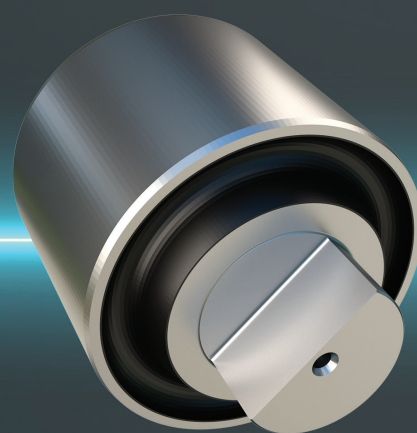


# Hydraulic axle guide bearing



A man and a woman are sitting in a train, looking out the window and smiling. The man is on the left, wearing a light-colored shirt, and the woman is on the right, wearing a light blue top. They are both looking towards the right side of the frame, where the window is. The lighting is warm and soft, suggesting a pleasant atmosphere.

# Quality, innovation, bespoke.

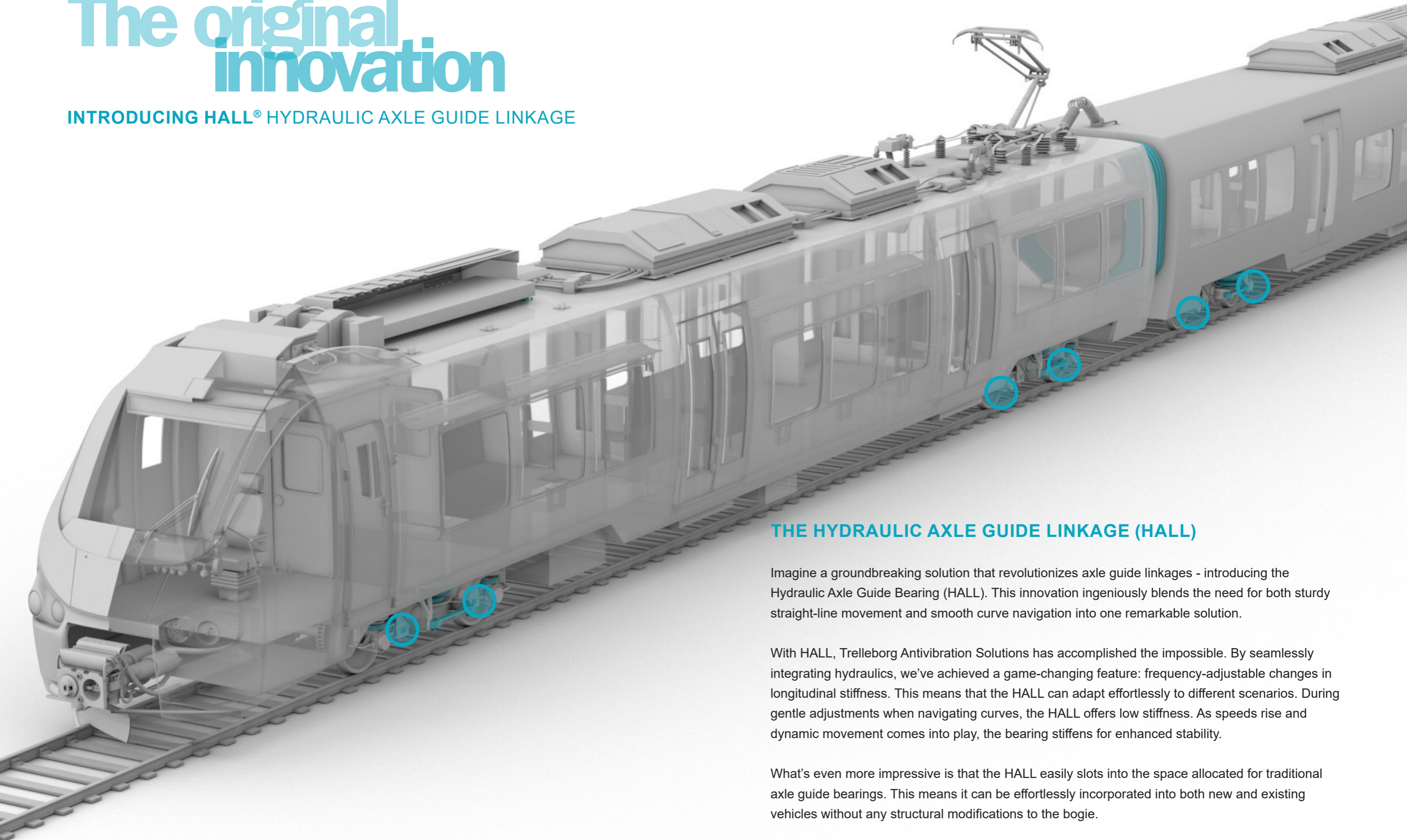
## EMBARKING ON A NEW RAIL FRONTIER OF COMFORT AND SAFETY

