JB-17, 18 Type Bellows Expansion Joint

1.6, 2.0MPa

Durable, corrosion resistant 2.0MPa expansion joint with stainless steel bellows. The face-to-face dimensions are the same as those of JB-13, 14 Type compliant with JIS standards.

JB-17 Type

JB-18 Type

FEATURES

- The part contacting with liquid is made of durable and corrosion-resistant stainless steel.
- Absorb expansion and contraction of pipe by thermal changes in the axial direction .

SPECIFICATIONS

Model name(Type)	JB-17(Single)	JB-18(Double)
Code name	JB17-N	JB18-N
Applicable fluid	Steam, air, inert gases, cold or hot water & oils	
Fluid temperature	Max. 250℃	
Applicable pressure	Max. 1.6, 2.0MPa	
End connection	Flanged JIS 16, 20KRF	
Materials	Flange(Carbon steel), External sleeve(Stainless steel), Internal sleeve & Bellows(Stainless steel)	
Pressure test	1.5 times of flange rated pressure. (Hydraulic)	
Expansion amount	45mm	90mm

DIMENSIONS JB-17 Type (Single Type)

(mm)

Size	L	Expansion amount		Mass(kg)
		Expansion	Contraction	
20(¾″)	365	10	35	7
25(1″)	365	10	35	8
32(1¼″)	365	10	35	10
40(1½″)	365	10	35	10
50(2″)	365	10	35	12
65(2½″)	415	10	35	17
80(3″)	415	10	35	19
100(4″)	415	10	35	24
125(5″)	440	10	35	41
150(6″)	440	10	35	53
200(8″)	440	10	35	63
250(10″)	465	10	35	81

Flange code JIS 20KRF

DIMENSIONS JB-18 Type (Double Type)

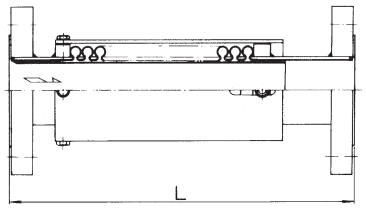
(mm)

Size	L	Expansion amount		H	A	B	T	h	Mass(kg)
		Expansion	Contraction						
20(¾″)	680	20	70	100	100	60	9	12	12
25(1″)	680	20	70	100	100	60	9	12	13
32(1¼″)	680	20	70	120	100	70	9	12	17
40(1½″)	680	20	70	120	100	70	9	12	18
50(2″)	680	20	70	130	100	80	12	15	18
65(2½″)	780	20	70	140	120	100	12	15	26
80(3″)	780	20	70	150	120	110	12	15	32
100(4″)	880	20	70	170	120	130	16	19	45
125(5″)	880	20	70	200	120	150	16	19	67
150(6″)	930	20	70	220	160	180	16	23	92
200(8″)	930	20	70	250	160	220	16	25	125
250(10″)	980	20	70	300	180	280	16	27	173

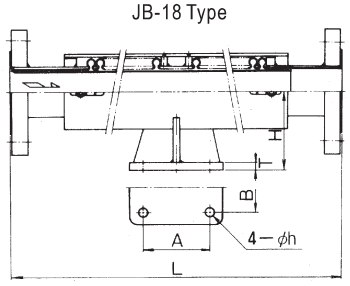
Flange code JIS 20KRF

CONSTRUCTION

JB-17 Type



JB-18 Type



Depending on size, the structure may vary.

POINTS FOR INSTALLATION

- The arrow mark on the main body should match with the flow of fluid.
- Make sure no torsional stress is applied on bellows.
- Remove nuts and washers for fixing faces after piping is completed.

