



WITZENMANN
managing flexibility

FLEXIBLE ELEMENTS FOR AUTOMOTIVE ENGINEERING

Witzemann GmbH

Östliche Karl-Friedrich-Str. 134
75175 Pforzheim, Germany
Phone +49 7231 581-0
Fax +49 7231 581-820
wi@witzemann.com
www.witzemann.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.

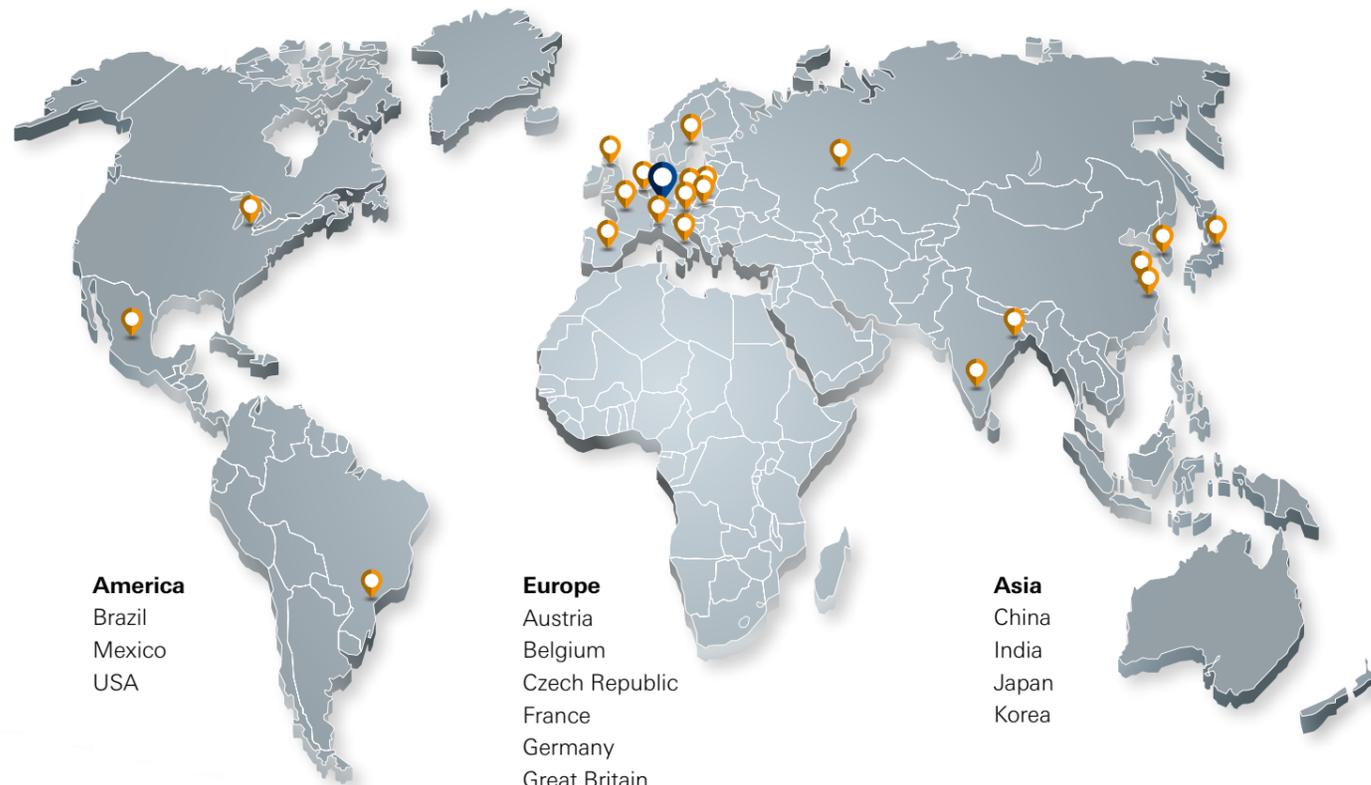
Always Close to the Customer

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 Witzenmann 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

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

Asia

China
India
Japan
Korea



QUALITY BY WITZENMANN

TS 16949, DIN ISO 9001, ...

German Quality manufactured by Witzmann



Welding technology that meets the highest demands

From welding thin-walled, high-alloyed stainless steels to connections of stainless steel with copper, aluminium or cast iron – in all areas Witzmann has technologically leading process competence and can fall back on many years of experience. This also means continually developing know-how further and testing it regularly. This happens, for example, via recurring requalification or certification.

