Belman

Our experience, your benefit

REFERENCES

OPTIMUM SOLUTIONS AROUND THE GLOBE

CONTENT BY INDUSTRY /APPLICATION

Through the years we have successfully solved challenging operational problems for our clients in many different industries. We have almost 50 years of experience within the design and manufacturing of steel expansion joints, this combined with constant development and the application of innovative technologies has established the Group as a recognised manufacturer on the global market.

This brochure presents the most interesting and demanding projects executed by our Group and further illustrates our expertise in handling technically complex projects. The list of references across industries and borders we have built up during the years proves our ability as an innovative, problem-solving and rapidly developing solution provider. We are committed to delivering technically and economically effective solutions to maximise the efficiency of the application for the benefit of our customers. We compliment this with an extensive after sales service including installation assistance if required.

Additional information

The references are divided into specific industries, with each industry segment having a WebLink for access to more detailed information and additional interesting projects online. The WebLink number can be typed into the box "WebLink" on the front page of www.belman.dk and will quickly take you to the relevant site.

REFERENCES

Energy
VATTENFALL
DONG ENERGY
RWE NPOWER
MOSENERGO
BRITISH ENERGY
E.ON
DRAX
AEP ENERGY SERVICES
STEAG

Oil & gas
STATOIL
SHELL
MURCO PETROLEUM LIMITED
LUKOIL
ROSNEFT
MÆRSK OIL
BP
LINDE AG

Engineering
ABB
ALSTOM
SIEMENS AG
SIEMENS VAI
ŠKODA POWER
METSO
MAPNA GROUP
FOSTER WHEELER
ZEP
ZORLU ENERJI
PAUL WURTH

Steel
THYSSENKRUPP STEEL EUROPE
SSI (TATA STEEL / CORUS)
ARCELORMITTAL
SEVERSTAL

Chemical
SASOL
AIR LIQUIDE
CABOT CORPORATION
DOW IZOLAN
SCHENECTADY EUROPE
UNILEVER

Shipping
MAN DIESEL & TURBO
WÄRTSILÄ OIL & GAS SYSTEMS (HAMWORTHY)
DRESSER-RAND
WÄRTSILÄ

Others
CUMMINS POWER GENERATION
INTERNATIONAL SILENCERS
ANDRITZ

STEEL PLANTS

WebLink: 14201

40 ton heavy weight

497-08417, Germany

One of the heaviest expansion joints ever manufactured by Belman was delivered to a steel plant. The weight of this unit was approximately 40 metric tons. The expansion joint was installed along with another relatively smaller unit (20 tons) at the fall-pipe leading to the blast furnace, and at a height of 100 meters. Different vapours and hot gases are released during the melting process, and are then discharged for purification at the gas cleaning system. The harsh operating conditions generated heavy loads (approx. 250 tons) on to the system, and presented the challenge of how they should be best absorbed. After detailed analysis our engineers proposed a solution with the simultaneous application of an angular and universal expansion joint utilised as a three-hinge system, ensuring compensation of two-plane movements. The hinged design enhanced the stability of the pipeline by movement control and suppression of the wind and torque effect on the expansion joints. Due to the presence of both corrosive and abrasive media the bellow and inner sleeve of the compensator were manufactured from Inconel 625 and Hardox 400 respectively. All designs and materials supplied were in accordance with AD 2000 HP0 – one of the strictest standards.

Dimension: **DN 2800** | Installation length: **9457 mm** | Medium: **Blast furnace gas** | Design temperature: **-10/300°C** | Design pressure: **3,1 bar** | AX: **+0/-26 mm** | AN: **+/-7°**

Replacements in a Pipe loop

3210-08038, Belgium

6 expansion joints were manufactured as replacements for the worn out units in a pipe loop. The old units had been operating for 25 years and had exceeded their service life operating under peak temperatures and peak pressure in the pipeline.

Dimension: **DN 300** | Installation length: **1140 mm** | Medium: **Steam** | Design temperature: **300°C** | Design pressure: **25 bar** | AN: **+/-10°** | Bellows: **1.4541** | Welding ends: **1.0305**

Different designs

468-10037, Sweden

32 expansion joints were installed near the blast furnace.

Dimension: **DN 500-1200** | Installation length: **500 mm** | Medium: **Cold blast gas** | Design temperature: **300°C** | Design pressure: **0,3-3 bar** | AX: **+0/-3 - +0/-18 mm** | AN: **+0/-0,5 - +25/-1,25°** | Bellows: **1.4541** | Welding ends: **1.0570** | Inner sleeve: **1.4571** | Cover: **1.0038**

Drainable expansion joint

5811-02021, Finland

During the shutdown the steel plant experienced a problem with the build-up of condensate and contaminates between the convolutions of the horizontally placed expansion joint. The pipeline was conveying blast furnace gases containing sulphur, the condensate combined with the sulphur present in the gases to produce sulphuric acid – an extremely corrosive substance. The problem was solved by replacing the unit with a drainable expansion joint, enabling the discharge of the condensate through the draining holes during the shutdown. Due to the low design temperature, all the components were manufactured in the special steel 1.0488.

Dimension: **DN 1500** | Installation length: **725 mm** | Medium: **Blast furnace gas** | Design temperature: **-40/+175°C** | Design pressure: **2 bar** | AX: **+/-50 mm** | Bellow: **1.4541** | Welding ends, flanges, inner sleeve, cover: **1.0488**

Gimbal expansion joint

496-03243, Germany

The expansion joint was installed in the air feed pipeline connected to the blast furnace. The bellows material selected for the application was the special austenitic steel 1.4539 due to its corrosion resistant properties which were well suited for the harsh operating environment.

Dimension: **DN 1400** | Installation length: **2791 mm** | Medium: **Cold air** | Design temperature: **-10/+165°C** | Design pressure: **4 bar** | AN: **+/-5°** | Bellows: **1.4539** | Welding ends, intermediate pipe: **1.0425**

Pantographic Linkage

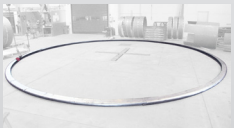
456-11023, Brazil

Pantographic linkage is a truss type accessory used to distribute large axial movements equally between two bellows, allowing lateral movement and supporting the weight of the centre pipe section between the bellows, thereby preventing overload and premature fatigue in one of the bellows. The expansion joints were installed in a chimney, channelling melting gases.

Dimension: **DN 2500** | Installation length: **2300 mm** | Design temperature: **300°C** | Design pressure: **0,005 bar** | AX: **+0/-62 mm** | LA: **+/-70 mm** | Bellows: **1.4541** | Flanges: **1.0038** | Inner sleeve: **1.0425** | Intermediate pipe: **1.4301**

Large dimension (DN 9500)

497-12225, Germany



13 expansion joints and one bellow, up to size DN 9500 were installed below the blast furnace. The bellow functioned as a sealing between the pipeline and the blast furnace. Due to the large dimensions involved, the bellows were supplied in segments and assembled together onsite. We have experience with the successful handling of big sizes, with an even larger size DN 12000 also delivered for the same steel plant. This expansion joint was also delivered in several segments.

Dimension: **DN 9500, 2700, 2400** | Installation length: **240-545 mm** | Design temperature: **350°C** | Design pressure: **3 bar** | AX: **+/-10, +/-40 mm** | AN: **+/-2°** | Bellows: **1.4301, 1.4435** | Welding ends: **1.0425**

High pressure pump connectors

977-06010, Russia

The expansion joints were manufactured completely from stainless steel and designed for 1.000.000 load cycles in order to reduce vibrations, emanating from the connected pumping equipment. The short and accurate delivery time was critical in this project, as installation had to be undertaken during a planned shutdown of the steel plant.

Dimension: **DN 250** | Installation length: **265 mm** | Medium: **Oil** | Design temperature: **20°C** | Design pressure: **30 bar** | AX: **+/-3 mm** | LA: **+/-1,5 mm** | Bellows: **1.4541** | Flanges: **1.4401**

STEEL PLANTS

WebLink: 14201

Supplied knocked down in segments

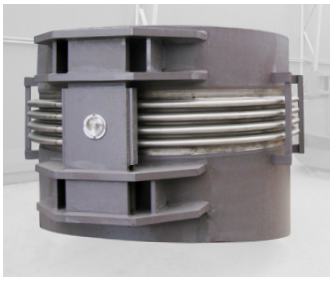
4911-11162, Germany

The replacement of expansion joints located on the top of a blast furnace presented a significant challenge due to the large dimensions involved, the limited installation space and its location. To make the installation work possible, Belman delivered the units in two segments, allowing the two pieces to be lifted to the installation. The segments were then fitted around the gap in the pipeline and expertly welded together. The replacement units had to be identical to those previously installed, complete with conical ends to ease their installation fitting to the top of the blast furnace. The fittings were designed with the help of 3D modeling. A few improvements were made to the previous design in accordance with the clients special request. The bellows and inner sleeve's material was changed to Inconel 625 and 1.0473 respectively. The inner sleeve would normally be manufactured from Hardox due to the wearing media, but since the entire construction had to be refractory lined after installation it was deemed unnecessary. Partial delivery was accepted in order to shorten the critical delivery time, additional cost savings were realized by the client due to the optimization of the design.

Dimension: **DN 2000** | Installation length: **5949 mm** | Design temperature: **150°C** | Design pressure: **2,3 bar** | AX: **+0/-55 mm** | LA: **+20/-0 mm** | Bellow: **2.4856**

Inconel bellows

496-12054, Germany



These expansion joints were installed in the pipeline that channels blast furnace gas to the gas cleaning plant. In this plant all particles from the gas are separated. The pipeline was placed at a height of 45 meters. The expansion joints have the same installation lengths, but the movements they absorbed were different due to their different locations in the pipe section. The bellows were made from Inconel 625, this material was chosen to resist the aggressive medium and at the same time add extra strength to the bellows.

