Expansion Joint

Ball Joint

Flexible Joint

Expansion Joint Selection

Application: Steam	Air	Water	Oil	Max. Pressure (MPa)	Expansion	Compression	Max. Temperature (˚C)	Model	Type: Bellows	Sleeve	Page
●	●	●	●	0.98	10	25	220	EB-1J	●		274
●	●	●	●		20	50		EB-2J	●		274
●	●	●	●	1.0	40	160		ES-10		●	276
●	●	●	●	2.0				ES-11		●	276
●	●	●	●		10	25		EB-11	●		275
●	●	●	●		20	50		EB-12	●		275
	●	●	●	1.0	10	25	120	EB-31	●		276
	●	●	●		20	50		EB-32	●		276
		●			10-20	10-35	150	EB-51-3	●		276

Ball Joint Selection

Application: Steam	Air	Water	Oil	Max. Pressure (MPa)	Max. Temperature (˚C)	Model	Connection: Screwed	Flanged	Butt-Weld	Page
●	●	●	●	0.98	220	UB-1	●			276
●	●	●	●			UB-2			●	276
●	●	●	●			UB-10		●		276
●	●	●	●			UB-11		●		276
	●	●	●	1.0	80	UB-3	●			276
	●	●	●			UB-13		●		276

Flexible Joint Selection

Application: Steam	Air	Water	Oil	Max. Pressure (MPa)	Max. Temperature (˚C)	Model	Connection: Screwed	Flanged	Page
●	●	●	●	1.0	220	YBF-1E	●		273
●	●	●	●			YBF-2E		●	273

Expansion/Compression of Piping

Piping is susceptible to the ambient temperature and the fluid temperature and varies in length due to expansion or compression.
Or, if a structure or building sinks on soft ground or its piping is subjected to external force, a tensile or compressive load is imposed on the piping.
Piping is not always in the same condition as described above, and it is, therefore, necessary in some situations to pay attention to various factors in designing piping. Expansion joints and displacement absorption joints are used to deal with changes in situations.

Types and Features of Expansion Joint

Applications	・Heating and cooling system / air-conditioning unit / sanitary plumbing for general building utilities ・Cold/hot water supply piping requiring corrosion proof for hygiene reasons (copper piping) ・Specifications for public office	・Main piping of high-rise buildings, district heating and cooling, plants, factories, etc.	・Same as on the left ・Specifications for public office ・Countermeasures against earthquake and ground subsidence
Types	Bellows	Sleeve	Ball
Displacement types	Straight	Straight・Rotation	Angle・Rotation
Heat resistance	Excellent	Excellent	Excellent
Durability	Good	Excellent	Excellent
Pressure resistance	Good	Excellent	Excellent
Expansion/Compression	Small	Large	Arbitral
Reaction force	Large	Medium	Small
Airtightness	Excellent	Excellent	Excellent
Corrosion resistance	Excellent	Excellent	Excellent
Accumulated drain	–	Excellent	Excellent
Maintenance check	Unnecessary	Necessary	Necessary
Major products	 **EB-1J**	 **ES-10-100**	 **UB-1**

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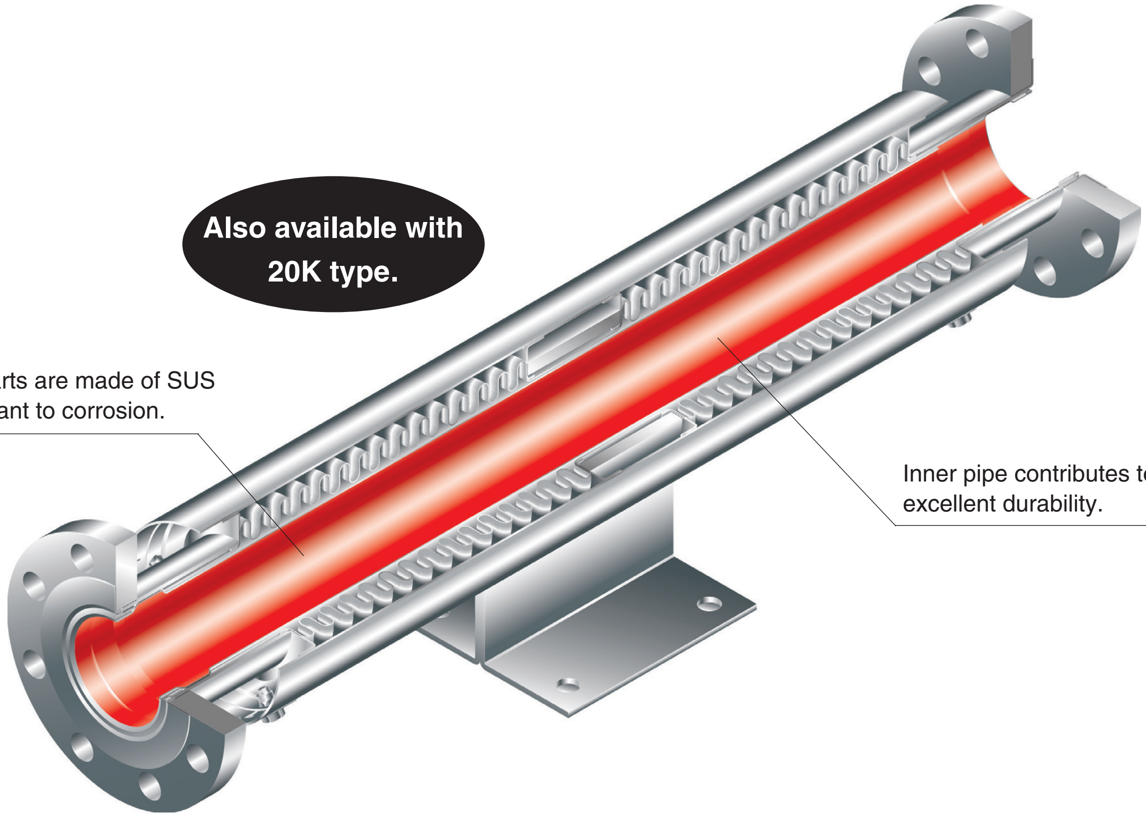
Bellows Type Expansion Joint <EB>

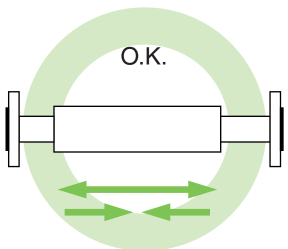
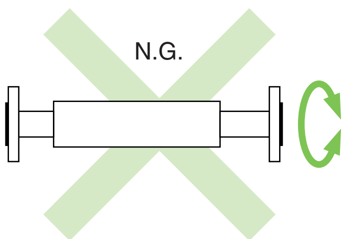
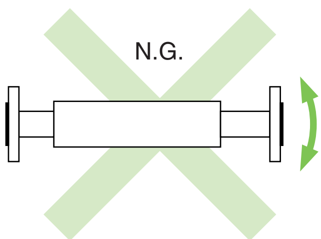
This type of expansion joint is easy to maintain and manage because it does not use any packing.
The EB expansion joint complies with application A of JIS B 2352 Bellows Type Expansion Joints (EB-1J・2J).

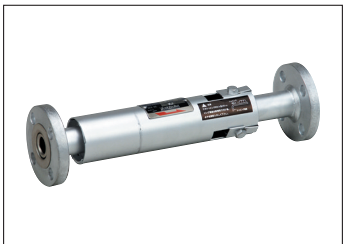


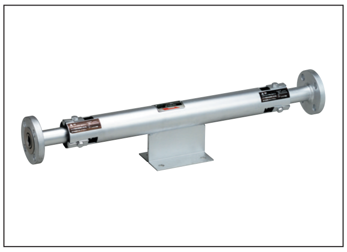
Wetted parts are made of SUS and resistant to corrosion.

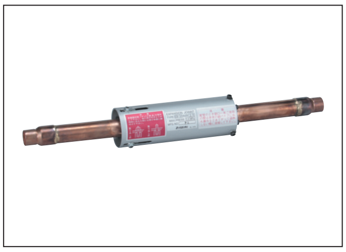
Inner pipe contributes to excellent durability.

● Applicable displacement

Straight	Rotation	Angle
 O.K.	 N.G.	 N.G.

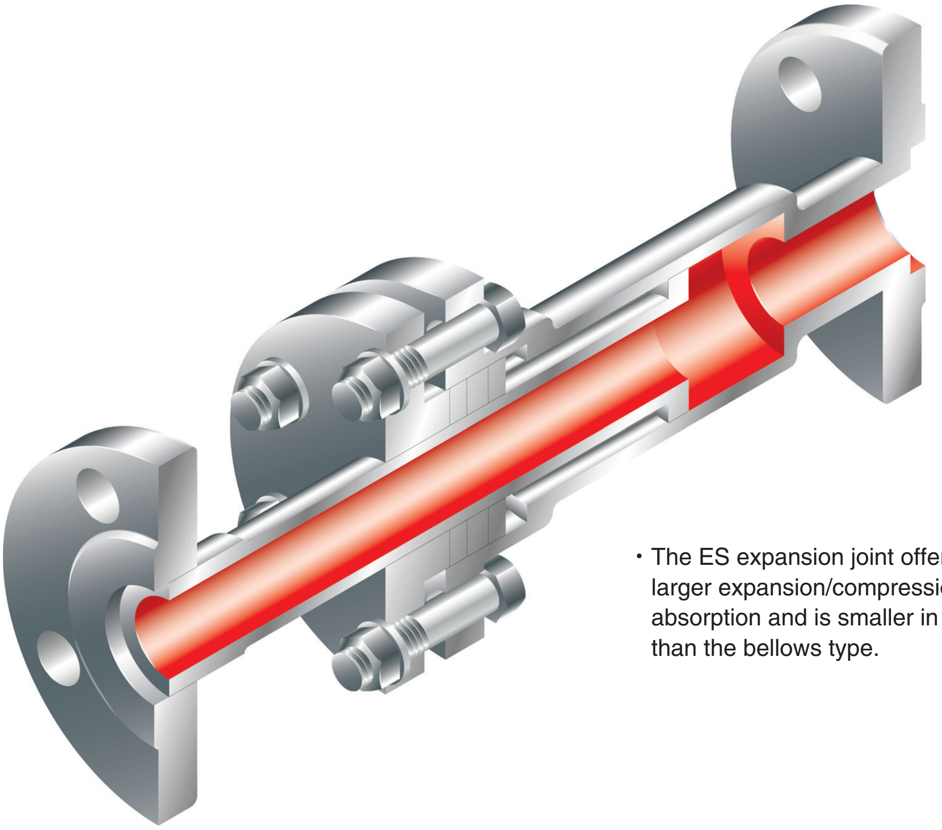

EB-1J


EB-2J


EB-31

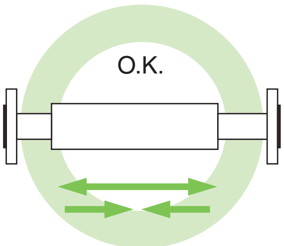
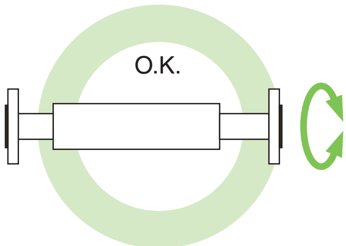
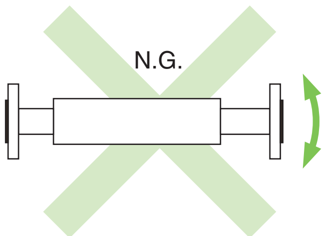
Sleeve Type Expansion Joint

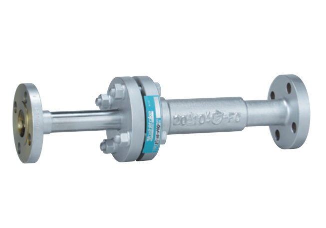
This type of expansion joint is superior to the bellows type in impact resistance.
The ES expansion joint complies with SHASE-S003 Sleeve Type Expansion Joints.