Technology Transfer from Other Markets

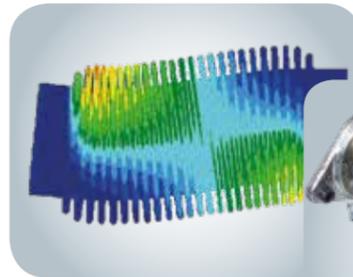
Witzmann is involved in many highly specialised markets including aerospace, nuclear power and even medical technology. These are all fields in which maximum functional reliability is required under the most demanding operating conditions. The resulting need for continuous development, with uncompromised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



DEVELOPMENT PARTNER

Our engineering expertise from the initial customer contact to the optimal production design is one of our core strengths.

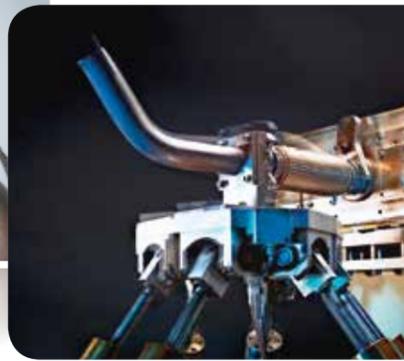
Starting with experience



Road load data acquisition



Precise validation...



... of operational loads



Professional partner



Systematic analysis



Quality standard



Starting with experience

As a pioneer in the industry we use our accumulated experience and thus support our customers in creating efficient product specifications and development methods. Well over 1,000 analyzed operational loads and calculation models are the basis for precise design optimization in the critical stress point between life span requirements, operational loads and framework conditions in the projects.

Road load data acquisition

On all continents, our engineers measure operational loads that are relevant for the life span of our products quickly, precisely and reliably. Thanks to many years of experience both in building capable measurement systems as well as in the interpretation of the various customer test tracks and

driving manoeuvres we can calculate the lifespan of our components quickly and precisely, allowing us to offer a design optimized for particular applications.

Precise validation of operational loads

Simulating the life of a vehicle in the shortest possible time requires precise knowledge of the interplay of all relevant operating loads, competence in computational analysis and fast, highly precise test bench technology. Continuous refinement of our calculation and testing methods allows us to secure an entire vehicle life on the test bench.

Professional partner

We use our experience to support our customers in system design and validation. For example we supply production-

representative prototypes and calculation models compared with them, whose characteristics are tuned to the system behavior. It is important for us to ensure the function of our products in the system and thus to contribute to an optimal overall result.

Systematic analysis after deployment

Thanks to the systematic analysis of components after their use in customer testing and in the field we know the demands placed upon our products very well. Over 2,000 analyzed components form the pivot points for many questions about design and material selection. This database, which is the largest of its type in the world, is the yardstick for our corrosion tests and ultimately confirms that our components maintain what we have previously calculated and tested.