Dimension: **DN 2200** | Installation length: **1725-1375 mm** | Medium: **Blast furnace gas** | Design temperature: **-10/+300°C** | Design pressure: **2,2 bar** | AN: **+/-2,5 - +/-5,3°** | Bellows: **2.4856** | Welding ends: **1.0425** | Inner sleeve: **Hardox 400**

6930 mm long expansion joint

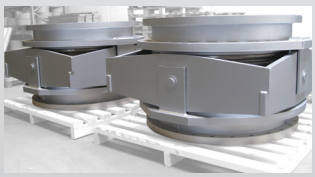
495-12122, Germany

This DN 2200 expansion joint was installed at the blast furnace at a height of 30 meters. The almost 7 meters long expansion joint was installed prior to the pipe bend on the horizontal stretch to absorb lateral and angular movements. A smaller expansion joint was installed right after the bend in the vertical pipe to absorb angular movements. This arrangement provided the system with much needed flexibility, but also ensured its stability through the hinged design. For the purposes of inspection the pipeline was equipped with a foot bridge, consequently the expansion joint was designed with a man hole to enable access to the internal part of the pipeline during shut-downs. Due to the abrasive medium involved the inner sleeve was manufactured from Hardox 400.

Medium: **Blast furnace gas** | Design temperature: **-10/+300°C** | Design pressure: **2,2 bar** | AN: **+/-4°** | Bellows: **2.4856** | Intermediate pipe: **1.5415**

Special painting

3212-05011, Belgium

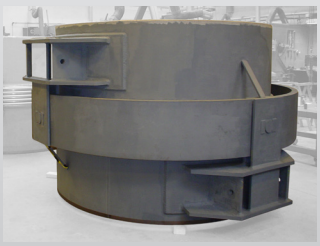


These expansion joints were coated with a special silicone zinc and silicone aluminium paint. This paint type was chosen due to its excellent heat resistant properties.

Dimension: **DN 1000** | Installation length: **800 mm** | Medium: **Air** | Design temperature: **-25/225°C** | Design pressure: **4,5** | AN: **+/-4°** | Bellows: **1.4541** | Welding ends: **1.0425** | Flanges: **1.0425**

Refractory lining

444-03008, Egypt



The refractory lining was made onsite to avoid any damage during transportation. The use of refractories was necessary due to the extremely high temperatures, conventional materials such as Kaowool or similar were deemed inappropriate for the operating conditions.

Dimension: **DN 2300** | Installation length: **1700 mm** | Medium: **Gas** | Design temperature: **980°C** | Design pressure: **1 bar** | AN: **+/-1°** | Bellows: **1.4404** | Welding ends: **1.0425** | Inner sleeve: **1.4301**

NUCLEAR POWER STATIONS

WebLink: 14202

Comprehensive demands and calculations

4610-12028, Sweden

2 expansion joints are installed in the pipeline between the high pressure turbine and the low pressure turbine. As the primary and the secondary system the expansion joints are in contact with the radioactive medium. All parts of the expansion joints are made from materials with low content of cobalt, as cobalt in connection with radioactive media can cause severe damages. On the expansion joint an inspection hole is made, so it is possible to check the inside of the pipeline during shutdown. To avoid turbulence when the medium passes the inspection hole a special design for the inspection hole is made to ensure a straight pipe on the inside. To pressure equalize the chamber between the top of the inspection hole and the inner sleeve a small hole was made, where the media access the chamber between the top and the inner sleeve. To ensure proper drain ability from this chamber a special drain spigot is mounted. Due to the application of this expansion joint complete test and documentation was needed. Likewise Finite Element Analysis (FEA) was completed for all items on the expansion joints; the front flange was calculated according to Taylor Forge, flange assemblies was calculated according to EN-13445-3 annex G and the inspection hole were calculated according to 13445-3 section 9. All this to ensure an optimum solution.

Dimension: **DN 800** | Installation length: **2155 mm** | Medium: **Steam (radio active)** | Design temperature: **280°C** | Design pressure: **-1/12 bar** | LA: **+/-35 mm** | Bellows: **1.4404** | Flanges, welding ends, inner sleeve: **1.0565** | Intermediate pipe: **1.1106**

Expansion joints made completely from 1.4306

464-08033, Sweden

More than 50 expansion joints were manufactured and installed near the turbines in the secondary system. The design of the units differed depending on which turbine they were installed near. Even though the secondary systems were never exposed to radioactive elements, due to the prevailing safety regulations all the components in contact with the medium were required to be manufactured from low cobalt content materials to avoid potential damages, arising from the possible reaction between the radioactive substances and cobalt.

Dimension: **DN 550-1200** | Installation length: **400-2195 mm** | Medium: **Steam** | Design temperature: **80-170°C** | Design pressure: **-1/0 - -1/3,6 bar** | AX: **+/-0 - +/-12,5 mm** | LA: **+/-5 - +/-21 mm** | AN: **+/-0 - +/-1,3°** | Bellow, welding ends, inner sleeve: **1.4306** | Flanges: **1.0038, 1.0425, 1.4306** | Cover: **1.0425**

Gimbal expansion joint

496-05155, Switzerland

4 axial and 48 gimbal expansion joints were designed and manufactured according to Swiss national standards. We have the capability to design and manufacture fully in accordance with the customers specified norms.

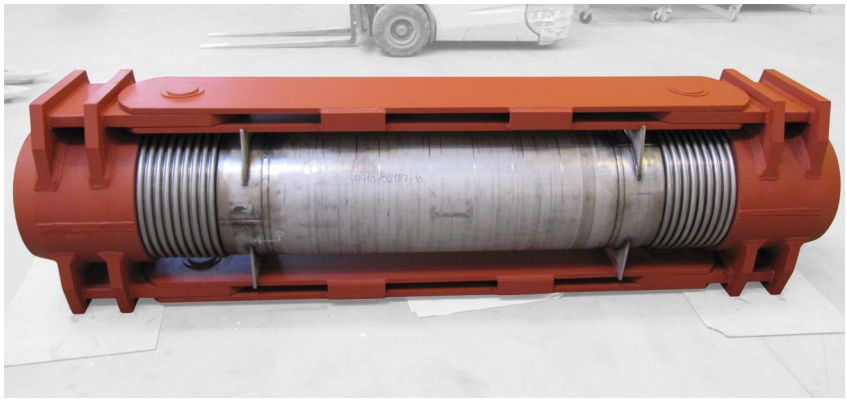
Dimension: **DN 250, 150** | Installation length: **245, 335 mm** | Medium: **Water** | Design temperature: **100°C** | Design pressure: **6 bar** | AX: **+/-15 mm** | AN: **+/-6, +/-2,5°** (the gimbals) | Bellows: **1.4541** | Welding ends: **1.0305, 1.4571** | Flanges: **1.0425** | Inner sleeves: **1.4571**

Extensive testing

3211-04022, Finland

30 expansion joints were installed at the exhaust ducts, water cooling and air intake lines within the plant's secondary systems. The bellows were designed in accordance with EJMA; whereas the flanges and assemblies were designed in compliance with EN 13445, Annex G. Due to the safety restrictions in place all the components in contact with the medium were to be manufactured from low cobalt content materials. Extensive testing was performed.

Dimension: **DN 100-950** | Installation length: **240-384 mm** | Design temperature: **-39/36 - -39/110°C** | Design pressure: **-0,05/0,1, 0,2, 3 bar** | AX: **+0/-56, +17/-20 mm** | LA: **+/-3 - +/-8 mm** | Bellow, flanges: **1.4404** | Inner sleeve: **1.4404, 1.4571**



High pressure and high temperature

4910-02187, Poland
Lignite-fired | 4 expansion joints were installed in the steam pipeline operating under extreme conditions with high temperature, pressure and large movements. The challenge with such difficult operating conditions was to find a balance between a solid/sturdy construction due to the high pressure/temperature and at the same time bellows flexibility in order to compensate large movements. To retain stability of the construction a design with two multilayer bellows was chosen. Even though the wall thickness of the mating pipe was 22 mm, it was necessary to increase the thickness of the compensators' welding ends to 40 mm, as additional loads transmitted to the pipe system by the fittings had to be absorbed, also minimizing the loads on the lugs and hinges. The design was verified through analytic calculations and Finite Element Analysis (FEA).

Dimension: **DN 450** | Installation length: **2770 mm** | Medium: **Water/steam** | Design temperature: **520°C** | Design pressure: **40 bar** | LA: **+150/-0 mm** | AN: **+0,08/-0°** | Bellows, intermediate pipe: **1.4571** | Welding ends: **1.7335** | Inner sleeve: **1.4541**

Hidden balance chamber

4310-06042, France
Hydro | Belman delivered several different expansion joints for this power plant, among them a pressure balanced expansion joint with a hidden balanced chamber. This meant that one of the two inline bellows on each side of the balance bellow is placed inside the balance bellow; the design gives a space-saving of approximately 1/3. A further advantage of this construction is relatively lower spring rates, achieved through the longer bellows. The pressure is equalised by letting the medium into the chamber between the two bellows, as the effective area of the chamber bellows corresponds to the inline bellows. The expansion joint was equipped with a drain, at the bottom of the balance chamber, allowing the chamber to be easily emptied during shutdowns of any medium which could gather inside.

Dimension: **DN 700** | Installation length: **1080 mm** | Medium: **Steam** | Design temperature: **400°C** | Design pressure: **-0,75/+1,5 bar** | AX: **+/-25 mm** | LA: **+/-10 mm** | Bellow: **1.4571** | Welding ends, flanges: **1.0425, 1.0305** | Inner sleeve: **1.4541**

Expansion joints for gas turbines

978-12024, Russia
Gas-fired | 49 expansion joints were installed near the gas turbines and water pumps in a newly built power plant. For this reason the design specifications were different, as the expansion joints had different functions in the pipeline. Some were working under high pressure and others under high flow velocities, which was also the reason for the differences in the materials selected.

