairing for maximizing performance and operating life, and for minimizing costs, can only be achieved in a perfectly balanced braking system. As a supplier of brakes and a full range of friction products, Knorr-Bremse is in an ideal position to design the best system.

Knorr-Bremse Friction Technologies offers a full range of brake discs made out of various materials which are clustered into the following product families

Product family	Material	DESIGNED FOR
<i>PRODISC</i>	Grey cast iron	... cost efficiency and a wide-range of applications
<i>ULTRADISC</i>	Steel	... high speed applications with highest demands for brake energies and associated surface temperatures
<i>LIGHTDISC</i>	Aluminum	... saving weight and energy

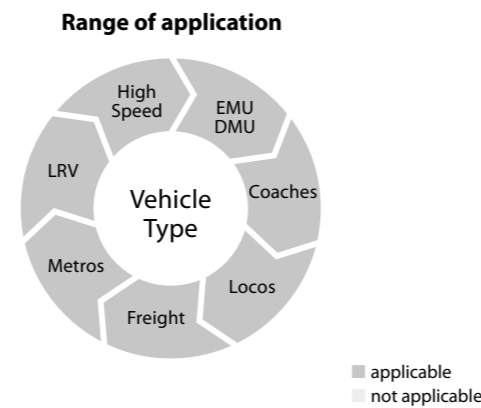
Advantages of Knorr-Bremse Brake Discs

- ▶ **Robust design**
- ▶ **Thermal resistance**
- ▶ **Optimized cooling**
- ▶ **Long service life**

Axle-mounted brake discs



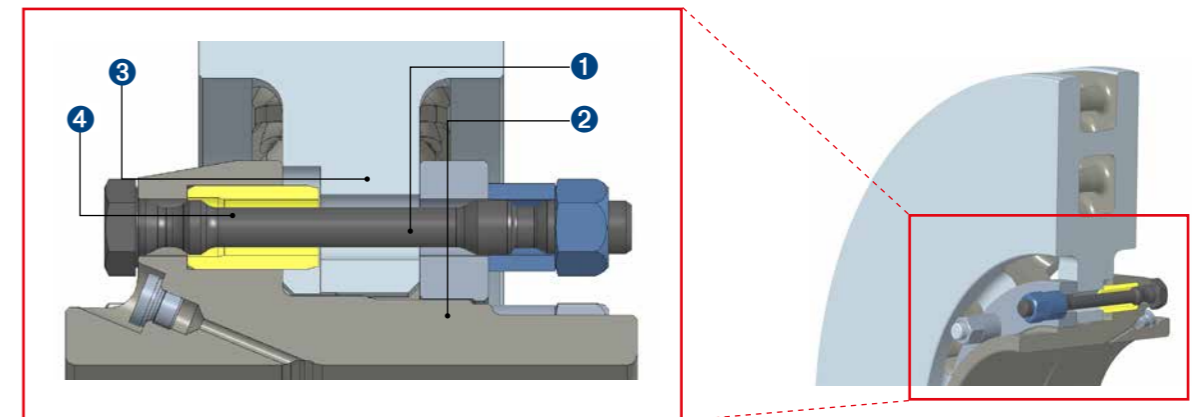
PRODISC ULTRADISC LIGHTDISC



ProDisc Axle ProDisc Axle Plus	UltraDisc Axle UltraDisc Axle Plus	LightDisc Axle
Grey cast iron	Steel	Aluminum
<ul style="list-style-type: none"> Available size: 350 – 700 mm Available width: 45 – 170 mm All axle-mounted discs are available as solid- and split discs Flat seated disc is the standard for Knorr-Bremse axle-mounted discs Project specific disc designs available (e.g. mono block discs, specific flange brake disc designs for LRV applications) Compliant with all international standards (EN14535, UIC, GOST, CRCC, etc.) 		

Axle-mounted brake discs

PRODISC ULTRADISC LIGHTDISC



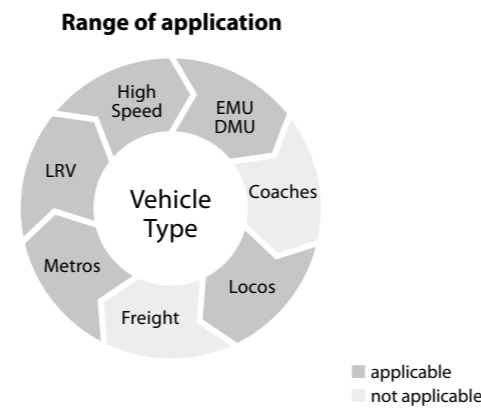
ProDisc Axle Plus / UltraDisc Axle Plus: Axle-mounted brake discs for highest brake loads and vibration levels

