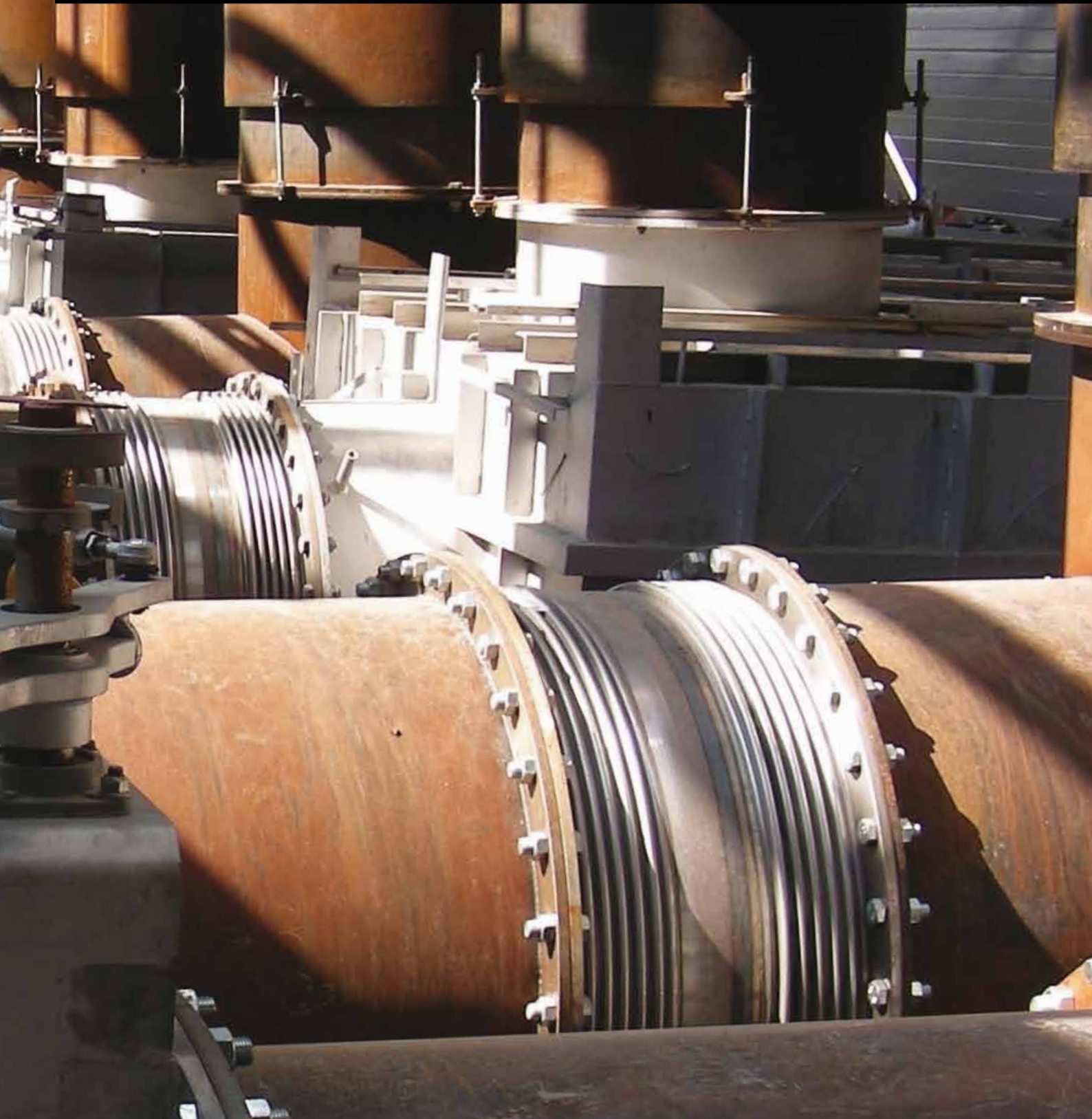


Excellence in Metal Expansion Joints



The Experience that counts!

Established in 1963, KE-Burgmann's first export order in 1969 set the grounds for continuous growth and internationalization of the company. Today, KE-Burgmann A/S is one of the largest global expansion joint manufacturers with 9 subsidiaries in 8 different countries and a worldwide sales network.

KE-Burgmann's core business is expansion joints - designing, manufacturing, technical support and service. Through continuous customer support and the development of innovative expansion technology, we strive to become the preferred partner to our customers by offering solutions to problems associated with fabric, metal and rubber expansion joints, as well as package solutions, related components and services.

Two subsidiaries, KE-Burgmann Bredan A/S and KE-Burgmann EJS, design, manufacturer and install metal expansion joints worldwide. By continuing to developing long-term relationships with our customers in the chemical, district heating, marine, oil & gas, petrochemical, and power generation industries, we strive to become the preferred partner for complete expansion joints solutions, related components and services.

Ownership

EagleBurgmann. In 1993 the KE-Burgmann Group became part of the international organisation, Burgmann Industries which brought the Japanese company Eagle into their core sealing technology business and operates under the name EagleBurgmann. Established in Dresden Germany in 1884, today Burgmann Industries comprises of over 50 subsidiaries, joint ventures, and affiliated companies with over 4000 employees worldwide.

Freudenberg The EagleBurgmann organisation is owned by the Freudenberg Group - an international family owned organisation with 14 business areas operating in various markets and sectors of industry. Freudenberg was founded in 1849 and is today active in 52 countries with over 30.000 employees.

