HYDRA®

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WITZENMANN GROUP

With 24 companies in 19 countries Witzenmann is the worldwide Number 1 in our industry.

World Leader
Witzenmann is a global group specialising in the design and manufacture of flexible metal elements. Guided by our vision of "managing flexibility", our company has become renowned as a reliable manufacturer and as the innovative development partner of choice within the industry. Today Witzenmann offers the widest range of products available, enabling us provide optimised solutions time and time again.

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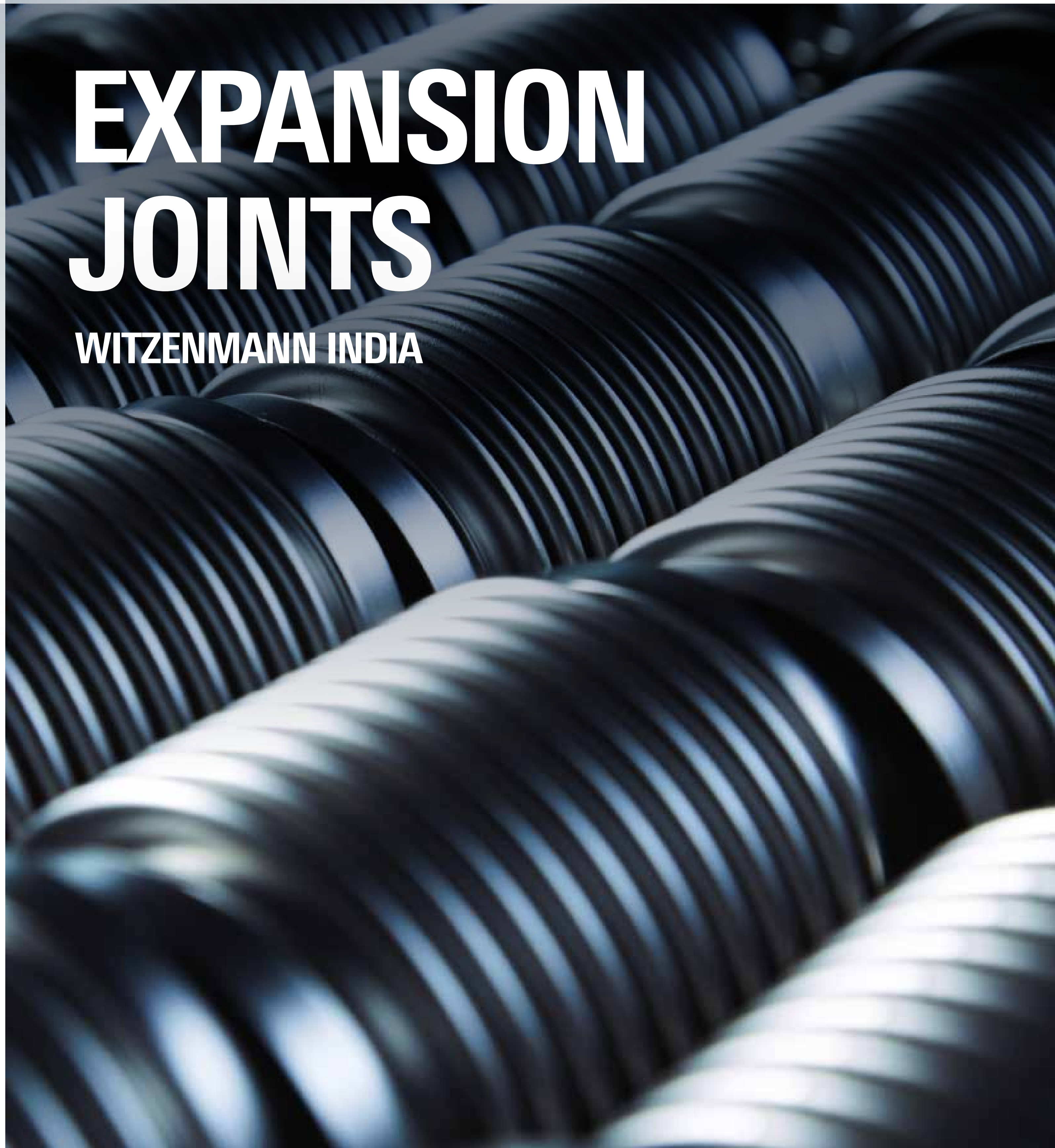
WITZENMANN

managing flexibility



EXPANSION JOINTS

WITZENMANN INDIA

CONTENT

WITZENMANN INDIA

As the inventor of the metal hose in 1885, the Witzenmann group still stands out for the high level of innovation combined with a high quality standard and manufacturing knowhow of flexible metal elements such as, for example, expansion joints.

History

Established in 2001, Witzenmann India started delivering high quality industrial products such as metal hoses, expansion joints, metal bellows, pipe supports and hangers to the general industry in India. In 2006, a metal bellows assembly operation was set-up at Kolkata under full technological support and guidance of the Headquarters. In 2008, we established a manufacturing facility at Chennai to manufacture exhaust decouplers for the Indian automotive industry.
With the establishment of manufacturing facilities for bellows and liners by 2018, we achieved 100% localisation of the components in the automobile exhaust decouplers. Also in 2018, a brand-new facility to manufacture expansion joints and pipe assemblies was set up to serve various core sectors of the Indian Industry.

Leader in technology

We offer products with standardized design, manufacturing processes, equipment and quality control procedures. As a technology leader we are able to offer comprehensive technical solutions and products to meet the needs of our customers. The design of pressurized pipe systems is based on stress calculations. Witzenmann provides all the necessary information for the selection of expansion joints and pipe supports, as well as a database for a reliable elaboration of their layout. The data is integrated into an online calculation program or can be downloaded from our website. The software FLEXPERTE allows the specialist a simple way to design bearings, hangers and supports, bellows, hoses or expansion joints up to 3D-CAD representation. It is compatible with all common planning tools via PDS and PDMS interfaces.

QUALITY BY WITZENMANN

This not only reflects the expertise of each individual employee – but also the quality of our processes.

Quality by Witzenmann
Product durability, reliability and an exceptional level of service are mandatory characteristics for a company seeking quality leadership.
Witzenmann is enlisted with some of the most important consultants and agencies, and approved for the supply to various critical industrial applications and industrial segments: such as Nuclear Power, Thermal Power, Solar Power, Oil & Gas, Refineries, Chemicals, Hydrocarbon and Petrochemicals, Fertilizers and Iron & Steel Industry. All at an international level, since our components and systems are installed all over the world and guarantee maximum reliability in operation.

Product validation tests, even under extreme operating conditions, ensure the required service life and operational reliability. For this, we have a world-class testing center that allows complete type test operations, X-ray or ultrasound verification for weld joints, electron beam microanalysis (EDX), pulsed pressure or cryogenic tests. Witzenmann is member of AEQ (Association Euro-Qualiflex) and EJMA (Expansion Joint Manufacturers Association). Every expansion joint can be designed and manufactured to the latest editions of all common standards. PED 2014/68/EU as well as ASME B31 and BPVC Section VIII-1 are frequently used and can be completely fulfilled. Witzenmann India is accredited with ISO 9001:2015, EN 15085-2 and IATF 16949.

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ENGINEERING

Design rules
The selection of the design and manufacturing standard of the expansion joint is made according to the specific requirements of the customer. Commonly used are:
- ASME B31.3, Appendix X
- ASME VIII-1, Appendix 26
- EJMA (Latest Edition)
- EN 13445
- EN 13480
- EN 14917

"Standard" expansion joints, which are listet in this catalogue, are calculated according to EJMA (latest edition) and the Witzenmann HYDRA method (Proprietary Method based on EN 13445 and EN 14917), in order to:
- allow to exceed 5 layer limit for bellows.
- using empirical fatigue curve (based on numerous test).
- determine the working stiffness coefficient, considering the actual behavior of the flexible element, and effects such as friction.
- optimize the column stability modeling equation, considering the influence of the movement.
- The design standard can be changed or adopted to specific customer and application requirements.

They are designed to withstand hydrostatic pressure with an adequate safety factor for industrial applications. All expansion joints manufactured by Witzenmann are subjected to a gas tightness test, regardless of the specific requirement of the customer.

The typical profile used to manufacture metal bellows is the multilayer "Omega" type, as it allows a good combination of flexibility and mechanical resistance to pressure. This guarantees a system with few expansion joints and consequently, an economic gain to the final customer.

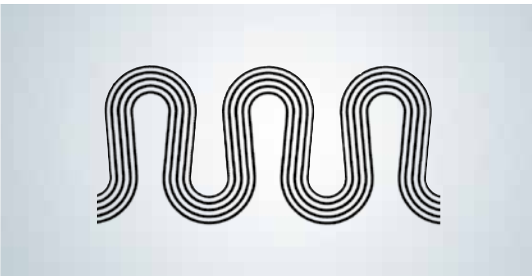


Figure 1: Multilayer Bellows

Achieving greater reliablity of our products - and as a notable safety advantage - monitoring holes are executed in multilayer bellows, in order to guarentee primary detection of possible leaks and intervention with acquisition of a new expansion joint without the need for immediate replacement, in view of the fact that the resistance of the product to the pressure is guaranteed.

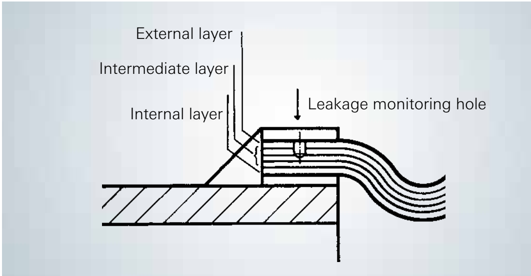


Figure 2: Monitoring Hole

Restraining parts are dimensioned to absorb axial pressure thrust and limit the lateral or angular movement of the bellows. Thus, expansion joints with restraint hardware do not add additional axial loads to the piping system. Example: hammer shaped tie bars, patented by Witzenmann, allow a better distribution of loads in addition to cost optimization.

Figure 3: Hammer shaped tie bar

Material
For a correct selection of materials to be used, the following should be considered:
1. Chemical compatibility of the material with the fluid to be transported,
2. Application-compatible mechanical strength (temperature and pressure),
3. Welding properties and ductility,
4. Material certification.

Established materials for usage in the construction of medium touched elements are:
ASTM A240–321/1.4541, A240–316Ti/1.4571, A240–304/1.4301, A240–316L/1.4404, Alloy 625/2.4856, Alloy 800H/1.4876, Alloy C4/2.4610, Alloy C276/2.4819, Duplex (ASTM A240 TP 2205) among others like Duplex, Titan, Tantalum etc. expansion joints are designed to withstand a test pressure of 1.5 times their nominal pressure. The materials used for the components of "standard" expansion joints are described on page 18 . The raw material can be changed according to the specific requirements of the project.

