

**Multifunctional axle-mounted sensors
for train control systems**



Improving train safety and planning of maintenance intervals

To ensure efficient train control and optimised maintenance, a variety of measured parameters must be acquired on the bogie.

Axis encoders from Lenord + Bauer are multifunctional all-rounders that - in addition to rotational speed - can also output temperature, rotation angle, vibrations and mileage.

In rail traffic, safety and availability are important factors besides speed and punctuality. For this reason, wheel slide protection, traction monitoring and train control systems are part of the technical standard for rail vehicles.

Particularly the bogie includes many safety-relevant components. The available space, however, is limited. Thus, it stands to reason to simultaneously acquire different measured parameters with one sensor system.

Multichannel axis encoders for speed acquisition

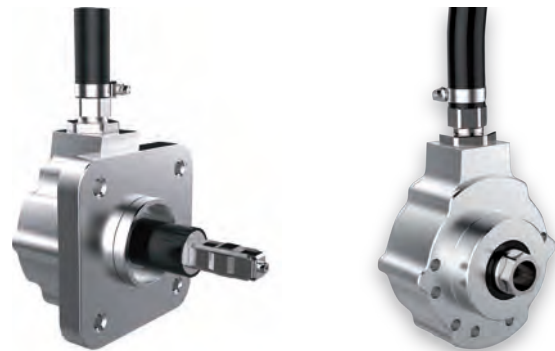
Axis encoders from Lenord + Bauer present a fail-safe and cost-effective solution, especially for use in harsh ambient conditions:

The magnetic measuring system outputs the rotational speed of the wheel set on maximum 8 channels with a resolution of up to 800 pulses/revolution. Up to four independently working systems - upon request electrically isolated - can be integrated in a compact housing. The axis encoders have even more to offer.

Multifunctional axle-mounted sensors for high availability

Lenord + Bauer is able to integrate additional sensors in the ultra compact housing of the axis encoder. In addition to rotational speed and rotation angle, this allows you to acquire temperatures, operating hours, mileage or vibrations on the axle.

These measurement data provide optimum adaptation of maintenance intervals to the actual bogie wear.



Your advantages at a glance:

■ Multifunctional

One single axle-mounted sensor supplies measurement data for rotational speed, rotation angle, temperature, mileage or operating hours in one housing. This saves space as well as cabling, and makes mounting much easier!

■ Efficient

Optimise your maintenance intervals. The independently working measuring systems provide your train control systems with information on hot axle boxes, wheel flats or cable breaks.

■ Individually configurable

Do you need a specific housing design? A certain cable or special connector? No problem. Talk to our experts!



Multifunctional axle-mounted sensors: Signal variety for more safety and economic efficiency

Do you want to make optimal use of the limited space on the wheel axle? We would be happy to individually tailor the axle-mounted sensor to your application!

Today, the safety-relevant parts of a bogie are replaced after a specific mileage. This, however, contradicts the economic aspects and is no substitute for continuous vehicle monitoring.

The multifunctional axle-mounted sensors from Lenord + Bauer offer a solution that is both accurate and compact.

Improving train safety and simultaneously planning of maintenance intervals

Axle-mounted sensors provide several independent rotational speed and rotation angle signals for wheel slide protection, train control and secondary applications. At the same time, they also acquire excessive temperatures, shock loads, mileage and operating hours. These measurement data provide your train control system with concrete information on the actual bogie wear. Here some examples:

- Temperature monitoring integrated in the sensor housing delivers information on hot axle boxes.
- Wheel flats can be detected by means of reoccurring shock events in relation to the absolute position of the wheel axle.
- Even cable breaks can be detected reliably through the output of a standstill voltage.

Variable configuration

On the next page we will introduce our technology portfolio to you. Whether mechanical properties, measuring system or required signal type: It gives us the freedom to respond to your requirements in a flexible manner and individually adapt technical specifications to your train control systems.

Do you need only some of the measurement data described above? No problem. The majority of our axle-mounted sensors are customer-specific solutions, manufactured according to your specifications.