- The ES expansion joint offers a larger expansion/compression absorption and is smaller in size than the bellows type.

● Applicable displacement

Straight	Rotation	Angle
		



ES-10-100

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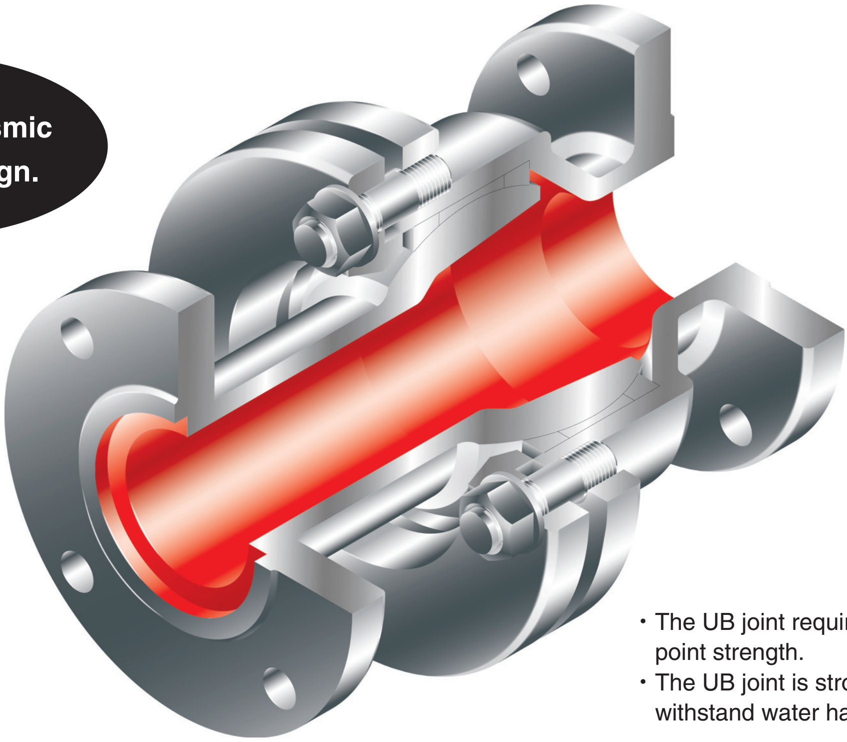
Ball joint <UB>

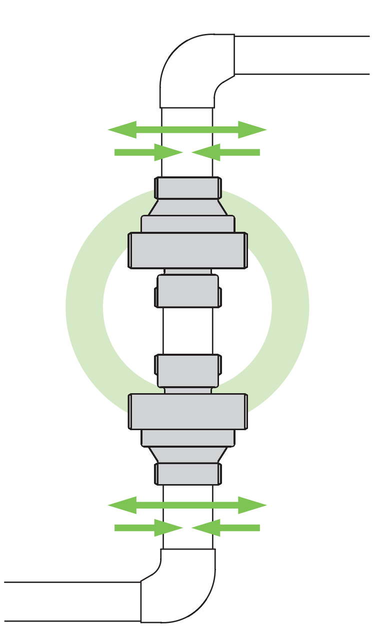
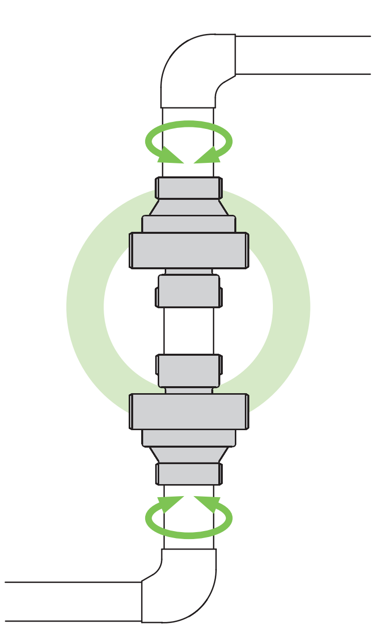
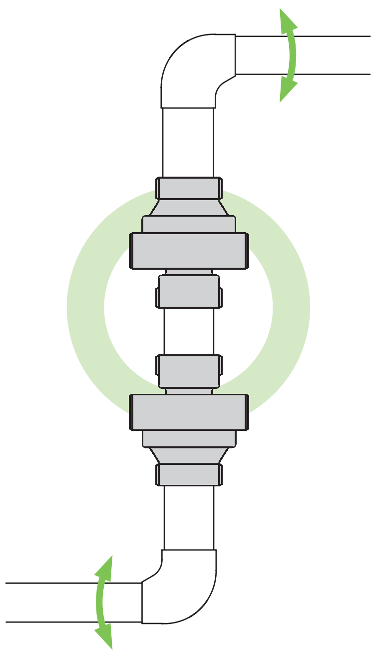
This type of joint is capable of absorbing an axial displacement of piping by combination use of ball joints angular absorption.
The UB joint complies with SHASE-S007 Mechanical Type Displacement Absorption Joints (UB-2・11).

Usable for seismic isolation design.



- The UB joint requires lower fixing point strength.
- The UB joint is strong enough to withstand water hammer, impact, etc.

● Applicable displacement

Straight	Rotation	Angle
O.K.	O.K.	O.K.
		

Expansion Joint

Expansion/Compression Length of Piping

Calculation of Expansion/Compression Length of Piping

Calculate the expansion/compression length of piping based on the temperature condition of the fluid, the ambient temperature in the location where the piping is laid, and the material and length of the piping.

<Calculation formula>

$\Delta\ell = \beta\,(T - t_1)\,\ell$

$\Delta\ell$: Expansion/compression length of piping [mm]
β : Expansion coefficient of piping (See Table-1 and Fig. 1.) [mm/m/˚C]
T : Maximum working temperature [˚C]
t_1 : Minimum working temperature or ambient temperature [˚C]
ℓ : Piping length [m]

<Calculation example>

β = 12.0 x 10^{-3} mm/m/˚C (See Table-1.)
T = 170˚C (saturated steam 0.7 MPa)
t_1 = –20˚C (minimum ambient temperature)
ℓ = 30 m (piping length)

Calculate the expansion/compression length of steel piping under the abovementioned conditions.

$\Delta = \beta\,(T - t_1)$
$= 12.0 \times 10^{-3} \times \{170 - (-20)\} \times 30$
$= 69$ mm

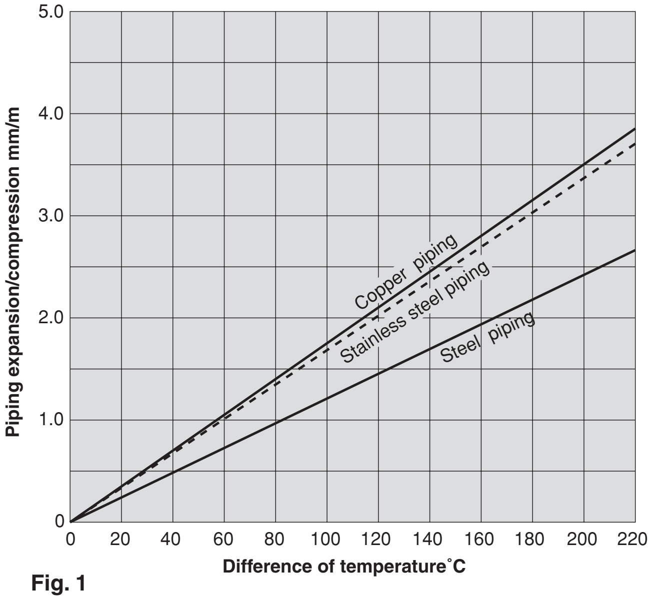


Fig. 1
Expansion/compression length of piping per meter (for 0˚C)

Steel piping β = 12.3 x 10^{-3} mm/m/˚C
Copper piping β = 17.6 x 10^{-3} mm/m/˚C
Stainless steel piping β = 17.3 x 10^{-3} mm/m/˚C

Table-1 Expansion coefficient of steel piping per temperature $\beta = 10^{-3}$ mm/m/˚C

Maximum temperature (˚C) \ Minimum temperature (˚C)	40	30	20	10	0	–10	–20	–30	–40
–30									10.8
–20								10.9	10.8
–10							11.0	10.9	10.9
0						11.0	11.0	10.9	10.9
10					11.1	11.0	11.0	11.0	10.9
20				11.2	11.2	11.1	11.0	11.0	11.0
30			11.5	11.4	11.3	11.2	11.1	11.1	11.1
40		11.6	11.6	11.4	11.4	11.3	11.2	11.2	11.1
50	11.9	11.8	11.7	11.6	11.5	11.4	11.3	11.3	11.2
60	11.9	11.8	11.7	11.6	11.5	11.4	11.4	11.3	11.3

Maximum temperature (˚C) \ Minimum temperature (˚C)	40	30	20	10	0	–10	–20	–30	–40
70	11.9	11.8	11.7	11.7	11.6	11.5	11.4	11.4	11.3
80	12.1	12.0	11.9	11.8	11.7	11.6	11.6	11.5	11.5
90	12.1	12.1	12.0	11.9	11.8	11.7	11.6	11.6	11.5
100	12.1	12.1	12.0	11.9	11.8	11.7	11.6	11.6	11.5
120	12.1	12.1	12.0	11.9	11.9	11.8	11.7	11.7	11.6
140	12.2	12.1	12.1	12.0	11.9	11.9	11.8	11.8	11.7
160	12.3	12.2	12.2	12.1	12.0	12.0	11.9	11.9	11.8
180	12.4	12.3	12.3	12.2	12.2	12.1	12.0	11.9	11.9
200	12.4	12.4	12.3	12.3	12.2	12.2	12.1	12.1	12.0
220	12.6	12.5	12.4	12.4	12.3	12.3	12.2	12.2	12.1

