Metallic expansion joints

James Walker

High Performance Expansion Joint Technology
Applications

Steel expansion joints are important components in many industries and are used extensively in, among others:

- Energy sector (conventional power plants, nuclear power plants, district heating pipe systems, etc.)
- Steel plants
- Petrochemical industry (oil refineries, pumping stations, oil rigs, etc.)
- Chemical industries (including asphalt manufacturers, etc.)
- Process industry (sugar refineries, etc.)
- Exhaust systems and engines
- Pulp and paper industries
- LNG/LPG tankers, carriers, etc.

Expansion joints are often installed adjacent to boilers, heat exchangers, pumps, turbines, condensers, engines and in long pipe systems or pipe ducts.

James Walker has been involved with the manufacture and supply of all types of expansion joints and bellows for over 75 years.

We are now working in partnership with Belman to provide our customers worldwide with quality assured and expertly engineered ranges of metallic expansion joints that are suitable for duties in virtually every industrial sector.

The standard ranges and customised joints described in this catalogue are designed and manufactured by Belman. They are supplied and, where required, on-site installed through James Walker’s global support and distribution network.
What is an expansion joint?

There are other terms in use for expansion joints such as expansion bellows, flexible joints and compensators.

A typical expansion joint comprises one or more metal bellows (most commonly stainless steel) or is manufactured in materials such as rubber, fabric or polymers such as PTFE. While materials such as rubber, polymer and fabric have their limitations, metal is the most versatile of all materials. Metals are suitable for use at high temperatures, have high strength properties and are resistant to corrosion.

Metallic expansion joints are designed to absorb safely the dimensional changes of steel pipe systems and ducts. The changes could be heat-induced expansion and contraction, vibrations caused by rotating machinery, pressure deformations, misalignment during installation or building settlements.

The main element of the expansion joint is the bellows. The bellows is made up of a series of convolutions, with the shape of the convolution designed to withstand the internal pressure of the system, but remain flexible enough to accept axial, lateral and angular deflections.

Expansion joints are considered as very important components of a complete pipe system and are widely used particularly in industries where thermal expansion in pipe systems occurs.

Expansion joints also offer the advantage of reducing stresses in pipe systems generated by thermal expansion, and reduce pipe loads at connections to sensitive equipment such as pumps and steam turbines. Taken together this acts to prolong the service life of pipe systems, and reduces the risk of their downtime for additional maintenance and repair.

Engineers and pipe designers routinely incorporate expansion joints into their pipe systems, as expansion joints add flexibility into the design and reduce costs through removing the complexity of fix points and guides, and reduce the overall space requirements for the pipe system.

Further, expansion joints are more effective than alternatives such as pipe bends and pipe loops due to their greater ability to conserve space plus their economic efficiency and better performance in absorbing larger movements.

Advantages

- Simple in design and function
- Space reduction
- Weight reduction
- Cost reduction
- Reduces engineering and design complexity to piping systems
- Better flexibility for piping layout
- Reliable and proven in the field.
Movements

**Axial movement**
Axial movement is movement of the bellows in the direction of the longitudinal axis.

This movement can be compressive, where the bellows shortens in length, or extensive where the bellows extends in length. The expansion joint is fitted in pipe systems and installed between two fix points (anchors).

In the majority of applications, the expansion joint is deemed necessary because of the increasing temperature of the pipe system.

Thermal expansion of the pipe system results in an axial compression of the installed expansion joints.

In some cases, typically cryogenic and chilled water services, the pipe system contracts in service causing the expansion joint to extend in length.

The specifications for expansion joints should always state the compensating movement required of the joint itself (compression or extension) and not the movement of the pipe system.

**Lateral movement**
Lateral movement is movement perpendicular to the bellows' longitudinal axis; it is a shearing movement of the bellows with one end offset from the other, usually with the ends of the bellows remaining parallel to each other.

A single bellow expansion joint, working with a shearing action, can accept a relatively limited amount of lateral movement, especially when the flow characteristics of the system demand that an inner sleeve is necessary. For larger lateral movement capability, it is usual to utilise a twin bellows arrangement with an intermediate pipe between the bellows, the expansion joint lateral movement is taken up by an angular rotation of the bellows in opposite directions.

The amount of lateral movement available depends on the rotational movement capacity of each bellows and the distance between them, increasing the distance between the bellows increases the lateral movement capability of the expansion joint proportionally.
Lateral movement can be applied in more than one plane; in such cases it is important that the expansion joint designer is made aware of the total lateral movement to be applied.

**Angular movement**

Angular movement is the rotation of the bellow's longitudinal axis at one end relative to the other, the axis of rotation is taken at exactly the midpoint of the bellow and perpendicular to the longitudinal axis.

Expansion joints using angular movement to control pipe system expansion are almost always used in pairs, sometimes combined as part of a twin bellows unit and sometimes in sets of two or three in pinned restrained expansion joints.

The intelligent use of the angular capability of the bellows can enable a large amount of movement to be absorbed. In particular, pinned units used in two-pin or three-pin arrangements can convert pipe growth into angular rotation and control the expansion from two directions and in two planes.

It is important not to confuse angular rotation with torsion. Torsion is a twisting rotational movement around the longitudinal axis; it generates undesirable shear forces within the bellows and its influence on the bellows should always be avoided.

**Universal movement**

Universal expansion joints can be designed and built to absorb applied axial, lateral and angular movements simultaneously. Such units usually require a lot of flexibility to absorb significant amounts of movements in combination. However, this often leads to a limited pressure containing capacity due to considerations towards the bellows' stability.