Pressure
"Standard" expansion joints are calculated with design temperature from –10 °C to +20 °C. If the design temperature is higher than 20 °C, the permissible pressure must be adjusted according to the table below:

Temperature	Reduction factor
°C	$K_{p\vartheta}$
20	1,00
100	0,83
150	0,78
200	0,74
250	0,71
300	0,67

Table 1: Adjustment of permissible pressure to elevated temperature

Number of cycles
"Standard" expansion joints are calculated to perform 100 % absorption of the specified movement per 1000 cycles. If the number of cycles required in the project exceeds 1000 cycles, the movement to be absorbed must be adjusted according to the table below:

Number of cycles	Reduction factor
°C	$K_{\Delta L}$
1000	1,00
2000	0,82
4000	0,68
7000	0,58
10000	0,53
20000	0,44

Table 2: Influence of number of cycles on movement

Calculation of linear thermal expansion
The thermal expansion is the variation of the dimensions of a material predominently caused by a temperature change. It can be determined according to the equation below, and can be considered to evaluate the amount of motion that the expansion joint must absorb during its operation:

$$\Delta_{\vartheta} = L \times \alpha \times \Delta_{\vartheta}$$

where:
Δ_{ϑ} = Length variation [mm]
L = Cold pipe length [m]
α = Coefficient of linear expansion [mm/(m·K)]
Δ_{ϑ} = Temperature variation [K]

Material	Temperature Range from 20 °C to 500 °C				
	100 °C	200 °C	300 °C	400 °C	500 °C
Carbon steel	0,0125	0,0130	0,0136	0,0141	0,0145
Austenitic Stainless Steel (321/1.4541)	0,0160	0,0165	0,0170	0,0175	0,0180
Copper	0,0155	0,0160	0,0165	0,0170	0,0175
Aluminium Alloy (AIMg3)	0,0237	0,0245	0,0253	0,0263	0,0272

Table 3: Thermal Expansion

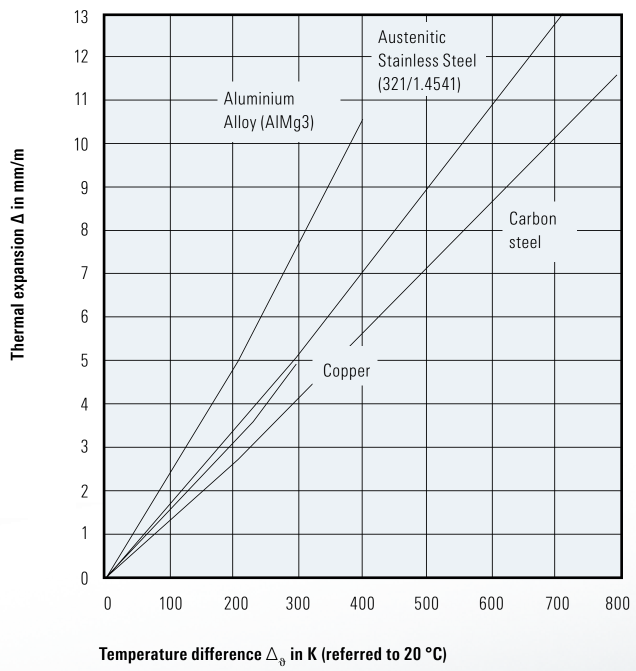


Figure 4: Thermal Expansion Chart

Forces
When expansion joints are used, the pipe anchor points of the piping system shall be designed to withstand loads resulting from:
- Bellows pressure thrust,
- Bellows stiffness,
- Friction between pipe and supports.

For axial expansion joints without restraint hardware, the resulting force is:

$$F = F_P + F_d + F_R$$

For expansion joints with restraint hardware, the axial force due to the pressure is not transmitted to the anchor points of the pipe. In this case the resulting force is:

$$F = F_d + F_R$$

where:
F_P = Force due to bellows pressure thrust
F_d = Force due to the stiffness of the metal bellows
F_R = Force due to friction between pipe and supports

(a) Force due to bellows pressure thrust F_P [N]
Unlike a rigid pipe, an axial expansion joint cannot absorb longitudinal forces caused by pressure due to its low axial stiffness. This axial pressure thrust released from the axial expansion joint is:

$$F_P = P \cdot 0.01 \cdot A$$

where:
P = Operating Pressure [N/mm^2 = bar]
A = Cross-sectional area of bellows [cm^2] with

$$A = \frac{p \cdot (D_i + D_a)^2}{1600}$$

where:
D_i = Bellows inner diameter [mm]
D_a = Bellows outer diameter [mm]

The value of the cross-sectional area can be found in the selection tables.

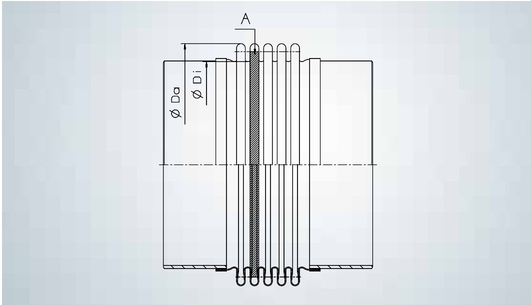


Figure 5: Cross-sectional area of a bellows

(b) Force due to stiffness of the metal bellows F_δ [N]
The adjusting force is defined as the force or moment of reaction of the metallic bellows when subjected to a movement, which may be axial, lateral or angular.

$$F_\delta = C_{\delta\vartheta} \cdot \delta$$

where:
$C_{\delta\vartheta}$ = Spring rate at operating temperature [N/mm]
δ = Movement to be absorbed (mm)

The spring rate of a metal bellows depends on the bellows geometry (primarily the ply thickness and the convolution height) and the material. “Standard” expansion joints are calculated for a temperature of 20 °C. For higher temperatures the spring rate should be adjusted as below:

$$C_{\delta\vartheta} = C_\delta \cdot K_c$$

where:
$C_{\delta\vartheta}$ = Spring rate at 20 °C [N/mm]
K_c = Correction factor for stiffness [mm]

Temperature [°C]	200	300	400	500	600	700	800	900
Correction factor K_c	0,93	0,9	0,86	0,83	0,8	0,75	0,71	0,67

c) Force due to friction between pipe and supports F_R [N]
The friction force is calculated by the sum of the loads on the supports (pipe weight) times the coefficient of friction between pipe and support:

$$F_R = \Sigma F_L \cdot K_L$$

where:
ΣF_L = Sum of loads of supports (pipe weight)
K_L = Coefficient of friction

Empirical values for K_L are:
Metal / Metal: 0,2 – 0,5
Metal / PTFE: 0,1 – 0,2
Roller bearings: 0,05 – 0,1

SELECTION OF EXPANSION JOINTS

The basic characteristics of metal expansion joints are:
- corrosion resistance,
- temperature resistance,
- tightness,
- pressure resistance,
- mechanical strength,
- flexibility,
- fatigue strength and
- freedom from maintenance.

Therefore they are used in the industry for:
- compensation of thermal expansion due to temperature variation in pipes,
- absorbtion of vibratory movements and acoustic vibrations,
- compensation of piping misalignments
- mounting adjustments,
- reduction of forces and resulting moments in connections and anchor points.

The selection of an expansion joint should be made according to the points described below.

TYPES OF COMPENSATION

Axial
- Compression and extension of the metallic bellows (+ δ / – δ)
- Combination with lateral and angular deflection possible.
- Little space for installation required.
- Length adjustment with tensioners possible.
- Long straight pipes with several expansion joint need intermediate anchor points.
- Transmits pressure thrust to the adjacent pipe supports.

Angular
- Angular deflection (+α / –α)
- Does not allow axial deflection. Pipe redirection necessary.
- Minimum two expansion joints needed.
- Absorbs pressure thrust. Low loads on adjacent pipe supports.

Lateral
- Lateral deflection (+ λ / – λ)
- Relatively simple design for low pressure.
- Does not allow axial deflection. Pipe redirection necessary.
- For high movement compensation.
- Absorbs pressure thrust. Low loads on adjacent pipe supports.

Note: Metal expansion joints should NEVER be subjected to torsion. They should be positioned in the piping system in order to avoid such loads.

Design Pressure and temperature

The knowledge of the design pressure and temperature is essential in order to guarantee the performance of the expansion joint. "Standard" expansion joints are dimensioned for 20 °C and are limited to applications with up to 300 °C. For higher temperatures a customized design can be offered.
If the design temperature is higher than 20 °C, use table 1 to figure out the permissible pressure at the design temperature. If the corrected pressure does not meet the design requirements, select a pressure level above.

Example: Expansion joint for a design pressure of 6 bar and a design temperature of 200 °C.
If an expansion joint of PN 6 is selected, using the correction factor 0.74, the permissible expansion joint design pressure will be 4.44 bar. Therefore select the next pressure level:
PN 10, which is suitable for 7.4 bar at 200 °C.

Nominal diameter

The diameter range of the standard joints is between DN 250 / NPS 10" and DN 1200 / NPS 48". Expansion joints outside this range will be designed on request.

Number of cycles

"Standard" expansion joints are calculated to perform 100 % absorption of the specified stroke, taking 1000 cycles. If more cycles are required, use table 2 to adjust the expansion joint movement to the needed number of cycles.

Example: Axial Expansion Joint URN 06.0350.100.0 for 1000 cycles.
According to table 2, Use a factor of 0.53to obtain permissible movement of Expansion joint.
1000 cycles: ±50 mm.
10000 cycles: ±50 mm x 0,53 = ±26,5 mm.

Connection

Expansion joint connecting parts must be compatible with the adjacent piping system. The following connecting parts are considered for "standard" expansion joints:
Welding ends: "Standard" weld-on expansion joints use ASME B36.10 STD tubes at their ends (dimensions shown in table 4). The bevel for welding is according to ASME B16.25 (Figure 6).

Flanges: "Standard" expansion joints with nominal diameter up to 600mm/24" use ASME B16.5 flanges, class 150 lbs and 300 lbs, and can be of fixed or loose type. The dimensions of flanges with nominal diameter above 600mm/24" meet the standard ASME B16.47 Series A, in the pressure classes of 150 lbs and 300 lbs.
The flange specification can be adapted on request, and can be designed according to special design, DIN 1092-1, DIN 86044, JIS, among others.

Nominal Diameter	External Diameter	Thickness
in	mm	Sch STD
10"	273,00	9,27
12"	323,80	9,53
14"	355,60	9,53
16"	406,40	9,53
18"	457,20	9,53
20"	508,00	9,53
24"	609,60	9,53
28"	711,20	9,53
32"	812,80	9,53
36"	914,40	9,53
40"	1016,00	9,53
44"	1117,60	9,53
48"	1219,20	9,53

Table 4: Dimension schedule for tubes acc. To ASME B36.10

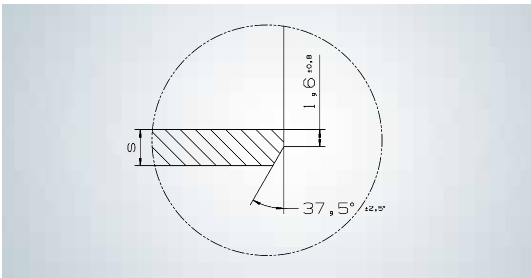


Figure 6: Welding Bevel ASME B16.25

Lateral and angular expansion joints require the use of restraint hardware in order to absorb pressure thrust and guide the expansion joint movement. Axial and universal expansion joints may have tensioners for adjusting the expansion joint length during installation (pre-tensioning), for limiting the deflection and for absorbing the axial pressure thrust at a end stop.

When the expansion joint does not have restraint hardware, the anchor points of the piping system must be calculated to absorb the reaction forces due to the pressure Fp and the axial adjustment force due to the stiffness of the metal bellows F_{δ} (see chapter "Forces").

Material

The selection of materials compatible with the transported fluid is fundamental to guarantee the performance of the expansion joint, especially for the design of the metal bellows, which is usually made with thin plates.
In "standard" expansion joints the metal bellows is made of austenitic stainless steel, which allows, even with thinner layers, an adequate corrosion resistant for most cases. Metal bellows in other materials or with a combination of different materials are possible on request.
The materials of "standard" expansion joint are suitable for temperatures above –10 °C. For cryogenic applications it is recommended to use austenitic stainless steel for all parts.

Inner guiding sleeve

If necessary, inner sleeves may be used to protect the expansion joint in order to:

- reduce the flow resistance,
- limit flow-induced vibrations,
- protect the bellows from damage from direct contact with the flowing medium and to
- avoid deposition of solid particles in the metal bellows.

If the expansion joint will be installed in an upright position, drainage holes on the sleeve are recommended in order to avoid condensate build-up between sleeve and metal bellows.

Expansion joints with inner sleeves are possible on request. Always communicate the installation position of the expansion joint and the flow velocity of the fluid being transported.

Outer protection

If necessary, outer jackets may be installed at the expansion joint to provide mechanical protection during assembly or operation, especially against mechanical impacts and possible damage during handling. Expansion joints with outer protection are possible on request.

Thermal insulation

When the operating temperature exceeds the permissible temperature of the metal bellows material, it is necessary to use thermal insulation between bellows and inner sleeve. Thermal insulation can also be installed between the metal bellows and outer protection jacket in order to minimize the thermal loss between fluid and environment.
Expansion joints with thermal insulation are possible on request.

Surface Coating

Carbon steel components, such as flanges and welding ends, are coated with corrosion-resistant epoxy paint or oil:

- Heat resistant aluminum paint to withstand 400 °C
- Fasteners such as carbon steel rods and nuts are coated with electrolytic galvanizing if required.

Special surface coating requirements are possible on request.

POSITIONING OF EXPANSION JOINTS

Supports
For proper operation expansion joints should not support the weight of the adjacent pipe. The piping system must be dimensioned using bearings, hangers or other supports in order to absorb the weight of the pipe.

Fixed points (FP) must be installed at the ends of the piping and are important for dividing the piping system into several sections.