Table-2 Expansion/compression length of steel piping per meter [mm]

Maximum temperature (˚C) \ Minimum temperature (˚C)	40	30	20	10	0	–10	–20	–30	–40
–30									0.108
–20								0.109	0.216
–10							0.110	0.218	0.327
0						0.110	0.220	0.327	0.436
10					0.111	0.220	0.330	0.440	0.545
20				0.112	0.224	0.333	0.440	0.550	0.660
30			0.115	0.228	0.339	0.448	0.555	0.666	0.777
40		0.116	0.232	0.342	0.456	0.565	0.672	0.784	0.888
50	0.119	0.236	0.351	0.464	0.575	0.684	0.791	0.904	1.008
60	0.238	0.354	0.468	0.580	0.690	0.798	0.912	1.017	1.130

Maximum temperature (˚C) \ Minimum temperature (˚C)	40	30	20	10	0	–10	–20	–30	–40
70	0.357	0.472	0.585	0.702	0.812	0.920	1.026	1.140	1.243
80	0.484	0.600	0.714	0.826	0.936	1.044	1.160	1.265	1.380
90	0.605	0.726	0.840	0.952	1.062	1.170	1.276	1.392	1.495
100	0.726	0.847	0.960	1.071	1.180	1.287	1.139	1.508	1.610
120	0.968	1.089	1.200	1.309	1.428	1.534	1.638	1.755	1.856
140	1.220	1.331	1.452	1.560	1.666	1.785	1.888	2.006	2.106
160	1.476	1.586	1.708	1.715	1.920	2.040	2.142	2.261	2.360
180	1.736	1.845	1.968	2.074	2.196	2.299	2.400	2.499	2.618
200	1.984	2.108	2.214	2.337	2.440	2.562	2.662	2.783	2.880
220	2.268	2.375	2.480	2.604	2.706	2.829	2.928	3.050	3.146

・How to read the table: The expansion/compression length of steel piping is 2.196 mm per meter when the temperature changes from 0˚C (minimum temperature) to 180˚C (maximum temperature).

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Selection of Bellows Type (EB) and Sleeve Type (ES) Joints

Selecting a Model and Number of Joints

Select an expansion joint type and a number of joints based on the material and expansion/compression length of piping.

<Calculation formula>

$n = \frac{\Delta\ell}{\delta}$

$\Delta\ell = \Delta K \times \ell$

n : Number of joints [pieces]
δ : Maximum expansion/compression length of joint [mm]
$\Delta\ell$: Expansion/compression length of piping [mm]
ΔK : Expansion/compression length of piping per meter [mm/m]
ℓ : Piping length [m]
Δt : Temperature difference [˚C]

<Selection example>

Piping length (ℓ): 25 m
Maximum working temperature (T): 160˚C
Minimum working temperature (t_1): –10˚C
Ambient Temp. at the time of mounting (t_2): 20˚C
Piping material: Steel piping

<Calculation formula>

1: Calculate the expansion/compression length of the piping.

Temperature difference on the piping's expansion side:

$\Delta t_1 = T - t_2 = 160 - 20 = 140$ [˚C]

Temperature difference on the piping's compression side:

$\Delta t_2 = t_2 - t_1 = 20 - (-10) = 30$ [˚C]

From Table-2:

Expansion length of the steel piping per meter:

$\Delta K_1 = 1.708$ [mm/m]

Compression length of the steel piping per meter:

$\Delta K_2 = 0.333$ [mm/m]

Consequently:

Expansion of the 25-meter-long steel piping:

$\Delta\ell_1 = \Delta K_1 \times \ell = 1.708 \times 25 = 42.7$ [mm]

Compression of the 25-meter-long steel piping:

$\Delta\ell_2 = \Delta K_2 \times \ell = 0.333 \times 25 = 8.3$ [mm]

2: Determine a joint type, and calculate the number of joints (pieces).

Assuming that the joint type is the EB-1J
(expansion: 10 mm, compression: 25 mm):

Piping's expansion side: $n_1 = \frac{\Delta\ell_1}{\delta} = \frac{42.7}{25} = 1.70$ (pieces)

Piping's compression side:

$n_2 = \frac{\Delta\ell_2}{\delta} = \frac{8.3}{10} = 0.83$ (piece)

Determine the number of joints based on n_1 or n_2, whichever is larger. In this case, the number of joint is two. Under the abovementioned conditions, two EB-1J joints are required.

Adjusting the Face-to-face Dimension

An expansion joint compresses or expands to absorb the expansion or compression of piping.
Before mounting an expansion joint, calculate the mounting face-to-face dimension from the air temperature at the time of mounting, the working temperature range, and the maximum expansion/compression length of the joint, and properly adjust it.

<Calculation formula>

$Ls = L_1 - \delta \frac{t_2 - t_1}{T - t_1}$

Ls : Mounting face-to-face dimension [mm]
L_1 : Maximum face-to-face dimension [mm]
δ : Maximum expansion/compression length of joint [mm]
T : Maximum working temperature [˚C]
t_1 : Minimum working temperature [˚C]
t_2 : Ambient temperature at the time of mounting [˚C]

<Calculation example>

$L_1 = 415 + 10 = 425$ mm (maximum face-to-face dimension of the EB-1J 80A joint)

$\delta = 35$ mm (maximum expansion/compression length of the EB-1J 80A joint): See page 274.

T = 170˚C (saturated steam: 0.7 MPa)

t_1 = –20˚C (minimum working temperature)

t_2 = 20˚C (ambient temperature at the time of mounting)

Calculate the mounting face-to-face dimension under the abovementioned conditions.

$Ls = L_1 - \delta \frac{t_2 - t_1}{T - t_1} = 425 - 35 \times \frac{20 - (-20)}{170 - (-20)} = 417.6$ mm

Guidelines for Expansion Joints EB and ES Series

Precautions during Installation

- The expansion/compression of piping depends significantly on temperature. To ensure satisfactory results, use the expansion joints within the maximum expansion/compression length.
- The joint is fastened with shipping bolts and shipping washers to maintain the face-to-face distance during transportation or installation. Remove all of them after piping connection (anchoring point and guide installation work).
- Secure anchoring points (anchors) and guides are required to make full use of the function of the joint connected to piping.
  1. Use a main anchor at both ends of each straight piping portion, each bent piping portion, each branch point, and the location where a valve is installed.
  2. When two or more single type joints are used between main anchors, set an intermediate anchor between each pair of joints.
  3. Use main and intermediate anchors strong enough to withstand the load to be applied.
  4. Align the piping to enable the joints to properly expand or compress. Install guides for the purpose of protecting the joints from the weight of the piping or a bending load. Position the first guide close to a joint.
  5. Mount a main anchor whenever the piping diameter changes due to a reducer.
- Using a sufficient number of anchors and guides is important not only for guiding the piping to absorb its expansion or compression with the joints, but also for preventing piping bending or buckling or joint damage. Check where anchors and guides should be set, and mount them according to the correct procedure.

Mounting Anchoring Points (Anchors) and Guides

<What must be considered>

1. Precautions when mounting anchors
2. The strength of anchors
3. Mounting guides

Using a sufficient number of anchors and guides is important not only for guiding the piping to absorb its expansion or compression with the joints, but also for preventing piping bending or buckling or joint damage.

1. Precautions when mounting anchors

1) Use an anchor at both ends of each straight piping portion, each bent piping point, each branch point, and the location where a valve is installed.
2) When two or more single type joints are used between main anchors, set an intermediate anchor between each pair of joints.
3) Mount a main anchor whenever the piping diameter changes due to a reducer.
4) The anchor base of double type joint functions as an intermediate anchor. Fix the anchor of the joint.
5) Use main and intermediate anchors strong enough to withstand the load to be applied.

2. The strength of anchors

1) Anchor for straight piping portion
Mount a main anchor at both ends of the piping, each branch point, and the location where a reducer or valve is installed. These main anchors need to be strong enough to withstand the force required to stretch or contract the bellows or sleeve plus the internal pressure thrust resulting from the effect of the internal fluid pressure.
2) Main anchor for bent piping point
Mount a main anchor at each point where the piping changes its direction.
The thrust works in two different directions and becomes a resultant vector of two thrusts. Additionally, when the fluid is highly viscous and flows at high velocity, a thrust produced by centrifugal force resulting from fluid movement.
3) Intermediate anchor
An intermediate anchor is required when two or more joints are mounted between main anchors. Intermediate anchors are strong enough to withstand the force required to stretch or contract the bellows or sleeve, the frictional force of pipe guides, and other loads.

<EB>

$$Fm = Fp + Fs = A \times 100P + \omega \ell$$

<ES>

$$Fm = Fp + Fs = A \times 100P + \mu$$

Fm : Axial direction thrust [N]
Fp : Internal pressure thrust [N]
Fs : Force required to push joint [N]
A : Effective area of joint (See Table-3・4.) [cm^2]
P : Pressure [MPa]
ω : Spring constant of bellows (See Table-3.) [N/mm]
ℓ : Expansion/compression length [mm]
μ : Frictional force of joint (See Table-4.) [N]

<Calculation formula>

$$Fb = 2\,Fm \sin\frac{\theta}{2} + Fc$$

$$Fc = \frac{2A\rho V^2}{\delta}\sin\frac{\theta}{2} \times 9.8$$

Fb : Thrust of main anchor at bent piping point [N]
θ : Bending angle of piping [°]
Fc : Thrust by flowing centrifugal force of fluid [N]
V : Velocity of fluid [cm/sec]
ρ : Density of fluid [kg/cm^3]
g : Gravitational acceleration [cm/sec^2]
A : Effective area of joint (See Table-3・4.) [cm^2]

<Calculation formula>

$$Fi = Fs$$

Fi : Thrust of intermediate anchor [N]

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Guidelines for Expansion Joints EB and ES Series

<Calculation example>

Nominal size of piping: 80A

Joint: EB-1J

= 25 mm (expansion/compression length)

A = 77 cm² (effective area of joint: See Table-3.)

ω = 75 N/mm
(spring constant of bellows: See Table-3.)

Fluid: 0.7 MPa saturated steam

Test pressure = 1.0 MPa

Calculate the load to be imposed on each anchor under the conditions shown on the left.