Memberships

KE-Burgmann is member of several associations, establishing and improving design standards for the expansion joint industry.

These memberships and certifications include the following:



The European Sealing Association (ESA) is an organisation with over

40 members and represents more than 85% of the fluid sealing industry in Europe.



Fluid Sealing Association (FSA) is an international trade organisation, representing over 85% of the manufacturing capacity for fluid sealing devices in North America.



Euro-Qualiflex is a union of metal expansion joint and hose manufacturers based in Germany.



Expansion Joint Manufacturers Association (EJMA) is an association of established manufacturers of metal expansion joints who develop the industry's design standards. KE-Burgmann is represented on both the Technical and Management committee.

Certifications



KE-Burgmann is approved by Bureau Veritas according to the quality standard ISO 9001:2000 which verifies documentation of controlled processes from receiving a quotation to the packing and shipping of the finished product. KE-Burgmann also holds the ISO 14001:2004 and OHSAS 18001:2007 environment and health & safety certifications, approved by Bureau Veritas.



To supply to pressurized systems over 0,5 Barg, KE-Burgmann is approved according to the European Pressure Equipment Directive (PED) 97/23/CE by Bureau Veritas.



KE-Burgmann holds an ASME, Section VIII, Division 1, U2 unfired pressure vessel certificate and is a UOP recommended manufacturer.

For more information on the company, KE-Burgmann or our products, please visit our websites:

www.ke-burgmann.com and www.keb-ejs.com

On the following pages you will find a short description of our metal expansion product types. For more technical information please request a copy of our Technical Design Manual.

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Bellows Design and Metal Expansion Joint basics

- Quality
- Reliability
- Flexibility

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- Low Pressure

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Installation, Service and Preventive Maintenance

- Improve Reliability
- Increase Service Life
- Worldwide Service Teams

1 Bellows Design and Metal Expansion Joint basics

- Quality
- Reliability
- Flexibility

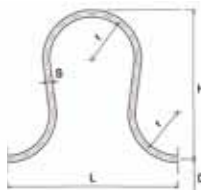


Bellows Design

The bellows is the basic element of an expansion joint. Design of bellows for expansion joints is predominantly determined by movement, pressure, temperature, service life, materials and corrosion. Bellows are designed in accordance with the EJMA (Expansion Joint Manufacturer Association), ASME B31.3, ASME Sec VIII, EN standards and the experience of the engineer to ensure the proper geometry is selected.

The bellows is manufactured by forming corrugations, or convolutions, in thin-walled metal cylinders. These cylinders can be inserted inside each other to form multi-ply bellows. The drawing process does not thin the bellows tube. All bellows are formed in their cold state and optional heat treatment can be performed afterward.

The ability of metallic bellows to absorb movements and cycle properly is determined by the bellows geometry and material which include total number of convolutions, convolution height, convolution pitch and radius, thickness of material and number of plies.



Bellows are designed to absorb axial, lateral and angular movement. Applying torsional movement on bellows should be avoided.

If torsional movement is present, appropriate hinge or gimbal hardware is highly recommended to counter the torque.

Materials

KE-Burgmann bellows are made of one or more plies of stainless steel.

Materials used for metal bellows:

- Austenitic Steel
- Incolloys
- Inconels
- Hastelloys
- Titanium
- Other formable materials

Connections, sleeves and casing

Fitted connections to the bellows can be:

- Plate flanges
- Vanstone flanges
- Welding ends
- Landing bars
- Special connections
- A combination of the different connections

At high temperatures or high flow velocities, internal sleeves, or liners, are recommended. The internal sleeve protects the bellows from erosion in harsh operating environments. An external cover, or shroud, protects the bellows against mechanical damage during installation, shipping and operation.

Mating, or connecting flanges, bolts, nuts and gaskets can also be installed as a part of a complete metal expansion joint solution.



Welding

KE-Burgmann weld according to EN or ASME Codes.

Tests

Welding integrity and product quality can be checked using various non-destructive tests (NDT) such as:

- Dye Penetrant test
- Magnetic Particle test
- Helium Leak test
- X-ray test
- Ultra Sonic test
- Pressure test

Other tests, such as cold movement check, can also be requested. Tests may be carried out in-house or externally and supervised by an independent notified body.



Certificates

KE-Burgmann holds Type Approval Certificates from:

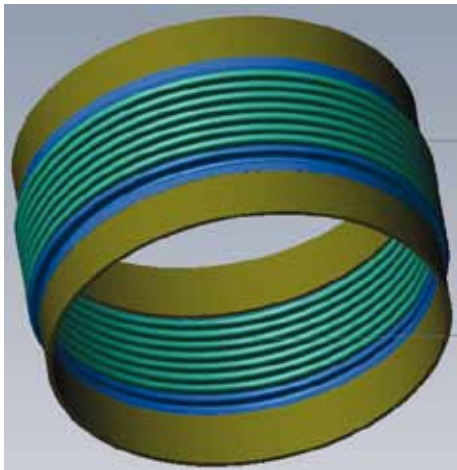
- Bureau Veritas
- Germanischer Lloyds (GL)
- American Bureau of Shipping (ABS)
- Lloyds Register of Shipping (LR)
- Russian Maritime Register of Shipping

2 Ducting Expansion Joints

- High Temperatures
- Low Pressure



KE-Burgmann exhaust expansion joints are designed to absorb axial, lateral and angular movements or combination of these.