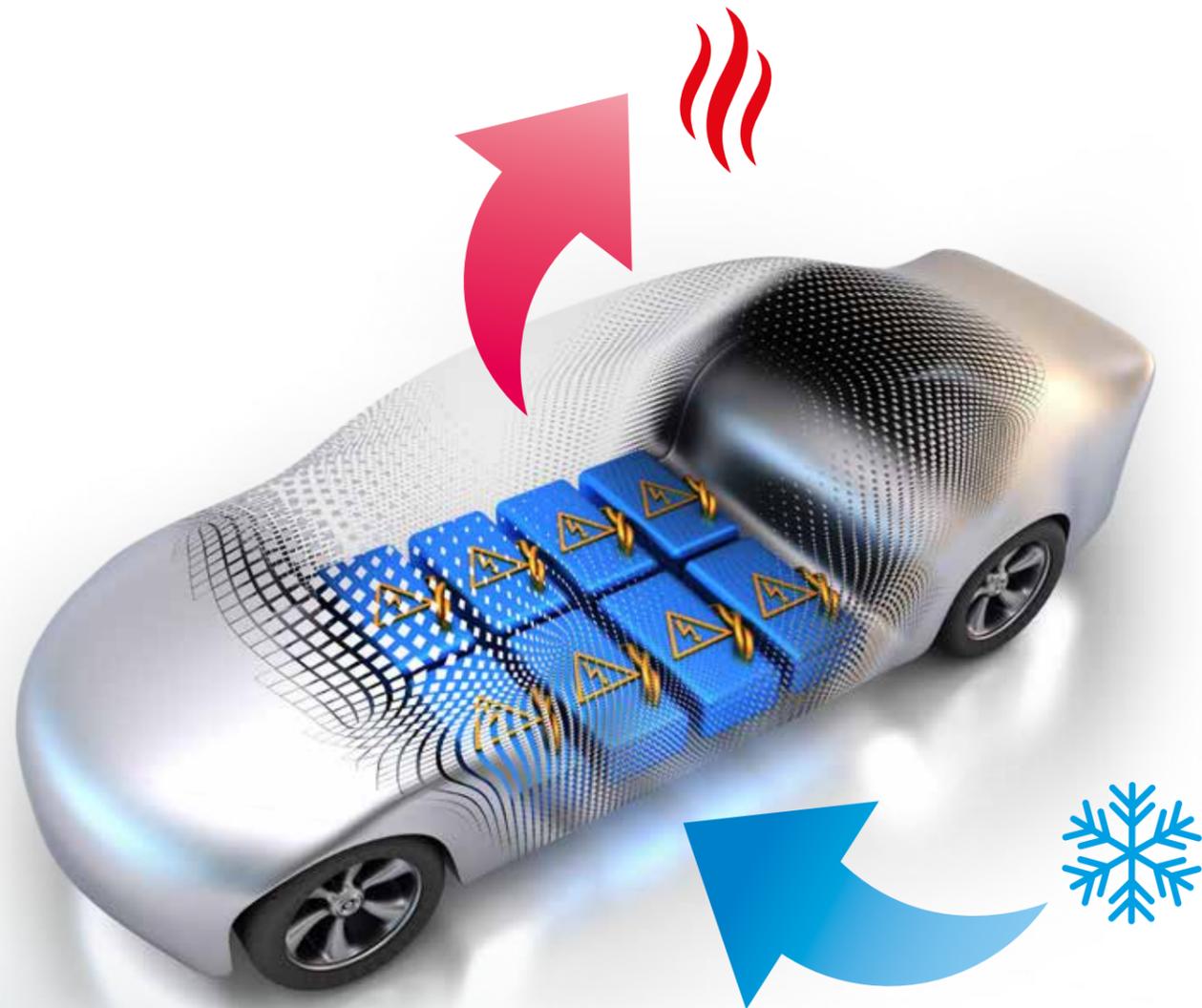
Global quality standard

We develop and manufacture for local markets at our strategically located production sites worldwide. In this, our own process and machine development, international product service teams, our global knowledge management and a comprehensive internal training system as well as the systematic application of "Lessons Learned" principles ensure that our global quality also sets the standard in future.

MOBILITY NEW THINKING

As a development partner, for decades we have been industry's favourite address when it comes to developing and implementing product ideas for new applications.

For this we use our experience and our direct access to those with know-how in the marketplace.



Our core competencies for new ideas

Thanks to the dynamic developments associated with the mobility transformation, new requirements are constantly emerging. In close cooperation with our new and established customers, innovative development scenarios are being created. The indispensable basis for this is formed by our core competencies: our practical expert knowledge in material, forming and connection technology related to thin-walled metals, as well as our comprehensive testing and validation equipment. It is this that allows us to make substantive data and test material available at an early stage. This is how we achieve quick-paced development cycles and rapid prototyping.

The future of the automobile is already in production

Hybrid, electric motors and fuel cells are currently the most promising new forms of propulsion. With our engineering and process know-how, we are bringing the transformation to the maturity required for series production. We are already implementing solutions for these new applications.

For example, battery gas discharge lines: they are used when the batteries must be degassed within seconds. With bellows elements manufactured in the clean room, we support the optimal combustion process in diesel and petrol engines and our low-pressure hose lines ensure functional safety for fuel cells.

The future doesn't sleep

Together with universities, institutes and our customers, we are in continuous discussion on the development of new product ideas. Currently our engineers are busy with topics such as thermal management in electrical vehicles, the cooling of electric motors, fuel and arrester cooling, but also battery housing.

As a development partner of OEMs and Tier-1 companies, we look forward to shaping the future of mobility with you.