- 1** Reinforced connection friction ring to hub
 - Highest strength waisted shankbolting
 - Vibration protected thread on bolts
- 2** Advanced hub
 - Optimized shape for heavy duty shock and vibration loads
 - Strengthened flanges
- 3** Friction ring design for highest thermal and mechanical loads
 - Increased permitted thermal load
 - Form-fit centering supported by sliding sleeves
- 4** Sliding keys transferred from service-proven wheel-mounted disc
 - Design variant as sleeves for combined function: guiding and bolting at same place
 - Shock and vibration protected centering

Wheel-mounted brake discs



PRODISC ULTRADISC LIGHTDISC

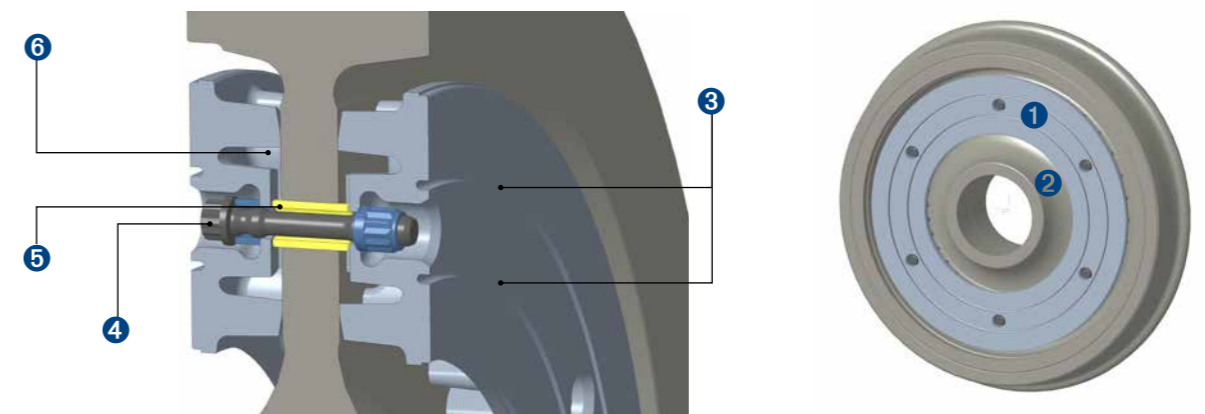


ProDisc Wheel	UltraDisc Wheel UltraDisc Wheel Lite	LightDisc Wheel
Grey cast iron	Steel	Aluminum
<ul style="list-style-type: none"> Available size: 370 – 1.085 mm Available width: 120 – 155 mm Standardized interface to wheel ensures highest thermal capacity and minimized weight Lite version for medium speed applications (e.g. regional commuter) – see UltraDisc Wheel Lite on right-hand side Most wheel-mounted discs are available as solid- and split disc version Project specific disc designs available 		

Wheel-mounted brake discs



PRODISC ULTRADISC LIGHTDISC



UltraDisc Wheel Lite: Innovative low-weight steel wheel-mounted brake disc

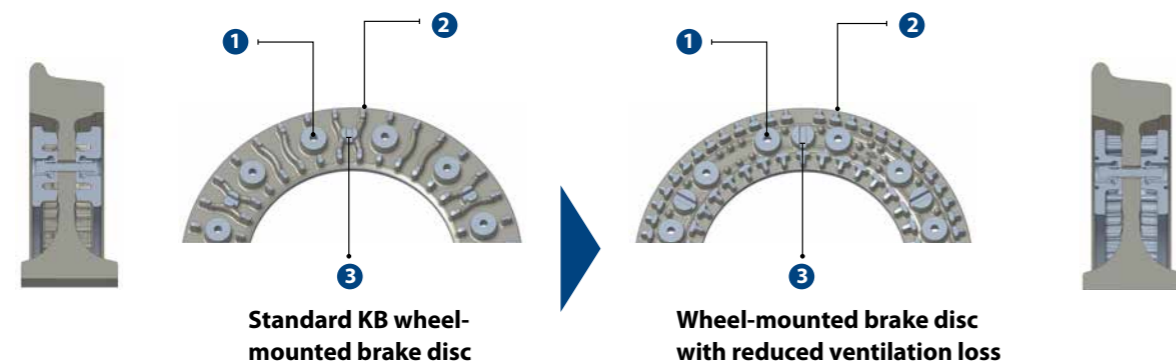
- 1 Weight optimization (-20%) for applications up to 160 (200) km/h
- 2 Service-proven casted steel technology
- 3 Stress-relieving grooves in friction face
- 4 Service-proven waisted bolts and lock nuts
- 5 Slide key centering at 6 places
- 6 Service-proven "3-Point-Support" on wheel web:
 - Parallel friction faces for constant friction performance and wear behavior
 - Compatibility to existing wheels
 - Fits to standard KB interface

