



WITZENMANN
managing flexibility

FLEXIBLE ELEMENTS FOR AEROSPACE



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THE GROUP

With 24 companies in 19 countries Witzenmann is number 1 in this branch of industry worldwide.



World market leader

Witzenmann is a global group of companies that specialises in flexible metallic elements. Our company is renowned as an innovative development partner and reliable manufacturer within the industry thanks to our vision of "managing flexibility". Today Witzenmann offers the widest range of products for the most diverse areas of application. This enables us to offer the correct solutions time and time again.

Assuming responsibility

By signing the Declaration of Accession the Witzenmann Group is committed to the 10 principles of the United Nations Global Compact. The initiative by former UN Secretary General Kofi Annan is derived from the "Universal Declaration of Human Rights", The International Labour Organization's "Declaration on Fundamental Principles and Rights at Work" (ILO) and The Rio Declaration on Environment and Development.



QUALITY BY WITZENMANN

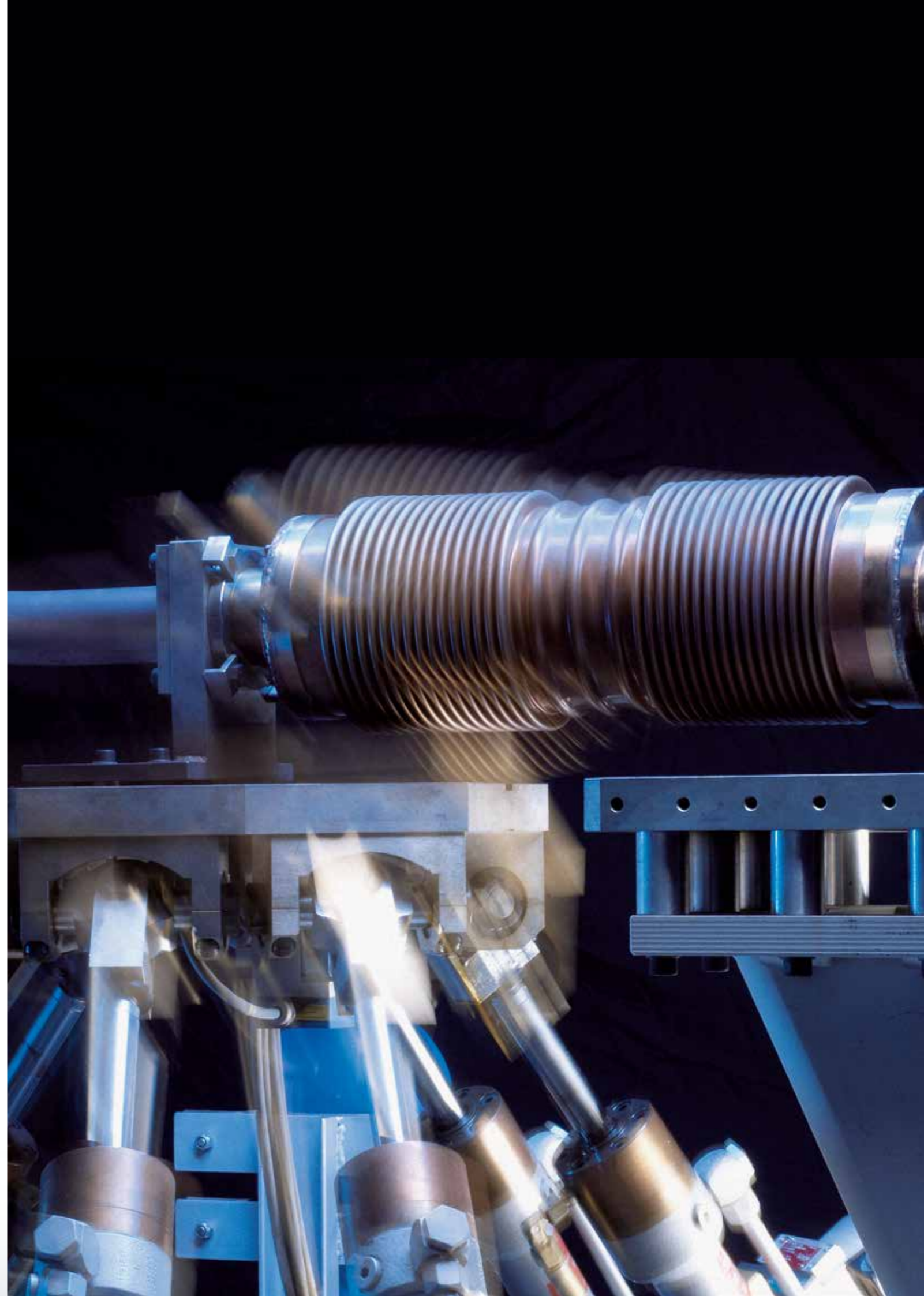
This does not only reflect the expertise of each individual employee – but also the quality of our processes.