The fixed points must be sized to absorb:
- axial pressure thrust of expansion joints without restraint hardware,
- forces due to bellows stiffness.
- friction forces between pipe and support.

When more than one axial expansion joint is installed in a branch, they must be separated by intermediate fixed points (ZFP) as shown in figure 7.

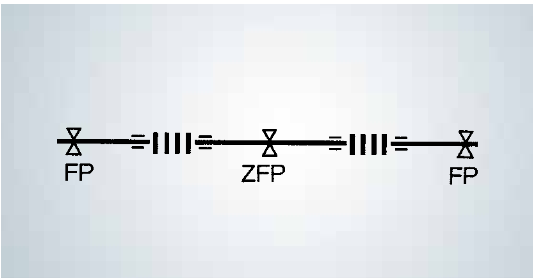


Figure 7: Positioning of fixed and intermediate fixed points

For axial compensation some rules must be respected for positioning supports in the piping system:

- The distance between the first support and the axial expansion joint L1 (figure 8) should be:

$L_1 = 3 \times DN$

- The distance between the first support and the axial expansion joint L1 (figure 8) should be:

$L_2 = 0{,}5 \times L_F$

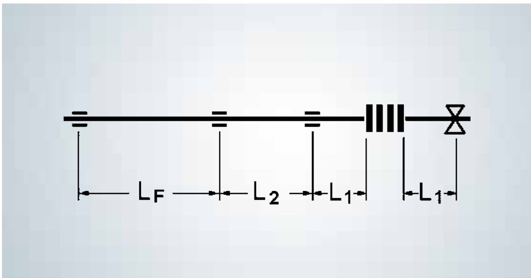
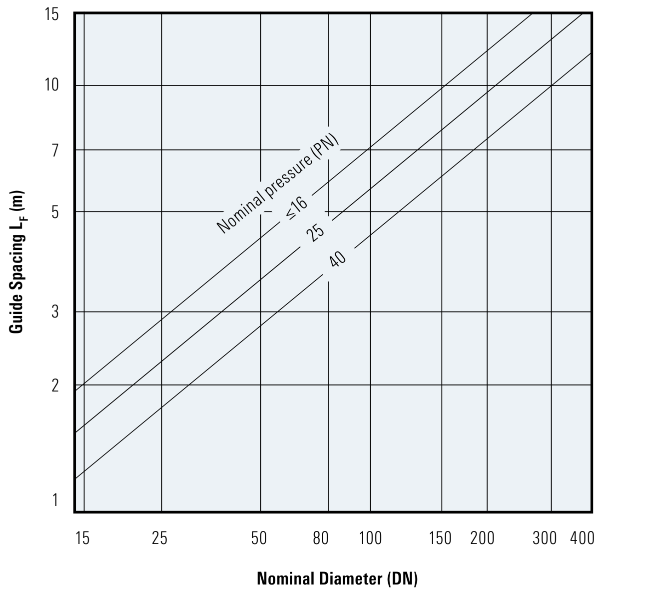


Figure 8: Pre-Tensioning

- The normal distance between supports LF is given below:



Recommended Spacings for pipe guides with axial expansion joints in the line.

L_F values for larger DNs can be provided on request.

The deflection of a lateral expansion joint always consists of the desired lateral deflection and an unavoidable axial deflection. The circular movement at the centre point of the joints determines in the lateral, deflected position an axial shortening by the height of the arch. In a “fully compensated” system, this is absorbed by an additional angular expansion joint. However, the pipe itself can often compensate this axial deflection by elastic bending but needs sufficient clearance between pipe and support to prevent additional reaction forces.

Pre-tension
“Standard” expansion joints are calculated to absorb the same magnitude of deflection in 2 directions: $2\delta = +\delta + |-\delta|$.

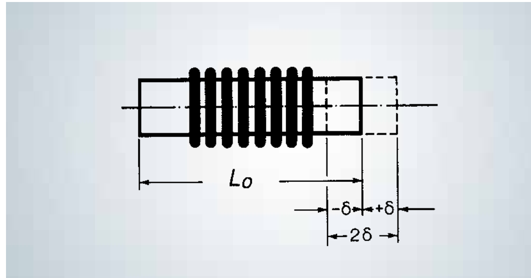


Figure 10: Pre-Tensioning

An expansion joint can be pre-tensioned during installation, allowing up to 2δ movement in one direction (100 % pre-tensioning).

The same concept can be used for lateral and angular expansion joints

FLEXIBLE ELEMENTS FOR VIBRATION

During their operation, hydrodynamic machines like pumps, compressors, and piston motors generate vibrations with different frequencies and amplitudes, resulting in cyclic movements. The piping connected to such a machine also vibrates which can lead the material to fatigue and premature rupture. This damage is inevitable if resonance occurs in the system.

Additionally high frequency vibrations have an unwanted effect in the form of noise, while low frequency vibrations can be transmitted by the factory foundation and floor, causing damage to adjacent buildings.

Any “standard” expansion joint can be used as a vibration damper. Vibration damping expansion joints with restraint hardware should be selected for high pressure or bigger diameter when fixed points may not withstand the high axial pressure thrust.

Vibration amplitude
Amplitude is the greatest displacement that a particle or body upon vibrating reproduces from its resting position. Usually the vibration amplitudes are axial and radial (lateral).

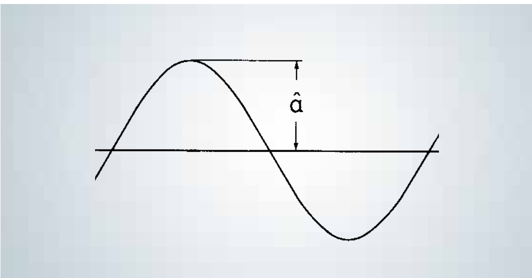


Figure 11: Vibration Amplitude

The axial and radial vibration amplitude must be known and considered in the design of the expansion joint. Permissible amplitudes of the “standard” expansion joints can be calculated by using the following equations:

$$\hat{a}_\delta = 0{,}03 \cdot 2\delta \quad \text{(axial)}$$

$$\hat{a}_\lambda = 0{,}01 \frac{l}{D_a} 2\delta \quad \text{(radial)}$$

where:
$\hat{a}_\delta$ = Axial vibration amplitude (mm)
2δ = Axial deflection of the expansion joint $\pm\delta$ (mm)
$\hat{a}_\lambda$ = Radial vibration amplitude (mm)
l = Corrugated length of metal bellows (mm)
D_a = Bellows outer diameter (mm)

(b) Natural frequency
Natural frequencies are specified for “standard” vibration damping expansion joints and must be compared to the vibration frequency of the system. The frequency of the system must be sufficiently far away from the natural frequency of an expansion joint in order to avoid resonance.

The given natural frequencies in this catalogue are only applicable for the use of gaseous fluids.

(c) Installation of expansion joints at vibrating machines
It is essential that the decoupled piping system is supported near the expansion joint and that this support is independend from the base of the vibrating machine (figure 12). For non-restraint expansion joints the fixed points of the piping system must withstand the axial pressure thrust of the bellows.

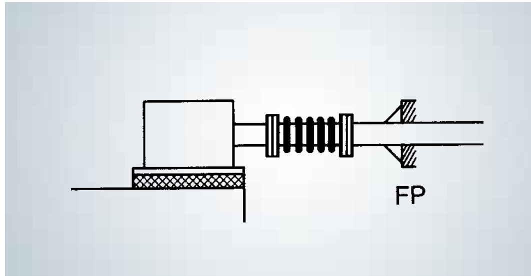


Figure 12: Vibration free shock absorber seals

When it is inevitable that the expansion joint will be used to simultaneously absorb vibration and thermal expansion, sliding guides must be installed, if required, to absorb lateral heat expansion (figure 13).

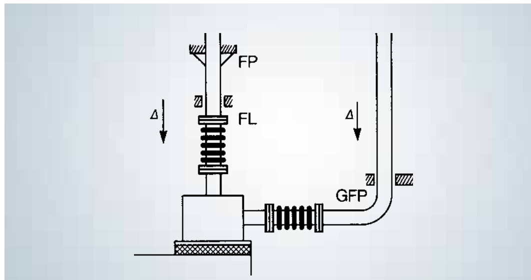


Figure 13: Expansion joints mounted on a vibrating machine

For radial vibrations, when vibration occurs only in one plane, the installation of one expansion joint with restraint hardware is sufficient, which is flexible on all sides in this plane (figure 14).

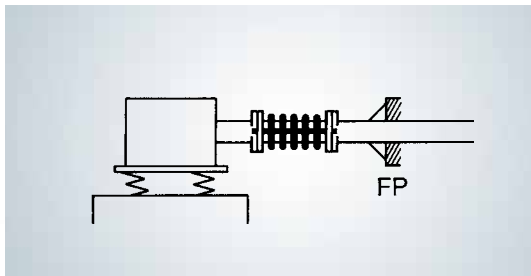


Figure 14: Expansion Joints for 1-dimensional vibration

If the movement occurs in 3 dimensions, the installation of a second expansion joint with restraint hardware is necessary. The second one must be installed perpendicular to the first one (figure 15).

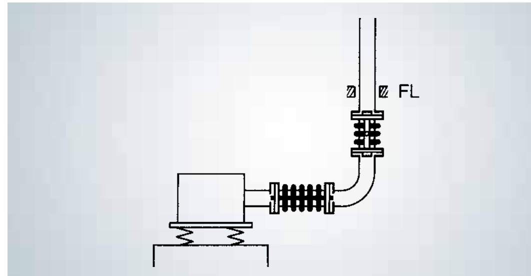


Figure 15: Layout with lateral expansion joints for 3-dimensional vibrations

For reducing noise during operation the restraint hardware of an expansion joints can be coupled to the anchor plate using anti-vibration cushions out of stainless steel which are resistant to aging and high temperatures (figure 16).

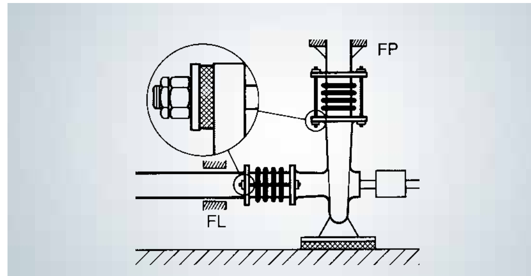


Figure 16: Anti-vibration cushions

WITZENMANN EXPANSION JOINTS

Design/Nomenclature

1. Nomenclature

A R N | 0 6 | 0 0 1 5 | 0 2 0 | 0

Nominal Pressure PN [bar]

Nominal Diameter DN [mm]

Deflection - 2δ

0. Without inner sleeve
1. With inner sleeve

Type:
A: Axial
L: Lateral
W: Angular
U: Universal

Connections
R: Weld end
F: Fixed flange
B: Rotary flange
S: Different connections

Construction
N: Standard
Z: Special Construction
S: Vibration damping
R: With tie-rods
K: Gimbal

1. Technical Specifications of “Standard” expansion joints

Design Temperature	Max. Temperature of operation	Design Pressure (*)	DN	N° of cycles (**)
°C	°C	bar	mm	-
–15 – 20	300	1 – 25	250 - 1200 (10" - 48")	Type "Standard": 1000 Vibration 10^9

(*) using the reduction factor $K_{P\vartheta}$ specified in table 1.
Vacuum applications on request.
(**) If necessary a greater number of cycles the movement to be absorbed by the Expansion joint shall be recalculated using the reduction factor $K_{\Delta L}$ specified in table 2.

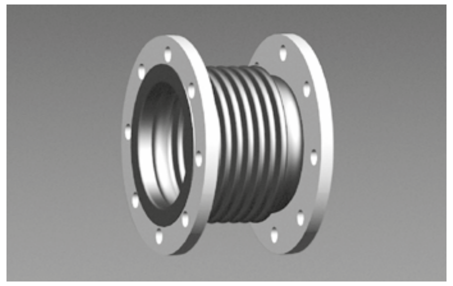
Expansion joints outside the technical specification range can be manufactured on request.

