Expansion Joint
Ball Joint
Flexible Joint

17

Step 0 Type/Structure/Features

Please refer to this for structure and feature of Expansion Joint, Ball Joint, and Flexible Joint.

Step 1 Selection

Please look at the ID chart to choose the right products depending on the intended of uses. Confirm the additional details in the main part.

Step 2 Sizing

Please refer to P.17-9 to 22 for selecting the suitable model and size.

Step 3 Attention for usage

Be sure to check guidelines for optimal usage of each products such as installation.

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

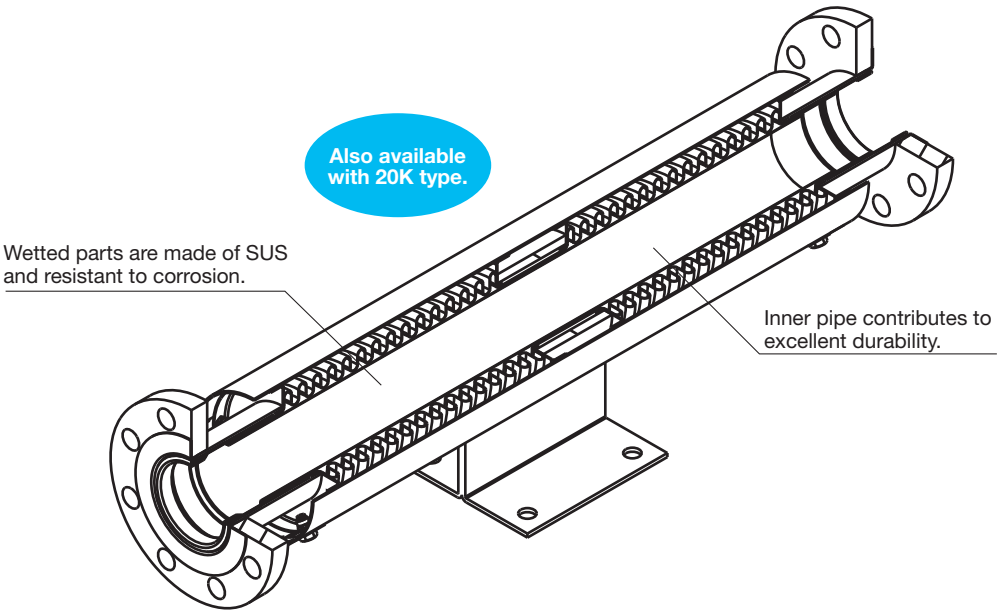
Types	Bellows	Sleeve	Ball
Appearance			
Material	Carbon steel / Stainless steel	Carbon steel / Stainless steel	Carbon steel / Stainless steel
Displacement types	Straight	Straight・Rotation	Angle・Rotation
Connection	Flanged	Flanged	Screwed Flanged Butt-weld
Heat resistance	Excellent	Excellent	Excellent
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
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

Bellows Type Expansion Joint

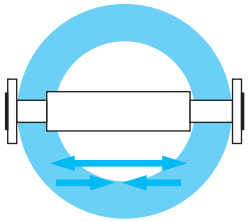
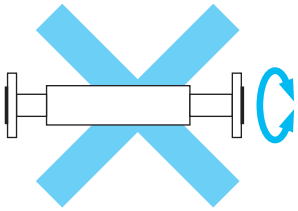
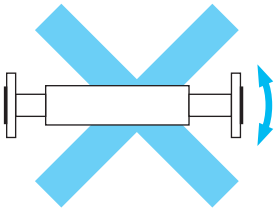
Step 0

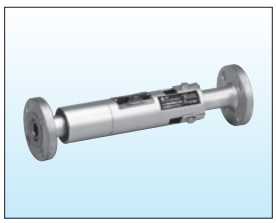
■EB

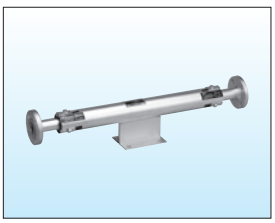
This type of expansion joint is easy to maintain and manage because it does not use any packing.
The EB expansion joint complies with application A of JIS B 2352 Bellows Type Expansion Joints (EB-1J・2J).

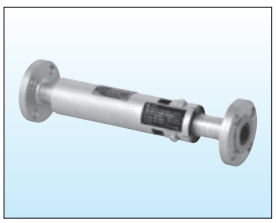


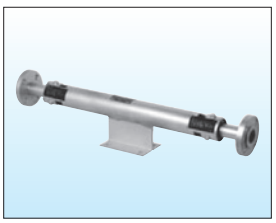
■Applicable displacement

Straight	Rotation	Angle
		


EB-1J


EB-2J

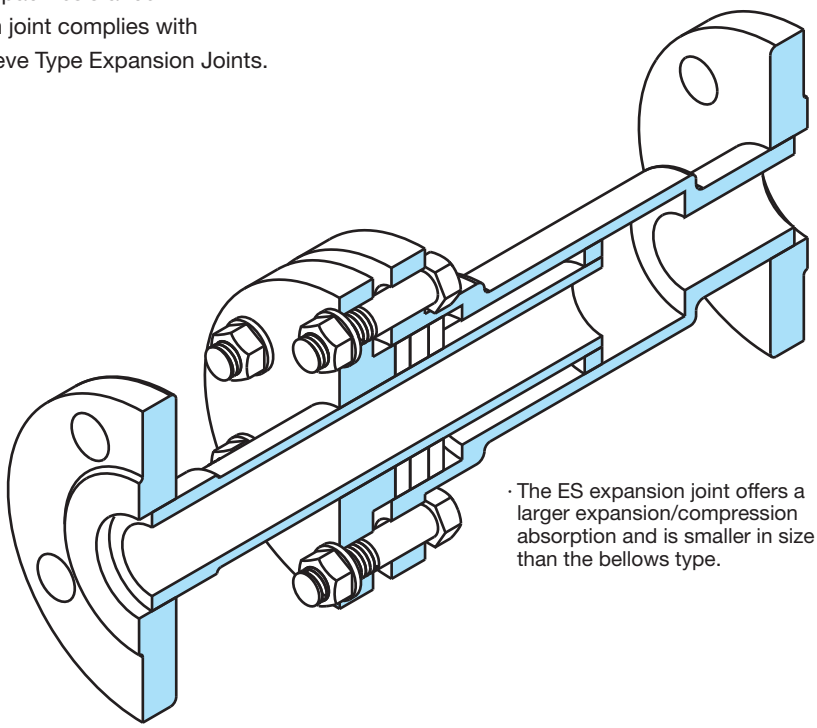

EB-1JL


EB-2JL

Sleeve Type Expansion Joint

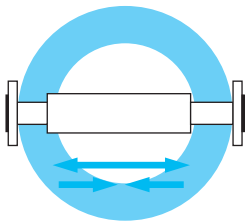
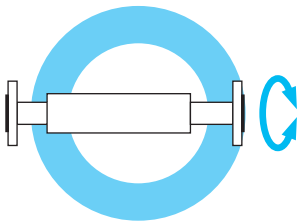
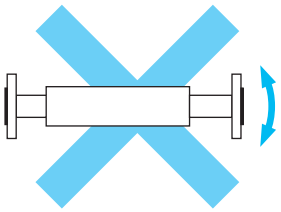
■ES

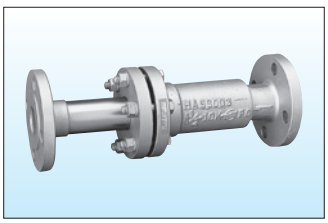
This type of expansion joint is superior to the bellows type in impact resistance.
The ES expansion joint complies with SHASE-S003 Sleeve Type Expansion Joints.