AXIAL DIRECTION LOAD ON MAIN FIXING POINT

Items \ Size(mm)		20	25	32	40	50	65	80	100	125	150	200	250
Bellows' effective area	Ae(mm²)	920	920	2020	2020	3130	5020	6640	11400	17700	24400	43400	62700
Spring constant	K(N/mm)	20	20	38	38	58	89	120	200	310	360	630	880
Load by max. working pressure at 1.0MPa	Fp(N)	1840	1840	4040	4040	6260	10040	13280	22800	35400	48800	86800	125400
Load by max. contraction at 35mm	Fe(N)	700	700	1330	1330	2030	3120	4200	7000	10850	12600	22050	30800
Total load by max. working pressure	Fm=Fp+Fe(N)	2540	2540	5370	5370	8290	13160	17480	29800	46250	61400	108850	156200
Load by hydraulic test pressure at 3.0MPa	(N)	2760	2760	6060	6060	9390	15060	19920	34200	53100	73200	130200	188100

DATA/JB Type Bellows Expansion Joint

■ ABOUT BELLOWS MATERIAL SUS316L (Stainless steel)

The JIS B 2352 Bellows Type Expansion Joint recommends SUS304, SUS304L, SUS316, SUS 316L, and others for making bellows. To ensure durability and corrosion resistance, which are extremely important parameters for high grade bellows, we selected SUS316L for making bellows and all parts that contact with fluid. With higher performance than SUS304, SUS316L is considered having the same or even higher characteristics than SUS304L. See the following table for characteristics of SUS316L and SUS304L.

■ COMPARISON BETWEEN SUS316L AND SUS304L

TABLE1. CHEMICAL COMPOSITION (%)

Type	Carbon C	Silicon Si	Manganese Mn	Phosphor P	Sulfur S	Nickel Ni	Chrome Cr	Molybdenum Mo
SUS316L	0.030 or less	1.00 or less	2.00 or less	0.045 or less	0.030 or less	12.00~15.00	16.00~18.00	2.00~3.00
SUS304L	0.030 or less	1.00 or less	2.00 or less	0.045 or less	0.030 or less	9.00~13.00	18.00~20.00	—

TABLE2. MECHANICAL PROPERTY

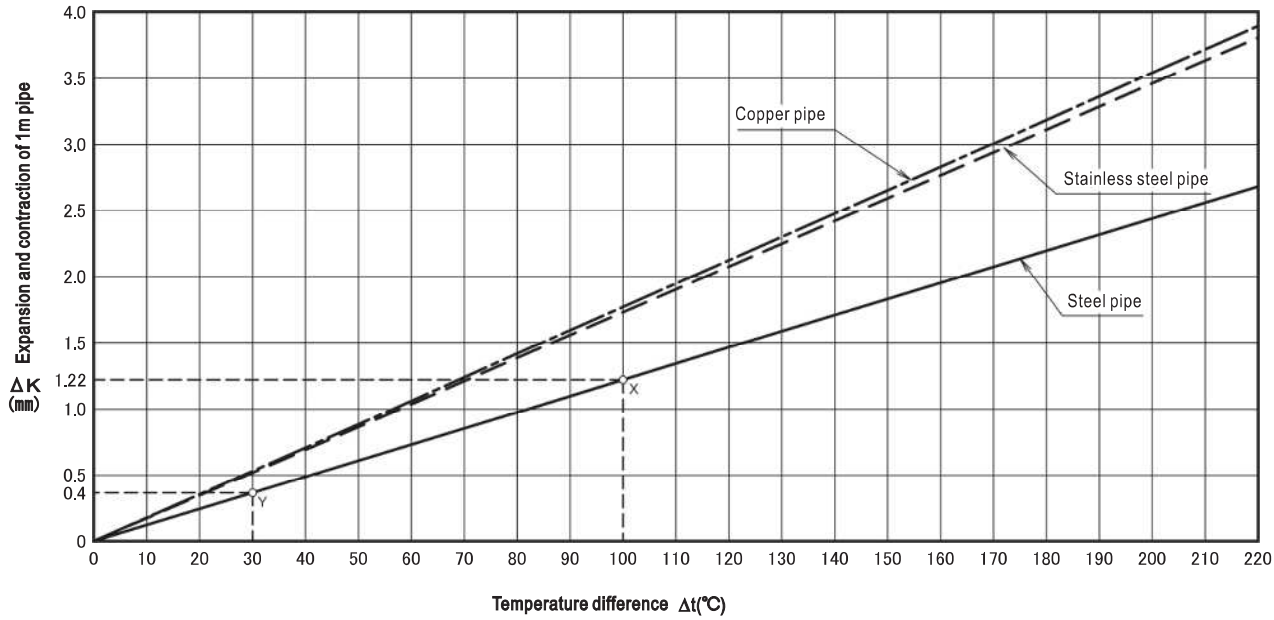
Type	Tensile test			Hardness test		
	Yield Strength N/mm²	Tensile N/mm²	Elongation %	HB	HRB	HV
SUS316L	175 or more	480 or more	40 or more	187 or less	90 or less	200 or less
SUS304L	175 or more	480 or more	40 or more	187 or less	90 or less	200 or less