Materials
Bellows: Austenitic stainless steel, multilayer (ASTM A240 Grade 321)
Flanges/Plates: ASTM A105, ASTM A516 Grade 70
Pipes: ASTM A106 Grade B / ASTM A516 Grade 70
Inner sleeve: ASTM A240 Grade 304L
Restraint hardware: ASTM A193-B7, ASTM A194-2H
Pins: ASTM A193-B7

WITZENMANN EXPANSION JOINTS

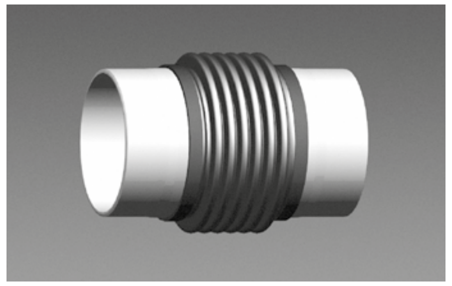
“Standard” Expansion Joints

AFN / ABN



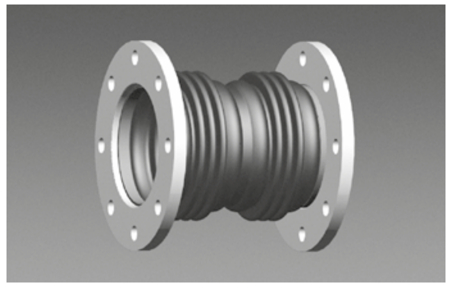
Axial expansion joint with loose flanges or with fixed flanges

ARN



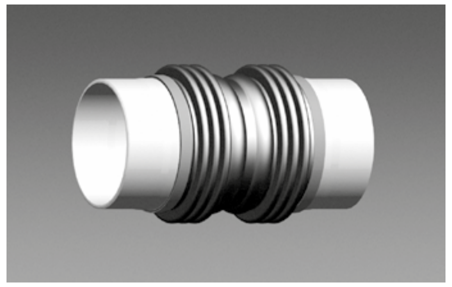
Axial expansion joint with weld ends

UFN / UBN



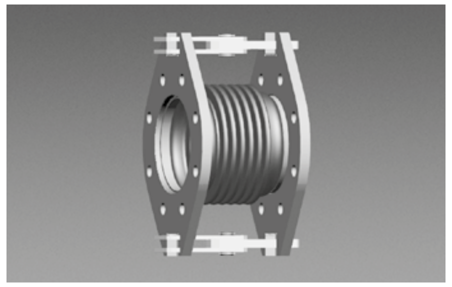
Universal expansion joint with loose flanges or with fixed flanges

URN



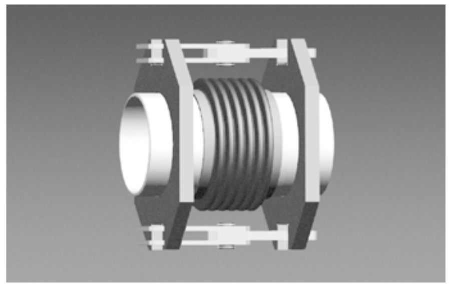
Universal expansion joint with weld ends

WFN / WFK



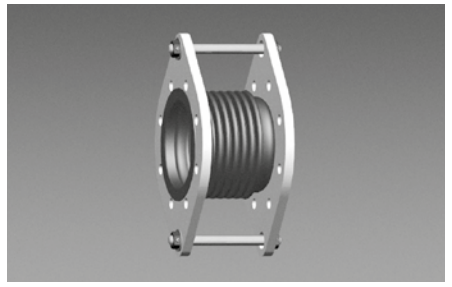
Angular expansion joint with loose flanges or with fixed flanges

WRN / WRK



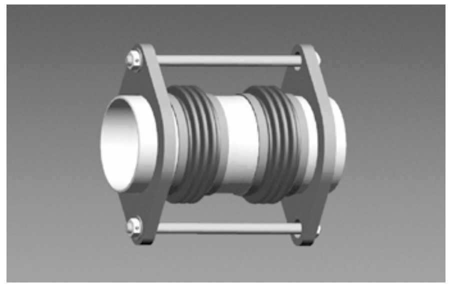
Angular expansion joint with weld ends

LFR / LBR



Lateral expansion joint with loose flanges or fixed flanges for movement in all planes

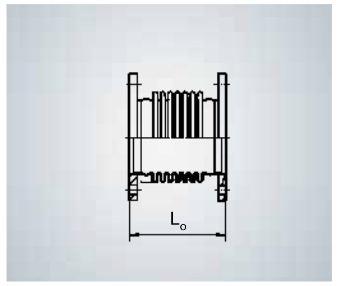
LRR / LRN / LRK



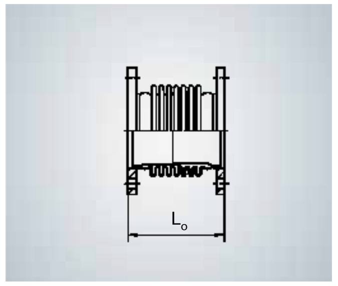
Lateral expansion joint with weld ends

AXIAL EXPANSION JOINTS TYPE AFN / ABN

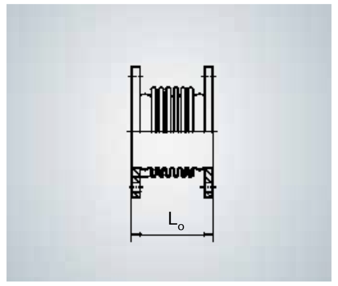
with loose flanges or with fixed flanges



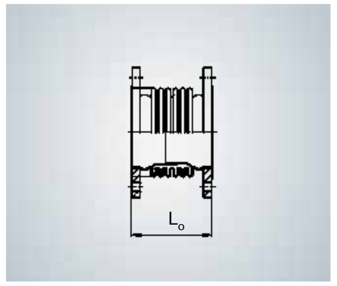
Type AFN without inner sleeve



Type AFN with inner sleeve



Type ABN without inner sleeve



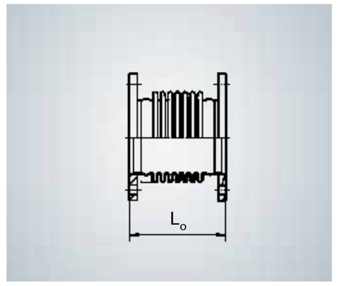
Type ABN with inner sleeve

PN 2,5

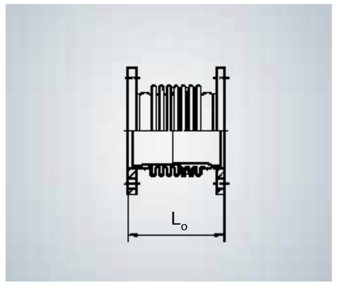
DN	Type	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Movement Absorption for 1000 cycles		Spring rate (Ambient.temp)			Natural frequency of Bellows	
	AFN 02 ... ABN 02 …	Axial				Lateral	Angular	Axial	Lateral	Angular	Axial	Radial
		$2\delta_N$	L_o			$2\lambda_N$	$2\alpha_N$	C_δ	C_λ	C_α	ω_a	ω_r
mm (")		mm	mm	kg	cm^2	mm	°	N/mm	N/mm	Nm/°	Hz	Hz
250 (10")	.0250.100.0	100	300	37	685	24	22	39	141	7	86	338
300 (12")	.0300.100.0	100	305	58	955	22	18	36	182	10	74	342
350 (14")	.0350.112.0	112	295	75	1135	16	18	40	305	13	79	455
400 (16")	.0400.140.0	140	295	100	1470	18	12	31	317	13	50	331
450 (18")	.0450.120.0	120	285	110	1850	12	12	38	657	19	56	481
500 (20")	.0500.144.0	144	450	140	2280	32	18	59	277	37	51	228
600 (24")	.0600.176.0	176	435	120	3265	28	16	60	411	54	47	253
650 (26")	.0650.176.0	176	435	135	3810	28	14	60	481	64	45	260
700 (28")	.0700.234.0	234	405	155	4395	28	12	54	626	66	37	259
750 (30")	.0750.234.0	234	410	185	5030	28	10	54	708	75	35	264
800 (32")	.0800.140.0	140	475	225	5710	18	16	172	1833	273	57	381
900 (36")	.0900.144.0	144	470	275	7195	16	16	169	2482	338	54	424
1000 (40")	.1000.144.0	144	450	330	8810	12	12	208	4227	510	60	554
1100 (44")	.1100.144.0	144	475	405	10570	12	12	240	5248	705	61	590
1200 (48")	.1200.144.0	144	480	480	12490	10	10	261	6739	906	61	641

AXIAL EXPANSION JOINTS TYPE AFN / ABN

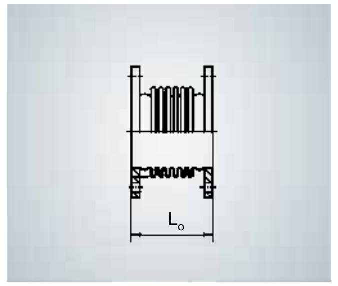
with loose flanges or with fixed flanges



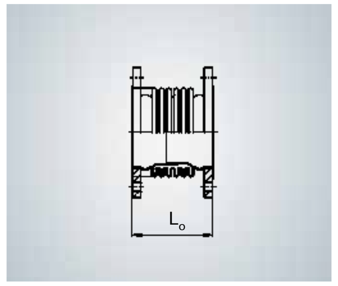
Type AFN without inner sleeve



Type AFN with inner sleeve



Type ABN without inner sleeve



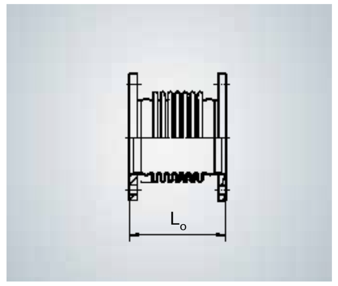
Type ABN with inner sleeve

PN 6

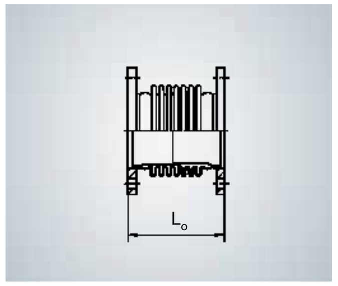
DN	Type	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Movement Absorption for 1000 cycles		Spring rate (Ambient.temp)			Natural frequency of Bellows	
	AFN 06 ... ABN 06 …	Axial				Lateral	Angular	Axial	Lateral	Angular	Axial	Radial
		$2\delta_N$	L_o			$2\lambda_N$	$2\alpha_N$	C_δ	C_λ	C_α	ω_a	ω_r
mm (")		mm	mm	kg	cm^2	mm	°	N/mm	N/mm	Nm/°	Hz	Hz
250 (10")	.0250.077.0	77	325	38	680	20	18	94	268	18	108	377
300 (12")	.0300.108.0	108	295	58	950	18	16	80	448	21	82	398
350 (14")	.0350.100.0	100	340	78	1135	18	14	81	381	25	85	382
400 (16")	.0400.128.0	128	320	102	1470	20	12	74	564	30	69	392
450 (18")	.0450.120.0	120	295	113	1850	12	10	71	1060	36	53	424
500 (20")	.0500.096.0	96	460	145	2285	22	16	165	737	104	71	310
600 (24")	.0600.110.0	110	405	125	3270	20	14	167	1101	152	65	346
650 (26")	.0650.110.0	110	445	145	3805	18	14	168	1285	177	62	355
700 (28")	.0700.180.0	180	445	165	4385	26	12	131	1159	160	46	284
750 (30")	.0750.156.0	156	335	200	5005	12	6	83	2058	116	35	354
800 (32")	.0800.168.0	168	370	250	5675	14	6	91	2186	143	32	325
900 (36")	.0900.144.0	144	485	305	7180	18	14	334	4359	665	53	395
1000 (40")	.1000.144.0	144	465	365	8810	14	12	387	7048	947	57	499
1100 (44")	.1100.154.0	154	485	440	10570	14	12	446	8790	1309	58	533
1200 (48")	.1200.152.0	152	495	520	12490	12	10	485	11286	1681	58	578

AXIAL EXPANSION JOINTS
TYPE AFN / ABN

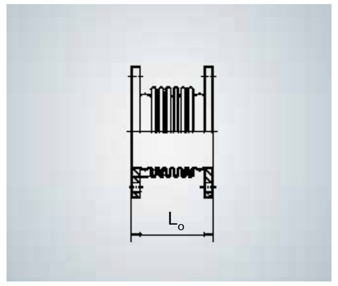
with loose flanges or with fixed flanges



