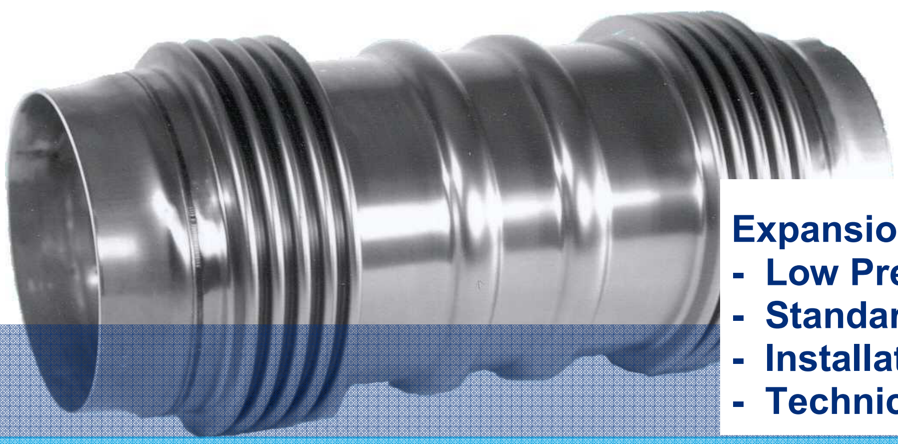
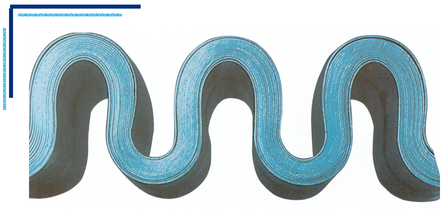


Expansion Joints Guide **Module 6**

- Low Pressure Expansion Joints General
- Standard Program (EFB)
- Installation Instructions
- Technical Data

Expansion Joints Guide

Summary Module 6



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 Low Pressure Expansion Joints General

BOA low pressure expansion joints are specifically built for applications where at low pressures (up to 3.0 bar at 20°C) large movements must be absorbed. In the following application fields, low pressure expansion joints have particularly proven themselves:

- any kind of flue gas piping
- exhaust gas pipes behind combustion engines, , especially emergency power systems, heat /power generation plants and similar.
- sewage and water treatment systems.

General

- Due to the multi-ply design, the expansion joint has a very low spring rate and therefore very small displacement forces (see standard tables).
- Designed for operating pressures up to 3.0 bar at 20°C.
  Example: Considering the reduction factors (see reduction table), operating pressures of 2.03 bar at 300°C, or 1.81 bar at 500°C are resulting.
- Thanks to the high quality bellows material, these expansion joints are suitable for applications in a wide temperature range from -180°C to 500°C. In fully austenitic steel, even up to 700°C (with dry, pressure-free media).
- For use up to a vacuum of 300 mbar (700 mbar abs.).
- The indicated movements are meant for 1000 full load cycles at 20°C. (CE-marking 500 full load cycles with safety factor 2)

Reduction factors for pressure and movement at higher temperatures
The reduction factors for movement are based on a constant number of cycles of 1000

Temperature [°C]	**Overpressure** [bar]	**Reduction factor movement** [-]
20	3.00	1.000
50	2.74	0.960
75	2.64	0.945
100	2.56	0.930
125	2.49	0.915
150	2.42	0.900
175	2.37	0.895
200	2.31	0.890
225	2.22	0.873
250	2.14	0.857
275	2.09	0.849
300	2.03	0.840
325	1.97	0.834
350	1.91	0.827
375	1.90	0.821
400	1.89	0.815
425	1.87	0.811
450	1.85	0.807
475	1.83	0.803
500	1.81	0.800
550	1.38	0.720
600	1.00	0.630
650	0.58	0.580
700	0.30	0.540

Table 1

Calculation example:
given: Type EXW, DN 300, movement axial ±59 mm / lateral ±10 mm
operating temperature 350°C
requested: possible movement and maximum pressure at 350°C

Proceeding:
reduction factor movement at 350°C according to table 1 = 0.827

axial movement = ±59 mm · 0.827 = ± 48.7 mm

lateral movement = ±10 mm · 0.827 = ± 8.3 mm

operating pressure is 1.91 bar

2 Standard Program BOA Low Pressure Expansion Joints (EFB)

2.1 General

Expansion joints manufactured by BOA AG Switzerland are formed in the elastomer process (EFB). The core element is the multi-ply metal bellows (2 to 16 layers) made of austenitic steel. Expansion joints produced by this method have a large expansion capacity and are very flexible. They are especially appropriate to compensate for thermal expansion and minor misalignment during installation. Their advantages are:

