



FLEXIBLE ELEMENTS FOR COMMERCIAL VEHICLES AND ENGINES

Witzenmann GmbH

Östliche Karl-Friedrich-Str. 134
75175 Pforzheim
Telefon +49 7231 581-0
Telefax +49 7231 581-820
wi@witzemann.com
www.witzenmann.de

THE GROUP

With 24 Companies in 19 countries
Witzenmann is the worldwide Number 1 in our industry.



World Leader

Witzenmann is a global group specialising in the design and manufacture of flexible metal elements. Guided by our vision of “managing flexibility”, our company has become renowned as a reliable manufacturer and as the innovative development partner of choice within the industry. Today Witzenmann offers the widest range of products available, enabling us provide optimised solutions time and time again.

Assuming Responsibility

As a signatory to the Declaration of Accession, the Witzenmann Group is committed to the 10 principles of the United Nations Global Compact. This initiative by former UN Secretary General Kofi Annan is based on internationally agreed conventions and treaties on human rights, labour standards, environmental protection and anti-corruption. The Global Compact aims to make the 10 principles an integral part of business strategy and operation.



OUR FLEXIBLE NETWORK

The group's renowned international technology network across Europe, Asia and the Americas generates advantage in terms of operational excellence and innovative strength.

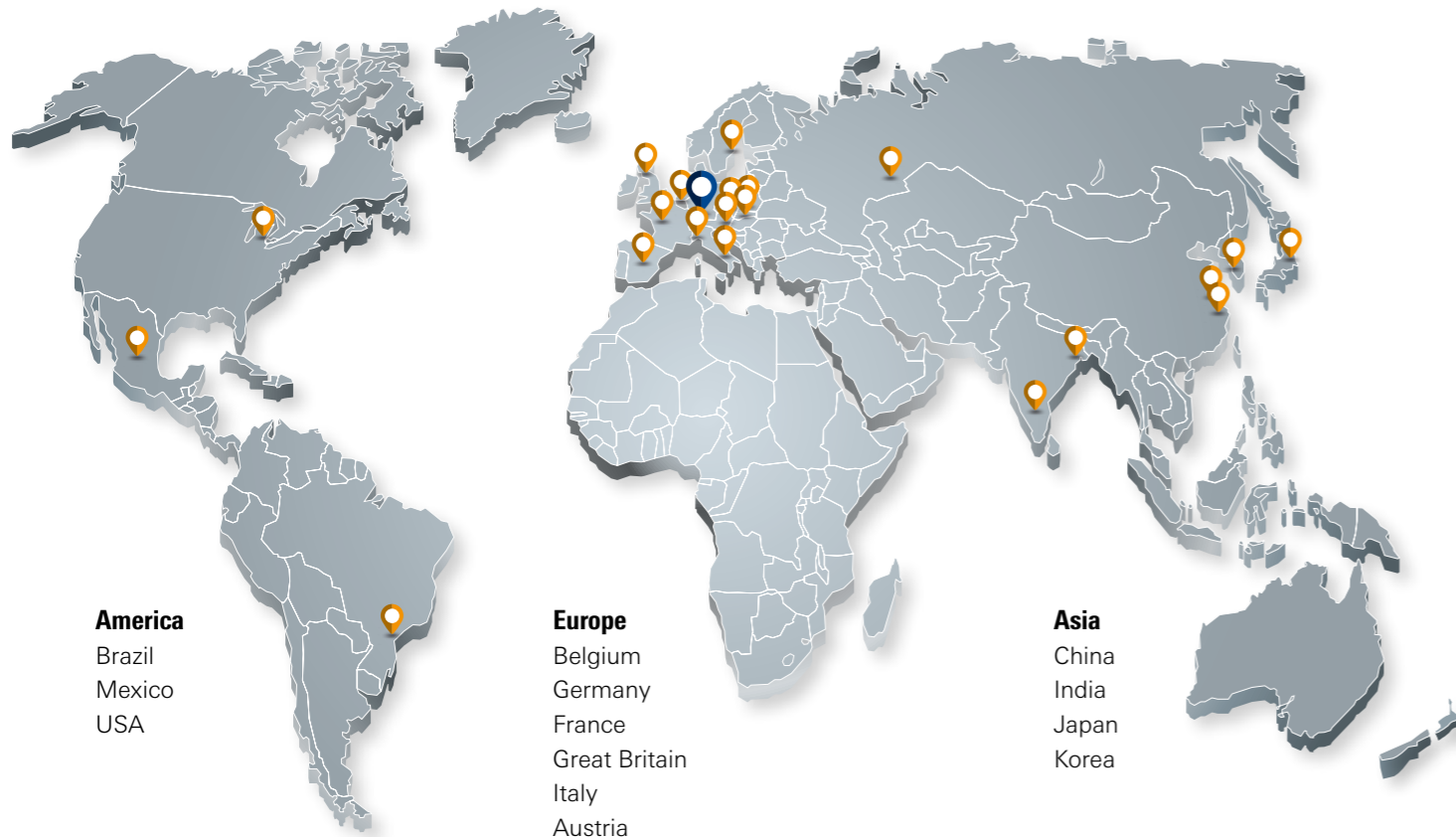
Always Close to the Customer

One of our corporate principles is to manufacture our products close to our markets. In practice, this entails establishing extensive local knowledge both in production and in engineering. To ensure this, our Competence Centre in Pforzheim provides the respective subsidiaries with the appropriate Witzemann technology. This strong technology network within the group enables us to address global trends and to develop corresponding optimised solutions. This has made us the innovation leader in our industry.

Fast Service, Efficient Production

To be "always close to the customer" is to provide fast, local, efficient service. Through our network of worldwide subsidiaries we are able to provide:

- Sales support and customer relationship management
- Engineering expertise including design calculations, whether for new components or complete piping systems
- Production and assembly services to meet required delivery times for replacement parts or new variants



America

Brazil
Mexico
USA

Europe

Belgium
Germany
France
Great Britain
Italy
Austria
Poland
Russia
Sweden
Slovak Republic
Spain
Czech Republic

Asia

China
India
Japan
Korea



QUALITY BY WITZENMANN

This not only reflects the expertise of each individual employee – but also the quality of our processes.