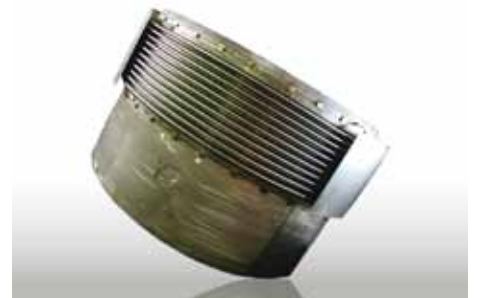
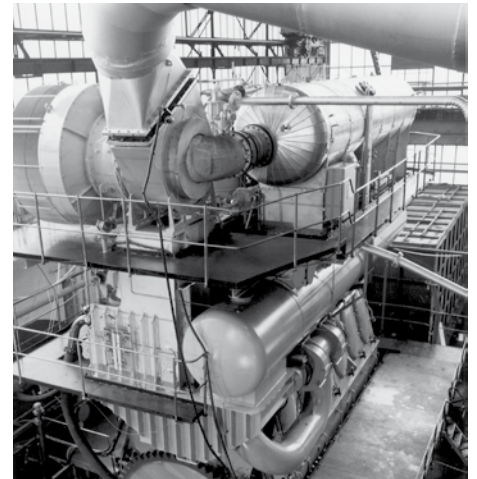


The exhaust expansion joint is used for high temperatures and low pressure to absorb thermal expansion in ducting from:

- Engines
- Boilers
- Turbines
- Ventilation
- Other low pressure systems

KE-Burgmann Exhaust Expansion Joints are installed in:

- Diesel / Gas Engines Power Plant
- Exhaust line
- District Heating Power Plant
- Coal / Gas / Biomass / Power Plant
- Gas Turbines
- Turbo Charger Air Inlet
- Turbo Charger Air Outlet
- Heat and Ventilation Systems
- Heat Recovery Boiler
- and Silencers



Gas Turbine Exhaust (GTX) expansion joints are ideal for absorbing thermal growth in a high temperature, pressure pulsating environment. The exhaust joints are supplied in one piece, complete with internal shipping spiders and lifting lugs. Removable insulation jackets can be also provided upon request.



3

Engines and Vehicles

- High Temperature



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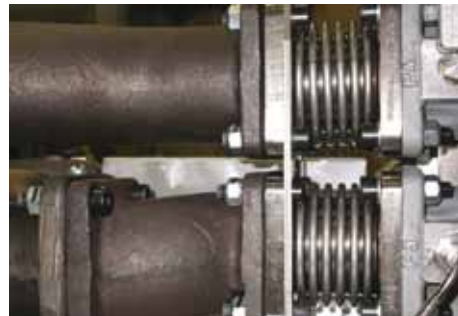
KE-Burgmann exhaust expansion joints for engines and vehicles are designed to absorb vibrations, axial, lateral and angular movements or any combination of these.



The bellows is a multi-ply construction with a customized design. Thin layers of material make it particularly well suited to absorb a combination of axial and lateral movements as well as vibrations.

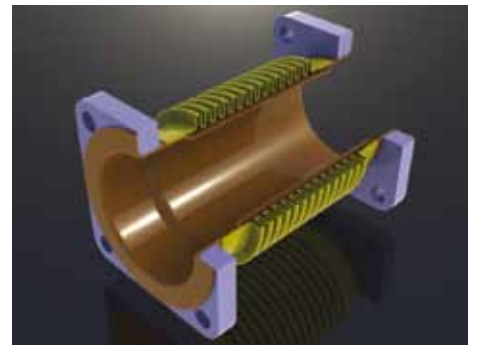


Exhaust expansion joints are used at high temperatures to absorb vibrations from engines, silencers, turbines or other exhaust systems.



KE-Burgmann Exhaust Expansion Joints are installed in:

- Turbocharger Exhaust Inlet
- Turbo Charger Air Outlet
- Exhaust Receiver
- Turbocharger By-pass
- Single Pipe or Pulse
- Exhaust Manifold
- Diesel Engine Exhaust Line
- Vehicles Exhaust Line
- Generator Sets Exhaust Line

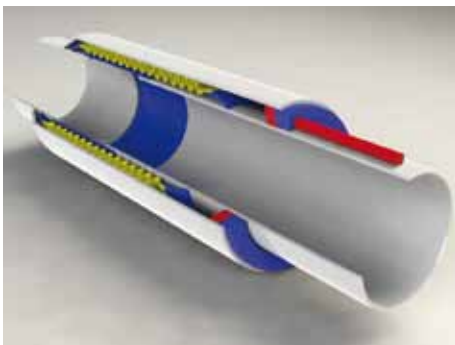


4 District Heating

- Long Movements
- High Pressure



Danmuff® expansion joints have been designed especially for installation in district heating pipe systems.



Danmuff®

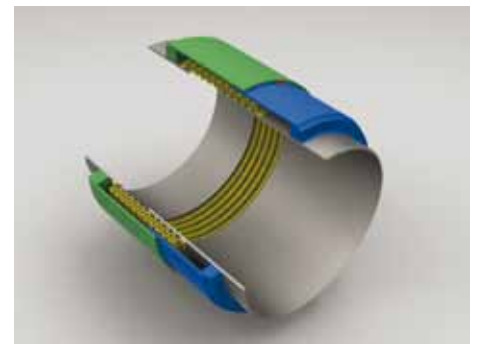
The axial compressive forces in the pipe system can be transferred directly through the media pipe without the bellows being overloaded.

If the temperature in the pipe system drops significantly, the stresses in the media pipe will be transferred to the stop ring through the outer casing pipe. The expansion joint is pre-stressed 100% at the factory using break-away bolts.