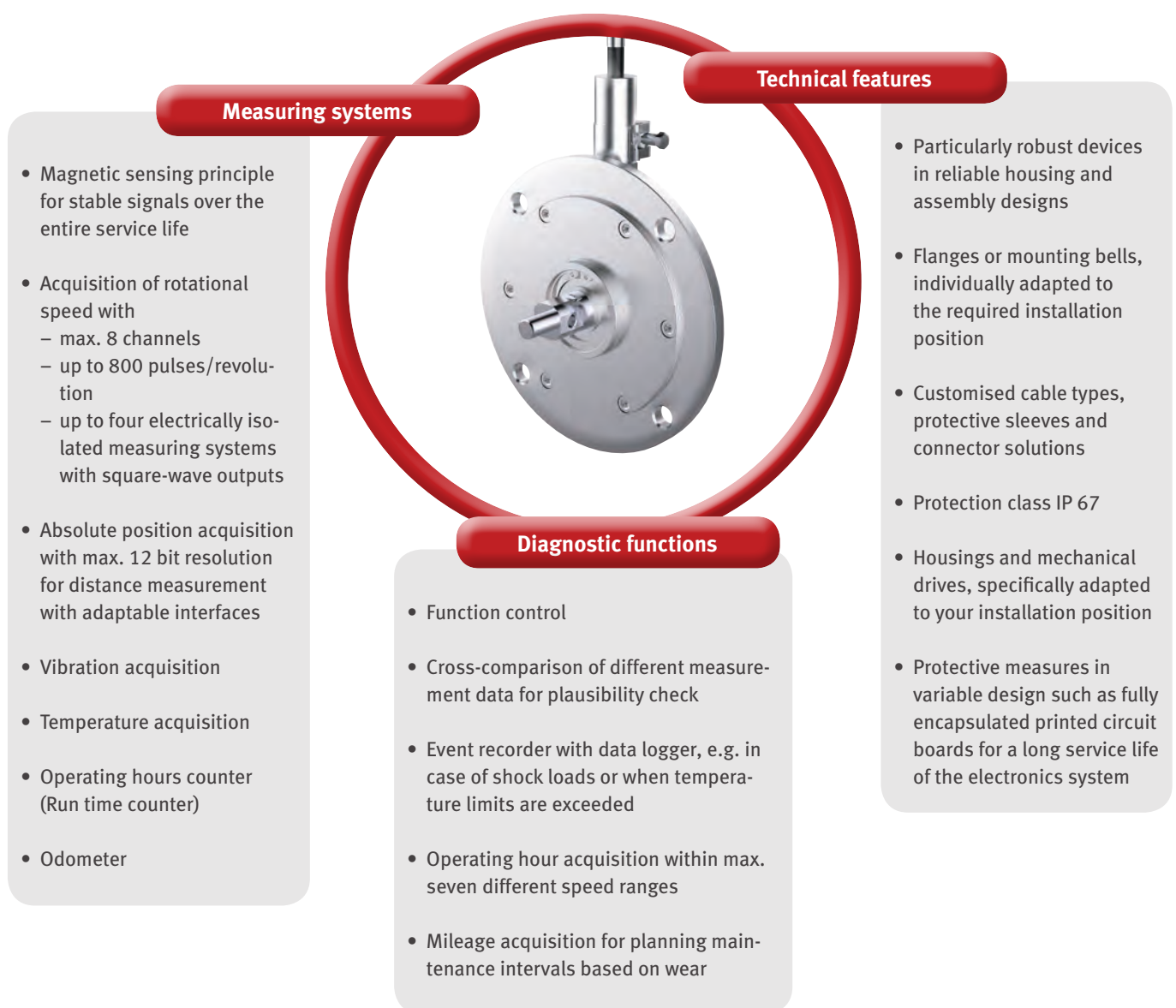
Also ideally suited to replace existing sensors

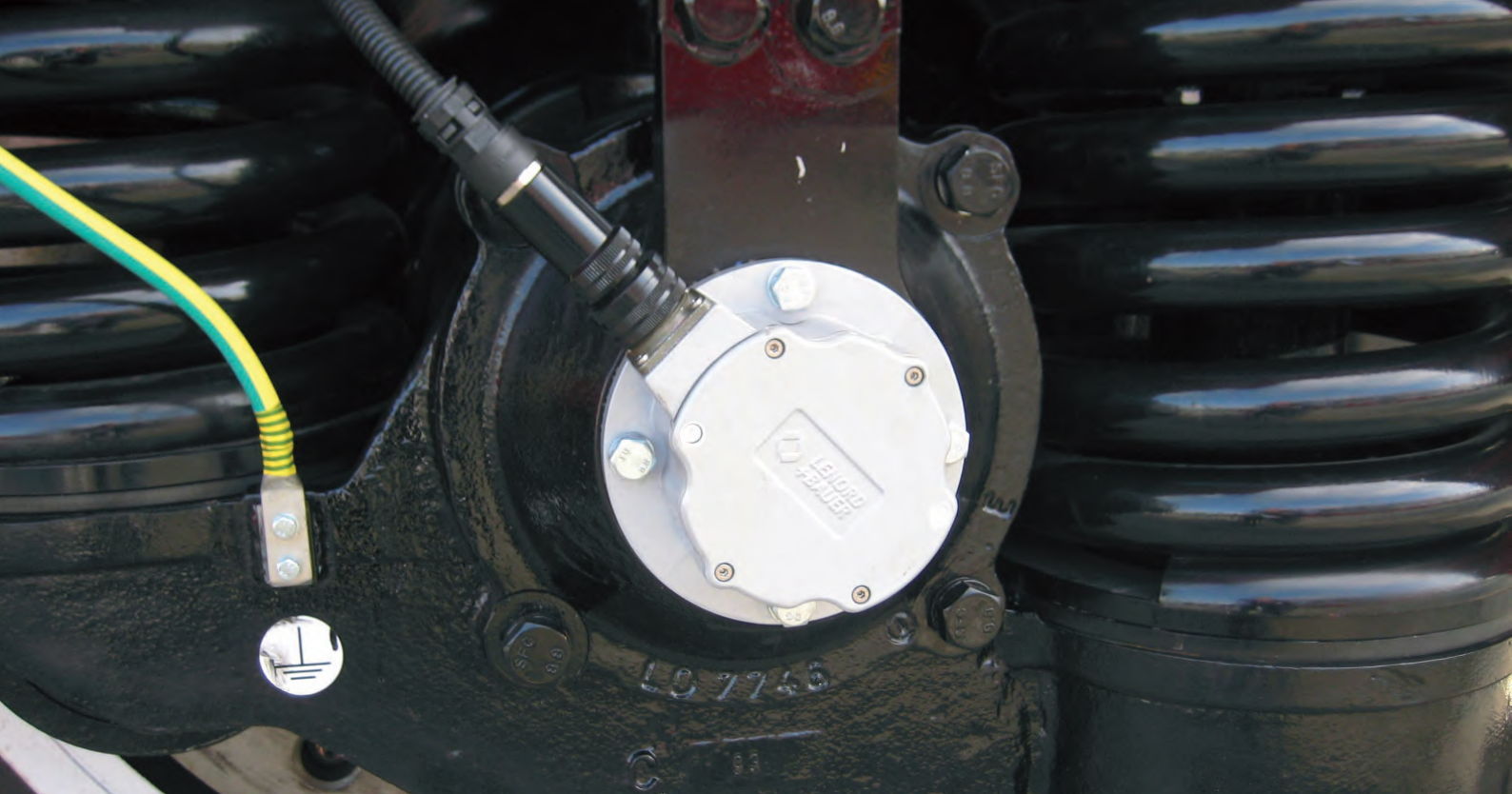
In retrofitting, our multichannel axle-mounted sensors are frequently applied when optical sensors are to be replaced by a significantly more robust magnetic measuring system.