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

■Applicable displacement

Straight	Rotation	Angle
		



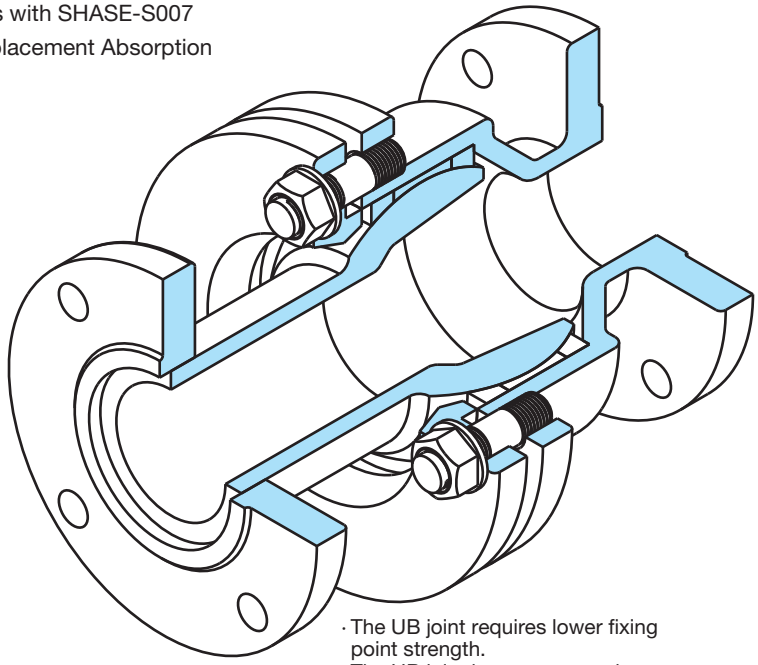
ES-10-100

Ball joint

Step 0

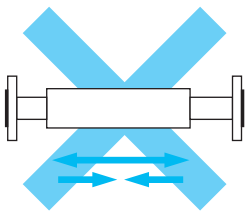
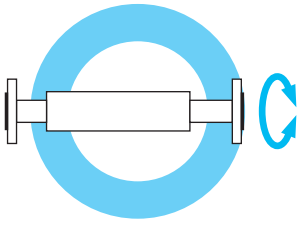
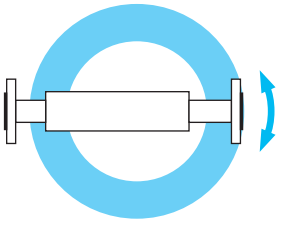
■UB

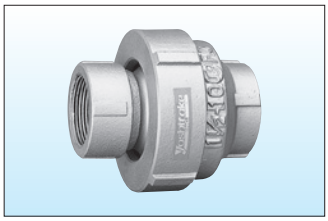
This type of joint is capable of absorbing an axial displacement of piping by combination use of ball joints angular absorption.
The UB joint complies with SHASE-S007 Mechanical Type Displacement Absorption Joints (UB-2·11).



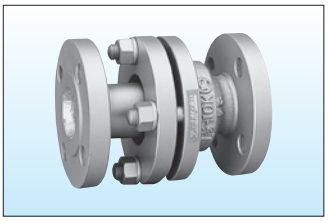
· The UB joint requires lower fixing point strength.
· The UB joint is strong enough to withstand water hammer, impact, etc.

■Applicable displacement

Straight	Rotation	Angle
		



UB-1



UB-10

Expansion Joint/Flexible Joint ID-Charts

	Model	Type	Fluid	Material	Max. Pressure (MPa)	Max. Axial extension (mm)	Max. Temperature (℃)	Connection	Size	Page
	EB-1J	Bellows type	Steam, Air, Water, Oil	Bellows: SUS316L Flanged: SS400	1.0	Expansion: 10 Compression: 25	220℃	JIS 10KFF	20-250A	17-23
	EB-1JL				1.0	Expansion: 10 Compression: 25		JIS 10KRF	20-250A	17-23
	EB-11				2.0	Expansion: 10 Compression: 25		JIS 20KRF	20-250A	17-25
	EB-2J	Bellows type	Steam, Air, Water, Oil	Bellows: SUS316L Flanged: SS400	1.0	Expansion: 20 Compression: 50	220℃	JIS 10KFF	20-250A	17-23
	EB-2JL				1.0	Expansion: 20 Compression: 50		JIS 10KRF	20-250A	17-23
	EB-12				2.0	Expansion: 20 Compression: 50		JIS 20KRF	20-250A	17-25
	ES-10-100	Sleeve type	Steam, Air, Water, Oil	Sleeve: STKM13A Body: FC250 or FCD450 Flange: SS400	1.0	Expansion: 20 Compression: 80	220℃	JIS 10KRF	20-300A	17-29
	ES-10-200			Sleeve: STKM13A Body: S25C or STKM13A Flange: SS400		Expansion: 40 Compression: 160			25-300A	17-29
	ES-11-100	Sleeve type	Steam, Air, Water, Oil	Sleeve: STKM13A Body: SS400 or FCD450 Flange: SS400	2.0	Expansion: 20 Compression: 80	220℃	JIS 20KRF	25-300A	17-29
	ES-11-200			Sleeve: STKM13A Body: S25C or STKM13A Flange: SS400		Expansion: 40 Compression: 160			25-300A	17-29
	EB-51-3	Bellows type	Water, Chemical products	Tube: PTFE Flange: FCD450	Please refer to P.17-27 due to difference of size.			JIS 10KRF	25-200A	17-27
	YBF-1E	Bellows type	Steam, Air, Water, Oil	Tube: SUS304 Braid: SUS304 Union: FCMB	1.0	—	220℃	JIS Rc (union joint)	15-50A	17-33
	YBF-2E	Bellows type	Steam, Air, Water, Oil	Tube: SUS304 Braid: SUS304 Flange: SS400	1.0 (125-200A: 0.8 250A: 0.5)	—	220℃	JIS 10KFF (loose flanges on both sides)	General piping usage 15-250A	17-33

* Please contact us for expect material and fluid that above mentioned.

Ball joint ID-Charts

Step 1

	Model	Fluid	Material	Max. Pressure (MPa)	Max. Displacement angle	Max. Temperature (℃)	Connection	Size	Feature	Page
	UB-1	Steam, Air, Water, Oil	Body: S25C Ball: S25C (STKM13A)	1.0	30℃	220℃	JIS Rc	20-50A	Screwed	17-31
	UB-2	Steam, Air, Water, Oil	Body: SCPH2 Ball: S25C (STKM13A)	1.0	20℃	220℃	Butt-weld	20-250A	SHASE-S007 Compliance product	17-31
	UB-10	Steam, Air, Water, Oil	Body: FC250 Ball: S25C (STKM13A)	1.0	20℃	220℃	JIS 10KRF	20-250A		17-31
	UB-11	Steam, Air, Water, Oil	Body: SCPH2 Ball: S25C (STKM13A)	1.0	20℃	220℃	JIS 10KRF	20-250A	SHASE-S007 Compliance product	17-31

* Please contact us for material and fluid other than above mentioned.

