



BOA® Group



Installation Instructions Expansion Joints

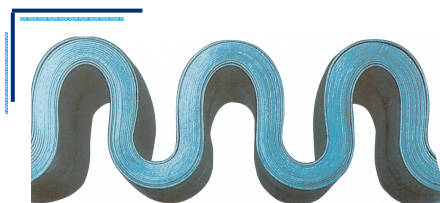
- Axial Expansion Joints
- Angular Expansion Joints
- Lateral Expansion Joints

Installation Instructions for Expansion Joints

Summary

1 INSTALLATION INSTRUCTIONS EXPANSION JOINTS	3
1.1 General safety recommendations	3
2 INSTALLATION INSTRUCTIONS AXIAL EXPANSION JOINTS	4
2.1 General safety recommendations	4
2.2 Description and application fields of Axial Expansion Joints	4
2.2.1 Axial Expansion Joints	4
2.2.1 Disassembly Joints	4
2.2.3 Type overview (Expansion Joints EFB and HFB)	5
2.3 Installation advice	6
3 INSTALLATION INSTRUCTIONS ANGULAR EXPANSION JOINTS	11
3.1 General safety recommendations	11
3.2 Description and application fields of Angular Expansion Joints	11
3.3 Type overview (Expansion Joints EFB)	12
3.4 Installation advice	12
4 INSTALLATION INSTRUCTIONS LATERAL EXPANSION JOINTS	14
4.1 General safety recommendations	14
The general recommendations of section 1.1 are valid.	14
4.2 Description and application fields of Lateral Expansion Joints	14
4.3 Type overview (Expansion Joints EFB)	15
4.4 Installation advice	15

Hydraulic Formed Bellows HFB: 1 – 5 bellows layers
Elastomer Formed Bellows EFB: 2 – 16 bellows layers



Elastomer Formed Bellows (EFB):

- several to multi-ply (2 to 16 layers)
- high flexibility
- short construction length
- low displacement forces
- big movement capacity
- small corrugation height
- vibration absorbing

1 Installation Instructions Expansion Joints

1.1 General safety recommendations

Prior to installation and start-up, installation and start-up instructions must be read and observed. Installation, start-up and maintenance work shall only be performed by **qualified and authorized staff**.

Maintenance

Expansion joints and disassembly joints are maintenance free.

CAUTION

Prior to disassembly and maintenance, the system must be

- depressurized,
- cooled down,
- emptied.

Otherwise there is a risk of accident!

Transport, packaging and storage

- The consignment must be checked for completeness upon receipt.
- Any transport damage must be reported to the carrier and the manufacturer.
- At an intermediate storage we recommend to use the original packaging.

Admissible ambient conditions for storage and transport:

- ambient temperature - 4 °C to +70 °C
- relative humidity up to 95%.

Expansion joints or disassembly joints must be protected against wetness, humidity, dirt, shocks and damage.

Warranty

A warranty claim requires professional installation and start-up in accordance with installation and start-up instructions. The necessary installation, start-up and maintenance work must be performed by qualified and authorized staff.

Operating pressure

NOTE

- The permissible operating pressure results in the nominal pressure considering the reduction factors.
- At higher temperatures, the expansion capacity has to be reduced according to the reduction factors.

Start-up and check

Before starting-up check if

- the pipeline is installed with sufficient inclination to avoid water pockets
- there is sufficient drainage
- pipe anchors and pipe supports/ guides are firmly installed prior to filling and pressure testing the system
- the expansion joint is not stressed by torsion, especially not expansion joints with socket attachment
- the flow direction has been observed for expansion joints with inner sleeves
- the steel bellows is free of dirt, welding, plaster or mortar splatters or any other soiling; clean if necessary
- all screwed connections are tightened properly
- the general due diligence requirements to avoid corrosion damage are observed, such as water treatment, or prevention of galvanic corrosion in copper and galvanized pipes.

Insulation

Expansion joints may be insulated exactly as the pipeline.

- If no coating is provided, protect the bellows by means of a slidable metal sleeve to avoid insulation material dropping into the convolutions.
- If the expansion joint is to be placed under plaster, a protective cover is essential. This ensures the bellows' function, protects against soiling and avoids contact with structure materials.

Improper operation

- The limits given in the technical data of the standard range must not be exceeded.
- Swinging suspensions adjacent to expansion joints are not permitted.
- Do not clean the newly installed pipeline by blowing it with steam to avoid water hammers and unacceptable vibration stimulating of the bellows.

System start-up

CAUTION

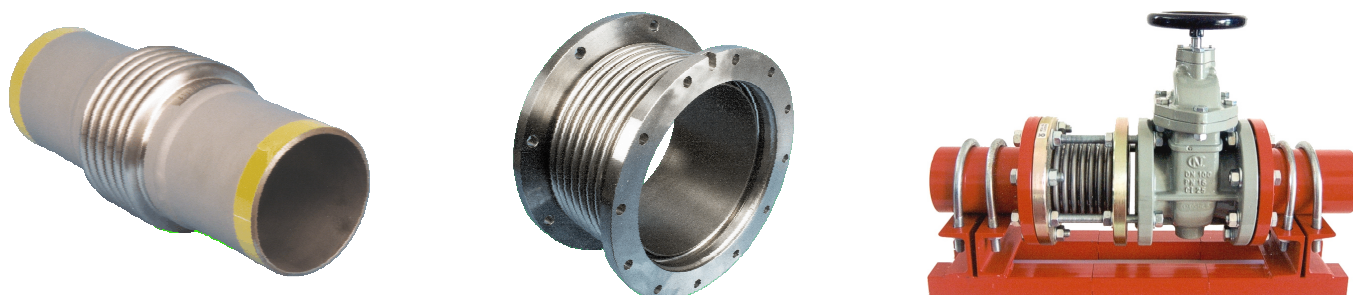
- During pressure testing and operation, the allowable test pressure or operating pressure defined for the expansion joint must not be exceeded.
- Excessive pressure peaks as a consequence of valves closing too abruptly, water hammers etc. are not permitted.
- Avoid contact with aggressive media.
- The start-up of steam lines must be performed such that the condensate has time to drain off.