INVISIBLE BUT INDISPENSABLE

Decoupling elements, ducts, return pipes, fluid pipes and precision bellows for engines and exhaust systems.



Our wide product range

All reputable automobile and system manufacturers are today among Witzemann's customers. In a wide range of areas, the company offers solutions that improve the life span, economic efficiency and comfort of a car. In the exhaust gas area there are decoupling elements or ducts of different design that decouple vibrations, heat expansions or engine movements. Flexible exhaust gas return pipes

contribute significantly to improved pollutant emissions as the formation of nitrogen oxides is reduced in the combustion process. In oil, fuel and cooling circuits, the advantages of flexible metal pipes are their absolute gas and diffusion tightness, long life span and temperature resistance. An essential criterion, especially when they are being built close to exhaust manifolds, turbochargers or the exhaust system.

EXHAUST GAS DECOUPLING ELEMENTS / HOSE ASSEMBLY

Highly flexible for large movements

Installation



Areas of use

- Decoupling of engine movements and vibrations
- Can be used universally, best-suited for near-engine installation in the frontpipe area
- With round or oval cross section

Execution forms

- Available in all standard connection diameters
- Flow guidance via stripwound hose as liner
- On request with connectors, e.g. flange

Technical characteristics

- Linear component characteristics within the working range
- Decoupling of engine and exhaust system movements
- Decoupling of engine vibrations
- Technically gas-tight via metal bellows
- Decoupling of structure-borne noise vibrations
- Heat-resistant / corrosion-resistant through suitable selection of materials
- Geometric and technical properties can be adapted to customer-specific requirements



EXHAUST GAS DECOUPLING ELEMENTS / HOSE JOINTS

Sturdy, load-bearing decoupling

Installation



Areas of use

- Decoupling of engine movements and vibrations
- Can be used universally in the entire exhaust gas system

Execution forms

- Available in all standard connection diameters
- With round or oval cross section
- Flow guidance via stripwound hose as liner or flame tube
- On request with connectors, e.g. flange

Technical characteristics

- Decoupling of engine and exhaust system movements
- Decoupling of engine vibrations
- Specifically tuned damping characteristics
- Compact design
- Technically gas-tight via metal bellows
- Heat-resistant / corrosion-resistant through suitable selection of materials
- Geometric and technical properties can be adapted to the respective customer-specific requirements



CLOSE TO THE ENGINE EXHAUST EXPANSION JOINTS

Compensates thermal expansions

Installation



Areas of use

- To compensate for heat expansions in the exhaust manifold and frontpipe area
- Before or after the turbocharger

Execution forms

- Single or multiply bellows
- Optional with wire mesh ring as vibration damper
- Customer-specific connectors
- Available in all standard connection diameters

Technical characteristics

- Compensation for heat expansions and assembly tolerances in exhaust manifolds and in the frontpipe area
- Vibration decoupling
- Technically gas-tight via metal bellows
- Heat-resistant / corrosion-resistant through suitable selection of materials
- If necessary with damping characteristics via wire mesh ring
- Geometric and technical properties can be adapted to customer-specific requirements



CLOSE TO THE ENGINE STRUCTURE-BORNE NOISE DECOUPLING ELEMENTS

Compact decoupling

Installation



Areas of use

- Decoupling of high-frequency vibrations caused, for example, by a turbocharger
- Reduction of unwanted turbocharger-specific noise such as "turbocharger squeal"

Execution forms

- Multi-layer bellows
- With wire mesh ring as vibration damper
- Flow guidance via flame tube
- If required, with customer-specific connectors e.g. V-band clamp connection
- Available in all standard connection diameters

Technical characteristics

- Element with damping characteristics for structure-borne noise
- Small, compact design
- Technically gas-tight via metal bellows
- Sturdy load-bearing function thanks to high rigidity
- Heat-resistant / corrosion-resistant through suitable selection of materials
- Geometric and technical properties can be adapted to customer-specific requirements



CLOSE TO THE ENGINE EXHAUST GAS RETURN PIPES

Reduces vehicle emissions

Installation



Areas of use

- Pipes for return of exhaust gas for use in gasoline and diesel engines

Execution forms

- Design according to customer specifications
- Ideal with corrugations
- With or without bending in the plain tube or corrugated range
- Connection via flange, V-band clamp connection or according to customer specification
- If necessary with bracket or heat protection pipe