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]

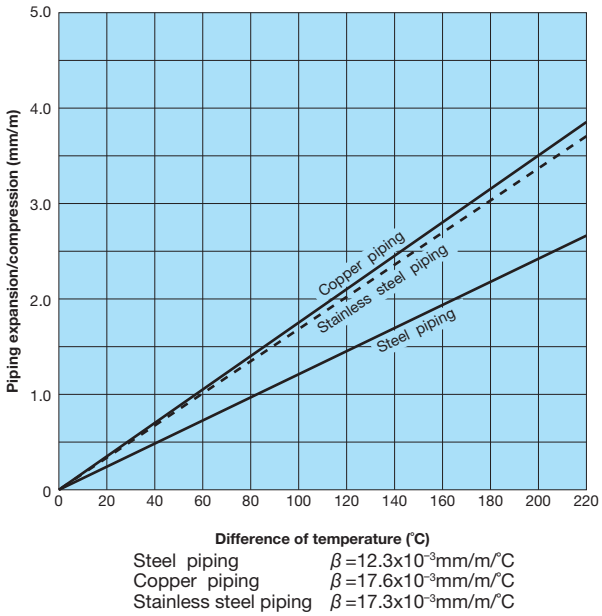
<Calculation example>

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 x 10^{-3} x {170 – (–20)} x 30
= 69 mm

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



Steel piping β =12.3x10^{-3}mm/m/°C
Copper piping β =17.6x10^{-3}mm/m/°C
Stainless steel piping β =17.3x10^{-3}mm/m/°C

Table-1 Expansion coefficient of steel piping per temperature β = 10^{-3} mm/m/°C

(°C) Maximum temperature \ 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

(°C) Maximum temperature \ 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

Step 2

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

Minimum temperature (℃) / Maximum temperature (℃)	40	30	20	10	0	−10	−20	−30	−40	Minimum temperature (℃) / Maximum temperature (℃)	40	30	20	10	0	−10	−20	−30	−40
−30									0.108	70	0.357	0.472	0.585	0.702	0.812	0.920	1.026	1.140	1.243
−20								0.109	0.216	80	0.484	0.600	0.714	0.826	0.936	1.044	1.160	1.265	1.380
−10							0.110	0.218	0.327	90	0.605	0.726	0.840	0.952	1.062	1.170	1.276	1.392	1.495
0						0.110	0.220	0.327	0.436	100	0.726	0.847	0.960	1.071	1.180	1.287	1.139	1.508	1.610
10					0.111	0.220	0.330	0.440	0.545	120	0.968	1.089	1.200	1.309	1.428	1.534	1.638	1.755	1.856
20				0.112	0.224	0.333	0.440	0.550	0.660	140	1.220	1.331	1.452	1.560	1.666	1.785	1.888	2.006	2.106
30			0.115	0.228	0.339	0.448	0.555	0.666	0.777	160	1.476	1.586	1.708	1.715	1.920	2.040	2.142	2.261	2.360
40		0.116	0.232	0.342	0.456	0.565	0.672	0.784	0.888	180	1.736	1.845	1.968	2.074	2.196	2.299	2.400	2.499	2.618
50	0.119	0.236	0.351	0.464	0.575	0.684	0.791	0.904	1.008	200	1.984	2.108	2.214	2.337	2.440	2.562	2.662	2.783	2.880
60	0.238	0.354	0.468	0.580	0.690	0.798	0.912	1.017	1.130	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℃ (minimum temperature) to 180℃ (maximum temperature).

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

Step 2

■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:

$$n_1 = \frac{\Delta \ell_1}{\delta} = \frac{42.7}{25} = 1.70$$

Piping's compression side:

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

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.

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

Guidelines for Expansion Joints EB and ES Series

Step 3

■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]

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 cm^2 (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:

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

$= 77 \times 100 \times 1.0 + 75 \times 25$

$= 9575$ N

Main anchor for bent piping point:

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

$$= 2 \times 9575 \times \sin\frac{90^\circ}{2} = 13541\ N$$

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

Intermediate anchor: $Fi = \omega \ell = 75 \times 25 = 1875$ 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		100.4	100.4	93.1	82.1	78.9	79.5	134.4	168.8	199	272.6	346.8	831.2
Effective area A cm^2		9.6	9.6	15	19.9	33.6	50.8	74.8	118.1	196.1	275.2	445.6	649.2
Internal pressure thrust FpN	Internal pressure 0.2MPa	200	200	310	400	680	1020	1500	2370	3930	5510	8920	12990
	Internal pressure 0.4MPa	390	390	610	800	1350	2040	3000	4730	7850	11010	17830	25970
	Internal pressure 0.6MPa	580	580	900	1200	2020	3050	4490	7090	11770	16520	26740	38960
	Internal pressure 0.8MPa	770	770	1200	1600	2690	4070	5990	9450	15690	22020	35650	51940
	Internal pressure 1.0MPa	970	970	1500	2000	3370	5090	7490	11820	19620	27530	44570	64930
Axial direction thrust at max. compression of 25 mm Fs N		2520	2520	2330	2060	1980	1990	3370	4230	4980	6820	8680	20790

· The value of internal pressure thrust and axial direction thrust are sample value as shown on above table.

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 cm^2		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 0.2MPa	116	182	278	362	566	906	1244	2040	3034	4274	7320	11200	15876
	Internal pressure 0.4MPa	232	364	556	724	1132	1812	2488	4080	6068	8548	14640	22400	31752
	Internal pressure 0.6MPa	348	546	834	1086	1698	2718	3732	6120	9102	12822	21960	33600	47628
	Internal pressure 0.8MPa	464	728	1112	1448	2264	3624	4976	8160	12136	17096	29280	44800	63504
	Internal pressure 1.0MPa	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

Step 3

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.

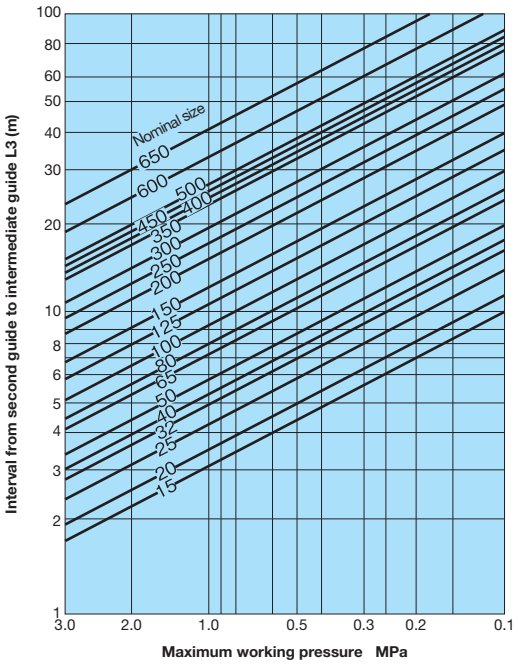
· Sleeve type (ES)

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.

· 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



<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]

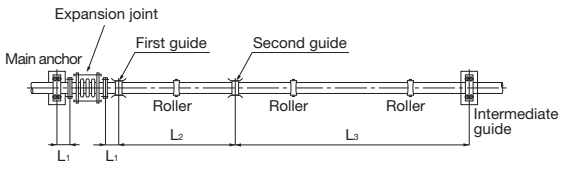
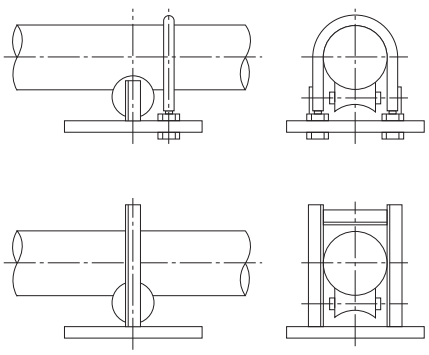
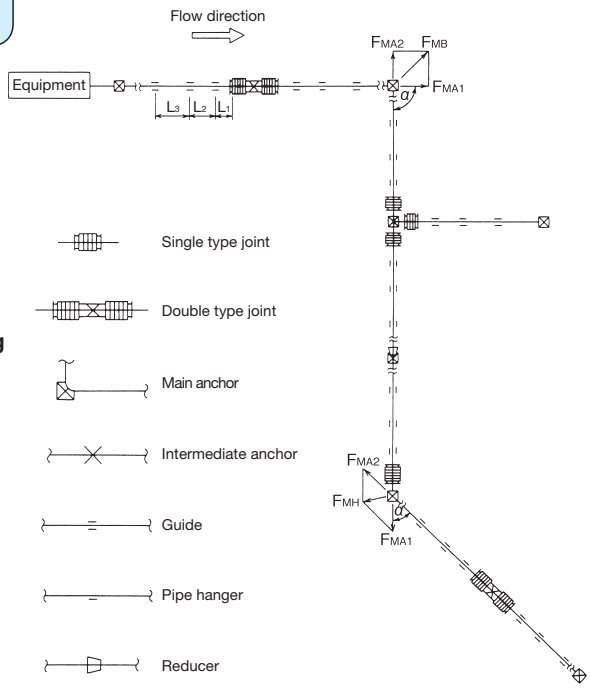