- BOA AG has over 70 years experience in manufacturing expansion joints
- multi-ply construction of the bellows, made of high-grade stainless steel (1.4571 and 1.4541), which means high resistance against ageing, temperature, UV-rays and most of aggressive media.
- very low spring rate due to the multi-ply construction of the bellows.
- large movements at short construction lengths
- due to reasonable stocks, various types in different sizes and pressure ranges are usually available at short time.

Inner sleeve
Inner sleeves protect the bellows and prevent it from being stimulated to oscillate by the fluid. The installation of an inner sleeve is recommended in the following cases:

- abrasive media
- large temperature variations
- flow rates **higher than approx. 8m/s for gaseous media**
- flow rates **higher than approx. 3m/s for liquid media**

When installing, the flow direction must be observed!

Low pressure expansion joints usually must absorb large lateral movements /vibrations. Therefore, they are usually used without inner sleeve. An inner guide sleeve structure allowing large lateral movements inevitably leads to a strong constriction of the flow cross-section. The resulting local acceleration of the flow medium very often is not accepted. On request (extra charge) inner sleeves may be installed.
Of course expansion joints can be designed and manufactured specifically for other materials, pressure ranges and life cycles.

2.2 Reduction

NOTE (Hereinafter the term **load cycle** is used for full load change cycle.)
The maximum permissible expansion capacity is indicated on the expansion joint. It refers to 1000 load cycles (for expansion joints conforming to EC standards: 500 load cycles with safety factor 2). At higher load cycles, the expansion capacity must be reduced by the load cycle factor K_L according to table 2. For the accurate determination of the load factor K_L the following formula can be applied:

$$K_L = (1000 / N_{adm})^{0.29}$$

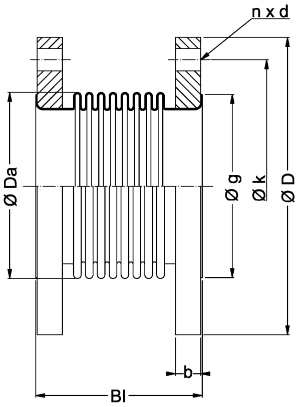
Load cycles N_{adm}	Load cycle factor K_L
1'000	1.00
2'000	0.82
3'000	0.73
5'000	0.63
10'000	0.51
30'000	0.37
50'000	0.32
100'000	0.26
200'000	0.22
1'000'000	0.14
25'000'000	0.05

Table 2

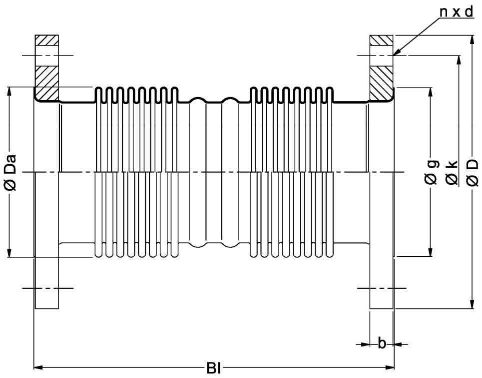
2.3 Low pressure expansion joints with flanges Type EXF and EXUF

- Expansion joints of types EXF and EXUF are **equipped with movable, collared flanges**. Flanges drilled according to DIN PN 6.
- The inside medium is only in contact with the austenitic bellows material.
- Due to the movable flanges, expansion joints Type EXF and EXUF are easy to assembly and therefore ideal as replacement units in existing systems.
- As a standard, the flanges are made of carbon steel.

Design Type EXF



Design Type EXUF



2.4 Low pressure expansion joints with weld ends Type EXW and EXUW

- The two weld ends (up to DN 400) are entirely made of austenitic steel (1.4571). At higher DN (from DN 450), the weld ends are made of carbon steel.
- Tight resistance welding for the connection bellows - weld ends.
- The diameters of the weld ends are metric as a standard (see table), yet they may easily be expanded to ISO dimensions. Please provide us with the required connection dimensions when ordering.

