



Genuine Remanufacturing

READY FOR ROUND TWO

KNORR-BREMSE







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Knorr-Bremse – experts in safety-critical technology

It's best left to Knorr-Bremse

Industrial remanufacturing of safety-related parts is a job that should only be entrusted to expert and reliable partners. Thanks to the high quality of remanufactured products from Knorr-Bremse, customers are protected against potential safety hazards. Because after hundreds of thousands of miles on the road, it takes highly specialized know-how and technology to get components like a Mechatronic Brake Control Module back in tip-top condition and ready for their second life cycle. Only a manufacturer with specialist know-how can determine exactly the residual performance of the re-used components. And only a manufacturer with specialist technology can ensure that second-life products conform to premium quality standards. As an original equipment manufacturer and supplier of original parts, Knorr-Bremse offers all this and much more, including:

- ▶ Engineering expertise acquired in millions of kilometers of testing, both simulated and driven – on test benches, test tracks and public roads
- ▶ Experience from fatigue testing in temperatures ranging from minus 40 to plus 80 degrees Celsius
- ▶ Each individual component of the product is remanufactured to precise specifications
- ▶ Extensive range of high-tech machinery

Knorr-Bremse has been developing and manufacturing brake systems and other safety-critical vehicle components for more than 100 years. To date, these components have been fitted in more than 30 million vehicles. The company also has more than 60 years' experience as a component remanufacturer. All this means that today, industrial remanufacturing is a routine part of Knorr-Bremse's business, while our range of remanufactured products is expanding all the time.

PRODUCT OFFERING DEPENDING ON VEHICLE AGE



Life cycle – value-based repair solutions for older vehicles

At the later stages in a vehicle's life cycle, it may not always make sense to exchange a faulty part for a brand-new one.

Fortunately there's an alternative: industrially remanufactured parts, which offer the following key advantages:

- ▶ Identical functionality to newly manufactured original parts
- ▶ Cost-effective
- ▶ Full statutory warranty period
- ▶ Environmentally friendly and resource-efficient

What is industrial remanufacturing?

Industrial remanufacturing is very much like assembling new parts, except that many of the components are taken from used parts. A remanufactured part has the following key features, according to a definition endorsed by organizations such as APRA, CLEPA, VDA and others: A remanufactured part fulfills a function which is at least equivalent compared to the original part. It is restored from an existing part (core), using standardized industrial processes in line with specific technical specifications. A remanufactured part is given the same warranty as a new part and it clearly identifies the part as a remanufactured part and states the remanufacturer.

More than just an ordinary repair

In an ordinary repair, the workshop dismantles the product only to the point where it is possible to carry out the necessary repair or replacement of the faulty individual component in order to get the vehicle up and running again. The warranty on such repairs applies only to the new parts and labor rendered. Industrial remanufacturing, on the other hand, goes much further. The used product is completely disassembled, wear parts are disposed of and all the remaining parts are cleaned, inspected and if necessary reconditioned, in compliance with industry process standards. The subsequent reassembly and quality assurance processes are the same as for a newly manufactured product. Industrially remanufactured products are therefore backed by a full statutory warranty.

Good for the environment

Industrial remanufacturing is the most efficient form of recycling. Compared to new manufacturing, it saves on resources, energy and above all CO₂ emissions. Numerous research studies show that CO₂ emissions for the entire remanufacturing process – including return of used products, dismantling, cleaning and reconditioning – are reduced by approximately 75 percent.







The remanufacturing process at a glance



Return of used products, disassembly, cleaning, reconditioning and reassembly – plus continuous quality testing every step of the way.



Return of used products

The remanufacturing process starts with the collection and return of used products. Knorr-Bremse uses its existing aftermarket logistics network for this purpose, so there are no additional transport efforts. As an incentive, customers receive a deposit back when they return used parts to the manufacturing loop. As far as the customer is concerned, this marks the last step in the product's life cycle. For Knorr-Bremse on the other hand, the end of one life cycle marks the beginning of the next.



Disassembly

Disassembly of used components is very difficult to automate. To take just one example, the two-channel pressure modulator of an electronic braking system consists of 80 individual subcomponents. Following disassembly, wear parts are disposed of in accordance with proper environmental procedures, while housings, brackets, covers and electronic control units are inspected and cleaned. Knorr-Bremse checks the condition of every component against precisely defined specifications. Only in this way can the component's condition be accurately evaluated.

Mechatronic and electronic components require particularly careful handling. For this purpose ESD work stations are used, where the components can be handled in an electrostatic discharge-protected environment.



Cleaning

To clean products that have been on the road for hundreds of thousands of miles, Knorr-Bremse uses a wide range of high-tech facilities, including spray washing systems, pyrolysis equipment – to burn off old paint coatings etc. – blasting systems utilizing a variety of media, and ultrasonic cleaning baths. Between them, these cleaning processes soon get used parts restored to their original shine.