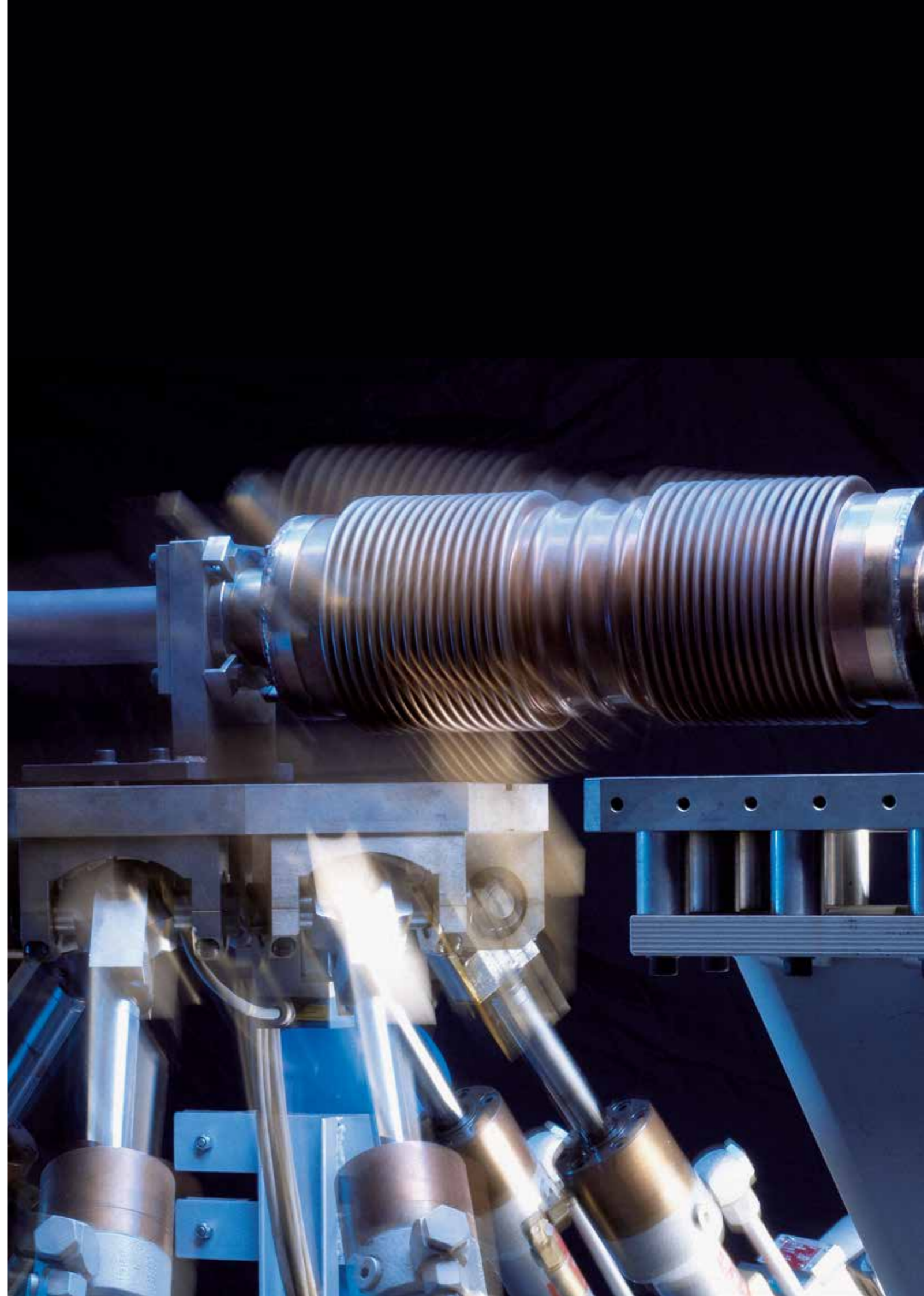


Quality by Witzenmann

Product durability, absolute reliability and outstanding levels of service are essential for a company that strives for overall quality leadership. "HYDRA – Quality by Witzenmann" is supported not only by our DIN ISO 14001 and IATF 16949 accreditation, but also by a wide variety of national and international approvals and certifications. Our customer base includes all of the world's major manufacturers. This is reason enough for us to consistently enhance the qualitative development of our product solutions.

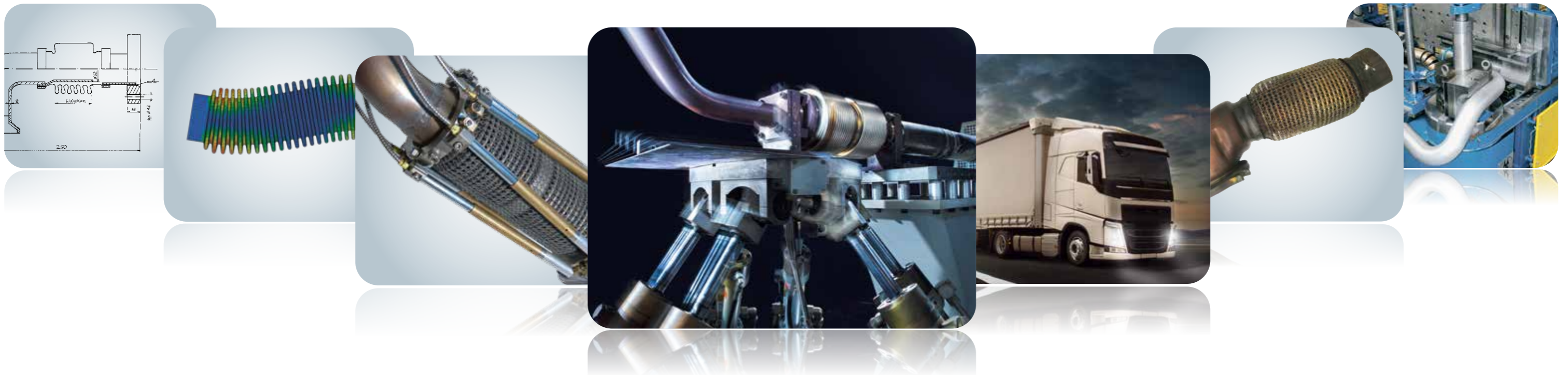
Technology Transfer from Other Markets

Witzenmann is involved in many highly specialised markets including aerospace, nuclear power and even medical technology. These are all fields in which maximum functional reliability is required under the most demanding operating conditions. The resulting need for continuous development, with uncompromised quality, is what makes Witzenmann the chosen development partner across the world.



ENGINEERING PARTNER

From the first idea to economic series production our structured development process helps us develop optimal product solutions without delay.