Durability and absolute reliability are a must for a company that strives for quality leadership. It is not only DIN ISO 9001/ TS 16949 certification, but also a wide variety of national and international approvals and certifications that constitute "HYDRA - Quality by Witzenmann". In the Aerospace sector we hold the system-approval acc. to EN 9100 as well as the NADCAP approvals for special processes welding (WLD) and non-destructive testing (NDT). Our customers include many major manufacturers in the aviation and space travel segment. This is reason enough for us to consistently enhance the qualitative development of our product solutions.

Spin-off effects from other markets

Besides Aerospace Witzenmann is involved in many highly specialised markets like nuclear power, automotive, truck, engines, sustainable energy and even medical technology. These are all fields in which maximum functional reliability is required under demanding operating conditions. This is one of the factors which makes us an experienced and innovative development partner for our customers worldwide.



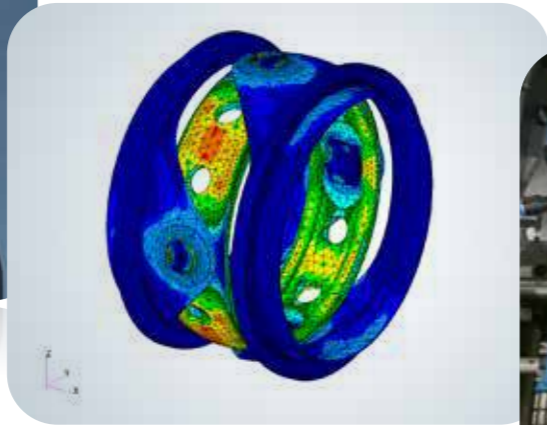
DEVELOPMENT PARTNER

Our certified development process helps us to industrialize optimal product solutions from the first idea to an economic series production.

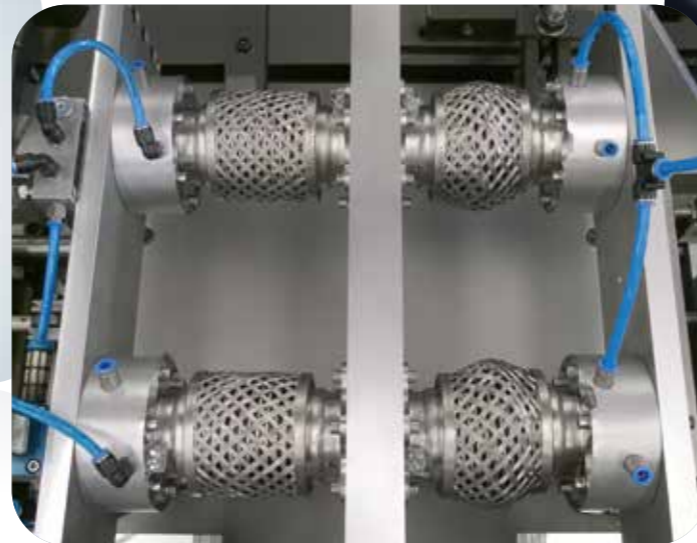
Concept Study



Engineering and Design



Testing & Qualification



Special Processes



Series production



Concept Study

One of our corporate principles is to develop our products always close to the market requirements. As a competent development partner of the aerospace industry our engineers transfer the first ideas or concept studies of our customers into smart and sophisticated product solutions.