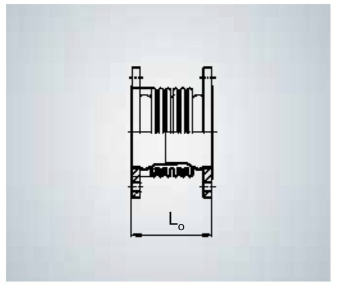
Type AFN without inner sleeve



Type AFN with inner sleeve



Type ABN without inner sleeve



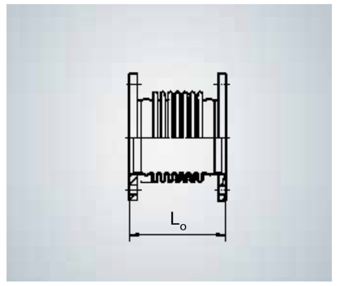
Type ABN with inner sleeve

PN 10

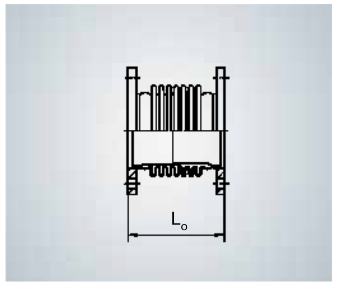
DN	Type AFN 10 ... ABN 10 …	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Movement Absorption for 1000 cycles		Spring rate (Ambient.temp)			Natural frequency of Bellows	
		Axial				Lateral	Angular	Axial	Lateral	Angular	Axial	Radial
		$2\delta_N$	L_o			$2\lambda_N$	$2\alpha_N$	C_δ	C_λ	C_α	ω_a	ω_r
mm (")		mm	mm	kg	cm^2	mm	°	N/mm	N/mm	Nm/°	Hz	Hz
250 (10")	.0250.070.0	70	250	39	685	12	16	111	737	21	122	652
300 (12")	.0300.096.0	96	245	65	940	12	10	94	1003	25	80	543
350 (14")	.0350.112.0	112	310	85	1130	18	12	119	760	37	79	411
400 (16")	.0400.112.0	112	305	105	1465	16	12	127	1164	52	78	490
450 (18")	.0450.108.0	108	365	120	1850	16	14	173	1223	89	77	426
500 (20")	.0500.110.0	110	455	145	2275	22	16	352	1612	222	76	336
600 (24")	.0600.168.0	168	380	220	3255	20	12	177	2340	160	53	396
650 (26")	.0650.168.0	168	415	325	3790	18	10	176	2702	185	50	405
700 (28")	.0700.182.0	182	440	365	4380	20	10	175	2745	213	47	386

AXIAL EXPANSION JOINTS
TYPE AFN / ABN

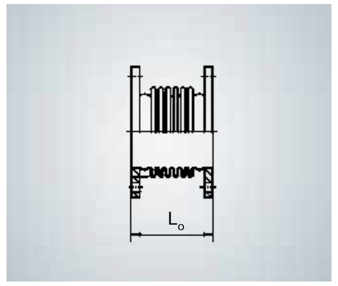
with loose flanges or with fixed flanges



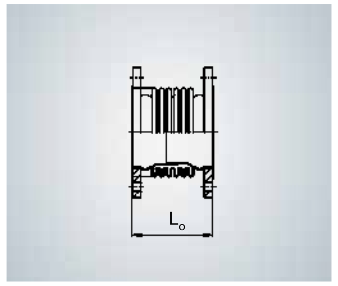
Type AFN without inner sleeve



Type AFN with inner sleeve



Type ABN without inner sleeve



Type ABN with inner sleeve

PN 16

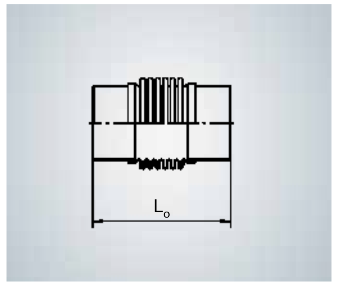
DN	Type AFN 16 ... ABN 16 …	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Movement Absorption for 1000 cycles		Spring rate (Ambient.temp)			Natural frequency of Bellows	
		Axial				Lateral	Angular	Axial	Lateral	Angular	Axial	Radial
		$2\delta_N$	L_o			$2\lambda_N$	$2\alpha_N$	C_δ	C_λ	C_α	ω_a	ω_r
mm (")		mm	mm	kg	cm^2	mm	°	N/mm	N/mm	Nm/°	Hz	Hz
250 (10")	.0250.070.0	70	300	78	680	12	14	167	1002	32	122	618
300 (12")	.0300.096.0	96	340	115	945	18	14	180	1048	47	91	453
350 (14")	.0350.100.0	100	410	165	1125	22	18	250	916	78	86	340
400 (16")	.0400.108.0	108	415	200	1465	20	16	258	1298	105	83	385
450 (18")	.0450.096.0	96	500	255	1850	24	14	320	1161	164	75	294
500 (20")	.0500.110.0	110	500	310	2275	20	12	352	1612	222	76	336

PN 25

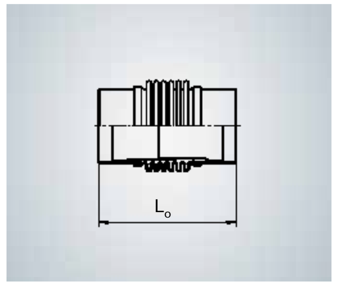
DN	Type AFN 25 ... ABN 25 …	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Movement Absorption for 1000 cycles		Spring rate (Ambient.temp)			Natural frequency of Bellows	
		Axial				Lateral	Angular	Axial	Lateral	Angular	Axial	Radial
		$2\delta_N$	L_o			$2\lambda_N$	$2\alpha_N$	C_δ	C_λ	C_α	ω_a	ω_r
mm (")		mm	mm	kg	cm^2	mm	°	N/mm	N/mm	Nm/°	Hz	Hz
250 (10")	.0250.72.0	72	350	82	680	16	16	338	1093	63	129	480
300 (12")	.0300.84.0	84	330	120	940	14	14	314	1993	82	104	541
350 (14")	.0350.66.0	66	435	165	1125	18	12	417	1286	130	109	394
400 (16")	.0400.96.0	96	400	210	1455	16	14	394	2240	159	94	464

AXIAL EXPANSION JOINTS TYPE ARN

with weld ends



Type ARN without inner sleeve



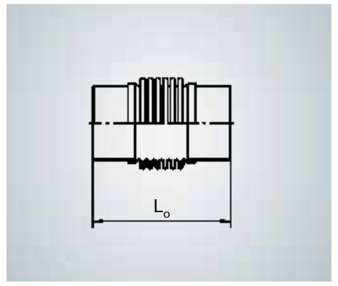
Type ARN with inner sleeve

PN 2,5

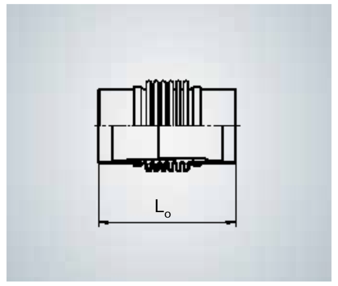
DN	Type	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Movement Absorption for 1000 cycles		Spring rate (Ambient.temp)			Natural frequency of Bellows	
	ARN 02 ...	Axial				Lateral	Angular	Axial	Lateral	Angular	Axial	Radial
		$2\delta_N$	L_o			$2\lambda_N$	$2\alpha_N$	C_δ	C_λ	C_α	ω_a	ω_r
mm (")		mm	mm	kg	cm²	mm	°	N/mm	N/mm	Nm/°	Hz	Hz
250 (10")	.0250.100.0	100	370	12,0	685	24	22	39	141	7	86	338
300 (12")	.0300.100.0	100	370	15,0	955	22	18	36	182	10	74	342
350 (14")	.0350.112.0	112	350	17,0	1135	16	18	40	305	13	79	455
400 (16")	.0400.140.0	140	350	22,0	1470	18	12	31	317	13	50	331
450 (18")	.0450.120.0	120	325	24,0	1850	12	12	38	657	19	56	481
500 (20")	.0500.144.0	144	490	28,0	2280	32	18	59	277	37	51	228
600 (24")	.0600.176.0	176	490	35,0	3265	28	16	60	411	54	47	253
650 (26")	.0650.176.0	176	490	38,0	3810	28	14	60	481	64	45	260
700 (28")	.0700.234.0	234	460	45,0	4395	28	12	54	626	66	37	259
750 (30")	.0750.234.0	234	460	49,0	5030	28	10	54	708	75	35	264
800 (32")	.0800.140.0	140	510	55,0	5710	18	16	172	1833	273	57	381
900 (36")	.0900.144.0	144	500	62,0	7195	16	16	169	2482	338	54	424
1000 (40")	.1000.144.0	144	485	67,0	8810	12	12	208	4227	510	60	554
1100 (44")	.1100.144.0	144	500	77,0	10570	12	12	240	5248	705	61	590
1200 (48")	.1200.144.0	144	500	85,0	12490	10	10	261	6739	906	61	641

AXIAL EXPANSION JOINTS TYPE ARN

with weld ends



Type ARN without inner sleeve



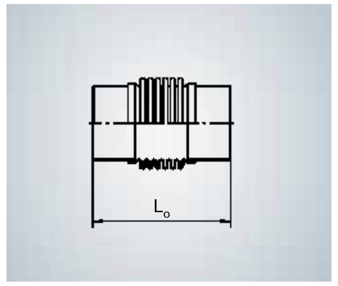
Type ARN with inner sleeve

PN 6

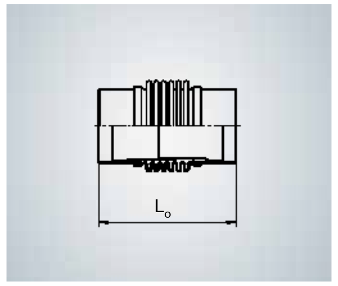
DN	Type	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Movement Absorption for 1000 cycles		Spring rate (Ambient.temp)			Natural frequency of Bellows	
	ARN 06 ...	Axial				Lateral	Angular	Axial	Lateral	Angular	Axial	Radial
		$2\delta_N$	L_o			$2\lambda_N$	$2\alpha_N$	C_δ	C_λ	C_α	ω_a	ω_r
mm (")		mm	mm	kg	cm²	mm	°	N/mm	N/mm	Nm/°	Hz	Hz
250 (10")	.0250.077.0	77	395	13,0	680	20	18	94	268	18	108	377
300 (12")	.0300.108.0	108	360	16,0	950	18	16	80	448	21	82	398
350 (14")	.0350.100.0	100	395	19,0	1135	18	14	81	381	25	85	382
400 (16")	.0400.128.0	128	375	23,0	1470	20	12	74	564	30	69	392
450 (18")	.0450.120.0	120	340	26,0	1850	12	10	71	1060	36	53	424
500 (20")	.0500.096.0	96	500	34,0	2285	22	16	165	737	104	71	310
600 (24")	.0600.110.0	110	495	41,0	3270	20	14	167	1101	152	65	346
650 (26")	.0650.110.0	110	495	45,0	3805	18	14	168	1285	177	62	355
700 (28")	.0700.180.0	180	500	54,0	4385	26	12	131	1159	160	46	284
750 (30")	.0750.156.0	156	390	62,0	5005	12	6	83	2058	116	35	354
800 (32")	.0800.168.0	168	410	72,0	5675	14	6	91	2186	143	32	325
900 (36")	.0900.144.0	144	520	88,0	7180	18	14	334	4359	665	53	395
1000 (40")	.1000.144.0	144	500	100	8810	14	12	387	7048	947	57	499
1100 (44")	.1100.160.0	160	520	112	10570	14	12	446	8790	1309	58	533
1200 (48")	.1200.160.0	160	520	122	12490	12	10	485	11286	1681	58	578