2 Installation Instructions Axial Expansion Joints

2.1 General safety recommendations

The general recommendations of section 1.1 are valid.

2.2 Description and application fields of Axial Expansion Joints



2.2.1 Axial Expansion Joints

Axial expansion joints are intended to compensate for axial expansion movements in straight pipeline sections. In addition, they are used:

- for vibration absorption and reduction of structure born noise on pumps and compressors
- as flexible seals at the end of jacketed pipes in district heating systems
- to compensate for thermal expansion and vibrations in exhaust gas lines of boilers and engines
- as disassembly joints for pumps, valves and plate heat exchangers
- as gas-tight wall penetration of pipelines in reactor construction and shipbuilding
- to take up occurring differential expansion in vessel and apparatus construction

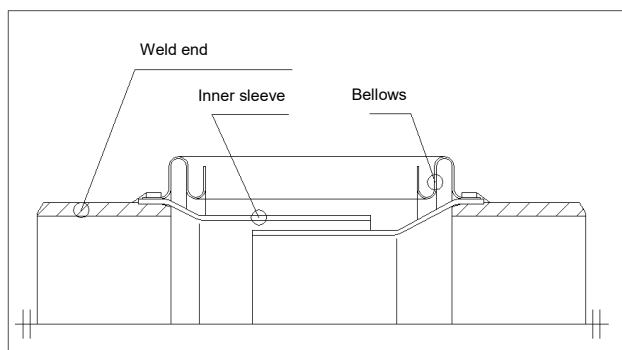


Fig. 1

Prerequisite for the application of axial expansions is the presence of appropriate anchor points and axial guide bearings. The technical data given on the rating plate are decisive for use.

These installation and start-up instructions apply to the types listed in table 1.

On site the general due diligence requirements to avoid corrosion damage must be observed, such as water treatment, or prevention of galvanic corrosion in copper and galvanized pipes.

2.2.1 Disassembly Joints

During assembly of piping and any subsequent dismantling and replacement of individual components (valves, shut-off gates, pumps, etc.) for maintenance reasons, an axial gap is essential to comfortably set and exit the components. Often there is inaccuracy and misalignment due to laterally displaced flanges. During operation of such systems also occur thermally induced expansions of pipe sections.

Therefore, so-called disassembly joints are installed between pipes and components.

2.2.3 Type overview (Expansion Joints EFB and HFB)

Type overview BOA Axial expansion joints			
not prestrained	connection	50% prestrained	connection type
FS	2	Za	1
FB	5	Ga	11
W	1	I	10
Alpha-C	5		
EXF	5		
EXW	1		
AKFB-U1	5		
AKFB-U2	5		
AKFS-U1	2		
AKFS-U2	2		
AKFB-Z1	5		
AKFB-Z2	5		
AKFS-Z1	2		
AKFS-Z2	2		
7179 00X MS	8		
7179 00X ME	8		
7160 00S TI, RI	6		
7160 00S TA, RA	6		
7160 00S LF	10		
7162 00S TI, RI	6		
7162 00S TA, RA	6		
7162 00S LF	10		
7951 00S	5		
7951 DFS	5		

Connection type:

- 1 weld end
- 2 flange, welded
- 5 flange, collared
- 6 threaded socket, female thread (I)
- 6 threaded socket, male thread (A)
- 8 press fitting
- 10 brazing fitting LF
- 11 threaded nipple, welded

Table 1

2.3 Installation advice

Assembly

- Anchor points and pipe guides must be firmly installed before filling and pressure testing the system.
- Expansion joints must be installed without being subject to torsion. This applies particularly to expansion joints with socket connection.
- The steel bellows must be protected against damage and dirt (e.g. welding, plaster or mortar splatter).
- Steam pipelines should be installed in such a way that water hammers are avoided. This can be achieved by adequate drainage, insulation, by preventing water pockets and by sufficient inclination of the line.
- Observe the flow direction while installing expansion joints with inner sleeves.
- Avoid the installation of expansion joints in the immediate vicinity of pressure reducers, hot steam coolers and shut-down valves, if high-frequency oscillations are expected due to turbulence. Otherwise special measures must be installed (e.g. thick-walled sleeves, perforated disks, calming sections etc.).
- If high frequency vibrations or turbulence or high flow speed are expected, we recommend the installation of expansion joints with inner sleeve.
- Inner sleeves are also recommended for expansion joints with $DN \geq 150$, if the flow speed of air, gas or steam media exceeds 8 m/s, or 3 m/s in case of liquid media.

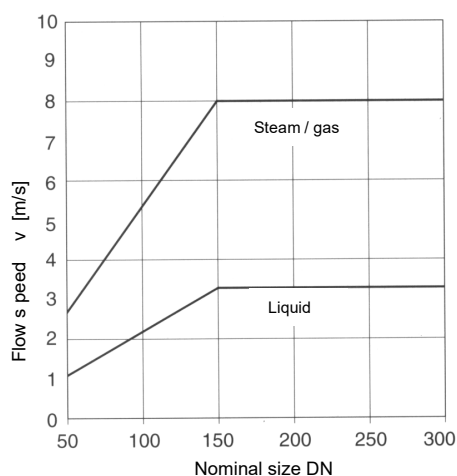


Diagram 1

Pipe guides, pipe supports

- Provide inclination for drainage
- Align the pipeline, distance between pipe guides according to fig. 2, table 2 and diagram 2

NOTE

Sliding or roller supports are the safest measures to avoid buckling and lifting of the pipeline.

CAUTION

Swing suspensions are not permitted adjacent to expansion joints!

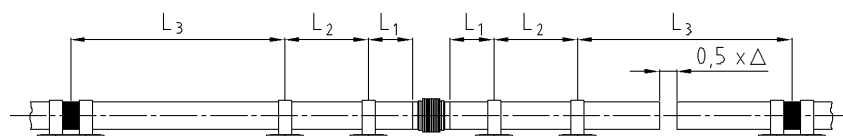


Fig. 2

Δ = expansion capacity of the expansion joint [mm]

L_1 = max. $2 \times DN + \Delta/2$ [mm]

L_2 = $0.7 \times L_3$ [mm]

L_3 = $400 \times \sqrt{DN}$ [mm] valid only for steel pipelines

L_3 is the distance between the pipe supports according to the formula above. If buckling must be expected, L_3 must be reduced according to diagram 2.