Engineering & Design

Our products are calculated and designed in accordance with international standards such as DIN, EN, EJMA, ASME or SAE Aerospace. FEM analyses of stress distribution and material tests are done in-house as important basis for the design of our products.

Testing & Qualification

Prototype-testing is done in-house to verify the static and dynamic characteristics of our products. Formal product-qualification according to customer's technical specification can be done by the use of our extensive testing facilities. Our central laboratory is equipped with hydraulic and electrodynamic vibration test stands. Multiaxis machines from 1DOF to 6DOF can perform full life-cycle-testing of our products under "real conditions". The effects of all types of operation conditions, like corrosive environment, pressure-pulsation, temperature, movement and vibration can be investigated in our own material laboratory.

Special Processes

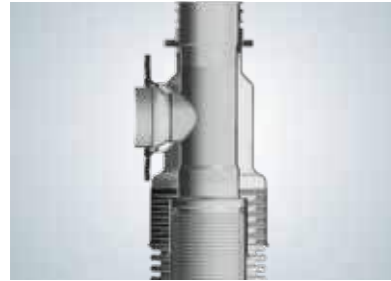
As the production processes welding and forming belong to our core competences, we can provide a lot of know-how and experience in the treatment of a wide range of different stainless steel alloys as well as for Inconel 625, Aluminium and different Titanium-alloys. For the Aerospace sector we can provide NADCAP certification for the special processes welding (WLD) and non-destructive testing (NDT).

Series Production

A modern machine park with a separate production area only for aerospace as well as the access to additional "State of the Art" production capacities in the production association of the Witzemann Group, allows us to optimally control our manufacturing-processes.

HYDRA® FLEXIBLE FLUID PIPE CONNECTIONS

Trim tank metal hose



Design and functionality

Two coaxial metal hose lines of stainless steel ensure flexibility. The inside unit is responsible for pressure resistance and the main transport of fuel. It connects the rigid transfer pipe with the moveable trim tank in the horizontal stabiliser of Airbus aircrafts. The outer hose line works as a protective and drainage shell and is firmly coupled to the inside unit at the rigid ends. The elevator movement is decoupled from the rigid fuel transfer pipes over the lifetime of the airplane.

Special properties

- Construction allows continuous drainage and hence provides leakage detection for the inside fuel line
- Additional side outlet with drainage and leakage detection
- Maintenance-free welding construction
- Low-weight design

Adapter for additional tanks

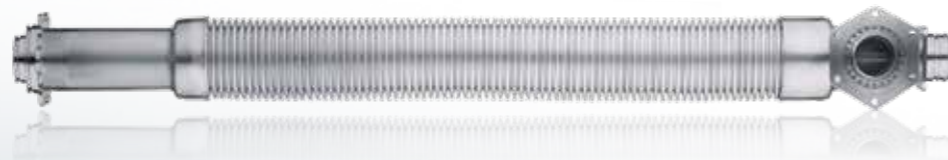


Design and functionality

Kerosene-carrying inside pipe with coaxially enclosing drainage space for leak-monitoring. Moveability is assured by two parallel switched metal bellows. The stroke-dependent anchoring against pressure thrust is enabled by a special outside braiding. These adapters connect the additional Kerosene tanks in the cargo bay of airplanes to the rigid fuel transfer pipes.

Special properties

- New welding configuration guarantees gap-free interior space
- User-friendly mounting
- High endurance
- Maintenance-free welding construction