Main anchor for straight piping portion:

$$Fm = A \times 100\,P + \omega\ell$$
$$= 77 \times 100 \times 1.0 + 75 \times 25$$
$$= 9575\ \text{N}$$

Main anchor for bent piping point:

$$Fb = 2\,Fm \sin\frac{\theta}{2} + Fc$$
$$= 2 \times 9575 \times \sin\frac{90^\circ}{2} = 13541\ \text{N}$$

However, $\theta = 90^\circ$, and the value of Fc is disregarded because it is small.

Intermediate anchor: Fi = $\omega\ell$ = 75 x 25 = 1875 N

(Note) Use the test pressure for the value of the pressure P for calculating the loads Fm and Fb to be applied to the main anchors for straight and bent piping portions. In the case of vertical piping, anchors will also be subjected to the piping and fluid weights.

Table-3 Load to be applied to the main anchors for straight piping portions (EB type)

● EB-1J・2J・11・12

Force \ Nominal size		20A	25A	32A	40A	50A	65A	80A	100A	125A	150A	200A	250A
Spring constant ω N/mm		58	58	78	70	66	70	75	143	167	229	306	766
Effective area A cm²		10	10	16	21	36	54	77	117	196	275	441	638
Internal pressure thrust FpN	Internal pressure 0.2 MPa	200	200	320	420	720	1080	1540	2340	3920	5500	8820	12760
	0.4 MPa	400	400	640	840	1440	2160	3080	4680	7840	11000	17640	25520
	0.6 MPa	600	600	960	1260	2160	3240	4620	7020	11760	16500	26460	38280
	0.8 MPa	800	800	1280	1680	2880	4320	6160	9360	15680	22000	35280	51040
	1.0 MPa	1000	1000	1600	2100	3600	5400	7700	11700	19600	27500	44100	63800
Axial direction thrust at max. compression of 25 mm Fs N		1450	1450	1950	1750	1650	1750	1875	3575	4175	5725	7650	19150

● EB-31・32

Force \ Nominal size		20A	25A	32A	40A	50A	65A	80A
Spring constant ω N/mm		23.0	23.0	24.1	24.6	24.3	46.0	74.0
Effective area A cm²		8.84	8.84	14.7	19.4	30.8	47.8	67.9
Internal pressure thrust FpN	Internal pressure 0.2 MPa	177	177	294	388	616	956	1358
	0.3 MPa	266	266	441	582	924	1434	2037
	0.5 MPa	442	442	735	970	1540	2390	3395
	0.7 MPa	619	619	1029	1358	2156	3346	4753
Axial direction thrust at max. compression of 25 mm Fs N		575	575	603	615	608	1150	1850

Table-4 Load to be applied to the main anchors for straight piping portions (ES type)

● ES-10-100, ES-11-100, ES-10-200, ES-11-200

Force \ Nominal size		20A	25A	32A	40A	50A	65A	80A	100A	125A	150A	200A	250A	300A
Effective area A cm²		5.8	9.1	13.9	18.1	28.3	45.3	62.2	102.0	151.7	213.7	366.0	560.0	793.8
Internal pressure thrust FpN	Internal pressure 0.2 MPa	116	182	278	362	566	906	1244	2040	3034	4274	7320	11200	15876
	0.4 MPa	232	364	556	724	1132	1812	2488	4080	6068	8548	14640	22400	31752
	0.6 MPa	348	546	834	1086	1698	2718	3732	6120	9102	12822	21960	33600	47628
	0.8 MPa	464	728	1112	1448	2264	3624	4976	8160	12136	17096	29280	44800	63504
	1.0 MPa	580	910	1390	1810	2830	4530	6220	10200	15170	21370	36600	56000	79380
Frictional force Fs N		2100	2300	2500	3300	4000	5100	6200	7520	9400	11300	14800	18400	22000

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Guidelines for Expansion Joints EB and ES Series

3. Mounting guides

To enable joints to properly expand or compress, align piping and use guides for the purpose of protecting the joints from the piping's center of gravity or bending load. Mount the first and second guides so that the interval to the former (L_1) and that to the latter (L_2) will not exceed the values calculated from the calculation formulas shown below. The interval from the second guide to an intermediate guide (L_3) can be found on Fig. 3.

・Bellows type (EB)

Keep the misalignment of 20A to 125A piping within ±2 mm and that of 150A and larger piping within ±3 mm. Adjust the parallelism of 20A to 200A piping to ±1.5° or less and that of 250A piping to ±2° or less.

・Sleeve type (ES)

Keep the misalignment of 125A and smaller piping within ±2 mm and that of 150A and larger piping within ±3 mm. Adjust the parallelism of piping to ±0.5° or less.

<Calculation formula>

$L_1 \leqq 4D$

$L_2 \leqq 14D$

L_1 : Interval from joint to first guide
L_2 : Interval from first guide to second guide
L_3 : Interval from second guide to intermediate guide
D : Outside diameter of piping [mm]

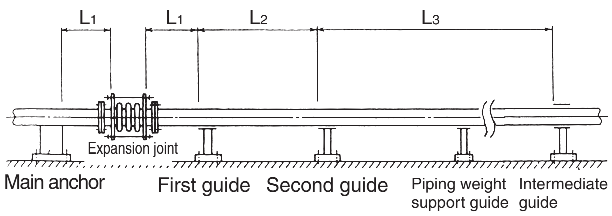


Fig. 2 Layout of guides

・Mounting piping weight support guides

Mount a roller support, hanger, etc. to prevent piping from bending under its weight or the weight of the fluid.

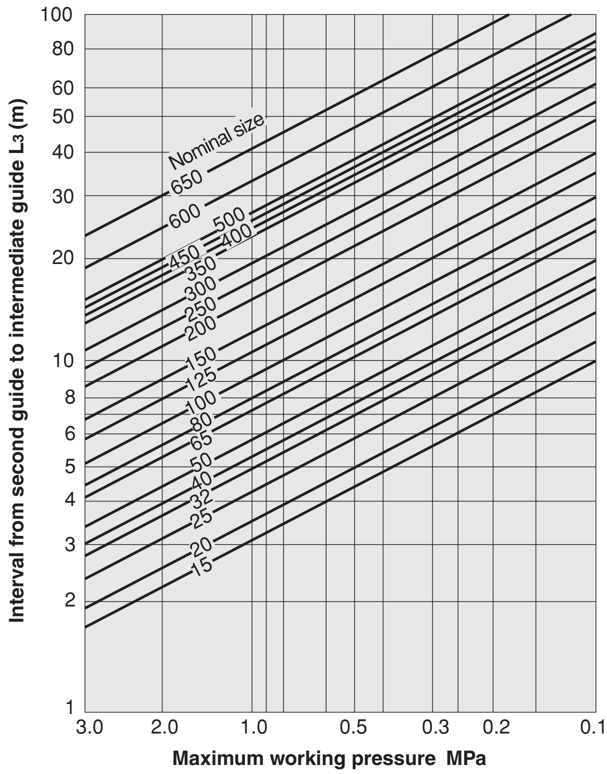
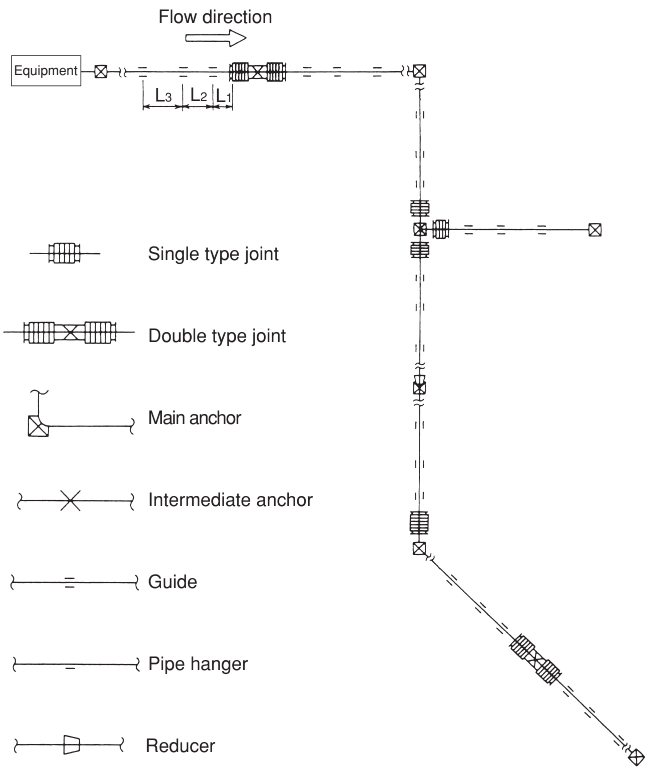


Fig. 3 Maximum interval to intermediate guide



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Selection of Ball Type UB-1・2・10・11 Joints

Consider the following points in selecting and installing the UB-1・2・10・11 joints:

- Determining the distance between joints
- Determining the positions for installing joints
- Calculating piping deflection and the minimum distance to the first guide
- Absorbing piping deflection
- The strength of anchors and guides

Determining the Distance between Joints

The axial direction displacement that the UB joints can absorb is determined by the distance between joints, and the relational formula shown below is established between the amount of the axial direction displacement and the distance.

<Calculation formula>

In the case of Fig. 4 (a)

$$\ell = \alpha \times \frac{\delta}{2 \times \sin(\theta/2)}$$

In the case of Fig. 4 (b)

$$\ell = \alpha \times \frac{\delta}{\sin(\theta/2)}$$

ℓ : Distance between joints [mm]
α : Safety factor (1.5 or more)
θ : Displacement angle [°]
δ : Displacement [mm]

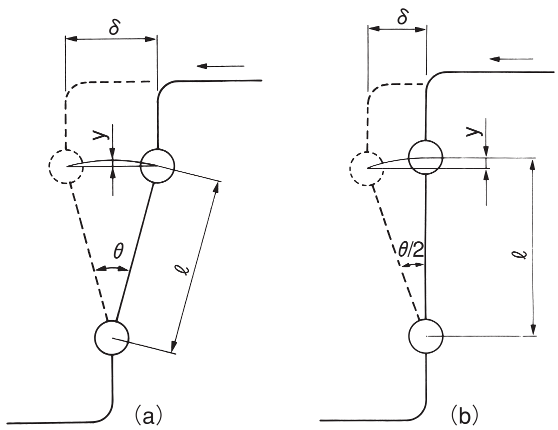

Fig. 4 Displacement of the UB joint (a)(b)

<Calculation formula>

$\theta = 20^\circ$ (displacement angle of the UB joint),
$\delta = 69$ mm (displacement)

Calculate the distance between the joints in Fig. 4 (a) under the abovementioned conditions.

$$\ell = \alpha \times \frac{\delta}{2 \times \sin(\theta/2)} = 1.5 \times \frac{69}{2 \times \sin 10^\circ}$$

= 299 mm or more

Determining the Positions for Installing Joints

The expansion or compression is absorbed by the displacement of joints. Before installing joints, adjust it with the ambient temperature at the time of installing, the working temperature range, and other factors taken into account.
When mounting the UB joints, secure space for the joint's displacement.