For this purpose, we have developed product variants with housing dimensions already established in the market which offer you - in addition to easy mounting - all the freedom for expanding the existing train control systems.

We individually tailor the axle-mounted sensor to your application

These are the elements of our technology portfolio. The choice is yours. Which measurement signals and mechanical solutions do you need for your application?





Robust axis encoder with long-lasting technique

Multichannel rotary encoder simultaneously outputs up to three different pulse numbers for train control systems

Lenord + Bauer offers special multichannel rotary encoders for wheel slide protection, train control and secondary applications on the bogie. They provide different signals for multiple control electronics, thus unfolding their full potential.

One multichannel rotary encoder for different systems

The sensors provide independent square-wave signals on up to eight channels. These square-wave signals are output by the integrated evaluation electronics with up to three different pulse numbers. Output takes place either in voltage or current levels.

Configuration and output of the channels can be carried out individually or in groups with fixed phase relationship. This allows accurate adjustment of the output signal properties to the control electronics. You will be provided with a solution that is individually tailored to your application.

Robust and durable sensors for harsh operating conditions

The rotary encoders are extremely robust and withstand even extreme impacts and vibrations. The magnetic sensors are resistant to the most severe environmental conditions.

Their operational reliability is resistant to dirt, oil, humidity or condensation due to temperature changes.

The multichannel axis encoders are maintenance-free and durable thanks to the selected and high quality bearings. This minimises the operating costs.

More freedom due to flexible configuration

The multichannel rotary encoders are designed for bogies with outside bearings and are flanged to the bearing cover of the wheel set. Upon your request, we will design and manufacture the mechanical drive.

Due to the flexible configuration, the encoders are ideally suited for new projects as well as for retrofitting. Whether you need a rectangular or round flange, or even an adapter flange, there are no limits to your mechanical requirements.

We will equip your encoder with special cables, protective sleeves and connectors, according to your specifications. This will give you a multichannel rotary encoder that is tailored to your requirements and ready for use.

Contact us so that we can configure your individual multichannel rotary encoder.



Your advantages at a glance:

■ Robust

Thanks to a multi-step encapsulation process and selected components, the rotary encoders withstand even high shock loads and strong vibrations.

■ Reliable

The magnetic measuring system is resistant to oil, dust, humidity and condensation. Even the condensation generated by temperature changes has no influence whatsoever on the measurement data.

■ Individual

Measuring system tailored to your requirements, with variable combination of channels and pulse numbers.

■ Design established on the market

Specifically for mounting on bogies with outside bearings.

Technical data

GEL 2710 / GEL 2712 / GEL 2713	
Features	<ul style="list-style-type: none"> • Up to 8 channels • Simultaneous output of maximal 3 different pulse numbers • Mounting on bogies with outside bearings • Voltage or current output, individually adjustable
Max. resolution per revolution	800
Housing diameter / length of housing edge	155 mm
Output signals	A/B/N $\bar{A}/\bar{B}/\bar{N}$
Signal level	HTL
Protection class	IP 67
Temperature range	-40 °C to +100 °C
Supply voltage	10 to 30 V DC
Housing material	Anodised aluminium
Maximum permitted rotational speed	5000 min ⁻¹



One encoder for different control systems

Reliable acquisition of rotary speed for the various train control systems in city railways and trams

In public passenger transport, the demands of railway operators on the vehicle fleet are very high. Safety, driving comfort, continuous operation and durability of the components play an important role. In addition, the high percentage of low floor area requires extremely compact bogies with inside bearings. The compact multichannel rotary encoders from Bauer + Lenord have been successfully used for decades for this application.

The space-saving all-rounder is quickly mounted

We individually tailor each rotary encoder to your vehicle control. Thus, one single encoder supplies independent output signals, for instance for wheel slide protection, train control and secondary applications. The encoder provides up to three different pulse numbers as incremental signals. A maximum of eight channels can be configured and output. This makes the multichannel rotary encoder a true all-rounder.

Durable and maintenance-free

The rotary encoder is robust and withstands even extreme impacts and vibrations. The magnetic sensors are resistant to harsh environmental conditions such as dirt, oil or humidity. Furthermore, the carefully selected bearings make the rotary encoder particularly durable and maintenance-free. This helps in reducing maintenance costs.



Ready-to-mount sensor solution for your application

Mounting is particularly easy. The rotary encoder is connected to the wheel set via a flange, allowing it to freely rotate. The connection cable fixed to the bogie frame prevents simultaneous rotation of the encoder.