When the installation is put into operation, the break-away bolts are initiated distributing movement throughout the expansion joint.



DanOne® is a one cycle expansion joint especially designed for district heating. The expansion joint is mounted in-line into the pipe system.



DanOne®

Once temperature has increased, the expansion joint will be compressed due to the growth of the pipe system. The expansion joint is secured by welding the outside casing to the pipe system.

The bellows is designed for only one cycle. Afterward, the bellows is no longer active. Future expansion in the pipe system caused by fluctuations in temperature will be absorbed as tensile and compressive stresses.

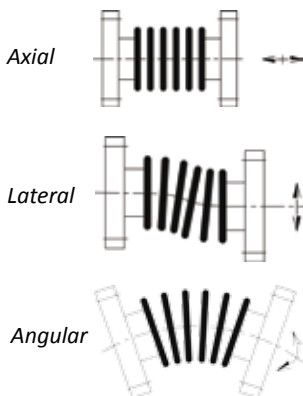
5

Axial, Lateral and Angular Types

- For Movements in Pipelines with Pressure



Metal expansion joints can be used in closed piping systems with movements in the axial, lateral and angular direction or a combination of the three types.



Axial Types

Axial expansion joints are used in pipeline systems for absorption of movements along the longitudinal axis of the pipeline.

Axial expansion joints are available with weld ends, plate flanges, welded neck flanges or a combination of connections.



Lateral Types

Lateral expansion joints are designed to absorb movement as the two ends of the expansion joints are sheared away from each other but are kept parallel. Lateral expansion joints are available with tie rods secured to the flanges by means of nuts and a specially designed spherical washer, allowing angular movement between bolt and flange.



The number of tie rods is dependent on diameter and pressure.



Tie rods are used to limit the movement of the expansion joint only perpendicular to the end connections. Lateral expansion joints are therefore ideal for installation in pipe systems with bends.



Tie rods restrain hydraulic forces (pressure thrust) in a piping system and eliminates the need for main anchors. Pressure thrust is the force created when an untied expansion joint is introduced into a piping system.



Universal Expansion Joints

Universal metal expansion joints are designed to be installed without hinges or tie rods. This means that the piping system must be able to accommodate vibrations and temperature variations. A metal expansion joint can also be locked to work in one direction.



Angular Types

Angular expansion joints are designed with only one bellows; however multiple angular expansion joints can be installed in a pipeline without a fixed point in between.

Angular Expansion Joints are divided into two types:

- one plane angular; a hinged type
- multiplane; a cardan or gimbal type.



One plane, hinged expansion joint.

The external hardware absorbs the pressure thrust force arising from the operating pressure but makes axial expansion impossible. Angular expansion joints can only absorb bending movements and are ideal when sturdy, fixed locations are not present in the piping system.

Hinged Types

Hinged expansion joints are designed to absorb angular movement in only one plane while restraining pressure thrust and any external loads that may be applied

Gimbal Types

Gimbal expansion joints are designed to absorb angular movement in any plane while restraining pressure thrust and any external loads that may be applied.

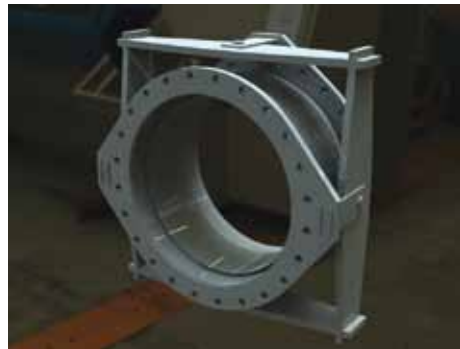
The gimbal assembly, which consists of a two hinge arrangements joined together by a floating central “gimbal” ring, allows for angular rotation in all planes.

Typical applications are:

- Power Plants
- Chemical Plants
- Pulp and Paper Plants
- Mining
- Desulphurisation plants



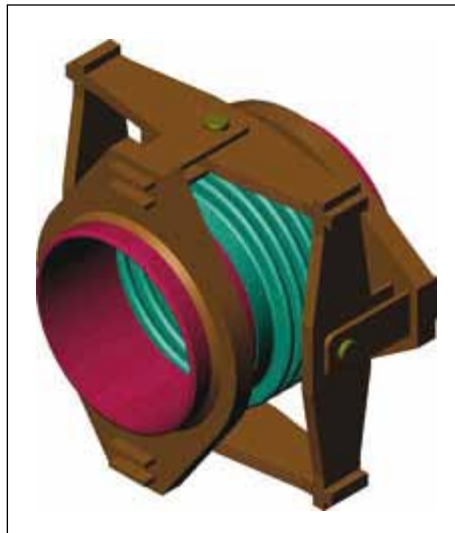
3D Drawing of a multiplane, hinged expansion joint - for angular movements.



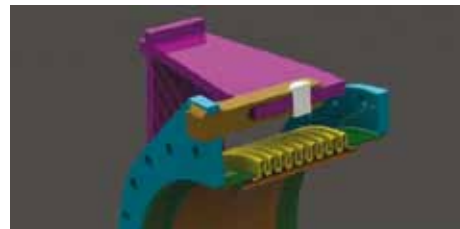
Multiplane, angular expansion joint with gimbal and flanges.