HYDRA® FLEXIBLE FLUID PIPE CONNECTIONS

AS 1424 metal hose assemblies



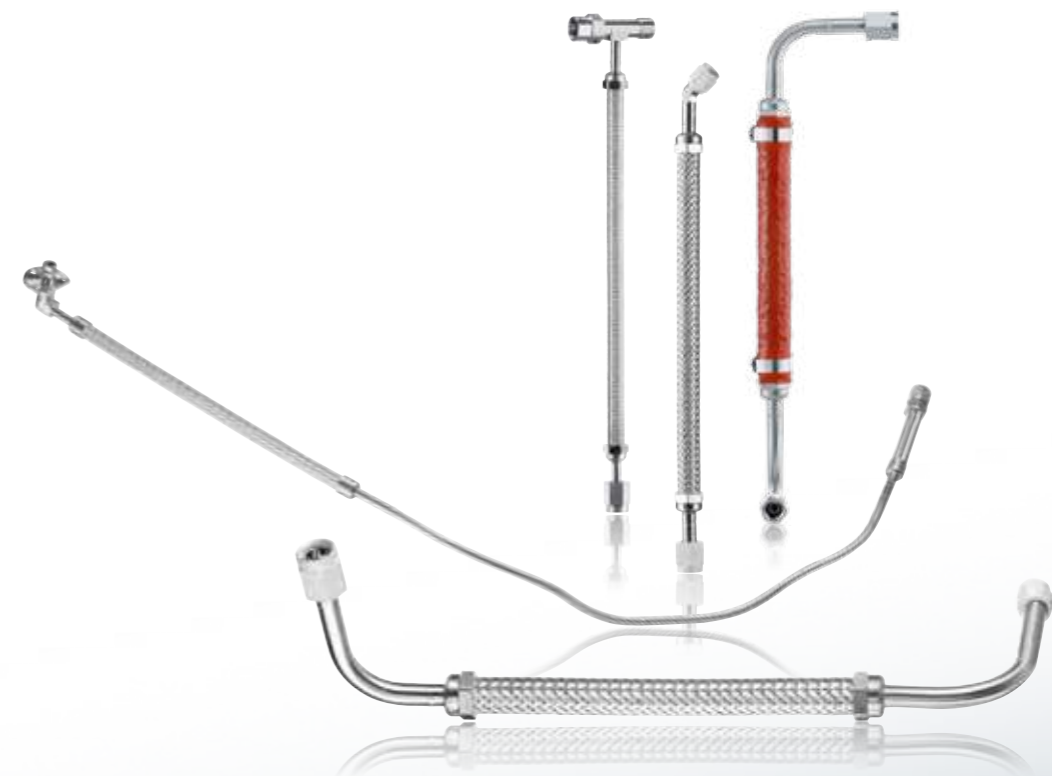
Witzenmann's metal hose program acc. to the international SAE Aerospace Standard

AS1424 covers a complete product-range from DN 06 up to DN 32 with the typical end-fitting-options, which are used in the Aerospace industry. They are designed also with different interface options and 3-D-bended rigid tubes on customers request.

The AS 1424 defines a high level of technical performance due to the combined requirements regarding temperature, flexibility and vibration-resistance. The hose-assemblies are typically used to forward and distribute bleed air which is taken from the compressor stage of the main engine of the aircraft.

- Pressure-range 38-138 bar (dependent on hose-diameter)
- High operation temperatures up to 430 °C in pneumatic systems, temperature excursions up to max. 650 °C for Class B an N
- High flexibility and vibration-resistance at operation-temperature 430 °C and medium pressure
- Optional with fire protection sleeve

The hose assemblies are produced with high sophisticated, special production processes acc. to PRI/NADCAP-requirements with tuned, narrow part tolerances. This guarantees a low scatter band for the technical performance of the metal hose assemblies for the use in the field. All relevant technical parameters are measured, checked and recorded during production.



HYDRA® EXPANSION JOINTS

Gimbal Joints



High-pressure design (gimbal joints)

Single or multi-ply bellows element with cardan anchors for absorbing pressure thrust, providing all-round angular flexibility. Available with different pipe connections. Already qualified for air travel in the 90's, these products are available in weight-optimised designs as per ABS0736 in different diameters, with inside anchoring. Stainless steel, Titanium and Inconel 625 are used as construction materials. Application for example in flexible bleed air ducts of aircrafts. An extensive program of different stainless steel designs is available for space travel, e.g. for cryogenic fuel lines for the Ariane 4 and 5 launcher.