DN	L ₁ [mm]	L ₂ [mm]	L ₃ [mm]
15	30 +Δ	1050	1550
20	40 +Δ	1200	1750
25	50 +Δ	1400	2000
32	64 +Δ	1550	2250
40	80 +Δ	1750	2500
50	100 +Δ	1950	2800
65	130 +Δ	2250	3200
80	160 +Δ	2500	3550
100	200 +Δ	2800	4000
125	250 +Δ	3100	4450
150	300 +Δ	3450	4900
200	400 +Δ	3950	5650
250	500 +Δ	4400	6300
300	600 +Δ	4850	6900
350	700 +Δ	5200	7450
400	800 +Δ	5600	8000
450	900 +Δ	5900	8450
500	1000 +Δ	6250	8900
600	1200 +Δ	6850	9800
700	1400 +Δ	7450	10600
800	1600 +Δ	7900	11300

Table 2 (only valid for steel pipelines)

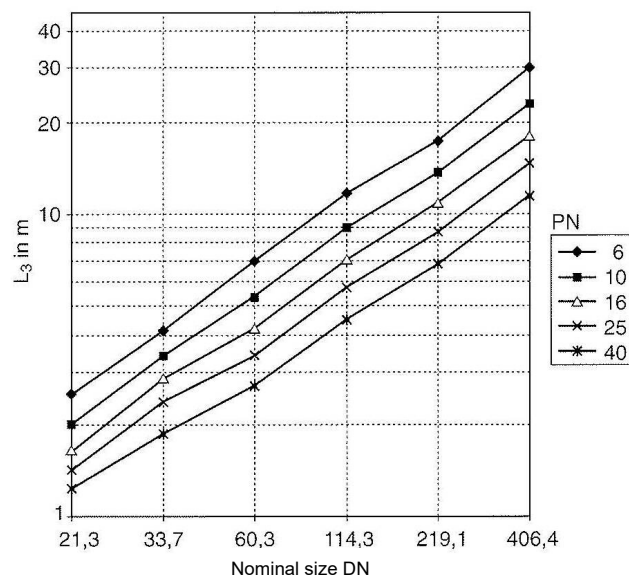


Diagram 2

Anchor points

- Install main anchors at locations where the pipeline changes direction.
- Limit by anchors each pipe section to be compensated for.
 - Only one expansion joint is allowed between two anchors.
 - Main anchors must be installed at locations where the pipeline changes direction. They must take up the pressure thrusts of the expansion joints as well as the frictional forces of the pipe supports/ guides.
 - Intermediate anchors must be installed if the movement capacity of one axial expansion joint is not sufficient to compensate for the entire expansion of a long pipeline. In that case, several axial expansion joints are required.
 - In vacuum mode, the anchor points must be capable to take up tensile and pressure forces.

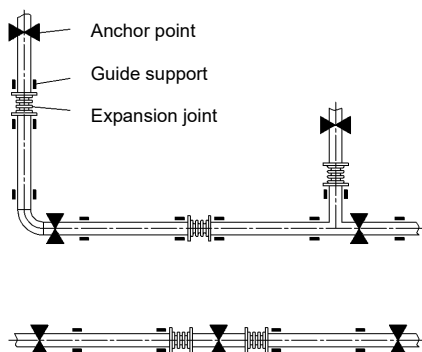


Fig. 3

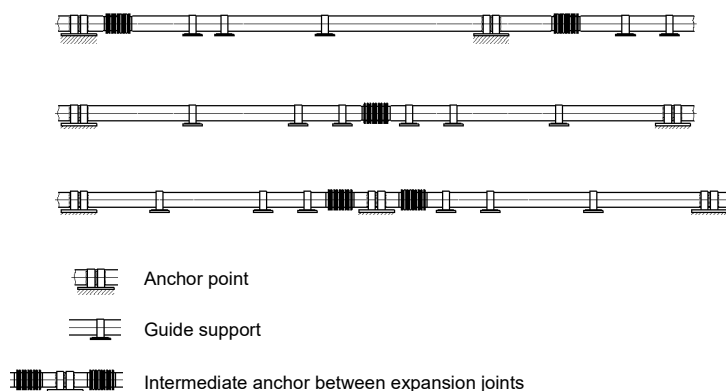


Fig. 4

Vibration compensation

- The expansion joint should be installed as close as possible to the vibrating unit to make use of its entire absorption capacity.
- The vibration absorber must be installed as close as possible to the vibration source so as to avoid resonance of the other parts.
- Primarily it must be ensured that the vibration amplitude acts laterally, i.e. perpendicular to the vibration absorber axis.
- Install an anchor directly behind the expansion joint. Installation is made without prerestraint.

CAUTION

If unrestrained vibration absorbers are installed, the reaction force must be taken into account.

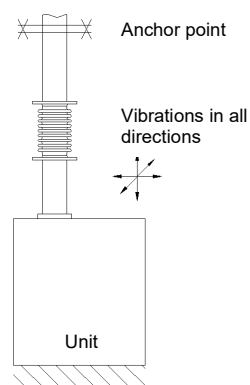


Fig. 5

Prerestraint

All common expansion joints must be installed prerestrained by 50% of their movement capacity (for heating systems: overall length of expansion joint plus 50%, whereas for cooling systems: overall length of expansion joint minus 50% of the movement). If an expansion joint is not installed at the lowest operating temperature of a heating system or at the highest operating temperature of a cooling system (e.g. repair of a still-warm pipe), an individual prerestraint mode must be chosen (see diagram 3).