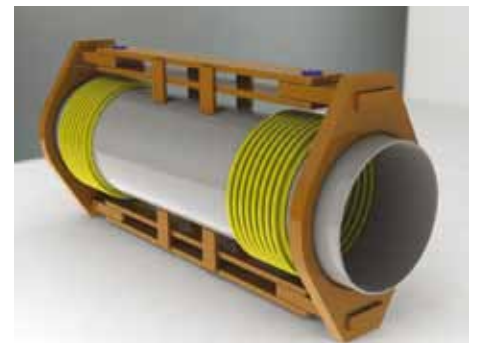
Multiplane, hinged expansion joint - for angular movements.



3D drawing of a multiplane, angular expansion joint with gimbal and weld ends.



Multiplane, angular expansion joint with gimbal.

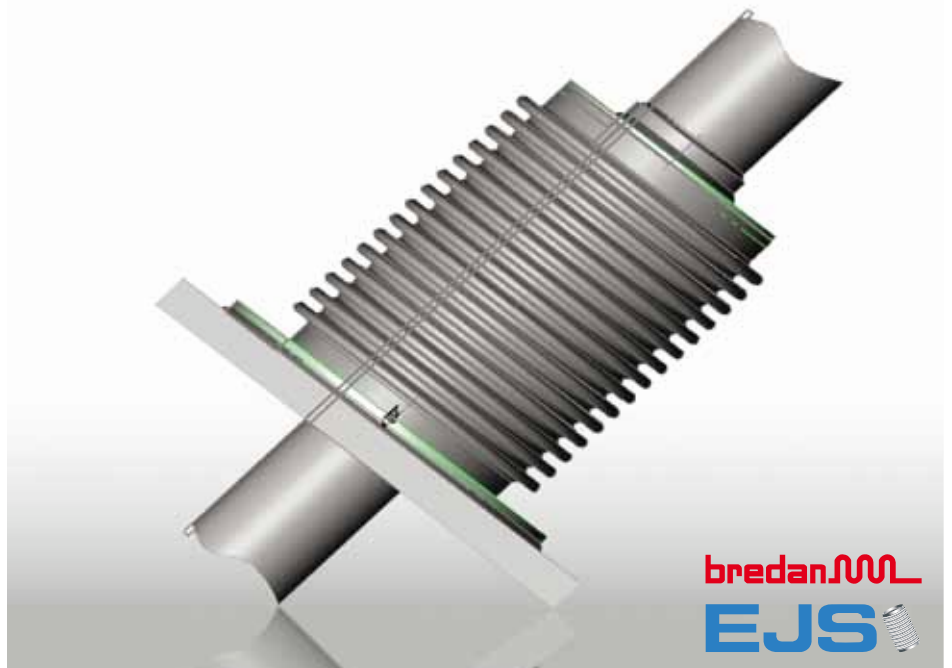


3D drawing of a single plane, hinged expansion joint.

6

Penetration Seals

- A Seal for Low maintenance
- For Thermal Pipe Expansion



Pipe penetration seals are used to allow tubes or pipes to expand thermally by penetrating the shell or pressure casing. It eliminates the leakage of heat and other emissions, reduces noise and protects maintenance personnel.



These seals are designed to accept axial, lateral and angular movements therefore, lowering the stress on the tubes and pipes to which they are attached.



Pipe penetration seals can accommodate most applications from original manufacturer to retrofits of existing installations. High operating temperatures typically keeps the temperature in the bellows warm enough to prevent media from condensing. Corrosion can occur if the media condenses and collects in the lower end of the seal during operation.

Metal expansion joints provide good insulation between the boiler wall and the attachment ring.

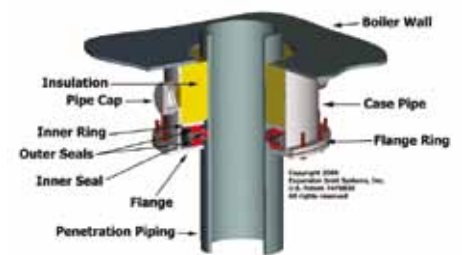
Penetration Seal Expansion Joint Advantages:

- Personnel are protected
- No leaks
- Reduces pipe stress
- Increased boiler efficiency
- Noise reduction
- No maintenance
- With insulation on request

Heat Recovery Steam Generators (HRSGs) are an excellent way to capture more value from the fuel budget. Achieving the most from an HRSG requires that the generators operate as efficient as possible. To increase efficiency and reduce maintenance cost, power plants are embracing a new generation of boiler penetration seals – slider seals that can significantly lower energy loss, while reducing the maintenance load and risk of unplanned outage.



PS Seals™ from KE-Burgmann EJS makes it easy to replace metal and fabric type bellow seals without the need for specially trained welders or installations technicians.



Our new PS Seal® offers an increasingly effective boiler seal with easy installation and lower maintenance costs.