Wheel-mounted brake discs

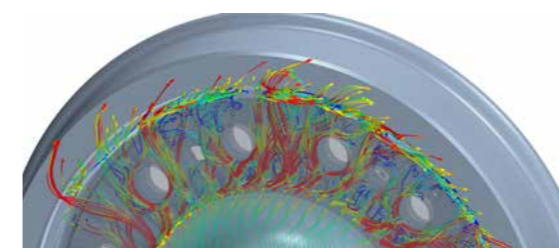


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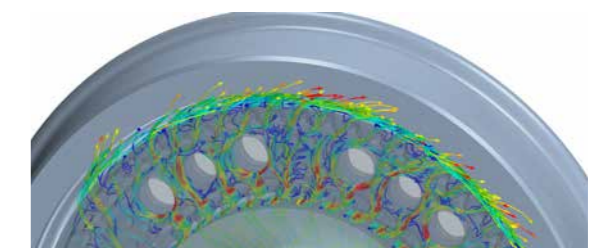
PRODISC ULTRADISC LIGHTDISC



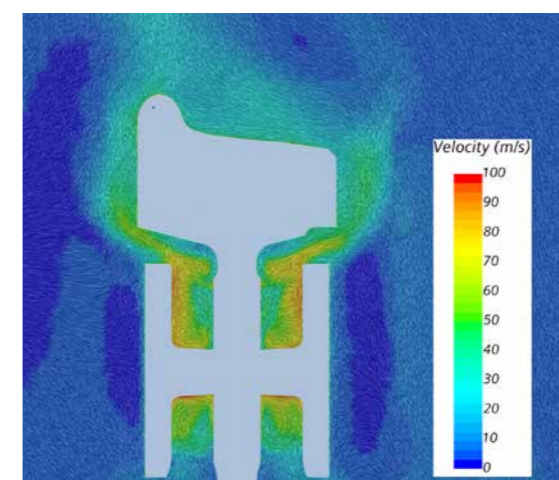
Reduced air flow and air velocity in between wheel body and brake disc without sacrificing structural and thermal performance



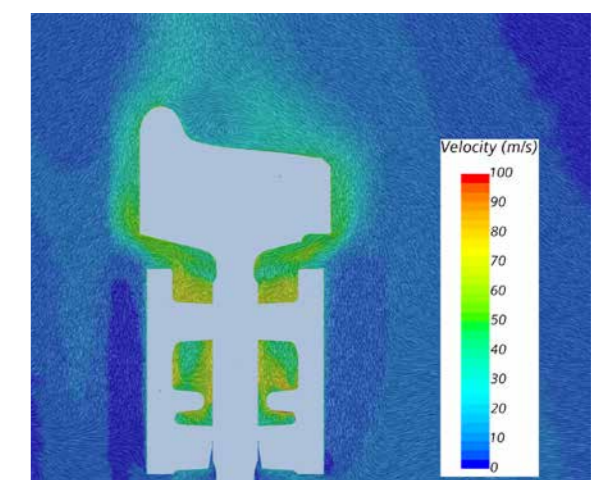
Established KB wheel-mounted brake disc design



Wheel-mounted brake disc with reduced ventilation loss



High air flow due to radial fins + high cross section



Reduced air flow due to pins + control fin

UltraDisc Wheel Eco: Innovative wheel mounted brake disc with minimized ventilation loss

- 1 Bolting domes for fastening with 12 waisted bolts and lock nuts (KB standard interface)
- 2 Optimized fin design to reduce air flow
- 3 Centering domes for slide key centering at 6 places
- Same structural and thermal performance as KB standard design & compatible with established KB interface
- Wheel-mounted brake disc with reduced ventilation loss of up to -70%
- Significantly contributes to train energy saving – Example calculation for high-speed train applications

Annual mileage:
700.000 km



Energy Saving per train and year:
1.2 Tera Joule



Route profile:
1300 km (¼ high speed – 320 km/h,
¾ conventional – 180 km/h)