Reconditioning

Some parts require reconditioning before they are reassembled. For example compressor piston bores must be re-honed and their precise dimensional tolerances restored, to minimize oil carryover during the product's second life. Faulty electronic components meanwhile must be swapped and replacement units soldered into place. Software

must be upgraded, while at all times closely checking the compatibility of different software and product versions.



Reassembly and testing

The industrial remanufacturing process at Knorr-Bremse concludes with final reassembly, the last step in ensuring a premium-quality product. Here, exactly the same processes are followed as for newly manufactured original parts. In some cases the work is even carried out on the same assembly lines. End-of-line testing provides the final proof of quality. For an EBS pressure control module, for example, more than 90 individual testing and measuring steps are performed per product. In the case of an Electronic Air Control (EAC) system, more than 100 such operations are performed. And only Knorr-Bremse knows the precise tolerances to which a product must conform in order to pass the end-of-line test.



SPRING BRAKE ACTUATORS



EBS COMPONENTS

- ▶ One and Two-Channel Pressure Modulators
- ▶ Foot Brake Modulators
- ▶ Trailer Control Modules



OIL SEPARATOR CARTRIDGE (OSC)



COMPRESSORS

- ▶ Single and Twin Cylinder
- ▶ Splitblock and Monoblock Variants



ELECTRONIC AIR CONTROL (EAC)

An extensive and growing portfolio

The Knorr-Bremse range of industrially remanufactured parts already comprises well over 300 individual products. By 2018, Knorr-Bremse aims to be offering industrial remanufacturing for the majority of its products – with no compromises on quality and safety.

Industrially remanufactured products can be distinguished from newly manufactured original parts by their special labeling. Some products may also show some cosmetic signs of use, which in no way affect the functionality of the product.

Compressors

The Knorr-Bremse remanufactured compressor portfolio comprises:

- ▶ Single and Twin-Cylinder Models
- ▶ Splitblock and Monoblock Variants

Electronic Braking System (EBS) modules

EBS from Knorr-Bremse controls vehicle dynamics functions like ABS, ASR and ESP. The remanufacturing portfolio includes:

- ▶ One and Two-Channel Pressure Modulators
- ▶ Trailer Control Modules
- ▶ Foot Brake Modulators

Electronic Air Control (EAC)

EAC uses regeneration and pressure regulation to ensure intelligent and active compressed air management.

Spring Brake Actuators

Spring Brake Actuators offer both service and parking brake functionality. Knorr-Bremse supplies a wide range of remanufactured K2 Actuators.

Oil Separator Cartridge (OSC)

The OSC filters out oil before drying the air and thereby ensures highest protection of the pneumatic braking system. The OSC is available for all spin-on cartridge types.



A full service – from the original manufacturer

Knorr-Bremse premium quality is not confined to the product alone. As an original parts manufacturer the company also provides full-line services for all its products including:

- ▶ Telephone hotline
- ▶ Online catalogue and ordering system
- ▶ Detailed technical documentation
- ▶ Diagnostic system
- ▶ Comprehensive training courses
- ▶ Knorr-Bremse service center concept
- ▶ Full service workshop concept: Alltrucks, a joint venture of Knorr-Bremse, Bosch and ZF

Knorr-Bremse is ready to support distributors, workshops as well as vehicle and fleet operators at all times.

Thinking in services – needs-driven, safe and reliable.



Your benefits

The Knorr-Bremse Remanufacturing Portfolio of industrially remanufactured products offers the following key advantages:

- ▶ Thanks to the high quality of remanufactured products from Knorr-Bremse, customers are protected against potential safety hazards
- ▶ Parts are functionally equivalent to newly manufactured original parts
- ▶ Identical production processes as for newly-manufactured original parts
- ▶ Identical quality assurance testing as for newly-manufactured original parts
- ▶ Full statutory warranty period
- ▶ Cost-efficient alternative for value-based repair
- ▶ Resource-efficient and eco friendly

The Knorr-Bremse remanufacturing process is based on:

- ▶ Robust, certified processes
- ▶ High-tech machinery, for example for parts cleaning and reconditioning
- ▶ Test procedures specifically designed to ensure that products conform to high standards of functional quality

Knorr-Bremse's industrially remanufactured products offer advantages that only a premium original parts manufacturer can deliver:

- ▶ All products conform to exact specifications
- ▶ Products incorporate exclusive know-how from experience in the field and extensive testing in product development and series production
- ▶ More than 60 years' experience in industrial remanufacturing
- ▶ Extensive product-related services – for both new and industrially remanufactured products

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