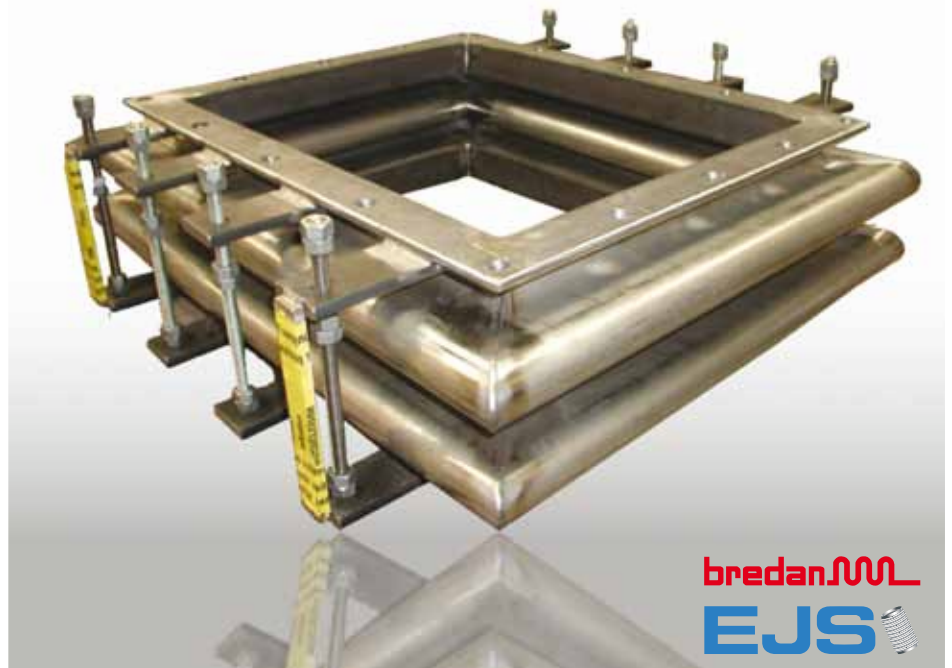
Our slider seal, the PS Seal®, uses a floating ring design with patented stainless steel flow reducing seals in contact with the penetration pipe outside diameter and lateral movement plates. The seals are compressed on assembly to provide minimal gas leakage during operation.

As particulates build up in the seal and further restricts passage of gas, any gas leakage in the seal increasingly reduces over time. The stainless steel wire mesh seal can be replaced easily during shutdowns eliminating the need to replace the entire unit.

7

Rectangular Ducting

- Absorb Vibrations in Rectangular Ductings



Rectangular metal expansion joints are designed to compensate for axial, lateral and angular movements over a diverse cross section of operating conditions.

Commonly installed in gas turbine exhaust systems, steam turbine/condenser connections, boiler breaching, forced draft fans, flue gas ducts, regenerations, precipitators and many other hot gas, large volume ducting

Rectangular design considerations include:

- Pressure capability
- Instability
- Stresses due to pressure
- Stresses due to deflection
- Fatigue life
- Spring rate and forces
- Materials



KE-Burgmann Bredan's product range includes two standard types of rectangular expansion joints:

- A single-ply type with different corner configurations or
- A multi-ply type with radius corners
- Corners can be mitered or rounded, if required



systems, rectangular metal expansion joints are used primarily for applications in power generation, steel, petrochemical, refining, chemical, and other industries.



Round corner



Single miter corner



Camera corner



Double miter corner



8

Pressure Balancing

- In-line Pressure Balanced
- Pressure Balanced Elbow

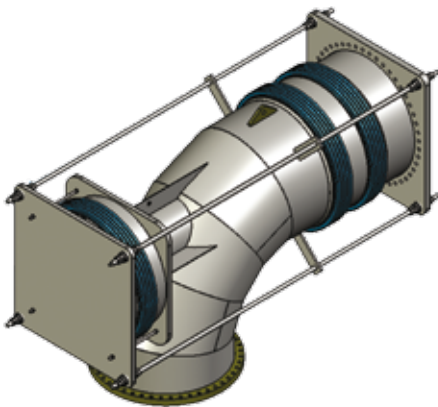


Pressure balanced expansion joints are designed to absorb axial, lateral and angular deflections while simultaneously absorbing the pressure thrust of the system. This eliminates the need for expensive anchors in the system.

The pressure thrust is absorbed using a combination of tie rods and an additional “balancing” bellows. They can be installed conveniently at any elbow in the piping system or, if no elbows are present, in any straight portion of the system.

Pressure Balanced Elbow

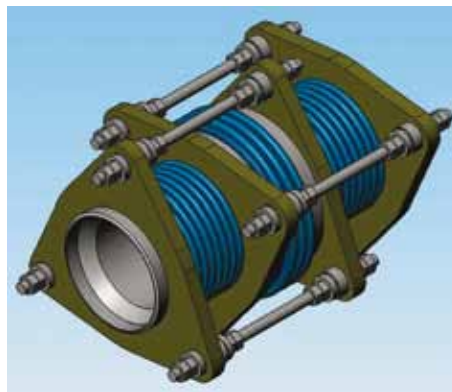
A Pressure balanced elbow is designed to absorb axial movement and/or lateral deflection, while absorbing pressure thrust. This is achieved by means of tie rod restraints that connect a line bellows with an opposed balanced bellows also subjected to line pressure.



In-Line Pressure Balanced

An In-Line pressure balanced joint is designed to absorb axial and lateral movement while counteracting the pressure thrust in a system. This is achieved with a series of rods and a balancing bellows with twice the effective area as the line bellows.