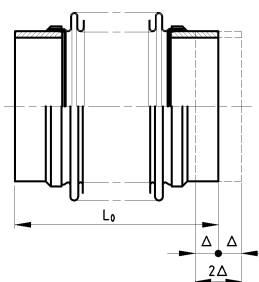


Fig. 6

Prerestraint diagram

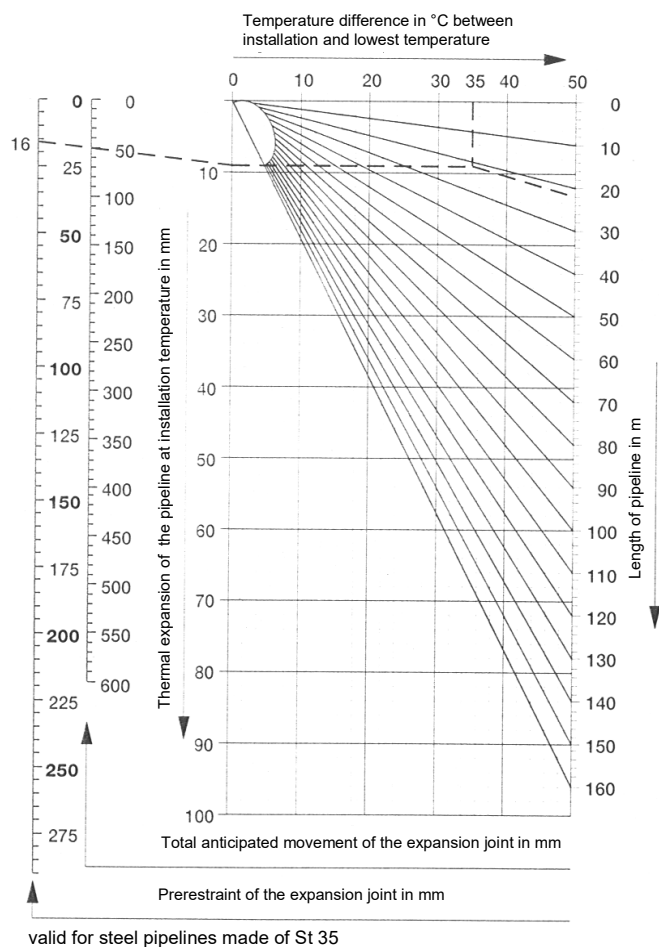


Diagram 3

Example for Diagram 3

Order is placed for an axial expansion joint to be installed in a pipeline of 22 m length.

Lowest temperature: -15°C .

Highest temperature: $+165^{\circ}\text{C}$.

Max. expansion corresponding to 180°C heating = 50 mm.

The expansion joint shall be restrained by 50% of this expansion = prestrained by 25 mm, i.e. pulled apart.

The remaining 50% = 25 mm will be compressed in operation mode.

Special attention must be given to the restraint during installation. The temperature shall not be -15°C , but $+20^{\circ}\text{C}$.

This results in a corresponding expansion of the pipeline of 9 mm (see diagram 3), by which the expansion joint must be less prestrained: $25 - 9 = 16$ mm.

The prestraint diagram (3) allows to determine the correct prestraint value without intermediate calculation:

1. Temperature difference between installation and lowest temperature: -15°C to $+20^{\circ}\text{C} = 35^{\circ}\text{C}$.
2. Length of the pipe section to be compensated for: = 22 m.
3. Draw a straight line from point "22 m pipe length" to the " 0°C " point.
4. Draw a vertical line from the " 35°C " point towards the beam coming from "22 m".
5. Draw a horizontal line from this intersection to the line "Thermal expansion of pipeline in mm"; the result is, as stated above, 9 mm.
6. Draw a straight line from the "9 mm" point to "Total anticipated movement" = 50 mm, and lengthen the connecting straight line to "Prestraint of the expansion joint in mm".

This results in a prestraint value of 16 mm, which is the value by which the axial expansion joint must be pulled apart during installation.

Installation of an expansion joint with flanges

- Align pipe axes and flange bolt holes.
 - ensure flanges are parallel
 - ensure gaskets are centred
 - tighten bolts crosswise.
- Make sure the expansion joint is not exposed to torsion during installation.
- After installation, check if the bellows convolutions are free of dirt.

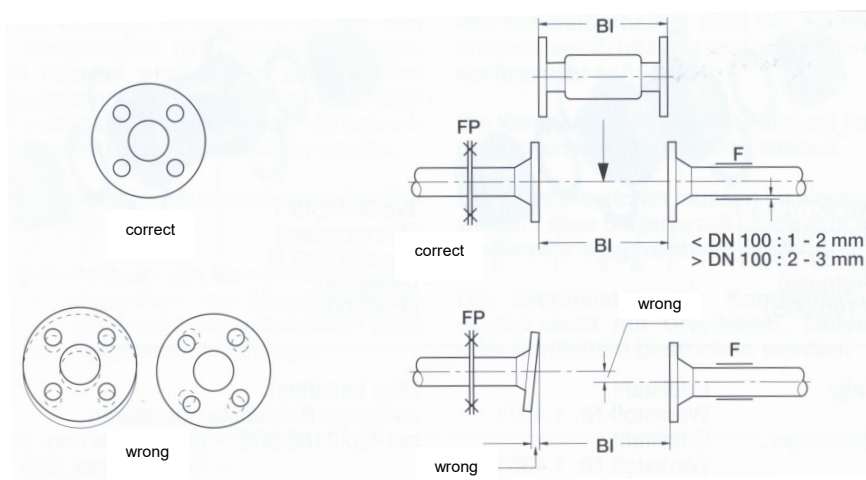


Fig. 7

Installation of pipes with pressfittings

BOA axial expansion joints of type 7179 00X are suitable for the compensation of axial movements in straight pipelines and are especially developed for the Mapress system. With the connection elements welded on both sides, fast and proper assembly is possible on site.

When expansion joints are installed in HVAC systems, the installation guidelines of the Mapress company must be strictly observed.

Disassembly joints

NOTE

Depending on the nominal diameter, the installation length EL of the disassembly joint shall be max. 50 mm longer than the unrestrained total length TL.

- Install anchor points on each side: With unrestrained expansion joints the reaction force must be absorbed by the anchors.