AXIAL EXPANSION JOINTS
TYPE ARN

with weld ends



Type ARN without inner sleeve



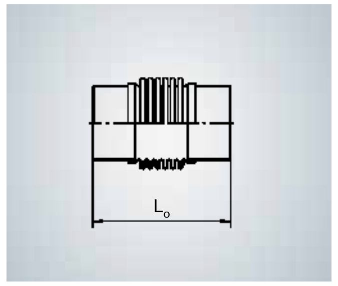
Type ARN with inner sleeve

PN 10

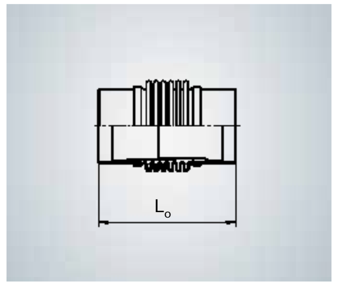
DN	Type ARN 10 ...	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Movement Absorption for 1000 cycles		Spring rate (Ambient.temp)			Natural frequency of Bellows	
		Axial				Lateral	Angular	Axial	Lateral	Angular	Axial	Radial
		$2\delta_N$	L_o			$2\lambda_N$	$2\alpha_N$	C_δ	C_λ	C_α	ω_a	ω_r
mm (")		mm	mm	kg	cm^2	mm	°	N/mm	N/mm	Nm/°	Hz	Hz
250 (10")	.0250.070.0	70	320	14,0	685	12	16	111	737	21	122	652
300 (12")	.0300.096.0	96	310	20,0	940	12	10	94	1003	25	80	543
350 (14")	.0350.112.0	112	370	23,0	1130	18	12	119	760	37	79	411
400 (16")	.0400.112.0	112	360	25,0	1465	16	12	127	1164	52	78	490
450 (18")	.0450.108.0	108	410	31,0	1850	16	14	173	1223	89	77	426
500 (20")	.0500.110.0	110	495	33,0	2275	22	16	352	1612	222	76	336
600 (24")	.0600.168.0	168	410	53,0	3255	20	12	177	2340	160	53	396
650 (26")	.0650.168.0	168	410	58,0	3790	18	10	176	2702	185	50	405
700 (28")	.0700.182.0	182	425	63,0	4380	20	10	175	2745	213	47	386

AXIAL EXPANSION JOINTS
TYPE ARN

with weld ends



Type ARN without inner sleeve



Type ARN with inner sleeve

PN 16

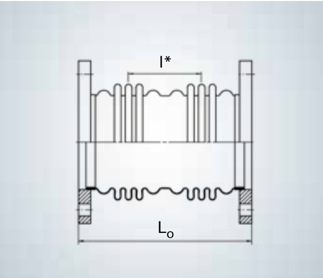
DN	Type ARN 16 ...	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Movement Absorption for 1000 cycles		Spring rate (Ambient.temp)			Natural frequency of Bellows	
		Axial				Lateral	Angular	Axial	Lateral	Angular	Axial	Radial
		$2\delta_N$	L_o			$2\lambda_N$	$2\alpha_N$	C_δ	C_λ	C_α	ω_a	ω_r
mm (")		mm	mm	kg	cm^2	mm	°	N/mm	N/mm	Nm/°	Hz	Hz
250 (10")	.0250.070.0	70	330	16,0	680	12	14	167	1002	32	122	618
300 (12")	.0300.096.0	96	360	23,0	945	18	14	180	1048	47	91	453
350 (14")	.0350.100.0	100	425	29,0	1125	22	18	250	916	78	86	340
400 (16")	.0400.108.0	108	425	33,0	1465	20	16	258	1298	105	83	385
450 (18")	.0450.096.0	96	500	43,0	1850	24	14	320	1161	164	75	294
500 (20")	.0500.110.0	110	495	46,0	2275	20	12	352	1612	222	76	336

PN 25

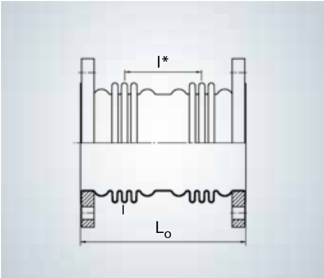
DN	Type ARN 25 ...	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Movement Absorption for 1000 cycles		Spring rate (Ambient.temp)			Natural frequency of Bellows	
		Axial				Lateral	Angular	Axial	Lateral	Angular	Axial	Radial
		$2\delta_N$	L_o			$2\lambda_N$	$2\alpha_N$	C_δ	C_λ	C_α	ω_a	ω_r
mm (")		mm	mm	kg	cm^2	mm	°	N/mm	N/mm	Nm/°	Hz	Hz
250 (10")	.0250.72.0	72	385	20,0	680	16	16	338	1093	63	129	480
300 (12")	.0300.84.0	84	350	26,0	940	14	14	314	1993	82	104	541
350 (14")	.0350.66.0	66	450	30,0	1125	18	12	417	1286	130	109	394
400 (16")	.0400.96.0	96	410	36,0	1455	16	14	394	2240	159	94	464

UNIVERSAL EXPANSION JOINTS TYPE UFN / UBN

with loose flanges or with fixed flanges



Type UFN



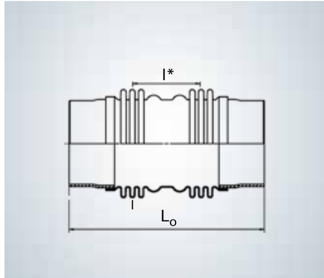
Type UBN

PN 06

DN	Type UFN 06 … UBN 06 …	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Distance between bellows centers	Movement Absorption for 1000 cycles		Spring rate (Ambient.temp)		
		Axial					Lateral	Angular	Axial	Lateral	Angular
		$2\delta_N$	L_o			l*	$2\lambda_N$	$2\alpha_N$	C_δ	C_λ	C_α
mm (")		mm	mm	kg	cm²	mm	mm	°	N/mm	N/mm	Nm/°
250 (10")	.0250.070.0	70	405	67	680	197	36	28	103	107	39
300 (12")	.0300.096.0	96	375	72	950	180	38	32	92	162	48,7
350 (14")	.0350.100.0	100	450	82	1135	217	40	30	81	114	50,7
400 (16")	.0400.128.0	128	430	90	1470	206	46	36	74	152	60,5
450 (18")	.0450.120.0	120	405	100	1850	187	38	30	71	226	72,8
500 (20")	.0500.114.0	114	570	110	2285	266	40	24	169	311	213,8

UNIVERSAL EXPANSION JOINTS TYPE URN

with weld ends



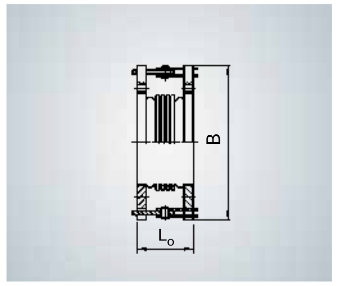
Type URN

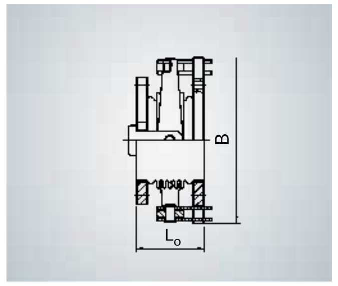
PN 06

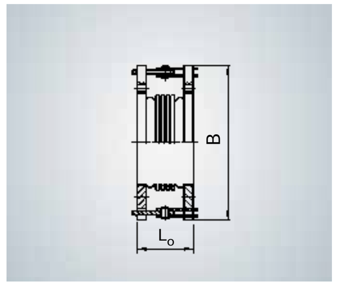
DN	Type URN 06 …	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Distance between bellows centers	Movement Absorption for 1000 cycles		Spring rate (Ambient.temp)		
		Axial					Lateral	Angular	Axial	Lateral	Angular
		$2\delta_N$	L_o			l*	$2\lambda_N$	$2\alpha_N$	C_δ	C_λ	C_α
mm (")		mm	mm	kg	cm²	mm	mm	°	N/mm	N/mm	Nm/°
250 (10")	.0250.070.0	70	475	14	680	197	36	28	103	107	39
300 (12")	.0300.096.0	96	440	17	950	180	38	32	92	162	48,7
350 (14")	.0350.100.0	100	505	20	1135	217	40	30	81	114	50,7
400 (16")	.0400.128.0	128	485	25	1470	206	46	36	74	152	60,5
450 (18")	.0450.120.0	120	450	30	1855	187	38	30	71	226	72,8
500 (20")	.0500.114.0	114	610	37	2285	266	40	24	169	311	213,8

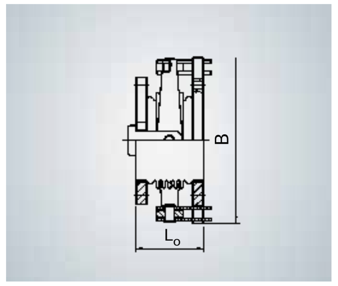
ANGULAR EXPANSION JOINTS TYPE WFN / WFK / WBN / WBK

with loose flanges or with fixed flanges
single hinge version (WFN/WBN) or gimbal hinge version (WFK /WBK)


Type WFN


Type WFK


Type WBN


Type WBK

PN 06

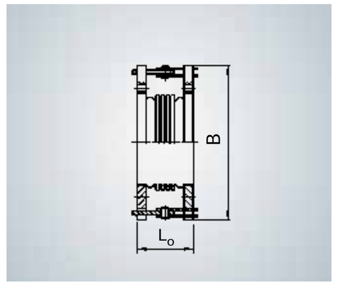
DN	Type WFN 06 ... WFK 06 ... WBN 06 ... WBK 06 ...	Movement Absorption	Overall Length	Weight WFN (approx)	Weight WFK (approx)	Bellows effective cross section	Width	Spring rate (Ambient.temp)		
		Angular							Angular	
		$2\alpha_N$	L_o				B	C_δ	C_λ	C_α
mm (")		mm	mm	kg	kg	cm^2	mm	(Nm/bar)	Nm/°	(Nm/bar°)
250 (10")	.0250.180.0	18	325	65,0	75,00	680	470	7	18	4,2
300 (12")	.0300.160.0	16	295	95,0	115,0	950	560	9	21	5
350 (14")	.0350.140.0	14	340	155,0	190,0	1135	655	20	25	7
400 (16")	.0400.120.0	12	320	160,0	200,0	1470	675	26	30	8,2
450 (18")	.0450.100.0	10	295	195,0	245,0	1850	735	33	36	8,2
500 (20")	.0500.160.0	16	460	235,0	300,0	2285	795	41	104	20,6
600 (24")	.0600.140.0	14	405	295,0	410,0	3270	965	78	152	29,2
650 (26")	.0650.140.0	14	445	305,0	475,0	3805	1010	91	177	34
700 (28")	.0700.120.0	12	445	350,0	515,0	4385	1065	105	160	39,1
750 (30")	.0750.060.0	6	335	375,0	610,0	5005	1135	120	116	28,5
800 (32")	.0800.060.0	6	370	475,0	690,0	5675	1185	136	143	35

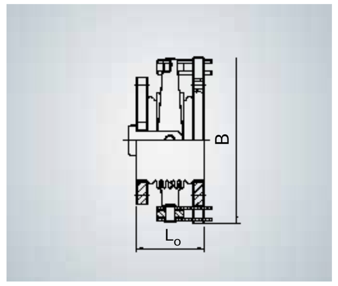
PN 10

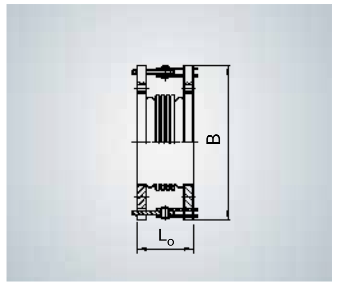
DN	Type WFN 10 ... WFK 10 ... WBN 10 ... WBK 10 ...	Movement Absorption	Overall Length	Weight WFN (approx)	Weight WFK (approx)	Bellows effective cross section	Width	Spring rate (Ambient.temp)		
		Angular							Angular	
		$2\alpha_N$	L_o				B	C_δ	C_λ	C_α
mm (")		mm	mm	kg	kg	cm^2	mm	(Nm/bar)	Nm/°	(Nm/bar°)
250 (10")	.0250.160.0	16	250	100,0	125,0	685	545	12	21	2,8
300 (12")	.0300.100.0	10	245	125,0	155,0	940	595	17	25	3,5
350 (14")	.0350.120.0	12	310	160,0	200,0	1130	655	20	37	6
400 (16")	.0400.120.0	12	305	185,0	235,0	1465	705	26	52	7,4
450 (18")	.0450.140.0	14	365	245,0	320,0	1850	795	33	89	12
500 (20")	.0500.160.0	16	455	325,0	425,0	2275	865	55	222	20,3
600 (24")	.0600.120.0	12	380	320,0	475,0	3255	975	78	160	20,5