Fig. 2 Layout of guides

· Example and guidelines for prevention of piping buckling





Expansion Joint/Ball Joint/Flexible Joint

17

Selection of Ball Type UB-1, 2, 10, and 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]

<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 [℃]
t_1 : Minimum working temperature [℃]
t_2 : Ambient temperature at the time of installing [℃]
δ : Axial direction displacement of piping [mm]

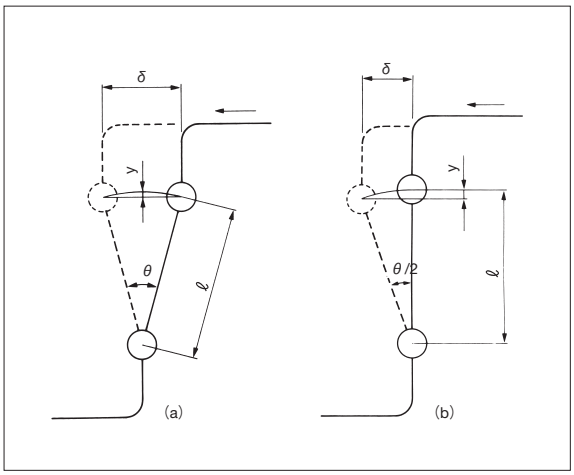


Fig. 4 Displacement of the UB joint (a)(b)

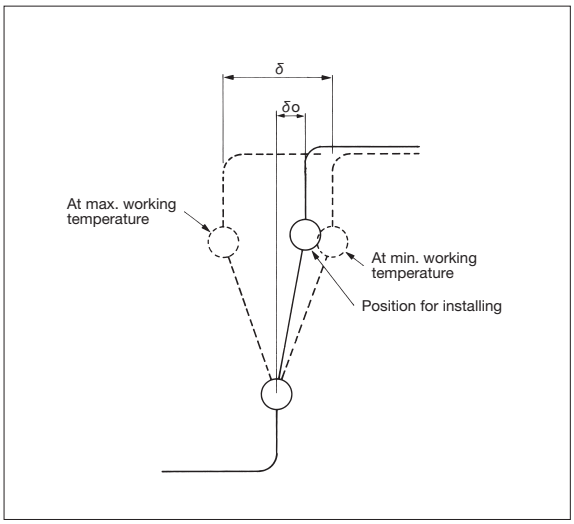


Fig. 5 Position for installing the UB joint

<Calculation example>

$T = 170$℃ (saturated steam: 0.7 MPa)
$t_1 = -20$℃ (minimum working temperature)
$t_2 = 20$℃ (ambient temperature at the time of installing)
$\delta = 69$ mm (axial direction displacement of piping)
Calculate the position for installing joints under the abovementioned conditions.

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

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

Step 2

■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>

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)

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

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

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/mm^2 in the case of steel piping) [N/mm^2]
E : Vertical elastic coefficient of piping
(E = 21.0 x 10^4)
N/mm^2 in the case of steel piping) [N/mm^2]
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/mm^2 (permissible stress of steel piping)
E = 21.0 x 10^4 N/mm^2 (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.

$$y = \ell - \sqrt{\ell^2 - \left(\frac{\delta}{2}\right)^2} = 300 - \sqrt{303^2 - \left(\frac{69}{2}\right)^2} = 2\text{m}$$

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

= 1791mm 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.

Selection of the UB-1, 2, 10, and 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.

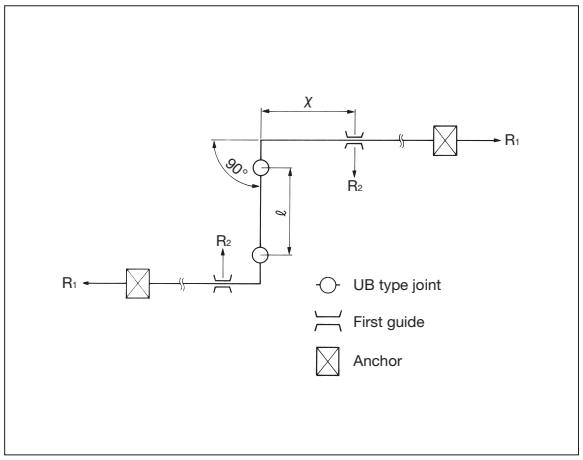


Fig. 6 Connection of the UB type joints, anchoring points and guides (1)

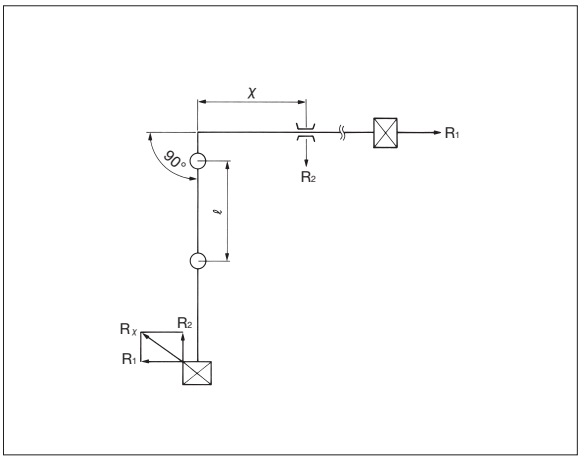


Fig. 7 Connection of the UB type joints, anchoring points and guides (2)

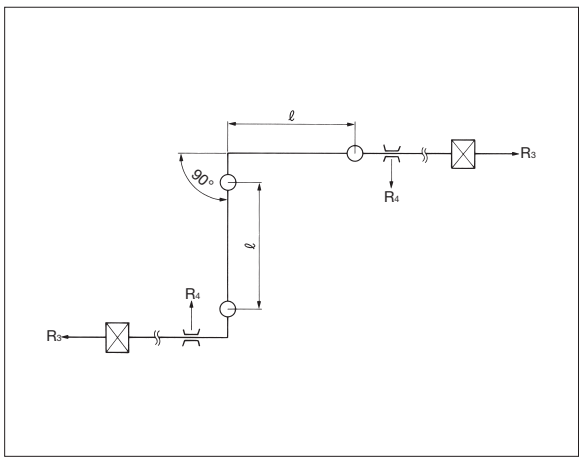


Fig. 8 Connection of the UB type joints, anchoring points and guides (3)

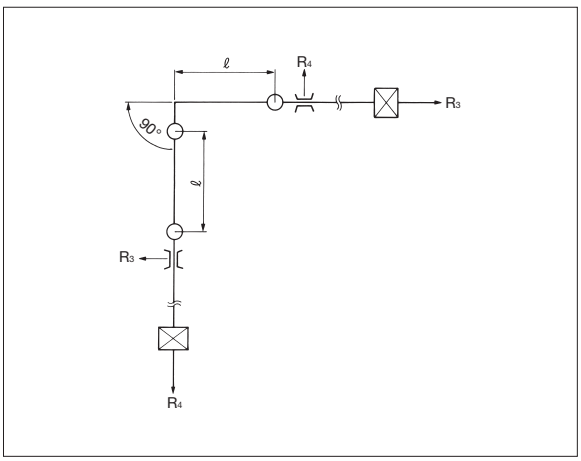


Fig. 9 Connection of the UB type joints, anchoring points and guides (4)