Installation

- Flange the disassembly joint to one pipe end (fig. 8). On the other side, pull the disassembly joint towards the components (valve, shut-off gate, pumps, etc.) either using long screws (unrestrained) or with the supplied threaded rods (restrained) (fig.9). When installed correctly, the disassembly joint is restrained (fig. 10).

Disassembly

- Loosen the extended screws or the threaded rods. - The disassembly joint swings back, creating a gap, which is necessary for comfortable subsequent assembly and disassembly of the components.

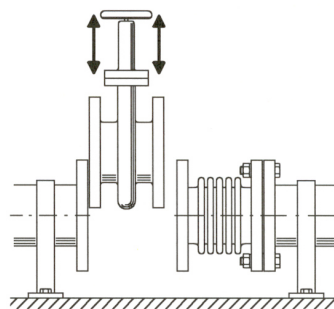


Fig. 8

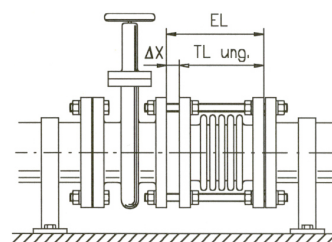


Fig. 9

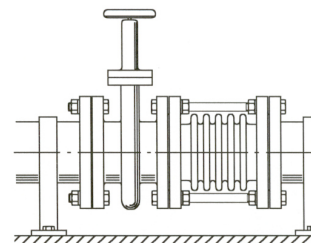


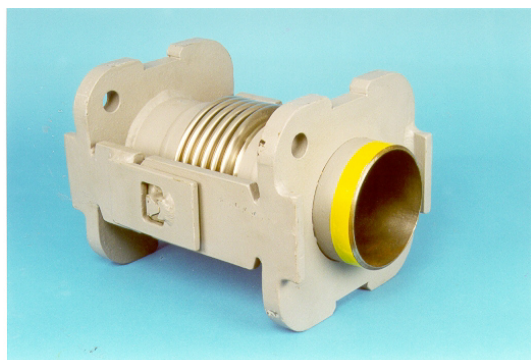
Fig. 10

3 Installation Instructions Angular Expansion Joints

3.1 General safety recommendations

The general recommendations of section 1.1 are valid.

3.2 Description and application fields of Angular Expansion Joints



Due to the angular movement of the steel bellows, **angular expansion joints** are suited to compensate for expansion movements occurring perpendicular to the longitudinal axis of the expansion joint.

The technical data are decisive for use and are given on the type plate.

These assembly and start-up instructions are valid for the types listed below in table 3.

On installation site, the general duty to care must be observed to prevent corrosion damage, such as water treatment, or prevention of galvanic corrosion in copper and galvanized pipes.

Angular expansion joints are appropriate for the compensation of both long pipe sections of district heating systems as well as short boiler and turbine room pipelines in plane or three-dimensional pipe systems.

A minimum of two and a maximum of three angular expansion joints form a statically defined hinge system making a construction unit. Their effect is based on an angular movement of the steel bellows, which is specified as "Nominal expansion capacity at 1000 full load cycles" in the technical data sheets.

The longer the distance L_1 between two angular expansion joints is (fig. 11), the bigger the movement that can be compensated by the expansion system, and the smaller become the displacement forces. The axial reaction forces generated by the internal pressure are transmitted by hinge bearings. The hinges' center of rotation is at half bellows length (fig. 11).

Gimbal expansion joints utilize a round or square gimbal joint to take up the reaction forces. This enables three-dimensional rotation around the X- and Z-axis (fig.12)

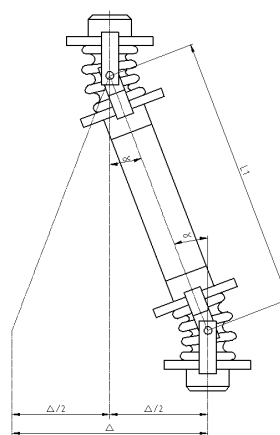


Fig. 11

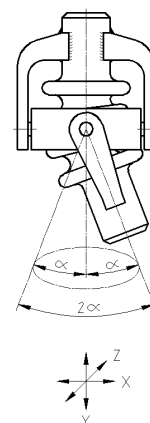


Fig. 12

Special characteristics:

- very low anchor loads, since the joint anchor transfer the reaction forces generated by the internal pressure
- lower requirements on pipe guides/ supports

Even swing hangers may be acceptable.

3.3 Type overview (Expansion Joints EFB)

BOA Angular and gimbal expansion joints	Connection type
AWT	1
AFS	2
AFB	5
KAWT	1
KAFS	2
KAFB	5

Table 3

Connection type:

- 1 weld end
- 2 flange, welded
- 5 flange, flared (collared)

Admissible operating temperature:

for standard design: maximum 300°C

3.4 Installation advice

Assembly

- Anchor points and pipe guides must be firmly installed before filling and pressure testing the system.
- Expansion joints must be installed without being subject to torsion.
- The steel bellows must be protected against damage and dirt (e.g. welding, plaster or mortar splatter).
- Steam pipelines should be installed in such a way that water hammers are avoided. This can be achieved by adequate drainage, insulation, by preventing water pockets and by sufficient inclination of the line.
- Observe the flow direction while installing expansion joints with inner sleeves.
- Avoid the installation of expansion joints in the immediate vicinity of pressure reducers, hot steam coolers and shut-down valves, if high-frequency oscillations are expected due to turbulence. Otherwise special measures must be installed (e.g. thick-walled sleeves, perforated disks, calming sections etc.).
- If high frequency vibrations or turbulence or high flow speed are expected, we recommend the installation of expansion joints with inner sleeve.
- Inner sleeves are also recommended for expansion joints with DN ≥ 150, if the flow speed of air, gas or steam media exceeds 8 m/s, or 3 m/s in case of liquid media.