Design and calculation

FEM calculation regarding stress distribution, material fatigue, liner calculations, iterative inclusion of the operating data, available or determined, as well as verification of the material according to the operational data determined.

Operational loads determination

The precise and reliable determination of loads in real operation. Measurement of all six degrees of freedom. All

relevant load cases/driving manoeuvres of the validation route will be taken into account. For that we have the largest testing equipment in the industry.

Prototype verification

Manufacture of prototypes for the static and dynamic characterisation of the components in its own prototype construction. First service life tests, creation of prototypes for real test series, first design for cost calculation.

Service life validation

Component testing at customers under real conditions.

Return parts database

Systematic and standardised documentation of all returned parts as well as the parts which have run through the internal test cycle. More than 100 relevant parameters are recorded here for each part. The concluding analysis of the return parts enables the final verification. The most comprehensive database worldwide as the basis for rapid and economic new product development.

From Built-to-Order to large series

Equipped with the most modern machine plant, we can economically manufacture products in both small and large series. And always wherever our customers are. Our global manufacturing network makes that possible.

ALWAYS THE RIGHT CONNECTION



Fusing new materials and different materials together is one of our core competencies. Very few in the industry are capable of doing it like we can. To achieve the best results in this, we employ a broad range of process techniques. This allows us to fashion reliable and durable connections. Welding stainless steel to cast parts is also part of our repertoire, as well as joining various material to memory metals. Mastering of these different connection technologies ensures we

are always able to implement the right connection – dependent on the materials and the requested batch sizes. Regardless of whether our flexible pipe systems are now implemented in weight-optimised form, or are designed for specially rugged use, whether they have to withstand 800 °C at 7 bar or compensate for all-round movements over a service life of 10 years. The best solutions always arise from the knowledge of specialists.

DIVERSITY

We have the widest product range in the industry. Therefore we are a strong partner in the commercial vehicles industry in the development of new solutions for a wide range of applications.

Whether in applications close to the engine or in the exhaust gas system, wherever movements, thermal expansions or vibrations need to be absorbed or compensated for, our flexible metallic elements are in demand. Different application areas impose additional requirements on our products and pipe systems.

Trucks, busses, transporters

Very long service lives with strict requirement for mobility and tightness under the most difficult installation conditions to fulfil emissions regulations: These characteristics distinguish our decoupling elements used in the engines or exhaust systems of heavy duty trucks, modern buses or transporters.

Large engines

Applications in ship construction and in gensets require the highest degree of reliability from engines and their components and maintenance-free, continuous operation. For applications such as heavy oil and/or gas operation (dual fuel) we have developed especially robust solutions. These are leak-free, seawater-resistant, burst-resistant and flame-resistant.

Rail vehicles

In railway vehicles our metal bellows solutions and metal hoses provide the required flexibility and high functional safety in exhaust gas and cooling systems in liquid circuits, braking, hydraulic and power transmission systems.