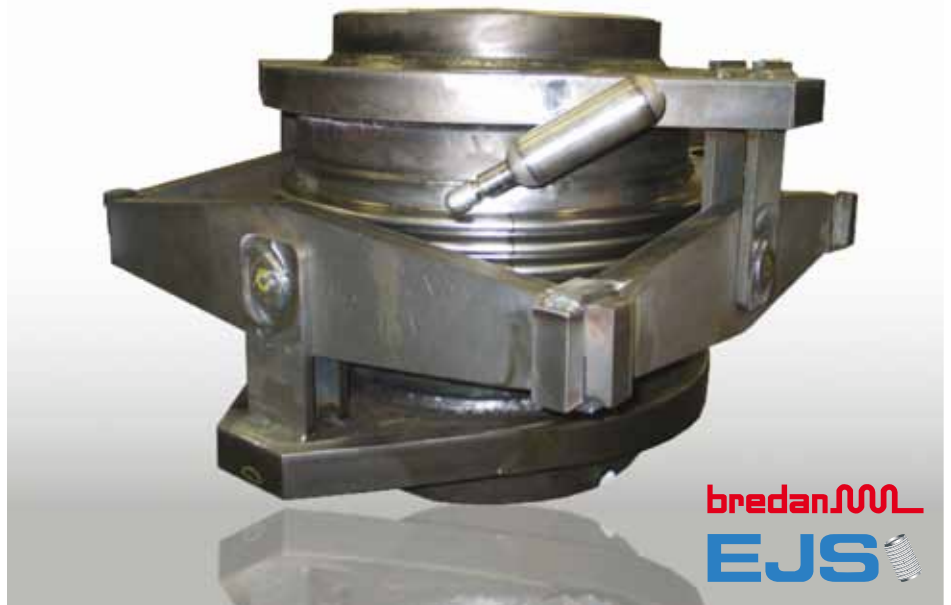
The most common applications for pressure balanced expansion joints are on the inlet or outlet of load sensitive, rotating equipment like a pump or turbine.



9

Leak Detection and PTFE Coating

- Leak Monitoring Bellows
- PTFE - a Coating for Aggressive Medias

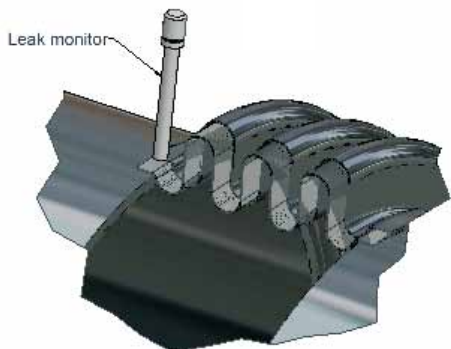


Two Ply Testable Bellows

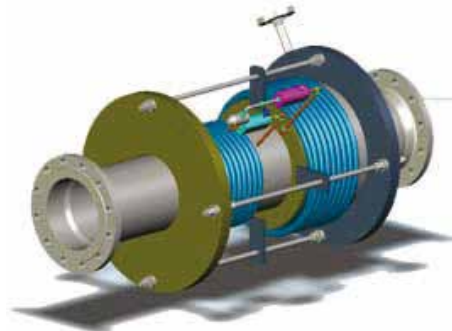
A two ply testable bellows has two plies and each is independently designed for the full system design conditions.



When the expansion joint is installed into the system the test ports are used to detect any leakage. Gauges, leak monitors, pop up detectors or direct monitoring to the control room can be attached to the test ports.



A two ply testable design can be used to monitor the bellows for deterioration. This prevents unexpected shut-downs and allows you to plan maintenance of the pipeline.



Metal expansion joints with PTFE liner combine the properties of metal and PTFE into the most advanced versatile metal expansion joints on the market.

The PTFE liner offers a relevant alternative to use high alloy nickel materials, eliminating the risk of stress corrosion.

Metal Expansion Joints with PTFE liner material, manufactured exclusively by KE-Burgmann, is suited for use in:

- Chemical Plants
- Medical/Pharmaceutical Plants
- Food Industry
- Pulp and Paper Industry
- Many Other Industries

The PTFE In-liner is excellent resistance to chemical attacks from:

- Chloride Water
- Diesel Oil
- Fuel Oil Acids
- Hydrochloride Acids
- Lubricating Oils
- Saltwater
- Ozone



PTFE

PTFE material can be added in expansion joints where the media is aggressive. PTFE is manufactured by KE-Burgmann. The foil is sintered and laminated together. The PTFE tube is welded inside the steel tube, and the bellows corrugations are subsequently formed into the tubes.



10 FCCU, CCR and Turbo Expander Units

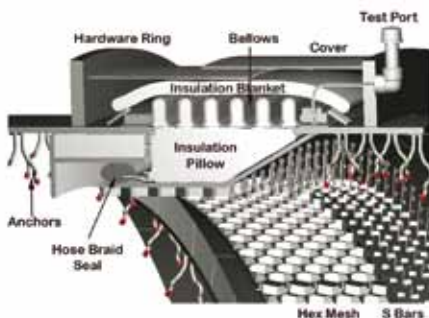
- Large Thermal Offsets
- Abrasive Media
- High Temperatures
- High Pressures
- Refractory Lined



Metallic expansion joints are an integral component of these complex refinery processes and their reliability can be significant to the refinery's productivity and performance. An unexpected joint failure can represent millions of dollars in losses to a refinery.

Expansion joints used in FCCU service are some of the most critical and complex expansion joints manufactured. Fluid Catalytic Cracking Units (FCCU) operate at very high pressures and temperatures, consequently resulting in large thermal movements that must be absorbed by the expansion joint. Furthermore, the introduction of abrasive media (catalyst) requires additional protection to avoid gradual deterioration and premature failure of the expansion joint.

The bellows membrane is the most critical element of the expansion joint



Cross section model of an FCCU expansion joint illustrating the various layers of this complex unit.

assembly. Its relatively thin wall construction is designed for maximum flexibility, but must be protected against erosive catalyst and other corrosive media.

Expansion Joints for FCC Service fall into three major categories:

- Cold Wall
- Hot Wall Lined
- Hot Wall Unlined

Various types of expansion joints and hardware (accessories) used in FCC applications including:

- Gimble
- Hinged
- Pressure Balanced
- Pantographic Linkages
- Restrained Universals

Continuous Catalytic Reforming (CCR) requires an unlined thin-wall, high alloy expansion joints to accommodate high temperatures and movements.