Experience a new era in rail innovation with Trelleborg's Antivibration Solutions. As rail networks grapple with overcrowding and evolving commuter patterns, Trelleborg's polymer engineering expertise offers groundbreaking solutions. Our century of experience transforms noise and vibration issues into enhanced passenger comfort and equipment protection. We collaborate closely with industry stakeholders to deliver bespoke solutions, from suspension systems to powertrains, all designed, developed, and tested in IRIS approved facilities. Our excellence is evident in compliance, innovation, and reduced maintenance, reflecting in improved safety and brand reputation. Trelleborg redefines rail travel by harmonizing tradition with cutting-edge advancements, promising a journey that is not just defined, but elevated.

Welcome to the frontline of rail innovation, welcome to Trelleborg.

# The original innovation

INTRODUCING HALL® HYDRAULIC AXLE GUIDE LINKAGE



## THE HYDRAULIC AXLE GUIDE LINKAGE (HALL)

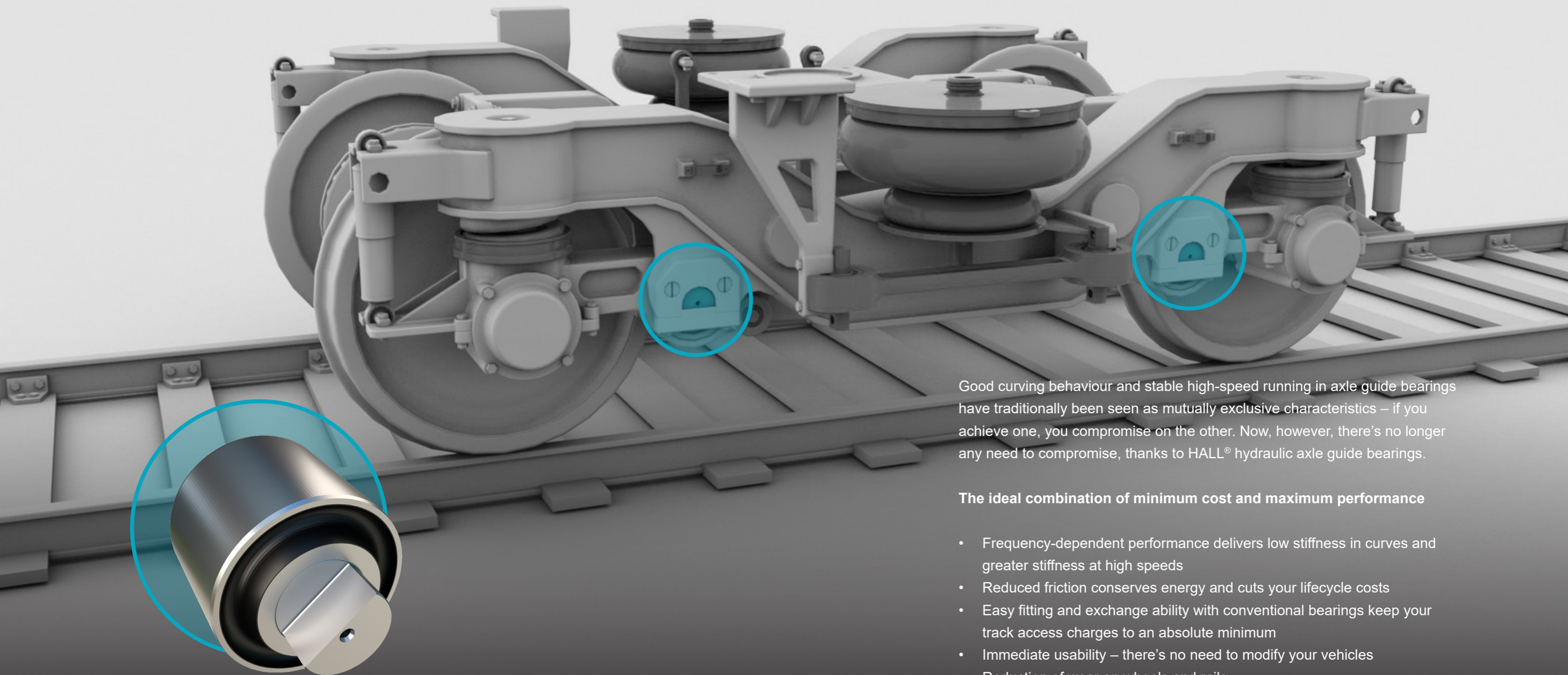
Imagine a groundbreaking solution that revolutionizes axle guide linkages - introducing the Hydraulic Axle Guide Bearing (HALL). This innovation ingeniously blends the need for both sturdy straight-line movement and smooth curve navigation into one remarkable solution.