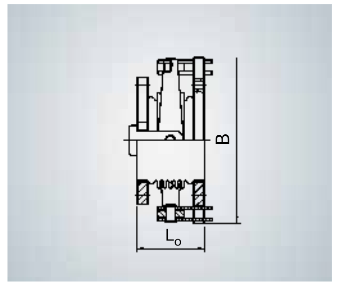
ANGULAR EXPANSION JOINTS TYPE WFN / WFK / WBN / WBK

with loose flanges or with fixed flanges
single hinge version (WFN/WBN) or gimbal hinge version (WFK/WBK)


Type WFN


Type WFK


Type WBN


Type WBK

PN 16

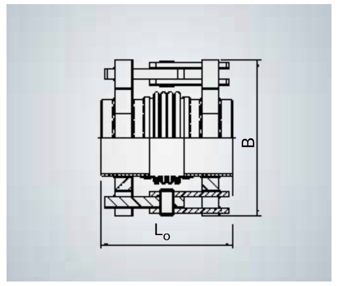
DN	Type WFN 16 ... WFK 16 ... WBN 16 ... WBK 16 ...	Movement Absorption	Overall Length	Weight WFN (approx)	Weight WFK (approx)	Bellows effective cross section	Width	Spring rate (Ambient.temp)		
		Angular							Angular	
		$2\alpha_N$	L_o				B	C_δ	C_λ	C_α
mm (")		mm	mm	kg	kg	cm^2	mm	(Nm/bar)	Nm/°	(Nm/bar°)
250 (10")	.0250.140.0	14	300	105,0	140,0	680	545	12	32	2,9
300 (12")	.0300.140.0	14	340	125,0	175,0	945	595	17	47	4,8
350 (14")	.0350.180.0	18	410	190,0	245,0	1125	695	20	78	7,9

PN 25

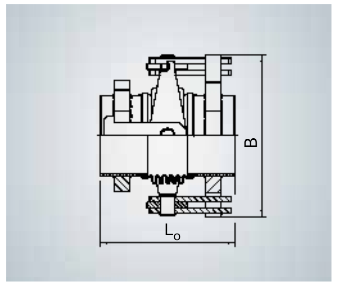
DN	Type WFN 25 ... WFK 25 ... WBN 25 ... WBK 25 ...	Movement Absorption	Overall Length	Weight WFN (approx)	Weight WFK (approx)	Bellows effective cross section	Width	Spring rate (Ambient.temp)		
		Angular							Angular	
		$2\alpha_N$	L_o				B	C_δ	C_λ	C_α
mm (")		mm	mm	kg	kg	cm^2	mm	(Nm/bar)	Nm/°	(Nm/bar°)
250 (10")	.0250.160.0	16	350	115,0	155,0	680	560	12	63	3,9
300 (12")	.0300.140.0	14	330	185,0	260,0	940	665	23	82	4,6
350 (14")	.0350.120.0	12	435	245,0	355,0	1125	745	27	130	8,6

ANGULAR EXPANSION JOINTS TYPE WRN / WRK

with weld ends
single hinge version (WRN) or gimbal hinge version (WRK)



Tipo WRN



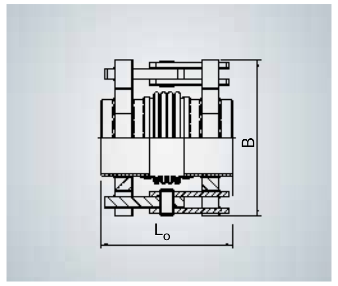
Tipo WRK

PN 06

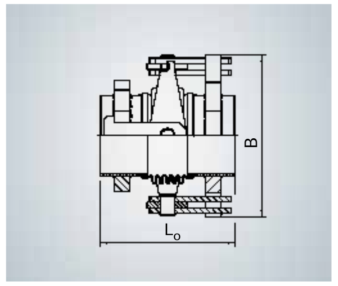
DN	Type WRN 06 ... WRK 06 ...	Movement Absorption	Overall Length	Weight WRN (approx)	Weight WRK (approx)	Bellows effective cross section	Width	Spring rate (Ambient.temp)		
		Angular							Angular	
		$2\alpha_N$	L_o				B	C_δ	C_λ	C_α
mm (")		mm	mm	kg	kg	cm^2	mm	(Nm/bar)	Nm/°	(Nm/bar°)
250 (10")	.0250.180.0	18	650	55	65	680	480	7	18	4,2
300 (12")	.0300.160.0	16	650	75	95	950	540	9	21	5
350 (14")	.0350.140.0	14	650	85	120	1135	580	20	25	7
400 (16")	.0400.120.0	12	650	105	145	1470	640	26	30	8,2
450 (18")	.0450.100.0	10	650	140	195	1850	720	33	36	8,2
500 (20")	.0500.160.0	16	850	170	235	2285	795	41	104	20,6
600 (24")	.0600.140.0	14	850	230	350	3270	905	78	152	29,2
650 (26")	.0650.140.0	14	850	300	460	3805	1015	91	177	34
700 (28")	.0700.120.0	12	900	325	495	4385	1065	105	160	39,1
750 (30")	.0750.060.0	6	800	365	580	5005	1115	120	116	28,5
800 (32")	.0800.060.0	6	850	390	620	5675	1165	136	143	35
900 (36")	.0900.140.0	14	950	540	865	7180	1295	215	665	67,4
1000 (40")	.1000.120.0	12	950	695	1115	8810	1450	264	947	77,7

ANGULAR EXPANSION JOINTS TYPE WRN / WRK

with weld ends
single hinge version (WRN) or gimbal hinge version (WRK)



Tipo WRN



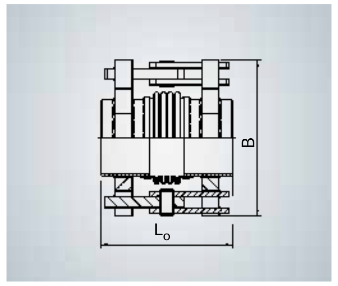
Tipo WRK

PN 10

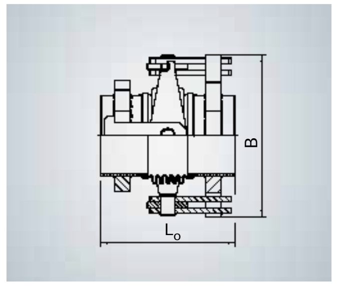
DN	Type WRN 10 ... WRK 10 ...	Movement Absorption	Overall Length	Weight WRN (approx)	Weight WRK (approx)	Bellows effective cross section	Width	Spring rate (Ambient.temp)		
		Angular							Angular	
		$2\alpha_N$	L_o				B	C_δ	C_λ	C_α
mm (")		mm	mm	kg	kg	cm^2	mm	(Nm/bar)	Nm/°	(Nm/bar°)
250 (10")	.0250.160.0	16	600	65	90	685	480	12	21	2,8
300 (12")	.0300.100.0	10	600	85	120	940	540	17	25	3,5
350 (14")	.0350.120.0	12	650	90	130	1130	580	20	37	6
400 (16")	.0400.120.0	12	650	110	165	1465	640	26	52	7,4
450 (18")	.0450.140.0	14	700	145	220	1850	720	33	89	12
500 (20")	.0500.160.0	16	850	190	300	2275	795	55	222	20,3
600 (24")	.0600.120.0	12	750	240	405	3255	905	78	160	20,5
650 (26")	.0650.100.0	10	750	345	570	3790	1015	114	185	23,8
700 (28")	.0700.100.0	10	825	370	615	4380	1065	131	213	29,3

ANGULAR EXPANSION JOINTS
TYPE WRN / WRK

with weld ends
single hinge version (WRN) or gimbal hinge version (WRK)



Tipo WRN



Tipo WRK

PN 16

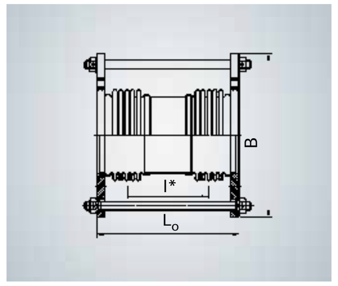
DN	Type WRN 16 ... WRK 16 ...	Movement Absorption	Overall Length	Weight WRN (approx)	Weight WRK (approx)	Bellows effective cross section	Width	Spring rate (Ambient.temp)		
		Angular							Angular	
		$2\alpha_N$	L_o				B	C_δ	C_λ	C_α
mm (")		mm	mm	kg	kg	cm^2	mm	(Nm/bar)	Nm/°	(Nm/bar°)
250 (10")	.0250.140.0	14	600	75	105	680	480	12	32	2,9
300 (12")	.0300.140.0	14	650	115	155	945	585	17	47	4,8
350 (14")	.0350.180.0	18	750	135	195	1125	625	20	78	7,9
400 (16")	.0400.160.0	16	750	175	255	1465	685	35	105	10
450 (18")	.0450.140.0	14	850	235	340	1850	785	44	164	16,7
500 (20")	.0500.120.0	12	850	265	390	2275	845	55	222	20,3

PN 25

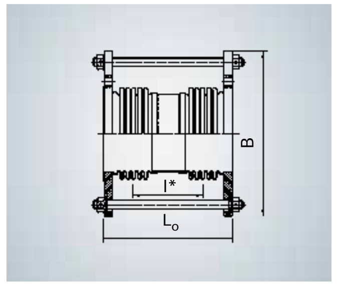
DN	Type WRN 25 ... WRK 25 ...	Movement Absorption	Overall Length	Weight WRN (approx)	Weight WRK (approx)	Bellows effective cross section	Width	Spring rate (Ambient.temp)		
		Angular							Angular	
		$2\alpha_N$	L_o				B	C_δ	C_λ	C_α
mm (")		mm	mm	kg	kg	cm^2	mm	(Nm/bar)	Nm/°	(Nm/bar°)
250 (10")	.0250.160.0	16	650	80	120	680	480	12	63	3,9
300 (12")	.0300.140.0	14	650	135	215	940	585	23	82	4,6
350 (14")	.0350.120.0	12	800	155	250	1125	625	27	130	8,6
400 (16")	.0400.140.0	14	750	195	315	1455	685	44	159	9,3

LATERAL EXPANSION JOINTS
TYPE LFR / LBR

with loose flanges or fixed flanges
for movement in all planes



Type LFR



Type LBR

PN 6

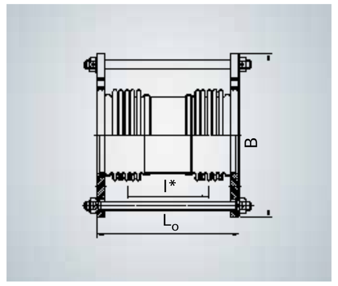
DN	Type LFR 06 ... LBR 06 ...	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Width	Distance between bellows centers	Spring rate (Ambient.temp)		
		Lateral							Lateral	
		$2\lambda_N$	L_o			B	l*	C_δ	C_λ	C_α
mm (")		mm	mm	kg	cm^2	mm	mm	N/bar	N/mm	N/mm bar
250 (10")	.0250.083.0	83	600	115	680	565	392	91,3	28	0
300 (12")	.0300.098.0	98	600	170	950	670	406	160,2	33	0
350 (14")	.0350.090.0	90	650	200	1135	720	417	176,2	33	0
400 (16")	.0400.110.0	110	650	300	1470	820	425	260,6	38	0
450 (18")	.0450.100.0	100	650	285	1850	775	432	287,8	44	0
500 (20")	.0500.090.0	90	810	345	2285	835	507	450	93	0

PN 10

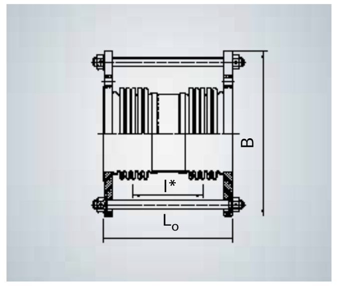
DN	Type LFR 10 ... LBR 10 ...	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Width	Distance between bellows centers	Spring rate (Ambient.temp)		
		Lateral							Lateral	
		$2\lambda_N$	L_o			B	l*	C_δ	C_λ	C_α
mm (")		mm	mm	kg	cm^2	mm	mm	N/bar	N/mm	N/mm bar
250 (10")	.0250.085.0	85	600	120	685	565	430	91,6	30	0
300 (12")	.0300.110.0	110	600	175	940	670	422	158,8	31	0
350 (14")	.0350.116.0	116	650	210	1130	720	432	175,7	45	0
400 (16")	.0400.104.0	104	700	315	1465	820	496	342,8	56	0
450 (18")	.0450.98.0	98	800	310	1855	775	560	329,8	73	0
500 (20")	.0500.100.0	100	900	365	2275	835	613	370,8	149	0