Dimension: **DN 150-1200** | Installation length: **265-1700 mm** | Medium: **Gas, water** | Design temperature: **40-340°C** | Design pressure: **10-44 bar** | AX: **+/- 0,67 - +0/-9 mm** | LA: **+/-3 - +94/-0,94 mm** | Bellows: **1.4541, 1.4571, 1.4547** | Welding ends: **1.0425, 1.0305** | Flanges: **1.0570** | Intermediate pipe: **1.0425** | Cover: **1.0038** | Inner sleeve: **1.4541, 1.0305**

Corner relief expansion joints

464-10011, Sweden
WTE | 2 corner relief expansion joints were installed between the turbine and condenser to relieve the turbine connection piece. The great advantage of the pressure balanced expansion joints supplied was that they neutralised reaction forces, which would be otherwise transmitted further on the pipeline. This made possible the reduction in the number and complexity of the anchors and guides, resulting in additional cost savings.

Dimension: **DN 1400** | Installation length: **7574 mm** | Medium: **Steam** | Design temperature: **200°C** | Design pressure: **-1/2 bar** | AX: **+/-4,3 mm** | LA: **+/-6,6 mm** | Bellow: **1.4571** | Welding ends, flanges, inner sleeve, pipe sections: **1.0425**

POWER STATIONS

WebLink: 14203

Space-saving construction

456-11056, Denmark

Diesel fired | This customized expansion joint was installed on the turbo-charger as a connecting piece between the rectangular turbo-charger and the round canal system. The chosen design helped to reduce the height of the diesel building by approx. 1,5-2 meters, as the expansion joint incorporates a connecting piece in itself. Even though the solution was more expensive when compared to an ordinary compensator, it was easily justified by the financial savings achieved through the reduction of the building's required height. The expansion joint functioned as a regular compensator with no loss in performance.

Dimension: **DN 2000** | Installation length: **1650 mm** | Medium: **Flue gas** | Design temperature: **550°C** | Design pressure: **0,5 bar** | AX: **+/-20 mm** | LA: **+/-20 mm** | Bellow, intermediate pipe: **1.4541** | Flanges, inner sleeve: **1.0038**

Double certified material

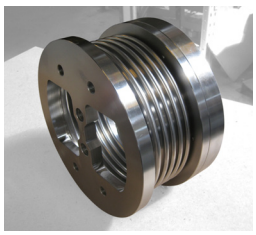
496-08318, UAE

IWPP – natural gas fired | 2 expansion joints were installed in a power and distillation plant. They were installed at two different locations in the same pipeline, located on the low pressure side of the steam turbine. Materials had to be supplied according to ASME. Due to short delivery it wasn't possible to supply all the materials according to ASME. Double certified materials were suggested instead, which was fully accepted by the customer.

Dimension: **DN 2200** | Length: **4000, 4950 mm** | Medium: **Steam** | Design temperature: **425°C** | Design pressure: **-1/5-9 bar** | Weight: **12, 15 tons** | LA: **+/-60, +/-86 mm** | Bellows, inner sleeve: **1.4541** | Welding ends, flanges, intermediate pipe: **1.0425**

Small, but special design

447-04014, Scotland + Canada



Coal fired | 4 expansion joints were installed in a high pressure heater near the turbines. The flanges and bellows material selected had to be suitable for the high operational and peak temperature of 420°C and 800°C respectively. Careful choice of the materials was extremely important within this temperature range, as unsuitable materials would have greatly reduced service lives or in the worst case scenario corrosion. The flanges were specially designed in order to meet the requirement of the Venturi effect. This effect is also known as Bernoulli's Principle and leads to a pressure decrease, when velocity of flow increases. Thus, when the medium passes through the pipeline and reaches the narrow part, it gains greater velocity. The Venturi effect can be used positively in many situations by incorporating its influences into the design of components.

Dimension: **DN 250** | Installation length: **110 mm** | Medium: **Water/ steam** | Design temperature: **420°C** | Peak temperature: **800°C** | Design pressure: **1 bar** | AX: **+/-2,5 mm** | LA: **+/-2,8 mm** | Bellow, flanges: **2.4856**

Rectangular expansion joint

499-02304, Germany

Gas fired | These expansion joints were installed in the flue gas ducts. The intermediate pipe was additionally supported, removing the strain on the bellows and the risk of their damage.

Dimension: **1100 x 2100** | Installation length: **2730 mm** | Design temperature: **300°C** | Design pressure: **0,3 bar** | LA: **+/-113 mm** | Bellow: **1.4541** | Welding ends: **1.0425** | Intermediate pipe: **1.0425**

Pressure balanced expansion joint

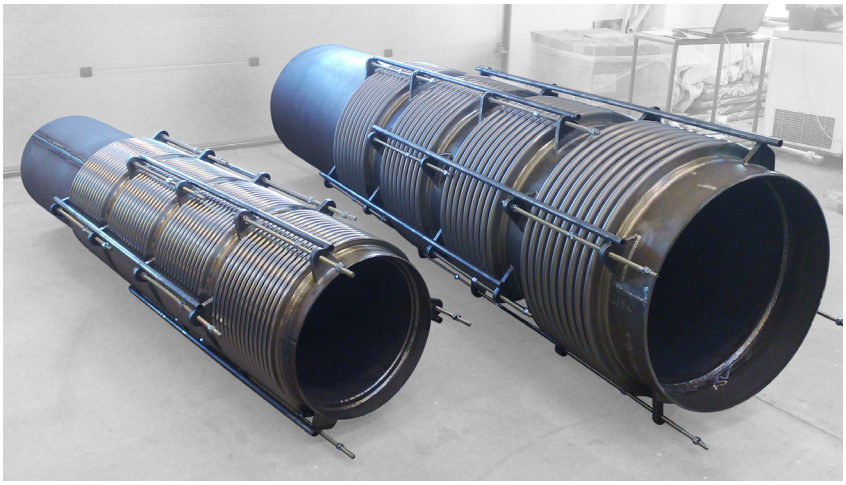
465-04012, Sweden

WTE | 2 pressure balanced expansion joints were installed between the turbine and condenser, to relieve the turbine connection pieces.

Dimension: **DN 1600** | Installation length: **820 mm** | Medium: **Steam** | Design temperature: **200°C** | Design pressure: **-1/2 bar** | AX: **+/-6,1 mm** | LA: **+/-13,6 mm** | Bellows: **1.4571** | Welding ends, flanges, inner sleeve, intermediate pipe: **1.0425**

DISTRICT HEATING

WebLink: 14204



Expansion joints for a concrete shaft

498-10409, Korea

6 expansion joints were installed at the entry to a concrete shaft in a district heating pipeline. This system is a sturdy and complex construction. In the core there is the actual district heating pipe which is surrounded by insulation. Around this insulation the expansion joints are installed. In turn, the expansion joints are surrounded by insulation and finally the outer pipe is installed around the insulation. There is a vacuum in the expansion joints to insulate against heat loss from the inner pipe. The long pipeline and the prevailing temperatures together resulted in large movements. It was necessary therefore to use a construction with four bellows in the expansion joint. An approximate guide or "rule-of-thumb" is that the more flexibility in the expansion joint, the less stability. Movement limiters were installed to ensure an even absorption of movement across the four bellows. Thus the movement acting on each bellow was controlled so that the individual bellows of the expansion joint only had to absorb a certain area of movement. The construction was insulated with Rockwool material. Even though the expansion joints were not in contact with the medium, the choice of material as well as the design of the expansion joints was based on the medium being steam, giving protection in case of any leakages.

Dimension: **DN 450-1300** | Installation length: **1630-2370 mm** | Medium: **Steam** | Design temperature: **180-260°C** | Design pressure: **Up to 7,5 bar** | AX: **Up to +/-580 mm** | Bellow: **1.4571** | Welding ends, intermediate pipe: **1.0425**

One step expansion joints

977-05005, Russia

20 one-step expansion joints were installed in a newly built district heating pipeline. One-step expansion joints are designed to absorb the one full cycle of movement that results from the commissioning of the pipeline. After which the expansion joints were welded and function as a part of the pipeline.

Dimension: **DN 700** | Installation length: **475 mm** | Medium: **Water** | Design temperature: **150°C** | Design pressure: **25 bar** | AX: **+0/-80 mm** | Bellow: **1.4541** | Welding ends and cover: **1.0038**

Angular expansion joints

499-10133, Germany

13 angular expansion joints installed in a district heating pipeline.

Dimension: **DN 800** | Installation length: **1445 mm** | Design temperature: **185°C** | Design pressure: **32,5 bar** | AN: **+25/-2,25°** | Bellows: **1.4571** | Welding ends: **1.0425**

258 similar expansion joints

4810-10003, Poland

The expansion joints were installed in a district heating line running through the bridge along the belt line for the transportation of coal. The construction of the expansion joints was based on the telescopic type, allowing the absorption of large movements.

Dimension: **DN 250** | Installation length: **1140 mm** | Medium: **District heating water** | Design temperature: **120°C** | Design pressure: **16 bar** | AX: **+/-125 mm** | Bellows: **1.4541** | Welding ends: **1.0254** | Flanges, cover, inner sleeve: **1.0038**

Extensive analysis

4310-04043, Austria

12 angular expansion joints were installed within a district heating pipeline. Finite Element Analysis (FEA) was completed for all expansion joints to optimize the design in correlation with the loads.

Dimension: **DN 500** | Installation length: **950 mm** | Design temperature: **180°C** | Design pressure: **25 bar** | AN: **-/+6,5°** | Bellows: **1.4541** | Welding ends, flanges: **1.0425**

FCCU

WebLink: 14205

FCCU – critical application

9710-03005, Russia

The fluid catalytic cracking (FCC) unit is one of the most important units in any oil refinery as it converts heavy distillates into lighter ones (gasoline and diesel), increasing the yield and efficiency of the refining process. The feedstock is mainly vacuum gas oil mixed with refinery residues heated up to extremely high temperatures. Given the very challenging environment, the expansion joints utilized in this application are the most technically advanced among all of the existing types and required great expertise in their design and manufacture. The expansion joints were designed, manufactured and refractory lined according to UOP specifications and the design job was carried out in close cooperation with UOP Chicago. Due to the high temperatures all expansion joints were refractory lined. The bellows were manufactured by punch forming. Heavy stresses on the bellows caused by high pressure, temperature and large movements make this component very vulnerable, which is why the membranes of the expansion joints were manufactured from Inconel 625 LCF – an exceptionally strong material. Another critical aspect was that the two-ply bellows had to be calculated so the single layer would be able to carry the full load in case of operating alone. In other words, if the inner layer failed, the outer ply would be able to secure operational safety of the expansion joint until a scheduled shutdown. Additionally, the expansion joints were fitted with a pressure gauge to indicate any possible failure of the inner ply of the bellow. Materials used, welding and test procedures were delivered according to ASME and API. All expansion joints received extensive NDT testing.