Special properties

- Best possible pressure resistance
- Lowest friction resistance and reaction moments
- Process / product qualification as per DAN481 (Test Report TR 03-97)
- Absolutely gas-tight
- Angular flexibility up to ± 7 degrees
- Maintenance-free

Ball Joints



Low-pressure design (ball joint)

Single or multi-ply bellows element with ball-shaped metal anchoring with in-between graphite slide ring for 360° angular flexibility. Conceptualised for air travel in the 90's as a lightweight design according to works standard. Nominal diameter for this low-pressure construction (up to 8 bar) ranges from DN38 to DN125.

Special properties

- Most compact design for a metal bellows joint
- Absolutely gas-tight
- Minimal weight
- Angular flexibility up to ± 7 degrees



HYDRA® SPECIAL APPLICATIONS

Antenna protection line



Design and functionality

Single-ply antenna protection conduit for high frequency signals. Connection between antenna tuning unit and antenna base. Positioning of this antenna component within the multiple bent ducting.

The bent sections of the protection conduit consist of semiflexible corrugated metal hoses. Three polyamide brackets located on both ends and in the centre are integrated to secure the coaxial feed of the antenna wire.

Special properties

- Exact bending of 3D layout for wire assembly group and external conduit, coaxial mounting.

Tank line for cable harness



Design and functionality

Pipe segmented into four different assembly groups (left – right design); The integrated metal bellows units of Inconel 625 relieve the two inside aluminium ducts which are responsible for the support of the lightning protection equipment. This protective conduit enables the secure feed of electrical cables through a filled aircraft tank and tolerates loads from all possible flying manoeuvres of military operations over the entire service life of the aircraft.

Special properties

- Most demanding requirements for nonporous welding of Aluminium alloy
- Sophisticated process for flange machining
- Weight-optimised construction
- Maintenance-free



HYDRA® SPECIAL APPLICATIONS

Anti-resonance vibration system



Design and functionality

Assembly group consisting of primary and inside secondary bellows unit, reduces vibration loads of helicopter main rotor on cell by 95%.

Special properties

- The secondary bellows unit, fitted with a mass and mechanical spring, is designed as a coupled single degree of freedom system aligned to a 4-times rotary frequency.
- Introduction of completely new material technologies (17-4 PH / 17-7 PH).
- Proof of high geometrical precision, measurement of narrow tolerance stiffness for individual parts / assembly groups

Accumulators for ISS



Design and functionality

A metal bellows, pre-tensioned by a mechanical or pneumatic spring, communicates with the medium of the connected system via its hydraulically-effective cross section. Pressure changes on the system side are converted into corresponding changes in volume on the system interface. Accumulators may be used as hydraulic energy reservoirs for actuators, e.g. for quick operation of rudder and flaps.

Special properties

- Compact design: By the use of a „special bellows profile“ and adjustment to required volume change
- Self-regulating and maintenance-free
- Fine regulation of response pressure (for mounting or subsequent adjustment)
- No elastomeric or plastic parts are used
- Reliable life cycle (no aging effects)
- Permanently vacuum-tight, including moveable system interface



HYDRA® METAL BELLOWS AND METAL HOSES

Bellows-Assemblies



Wide range of metal bellows

Corrugated bellows combine higher pressure resistance with low displacement forces and optimized expansion capacity. Small size steps for ideal interfacing from DN 2 to DN 1000 and beyond, also from special materials (e.g. IN718 or Ti 15-3-3-3).

Most adaptive and reliable components

- Multi-ply constructions for high flexibility at maximum pressure strength
- Alternative constructions / combinations (e.g. formed, edge welded, with / without braiding, coaxial).
Membrane bellows with a very high degree of elasticity and low spring rates

Metal Flex Hose Assemblies



Wide range of metal hoses

- Small size steps for ideal interfacing from DN 6 to DN 300
- Different hose types engineered for specific applications with individual end-fittings to customer's request
- High flexibility-version available
- Different hose profiles offer specific performance to customer's request
- Inconel versions for high temperature applications available

Safe and reliable components

- Separate welding of inner core and braiding
- Optimal constructional stress reduction at the welded braid joint