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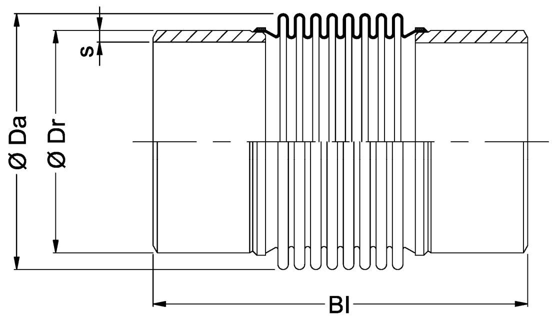
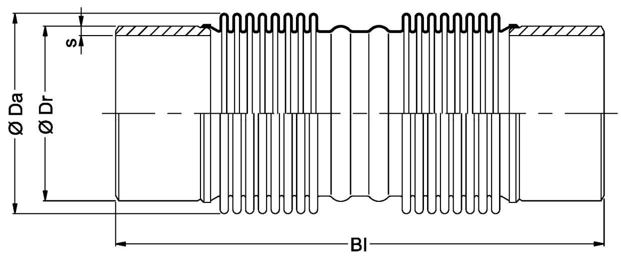
Design Type EXW



Design Type EXUW



3 Installation Instruction Low Pressure Expansion Joints

3.1 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
Low pressure expansion 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%.

Low pressure expansion 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 given in section 2.2 "Reduction".
- At higher temperatures, the expansion capacity has to be reduced according to the reduction factors (see section 2.2).

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.

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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.

3.2 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 ≥ 150, if the flow speed of air, gas or steam media exceeds 8 m/s, or 3 m/s in case of liquid media.

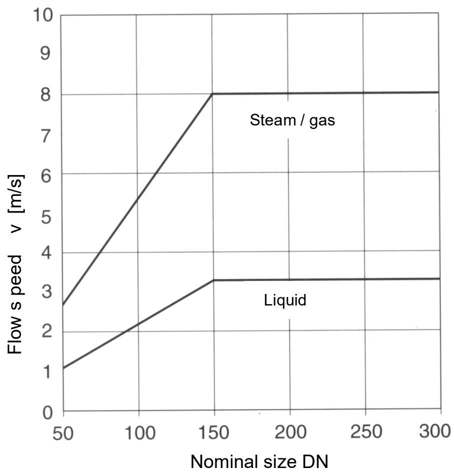


Diagram 1

Pipe guides, pipe supports

- Provide inclination for drainage
- Align the pipeline, distance between pipe guides according to fig. 1, table 3 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!

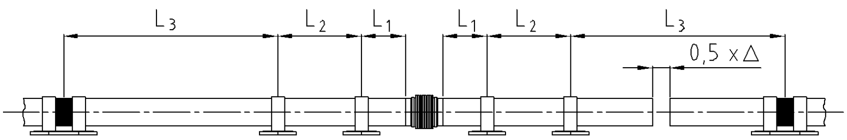


Fig. 1

Δ = expansion capacity of the expansion joint [mm]
L_1 = max. 2 x DN + Δ/2 [mm]
L_2 = 0.7 x L_3 [mm]
L_3 = 400 x $\sqrt{DN}$ [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

Tabelle 3 (only valid for steel pipelines)

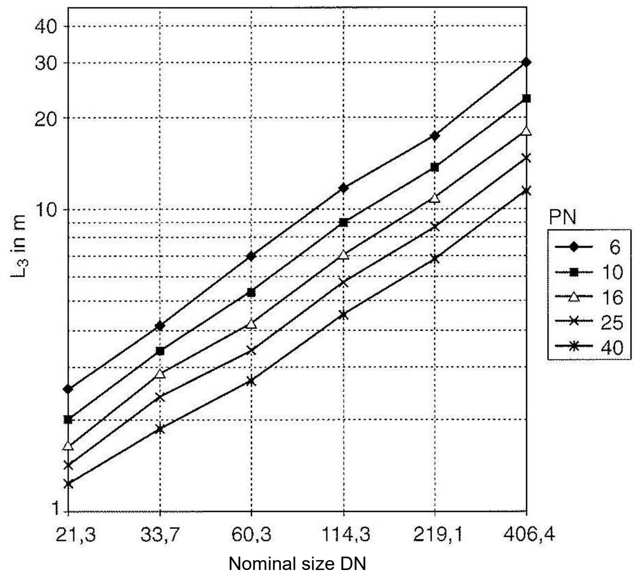


Diagram 2

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.