Dimension: **DN 900-1300** | Installation length: **2488-10432 mm** | Design temperature: **-30/+538°C** | Design pressure: **3,9-7,6 bar** | AX: **+50/-90 mm** | LA in plane: **+65/-15 mm** | LA out of plane: **+40/-0 mm** | AN: **+2,12/0°** | Weight: **5-25 tons** | Bellows: **2.4856**

33 tonnes FCCU

9711-09025, Russia

The expansion joint was installed around the reactor at the flue gas line and refractory lined due to the high operating temperature. Design and manufacturing was carried out according to UOP specifications. Bellows were manufactured by punch forming. Materials used, welding and the extensive NDT procedures were delivered according to ASME standards.

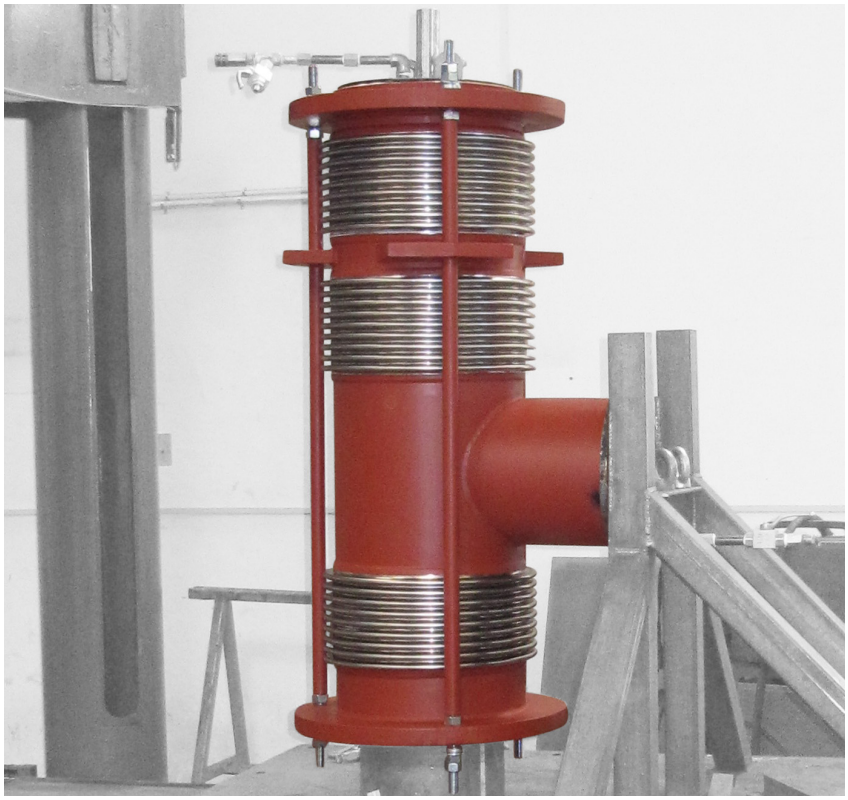
Dimension: **DN 1800** | Installation length: **13500 mm** | Design temperature: **-30/+538°C** | Design pressure: **From 5,2 bar** | AX: **+0/-57 mm** | LA in plane: **+/-85 mm** | LA out of plane: **+/-0 mm** | AN: **0°** | Weight: **33 tons** | Bellows: **2.4856**

FCCU – design variations

9711-03041, Russia

Installed around the reactor. All compensators were refractory lined due to the high operating temperature. Design, manufacturing and refractory lining was also executed according to the UOP specifications. All bellows were manufactured by punch forming and materials used, welding and comprehensive NDT test procedures were delivered according to ASME standards.

Dimension: **DN 900-1300** | Installation length: **2488-10432 mm** | Design temperature: **-30/+538°C** | Design pressure: **3,9-7,6 bar** | AX: **+50/-90 mm** | LA in plane: **+65/-15 mm** | LA out of plane: **+40/-0 mm** | AN: **+2,12/0°** | Weight: **5-25 tons** | Bellows: **2.4856**



Pressure tested at 165 bar

9710-09012, Russia

18 Corner relief expansion joints were installed at the central pump station of one Russia's largest oil fields with 4 of the joints designed for 120 bar pressure. Belman has delivered numerous, mainly inline pressure balanced expansion joints for the oil field's infrastructure during the last years, with construction divided into several stages. The design work was quite challenging due to restrictions with regards to the allowed stresses on the anchors and pumps' mating flanges, which in the case of operating under 120 bar design pressure would be enormous. The initial design proposed by the customer was built around two ring-reinforced axial compensators placed at a pipe bend to absorb axial movement. However, the permitted stresses and torque impact on the pump connections had to be so low that this proposal was founded unsuitable. Another proposed solution with a longer joint was further rejected, as it would have resulted in unstable bellows and further made unfeasible due to the space restrictions. Our engineers proposed a solution with a corner relief joint, reducing the stresses on the pump connections and keeping the length of the joint at an acceptable level. Additionally, this design made possible the reduction in the number of joints to merely one per pump and to spare a pipe bend, which became an integrated part of the corner relief unit. Further, we also advised our client on the support systems and its proper location within a given pipeline. Extensive testing procedures were performed due to the requirements, among others hydraulic tests at 165 bar.

Dimension: **DN 300** | Installation length: **1604 mm** | Medium: **Crude oil** | Design temperature: **-10/+50°C (storage at -60°C)** | Design pressure: **120 bar** | AX: **+/-5,5 mm** | LA: **+/-1,5 mm** | Weight: **642 kg** | Life cycles: **5000** | Bellows thickness: **9x0,5mm** | Bellows: **1.4462** | Flanges, welding ends, inner sleeve, intermediate pipe: **1.1106** | T-shape pipe: **09G2S** | Tie rods: **1.7225**

Complete Inconel 600

316-11069, Holland

This expansion joint was installed in an oil refinery pipeline carrying hot air with chlorides. In order to withstand the corrosive medium the expansion joint was completely manufactured from Inconel 600. Our customer requested the delivery of a complete piece of the given pipeline, which is the reason for the installation length.

Dimension: **DN 500** | Installation length: **7000 mm** | Design temperature: **565°C** | Design pressure: **0,7 bar** | LA: **+/-25 mm** | All parts: **2.4816**

According to ASME

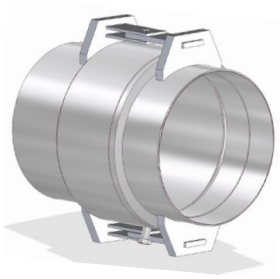
447-05010, Great Britain

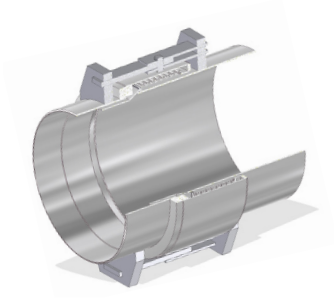
This expansion joint was installed at the bottom of the oil tank. The special material for the flange was stipulated by the plant's initial design standards according to ASME.

Dimension: **DN 150** | Installation length: **1829 mm** | Medium: **Steam** | Design temperature: **60°C** | Design pressure: **16 bar** | LA: **+/-52,5 mm** | Bellows, inner sleeve: **2.4858** | Welding ends: **A 106 Gr.B** | Flanges: **A105** | Cover: **1.0038**

OFFSHORE, OIL REFINERIES

WebLink: 14206





Drainable expansion joint

3510-02003, Portugal

1 hinged and 2 drainable expansion joints were installed in the pipeline at an oil refinery. A 100% drainable system and consequently drainable expansion joints were required, so that no residue of the medium remained in the convolutions of the bellows. Full drainability is often required within some industries and production facilities during the cleaning procedure between production cycles, as it helps to ensure the composition of the medium would not be contaminated by residue substances. Horizontally placed expansion joints are typically not 100% drainable as a limited amount of the medium will always remain at the bottom of the convolutions. The delivered design enabled the medium to be kept on the bellow's outer side, with draining made possible during scheduled shutdowns via the downward facing drain spigot.

Dimension: **DN 900** | Installation length: **1250-3000 mm** | Design temperature: **290°C** | Design pressure: **3,5 bar** | LA: **+19/-120 mm** | AN: **2°** | Bellows: **1.4571** | Welding ends, flanges, cover: **1.0425** | Inner sleeve: **1.4541**

High requirements for test and inspection

076-10002, Russia

Approximately 100 expansion joints with different design parameters were installed at a new oil terminal, transferring crude oil extracted in the northern part of Russia. Stringent quality standards had to be met, requiring comprehensive testing and inspection by a 3d party authority. All expansion joints underwent X-ray, dye-penetrant and hydraulic testing. These requirements were stipulated by the plant and were required due to the harsh operational conditions.

Dimension: **DN 100-1200** | Installation length: **500-2083 mm** | Medium: **Oil** | Design temperature: **35-150°C** | Design pressure: **2-25 bar** | AX: **+/-25 - +/-60 mm** | LA: **+/-0 - +/-80 mm** | AN: **+/-0 - +/-2°** | Bellows: **1.4541** | Welding ends: **1.0570** | Flanges: **A105, 1.0038** | Inner sleeve: **1.4571** | Cover: **1.0038** | Intermediate pipe: **1.0421, A106gr B**

High quality requirements

478-09002, Norway

6 expansion joints were installed in the pipeline at a silencer in the back-up power system. The system was located on an oil drilling rig in the North Sea, its purpose being to supply power to the rig in case of unexpected power shutdown. The system is tested on the weekly basis to ensure its operability, as a shutdown may have catastrophic consequences. The offshore industry is known for its strict quality requirements towards the equipment and materials in use and has created its own standards and regulations. For this reason the expansion joints were manufactured according to: MDS S01, S05 and EDS.