TABLE3. ANTICORROSION

Type	All surface corrosion	Intercrystalline corrosion	Stress corrosion crack	Porous corrosion	Gap corrosion
SUS316L	○	○	◎	◎	◎
SUS304L	○	○	○	○	○

＊○:Superior ◎:Much superior

■ FIG.1 EXPANSION AND CONTRACTION OF 1m PIPE



■ SELECTING EXPANSION JOINT

Determine the type and number of expansion joints based on the material of pipe and change of temperature, which are factors affecting expansion/ contraction of pipe.

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

$$\Delta \ell = \beta \times \Delta t \times \ell$$

n : number of joints
δ :max. expansion/contraction of joint (mm)
Δℓ : expansion/contraction of pipe (mm)
β : linear expansion coefficient of pipe (mm/m/℃)
Steel pipe (12.2×10^{-3})
Copper pipe (17.7×10^{-3})
Stainless steel pipe (17.3×10^{-3})

Δt : temperature difference (℃)
ℓ : length of pipe (m)

● Example

Under the following conditions:
Length of pipe (ℓ): 35m
Max. working temperature (t_1): 120℃
Min. ambient temperature (t_2): −10℃
Ambient temperature at the time of installation (t_3): 20℃
Determine the type and number of expansion joints.
The pipe is steel pipe and the joint is to be determined based on standard face-to-face dimensions.

DATA/JB Type Bellows Expansion Joint

Step 1: Calculate expansion/contraction of pipe

Temperature difference at the expansion side of pipe:

$\Delta t_1 = t_1 - t_3 = 120 - 20 = 100℃$

Temperature difference at the contraction side of pipe:

$\Delta t_2 = t_3 - t_2 = 20 - (-10) = 30℃$

According to point X in Fig.1,

Expansion of 1m pipe $\Delta k_1 = 1.22mm$

According to point Y in Fig.1,

Contraction of 1m pipe $\Delta k_2 = 0.366mm$

Therefore,

The expansion of 35m pipe is:

$\Delta \ell_1 = k_1 \times \ell$

$= 1.22 \times 35 = 42.7mm$

The contraction is:

$\Delta \ell_2 = k_2 \times \ell$

$= 0.366 \times 35 = 12.81mm$

Step 2: Determine type and number of joints

For selecting JIS certified JB-13, 21 (single type),

The expansion side of pipe (δ=25mm): $n = \frac{\Delta \ell_1}{\delta} = \frac{42.7}{25} = 1.71$

The contraction side of pipe (δ=10mm): $n = \frac{\Delta \ell_2}{\delta} = \frac{12.81}{10} = 1.281$

The number of joints should be the larger one, i.e., 2.

For selecting compliant with JIS JB-14, 22 (double type),

The expansion side of pipe (δ=50mm): $n = \frac{\Delta \ell_1}{\delta} = \frac{42.7}{50} = 0.854$

The contraction side of pipe (δ=20mm): $n = \frac{\Delta \ell_2}{\delta} = \frac{12.81}{20} = 0.641$

The number of joints should be the larger one, i.e., 1.

To select other types of joints, follow the same steps as above mentioned.

■ POINTS FOR INSTALLATION

- The arrow mark on the main body should match with the flow direction of fluid.
- Make sure no torsional stress is applied on bellows.
- The following parts are for fixing faces and need to be removed after piping is completed.