**Important**

It is important that the designer of an expansion joint is fully informed of all the movements that the expansion joint will encounter. Knowledge of the amount of movement, its direction and any combination of axial, lateral and angular movements occurring together is essential for the correct design of the expansion joint.

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**Animations of movements**

See how movements are absorbed in the various types of expansion joints:

visit the [Belman channel on www.youtube.com](http://www.youtube.com)

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Expansion joint types

Expansion joints come in a wide variety of designs. Some of them are standard and some are customised to client requirements.

Although their design may vary significantly, all expansion joints are nevertheless composed from some of the following components, all with one or more specific functions: bellows, welding ends, flanges, hinges, tie-rods, spherical washers, wire mesh, insulation, inner sleeve, external cover, elbow and/or ring reinforcement/equalising rings.

Axial
with welded flanges & liner
AX1FU / ID no. 42
DN 40 - 300
PN 16

Angular
with welded flanges, hinges & liner
AN1FH / ID no. 63
DN 50 - 250
PN 16

Lateral
fully articulated double tied with liner
LA2FT / ID no. 84
DN 50 - 250
PN 16
Standard range design

Bellow
We provide an entire line of standard multi-ply bellows fabricated with certified materials:
EN 1.4541/AISI 321 Stainless steel or EN 1.4404/AISI 316L Stainless steel

This range includes:

- **Axial expansion joints**
  Designed to absorb linear expansion (movements such as extension and compression in its longitudinal axial direction).

- **Lateral expansion joints**
  Designed to absorb lateral deflection. Lateral expansion joints can move in all lateral directions simultaneously for absorbing expansion from two pipe sections in different directions.

- **Angular expansion joints**
  Designed to allow only angular movements. The angular expansion joint moves in an angular rotation in one or several planes, controlled by a pair of hinges.

Connection ends
**Flanges**
We offer both loose and welded flanges on all our Standard range. Flanges used on the range are drilled according to EN 1092-1 - PN 16.

Flanges are available in pressure vessel quality steel, EN 1.0425 / P265GH (HII) typically, however where the pressure/temperature conditions allow, EN 1.0038 / S235JR may be used for economy (only applicable for axials).

**Pipe ends**
Pipe ends are available on all our Standard range.
Material: A106 Gr.B

On request
Please contact us, if you have any special requirements, for example, temperature down to -60°C, a special combination of ends, etc.

**Tie rods**
For our Standard restrained expansion joints range tie rods are available, the number for which is determined by the diameter and pressure.
Material: ASTM A 193 Grade B7

**Attachment plates and lugs**
Material: EN 1.0425 / P265GH (HII)

**Accessories**
Inner sleeve, cover, counter flanges, gaskets, insulation, etc, are just a few of the add-ons we can offer based on your requirement.
Design conditions

- Design code: EN 14917
- PED category: Sound engineering practice
- All our Standard range is designed for a minimum 1000 load cycles at 20°C
- Operating temperature ranging from -10°C to +400°C
- All our expansion joints are designed to be tested at a pressure 1.5 x the design pressure
- Our Standard range is designed to operate at a rated pressure up to 1.6MPa/16barG and temperature up to +120°C

If your requirements for pressure and temperature exceed the Standard range please contact us so that we can offer a best-fit solution.

Quality Assurance

Where applicable/required we can offer 3.1 material certification according to EN 10204 and/or ASME standards. Other certificates and Declarations of Conformity are also available on request.

Full range

To view our full range please request the full Expansion Joint Catalogue or view it online here:
Download > http://ipaper.ipapercms.dk/Belman/EN/ExpansionJointCatalogue/

Also check out the BelMaker Light® expansion joint software:
Download > http://www.belman.com/belmaker-light/

Customised solutions

If the required/specifed expansion joint is not found in this product catalogue, please do not hesitate to forward your specifications to us.

We are happy to design and manufacture custom solutions even within standard delivery times.
Axial expansion joints
with welded flanges & liner

AX1FU / ID no. 42

PN 16 - with flange drilling according to EN 1092-1

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Further technical data
Information regarding adjusting forces, maximum width, etc, can be provided on request.

Design code: EN 14917
Temperature: Calculated at 20°C (EN 1333)
Minimum fatigue life: 1000 cycles

Important: The movements should be considered alternatives. The total accumulated coefficient of utilisation cannot exceed 1.
Angular expansion joints
with welded flanges, hinges & liner

AN1FH / ID no. 63

PN 16 - with flange drilling according to EN 1092-1

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Further technical data
Information regarding adjusting forces, maximum width, etc, can be provided on request.

Design code: EN 14917
Temperature: Calculated at 20°C (EN 1333)
Minimum fatigue life: 1000 cycles
# Lateral expansion joints

Fully articulated double tied with liner

**LA2FT / ID no. 84**

PN 16 - with flange drilling according to EN 1092-1

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**Further technical data**

Information regarding adjusting forces, maximum width, etc, can be provided on request.

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Temperature: Calculated at 20°C (EN 1333)
Minimum fatigue life: 1000 cycles
## Lateral expansion joints

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Special expansion joints

- Pressure balanced expansion joints
- Compact design
- Crossover bellows

- Pressure balanced expansion joints
- Elbow
- Expansion joints for LNG/LPG

- Pressure balanced expansion joints
- Pantographic linkage

- Chamber expansion joints
- Equalising ring reinforced expansion joints

- Rectangular expansion joints
- Clamshell bellows

- Externally pressurised expansion joints
- Expansion joints supplied in segment

- FCCU expansion joints
- Lens expansion joints
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