Technical characteristics

- Compensation of vibrations, thermal expansions, fitting tolerances
- Technically gas-tight
- Heat-resistant / corrosion-resistant through suitable selection of materials
- Low weight thanks to thin-walled initial pipes



CLOSE TO THE ENGINE EXHAUST GAS RETURN PIPES WITH FINEST FILTER

Reduces vehicle emissions

Installation



Areas of use

- Pipes for return of exhaust gas for use in gasoline and diesel engines

Execution forms

- Design according to customer specification for low pressure EGR systems
- Preferably with damping device
- With or without bending in the plain tube
- Connection via flange, V-band clamp connection, casting or deep-drawn parts according to customer specification
- With finest filter element

Technical characteristics

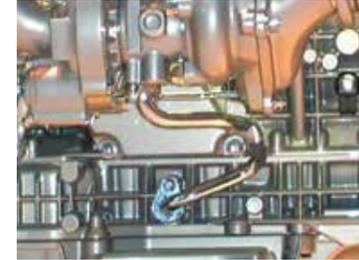
- Compensation of vibrations, thermal expansions, fitting tolerances
- Technically gas-tight
- Heat-resistant / corrosion-resistant through suitable selection of materials
- Protection of components close to the engine such as turbochargers and EGR cooler by means of finest filter
- Protection against soot and ceramic particles up to 200 µm as well as varnish
- No exchange necessary – lifelong deployment with continuous regeneration during operation



CLOSE TO THE ENGINE RETURN PIPES FOR OIL AND WATER

Near-engine, temperature-resistant media supply

Installation



Areas of use

- Feed and return pipe for oil, water and other fluids in the near-engine area
- E.g. turbocharger oil supply, in gasoline and diesel engines

Execution forms

- Design according to customer specifications
- Ideal with corrugations
- With or without bending in the plain tube or corrugated area
- Connection via flange, screw or according to customer specification
- As a semi-flexible line for adaptation by the customer

Technical characteristics

- Compensation of vibrations, thermal expansions, fitting tolerances
- Technically gas-tight
- Heat-resistant / corrosion-resistant through suitable materials
- Low weight thanks to thin-walled initial pipes



CLOSE TO THE ENGINE BELLOWS ELEMENTS FOR FUEL PUMPS

Resistant to high pressure

High pressure fuel pumps



Pump bellows (Witzenmann) and high-pressure fuel pump (Continental Automotive GmbH)

Areas of use

- Separating diaphragms in high pressure fuel pumps

Technical characteristics

- Fatigue endurable design for movement, pressure pulse and vibration excitation: >1,000,000,000 load cycles
- System pressure of up to 300 bar
- Special test stands and corresponding know-how available for component development and validation
- Corrosion-resistant against all current motor fuels
- Cost-effective mass production thanks to the most modern manufacturing technologies
- Delivered as bellows or bellows with connector part
- Individual design optimization with regards to function, installation space, mountability, costs



CLOSE TO THE ENGINE BELLOWS ELEMENT FOR PIEZO-INJECTORS

Precision from clean room production

Installation



Areas of use

- Metal bellows as highly dynamic seal of piezo elements against fuel

Technical characteristics

- Fatigue endurable design for movement, pressure pulse and vibration excitation: >1,000,000,000 load cycles
- Pressure pulse up to 300 bar, static pressure resistance > 700 bar
- Special test stands and corresponding know-how available for component development and validation
- Corrosion-resistant against all current motor fuels
- Cost-effective mass production thanks to the most modern manufacturing technologies
- Delivered as bellows or bellows with connector part
- Individual design optimization with regards to function, installation space, mountability, costs