  JB-13~18: nut and washer

  JB-21~24: set bolt

■ POINTS FOR HANDLING

1. Fixing point

Fixing point with sufficient strength are necessary for installing expansion joint. The position and type of fixing point are the following.

① Main fixing point

- The end of straight pipe where closing plate is installed;
- Bending pipe where the direction of flow changes;
- Between two expansion joints, where reducer is used to change the diameter of pipe;
- Pipe between two expansion joints, where valve is installed;
- The inlet of branch pipe where free expansion joint is installed.

② Intermediate fixing point

- In the middle of two expansion joints between main fixing point;
- Anchor base (installation position) of double type expansion joint.

2. Guide and pipe support

① Guide

To ensure correct expansion and contraction of expansion joint, the axes of expansion joint and pipe must match with each other. In addition, it is necessary to use guides to transmit the force for the movement in axial direction to fixing points. The guides need to be installed according to the following intervals.

The deviation of pipe axes is ±2mm for size 125mm or smaller pipes, and ±3mm for size 150mm or larger pipes. The deviation of degree of parallelization of pipe should be within ±2°.

L_1: The interval between expansion joint and No.1 guide.

L_2: The interval between No.1 guide and No.2 guide.

L_3: The interval between No.2 guide and middle guide.

Load on main fixing point of main straight pipe Fm (N)

$Fm = Fp + Fe$

$Fp = Ae \times P$

$Fe = K \times S$

Load on main fixing of bending pipe Fb (N)

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

$Fc = \left(\frac{2A\rho V^2}{g} \sin\frac{\theta}{2} \right) \times 98.0665$

Load on intermediate fixing Fi (N)

$Fi = Fe$

Fp: Load in axial direction due to internal pressure	(N)
Fe: Load due to specified contraction	(N)
Ae: Effective area of bellows	(mm^2)
P : Working pressure	(MPa)
K : Bellows spring constant	(N/mm)
S : Expansion/contraction	(mm)
θ : Bending angle of pipe (See Fig.5 Piping example)	
Fc: Load due to centrifugal force of fluid	(N)
A : Cross sectional area of pipe	(cm^2)
ρ : Density of fluid	(g/cm^3)
V : Velocity of flow	(m/s)
g : Acceleration of gravity	($980cm/s^2$)

Fig.2-1 Interval of guides

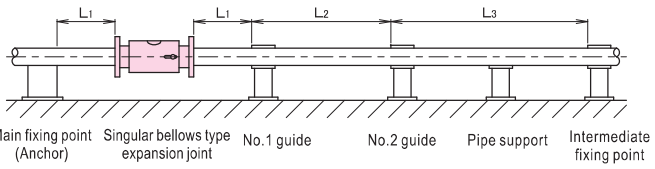
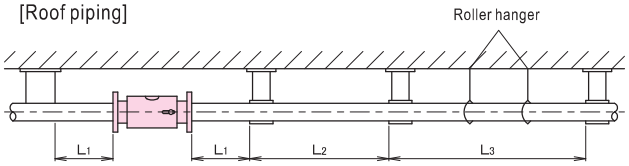


Fig.2-2 Example of roof piping

[Roof piping]



Note: The pipe may buckle if only roller hanger is used. In this case, guides are necessary.

DATA/JB Type Bellows Expansion Joint

The maximum interval between guides can be calculated using the following formula.
The interval (max.) between intermediate guides (L_3) can also be determined using Fig.3.