With HALL, Trelleborg Antivibration Solutions has accomplished the impossible. By seamlessly integrating hydraulics, we've achieved a game-changing feature: frequency-adjustable changes in longitudinal stiffness. This means that the HALL can adapt effortlessly to different scenarios. During gentle adjustments when navigating curves, the HALL offers low stiffness. As speeds rise and dynamic movement comes into play, the bearing stiffens for enhanced stability.

What's even more impressive is that the HALL easily slots into the space allocated for traditional axle guide bearings. This means it can be effortlessly incorporated into both new and existing vehicles without any structural modifications to the bogie.

# Achieve the optimum linkage profile

INTRODUCING HALL® HYDRAULIC ELASTOMERS



Good curving behaviour and stable high-speed running in axle guide bearings have traditionally been seen as mutually exclusive characteristics – if you achieve one, you compromise on the other. Now, however, there's no longer any need to compromise, thanks to HALL® hydraulic axle guide bearings.

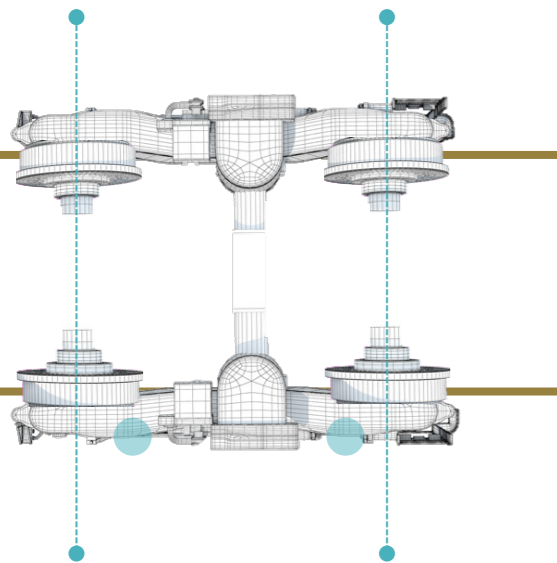
#### The ideal combination of minimum cost and maximum performance

- Frequency-dependent performance delivers low stiffness in curves and greater stiffness at high speeds
- Reduced friction conserves energy and cuts your lifecycle costs
- Easy fitting and exchange ability with conventional bearings keep your track access charges to an absolute minimum
- Immediate usability – there's no need to modify your vehicles
- Reduction of wear on wheels and rails
- Greater protection of vehicles and platforms

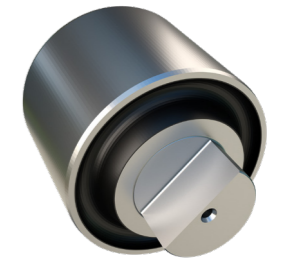
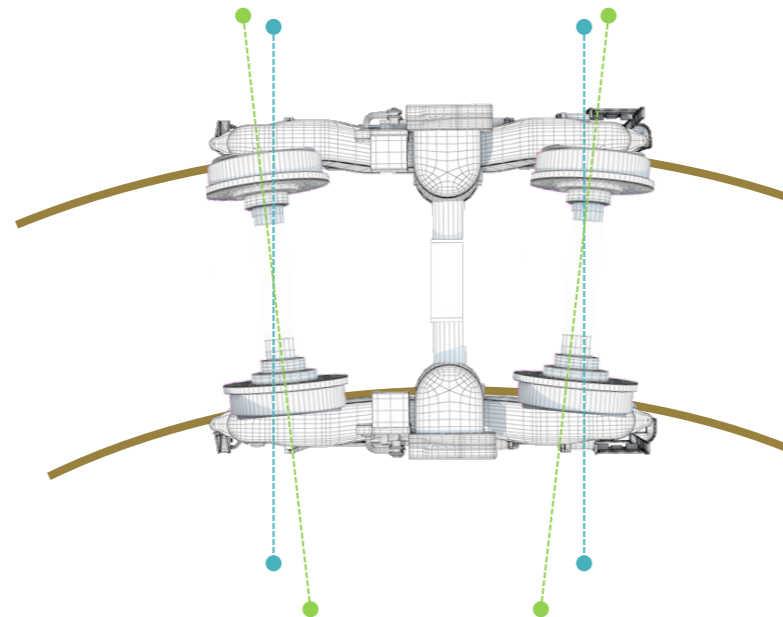
With HALL®, you can combine the low longitudinal stiffness for curves with the high longitudinal stiffness for movement in a straight line in a single component. The hydraulics integrated hydraulics lead to frequency dependent changes of the longitudinal stiffness.