Step 2

<Calculation formula>

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

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

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

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

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

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 x 10^4 N/mm^2 in the case of steel piping) [N/mm^2]
I : Moment of inertia of piping cross section [mm^4]

$$I=\frac{\pi}{64}(D^4-d^4)$$

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

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

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

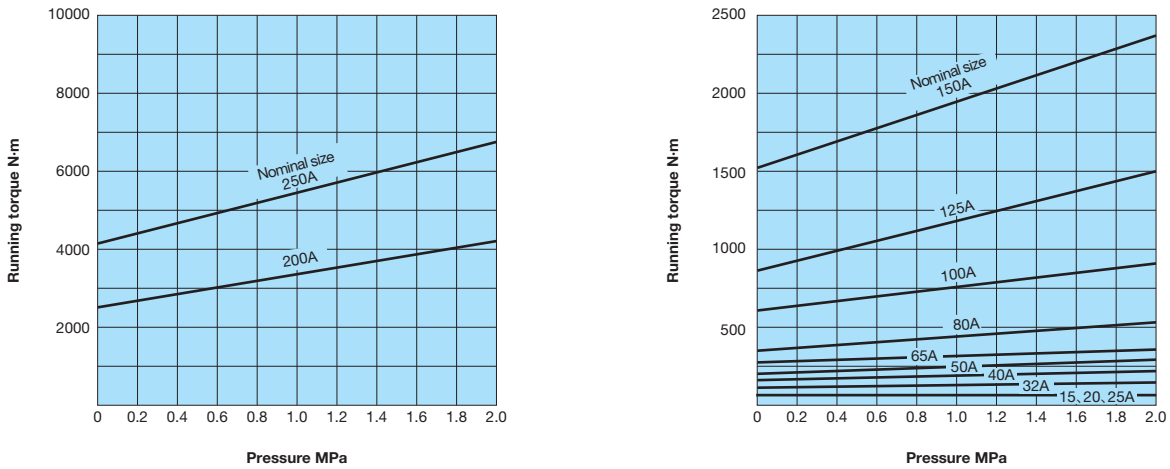


Fig. 10 Running torque of UB joint

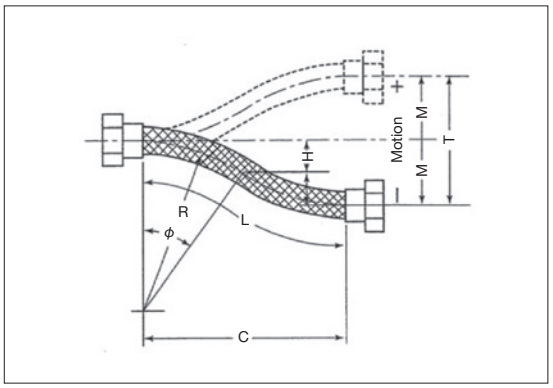
Install guides for buckling prevention and piping weight support guides in the same manner as the EB and ES joints. Use a guide that can slide between the UB joints because of piping displacement.

Selection of 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)

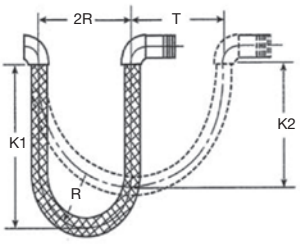
Radial motion means the motion in which the end point of arc-shape joint moves horizontally or vertically when installed with bent as shown in Figs. 14 and 15 below.
This is generally called “moving loop”. Its moving distance is shown by horizontal or vertical moving distance.
If total distance T is 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.

Step 2

Fig. 14



<Calculation formula>

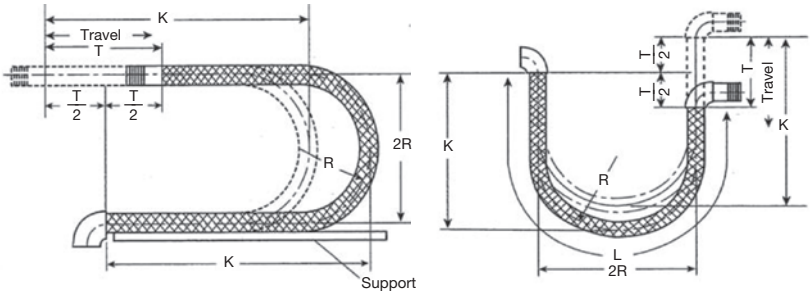
Formula for horizontal moving loop

(1) $L = 4R + 1.57T$

(2) $K_1 = 1.43R + .785T$

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

Fig. 15



<Calculation formula>

Formula for moving loop

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

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

· 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.

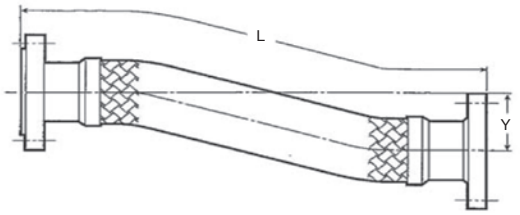
· Prohibited movement

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.

Selection of Flexible Joint

Step 2



■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. (Y)

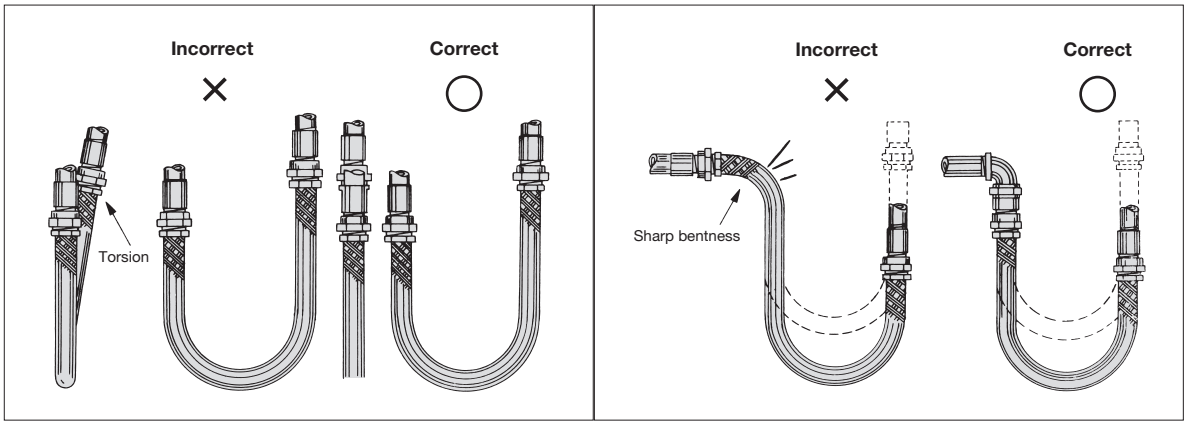
(mm)

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

Precautions for Installation: Flexible Joints

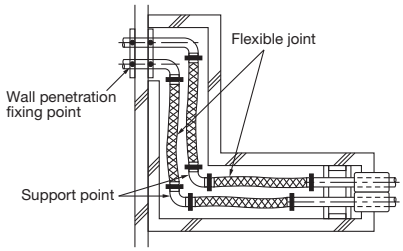
Step 3

· 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.

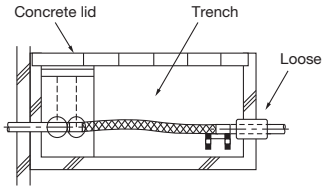


■Piping example

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

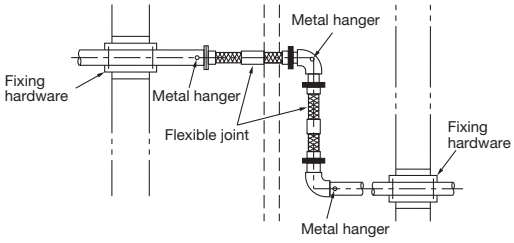


Top view

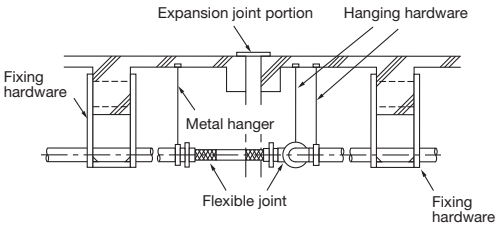


Elevational view

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



Top view



Elevational view

⚠Warning

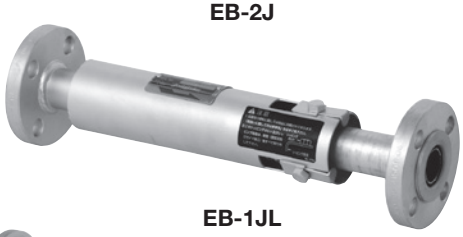
1. Prevent water hammer.
   *Water hammer may damage the joints and lead to cause outside leakage.
2. Do not touch flexible joints with bare hands when fluid is in high temperature.
   *This may lead to burn.
3. Do not use flexible joints as installed in axial direction of piping to absorb expansion 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.