$L_1 \leqq 4D$

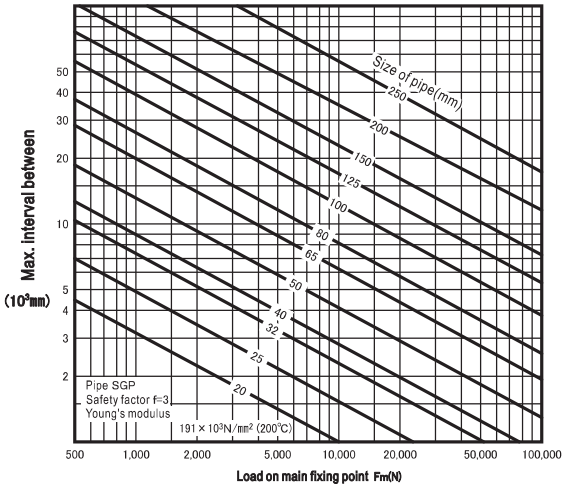
$L_2 \leqq 14D$

$L_3 \leqq \sqrt{\frac{\pi^2 EI}{fFm}}$ $\quad I = \frac{\pi}{64}(D^4 - d^4)$

L_1, L_2, L_3: Interval between guides (max.)	(mm)
D: External diameter of pipe	(mm)
d: Internal diameter of pipe	(mm)
E:Young's modulus at the designed temperature of pipe material	(N/mm^2)
Steel pipe 200℃:	$191\times10^3 N/mm^2$
Stainless steel pipe 200℃:	$183\times10^3 N/mm^2$
Copper pipe 200℃:	$116\times10^3 N/mm^2$
I: Secondary moment of the cross section of pipe	(mm^4)
f: Safety factor	(3 or larger)
Fm: Load on main fixing point	(N)

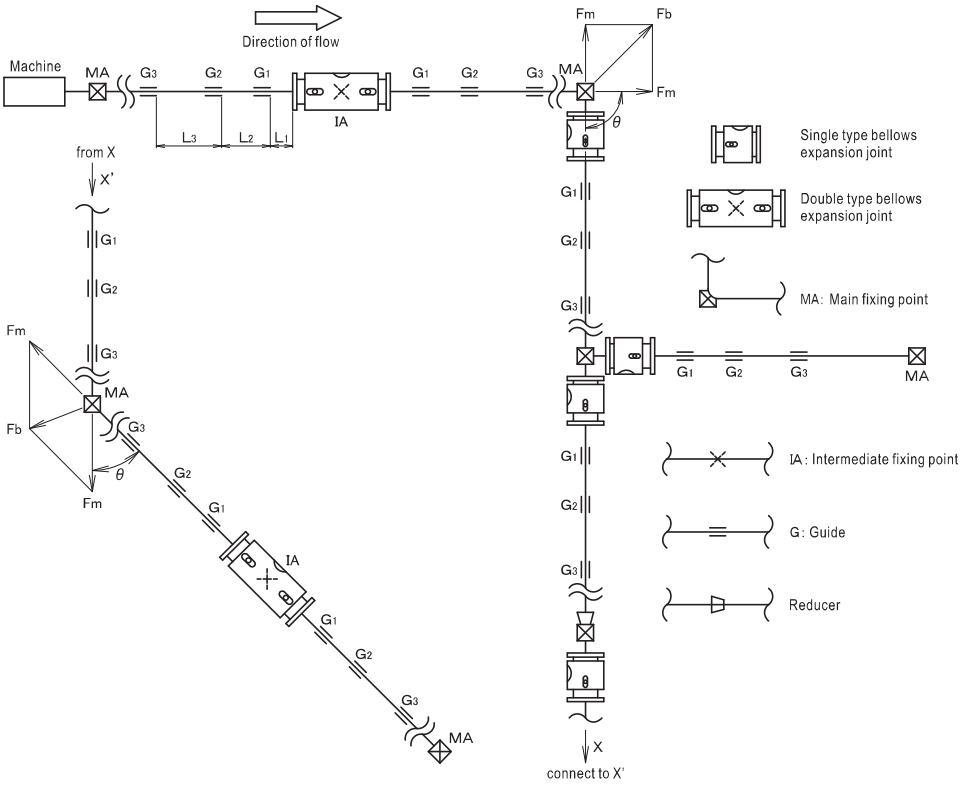
② Pipe supporting
Install roller support or roller hanger guide to prevent pipe from bending due the weight of pipe or fluid.

Fig.3 Max. interval between intermediate guides



Note: See Page 185 for STPG (carbon steel)pipe.

Fig. 5 Piping example



Note: Carry out axes matching before installing expansion joint.

Fig.4 Fixing point and guide (example)