WITZENMANN

WITZENMANN

managing flexibility

Flexible solutions for aviation and space travel

6500e/3/05/09/1,5

Witzenmann GmbH

Östliche Karl-Friedrich-Str. 134
75175 Pforzheim
Phone +49 - (0)7231 - 581 - 0
Fax +49 - (0)7231 - 581 - 820
wi@witzenmann.com
www.witzenmann.com

HYDRA

Quality by Witzenmann

Worldwide development partner

The Witzenmann Group is a worldwide leader in development and production know-how for flexible elements. As an internationally active Group with 23 companies and over 3,000 employees we are driving innovations in our industry. At the competence centre in Pforzheim solutions are continuously optimised and new solutions are developed. Such as those for aviation and space travel.

MANAGING FLEXIBILITY – A MISSION WITH ITS OWN DEMANDS

Our product program for aviation and space travel covers the entire range of applications for flexible metallic elements. When it comes to decoupling and absorbing vibrations and movements, the safe transport of cryogenic fluids under pressure or compensating for stress from thermal expansion – we are a development partner who is in high demand. As a founder of the metal hose and expansion joint sector we are able to draw from an extensive knowledge and experience pool, assisting us to quickly develop optimum tailor-made product solutions, starting from a “simple” hose line for the fuel pipes of aircraft to the complex bellows system for the decoupling of vibrations. To us, managing flexibility means always finding the right answer for the challenges facing our partners.

Approvals and certificates

AECMA EASE authorised

EN9100 (incl. responsibility for development)

Listed in the IAQG OASIS database

Authorisation as per DVS2718,
defence technology welding approval

JAR / EASA - 145

Process and product audits
as per SAE AS 7003 (NADCAP)

The HYDRA®- product brand stands for products which meet the most demanding quality requirements. Corresponding with our claim to quality leadership, Witzenmann quality management is firmly anchored in all processes and structures, and hence secures uniformly high quality standards within the Witzenmann Group on a global basis.

Quality at the system level

The certification of the quality management system pursuant to the standards ISO 9001 as well as TS 16949 forms the basis for a process-oriented quality assurance for the entire Witzenmann Group. In addition, an annual audit by an IAQG accredited certification company according to EN9100 is carried out specifically for the special requirements of aviation and space travel.

Quality at the process level

In view of the small batch sizes in aviation and space travel, the 100% quality inspection for individual and final parts is at the forefront. As a result, investigations regarding equipment capability and automated, Statistical Process Control (SPC) that would be applied to large series are replaced by elaborate customer-specific process qualifications. In this vein the aviation and space travel industry has begun to describe standard processes, which are regularly audited and certified at the respective supplier according to SAE AS 7003 (NADCAP) and the respective process specifications of the independent Performance Review Institute (PRI) of the SAE. Witzenmann works on both levels and therefore belongs to one of the few companies worldwide which are able to conduct an entirely in-house qualification process for e.g. metal hose programs as per AS1424.

Quality at the product level

In order to address all requirements when verifying a product property for functionality and materials, we make use of our very extensive testing facilities. Hydraulic and electro-dynamic vibration test stands, hot gas and life cycle inspection facilities, corrosion testing equipment are just a few of the stations we use to test and put our products into extreme conditions. Effects of all types of operating conditions on metallic product or component structure are investigated in our own material laboratory, including the use of scanning electron microscopy.

References

Airbus Deutschland
Avio-Diepen
DLR e.V.
Dräger Aerospace
EADS Astrium
EADS Military
EADS Space Transportation
Eaton Aerospace
Eurocopter Deutschland
Industria de Turbo Propulsores
Liebherr Aerospace
Magna Steyr Space Technology
MTU Aero Engines
Pfalz - Flugzeugwerke
Snecma
Techspace Aero
Thales
Verhaert

ENGINEERING IS THE BASIS – RELIABILITY IS THE PRODUCT

Nowhere are the demands on technology and production greater than in aviation and space travel. Witzenmann designs, develops and manufactures products for extreme conditions.

As a result, by virtue of our know-how and products we are participating in many prestigious projects. Whether it is Ariane, Galileo, ISS, Eurofighter, Eurocopter and Rolls-Royce, or as part of each currently produced Airbus aircraft model: Our flexible metal elements are always on board.

Whether it concerns flexible hot gas lines for the de-icing of aerodynamically sensitive areas on an aircraft, or anti-vibration systems for helicopters or cryogenic supply lines maintaining rocket motors pivotable – flexible elements and systems are significant contributors enabling seminal research projects to take flight. All the way up to space, where they ensure the necessary installation and pressure compensation in the cooling cycle of the Columbus module. In order to ensure the development of these solutions, we continuously invest in the optimisation of our research, development and manufacturing processes and technology. Because – extraordinary efforts lead to extraordinary products.

Flexible pipe systems

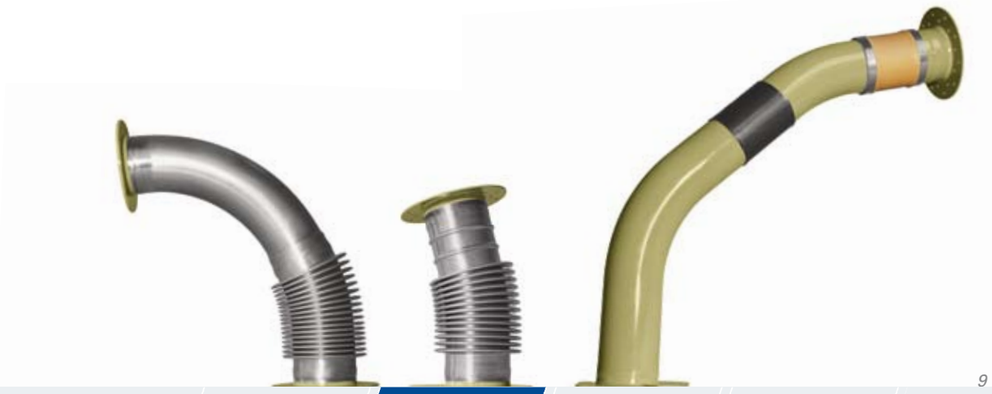
Design and functionality

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

The bent sections of the shroud consist of annular corrugated hoses. Three polyamide brackets located on both ends and in the centre are provided for the coaxial feed of the antenna wire. All metal parts for high frequency performance, starting with copper and copper-plated brass, are galvanically coated with silver.