Dimension: **DN 400-800** | Installation length: **500-1200 mm** | Medium: **Exhaust** | Design temperature: **-9/+580°C** | Design pressure: **0,5 bar** | AX: **+/-45 - +/-170 mm** | LA: **+/-3 - +/-45 mm** | Bellows, inner sleeve: **1.4541** | Flanges: **1.4404, 1.4401**

Double expansion joints with tie rods

438-05013, Austria

22 expansion joints were installed at an oil refinery.

Dimension: **DN 150-400** | Installation length: **365-750 mm** | Medium: **Heating oil (light), diesel fuel** | Design temperature: **50°C** | Design pressure: **16, 25 bar** | AN: **+/-2,5 - +/-10°** | Bellows: **1.4541** | Flanges: **1.0570, 1.0425** | Inner sleeve: **1.4404** | Intermediate pipe: **1.0305**

High test pressure

977-10003, Russia

8 gimbal expansion joints were installed at an oil refinery. They were pressure tested at 98,5 bar.

Dimension: **DN 500** | Installation length: **7400 mm** | Design temperature: **55°C** | Design pressure: **67 bar** | Medium: **Oil** | AN: **+/-4°** | Bellows: **2.4856** | All other parts: **1.0473**

Pressure balanced expansion joint

319-11044, Holland
This pressure balanced expansion joint was installed at a gas production facility. The expansion joint was installed horizontally and fixed via permanent hangers, explaining the lifting lugs on top of it. It is not always possible to use complex anchor and support systems at a given pipeline. A pressure balanced expansion joint can often bring both economic and operational advantages. It can reduce reaction forces, stabilize the pipe system and absorb movements, and in time reduces the complexity and number of anchors needed.

Dimension: **DN 800** | Installation length: **600 mm** | Medium: **Compressed air with chlorides, condensate** | Design temperature: **100°C** | Design pressure: **10 bar** | AX: **+/-6 mm** | LA: **+/-2,4 mm** | Bellows: **1.4571** | Welding ends: **1.0425** | Inner sleeve: **1.4541** | Intermediate pipe: **1.0425**

Reduces numbers and size of anchors

977-11001, Russia

These pressure balanced expansion joints were purchased several times for the infrastructure development of one of the biggest oil fields in Europe, more specifically the pump stations. Due to the limited space and the pumps' low tolerance level, we proposed a solution with inline pressure balanced expansion joints, as they are able to offset reactive forces induced by the pressure, which otherwise would have been transmitted to the connected equipment (the pumps). At the same time these expansion joints give much greater design freedom, as the size and number of anchors and guides can be significantly reduced. This leads to an operationally and economically efficient solution as they absorb movements, relieve the pipeline and connected equipment from reactive forces and provide good stability.

Dimension: **DN 300** | Installation length: **1030 mm** | Design temperature: **30°C** | Design pressure: **16 bar** | AX: **+/-10 mm** | LA: **+/-5 mm** | Bellows: **1.4541** | Welding ends: **1.0038** | Inner sleeve: **1.0305** | Intermediate pipe: **1.0030**

Special design

448-05029, United Kingdom

This expansion joint was manufactured as a replacement for the existing one and is absolutely identical to the worn out unit.

Dimension: **DN 350** | Installation length: **1045 mm** | Design temperature: **360°C** | Design pressure: **1 bar** | AX: **+/-16 mm** | LA: **+/-1 mm** | Bellows: **1.4541** | Welding ends: **A106 gr. A**

Special flanges

9710-03010, Russia

These 12 expansion joints are installed in the gas ducts. The hexagonal flanges were required in order to fit to the mating flanges.

Dimension: **DN 350, 600** | Installation length: **330, 445 mm** | Design temperature: **-47/170°C** | Design pressure: **16 bar** | AX: **+0/-24 mm** | LA: **+/-3, +/-10 mm** | AN: **0,6°** | Bellows: **1.4571** | Flanges: **1.1106**

355 expansion joints

317-11007, Holland

All 355 identical expansion joints were installed at an oil terminal.

Dimension: **DN 200-500** | Installation length: **440-590 mm** | Medium: **Diesel** | Design temperature: **-20/50°C** | Design pressure: **-1/16 bar** | LA: **+/-50 mm** | Bellows: **1.4541** | Flanges: **1.0425** | Intermediate pipe: **1.0255**

OFFSHORE, OIL REFINERIES

WebLink: 14206

5,5 meter long expansion joint

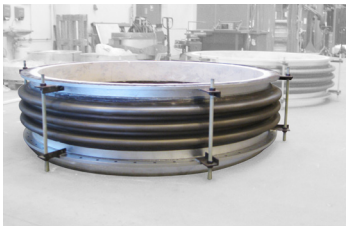
319-11043, Holland

The illustrated expansion joint was installed at an oil refinery. Due to the requirements for an extended service life the expansion joint was designed with a longer intermediate pipe, which consequently reflected on its installation length. Normally, large movements would have a great impact (loads) on the bellows operational life. These loads can be reduced to a certain amount by using a longer intermediate pipe. However, this solution has also a disadvantage in that a longer intermediate pipe may cause instability and vibrations. This was prevented in this project through the use of tie-rods, adding stability to the whole construction.

Dimension: **DN 600** | Installation length: **5585 mm** | Design temperature: **100°C** | Medium: **Cooling water** | Design pressure: **4,9 bar** | LA: **+50/-150 mm** | Bellows: **1.4571** | Welding ends: **A106 Gr.B** | Flanges: **1.0425**

Refractory lining

448-09034, Saudi Arabia

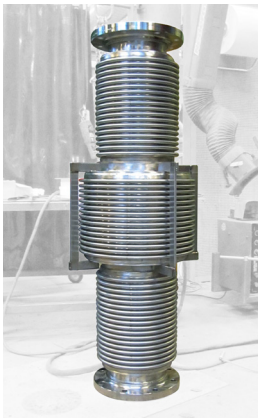


3 expansion joints with refractory lining were installed in the gas duct near the FCC reactor. The refractory lining was required due to the high design temperature. It was necessary to ensure that the outer pipe and the expansion joints would be insulated against the 650-1000°C temperature.

Dimension: **DN 1900** | Installation length: **450-500 mm** | Medium: **Flue gas** | Design temperature: **650-1000°C** | Design pressure: **0,0098 bar** | AX: **+/-20 mm** | Bellow: **1.4301** | Welding ends: **1.0425** | Flanges: **1.0570** | Inner sleeve: **1.4828** | Refractory brickwork: **Golit 135R light** | Insulation: **Superwool n607 HT**

Pressure balanced expansion joints

4710-10004, Norway



These pressure balanced expansion joints were installed together with ordinary expansion joints at the blow down header in a test rig. The rig is planned to run for a certain period and then is to be decommissioned, it is used only for test purposes.

Dimension: **DN 200** | Installation length: **900, 1350 mm** | Medium: **Liquid gas** | Design temperature: **200°C** | Design pressure: **13,7 bar** | AX: **+/-14, +/-41 mm** | LA: **+/-1 mm** | AN: **+/-1°** | Bellows: **1.4571** | Welding ends, flanges: **1.4404**

Ring-reinforced bellows

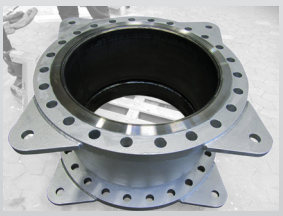
599-01001, Finland

These two expansion joints were ring-reinforced due to the high pressure. When ring-reinforcing a bellow, both pressure integrity and extended service life can be achieved. The rings are manufactured from the same material as the bellow and suitable for the medium. To ensure the rings' pressurized integrity 100% test was made.

Dimension: **DN 300** | Installation length: **545 mm** | Design temperature: **+20°C** | Design pressure: **60 bar** | AX: **+0/-20 mm** | Bellows: **2.4856** | Welding ends: **A106 gr. A**

Special paint

4410-08035, Nigeria



These 16 expansion joints were installed at an oil refinery. The design of the expansion joints differs depending on their location in the pipeline. Additionally, our customer required a special paint coating – zinc silicate, possessing extremely good anticorrosive qualities. Comprehensive testing of the expansion joints was conducted.

Dimension: **DN 150-700** | Installation length: **185-310 mm** | Design temperature: **66°C** | Design pressure: **15 bar** | AX: **+/-30, +0/-8,81 mm** | Bellows: **1.4404** | Welding ends, flanges, inner sleeve, cover: **1.0425**

Inconel bellow

979-05014, Russia

16 expansion joints were installed in the gas ducts in an FCC unit at an oil refinery. As the medium contains catalytic residues both the bellows and the inner sleeve were made from Inconel 625.

Dimension: **DN 250-800** | Installation length: **175-280 mm** | Design temperature: **730°C** | Design pressure: **2,5 - 4 bar** | AX: **+/-7 - +/-28 mm** | Bellows, inner sleeve: **2.4856** | Welding ends: **1.4828**

LPG/LNG CARRIERS

WebLink: 14207

LPG carrier

4712-07021, South Korea + Norway

48 expansion joints were supplied according to customer specifications. They were installed in connection with valves on the deck of a LPG carrier. As the application was critical extensive testing and approvals were required by the customer. In this project our expansion joints were type approved by 3 different notified bodies; LR, ABS and DNV. The approvals obtained can be used also for future projects. Expansion joint design is a double bellow solution to absorb larger movements.

Dimension: **DN 250** | Installation length: **500 mm** | Medium: **Liquid petroleum gas** | Design temperature: **-50/50°C** | Design pressure: **5 bar** | AX: **+/-18 mm** | LA: **+/-7 mm** | Bellows: **1.4541** | Flanges: **1.4404** | Intermediate pipe: **1.4301**

LPG-carrier

976-05001, UAE

5 expansion joints were installed on the gas tanks of a LPG carrier. The gas tanks were fixed on anchors, allowing a certain amount of movement. The expansion joints were installed in connection with each single anchor to compensate for this movement. The expansion joints were produced using stainless steel due to the low design temperature. Likewise the connection ends were manufactured from a special seamless pipe. All expansion joints underwent 100% X-ray tests.