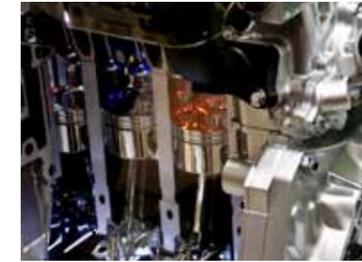


Millimetre

CABLES FOR HYDROGEN AND FUEL CELL DRIVES

Future technology security

Installation

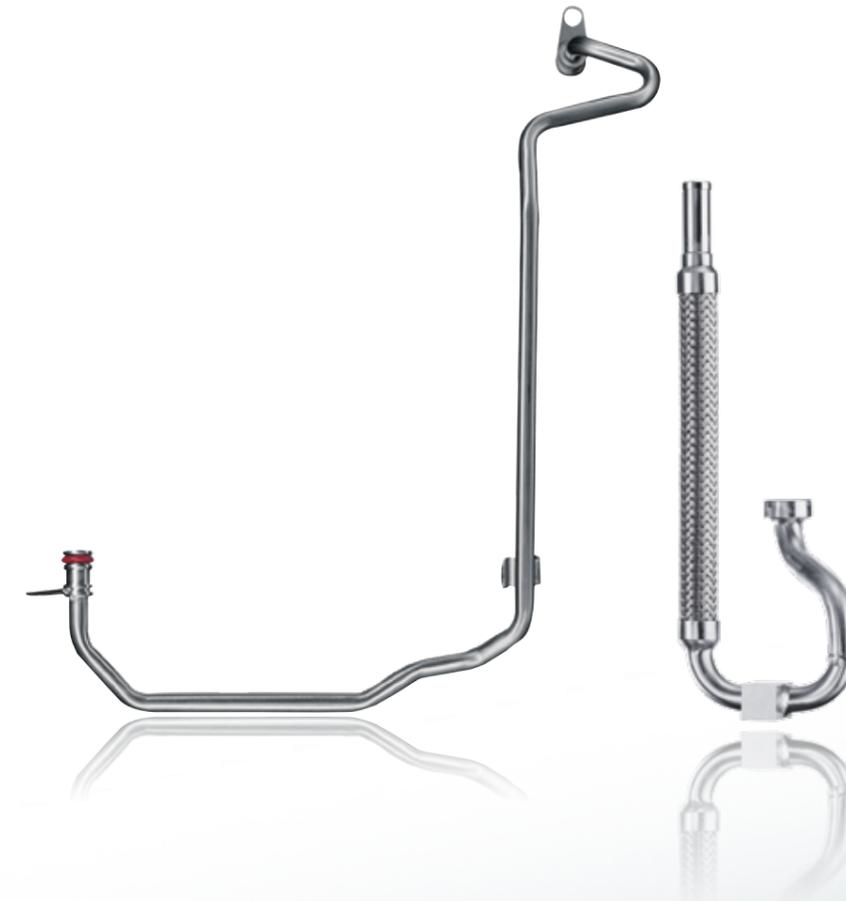


Areas of Application

- Fuel cell, medium and low pressure

Technical characteristics

- Customer-specific certified stainless steels
- Extreme safety: designed for pressures of 10 – 20 bar; burst pressure testing over 500 bar
- 100% Helium leak-tested components
- Customer-specific weld certificates and specific certificates of approval of welding power

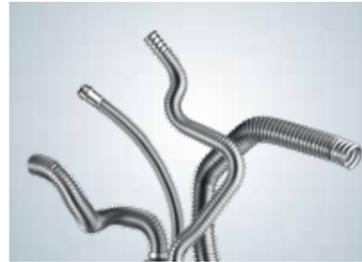


OTHER APPLICATIONS

CORRUGATED HOSES FOR FLUID HANDLING

Resistant to diffusion

Application Example



Areas of use

- Flexible line systems
- media-resistant
- gas-tight
- pressure-resistant

Execution forms

- Pressure-resistant hydraulic hoses
- Gas hoses
- Cooling water hoses
- Connection to flange, screw or according to customer specification

Technical characteristics

- Compensation of movements, thermal expansions and fitting tolerances
- Technically gas-tight via metal hose
- Low weight thanks to thin-walled initial pipes
- Resistant to corrosive media thanks to the use of chromium-nickel steels and nickelbase alloys
- Resistant to high temperatures
- Minimal volume increase under pressure load



OTHER APPLICATIONS

STRIPWOUND HOSES FOR CABLE PROTECTION

Robust and highly flexible

Installation



Areas of use

- Protective hose for electrical installation with VDE authorization

Execution forms

- Wound metal hose
- With cross section according to the requirements of the installation space (round, oval, right-angled, square, triangular)
- Stainless steel with and without coating
- Zinc-plated steel
- Bright brass, nickel-plated or chromium-plated

Technical characteristics

- High flexibility
- Mechanical protection
 - Anti-theft device
 - High tensile loads fixture
 - Crash protection
- Thermal protection
- Liquid-tight with coating