We develop and manufacture the matching flange according to your specifications. The multichannel rotary encoder can also be equipped with a special cable, protective sleeve and connector. This will give you a sensor solution that is tailored to your requirements and ready for use.

Save valuable time during mounting by letting us configure your multichannel rotary encoder for you.



Your advantages at a glance:

■ Robust

Thanks to a multi-step encapsulation process and selected components, the rotary encoders withstand even high shock loads and strong vibrations.

■ Reliable

The magnetic measuring system is resistant to oil, dust, humidity and condensation. Even the condensation generated by temperature changes has no influence whatsoever on the measurement data.

■ Individual

Measuring system tailored to your requirements, with variable combination of channels and pulse numbers.

■ Design established on the market

Also ideal for mounting on rotor flange.

Technical data

GEL 2701	
Features	<ul style="list-style-type: none"> • Up to 8 channels • Simultaneous output of maximal 3 different pulse numbers • For mounting on bogies with inside bearings • Voltage or current output, individually adjustable
Max. resolution per revolution	800
Housing diameter	120 mm
Output signals	A/B/N $\bar{A}/\bar{B}/\bar{N}$
Signal level	HTL
Protection class	IP 67
Temperature range	-40 °C to +100 °C
Supply voltage	10 to 30 V DC
Housing material	Anodised aluminium
Maximum permitted rotational speed	5000 min ⁻¹

Ready to use and 100% tested for all-round safety

Complete systems - Easy mounting and reliable operation!



"Plug and Play" is today not only a matter of course in computer networks. Vehicle manufacturers, machine and plant manufacturers have also discovered the advantages of completely ready to use products. Increasingly they are using components that they can quickly and straightforwardly integrate into their systems.

Your added value – our product with cable and connector

The fabrication of cables and connectors forms part of our core business. Hundreds of completely ready to use products leave our factory every day.



The cables and wires installed are often subject to a wide range of standards, specifically in railway technology. We will gladly assist you in the configuration of your axle-mounted sensor or rotary encoder in terms of the material to be selected, based on the following industrial standards:

- Fire resistance in accordance with DIN 5510, NFF 16-101
- Halogen-free in accordance with DIN EN 50267-2-1
- Flame-retardant in accordance with DIN 50265-2-1 / DIN 50266-2
- Temperature, UV and ozone-resistant
- Characteristics in accordance with UIC specification
- Characteristics in accordance with UL/CSA specification

Tell us about your requirements and we will coordinate with you to determine the right material for your application.

Your advantages at a glance:

■ Flexible

We tailor our products to suit your needs so that they are suitable for your specific application. We promptly prepare technical drawings and functional samples. This allows you to check the new development and test the function in your facility.

■ Proven

Our products are successfully in use worldwide in heavy-duty applications. Profit from our many years of experience and utilise our know-how.

■ Quick

Thanks to our modern logistics and our high added value we can realise customer-specific product modifications in our in-house production at short notice.

Quality and service “Made in Germany”

Guarantor for high reliability

Reliability and efficiency characterise modern components for rail vehicles. For this reason we place particularly high value on high quality components and continuous quality control. This is your guarantee for durable and reliable products.

Our path to excellent quality

For us quality management starts as early as product development and extends as a common theme through all areas of the organisation. Each year we subject our measures to internal and external audits. As such we are certified to DIN EN ISO 9001, ISO 14001 as well as IRIS.



Only tested quality leaves our factory

Final test is a fixed element of our production. Thus, we test concentricity and synchronism of our encoders, their current consumption as well as level, position and strength of the output signals. We save the measurement data of each individual product to ensure long-term access for our customers. Upon request, we also issue test certificates.

Challenge us. Our most important objective is to provide you with a reliable solution for the measurements on your application. We look forward to accepting the challenge!

Your contacts at Lenord + Bauer

For new developments and/or further developments you will find the right contact for your projects in Lenord + Bauer. We offer you our know-how and our support.

Technical support **+49 208 9963 - 215**

Do you have technical questions about our products or need help with commissioning? Our competent support staff will be happy to offer you advice and practical help.

support@lenord.de

Customer Service Center **+49 208 9963 - 216**

You need the products urgently, or you have questions about delivery conditions, repairs or the status of a current order? Our Customer Service Center will be happy to assist you with commercial queries!

kundencenter@lenord.de

Call centre **+49 208 9963 - 0**

Are you looking for a competent contact person or the relevant employee for your topic in our company? Our call center will be happy to assist you!