<Calculation formula>

$$\delta o = \left(\frac{1}{2} - \frac{t_2 - t_1}{T - t_1}\right)\delta$$

δo : Distance to position for installing the UB joint [mm]
T : Maximum working temperature [˚C]
t_1 : Minimum working temperature [˚C]
t_2 : Ambient temperature at the time of installing [˚C]
δ : Axial direction displacement of piping [mm]

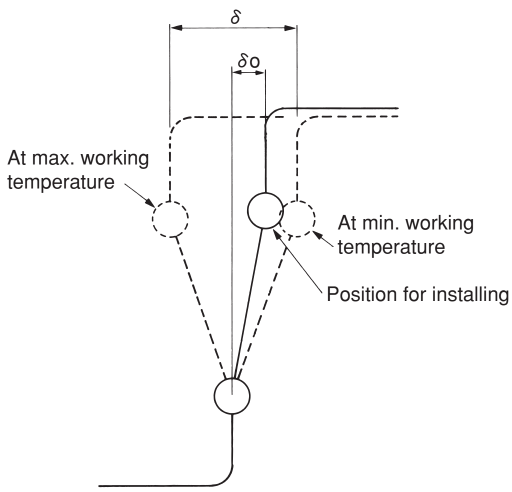

Fig. 5 Position for installing the UB joint

<Calculation example>

T = 170˚C (saturated steam: 0.7 MPa)
t_1 = –20˚C (minimum working temperature)
t_2 = 20˚C (ambient temperature at the time of installing)
δ = 69 mm (axial direction displacement of piping)

Calculate the position for installing joints under the abovementioned conditions.

$$\delta o = \left(\frac{1}{2} - \frac{t_2 - t_1}{T - t_1}\right)\delta$$

$$= \left\{\frac{1}{2} - \frac{20-(-20)}{170-(-20)}\right\} \times 69 = 20 \text{ mm}$$

Selection of Ball Type UB-1・2・10・11 Joints

Calculating Piping Deflection and the Minimum Distance to the First Guide

When two UB joints are used, the joints move in an arc and, as a result, cause deflection as given by the following formula to the piping.

<Calculation formula>

y : Deflection of piping [mm]
ℓ : Distance between joints [mm]
δ : Displacement of piping [mm]

In the case of Fig. 4 (a)

$$y = \ell - \sqrt{\ell^2 - \left(\frac{\delta}{2}\right)^2}$$

In the case of Fig. 4 (b)

$$y = \ell - \sqrt{\ell^2 - \delta^2}$$

If the deflection of the piping exceeds a given limit, the degree of bending stress increases, which may result in a dangerous situation. The distance to the first guide must be longer than the value derived from the formula shown below.
The piping does not deflect when three or more UB joints are used. Place the first guide close to a joint.

<Calculation formula>

$$\chi = \alpha \sqrt{\frac{3EDy}{2\sigma}}$$

χ : Minimum distance to first guide [mm]
α : Safety factor (2 or more)
σ : Permissible stress of piping
(σ = 70 N/mm² in the case of steel piping) [N/mm²]
E : Vertical elastic coefficient of piping (E = 21.0 x 10^4 N/mm² in the case of steel piping) [N/mm²]
D : Outside diameter of piping [mm]
y : Deflection of piping [mm]

<Calculation formula>

ℓ = 303 mm (distance between joints)
δ = 69 mm (displacement of piping)
σ = 70 N/mm² (permissible stress of steel piping)
E = 21.0 x 10^4 N/mm² (vertical elastic coefficient of steel piping)
D = 89.1 mm (outside diameter of 80A SGP piping)

Calculate the distance to the first guide in the case of Fig. 4 (a) under the abovementioned conditions.

$$y = \ell - \sqrt{\ell^2 - \left(\frac{\delta}{2}\right)^2} = 303 - \sqrt{303^2 - \left(\frac{69}{2}\right)^2} = 2 \text{ mm}$$

$$\chi = \alpha \sqrt{\frac{3EDy}{2\sigma}} = 2 \times \sqrt{\frac{3 \times 21.0 \times 10^4 \times 89.1 \times 2}{2 \times 70}} = 1791 \text{ mm or more}$$

Absorbing Piping Deflection

The deflection of piping caused when two UB joints are used can be absorbed by using a third one. Three joints can also absorb expansion or compression in two directions and three-dimensional displacement. In this case, the distance between each pair of joints can be calculated in the same manner as when two joints are used. However, calculate that distance based on the maximum displacement (safety factor: 3 or more), and mount the joints at equal intervals.

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Selection of the UB-1・2・10・11 Joints

The Strength of Anchoring Points and Guides

When joints are used to absorb the displacement of piping, reaction force is generated at the anchors and the guides by the running torque of the joints as shown in Fig. 6 to Fig. 9. These anchors and guides are required to be strong enough to withstand this reaction force.

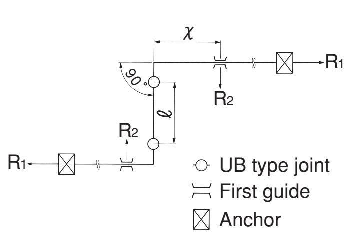


Fig. 6
Connection of the UB type joints, anchoring points and guides (1)

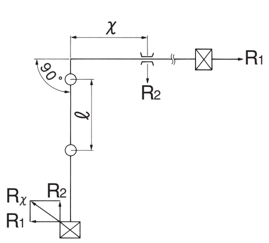


Fig. 7
Connection of the UB type joints, anchoring points and guides (2)

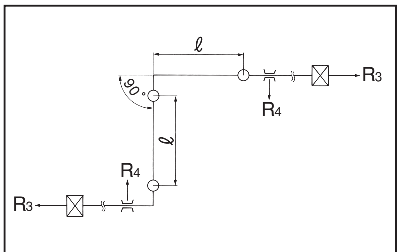


Fig. 8
Connection of the UB type joints, anchoring points and guides (3)

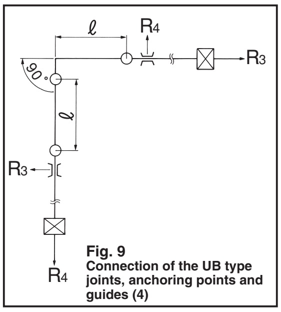


Fig. 9
Connection of the UB type joints, anchoring points and guides (4)

<Calculation formula>

$$R_1 = \frac{2T \times 1000}{\ell}$$

$$R_2 = \frac{3EIy}{\chi^3}$$

$$R_3 = \frac{2T \times 1000}{\ell}$$

$$R_4 = \frac{2T \times 1000}{\ell}$$

$$R_\chi = \sqrt{R_1^2 + R_2^2}$$

R : Load imposed on anchor and guide [N]
T : Running torque of the UB joint (See Fig. 10.) [N・m]
ℓ : Distance between the UB joints [mm]
χ : Distance between bent piping point and first guide [mm]
E : Vertical elastic coefficient of piping
(E = 21.0×10^4 N/mm² in the case of steel piping) [N/mm²]
I : Moment of inertia of piping cross section [mm⁴]
$I = \frac{\pi}{64}(D^4 - d^4)$
D : Outside diameter of piping (mm)
d : Inside diameter of piping (mm)
y : Deflection of piping [mm]

<Calculation example>

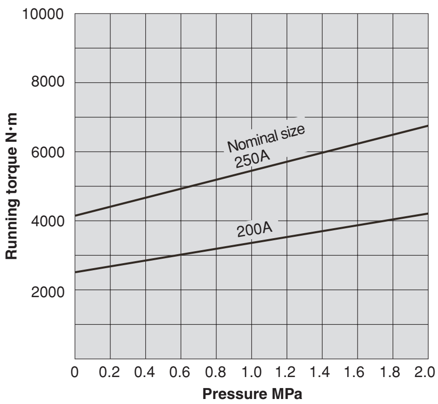
Nominal size of piping: 80A
Joint: UB-10

Fluid: 0.7 MPa saturated steam
Calculate the load to be imposed on the anchors and the guides in the case of Fig. 6 under the abovementioned conditions.

T = 410 N・m (running torque of joint: See Fig. 10.)
ℓ = 303 mm (distance between joints)
χ = 1791 mm
E = 21.0×10^4 N/mm² (vertical elastic coefficient of steel piping)
I = 101.185×10^4 mm⁴ (moment of inertia of SGP 80A piping)
y = 2 mm (deflection of piping)

$$R_1 = \frac{2T \times 1000}{\ell} = \frac{2 \times 410 \times 1000}{303} = 2710 \text{ N}$$

$$R_2 = \frac{3EIy}{\chi^3} = \frac{3 \times 21.0 \times 10^4 \times 101.185 \times 10^4 \times 2}{1791^3} = 230 \text{ N}$$



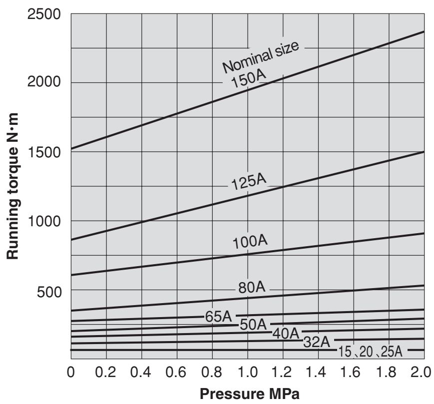


Fig. 10 Running torque of UB joint

Install guides for buckling prevention and piping weight support guides in the same manner as the EB and ES joints. Use a guide that can slide between the UB joints because of piping displacement.

Selection of the UB-3・13 Joints

Consider the following points in selecting and installing the UB-3・13 joints:

- Determining the distance between joints
- Calculating the displacement of the UB-3・13 joints
- The strength of anchors and guides

Determining the Distance between Joints

Calculate the distance between joints in the same manner as the UB joints.

Calculating the Displacement of the UB-3・13 Joints

The distance between joints changes with the displacement of a joint in piping shown in Fig. 11. The relational formula shown below is established between the distance and the displacement. Make sure that the displacement of the distance between joints calculated from the formula can be absorbed by joints.

<Calculation formula>

$$y = \ell - \sqrt{\ell^2 - \delta^2}$$

y : Displacement of distance between joints [mm]
ℓ : Distance between joints before displacement [mm]
δ : Displacement of piping [mm]

The Strength of Anchors and Guides

In case of piping displacement due to an earthquake or uneven settlement, reaction force is generated at the anchors and the guides as shown in Fig. 11. Anchors and guides that are strong enough to withstand this reaction force are thus required. Mount an anchor and the first guide close to a joint. Additionally, mount guides for buckling prevention and piping weight support guides in the same manner as the EB and ES joints.