LATERAL EXPANSION JOINTS TYPE LFR / LBR

with loose flanges or fixed flanges
for movement in all planes



Type LFR



Type LBR

PN 16

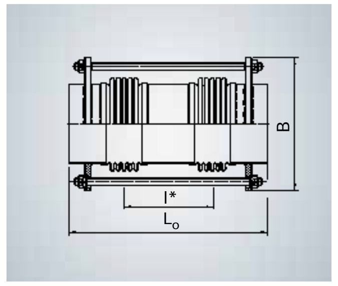
DN	Type LFR 16 ... LBR 16 ...	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Width	Distance between bellows centers	Spring rate (Ambient.temp)		
		Lateral							Lateral	
		$2\lambda_N$	L_o			B	l*	C_δ	C_λ	C_α
mm (")		mm	mm	kg	cm^2	mm	mm	N/bar	N/mm	N/mm bar
250 (10")	.0250.100.0	100	700	505	680	600	485	98,1	36	0
300 (12")	.0300.114.0	114	700	565	945	670	448	140,3	53	0
350 (14")	.0350.106.0	106	750	870	1125	765	459	173,1	83	0

PN 25

DN	Type LFR 25 ... LBR 25...	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Width	Distance between bellows centers	Spring rate (Ambient.temp)		
		Lateral							Lateral	
		$2\lambda_N$	L_o			B	l*	C_δ	C_λ	C_α
mm (")		mm	mm	kg	cm^2	mm	mm	N/bar	N/mm	N/mm bar
250 (10")	.0250.108.0	108	800	545	680	600	559	85,4	52	0
300 (12")	.0300.120.0	120	800	610	940	670	564	118,4	68	0
350 (14")	.0350.106.0	106	950	990	1125	765	660	136,8	75	0

LATERAL EXPANSION JOINTS TYPE LRR

with weld ends
for movements in all planes



Type LRR

PN 06

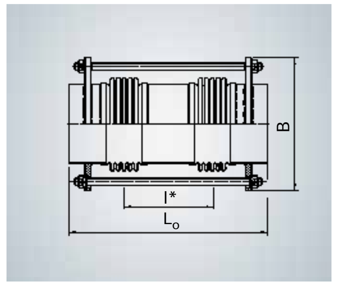
DN	Type LRR 06 ...	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Width	Distance between bellows centers	Spring rate (Ambient.temp)		
		Lateral							Lateral	
		$2\lambda_N$	L_o			B	l*	C_δ	C_λ	C_α
mm (")		mm	mm	kg	cm^2	mm	mm	N/bar	N/mm	N/mm bar
250 (10")	.0250.083.0	83	800	75	680	495	392	67,9	28	0
300 (12")	.0300.098.0	98	800	105	950	575	406	119,7	33	0
350 (14")	.0350.090.0	90	800	110	1135	610	417	142,8	33	0
400 (16")	.0400.110.0	110	850	190	1470	700	425	199,6	38	0
450 (18")	.0450.100.0	100	850	225	1850	685	432	219,4	44	0
500 (20")	.0500.090.0	90	1000	255	2285	740	507	450	93	0

PN 10

DN	Type LRR 10 ...	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Width	Distance between bellows centers	Spring rate (Ambient.temp)		
		Lateral							Lateral	
		$2\lambda_N$	L_o			B	l*	C_δ	C_λ	C_α
mm (")		mm	mm	kg	cm^2	mm	mm	N/bar	N/mm	N/mm bar
250 (10")	.0250.085.0	85	800	80	685	495	430	68,1	30	0
300 (12")	.0300.110.0	110	800	115	940	575	422	118,7	31	0
350 (14")	.0350.116.0	116	800	120	1130	610	432	142,4	45	0
400 (16")	.0400.104.0	104	900	205	1465	700	496	342,8	56	0
450 (18")	.0450.098.0	98	1000	235	1850	685	560	329,8	73	0
500 (20")	.0500.100.0	100	1100	285	2275	740	613	370,8	149	0

LATERAL EXPANSION JOINTS TYPE LRR

with weld ends
for movements in all planes



Type LRR

PN 16

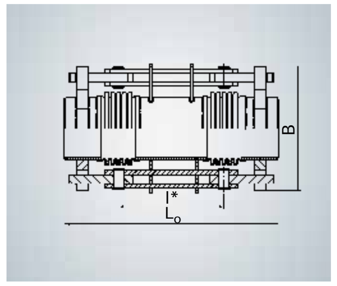
DN mm (")	Type LRR 16 ...	Movement Absorption Lateral 2λ_N mm	Overall Length L_o mm	Weight (approx) kg	Bellows effective cross section cm²	Width B mm	Distance between bellows centers l* mm	Spring rate (Ambient.temp) C_δ N/bar	Spring rate Lateral C_λ N/mm	Spring rate C_α N/mm bar
250 (10")	.0250.100.0	100	900	440	680	495	485	76,1	36	0
300 (12")	.0300.114.0	114	900	495	945	545	448	108,1	53	0
350 (14")	.0350.106.0	106	950	725	1125	610	459	136,8	83	0
400 (16")	.0400.100.0	100	1000	525	1465	630	515	147,4	101	0
450 (18")	.0450.100.0	100	1100	880	1850	720	536	194,1	128	0

PN 25

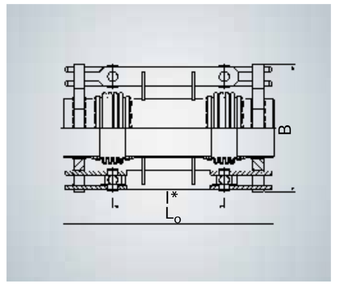
DN mm (")	Type LRR 25 ...	Movement Absorption Lateral 2λ_N mm	Overall Length L_o mm	Weight (approx) kg	Bellows effective cross section cm²	Width B mm	Distance between bellows centers l* mm	Spring rate (Ambient.temp) C_δ N/bar	Spring rate Lateral C_λ N/mm	Spring rate C_α N/mm bar
250 (10")	.0250.108.0	108	1000	475	680	495	559	68,2	52	0
300 (12")	.0300.120.0	120	1000	540	940	545	564	94,5	68	0
350 (14")	.0350.106.0	106	1150	840	1125	720	660	113,1	75	0

LATERAL EXPANSION JOINTS TYPE LRN / LRK

with weld ends
for movement in one plane; for movement in all planes



Type LRN



Type LRK

PN 06

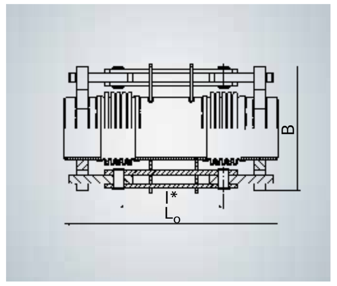
DN mm (")	Type LRN 06 ... LRK 06 ...	Movement Absorption Lateral 2λ_N mm	Overall Length L_o mm	Weight (approx) kg	Bellows effective cross section cm²	Width B mm	Distance between bellows centers l* mm	Spring rate (Ambient.temp) C_δ N/bar	Spring rate Lateral C_λ N/mm	Spring rate C_α N/mm bar
600 (24")	.0600.060.0	60	950	260	280	3270	900	361,4	203	8,1
700 (28")	.0700.080.0	80	1000	335	360	4385	1010	496,1	204	12,5
800 (32")	.0800.070.0	70	1000	420	445	5675	1120	643,6	184	11,2
900 (36")	.0900.066.0	66	1200	645	685	7180	1285	806,5	602	12,1
1000 (40")	.1000.060.0	60	1200	715	760	8810	1395	1012	797	16,4

PN 10

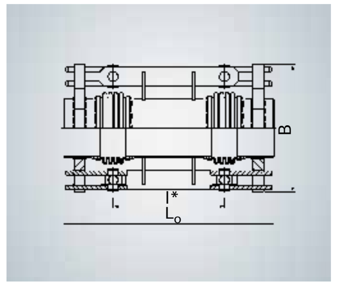
DN mm (")	Type LRN 10 ... LRK 10 ...	Movement Absorption Lateral 2λ_N mm	Overall Length L_o mm	Weight (approx) kg	Bellows effective cross section cm²	Width B mm	Distance between bellows centers l* mm	Spring rate (Ambient.temp) C_δ N/bar	Spring rate Lateral C_λ N/mm	Spring rate C_α N/mm bar
600 (24")	.0600.076.0	76	900	315	340	3255	900	405,5	289	6,8
700 (28")	.0700.080.0	80	1000	485	525	4380	1065	603,7	301	7,6
800 (32")	.0800.080.0	80	1100	560	600	5685	1165	725,3	381	9,3
900 (36")	.0900.080.0	80	1200	750	795	7180	1315	905,9	531	15,9
1000 (40")	.1000.080.0	80	1500	1095	1200	8810	1450	1068	696	10,8

LATERAL EXPANSION JOINTS TYPE LRN / LRK

with weld ends
for movement in one plane; for movement in all planes



Type LRN



Type LRK

PN 25

DN	Type	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Width	Distance between bellows centers	Spring rate (Ambient.temp)		
	LRN 16 ... LRK 16 ...	Lateral							Lateral	
		$2\lambda_N$	L_o			B	l*	C_δ	C_λ	C_α
mm (")		mm	mm	kg	cm²	mm	mm	N/bar	N/mm	N/mm bar
500 (20")	.0500.064.0	64	1000	295	315	2275	790	245,8	284	5,4
600 (24")	.0600.070.0	70	1000	450	490	3245	945	472,8	400	8,1
700 (28")	.0700.066.0	66	1000	575	615	4360	1085	706,9	678	11,5
800 (32")	.0800.080.0	80	1200	835	940	5675	1220	949,7	592	12,3

PN 25

DN	Type	Movement Absorption	Overall Length	Weight (approx)	Bellows effective cross section	Width	Distance between bellows centers	Spring rate (Ambient.temp)		
	LRN 25 ... LRK 25 ...	Lateral							Lateral	
		$2\lambda_N$	L_o			B	l*	C_δ	C_λ	C_α
mm (")		mm	mm	kg	cm²	mm	mm	N/bar	N/mm	N/mm bar
400 (16")	.0400.080.0	80	950	255	275	1455	680	163,9	201	3,0
450 (18")	.0450.080.0	80	1000	390	430	1840	785	258,6	274	3,9
500 (20")	.0500.085.0	85	1050	445	485	2265	845	292,3	288	4,3

ENQUIRY FORM FOR EXPANSION JOINTS

COMPANY /ADDRESS — Enquiry No

CONTACT — Dept. — Tel. — Fax — E-mail

PROJECT — Project-Nr./-Name

ITEM

QUANTITY

TYPE DESIGNATION

NOMINAL DIAM. DN

NOMINAL PRESSURE PN

NOMINAL LENGTH NL

END FITTINGS/TYPE
OR CONNECTION DIMENSIONS

MEDIUM/DESIGNATION

- for acidic concentration — ❑ internal ❑ external
- Additives — ❑ gaseous ❑ liquid
- Condensates — ❑ highly toxic ❑ toxic
- Other — ❑ combustible ❑ caustic
- Flow velocity (m/s) — ❑ ❑

PRESSURE (overpressure) in bar — ❑ internal ❑ external

- Operating pressure: — ❑ constant ❑ intermittent
- Design pressure (if applicable)
- Test pressure

TEMPERATURE in °C — Operating temperature
- Design temperature

MOVEMENT ACCOMMODATION — ❑ axial
- ❑ angular
- ❑ lateral

LOADING CYCLES — ❑ standard = 1,000
- ❑ for drinking water =10,000

VIBRATIONS — Amplitude (mm)
- Frequency (Hz)
- Direction — ❑ axial ❑ radial ❑ all directions

MATERIAL — Bellows
- End fittings

DESIGN REGULATIONS

ACCEPTANCE REGULATIONS/CERTIFICATION

MISCELLANEOUS/REMARKS

Date — Signature — Sheet No.

NOTES

NOTES