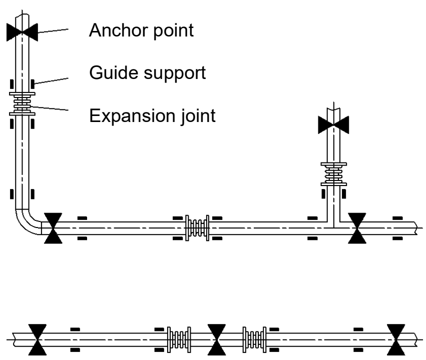


Fig. 2

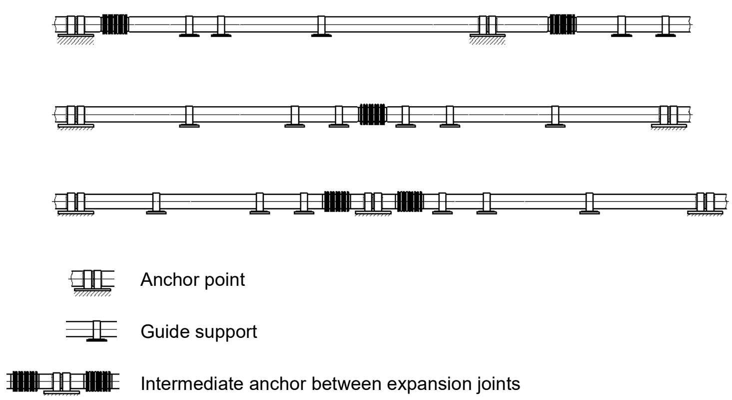


Fig. 3

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.

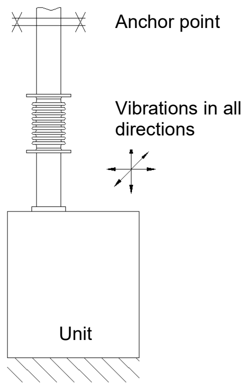


Fig. 4

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).

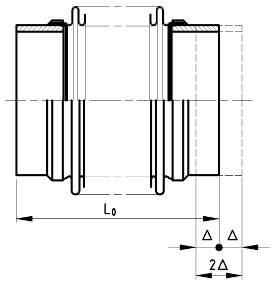


Fig. 5

Prerestraint diagram

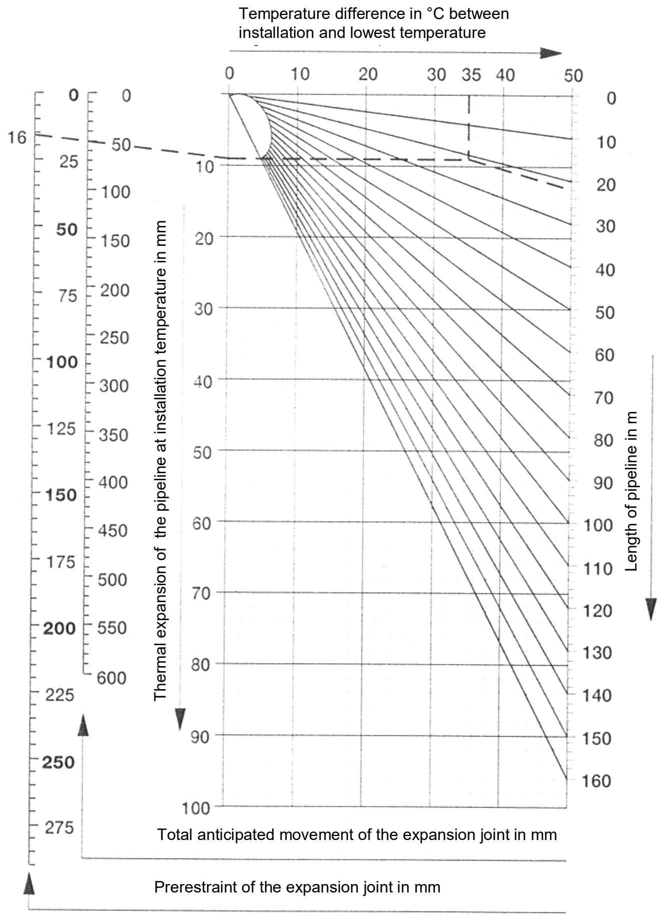


Diagram 3

Example for Diagram 3

Order is placed for a universal expansion joint to be installed in a pipeline of 22 m length.
Lowest temperature: –15°C.
Highest temperature: +165°C.
Max. expansion corresponding to 180°C heating = 50 mm.
The expansion joint shall be restrained by 50% of this expansion = prerestrained 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°C.
This results in a corresponding expansion of the pipeline of 9 mm (see diagram 3), by which the expansion joint must be less prerestrained: 25-9 = 16 mm.