<Calculation formula>

$$R_1 = A \times 100\,P + 2\mu$$

$$R_2 = \frac{2\,T \times 1000}{\ell}$$

$$R_x = \sqrt{R_1^2 + R_2^2}$$

R : Load imposed on anchor and guide [N]
A : Effective area of joint (See Table-5.) [cm²]
P : Pressure [MPa]
μ : Frictional force of joint (See Table-5.) [N]
T : Running torque of UB joint (See Fig. 12.) [N・m]
ℓ : Distance between UB joints before displacement [mm]

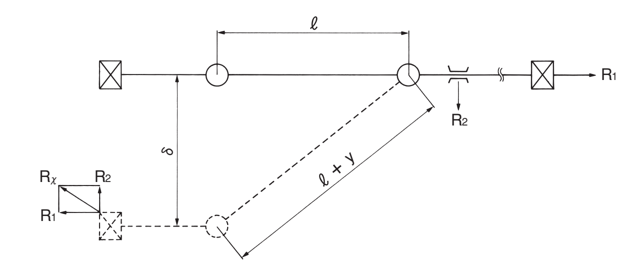


Fig. 11 Displacement of the UB-3・13 joints

<Calculation example>

ℓ = 400 mm (distance between joints before displacement)
δ = 100 mm (displacement of piping)
Joint: UB-13 80A
Calculate the displacement of the distance between joints under the abovementioned conditions.

$y = \ell - \sqrt{\ell^2 - \delta^2} = 400 - \sqrt{400^2 - 100^2} = 13$ mm

The expansion/compression length of the UB-13 80A joint is within 40 mm.

<Calculation example>

Nominal size of piping: 80A
T = 400 N・m (running torque of joint: See Fig. 12.)
Joint: UB-13
ℓ = 400 mm (distance between joints before displacement)
A = 68.4 cm² (effective area of joint: See Table-5.)
Fluid: 0.3 MPa water
μ = 6550 N (frictional force of joint: See Table-5.)
Test pressure: 1.0 MPa
Calculate the load to be imposed on the anchors and the guides under the abovementioned conditions.

$R_1 = A \times 100P + 2\mu = 68.4 \times 100 \times 1.0 + 2 \times 6550 = 19940$ N

$$R_2 = \frac{2T \times 1000}{\ell} = \frac{2 \times 400 \times 1000}{400} = 2000 \text{ N}$$

$R_x = \sqrt{R_1^2 + R_2^2} = \sqrt{19940^2 + 2000^2} = 20040$ N

(Note) Use the test pressure for the value of the pressure P for calculating the load to be applied to the anchors. In the case of vertical piping, the anchors will also be subjected to the piping and fluid weights.

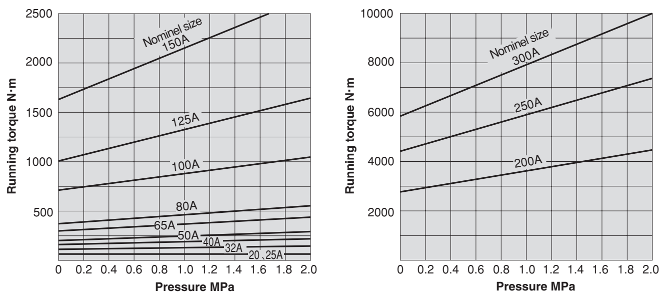


Fig. 12 Running torque of the UB-3・13 joints

Table-5 Load imposed on anchor (UB-3・13)

Force \ Nominal size		20A	25A	32A	40A	50A	65A	80A	100A	125A	150A	200A	250A	300A
Effective area A cm²		6.7	10.2	15.5	20.0	31.1	49.8	68.4	112.0	167.0	235.0	403.0	616.0	873.0
Internal pressure thrust N (Internal pressure)	0.2 MPa	134	204	310	400	622	996	1368	2240	3340	4700	8060	12320	17460
	0.4 MPa	268	408	620	800	1244	1992	2736	4480	6680	9400	16120	24640	34920
	0.6 MPa	402	612	930	1200	1866	2988	4104	6720	10020	14100	24180	36960	52380
	0.8 MPa	536	816	1240	1600	2488	3984	5472	8960	13360	18800	32240	49280	69840
	1.0 MPa	670	1020	1550	2000	3110	4980	6840	11200	16700	23500	40300	61600	87300
Frictional force Fs N		2250	2440	2650	3500	4240	5400	6550	7980	9960	11950	14900	18500	22300

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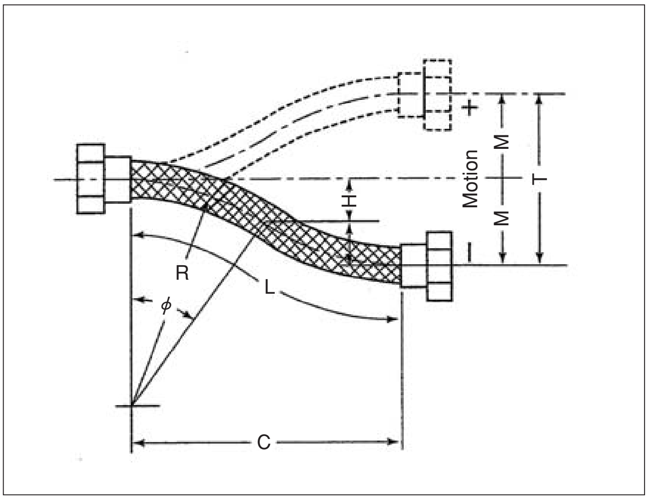
Selection of Flexible Joint

Moving Type and Estimation for Moving Displacement of Flexible Joint

● Moving of the misalignment (moving of the misaligned center line)

This is the case in which one side of the joint ends (flange, screw, union, or coupling, etc.) moves vertically up and down in the same horizontal length with the other side fixed (movement on the same level).



T: Total offset [mm]
M: Center line offset [mm]
H: 1/2M = 1/4T [mm]
L: Actual length of tube [mm]
C: Face-to-face distance of tube [mm]
R: Bending radius of center line [mm]
ϕ : Deviation angle [C˚]

<Calculation formula>

1) $\frac{H}{R} = 1 - \cos\phi$

2) $\frac{C}{R} = 2\sin\phi$

3) $\phi = 28.65\,\frac{L}{R}$ when L ≒ C (when the movement is small)

4) $R = \frac{4H^2 + L^2}{8H}$

● Horizontal (lateral direction) and vertical (longitudinal direction) movement (plumbing of U-shaped joint/Sideways U-shaped joint)

Radial motion means the motion in which the end point of arc-shape joint moves horizontally or vertically when installed with bent as shown in Figs. 14 and 15 below.
This is generally called “moving loop”. Its moving distance is shown by horizontal or vertical moving distance.
If total distance T is given and curvature radius is chose properly, actual length of tube L and loop length K can be calculated by the formulas below.
* Total length = L + length of fitting

T= Total travel length [mm]
L= Actual length of tube [mm]
R= Curvature radius [mm]
K= Loop length [mm]

Note) Movement shall be on the same level of fixed side.

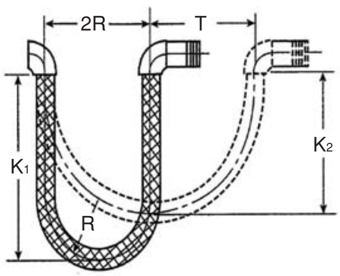


Fig. 14

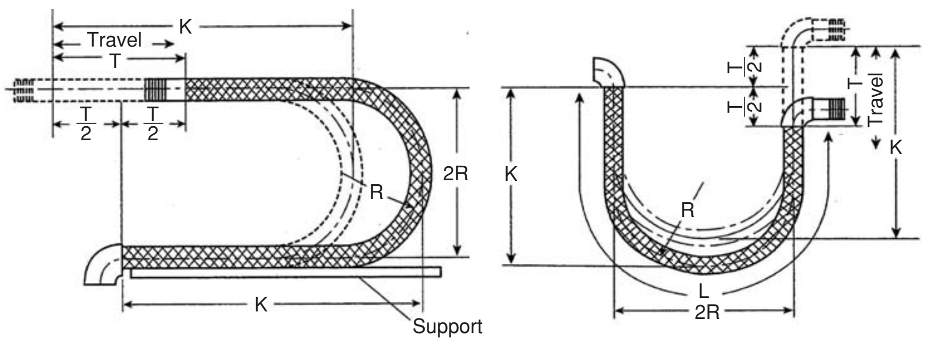


Fig. 15

<Calculation formula>
Formula for horizontal moving loop

1) L = 4R + 1.57T

2) K_1 = 1.43R + .785T

3) $K_2 = 1.43R + \frac{T}{2}$

<Calculation formula>
Formula for moving loop

1) $L = 4R + \frac{T}{2}$

2) $K = 1.43R + \frac{T}{2}$

Selection of Flexible Joint

● Eternal bending (fixed bending)

This means that using flexible joint with bent once without a normal bend to facilitate the connection of two piping components. Install the joint at more than allowable minimum bending radius (for low pressure piping only).
Do not use this to prevent vibration absorption or thermal expansion of piping system. Failure to follow this instruction may lead to trouble.

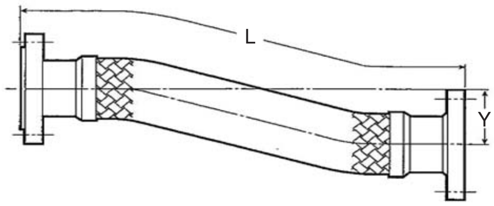
● For unregulated bending movement

If using flexible joint for sprinkler hose (garden hose), for example, it is recommended to use spring rolling to prevent bending stress from concentrating especially on the base of the fitting. In addition, spiral form is better for tube (bellows) due to the movement of pulling around freely.

● Prohibited movement

Do not displace the tube in axial direction on installation line. It is not possible since the tube is covered with braid. It also is not possible for uncovered tube (non braid type) since buckling occurs on the tube. For axial direction, it is recommended to use the bellows type expansion joint.

● The tube cannot be twisted.



Maximum Displacement of the YBF-2E Flexible Joint

(The values below are the calculated values when designation of pressure and temperature are disregarded and maximum repeated time is 1000.)

● The values below are one direction displacement from center line.