Construction equipment

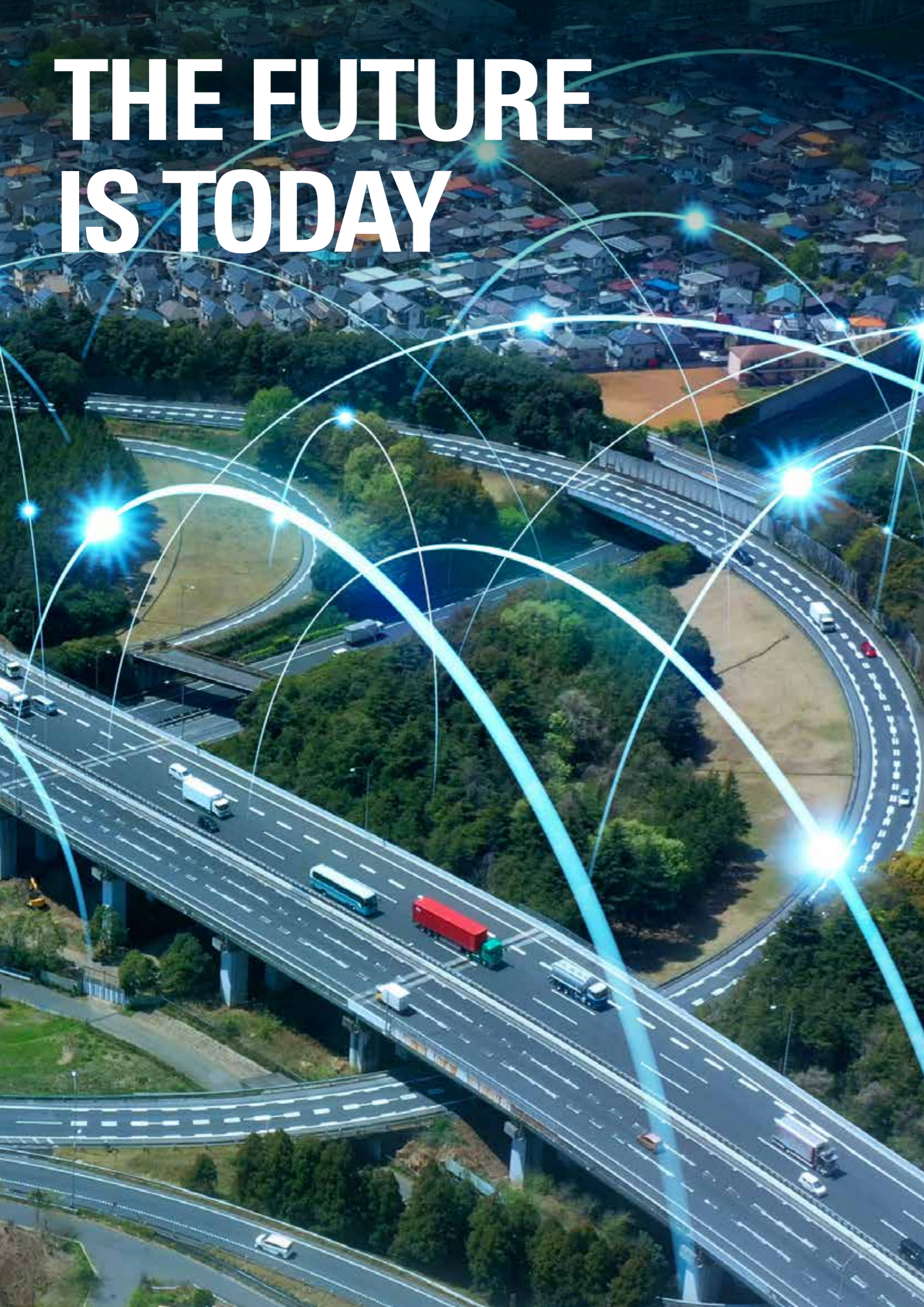
Here, too, our flexible elements guarantee continuous functional safety even under extreme conditions – if necessary also in combination with complete pipe systems (with and without insulation).

Agricultural equipment

Sturdy and long-lived while having optimal installation geometry – these are some of the requirements for our components in this market sector. Also with tractors, combine harvesters or other agricultural machines our elements ensure economical use of the vehicles while taking account of the latest emissions regulations.



THE FUTURE IS TODAY



Lightweight construction, weight reduction, multifunctional elements or new materials are issues that concern our engineers and innovation management on a daily basis.

Economical operation with lower emissions and greater mileage at the same time – these are the current and future challenges in the commercial vehicle sector. That requires leak-free pipe systems with increasingly smaller component weight, as well as multifunctional components and increasingly more complex requirements for the individual functional elements.

New from our R&D

To assert our market leadership even in these new segments, we are developing and testing the future already. An important foundation for that is our knowledge of materi-

als linked to leading process engineering. Lightweight and highly durable Kevlar® joints also count as part of our development spectrum as well as memory metals or new forming methods. To break new ground here, we work closely with universities, institutes and our customers. Our internal innovation management also helps us bringing together knowledge from a wide range of markets and business areas. Whether it's the processing of high-tech materials or just a good idea – our engineers have perhaps the broadest range of resources in the industry. As a development partner, we invite you to shape the mobility of the future with us.



HYDRA® COMPONENTS CLOSE TO THE ENGINE

Flexible elements for efficient engine technology for on and off-highway applications

Expansion Elements



Areas of application

Exhaust expansion elements are bellows that compensate thermal expansions, movements or assembly tolerances. They are used in the manifold areas upstream, downstream or between the turbochargers. The elements are in a compact design and are fitted with individual connections in accordance with customer specifications. Such as, for example, connections made from spheroidal iron alloy or stainless steel cast materials.