Dimension: **DN 200-250** | Installation length: **800-1300 mm** | Medium: **Liquid petroleum gas** | Design temperature: **-20°C** | Design pressure: **16 bar** | AX: **+/-10 mm** | Bellows, inner sleeve: **1.4571** | Welding ends: **1.4404**

LNG carrier

4710-10015, Norway

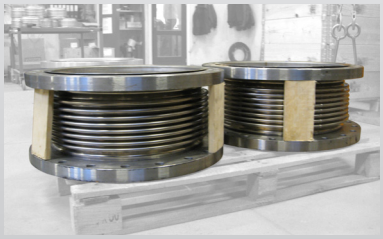
12 expansion joints installed in a LNG carrier.

Dimension: **DN 250** | Installation length: **500 mm** | Medium: **Liquid natural gas** | Design temperature: **-50/+45°C** | Design pressure: **5 bar** | AX: **+/-10 mm** | LA: **+/-25 mm** | All parts: **1.4404**

LPG carrier

4710-10017, Norway

3 expansion joints for a LPG carrier. The expansion joints are for the scrubber systems (cleaning systems).

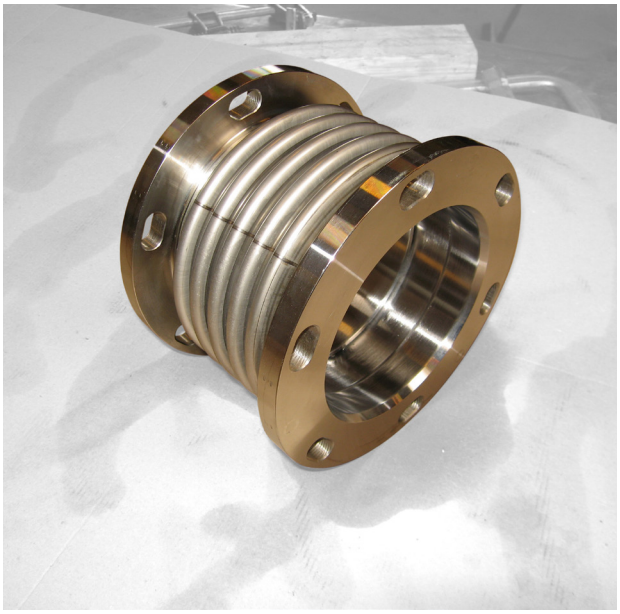


Dimension: **DN 500** | Installation length: **295 mm** | Medium: **Liquid petroleum gas** | Design temperature: **550°C** | Design pressure: **2,5 bar** | AX: **+/-58 mm** | Bellows: **2.4858** | Flanges: **1.0038** | Inner sleeve: **1.4571**

EXHAUST

Exhaust systems, engines, gen-sets

WebLink: 14208



Special flanges

016-03002, Canada

10 small expansion joints were installed at the engines. Special flanges were produced in order to fit the mating flanges of the engines. High operating temperatures required the installation of the inner sleeves to be mounted in such a way that left no opening between the bellow and the inner sleeve.

Dimension: **DN 150** | Installation length: **110 mm** | Design temperature: **650°C** | Design pressure: **1 bar** | AX: **+4/-20 mm** | Bellows: **1.4541** | Flanges: **1.0254**

Incoloy bellows

3110-06053, Holland

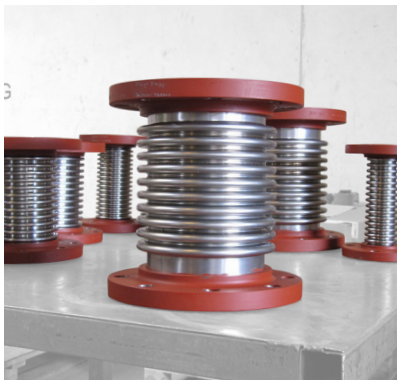
4 expansion joints were installed at the engine's exhaust system on a ship. Hexagonal flanges were required in order to fit to the mating flanges.

Dimension: **DN 150** | Installation length: **66 mm** | Design temperature: **700°C** | Design pressure: **1 bar** | AX: **+0/-4 mm** | Bellow: **2.4858** | Flanges: **1.0038**

Oil tanker

9611-06005, Scotland

8 axial expansion joints were installed on an oil tanker operating at an oil field.



Dimension: **DN 50 -150** | Installation length: **230-300 mm** | Design temperature: **200°C** | Design pressure: **16 bar** | AX: **-/+35 mm** | Bellow: **1.4571** | Flanges: **A105** | Inner sleeve: **1.4571**

Expansion joints for flue gas

457-11043, Denmark

3 expansion joints were installed in the flue gas system of a newly built ship.

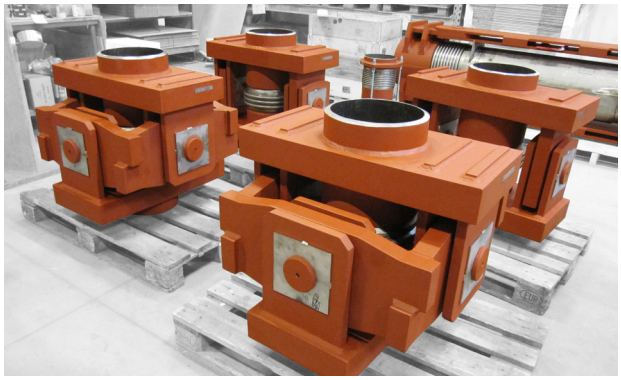
Dimension: **DN 1500–2900** | Installation length: **680-1460 mm** | Medium: **Exhaust gas** | Design temperature: **500°C** | Design pressure: **0,5 bar** | AX: **+2/-108 - +55/-155 mm** | LA: **+/-1 - +/-19,1 mm** | AN: **+/-1,8 - +/-7,9°** | Bellows: **1.4541** | Welding ends: **1.0038**

Warship

3110-04032, France

12 expansion joints were installed at the engine of a French multi-mission frigate (FREMM) warship to absorb axial and lateral movements emanating from the engine.

Dimension: **DN 500** | Installation length: **600 mm** | Design temperature: **550°C** | Design pressure: **1 bar** | AX: **+/-90,8 mm** | LA: **+45/-0 mm** | AN: **+/-9,7°** | All parts: **1.4541**



High pressure

1710-10002, South Africa

A chemical plant experienced a leakage in the compensator and decided to carry out remedial work on three other expansion joints during an unplanned shutdown. The accurate and quick replacement was therefore critical. Belman was faced not only with a critical timeframe, but also challenging design work, as the expansion joints had to be suitable for very demanding operational conditions, among others design pressure of 100 bar. In order to enable the compensators to absorb the 90 ton pressure thrust force it was necessary to use a very strong and solid construction of flanges and gimbals/fittings. The compensators had to absorb an angular movement of 1°, but in order to limit the resistance against movement, spherical bearings were inserted in the joints and lubricating channels were placed in the punches to make periodical lubrication possible. The construction had to be approved and inspected by TÜV, which put even greater demands on the timeframe. A further complication was added by the fact that South Africa does not have its own national norms for pressurized equipment but has implemented a mixture of ASME and PED regulations. The approval process was expedited by the fact that PED does not require additional calculations for the construction, which has already proven its worth in operation and under the conditions that it is identical to the replaced unit. However, as a further safety factor the design was verified through Finite Element Analysis (FEA) with prior hydraulic testing at 150 bar during the final inspection. The compensators in question were two angular compensators and two gimbal compensators for installation in the steam plant.

Dimension: **DN 300** | Installation length: **800 mm** | Medium: **Boiler feed water** | Design temperature: **120°C** | Design pressure: **100 bar** | AN: **1°** | Bellows: **1.4541** | Welding ends: **1.0305** | Inner sleeve: **1.4571**

Chamber expansion joint

334-01012, France

An asphalt manufacturer had repeatedly damaged expansion joints in their pipeline. The high viscosity resulted in the build-up of the medium in the bellows blocking the flow through of the expansion joint. Moreover the sticky medium was settling between the convolutions and damaging the bellows. Such difficult operating conditions challenged the pipe work designers to find a better solution. As the fluidity of the medium generally increased with higher temperature, the answer to the problem was the use of a chamber expansion joint. A chamber expansion joint is a compensator with a larger bellows mounted around it, whereby a chamber is formed between the two. The medium flows through the inner compensator as intended, while a heated medium, in this case oil, runs into the chamber via the inlet and outlet. On its way through the chamber the oil heats the inner compensator, thus maintaining/increasing the temperature of the asphalt. This increases the fluidity of the asphalt and minimizes the risk of "clogging up".

Dimension: **DN 125, 175** | Installation length: **365, 232 mm** | Design temperature: **200°C** | Design pressure: **6 bar** | AX: **+/-30 mm** | LA: **+/-6,72, +/-4,15 mm** | AN: **+/-23,6, +/-17,6°** | Bellow: **1.4571** | Welding ends: **1.0305** | Flanges: **1.0038**

Complete stainless steel

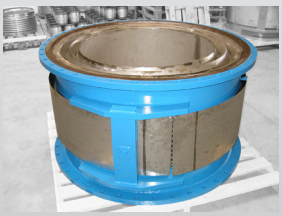
499-09315, Germany

16 chamber expansion joints were installed in a phenol plant to absorb vibrations emitted from the centrifuge. The chamber expansion joints had different design parameters and were completely manufactured from stainless steel due to the temperature and medium. The design was determined by the medium's high viscosity, which had to be kept at an acceptable level to ensure an easy flow through the expansion joint.

Dimension: **DN 50-300** | Installation length: **428-960 mm** | Medium: **Phenol liquid/steam** | Design temperature: **160, 200°C** | Design pressure: **5,5, 12 bar** | AX: **+/-5 mm** | LA: **+/-25 mm** | Bellows, welding ends, inner sleeve, cover, intermediate pipe: **1.4571** | Flanges: **1.4404**

1000°C on the inside, 80°C on the outside

442-06006, France



These high temperature expansion joints were installed at a carbon black manufacturer. Carbon black is manufactured at very high temperatures approx. 1000°C. To protect the surroundings the expansion joints were insulated, enabling the temperature to be reduced to 80°C.