(mm)

Nominal size \ Length	200	300	400	500	600	700	800	1000	1200	1500	2000
15A	12	51	118	210	331	475	510	710	910	1210	1710
20A	9	37	83	150	236	338	463	640	840	1140	1640
25A	8	33	76	137	216	312	421	580	780	1080	1580
32A	5	22	50	91	143	207	282	463	695	1030	1530
40A	4	19	45	80	127	183	251	416	623	940	1440
50A	3	15	33	61	95	138	187	309	463	756	1387
65A	2	10	27	50	80	118	158	268	406	667	1233
80A	1	13	30	60	99	142	200	335	517	849	1200
100A	1	8	21	41	68	107	147	248	376	629	1165
125A	—	4	15	31	52	80	113	191	296	497	933
150A	—	3	13	28	49	71	102	182	277	461	882
200A	—	2	8	20	36	54	80	141	219	372	712
250A	—	1	7	17	30	47	68	128	198	333	647

Maximum Displacement of the YBF-2EM Flexible Joint

(The values below are the calculated values when designation of pressure and temperature are disregarded and maximum repeated time is 1000.)

● The values below are one direction displacement from center line.

(mm)

Nominal size \ Length	300	400	500	600	700	800	1000
20A	52	120	210	332	380	480	680
25A	35	76	140	216	316	425	660
32A	41	92	164	257	370	504	640
40A	32	74	131	206	296	403	667
45A	31	68	126	194	285	382	634
50A	26	59	105	165	237	323	534
65A	21	49	90	151	217	296	503
80A	18	44	86	142	213	286	479
100A	11	34	68	107	162	230	386
125A	8	26	49	86	133	182	323
150A	4	17	40	68	103	145	252
200A	3	14	31	56	88	126	225
250A	—	8	19	36	53	79	147
300A	—	6	17	29	45	69	118

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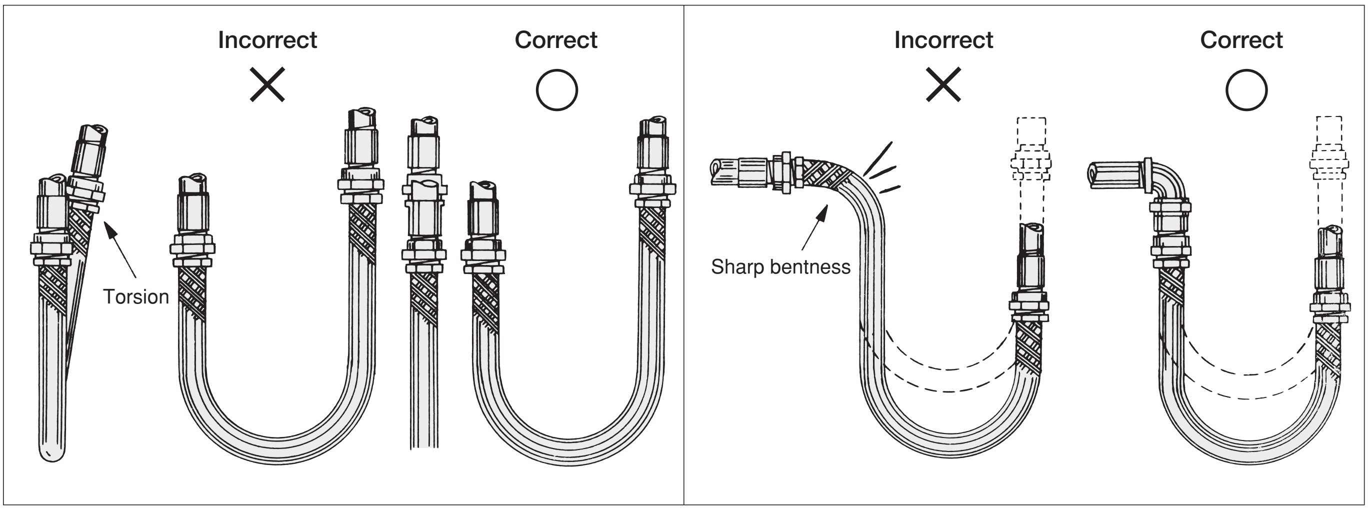
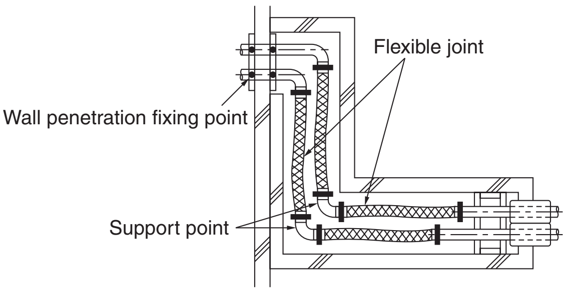
Precautions for Installation: Flexible Joints

- Install flexible joints so that bent portions of joints do not concentrate in a specific position.
- Install flexible joints so that the bending radius of joints does not become excessively small.
- Do not use flexible joints in a position subjected to a pressure higher than the permissible pressure.
- Beware of an excessive velocity of the internal fluid.

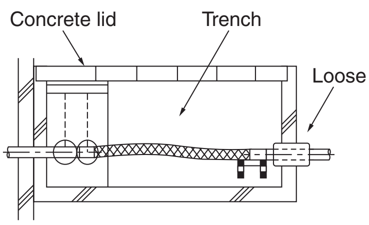


Piping Example

● Displacement absorption piping procedure for introduction area to building (when using flexible joint)

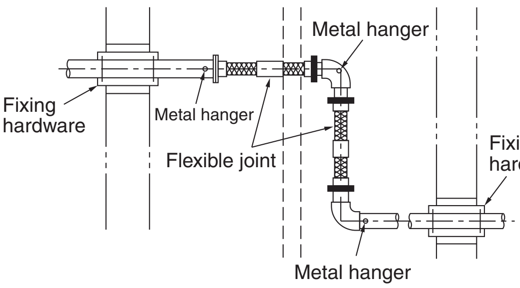


Top view

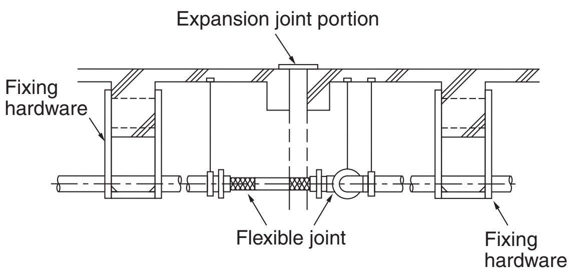


Elevational view

● Expansion joint piping procedure for building (when using flexible joint)



Top view



Elevational view

⚠ **Warning**

1. Prevent water hammer.
 ･Water hammer may damage the joints and lead to cause outside leakage.
2. Do not touch flexible joints with bare hands when fluid is in high temperature.
 ･This may lead to burn.
3. Do not use flexible joints as installed in axial direction of piping to absorb expansion or compression of piping.
 ･Failure to follow this instruction damages flexible joints.
4. Make sure to fix the devices or pipes to which flexible joints are connected.

YBF-1E・2E

Features

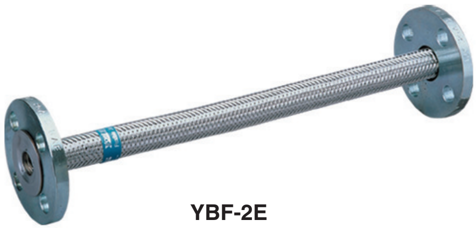
1. The best flexible joints among other similar products using metallic bellows, offering outstanding flexibility against bending.
2. Stainless steel made bent portions (bellows and braid) offers high resistance to corrosion and ensures distinguished durability.

Specifications

Model		YBF-1E	YBF-2E
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	
Maximum pressure		1.0 MPa	*
Maximum temperature		220˚C	
Material	Connection	Malleable cast iron	Rolled steel
	Braid	Stainless steel	
	Bellows	Stainless steel	
Connection		JIS Rc screwed (union joint)	JIS 10K FF flanged (loose flanges on both sides)

・Wire braid is used for 100A or less, and plate braid is used for 125A or larger.
・Available with for high pressure, underground use or complies with the Fire Service Law.
・Available with all stainless steel made (YBF-6E・7E).
・For vibration absorption around pump, the YBF-2EM (flanged type only) is appropriate. Contact us for details.

YBF-1E



YBF-2E

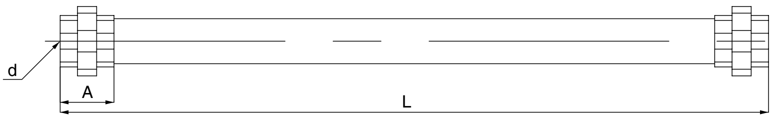
* 〔YBF-2E Maximum pressure〕

Nominal size	Maximum pressure
15A-100A	1.0 MPa
125A-200A	0.8 MPa
250A	0.5 MPa

Dimensions (mm)

●YBF-1E

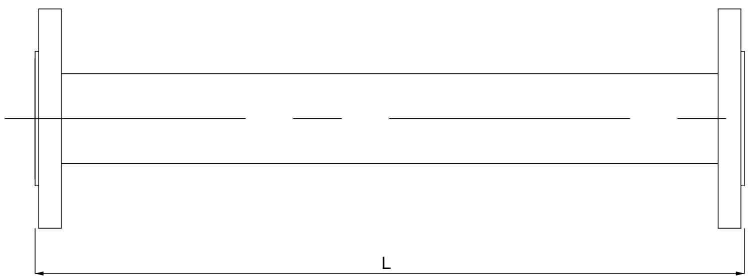
Nominal size	L	d	A
15A		Rc 1/2	42
20A	300	Rc 3/4	50
25A	500	Rc 1	55
32A	800	Rc 1-1/4	61
40A	1000	Rc 1-1/2	68
50A		Rc 2	76



YBF-1E

●YBF-2E

Nominal size	L
15A	
20A	300
25A	400
32A	500
40A	600
50A	700
65A	800
80A	1000
100A	
125A	300・400・500
150A	600・700・800
200A	1000・1200
250A	1500・2000



YBF-2E

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EB-1J・2J

Features

1. Complies with JIS B 2352 (Bellows type expansion joints: Application A) of Japanese Industrial Standards.
2. No need for retightening and replacement due to aging since packing is not used. Easy to maintain and manage.
3. Simple structure since flange, short pipe and bellows are united.
4. Outer pipe is attached in order to protect the bellows from damage due to external impact.
5. Stainless steel inner pipe is attached in order to prevent fluid pressure loss, vibration, impact, corrosion, etc.
6. Stainless steel made wetted parts offer high resistance to corrosion and ensures distinguished durability.

Specifications

Model		EB-1J	EB-2J
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	
Maximum pressure		0.98 MPa	
Max. temperature		220˚C	
Max. axial extension		35 mm (Expansion 10 mm Compression 25 mm)	70 mm * (Expansion 20 mm Compression 50 mm)
Material	Outer pipe	Carbon steel	
	Bellows, inner pipe	Stainless steel (SUS316L)	
Connection		JIS 10K FF flanged	
Pressure test (Water pressure)		1.5 MPa	

* Expansion of one side from the centering anchor base is 10 mm and compression is 25 mm.
・Available with all stainless steel made.
・Available with loose flanged type (EB-1JL・2JL).
・Available with nominal size from 300A to 450A (EB-3・4).