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

1. Temperature difference between installation and lowest temperature: –15°C to +20°C = 35°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 "Prerestraint of the expansion joint in mm".

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

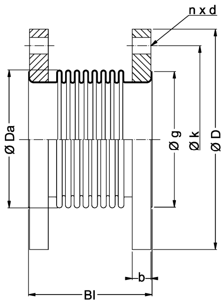
4 Technical Data BOA Standard Low Pressure Expansion Joints (EFB)

4.1 Low pressure expansion joints with flanges

4.1.1 Type EXF (equipped with movable, collared flanges)

- Expansion joints of Type EXF are **equipped with movable, collared flanges**. flanges drilled according to DIN PN 6.
- The inside medium is only in contact with the austenitic bellows material.
- Due to the movable flanges, expansion joints Type EXF are easy to assembly and therefore ideal as replacement units in existing systems.
- As a standard, the flanges are made of carbon steel.

Design Type EXF



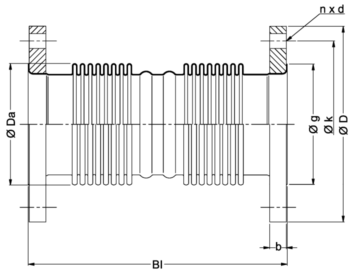
Overall length unrestrained
Consider the reaction force of the expansion joint: 10x cross section area = reaction force in [N/bar]
[1)] Nominal expansion capacity: these indications are meant for 1000 full load cycles SL=1 at 20°C either axial or lateral
Type designation: L = with inner sleeve; B = without inner sleeve; * = optionally with/without inner sleeve
If an inner guide sleeve is required by the customer, the construction length can be different from the data table below.

DN	PN	Type	Nominal expansion capacity[1)]		Overall length unrestrained	Weight (without inner sleeve)	Flange					Bellows				
		EXF	Axial	Lateral			Outside Ø	Thickness	Hole circle Ø	Number of holes	Hole Ø	Outside Ø	Male face Ø	Effective area of the bellows	Spring rate ± 30%	Spring rate ± 30%
			$\pm\Delta_{ax}$	$\pm\Delta_{lat}$	Bl.	m	D	b	k	n	d	Ø Da	g	A_B	C_{ax}	C_{lat}
-	-	-	mm	mm	mm	kg	mm	mm	mm	-	mm	mm	mm	cm^2	N/mm	N/mm
50	2.5	EXF	±40	±32	220	3.1	140	14	110	4	14	79.8	80	39.0	24.0	6.0
65	2.5	EXF	±47	±28	230	3.9	160	14	130	4	14	102.6	104	66.0	23.0	10.0
80	2.5	EXF	±49	±28	240	6.0	190	16	150	4	18	116.0	115	84.0	31.0	15.5
100	2.5	EXF	±50	±22	240	6.8	210	16	170	4	18	140.8	136	127.0	32.0	26.0
125	2.5	EXF	±56	±21	240	8.9	240	18	200	8	18	169.0	166	184.0	30.0	36.0
150	2.5	EXF	±59	±18	240	10.9	265	20	225	8	18	200.2	196	262.0	29.0	51.0
175	2.5	EXF	±59	±15	235	14.7	295	22	255	8	18	228.2	230	342.0	29.0	71.0
200	2.5	EXF	±59	±14	245	15.6	320	22	280	8	18	253.0	254	434.0	32.0	95.0
250	2.5	EXF	±60	±11	240	20.4	375	24	335	12	18	309.6	310	660.0	34.0	157.0
300	2.5	EXF	±59	±9	225	19.1	440	16	395	12	22	362.2	362	911.0	34.0	254.0
350	2.5	EXF	±60	±8.5	205	24.2	490	16	445	12	22	395.2	400	1101.0	38.0	306.0
400	2.5	EXF	±63	±8	210	27.0	540	16	495	16	22	447.2	450	1417.0	37.0	364.0
450	2.5	EXF	±77	±14	335	34.7	595	16	550	16	22	502.0	500	1798.0	61.0	305.0
500	2.5	EXF	±81	±13.5	340	37.5	645	16	600	20	22	553.6	553	2204.0	61.0	354.0
600	2.5	EXF	±65	±9	340	57.9	755	20	705	20	26	658.0	656	3145.0	130.0	1133.0
700	2.5	EXF	±64	±7	330	67.7	860	20	810	24	26	761.4	760	4224.0	145.0	1902.0
750	2.5	EXF	±64	±6	310	77.2	920	20	865	24	30	826.0	820	4951.0	144.0	2584.0
800	2.5	EXF	±69	±7	335	80.8	971	20	920	24	30	866.0	864	5519.0	144.0	2304.0
900	2.5	EXF	±66	±5.5	315	90.0	1071	20	1020	24	30	969.0	967	6903.0	161.0	3782.0
1000	2.5	EXF	±70	±5.5	320	99.2	1171	20	1120	28	30	1073.0	1072	8539.0	162.0	4470.0