Dimension: **DN 1200** | Installation length: **1800 mm** | Medium: **Exhaust** | Design temperature: **Internal 1000°C, outside 80°C** | Design pressure: **1 bar** | LA: **+/-25 mm** | Bellows: **1.4571** | Welding ends + hinges: **1.0425** | Inner sleeve: **1.4828** | Insulation: **Ceramic wool; Superwool 607 MAX**

CHEMICAL

WebLink: 14209

Tantal coated bellow

319-08002, Germany

A polymerization plant was working with a very aggressive medium (WFML), requiring high alloyed material. The customer requested an effective and cost efficient solution. For one of the applications the solution was a bellow with tantalum metal alloyed into the stainless steel bellow. This resulted in the bellows attaining a higher corrosion resistance, exceeding the corrosion characteristics of special metals (such as titanium, Hastelloy etc.) while at the same time preserving the ductility of the steel. These kind of bellows are well suited for hot and acidic environments, operating in temperatures up to 300°C. The coating of tantalum gives a matt charcoal grey surface.

Dimension: **DN 400** | Installation length: **418 mm** | Medium: **WFML** | Design temperature: **-10/ 300°C** | Design pressure: **-1/+6,5 bar** | AX: **+/-4 mm** | LA: **+/-10 mm** | AN: **+/-0,3°** | Bellows, inner sleeve: **1.4541 (tantalum coated (50 µm)** | Flanges: **1.4404**

Leak detector

5810-06018, Finland

3 expansion joints were installed between two tanks in a chemical plant producing additives for the pulp and paper industry. The medium was fatty rosin containing flammable and corrosive acid. For this reason the double bellows were manufactured from SMO254. The media runs into the inner bellow. The outer bellow is mounted for safety purposes and therefore designed for a longer service life than the inner bellow. In case of leakage of the inner bellow the leaking medium is stored in the chamber. Any leakage is indicated through a leak detector.

Dimension: **DN 150, 400** | Installation length: **383, 400 mm** | Medium: **Fatty rosin liquid** | Design temperature: **-35°C - 300°C** | Design pressure: **-1/+3 bar** | AX: **+0/-26 mm** | LA: **+/-2 mm** | Angular: **3°** | Bellows, welding ends, inner sleeve: **1.4547 (254 SMO)** | Flanges: **1.1106**

Large convolutions

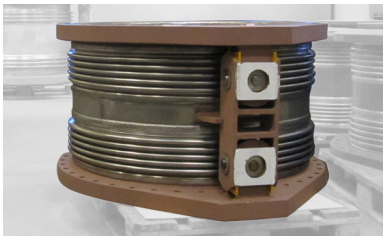
448-05001, Great Britain

5 hinged expansion joints were installed in an acid recovery plant as replacements for existing expansion joints. As the media was acidic the customer was advised to use Incoloy bellows to achieve better corrosion resistance. All other aspects of the design were similar to the existing expansion joints. A hinged expansion joint was necessary. Due to limited space between the high convolutions and the location of the installation, hinges installed on the outside of the expansion joint were not viable. Therefore the expansion joints were designed with hinges on the inside of the bellow.

Dimension: **DN 900-1700** | Installation length: **600-1730 mm** | Medium: **Gas** | Design temperature: **393°C, 240°C** | Design pressure: **0,68 bar** | AX: **+100/-50 mm** | LA: **+/-40 mm** | AN: **+/-1,5, +/- 3,5, +/-2,8°** | Bellow: **2.4858** | Welding ends: **1.0425, 1.4301** | Intermediate pipe: **1.4301**

Hinged expansion joints

3310-12007, Brazil



The expansion joints were installed in connection with the compressors in a chemical plant. The operating conditions included vibrations and a high flow velocity.
The special construction of the hinges was necessary to allow the lateral movements. The expansion joint also had to absorb angular movements. In this case the white marked plates which functioned as limiters can be removed enabling angular movement. Only materials produced from European steel plants were allowed to be used in the manufacture of the expansion joints.

Dimension: **DN 950** | Installation length: **850, 625 mm** | Medium: **Wet air** | Design temperature: **140°C** | Design pressure: **5,5 bar** | LA: **+/-15 mm** | Bellow, cover: **1.4571** | Welding ends, inner sleeve: **1.4541** | Flanges: **1.0425**

Inconel bellows

4611-02021, Sweden

2 universal expansion joints were installed in an acid plant. The bellow is manufactured from Inconel due to the aggressive medium - sulphuric acid. Inconel has better corrosive properties than ordinary stainless steels.

Dimension: **DN 300** | Installation length: **330-480 mm** | Medium: **H_2SO_4** | Design temperature: **420°C** | Design pressure: **0,2 bar** | AX: **+0/-50 mm** | AN: **+/-1°** | Bellows: **2.4856** | Welding ends: **1.4404**

Chamber expansion joints

499-09291, Germany

These chamber expansion joints were installed in the outer part of a supply pipeline in a polymerization plant. Due to the location of the pipeline, all fittings as well as the expansion joints were designed in stainless steel. The operating media was an additive for the melting process and therefore required a constant operating pressure of 2 bar and could not pass thermal bridges. For this reason chamber expansion joints were the solution.

Dimension: **DN 50** | Installation length: **300 mm** | Medium: **Melted polymer** | Design temperature: **170°C** | Design pressure: **2 bar** | AX: **+/-5 mm** | LA: **+/-1,5 mm** | Bellows, welding ends: **1.4571** | Flanges: **1.4404**

OTHER APPLICATIONS

WebLink: 14210

Water pipeline

595-06001, Turkey

These expansion joints are installed in a city water pipeline. This pipeline leads water from the mountains to a water treatment plant with the water being used later for drinking. The pipeline (DN2500) is located along the pump stations, the expansion joints are installed before and after the pumps. The expansion joints are designed for the absorption of minor earth quakes and smaller movements in the earth's crust.

Dimension: **DN 1100-2500** | Installation length: **2650-4668 mm** | Medium: **Water** | Design temperature: **20°C**. | Design pressure: **22 bar** | AX: **+120/-60 mm** | LA: **+0/-200 mm** | Bellows: **1.4301** | Flanges: **1.0473** | Welding ends, inner sleeve, intermediate pipe: **1.0038**

Pulp and paper

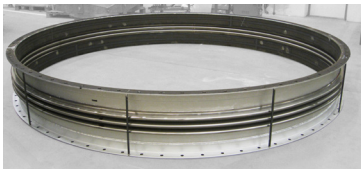
4910-12111, China

28 expansion joints were installed in a cellulose plant.

Dimension: **DN 1600, 1400** | Installation length: **2000 mm** | Medium: **Air** | Design temperature: **480°C** | Design pressure: **-0,05/0,05 bar** | AX: **+0/-24 mm** | LA: **+/-150 mm** | Bellows: **1.4571** | Welding ends, intermediate pipe: **1.8962** | Flanges: **1.0038**

Cement plant

449-12013, Great Britain



This expansion joint was installed in an air supply pipeline that channels air containing lime dust in a cement plant. The expansion joint was designed in cooperation with the customer. A flow liner and a fibre packing was mounted to prevent the dust from getting in to contact with the convolutions, which could result in dust build-up and in the long run damage to the expansion joint.

Dimension: **DN 3350** | Installation length: **500 mm** | Design temperature: **100°C** | Design pressure: **0,25 bar** | AX: **+/-43 mm** | Bellow: **1.4541** | Welding ends: **1.0425** | Flanges: **1.0038**

Airstrip

4911-01133, Germany

55 expansion joints with different design parameters were installed in drainage system next to a runway at an airport. With the constant impact from landing aircraft the resulting ground movement had to be absorbed in order to protect the drainage pipeline. The main part of the pipeline was placed above the ground, with the remainder submerged. It was necessary to protect the bellows from the soil settling between the convolutions and creating damage. A casing and insulation was not an option due to the large movements. The solution was to install the expansion joints underground in plastic shafts.

Dimension: **DN 100-800** | Installation length: **240-875 mm** | Medium: **Water** | Design temperature: **40-120°C** | Design pressure: **10 bar** | AX: **+1/-0 - +10/-140 mm** | LA: **+/-40 - +/-105 mm** | Bellows: **1.4571** | Flanges: **1.0425, 1.0460, 1.0421, 1.0038** | Intermediate pipe: **1.0038, 1.0425** | Cover: **1.4541**

Heat exchanger

498-06303, Germany

This expansion joint was installed in a heat exchanger. Due to the large diameter (DN 2000) and the high pressure a high wall thickness of the bellow was required. For this reason the bellow is manufactured from 8 x 1,5 mm plate with total thickness of 10 mm.

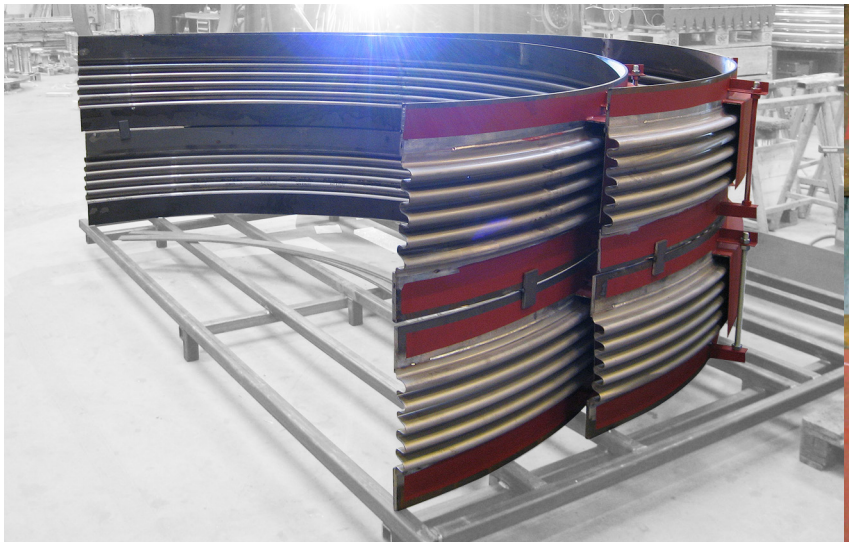
Dimension: **DN 2000** | Installation length: **610 mm** | Design temperature: **280°C** | Design pressure: **-1/23 bar** | AX: **+/-15 mm** | Bellow: **1.4571** | Welding ends: **1.0565**

Brickworks

977-08002, Tatarstan

157 expansion joints were installed in the gas ducts in a brickwork plant.