Special properties

Exact bending of 3D layout for wire assembly group and shroud, coaxial mounting.



Flexible pipe systems

Design and functionality

Pipe segmented into four assembly groups (left – right design); using the integrated metal bellows, both outside Inconel 625 units relieve the two inside aluminium units which are responsible for the support of the lightening protection equipment.
This protective pipe enables the secure feed of a bundle 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 plane.

Special properties

- Aluminium mounting / lightening protection insulator using „Shape Memory“ – alloy
- Most demanding requirements for partially automated, nonporous welding of Aluminium alloy
  requirements for pore freedom
- Special process for flange machining
- Weight-optimised construction
- Maintenance-free

Coaxial pipe systems

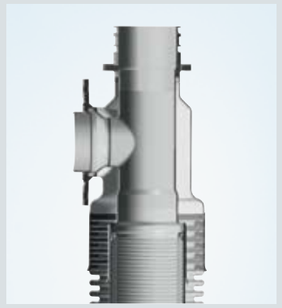
Design and functionality

Two coaxial metal hose lines made 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 of Airbus planes, the outer hose line forms the protective and drainage shroud and is firmly coupled to the inside unit at the rigid ends.

The movement of the elevator, which contains the trim tank, is decoupled from the rigid fuel transfer pipe of the fuselage over the entire life cycle of the plane.

Special properties

- Construction allows for continuous drainage through rigid interface connection and hence provides leakage detection for the inside fuel line
- Additional side outlet as complete main connection with drainage and leakage detection
- Complete welding construction, x-ray compatible
- Maintenance-free



Coaxial bellows systems

Design and functionality

Kerosene-carrying inside pipe with coaxially enclosing drainage space for monitoring leaks. Moveability is assured by two parallel switched metal bellows; in axial direction the stroke-dependent anchoring against pressure thrust is enabled by a special outside braiding. These elements in different lengths form the connection between the additional tanks in the cargo bay and the fuel pipes.

Special properties

- New welding configuration guaranteed Gap-free interior space, as well as user-friendly mounting during production despite coaxial configuration of elements
- Extensive qualification of welding process
- High endurance
- Maintenance-free

Bellows solutions

High-pressure design (Gimbal joint)
Single or multi-ply bellows element with cardan anchors for absorbing pressure thrust, providing all-round angular flexibility, and with different pipe connections. Already qualified for air travel in 1996, these products are available in weight-optimised designs as per ABS0736 for nominal dia-meters 4 and 6 inches, with inside anchoring. Mainly titanium and Inconel 625 as construction material. Used in bleed air ducts of aircraft engines.
Also available in the area of space travel is an extensive program of different stainless steel designs for cryogenic fuel lines (tank and feed 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

Low-pressure design (ball joint)
Single or multi-ply bellows element with ball-shaped sheet metal anchoring with in-between graphite slide ring for all-round angular flexibility and as pipe welding solution. First conceptualised for air travel in 1993 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

Hose program

Design
These annular corrugated hose lines as per AS1424 / ISO 7314, for hot air (bleed air) at medium operating pressures (38-138 bar) and high temperature (430 degrees Celsius), allow customers to decide shortly before delivery which removable fittings according to standards AS136-141 („flareless“) and AS5458-5463 („flared“) will be used for assembly, using a basic configuration (metal hose with pipe weld-on ends).
These products are used for aircraft turbines and in the area of hot air lines for an aircraft’s air conditioning and de-icing system. Similar configurations are used in the upper stages of the Ariane 5 launcher.

Special properties
- International standard specifications as per AS1424 / ISO7314 enable a worldwide use without additional costs for product qualification and tests acceptance, under the condition that the supplier carries out an independent certification of his product program on an annual basis.
- For the internal verification inspections and official qualifications for the PRI/Nadcap-approvals, special high-temperature testing equipment for the verification of endurance (superposed with pulsed flexing inside pressure) and vibrating loads has been developed.
- Special production processes in connection with tuned, narrow part tolerances guarantee a low scatter band for the functional properties of these products.

Decoupling systems

Design and functionality

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

Special properties

- The core unit, 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

Bellows systems

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 sectional area. Pressure changes on the system side are converted into corresponding changes in volume on the system interface.
In this vein, it is possible to e.g. maintain system pressure of a coolant cycle of the International Space Station (ISS) at the desired pressure interval during temperature changes. In the event of pressure pulsations in pipe systems, e.g. the „feed lines“ of a booster rocket or a spacecraft, the pressure-dependent volume balancer effects a smoothing out of peak pressure values of fuel (e.g. oxidisers) and thus prevents the dreaded „Pogo“effect. In aircraft similar accumulators are used as hydraulic energy reservoirs for actuators, e.g. for quick operation of rudder and flaps.

Special properties

- Compact design
  - Optimisation possible with „special bellows profile“
  - Adjustment to required volume change
- Self-regulating
- 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
- Smallest pressure / stroke hysteresis
- Maintenance-free