info@lenord.de



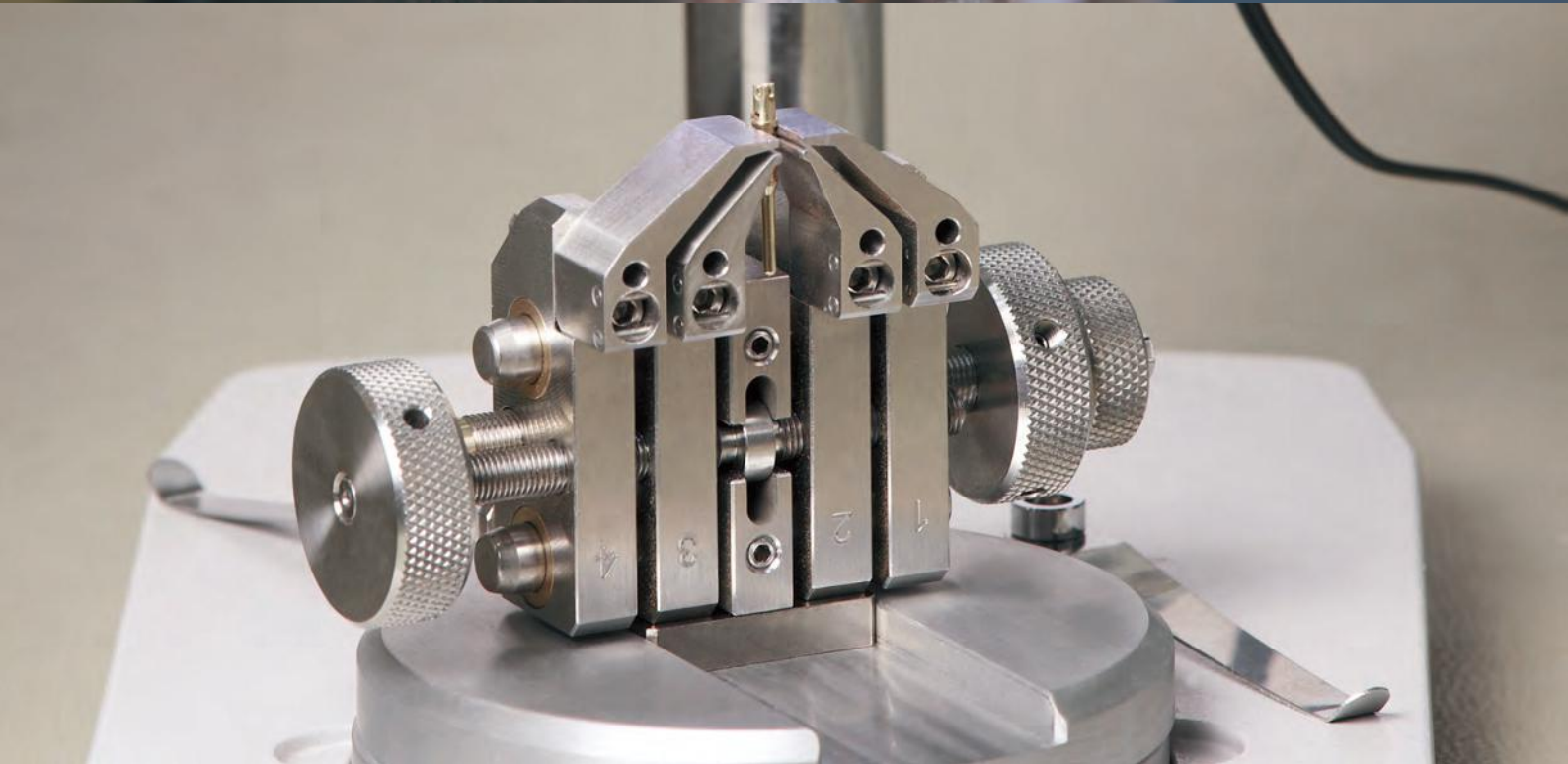
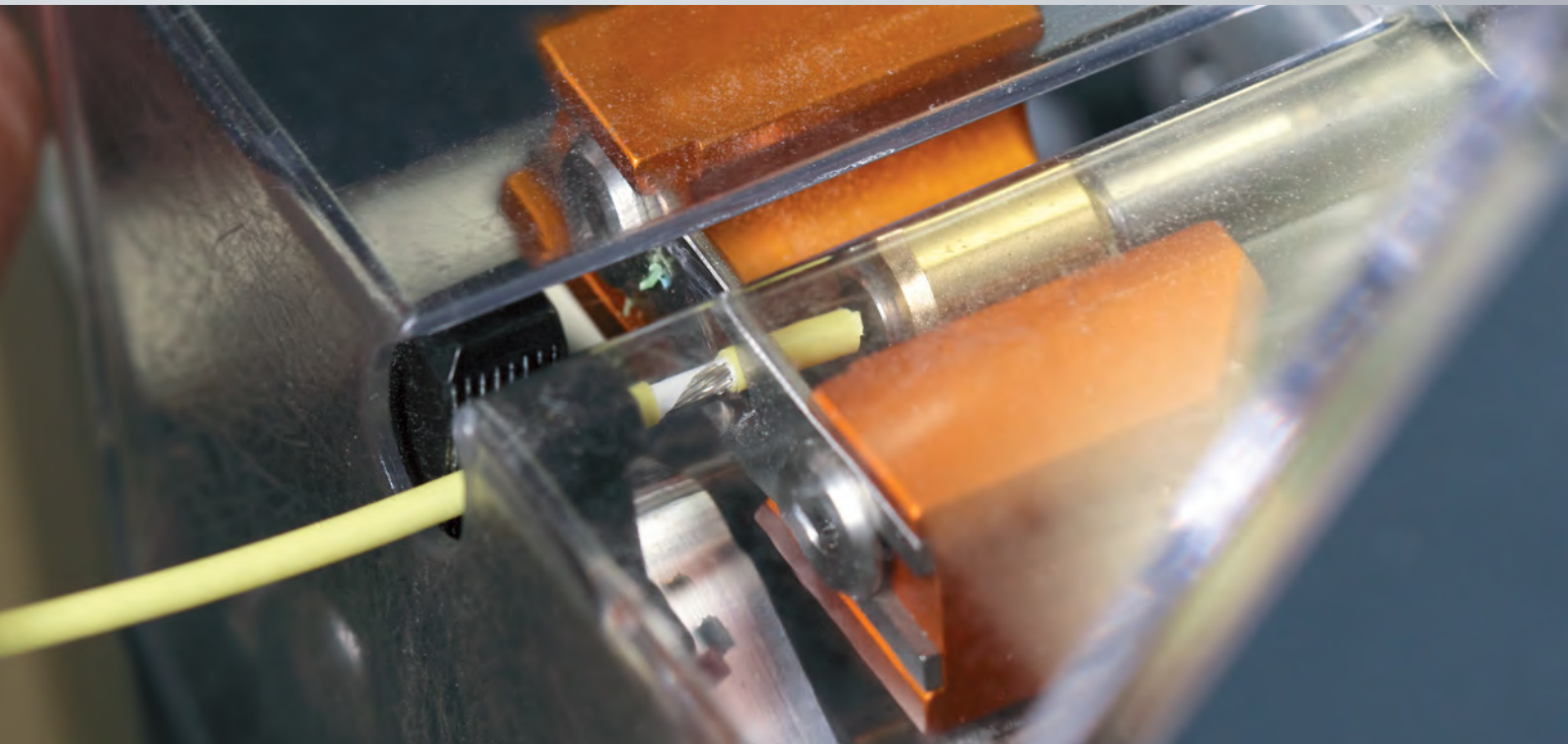
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A company in the **LENORD + BAUER** corporate group