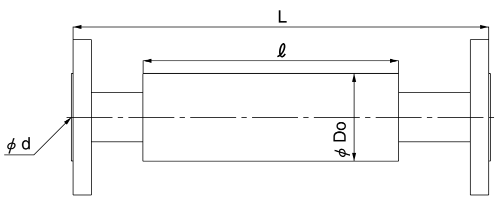
Dimensions (mm) and Weights (kg)

●EB-1J

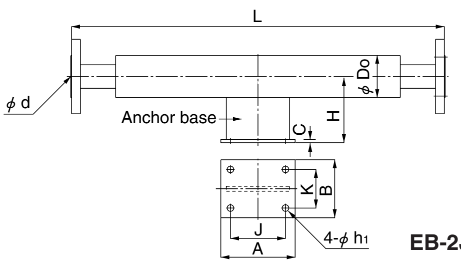
Nominal size	L	Max. operating length	Min. operating length	Max. axial extension δ	Do	d	ℓ	Weight
20A	365	375	340	35	58.2	20.6	235	2.6
25A	365	375	340	35	58.2	20.6	235	3.3
32A	365	375	340	35	73.2	28.1	235	4.8
40A	365	375	340	35	73.2	34.1	235	5.0
50A	365	375	340	35	98.2	44.0	239	5.7
65A	415	425	390	35	109.7	59.5	289	8.9
80A	415	425	390	35	135.7	72.0	288	10.1
100A	415	425	390	35	161.7	97.0	288	12.9
125A	440	450	415	35	212.1	121.0	292	21.0
150A	440	450	415	35	235.1	143.0	293	26.3
200A	440	450	415	35	291.6	193.0	280	35.3
250A	465	475	440	35	332.6	241.0	287	52.5

●EB-2J

Nominal size	L	Max. operating length	Min. operating length	Max. axial extension δ	Do	d	Dimensions of ancher base・JIS B 2352								Weight
							H	J	K	A	B	C	h1	Bolt size	
20A	680	700	630	70	60.5	20.6	100	100	60	135	95	3.2	12	M10	4.6
25A	680	700	630	70	60.5	20.6	100	100	60	135	95	3.2	12	M10	5.5
32A	680	700	630	70	76.3	28.1	120	100	70	135	105	3.2	12	M10	6.7
40A	680	700	630	70	76.3	34.1	120	100	70	135	105	3.2	12	M10	7.0
50A	680	700	630	70	101.6	44.0	130	100	80	140	120	3.2	15	M12	9.8
65A	780	800	730	70	114.3	59.5	140	120	100	160	140	4.0	15	M12	11.1
80A	780	800	730	70	139.8	72.0	150	120	110	160	150	4.0	15	M12	12.6
100A	880	900	830	70	165.2	97.0	170	120	130	160	175	4.0	19	M16	16.3
125A	880	900	830	70	216.3	121.0	200	120	150	175	205	4.0	19	M16	34.5
150A	930	950	880	70	236.4	143.0	220	160	180	215	235	4.5	23	M20	41.6
200A	930	950	880	70	293.4	193.0	250	160	220	215	285	4.5	25	M22	59.9
250A	980	1000	930	70	334.4	241.0	300	180	280	255	375	4.5	27	M24	83.0



EB-1J



EB-2J

EB-11・12

Features

1. Control ring is provided for the purpose of reinforcement against internal pressure and equalization of bellows expansion.
2. No need for retightening and replacement due to aging since packing is not used. Easy to maintain and manage.
3. Simple structure since the flange, short pipe and bellows are united.
4. Outer pipe is attached in order to protect the bellows from damage due to external impact.
5. Stainless steel inner pipe is attached in order to prevent fluid pressure loss, vibration, impact, corrosion, etc.
6. Stainless steel made wetted parts offer high resistance to corrosion and ensures distinguished durability.

Specifications

Model		EB-11	EB-12
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	
Maximum pressure		2.0 MPa	
Max. temperature		220˚C	
Max. axial extension		35 mm (Expansion 10 mm Compression 25 mm)	70 mm * (Expansion 20 mm Compression 50 mm)
Material	Outer pipe	Carbon steel	
	Bellows, inner pipe	Stainless steel (SUS316L)	
Connection		JIS 20K RF flanged	
Pressure test (Water pressure)		3.0 MPa	

* Expansion of one side from the centering anchor base is 10 mm and compression is 25 mm.
・Available with nominal size from 300A to 450A (EB-7・8).


EB-11


EB-12

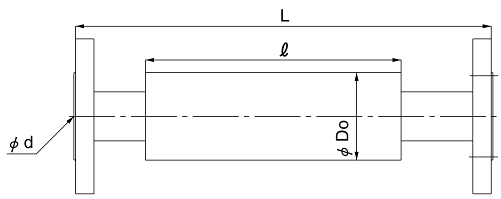
Dimensions (mm) and Weights (kg)

●EB-11

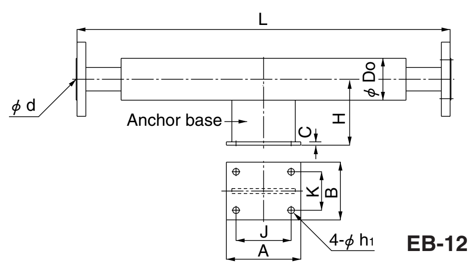
Nominal size	L	Max. operating length	Min. operating length	Max. axial extension	Do	d	ℓ	Weight
20A	365	375	340	35	58.2	20.6	235	2.7
25A	365	375	340	35	58.2	20.6	235	3.6
32A	365	375	340	35	73.2	28.1	235	4.4
40A	365	375	340	35	73.2	34.1	235	5.3
50A	365	375	340	35	98.2	44.0	239	6.8
65A	415	425	390	35	109.7	59.5	289	9.5
80A	415	425	390	35	135.7	72.0	288	13.1
100A	415	425	390	35	161.7	97.0	288	13.9
125A	440	450	415	35	212.1	121.0	292	34.7
150A	440	450	415	35	235.1	143.0	293	43.2
200A	440	450	415	35	291.6	193.0	280	55.8
250A	465	475	440	35	332.6	241.0	287	85.7

●EB-12

Nominal size	L	Max. operating length	Min. operating length	Max. axial extension δ	Do	d	Dimensions of ancher base・JIS B 2352								Weight
							H	J	K	A	B	C	h_1	Bolt size	
20A	680	700	630	70	60.5	20.6	100	100	60	135	95	3.2	12	M10	4.8
25A	680	700	630	70	60.5	20.6	100	100	60	135	95	3.2	12	M10	5.7
32A	680	700	630	70	76.3	28.1	120	100	70	135	105	3.2	12	M10	7.5
40A	680	700	630	70	76.3	34.1	120	100	70	135	105	3.2	12	M10	7.6
50A	680	700	630	70	101.6	44.0	130	100	80	140	120	3.2	15	M12	10.8
65A	780	800	730	70	114.3	59.5	140	120	100	160	140	4.0	15	M12	13.4
80A	780	800	730	70	139.8	72.0	150	120	110	160	150	4.0	15	M12	18.2
100A	880	900	830	70	165.2	97.0	170	120	130	160	175	4.0	19	M16	21.6
125A	880	900	830	70	216.3	121.0	200	120	150	175	205	4.0	19	M16	48.2
150A	930	950	880	70	236.4	143.0	220	160	180	215	235	4.5	23	M20	58.5
200A	930	950	880	70	293.4	193.0	250	160	220	215	285	4.5	25	M22	80.4
250A	980	1000	930	70	334.4	241.0	300	180	280	255	375	4.5	27	M24	116.2



EB-11



EB-12

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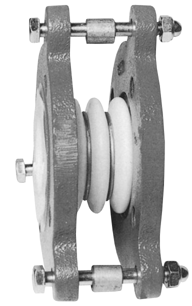
Feature	For copper pipe / Single type	For copper pipe / Double type	Anti-corrosion / PTFE joint	Sleeve joint / 1.0, 2.0 MPa
Model	**EB-31**	**EB-32**	**EB-51-3**	**ES-10･11**
Picture	 EB-31	 EB-32		 ES-10-100
Application	**Air, Cold and hot water, Oil, Other non-dangerous fluids**		**Cold and hot water, Chemicals, etc.**	**Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids**
Max. pressure	1.0 MPa		1.0 MPa *1	ES-10: 1.0 MPa ES-11: 2.0 MPa
Max. temperature	120˚C		150˚C *1	220˚C
Axial extension	10 mm	20 mm	10-20 mm *2	ES-10-100, ES-11-100: 20 mm ES-10-200, ES-11-200: 40 mm
Axial compression	25 mm	50 mm	10-35 mm *2	ES-10-100, ES-11-100: 80 mm ES-10-200, ES-11-200: 160 mm
Connection	Socket soldered type		JIS 10K RF flanged	ES-10: JIS 10K RF flanged ES-11: JIS 20K RF flanged
Material: Outer pipe	Carbon steel		—	Body-ES-10: Cast iron or Rolled steel
Material: Bellows	Stainless steel (SUS316L)		PTFE	ES-11: Rolled steel
Material: Connection	Copper		Flange: Ductile cast iron	Sleeve: Carbon steel (HCr plating)
Size	20A-80A		25A, 40A-200A	20A-300A
Others	—	—	*1 Depends on the size and rating. Contact us for details. *2 Depends on the size. Contact us for details.	—

Feature	Ball joint / Screwed	Ball joint / Butt-weld	Ball joint / Flanged	Universal joint / Axial & angle
Model	**UB-1**	**UB-2**	**UB-10･11**	**UB-3･13**
Picture	 UB-1		 UB-10	 UB-13
Application	**Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids**			**Air, Cold and hot water, Oil, Other non-dangerous fluids**
Max. pressure	0.98 MPa			1.0 MPa
Max. temperature	220˚C			80˚C *1
Max. displacement angle	20˚			UB-3: 20˚ UB-13: 30˚
Max. axial displacement	—			12 mm-80 mm *2
Connection	JIS Rc screwed	Butt-weld	JIS 10K RF flanged	UB-3: JIS Rc screwed UB-13: JIS 10K RF flanged
Material: Body	Cast iron	Carbon steel	UB-10: Cast iron UB-11: Carbon steel	Cast iron
Material: Ball	Cast iron (HCr plating)	Carbon steel (HCr plating)		Cast iron (HCr plating)
Size	20A-50A	50A-250A		UB-3: 20A-50A UB-13: 40A-300A
Others	—	—	—	*1 Available with max. temp. 120˚C. *2 Depends on the size. Contact us for details.

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