DN800 (32") OD Tied Universal Expansion Joint for Continuous Catalytic Reforming.

With a great need to achieve higher performance and profitability, these expansion joints are critical to the overall success of the refinery.

The high temperature Turbo Expander is another important system within a refinery that can have a significant effect on production profits. The losses are extremely high to a refinery that must shutdown for major repairs to any equipment related to the expander such as the universal (double) hinged or gimbaled expansion joints expansion joints installed within the turbo expander piping system.

As with the FCC and CCR processes, this piping system requires experienced professionals to provide expansion joint designs to ensure long term safety, reliability and maintainability.

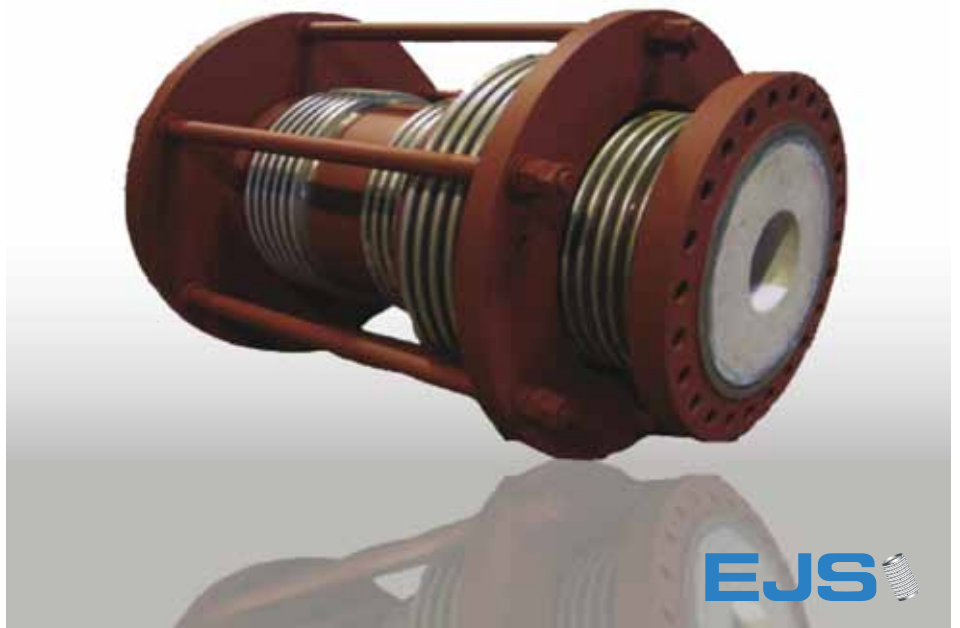


DN2000 (72") Hinged Expansion Joint for a Turbo Expander Piping System.

11

Petrochemical and Styrene Processing

- Extreme Pressure
- High Operating Temperatures



Petrochemical and styrene process lines require expansion joints to handle extreme pressures and operating temperatures up to 926 deg C/1700 deg F.

These expansion joints are commonly equipped with testing ports to detect leakage in between two plies bellows and/or have a refractory lining to eliminate erosion from catalyst.

ed to the expansion joint by welding in special stainless anchors. A form is made and liquidized concrete is added between the form and the steel parts.



DN2600 (102") Universal Hinge Elbow Expansion Joint for a large European Petrochemical Refiner.

Typically this application uses a combination of hinge and gimbal expansion joints that are designed to accommodate these extreme conditions.



Vertical piping system with hinged joints are a commonly used configuration for styrene processing.

The refractory lining is often used at:

- Steel Plants
- Refineries
- Copper and Aluminum Smelters
- Cement Plants
- Galvanizing Furnaces
- Chemical Plants



DN2000 (78") Universal Hinged Crossover Expansion Joint for a Styrene Revamp Project.



Metal expansion joint with refractory lining, in process.

Refractory Lining

Refractory lining can be added in expansion joints for high temperature applications.

The refractory lining is made to protect the steel parts from the high service temperature and from any erosion particles in the media. The lining is add-

12

Installation, Service and preventive maintenance

- Improve Reliability
- Increase Service Life
- Worldwide Service Teams



Proper installation of your expansion joints is key to increasing the service life and maintaining reliability. Whether an outage or turnaround is planned or unplanned, KE-Burgmann can help support your next project. Our field services technicians have extensive experience having installed and supervised constructions all over the world. Helping our customers reduce costs, decrease outage time and eliminate installation problems, quickly and safely.

KE-Burgmann comprehensive service includes:

- Evaluations & Troubleshooting
- Initial Dimensional Measurements
- Pipe Stress Analysis
- Installation & Refurbishment
- Supervision & Training
- Onsite Repair – Online and Offline
- Emergency Services
- Final Inspection
- Experience Service Engineers

Clamshell Solution

KE-Burgmann offers clamshell expansion joints – a solution if replacement of a leaking expansion joint is not possible immediately or to prevent unexpected shutdown.



A clamshell provides a temporary elimination of the leak allowing the plant to continue operating until a planned shutdown. The clamshell is a single ply metal bellows supplied in 2 or more parts. This allows fitting around the installed unit and minimizes impact on connecting parts.

The key to long-term life and reliable expansion joints is dependent on a well-trained installation team.



KE-Burgmann has extensive experience having installed and supervised constructions all over the world.

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KE-BURGMANN

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