EB-1J,2J,1JL,2JL

Bellows | Sleeve | Ball
Single type | Double type | PTFE | Copper pipe

EB-1J

EB-2J



EB-1JL

EB-2JL

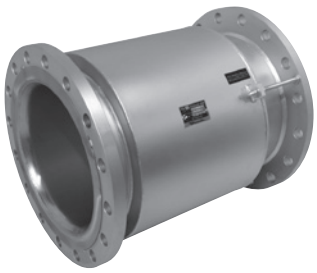
■Features

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.
7. EB-1JL and 2JL, use a loose flange on the end connection and can absorb the displacement of the circumference side of the bolt hole.

■Specifications

Model		EB-1J	EB-1JL	EB-2J	EB-2JL
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids			
Maximum pressure		1.0 MPa			
Max. temperature		220℃			
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	JIS 10K loose flanged	JIS 10K FF flanged	JIS 10K loose flanged
Pressure test (water pressure)		1.5 MPa			

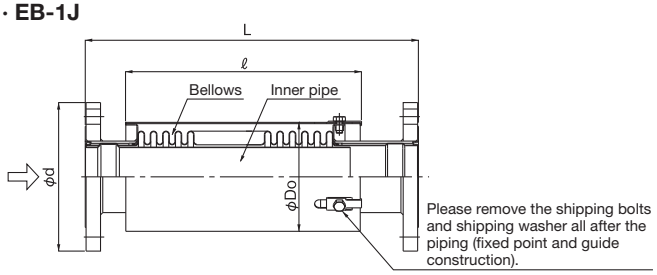
* Expansion of one side from the centering anchor base is 10 mm and compression is 25 mm.
· Available with all stainless steel made.
· Available with nominal size from 300A to 450A. (Single type: EB-3, Double type: EB-4)



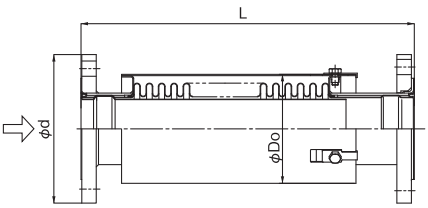
EB-3

■Dimensions (mm) and Weights (kg)

· **EB-1J**



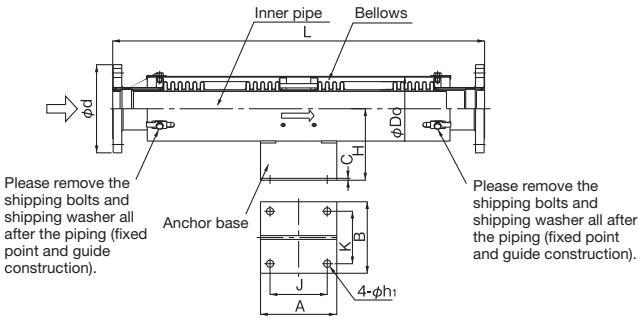
· **EB-1JL**



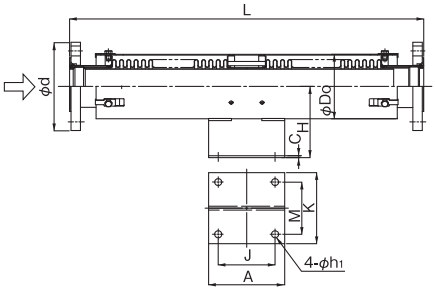
Nominal size	L	Max. operating length	Min. operating length	Max. axial extension δ	Do	d	ℓ	Weight
20A	365	375	340	35	58.2	20.6	235	2.6
25A	365	375	340	35	58.2	20.6	235	3.3
32A	365	375	340	35	73.2	28.1	235	4.8
40A	365	375	340	35	73.2	34.1	235	5.0
50A	365	375	340	35	98.2	44.0	239	5.7
65A	415	425	390	35	109.7	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

· Available with nominal size from 300A to 450A (EB-3).

· **EB-2J**



· **EB-2JL**



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	4.6
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

· Available with nominal size from 300A to 450A (EB-4).

EB-11,12

Bellows | Sleeve | Ball
Single type | Double type | PTFE | Copper pipe

EB-11

EB-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

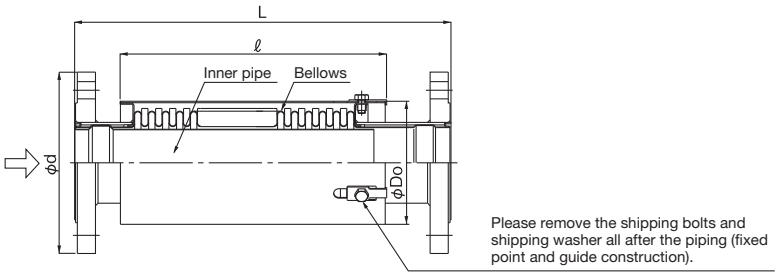
Model		EB-11	EB-12
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	
Maximum pressure		2.0 MPa	
Max. temperature		220℃	
Max. axial extension		35 mm (Expansion 10 mm Compression 25 mm)	70 mm (Expansion 20 mm Compression 50 mm) *
Material	Outer pipe	Carbon steel	
	Bellows, inner 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. (Single type: EB-7, Double type: EB-8)

EB-8

■Dimensions (mm) and Weights (kg)

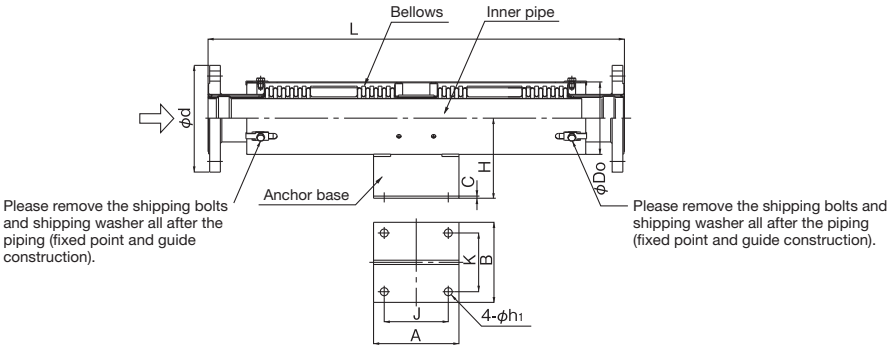
· EB-11



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

· Available with nominal size from 300A to 450A (EB-7).

· EB-12

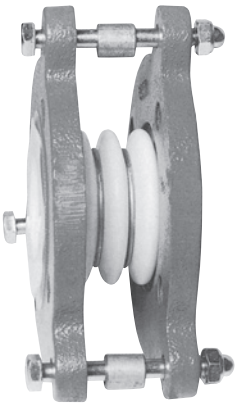


Nominal size	L	Max. operating length	Min. operating length	Max. axial extension δ	Do	d	Dimensions of ancher base·JIS B 2352								Weight
							H	J	K	A	B	C	h_1	Bolt size	
20A	680	700	630	70	60.5	20.6	100	100	60	135	95	3.2	12	M10	4.8
25A	680	700	630	70	60.5	20.6	100	100	60	135	95	3.2	12	M10	5.7
32A	680	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

· Available with nominal size from 300A to 450A (EB-8).