Equivalent to annual electricity consumption of ~100 households



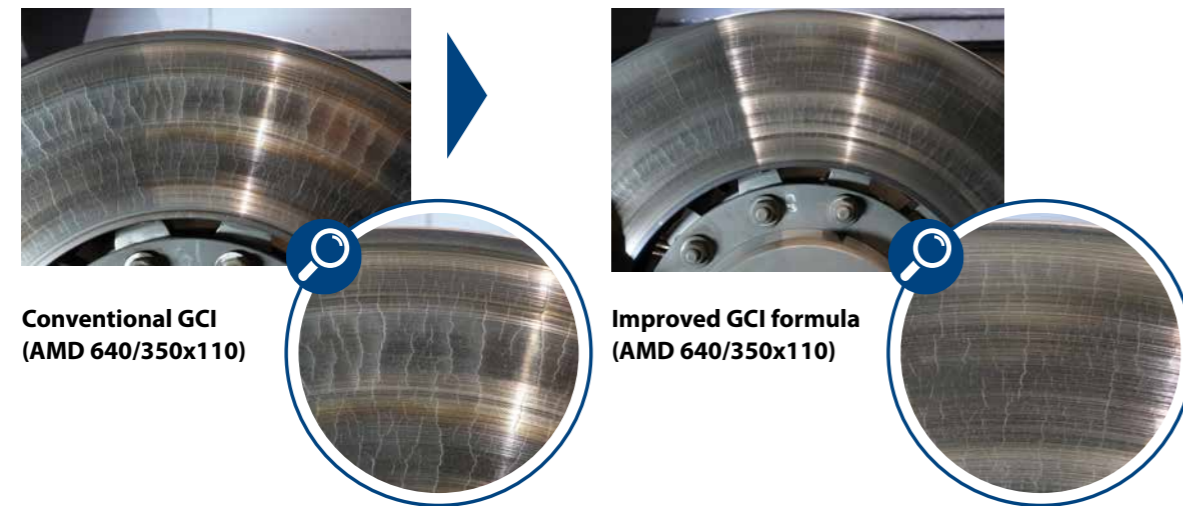
Wheel mounted brake discs per trainset: **64**

Reduced ventilation losses per disc and round-trip:
35 MJ

Advanced materials for brake discs



PRODISC ULTRADISC LIGHTDISC



Conventional GCI (AMD 640/350x110)

Improved GCI formula (AMD 640/350x110)

High performance grey cast iron brake disc for applications with increased thermal load

- Grey cast iron material with improved material properties
- Higher thermal resilience
- Higher resistance to surface cracks
- Increase application range with high performance grey cast iron
- Applicable for axle-mounted and wheel-mounted brake discs

Advanced materials for brake discs



PRODISC ULTRADISC LIGHTDISC

High performance aluminum alloy brake disc for weight reduction of railway vehicles

- 1 Brake disc surface after fatigue test
 - 2 UltraPad Flex pad friction surface after fatigue test
 - 3 Dismantled bolts after fatigue test
 - 4 Thermography of disc during fatigue test
- Weight reduction of ~70 kg in relation to a standard steel wheel-mounted brake disc
 - Energy savings due to reduced weight (particularly significant in the case of a metro application)
 - Fatigue tests for Chinese-standard regional commuter application up to 200 km/h revealed no cracks, good surface status, good bolt fixation and stable friction coefficient

System, Testing & Friction Pairing Excellence

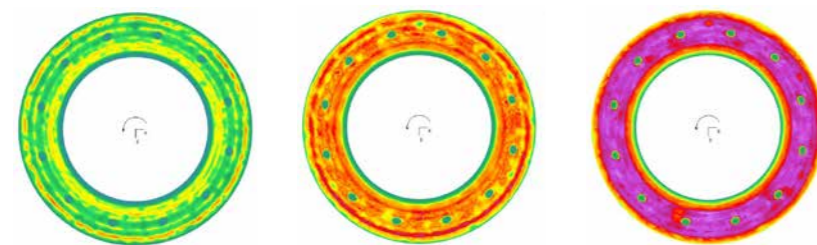


One of the most advanced testing facilities worldwide allows Knorr-Bremse to close up the cycle for every customer application with the assurance that the most reliable braking system has been designed for our customers. Knorr-Bremse's holistic approach as a system supplier puts the customer specific applications into the focus. This expertise culminates in the ability to optimize life-cycle costs of friction pairs and creating value-add for customers by:

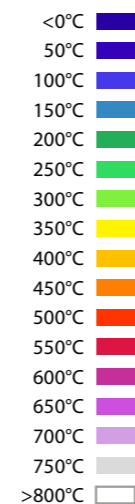
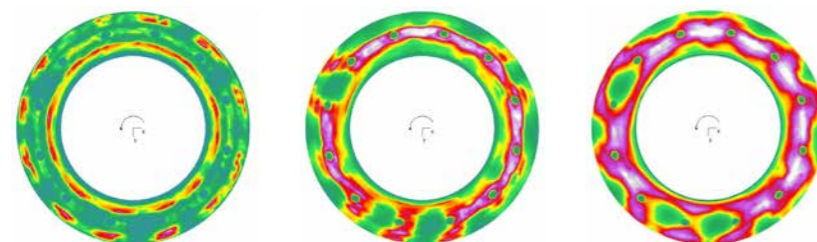
- Optimizing pad design (flexible vs. rigid design) and wear volume (KRS shape)
- Optimizing heat flow and heat distribution on friction surface of disc and pad
- Optimizing cooling performance of brake disc and brake pad
- Avoiding hot spots on friction surfaces

Thermographic investigation of friction pair with state-of-the-art testing equipment in the Knorr-Bremse technology center:

UltraPad Flex



Competitor's rigid sinter pad



speed →

System, Testing & Friction Pairing Excellence

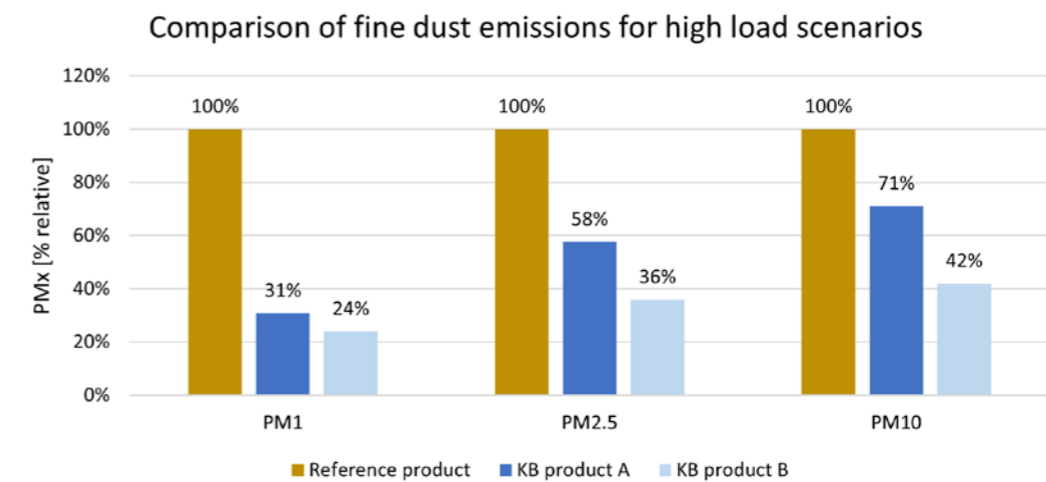


Environmental and sustainability aspects as part of friction pairing excellence

Particulate matter emissions from the friction pair have become and will become of crucial importance for many municipal and federal railway operators in near future. Knorr-Bremse takes environmental protection and health safety issues in that regard seriously and addresses this by:

- The ability to measure particulate matter emission from the friction couple during dynamometer testing of any application
- Continuously contributing to the preparation of industry standards for particulate matter emission measurements
- Putting the reduction of particulate matter emissions to the heart of future friction pair combinations (brake pads and brake discs / brake blocks and wheels)

Comparison of particulate matter emission for different brake pads and particle sizes for a generic EMU application:



Production Excellence

With one of the biggest production footprints, Knorr-Bremse assures supply chain excellence. Our facilities are equipped with state-of-the-art production technology to ensure high-quality and reliable products.



Knorr-Bremse Berlin (Germany)

- Manufacturing since 1996
- **Products:** Axle- and wheel-mounted discs for all types of rail vehicles



Knorr-Bremse Suzhou (China)

- Manufacturing since 2005
- **Products:** Axle- and wheel-mounted discs for EMUs/DMUs and locomotives



Knorr-Bremse Palwal (India)

- Manufacturing since 2014
- **Products:** Axle- and wheel-mounted discs



New York Air Brake, Watertown (USA)

- Manufacturing since 2024
- **Products:** Axle- and wheel-mounted discs

References (extract)

Knorr-Bremse delivers brake discs all over the world with local sales teams