Characteristics

- Technical leak-free solution due to metal bellows
- Temperature and corrosion resistant under extreme conditions (pressure, temperature)
- Compensation for movements and/or thermal expansions as well as low assembly tolerances
- Optimised gas guidance and reduced thermal radiation through integrated guiding tube
- If necessary with specifically tuned damping characteristics

Return pipes



Areas of application

Exhaust gas return pipes guarantee a secure connection between exhaust cooler and return valve or suction module in the area close to the engine, thus reducing emissions of pollutants and improving efficiency levels. Other application options result from maintenance-free use in oil and other fluid circuits.

The pipelines will be bent in a customised way for the perfect fit according to the existing installation conditions.

Characteristics

- Technical leak-free/oil-tight solution due to metal bellows
- Temperature and corrosion resistant under extreme conditions (pressure, temperature)
- Compensation of movements, vibrations, thermal expansions, assembly tolerances
- Low weight
- Aging resistant and resistant to diffusion



HYDRA® EXHAUST DECOUPLING ELEMENTS

Perfect movement and sound compensation for on and off-highway applications

Stripwound hoses



Areas of application

Stripwound hoses with interlocked profiles or corrugation profiles are characterised by high tension and resistance to transversal pressure. They are very economical and optimised structurally for use in the commercial vehicle sphere. They are frequently used in exhaust gas systems in light and heavy duty trucks, buses, construction equipment or fork lifts.

Characteristics

- Absorption of movements in axial, lateral and angular direction
- Torsion compensation possible in specific range
- High mobility with a defined bending radius and low external diameter
- Installation possible in bent state depending on design and specification

Structure-borne sound decoupling elements



Areas of application

Structure-borne sound decoupling elements consist of a short compact bellows, which has an external wire mesh for damping purposes. They are used for the decoupling of high-frequency vibrations, caused by the turbo charger, in the front pipe area. Their shape, design and connections can be customised according to requirements.

Characteristics

- Technical leak-free solution due to metal bellows
- Temperature and corrosion resistant under extreme conditions (pressure, temperature)
- Decoupling of high-frequency vibrations
- Low weight while utilising the specific characteristics of the construction area

Decoupling elements



Areas of application

Decoupling elements compensate for engine movements such as tipping moments or vibrations and movements from the exhaust gas system. Elements are available with differing degrees of flexibility depending on the intended application. Various design shapes (round, oval with/without inner liner, with/without damping) as well as customised assembly of connectors guarantee a broad range of application options.

Characteristics

- Technical leak-free solution due to metal bellows
- Temperature and corrosion resistant under extreme conditions
- Small, compact construction according to the available construction space
- Broad range of flexibility (from self-supporting solutions with very high statistical rigidity to highly flexible models)
- High service lives within the framework of customer specifications
- Optimised gas guidance and reduced thermal radiation through the interior liner
- Assembly in conjunction with customer-specific fittings

HYDRA® PIPE ASSEMBLIES

The system solution for robust transport of media of all types

Pipe systems



Areas of application

Flexible, pressure-resistant pipes in conjunction with both rigid and flexible elements are used as cooling water, oil and air-conditioning lines as well as charge air lines. In general the pipes are made from a single piece, bent according to the requirements of the installation geometry and fitted with a welded flexible element as metal bellows or metal hose.

Characteristics

- Compensation of movements, vibrations, thermal expansions and installation tolerances
- Technical leak-free solution due to metal bellows or flexible metal hose
- Temperature and corrosion resistant under extreme conditions
- Broad range of flexibility
- Optimised gas guidance and reduced thermal radiation through the inner liner
- Assembly in conjunction with customer-specific connectors
- Pressure stability and mechanical protection via external braiding
- Aging resistant and resistant to diffusion
- Design with/without insulation according to customer specifications



SPECIAL APPLICATIONS

Example product solutions for special application

HYDRA Piezo injector



Areas of application

Metal bellows as highly dynamic sealing of piezo elements against fuel in injection systems of vehicle engines

Technical properties

- Non fatigue critical design for movement, pressure pulse and vibration: >1,000,000,000 load cycles
- Pressure pulse up to 300 bar, static pressure resistance > 700 bar
- Corrosion resistant against all current fuels

HYDRA CO₂ pipes



Areas of application

Flexible hose lines for CO₂ high-pressure air-conditioning systems

Designs

In the coolant area, completely pre-insulated or jacketed pipelines for direct mounting