**Tested and ready to use
Quality from a single-source**



100% tested and ready to use for all-round certainty

Quickly assembled and reliable in operation – that is how machine components must be these days! Ready to use components with reliable final test support you!

"Plug and Play" is today not only a matter of course in computer networks. Vehicle manufacturers, machine and plant manufacturers have also discovered the advantages of completely ready to use products. Increasingly they are using components that they can quickly and straightforwardly integrate into their systems.

Your added value – our product with cable and connector

The fabrication of cables and connectors forms part of our core business. Hundreds of completely ready to use products leave our factory every day. From the simple connection cable to the complex hybrid cable, we combine a very wide range of connectors and connection cables in our products.

Irrespective of whether you need an unusual cable, special protective features are required, or you use a particular connector, we equip your product correspondingly.

As a manufacturer of sensor and drive solutions we undertake 100% testing of our devices with cables and connectors in final test and therefore ensure reliable operation. During this process, e.g. as on the MiniCODER, the sensor system is tested using a rotating target wheel. The test results are saved in a database after each test and are therefore available years later. We deliver your product completely ready to use and tested. Just as you want it.

Complete systems – sensor and target wheel

For more than 20 years we have supplied our customers with complete systems comprising a sensor, including ready to use cable and connector, as well as a target wheel. An invaluable advantage for our customers, as they receive a complete system in which the individual components are one hundred-percent matched to each other and tested.

On our highly modern production machines we produce target wheels with inside diameters of up to 500 mm specifically in accordance with your requirements.

For high-speed spindles in machine tools that operate at up to 100,000 revolutions per minute, we manufacture precision target wheels with an H6 internal fit, an axial run-out tolerance of 0.01 mm, as well as a tolerance on the radial run-out of the teeth of 0.015 mm. The quality of the teeth is AAA and corresponds to Q7.

Our experience – your benefit

For almost 50 years, the name Lenord + Bauer has stood for the automation of industrial motion sequences. We develop, produce and market highly integrated sensor and drive systems. As a specialist for customer-specific products we manufacture individual systems in batches from small quantities to thousands of pieces per year.

Our cable fabrication shop is equipped with the latest machinery so that we can flexibly implement customer wishes.

Perfectly fabricated and reliably connected

With our carefully fabricated systems you save assembly costs and increase reliability

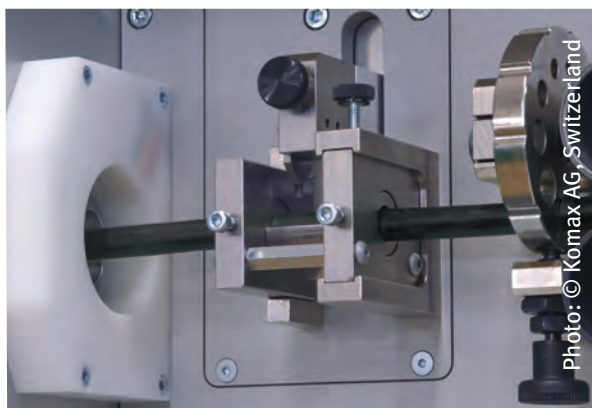
We very consciously rely on a high level of vertical integration and modern production methods. For this reason it is a matter of course for us that we also use technologies and machinery of the latest generation in cable fabrication.

Reel material cut to length precisely and quickly

We have up to 50 different cable drums always ready at hand in the paternoster. We store cable types that are not required so frequently in our modern high-bay warehouse. A high performance automatic unwinder pulls the cables off the reel. The cables are processed fully automatically with partial or complete removal of the insulation.

A highly modern automatic cutting machine processes cables with an outside diameter of up to 15 mm. The cables are pulled off the reels to suit the specific customer and order, cut to length, and then insulation on the individual cores and wires stripped.

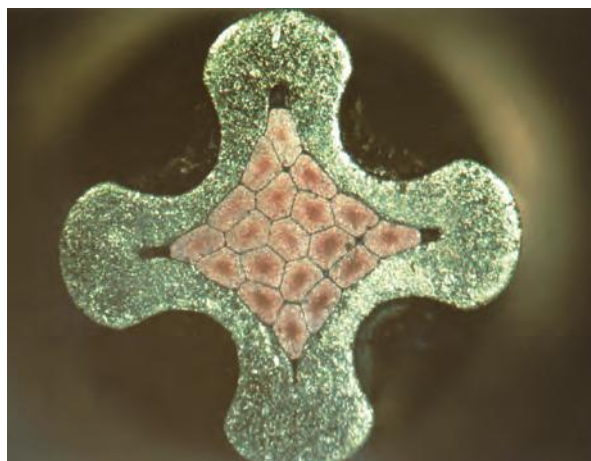
All these actions are undertaken based on programmed datasets to obtain 100 % repeat accuracy.