4.1.2 **Type EXUF** (equipped with movable, collared flanges)

- Expansion joints of Type EXUF are **equipped with movable, collared flanges**. Flanges drilled according to DIN PN 6.
- The inside medium is only in contact with the austenitic bellows material.
- Due to the movable flanges, expansion joints Type EXUF are easy to assembly and therefore ideal as replacement units in existing systems.
- As a standard, the flanges are made of carbon steel.

Design Type EXUF



Overall length unrestrained
Consider the reaction force of the expansion joint: 10x cross section area = reaction force in [N/bar]
1) Nominal expansion capacity: these indications are meant for 1000 full load cycles SL=1 at 20°C either axial or lateral
Type designation: L = with inner sleeve; B = without inner sleeve; * = optionally with/without inner sleeve
If an inner guide sleeve is required by the customer, the construction length can be different from the data table below.

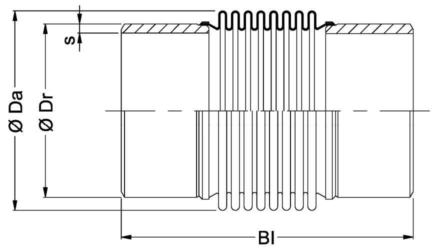
DN	PN	Type	Nominal expansion capacity[1]		Overall length unrestrained	Weight (without inner sleeve)	Flange					Bellows				
		EXUF	Axial	Lateral			Outside Ø	Thickness	Hole circle Ø	Number of holes	Hole Ø	Outside Ø	Male face Ø	Effective area of the bellows	Spring rate ± 30%	Spring rate ± 30%
			$\pm\Delta_{ax}$	$\pm\Delta_{lat}$	Bl.	m	D	b	k	n	d	Ø Da	g	A_B	C_{ax}	C_{lat}
-	-	-	mm	mm	mm	kg	mm	mm	mm	-	mm	mm	mm	cm^2	N/mm	N/mm
50	2.5	EXUF	±27	±51	285	3.1	140	14	110	4	14	79.8	80	39.0	35.0	3.0
65	2.5	EXUF	±35	±107	460	4.5	160	14	130	4	14	102.6	104	66.0	30.0	2.0
80	2.5	EXUF	±27	±104	575	7.0	190	16	150	4	18	116.0	115	84.0	47.0	1.0
100	2.5	EXUF	±38	±113	565	8.0	210	16	170	4	18	140.8	136	127.0	42.0	2.0
125	2.5	EXUF	±46	±100	530	10.0	240	18	200	8	18	169.0	166	184.0	36.0	3.0
150	2.5	EXUF	±50	±86	520	12.0	265	20	225	8	18	199.0	196	262.0	36.0	5.0
175	2.5	EXUF	±54	±71	490	15.0	295	22	255	8	18	226.4	230	342.0	33.0	7.0
200	2.5	EXUF	±59	±67	490	17.0	320	22	280	8	18	253.0	254	434.0	33.0	9.0
250	2.5	EXUF	±64	±58	495	22.0	375	24	335	12	18	309.0	310	660.0	32.0	13.0
300	2.5	EXUF	±43	±36	500	24.0	440	16	395	12	22	362.0	362	911.0	94.0	44.0
350	2.5	EXUF	±47	±35	470	27.0	490	16	445	12	22	396.0	400	1101.0	89.0	52.0
400	2.5	EXUF	±49	±33	475	30.0	540	16	495	16	22	448.0	450	1417.0	89.0	66.0
450	2.5	EXUF	±51	±25	460	35.0	595	16	550	16	22	502.0	500	1798.0	92.0	115.0
500	2.5	EXUF	±32	±20	520	38.0	645	16	600	20	22	554.0	553	2204.0	238.0	231.0
600	2.5	EXUF	±35	±17	515	58.0	755	20	705	20	26	658.0	656	3145.0	238.0	357.0
700	2.5	EXUF	±38	±15	490	68.0	860	20	810	24	26	762.0	760	4224.0	242.0	570.0
750	2.5	EXUF	±38	±12	460	75.0	920	20	865	24	30	824.0	820	4951.0	240.0	785.0
800	2.5	EXUF	±41	±12	465	81.0	971	20	920	24	30	866.0	864	5519.0	240.0	867.0
900	2.5	EXUF	±44	±10	435	91.0	1071	20	1020	24	30	969.0	967	6903.0	242.0	1355.0
1000	2.5	EXUF	±46	±10	430	100.0	1171	20	1120	28	30	1073.0	1072	8539.0	243.0	1777.0