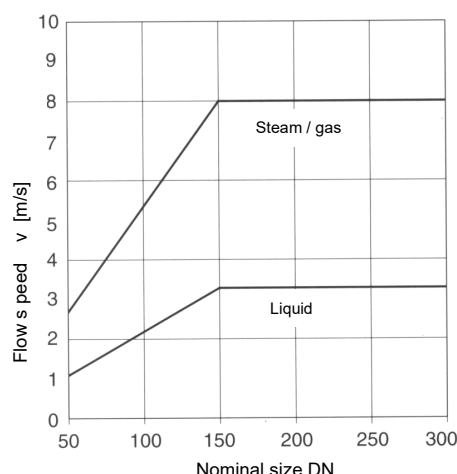


Diagram 4

Pipe guides, pipe supports

- When installing angular and gimbal expansion joints (fig. 13), which can take up lateral expansion only in one plane, pay attention to consistency between the direction of the pipe expansion and the movement capability of the expansion joints (perpendicular to the bolt axis). The nominal angular expansion capacity can be taken from the technical data sheets. Angular expansion joints have no special demands on guide supports. For short-leg boiler and turbine room pipelines guide bearing is not necessary.
- The weight of the pipeline (including medium and insulation) and all wind and additional loads must be absorbed by suitable pipe hangers or supports. Movements of the expansion joint must not be hindered!
- Long pipe sections before and after the hinge system need a guide support.

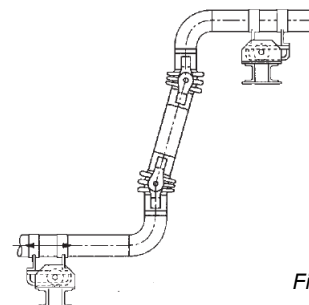


Fig. 13

Anchor points

- Only one hinge system is allowed between two anchor points. The anchor points must absorb the inherent resistance of the expansion joint, resulting from the bending resistance of the bellows and the pin friction of the hinge supports as well as the frictional forces of the guides/supports.

NOTE

Pipe guides with excessive frictional resistance resulting from a too high surface pressure, dirt or corrosion deposits may block and cause considerable pressure peaks in the pipeline, its anchors and connections.

Prerestraint

Angular and lateral expansion joints are usually installed with 50% prerestraint of their expansion capacity. It is advisable to carry out prerestraining on the completely installed system.

- While prerestraining, consider the installation temperature of the pipeline, particularly for above ground level pipelines.
- If the installation temperature differs from the lowest design temperature, reduce the prerestraint in accordance with the prerestraint diagram 5

Prerestraint diagram 5

Example to diagram 5

Hinge system for a pipeline measuring 140 m in length:

Lowest temperature is -7°C .

Highest temperature is $+293^{\circ}\text{C}$.

The maximum anticipated thermal movement equals 500 mm at the temperature difference of 300°C .

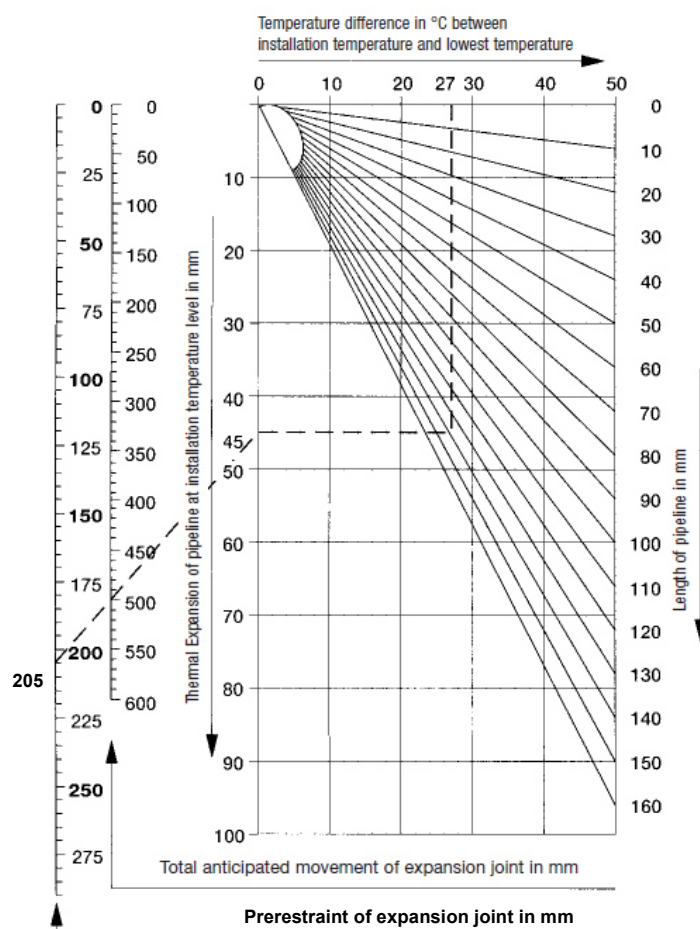
The hinge system or expansion joint shall be prerestrained by 50% of the pipelines expansion = 250mm (i.e. acting in opposite direction of the pipeline movement).

While installing, pay special attention to the correct restraining. Temperature while installing shall not be -7°C but $+20^{\circ}\text{C}$. This results in a thermal expansion of the pipeline of 45 mm (see diagram 5). This amount must be subtracted from the original prerestraint value of the hinge system or expansion joint: $250 - 45 = 205$ mm.

The prerestraint diagram (5) allows determining the prerestraint value directly without calculation:

1. Temperature difference between installation temperature and lowest temperature: $+20^{\circ}\text{C} - (-7^{\circ}\text{C}) = 27^{\circ}\text{C}$.
2. Length of pipeline to be compensated for: 140 m
3. Draw a vertical line from the " 27°C " point towards the beam coming from "0 - 140m".
4. Draw a horizontal line from this intersection to the line "Thermal expansion of pipeline in mm"; the result is, as stated above, 45 mm.
5. Draw a straight line from the "45 mm" point to "Total anticipated movement", this equals 500 mm, and go further to "Prerestraint of hinge system/ expansion joint in mm".