The cable runs from the cable paternoster through the automatic unwinder to the modern cutting and insulation stripping machine. Fully automatic cutting to length and insulation stripping make formats reproducible at any time.

A reliable connection safeguards the function

A prerequisite for the trouble-free operation of our products is correct electrical connections. Depending on the application, we crimp, solder or clamp the contacts.

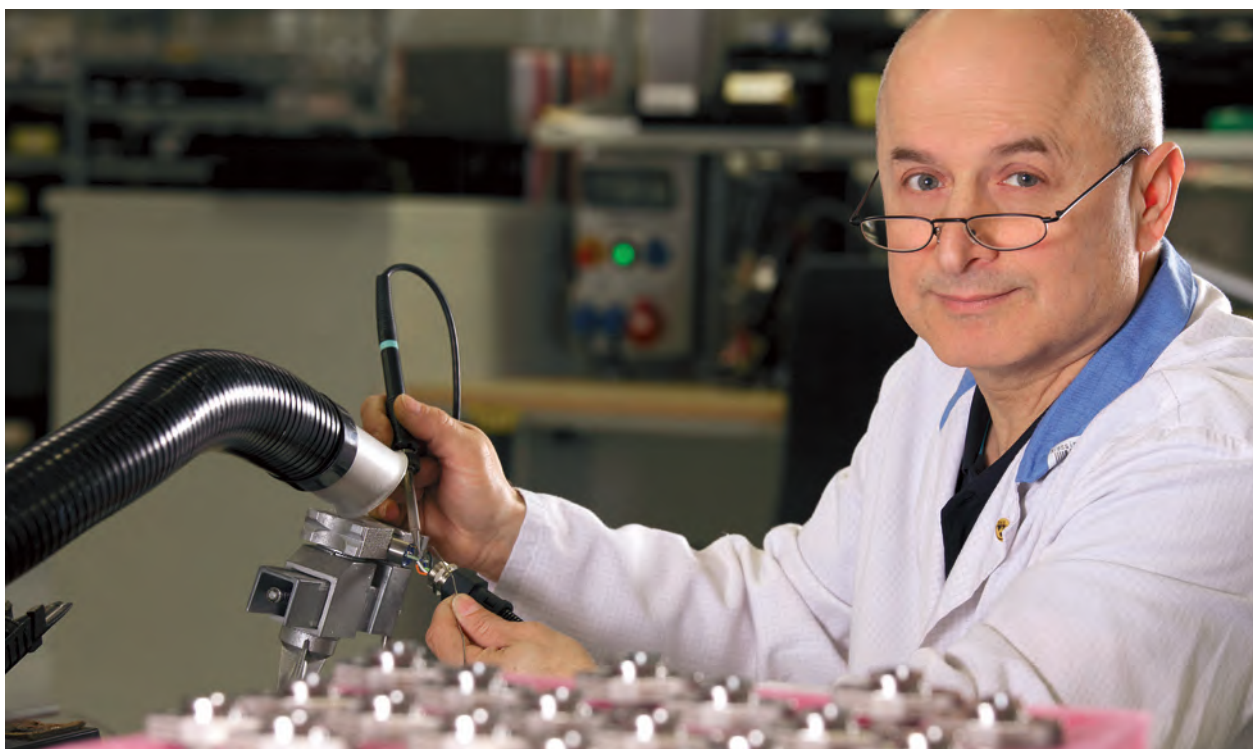


The quality of the crimp connection is right, as the contact is not damaged and there are no air inclusions in the structure.

Crimping, that is pressing together metal sleeves and wires, is state of the art these days. During this process the wire cross-section must not be reduced by excessive pressing.

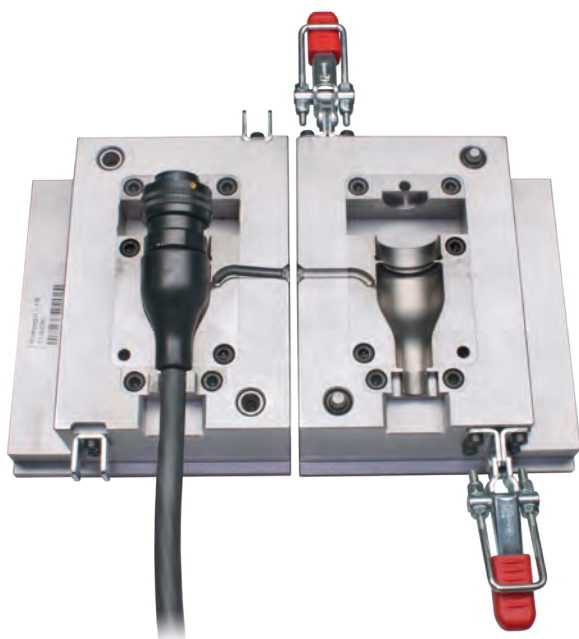
If sleeve and wire are correctly crimped, a structure almost without air inclusions is produced. Only in this way is the connection reliably protected against corrosion. To ensure a high quality connection, we rely in the latest machinery and trained staff for crimping.