4.2 Low pressure expansion joints with weld ends

4.2.1 **Type EXW** (tight resistance welding for the connection bellows - weld ends)

- The two weld ends (up to DN 400) are entirely made of austenitic steel (1.4571). At higher DN (from DN 450), the weld ends are made of carbon steel.
- Tight resistance welding for the connection bellows - weld ends.
- The diameters of the weld ends are metric as a standard (see table), yet they may easily be expanded to ISO dimensions. Please provide us with the required connection dimensions when ordering.

Design Type EXW



Overall length unrestrained
Consider the reaction force of the expansion joint: 10x cross section area = reaction force in [N/bar]
[1)] Nominal expansion capacity: these indications are meant for 1000 full load cycles SL=1 at 20°C either axial or lateral
Type designation: L = with inner sleeve; B = without inner sleeve; * = optionally with/without inner sleeve
If an inner guide sleeve is required by the customer, the construction length can be different from the data table below.

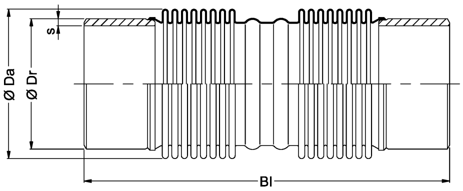
DN	PN	Type	Nominal expansion capacity[1)]		Overall length unrestrained	Weight (without inner sleeve)	Weld end		Bellows			
		EXW	Axial	Lateral			Outside Ø	Thickness	Outside Ø	Effective area of bellows	Spring rate ± 30%	Spring rate ± 30%
			$\pm\Delta_{ax}$	$\pm\Delta_{lat}$	Bl.	m	Ø Dr	s	Ø Da	A_B	C_{ax}	C_{lat}
-	-	-	mm	mm	mm	kg	mm	mm	mm	cm^2	N/mm	N/mm
50	2.5	EXW	±40	±25	300	0.9	54	2.0	80.0	39	23	10
65	2.5	EXW	±47	±23	300	1	69	2.0	102.5	66	23	15
80	2.5	EXW	±49	±23	300	1.2	84	2.0	116.0	84	31	24
100	2.5	EXW	±50	±18	300	1.7	104	2.0	141.0	127	32	39
125	2.5	EXW	±56	±18	300	2	129	2.0	169.0	184	30	46
150	2.5	EXW	±59	±16	300	2.4	154	2.0	200.0	262	29	64
175	2.5	EXW	±59	±13	300	2.7	179	2.0	228.0	342	29	88
200	2.5	EXW	±59	±12	300	3.2	204	2.0	253.0	434	32	121
250	2.5	EXW	±60	±10	300	4.1	254	2.0	309.5	660	34	201
300	2.5	EXW	±59	±8	300	4.8	304	2.0	363.0	911	34	316
350	2.5	EXW	±60	±7.5	300	6.7	356	3.0	395.0	1101	38	396
400	2.5	EXW	±63	±7	300	7.6	406	3.0	447.0	1417	37	475
450	2.5	EXW	±77	±14	420	13.7	457	4.0	502.0	1798	61	305
500	2.5	EXW	±81	±14	420	15.3	508	4.0	554.0	2204	61	354
600	2.5	EXW	±65	±9	420	21	610	4.0	658.0	3145	130	1133
700	2.5	EXW	±64	±7	420	25	711	4.0	761.5	4224	145	1902
750	2.5	EXW	±64	±6	420	27.5	758	4.0	824.0	4951	144	2574
800	2.5	EXW	±69	±7	420	28.5	813	4.0	866.0	5519	144	2304
900	2.5	EXW	±66	±6	420	32.5	914	4.0	969.0	6903	161	3782
1000	2.5	EXW	±70	±5	420	36	1016	4.0	1073.0	8539	162	4470