Dimension: **DN 400-2500** | Installation length: **160-300 mm** | Medium: **Exhaust** | Design temperature: **250-900°C** | Design pressure: **0,5 - 2,5 bar** | AX: **+/-12 - +/-30 mm** | Bellows: **1.4541, 1.4828** | Welding ends: **1.0421, 1.4541, 1.4828**



Repair with clamshell bellows

445-08006, United Kingdom
A steel plant had problems with a DN 3200 refractory-lined pipe carrying blast furnace gas to the gas cleaning plant. The pipe work contained 2 universal pressure balanced expansion joints. Over time the corrosive coastal environment had caused the welds to corrode allowing gas to escape. The leaks caused significant operational problems at the plant, in particular this blast furnace gas had high carbon monoxide content and its presence made routine maintenance work in the area difficult due to personnel safety issues. The solution to the problem was the installation of two over-size clamshell bellows. Site measurements were made and a great deal of care was taken to ensure that the clamshell bellows were correctly sized and were large enough to cover the existing bellows currently installed and suitable for the operating conditions. Furthermore, it was necessary to ensure that the hinge pins in the existing retaining structure cleared the new clamshell bellows. The design and installation procedure was approved by the customer. The two clamshell bellows were manufactured in 2 mm 2.4858 (Incoloy 825). To enable access to carry out welding on-site, the bellows profiles were designed with a wide convolution pitch. All the necessary preparation work such as cleaning the existing plate work and adding split rings sized to accept the new clamshell bellows had been done by a pipework contractor. Our installation team secured the mounting of the clamshell bellows and welded them while the system was online. The final testing of all welds was made when the installation was completed. Additionally, we have installed a cover to protect the bellows from mechanical damages. The installation team worked within strict site regulations and obtained all the necessary health and safety approvals.

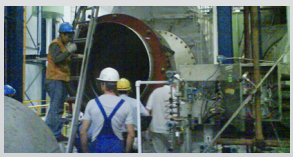
Inspection

969-02003, Saudi Arabia

A petrochemical plant required an inspection report on the expansion joints in use at the production. More specifically, they were interested to know the expected remaining service life of the units. The inspection team examined all the expansion joints and prepared a detailed report for the customer containing information on the condition of the expansion joints, advice and suggested time frame on replacement, repair and corrective actions.

Replacement of bellows on-site

498-06040, China



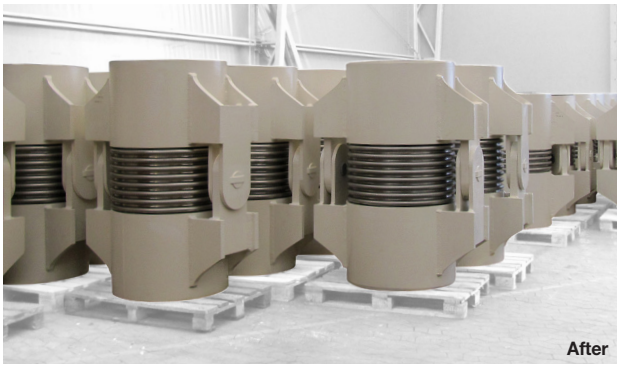
Belman has performed a bellows replacement on 6 expansion joints utilized in a chemical plant. They are installed at the gas turbines at the inlet and the outlet. The expansion joints were demounted from the pipe work, afterwards the bellows and the inner sleeve were removed. The remaining parts were prepared for the insertion of new bellows and inner sleeves. The complete expansion joints were re-installed in the pipe work. The replacement job was carried out in cooperation with the customers on-site personnel.

Dimension: **DN 1500, 800** | Installation length: **920, 1180 mm** | Medium: **Exhaust** | Design temperature: **450°C** | Design pressure: **2, 11 bar** | LA: **+/-30, +/-40 mm** | Bellow: **1.4404**

SERVICES

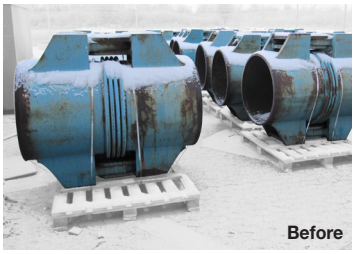
Installation, replacement, repair and inspection

WebLink: 14211


After

Replacement of bellows

4910-08116, Germany

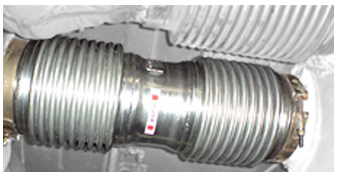

Before

25 expansion joints from a district heating pipeline were demounted during a planned shut-down and shipped to Belman, as the bellows had exceeded their service life. The most cost-efficient solution was to demount and restore the existing expansion joints instead of manufacturing new ones from scratch. Likewise it was also cheaper to demount and ship the expansion joints to Belman rather than performing the restoration on-site. The expansion joints were disassembled at our production facility, afterwards all the components were sandblasted and welded back together along with the new bellows. The expansion joints were painted, tested and made ready for shipment back to the plant.

Dimension: **DN 800** | Installation length: **1430, 1630 mm** | Design temperature: **185°C** | Design pressure: **32,5 bar** | AN: **+/-2,25, +/-4,5°** | Bellow: **1.4571**

Trouble shooting

4411-13008, United Kingdom



A train manufacturer had problems with exhaust gas expansion joints that kept breaking and required constant replacement. This proved to be not just time consuming and expensive for the customer but more importantly posed a safety risk to people near the moving trains. After design, prototyping, on-vehicle-testing then finally approval for full scale manufacture, the customers' problem was solved. The expansion joints are now in service and are living up to the client's high expectations. The expansion joints (DN 180) are all installed in the exhaust systems after the turbocharger at the diesel engines. They are designed for maximum 20 mm axial and 20 mm lateral movements and are subjected to very rigorous conditions with the locomotives frequently stopping and starting during each day of operation.

Delivery within 24 hours

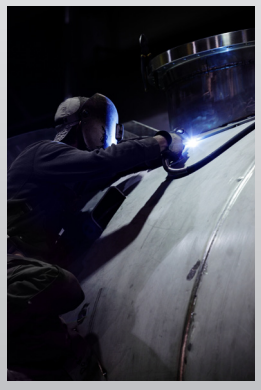
326-12006, Belgium

An oil refinery had a leakage in an existing expansion joint causing an unplanned and very costly shutdown. Naturally, the refinery wished to minimize the costs connected with the downtime and perform an urgent and effective replacement. We acted quickly; the inquiry was received at 4.30 PM and by 11.30 AM the following day the completed expansion joint was shipped back to the customer. The expansion joint was installed between the tank and the pipeline to relieve the sensitive tank from loads caused by settlements and other movements.

Dimension: **DN 600** | Installation length: **1234 mm** | Medium: **Process gas with H_2S** | Design temperature: **400°C** | Design pressure: **4 bar** | AX: **+/-8 mm** | LA: **+/-10 mm** | Bellow, Inner sleeve, cover: **1.4404** | Welding ends: **1.0425**

Repair

329-12005, Belgium

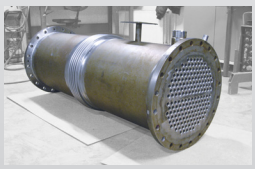


The installation team installed clamshell bellows at a heat exchanger in a zinc melting plant. Normally, clamshell bellows are supplied in two segments. These clamshell bellows due to their size, were supplied in four segments and welded together onsite.

Dimension: **DN 4600** | Installation length: **350 mm** | Medium: **SO_2, SO_3 (risk for sulphuric acid at cooling)** | Design temperature: **550°C** | Design pressure: **0,3 bar** | AX: **+/-10 mm** | Bellows: **1.4571**

Repair of heat exchanger

459-12008, Denmark



Replacement of the bellows at a heat exchanger would normally lead to the following sequence of events: Dismantling and repair of the heat exchanger, shutdown while repairing, installation of the new heat exchanger or repair with clamshell bellows (can be done without a shutdown). In this case the most cost efficient solution was to dismantle the heat exchanger during a planned shutdown and perform the repairs at our facility, which saved travelling expenses for the installation team. We separated the heat exchanger, cleaned it, attached the bellows and welded everything back together and sent it back for re-installation.

Dimension: **DN 450** | Installation length: **1400 mm** | Design temperature: **400°C** | Design pressure: **4 bar** | AX: **+/-10 mm**

OUR EXPERIENCE, YOUR BENEFIT

The successful installation of expansion joints in a pipe system requires the careful consideration of many variables. We expertly assist our clients in all stages, from the initial design to installation and after sales services. In the design phase we advise on the appropriate selection and specification of expansion joints to help provide safe, reliable and cost-effective results. Working with the technical specifications, and all other relevant information we can design a superior solution for the benefit of our customer. Our dedication to serving our clients applies to both complex projects requiring detailed analysis and also routine requests where the expansion joint design is fully defined at the enquiry stage, including the replacement of existing units.

Over the years we have been able to build up a strong technical base, with extensive references across the industries proving our abilities as a committed, problem-solving, innovative and rapidly developing manufacturer. We strive constantly to deliver an excellent solution by applying the latest available technologies and maximising efficiency throughout the entire design and manufacturing process. We dare to take on challenging tasks and develop solutions according to your requirements and believe that by staying committed and true to our values ensures benefits for our customers.

Our experience, your benefit

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