EB-51-3

Bellows | Sleeve | Ball
Single type | Double type | PTFE | Copper pipe



■Features

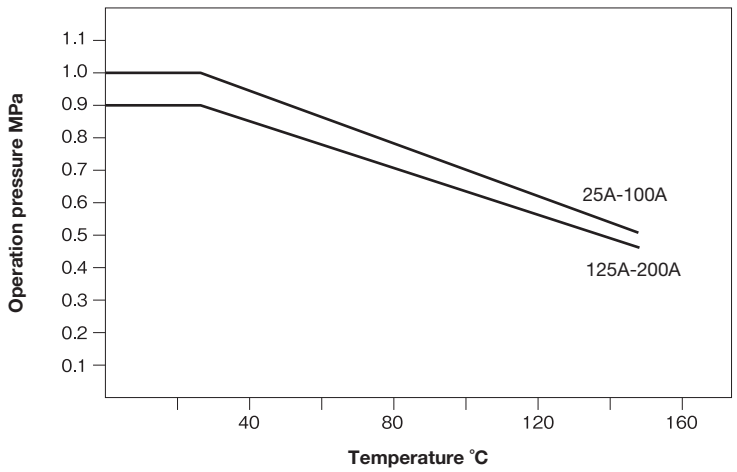
1. Flange and bellows jointed very simple structure.
2. Great chemical resistance by using fluororesin.
3. Fluororesin has outstanding outdoor weather resistance and rarely deteriorate. It can endure to long term storage and using.
4. Non-adhesive and easy inside cleaning.
5. Bellows body has high flexibility since it is made of fluororesin. It is durable to continuous bending vibration and no fatigue.

■Specifications

Threads		3
Application		Cold and hot water, Chemicals, etc.
Maximum pressure		1.0 MPa (refer to working pressure chart)
Maximum temperature		150˚C (refer to working pressure chart)
Connection		JIS 10K RF flanged *
Material	Flange	Ductile cast iron (FCD450)
	Bellows	PTFE

* Flange bolt holes are the tap on both side.

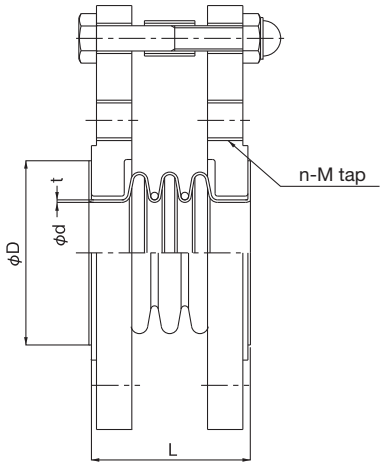
■Working Pressure Chart



Working pressure chart shows the value of standard face-to-face dimension. Please multiply the coefficient below when using at maximum extension and axial displacement.

Max. extension: 0.7
Max. axial displacement: 0.5

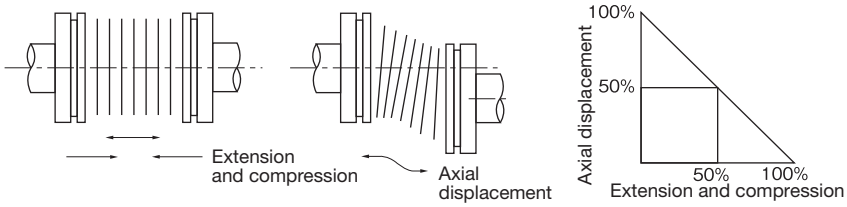
■Dimensions (mm) and Weight (kg)



Nominal size	EB-51-3			Axial displacement	Bellows				Weight
	Face-to-face dimension L	Extension/compression length			Inner diameter d	Flare diameter D	Thickness t	n-M tap	
		+	−						
25A	45	13	13	±6	25	50	1.5	4-M16	1.6
40A	50	13	13	±6	38	73	1.5	4-M16	1.9
50A	70	19	19	±10	49	92	2	4-M16	3.1
65A	75	19	19	±10	63	105	2	4-M16	4.1
80A	85	25	25	±13	73	120	2	8-M16	4.2
100A	85	25	25	±13	97	145	2.5	8-M16	6.0
125A	100	20	30	±3	119	175	2.5	8-M20	10.2
150A	100	20	30	±3	145	205	2.5	8-M20	12.4
200A	110	20	35	±3	196	255	2.5	12-M20	18.3

■Relation between extension/compression length and axial displacement

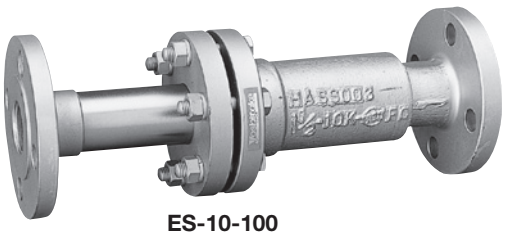
The dimension table indicates the length of extension/compression and axial displacement when these displacements operate separately. Please use at the range in figure below, when both displacements operate together.



$$\frac{\text{Operating extension/compression length}}{\text{Permissible extension/compression length}} + \frac{\text{Operating axial displacement length}}{\text{Permissible extension/compression length}} \leqq 1$$

ES-10,11

Bellows | Sleeve | Ball
Single type | Double type | PTFE | Copper pipe



ES-10-100

■Features

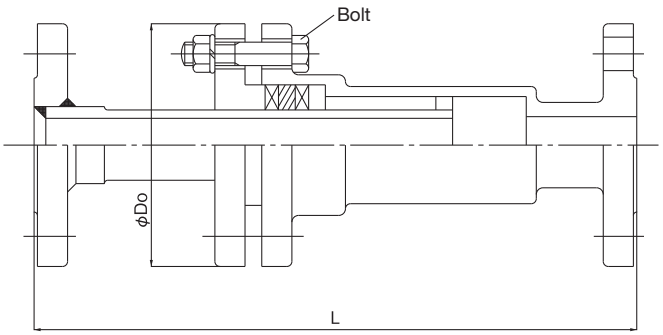
1. Complies with SHASE-S003 Sleeve Type Expansion Joints.
2. Large expansion/compression length can lessen the pipe joint and anchor.
3. No need for lubrication and easy maintenance by original packing. Smooth sliding and excellent airtightness.
4. Outstanding corrosion resistance and wear resistance due to hard chrome plating on the sleeve surface.

■Specifications

Model		ES-10-100	ES-10-200	ES-11-100	ES-11-200
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids			
Maximum pressure		1.0 MPa		2.0 MPa	
Maximum temperature		220˚C			
Max. axial extension		20 mm	40 mm	20 mm	40 mm
Max. axial compression		80 mm	160 mm	80 mm	160 mm
Material	Body	Ductile cast iron *1	Rolled steel	Ductile cast iron or Rolled steel *2	Rolled steel
	Sleeve	Carbon steel (HCr plating)			
Connection		JIS 10K RF flanged		JIS 20K RF flanged	
Pressure resistance test (water)		1.5 MPa		3.0 MPa	

*1 Cast iron for over 250A.
*2 Ductile cast iron for 25 to 100A, and rolled steel for 125 to 300A.

■Dimensions (mm) and Weights (kg)



· ES-10-100 · ES-11-100

Nominal size	Face-to-face dimension L			Max. axial extension δ	Do	Nominal size of bolt thread	Quantity
	Set length	Max. operating length	Min. operating length				
* 20A	380	400	300	100	100(100)	M12 × 60	4
25A	380	400	300	100	114(125)	M12 × 60	4
32A	380	400	300	100	124(135)	M12 × 65	4
40A	380	400	300	100	130(140)	M12 × 65	6
50A	380	400	300	100	142(155)	M12 × 65	6
65A	430	450	350	100	175(175)	M16 × 75	6
80A	430	450	350	100	188(200)	M16 × 75	6
100A	430	450	350	100	216(225)	M16 × 80	8
125A	500	520	420	100	242(270)	M16 × 80	10
150A	500	520	420	100	290(305)	M20 × 90	10
200A	500	520	420	100	340(350)	M20 × 90	12
250A	580	600	500	100	400(430)	M22 × 100	12
300A	580	600	500	100	465(480)	M22 × 110	16

The value in ( ) is dimension of ES-11-100.
* 20A for ES-11-100 is not available.