Subject to changes; latest specifications on www.boagroup.com

4.2.2 Type EXUW (tight resistance welding for the connection bellows - weld ends)

- The two weld ends (up to DN 400) are entirely made of austenitic steel (1.4571). At higher DN (from DN 450), the weld ends are made of carbon steel.
- Tight resistance welding for the connection bellows - weld ends.
- The diameters of the weld ends are metric as a standard (see table), yet they may easily be expanded to ISO dimensions. Please provide us with the required connection dimensions when ordering.

Design Type EXUW



Overall length unrestrained
Consider the reaction force of the expansion joint: 10x cross section area = reaction force in [N/bar]
[1)] Nominal expansion capacity: these indications are meant for 1000 full load cycles SL=1 at 20°C either axial or lateral
Type designation: L = with inner sleeve; B = without inner sleeve; * = optionally with/without inner sleeve
If an inner guide sleeve is required by the customer, the construction length can be different from the data table below.

DN	PN	Type	Nominal expansion capacity[1)]		Overall length unrestrained	Weight (without inner sleeve)	Weld end		Bellows			
		EXUW	Axial	Lateral			Outside Ø	Thickness	Outside Ø	Effective area of bellows	Spring rate ± 30%	Spring rate ± 30%
			$\pm\Delta_{ax}$	$\pm\Delta_{lat}$	Bl.	m	Ø Dr	s	Ø Da	A_B	C_{ax}	C_{lat}
-	-	-	mm	mm	mm	kg	mm	mm	mm	cm^2	N/mm	N/mm
50	2.5	EXUW	±27	±51	397	1.1	54	2.0	79.8	39	35	3
65	2.5	EXUW	±35	±107	556	1.8	69	2.0	102.6	66	30	2
80	2.5	EXUW	±39	±141	667	2.5	84	2.0	116.0	84	39	1
100	2.5	EXUW	±38	±113	657	2.8	104	2.0	140.8	127	42	2
125	2.5	EXUW	±46	±100	606	3.6	129	2.0	169.0	184	36	3
150	2.5	EXUW	±50	±86	594	4.4	154	2.0	199.0	262	36	5
175	2.5	EXUW	±54	±71	564	5.8	179	2.0	226.4	342	33	7
200	2.5	EXUW	±59	±67	562	6.3	204	2.0	253.0	434	33	9
250	2.5	EXUW	±64	±58	569	8.3	254	2.0	309.0	660	32	13
300	2.5	EXUW	±43	±36	586	9	304	2.0	362.0	911	94	44
350	2.5	EXUW	±47	±35	584	11.2	256	3.0	396.0	1101	89	52
400	2.5	EXUW	±49	±33	585	12	406	3.0	448.0	1417	89	66
450	2.5	EXUW	±51	±25	544	12.8	457	4.0	502.0	1798	92	115
500	2.5	EXUW	±32	±20	600	14.4	508	4.0	554.0	2204	238	231
600	2.5	EXUW	±35	±17	596	18.4	610	4.0	658.0	3145	238	357
700	2.5	EXUW	±38	±15	580	21.6	711	4.0	762.0	4224	242	570
750	2.5	EXUW	±38	±12	568	23.2	758	4.0	824.0	4951	240	785
800	2.5	EXUW	±41	±12	549	29.6	813	4.0	866.0	5519	240	867
900	2.5	EXUW	±44	±10	539	32.8	914	4.0	969.0	6903	242	1355
1000	2.5	EXUW	±46	±10	530	36	1016	4.0	1073.0	8539	243	1777