The intersection shows a prerestraint of 205 mm. This is the value by which the hinge system must be prerestrained during installation.



valid for steel pipelines made of St 35

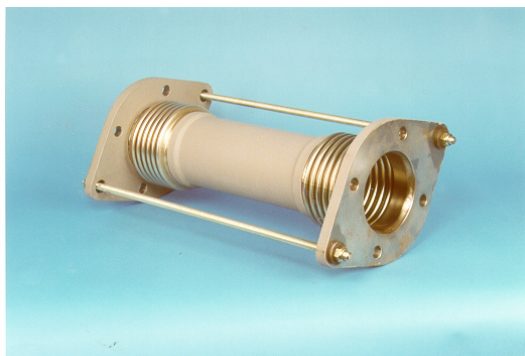
Diagram 5

4 Installation Instructions Lateral Expansion Joints

4.1 General safety recommendations

The general recommendations of section 1.1 are valid.

4.2 Description and application fields of Lateral Expansion Joints



Lateral expansion joints work in the same way angular expansion joints do, utilizing the angular rotation of the steel bellows. They are also suitable for limited installation space. The expansion capacity depends on the construction length of the bellows and their center-to-center distance. The longer the distance between the bellows, the larger is the lateral expansion capacity (fig. 14).

A longer center-to-center distance also results in lower displacement forces of the expansion joint.

A lateral expansion joints is an independent expansion system representing a complete two-pin hinge system.

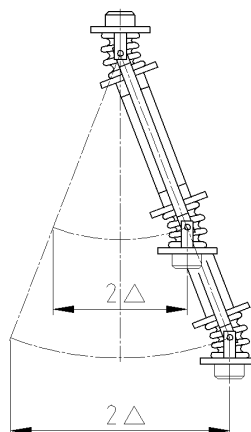


Fig. 14

Special characteristics:

- very low anchor loads as the tie bars restrain the pressure thrust resulting from internal pressure
- less demanding regarding pipe supports/ guides

Even swing hangers may be acceptable.

Depending on the expansion capacity, there are two types of lateral expansion joints:

- expansion joints with lateral expansion capacity in one plane
- expansion joints with lateral expansion capacity in a circular plane

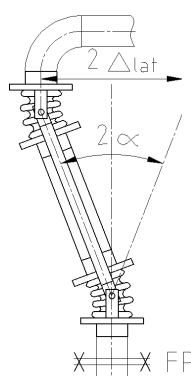


Fig. 15

Movement from one direction is possible

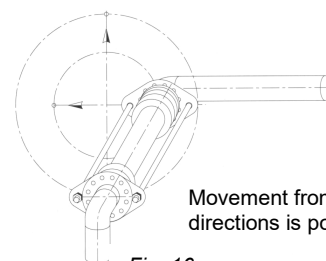


Fig. 16

Movement from two directions is possible

4.3 Type overview (Expansion Joints EFB)

Lateral expansion joints	Connection type	Vibration absorber	Connection type
LW	1	Epsilon-C	5
LFS	2		
LFB	5		

Table 4

Connection type:

- 1 weld end
- 2 flange, welded
- 5 flange, flared (collared)

Admissible operating temperature:

for standard design: maximum 300°C

4.4 Installation advice

Assembly

- Anchor points and pipe guides must be firmly installed before filling and pressure testing the system.
- Expansion joints must be installed without being subject to torsion.
- The steel bellows must be protected against damage and dirt (e.g. welding, plaster or mortar splatter).
- Steam pipelines should be installed in such a way that water hammers are avoided. This can be achieved by adequate drainage, insulation, by preventing water pockets and by sufficient inclination of the line.
- Observe the flow direction while installing expansion joints with inner sleeves.
- Avoid the installation of expansion joints in the immediate vicinity of pressure reducers, hot steam coolers and shut-down valves, if high-frequency oscillations are expected due to turbulence. Otherwise special measures must be installed (e.g. thick-walled sleeves, perforated disks, calming sections etc.).
- If high frequency vibrations or turbulence or high flow speed are expected, we recommend the installation of expansion joints with inner sleeve.
- Inner sleeves are also recommended for expansion joints with $DN \geq 150$, if the flow speed of air, gas or steam media exceeds 8 m/s, or 3 m/s in case of liquid media.

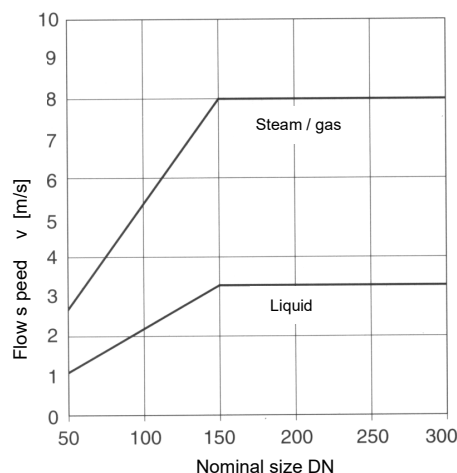


Diagram 6

Pipe guides, pipe supports

- When installing lateral expansion joints (fig. 17), which can take up lateral expansion only in one plane, pay attention to consistency between the direction of the pipe expansion and the movement capability of the expansion joints (perpendicular to the bolt axis). The nominal lateral expansion capacity can be taken from the technical data sheets. Lateral expansion joints have no special demands on guide supports. For short-leg boiler and turbine room pipelines guide bearing is not necessary.
- The weight of the pipeline (including medium and insulation) and all wind and additional loads must be absorbed by suitable pipe hangers or supports. Movements of the expansion joint must not be hindered!
- Long pipe sections before and after the lateral expansion joint need a guide support.

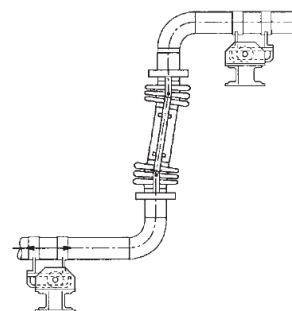


Fig. 17

Anchor points

- Only one lateral expansion joint is allowed between two anchor points. The anchor points must absorb the inherent resistance of the expansion joint, resulting from the bending resistance of the bellows and the pin friction of the hinge supports as well as the frictional forces of the guides/supports.