· ES-10-200 · ES-11-200

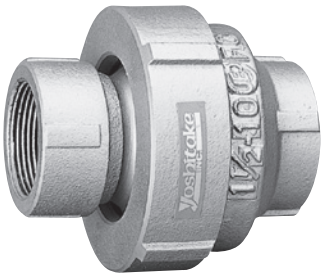
Nominal size	Face-to-face dimension L			Max. axial extension δ	Do	Nominal size of bolt thread	Quantity
	Set length	Max. operating length	Min. operating length				
25A	560	600	400	200	114(125)	M12 × 60	4
32A	560	600	400	200	124(135)	M12 × 65	4
40A	560	600	400	200	130(140)	M12 × 65	6
50A	560	600	400	200	142(155)	M12 × 65	6
65A	600	640	440	200	175(175)	M16 × 75	6
80A	600	640	440	200	188(200)	M16 × 75	6
100A	640	680	480	200	216(225)	M16 × 80	8
125A	640	680	480	200	242(270)	M16 × 80	10
150A	690	730	530	200	290(305)	M20 × 90	10
200A	690	730	530	200	340(350)	M20 × 90	12
250A	740	780	580	200	400(430)	M22 × 100	12
300A	740	780	580	200	465(480)	M22 × 110	16

The value in ( ) is dimension of ES-11-200.

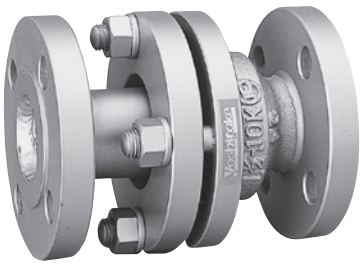
UB-1,2,10,11

Bellows | Sleeve | **Ball**

Single type | Double type | PTFE | Copper pipe



UB-1



UB-10

■Features

1. Capable of absorbing every type of displacement all together, such as expansion, compression, rotation and twist.
2. Suitable to the place where piping space is limited.
3. Outstanding heat, oil, corrosion and wear resistance by original packing.
4. Able to make the anchor and guide smaller, also lessen them.
5. It is strong enough to withstand water hammer, impact, etc.
6. Complies with SHASE-S007 Mechanical Type Displacement Absorption Joints.

■Specifications

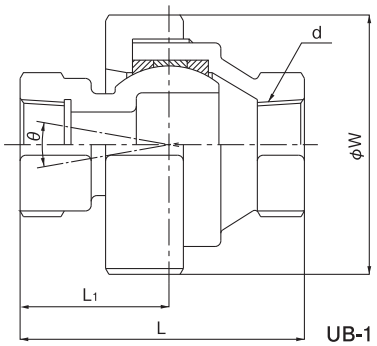
Model		UB-1	UB-2	UB-10	UB-11
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids			
Maximum pressure		1.0 MPa			
Maximum temperature		220˚C			
Maximum displacement angle		30˚	20˚		
Material	Body	Cast carbon steel	Cast carbon steel	Cast iron	Cast carbon steel
	Ball	Cast carbon steel (HCr plating)	Carbon steel (HCr plating)		
	Packing	PTFE			
Connection		JIS Rc screwed	Butt-weld	JIS 10K RF flanged	

· Available with stainless steel made.

■Dimensions (mm) and Weights (kg)

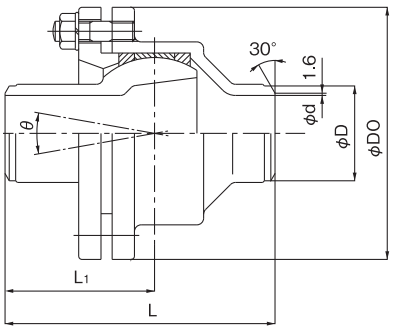
· UB-1

Nominal size	d	L	L_1	ϕW	Displacement angle θ	Weights
20A	Rc 3/4	102	58	93	30˚	1.7
25A	Rc 1	102	58	93	30˚	1.7
32A	Rc 1-1/4	115	63	103	30˚	2.5
40A	Rc 1-1/2	115	63	112	30˚	3.0
50A	Rc 2	130	70	125	30˚	4.5



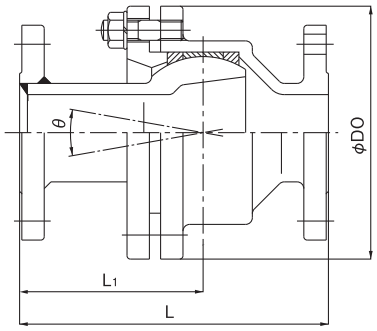
UB-1

· **UB-2**



Nominal size	ϕd	ϕD	L	L1	ϕDo	Displacement angle θ	Weights
50A	52.7	60.5	190	110	160	20°	7
65A	65.9	76.3	220	130	175	20°	11
80A	78.1	89.1	235	130	195	20°	14
100A	102.3	144.3	270	150	235	20°	20
125A	126.6	139.8	310	170	275	20°	30
150A	151.0	165.2	370	190	310	20°	45
200A	199.9	216.3	430	220	380	20°	78
250A	248.8	267.4	480	240	465	20°	145

· **UB-10, 11**



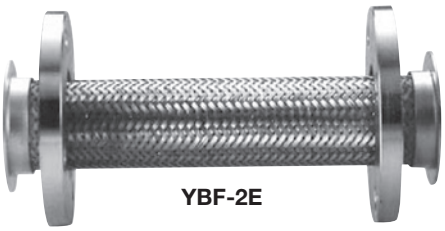
Nominal size	L	L1	ϕDo	Displacement angle θ	Weights
50A	190	110	156(160)	20°	12
65A	220	130	174(175)	20°	17
80A	235	130	194(195)	20°	18
100A	270	150	232(235)	20°	30
125A	310	170	270(275)	20°	45
150A	370	190	310(310)	20°	62
200A	430	220	380(380)	20°	90
250A	480	240	465(465)	20°	155

The value in ( ) is dimension of UB-11.

YBF-1E,2E

Bellows | Sleeve | Ball
Single type | Double type | PTFE | Copper pipe

YBF-1E



YBF-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

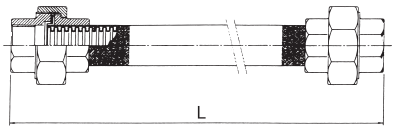
Model		YBF-1E	YBF-2E
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	
Maximum pressure		1.0 MPa	15A-100A 1.0 MPa 125A-200A 0.8 MPa 250A 0.5 MPa
Maximum temperature		220˚C	
Material	Connection	SS400	
	Braid	Stainless steel	
	Bellows	Stainless steel	
Connection		JIS Rc screwed (union joint)	JIS 10K FF flanged (loose flanges on both sides)

· Available with tube made of stainless steel (SUS316L).
· 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.

■Dimensions (mm)

· YBF-1E

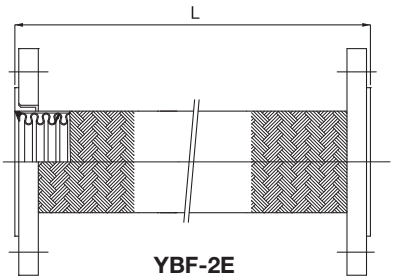
Nominal size	L	Shortest distance between surface
15A	300 500 800 1000	120
20A		150
25A		150
32A		170
40A		180
50A		200



YBF-1E

· YBF-2E

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



YBF-2E

MEMO