The hydraulic axle guide bearing can be designed in such a way that a low stiffness is automatically available during steady adjusting movements when entering or exiting a curve. The bearing stiffness increases during dynamic excitation at higher speeds. As the HALL® fits in the existing space for conventional axle guide bearing, it can be integrated in new, as well as existing, vehicles without structural modifications to the bogie.

### HIGH STIFFNESS FOR A SMOOTH RIDE ON STRAIGHT TRACKS



### LOW STIFFNESS ON CURVED TRACKS ALLOWING THE WHEELS TO ADJUST



Various designs of HALL with partially significant different requirements and properties are in use and further designs are under development at present.

Article no.	Outside- $\phi$ [mm]	Stud- $\phi$ [mm]	Width / total width	Stiffness longitudinal static / dynamic	Stiffness transvers	Application
HB 02001 001	190	85	150 / 270	Cx.stat = 7 kN/mm Cx.dyn > 25 kN/mm	Cy = 5 kN/mm	CH since 2003 UK since 2009
HB 02002 001 (32.10266)	190	85	150 / 237	Cx.stat = 3,8 kN/mm Cx.dyn > 25 kN/mm	Cy = 9,5 kN/mm	UK since 2011
HB 02003 001 (32.10259)	190	85	150 / 237	Cx.stat = 2,8 kN/mm Cx.dyn > 15 kN/mm	Cy = 8 kN/mm	UK since 2011
32.10247	190	85	150 / 270	Cx.stat = 3,5 kN/mm Cx.dyn > 25 kN/mm	Cy = 8,5 kN/mm	CH since 2012
HB 2007 001	160	66	110 / 240	Cx.stat = 4 kN/mm Cx.dyn > 23 kN/mm	Cy = 10 kN/mm	Prototype
HB 2004 001	140	53	148 / 222	Cx.stat = 6 kN/mm Cx.dyn > 25 kN/mm	Cy = 5 kN/mm	Prototype
HB 2008 001 (32.10332)	140	50	140 / 226	Cx.stat = 4,5 kN/mm Cx.dyn > 20 kN/mm	Cy = 6 kN/mm	Prototype

## 1.1 MILLION MILES WITHOUT LOSING PERFORMANCE

In a recent customer test, HALL® hydraulic axle guide bearings were shown to continue delivering the optimum combination of outstanding curving behavior and stable high-speed running, even after 1.1 million miles.



## PROTECTING THE ESSENTIAL THROUGH ENERGY SAVINGS IN RAIL INFRASTRUCTURE:

### **A Vital Focus on Infrastructure Sustainability**

Within the realm of railway operations, the maintenance of infrastructure stands out as a substantial component of the overall cost structure. In recent times, the escalation of axle loads, amplified speeds, and the heightened demand for enhanced axle control stiffness have contributed to an exacerbation of these maintenance expenses.

### **Pioneering Sustainability Efforts**

A turning point has emerged through extensive research efforts conducted in the United Kingdom and Sweden. These studies delved deeply into the intricate interplay between vehicle characteristics and the wear experienced by both wheels and rails. The outcome of these endeavors has been the formulation of innovative fee models for track access. Notably, these models foster a sustainable ethos by placing emphasis on adaptable axle control, thereby leading to a reduction in access fees.

### **A Paradigm Shift in Measurement**

Advancements in measurement techniques have brought about a transformational understanding. The application of HALL® technology to secure measurements within vehicles has yielded remarkable insights. Specifically, a significant regression in wear and rolling contact fatigue (RCF) in both wheels and rails has been observed, underscoring the potential of sustainable practices to mitigate infrastructure wear.

### **Incorporating Sustainability through Energy-Saving Initiatives**

As we navigate the future of rail operations, integrating sustainability through energy-saving measures has emerged as a critical consideration. The correlation between flexible axle control and diminished fees is indicative of a broader shift toward environmentally conscious practices. This not only reduces operational costs but also aligns the railway industry with a path toward long-term sustainability.

**Trelleborg - on the frontline of sustainability**

# Protecting the essential

**SUSTAINABLE RAIL SOLUTIONS**



Trelleborg Antivibration Solutions (AVS) - Leading the Frontier of Innovation in Noise and Vibration Control. With our advanced polymer technology and expertise in rubber-to-metal bonding, we're pioneers in combating noise and vibration. As part of Trelleborg Group's Industrial Solutions, we bring over a century of excellence to various sectors like rail, marine, and industrial. Our focus is on crafting isolation, attenuation, and suspension solutions that redefine quality and reliability. Our new value proposition, "The Frontline of Innovation," signifies our commitment to pushing polymer technology's limits. We enhance comfort, safety, and efficiency while extending product life and optimizing costs. Join us at Trelleborg AVS for innovation-driven excellence.



Website



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