High-quality, qualified contacts are a further important criterion for exact crimp connections. By means of careful supplier selection we ensure optimal pre-conditions. We also prepare microsections of the crimp connections in our test laboratory and check the quality.



Cable and connector completely sealed

To seal the joints between cables and connectors, among other methods we use the proven method of shrinking shaped parts and sleeves. As an alternative, we also use the hotmelt method. During this process the components are carefully encapsulated using injection pressures of up to 40 bar at temperatures of up to 240 °C. The encapsulation material is particularly resistant to oil, moisture, chemicals and UV radiation.



Hotmelt encapsulation method, in this way cable and connector are reliably and durably encapsulated.

Connections secured in this manner withstand even high pressure and heavy vibration. They feature high tensile strength and elongation at fracture as well as particularly good sealing. They reliably protect sensitive electrical and electronic components.

Reliable cable protection for harsh environments

In operation our products are often subjected to extreme loads. As such, e.g. on rail vehicles, stone impacts and vibration are also the order of the day along with fluctuating temperatures and humidity. These situations require additional protection of the cables and wires. For this reason we also use corrugated tubes, rubber sleeves and other protective sleeves to protect your cable against damage.

Special connectors are our day-to-day business

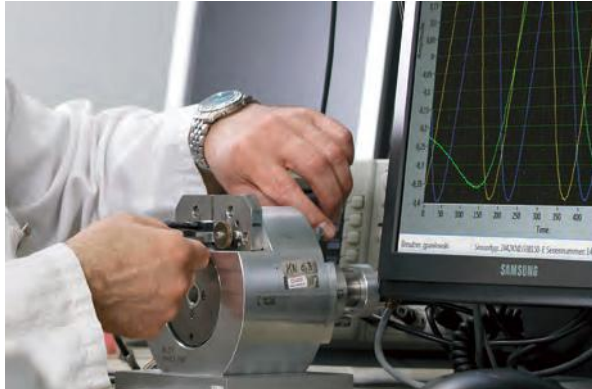
The connectors required are as varied as the fields of application of our products. We have more than 400 connector variants listed in our order system. From the simple M12 connector to the special coupling for hybrid cables - we connect all common connectors to the related cable.

Irrespective of whether provided by us or by the customer: even very unusual special connectors are not a challenge for us. Upon request we will also procure and stock these connectors for you. When needed we can supply your product quickly and reliably on demand.

Quality "Made in Germany"

Guarantor for high reliability

Reliability and efficiency characterise modern machinery and plants. For this reason we place particularly high value on high quality components and continuous quality control. This is your guarantee for durable and reliable products.



Completely ready to use rotational speed sensor MiniCODER in final test

Our path to excellent quality

For us quality management starts as early as product development and extends as a common theme through all areas of the organisation. Each year we subject our measures to internal and external audits. As such we are certified to DIN EN ISO 9001, ISO 14001 as well as IRIS.

Our quality assurance measures also include the annual training of our staff. For manufacturing, among other documents the IPC* guidelines define important regulations for manufacturing, for example IPC-A-620, for acceptance criteria for cables and cable assemblies, and IPC-J-STD, which defines requirements on soldered electrical and electronic connections.

Only tested quality leaves our factory

We test the quality of parts and components supplied as early as on receipt from our suppliers. In all our production areas we ensure only items in perfect conditions are further processed! Our employees are excellently qualified and manufacture your product with the greatest possible care and attention to detail.

Final test is a fixed element of our production. For instance we test the function of our rotational speed sensors against a rotating measuring scale at room temperature. If you require, we can also test the function at 100 °C. In the end you receive a complete system that can be used immediately.

Recognised standards are our basis

We manufacture and fabricate our products in accordance with the internationally recognised guidelines published by the IPC*.

Many of our sensors are used in very harsh ambient conditions. Cables and wires used here must meet comprehensive standards. As early as product development we clarify the suitability of the material used for the field of application.

- Fire resistance in accordance with DIN 5510, NF F 16-101
- Halogen-free in accordance with DIN EN 50267-2-1
- Flame-retardant in accordance with DIN 50265-2-1 / DIN 50266-2
- Temperature, UV and ozone-resistant
- Characteristics in accordance with UIC specification
- Characteristics in accordance with UL/CSA specification

Tell us about your requirements and we will agree with you the right material for your application.

* IPC Industry association for printed circuit board and electronics manufacturing service companies



Your component management in our hands

Relieve the load on your procurement and your logistics!

In every development project and in every new solution our focus is on the reliability of our products. For this reason we also set high quality requirements during the selection of our suppliers.

Your needs are our day-to-day business

Standard products are often inadequate for extremely demanding applications. Finding suitable material here requires specialist knowledge and expertise.

Profit from our almost 50 years of experience. If necessary we will advise you on the selection of suitable cables and connectors. If you wish, we will search for the best material for your specific application.

Our component management simplifies your logistics

Reliable, trouble-free operation of our products is only possible with qualified components. Along with the long-term availability and quality of our components, for us reliable delivery and adherence to schedule play a major role. For this reason we audit our suppliers at regular intervals.

If necessary, we also stock special components for our customers. We combine order-based stockholding, modern logistics and high added value to form a complete service. During this process we ensure that parts and components with long-term availability are used. We deliver your product at short notice on the agreed date – and that for decades.

Simplify your component and supplier management and order your completely ready to use solution directly from Lenord + Bauer.

Talk to us. We would be pleased to advise you!



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