NOTE

Pipe guides with excessive frictional resistance resulting from a too high surface pressure, dirt or corrosion deposits may block and cause considerable pressure peaks in the pipeline, its anchors and connections.

Vibration compensation with lateral expansion joints

Lateral expansion joints in spherical hinge design are suitable for compensating mechanical oscillations in pressure lines laterally in circular plane, such as for pumps, compressors and other power machinery (fig. 18). If the machine is securely mounted on a concrete base, in most cases the installation of a lateral expansion joint is sufficient. However, if the machine is mounted on a flexible foundation, two lateral expansion joints making a 90° L-arc system are to be provided (fig. 19) in order to compensate for the all-around vibrations. Immediately behind the expansion joint, an anchor point independent from the flexible foundation is required!

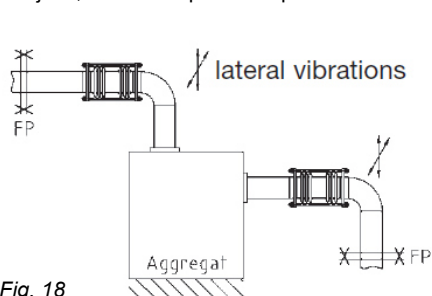


Fig. 18

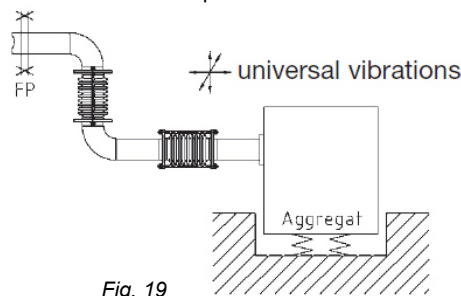


Fig. 19

Install the expansion joint as close as possible to the vibrating unit.
Installation without prestraint!

CAUTION

In general, vibrations of very high frequency due to strong turbulent flows, such as those occurring after safety, reducing and shut-down valves, as well as vibrations caused by vibrating gas or liquid columns can not be compensated.

Prerestraint

Lateral expansion joints are usually installed with 50% prerestraint of their expansion capacity. It is advisable to carry out prerestraining on the completely installed system.

- While prerestraining, consider the installation temperature of the pipeline, particularly for above ground level pipelines.
- If the installation temperature differs from the lowest design temperature, reduce the prerestraint in accordance with the prerestraint diagram 7

Prerestraint diagram

Example to diagram 7

Hinge system for a pipeline measuring 140 m in length:

Lowest temperature is -7°C.

Highest temperature is +293°C.

The maximum anticipated thermal movement equals 500 mm at the temperature difference of 300°C.

The hinge system or expansion joint shall be prerestrained by 50% of the pipelines expansion = 250mm (i.e. acting in opposite direction of the pipeline movement).

While installing, pay special attention to the correct restraining. Temperature while installing shall not be -7°C but +20°C. This results in a thermal expansion of the pipeline of 45 mm (see diagram 7). This amount must be subtracted from the original prerestraint value of the hinge system or expansion joint: 250 - 45 = 205 mm.

The prerestraint diagram (7) allows determining the prerestraint value directly without calculation:

1. Temperature difference between installation temperature and lowest temperature: $+20^{\circ}\text{C} - (-7^{\circ}\text{C}) = 27^{\circ}\text{C}$.
2. Length of pipeline to be compensated for: 140 m
3. Draw a vertical line from the "27°C" point towards the beam coming from "0 - 140m".
4. Draw a horizontal line from this intersection to the line "Thermal expansion of pipeline in mm"; the result is, as stated above, 45 mm.
5. Draw a straight line from the "45 mm" point to "Total anticipated movement", this equals 500 mm, and go further to "Prerestraint of hinge system/ expansion joint in mm".

The intersection shows a prerestraint of 205 mm. This is the value by which the hinge system must be prerestrained during installation.

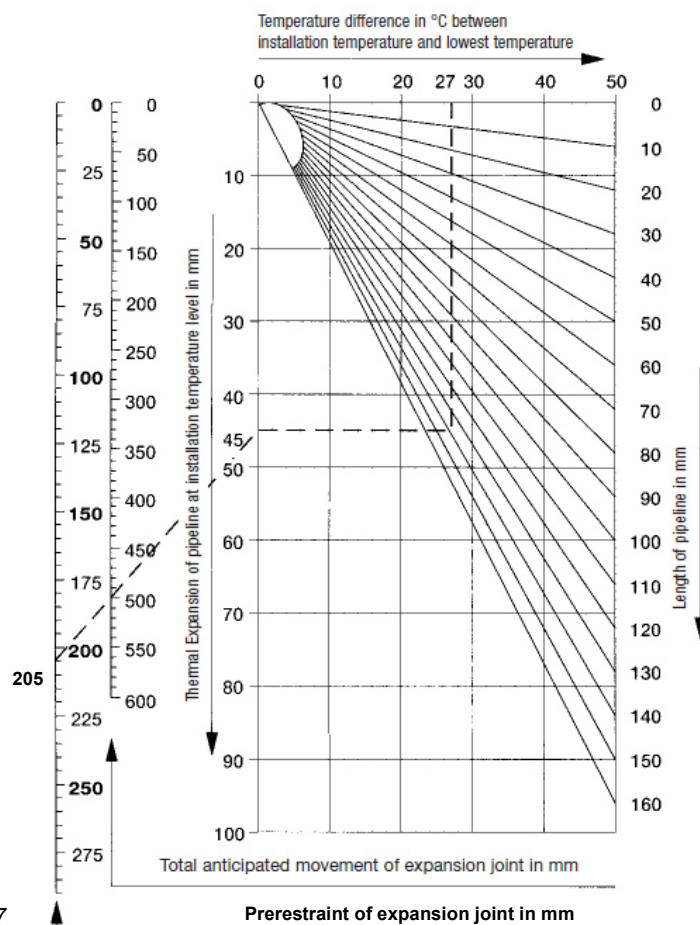


Diagram 7

valid for steel pipelines made of St 35