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(JSPE/JSA)

Bellows type expansion joints

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Society of Piping Engineers of Japan (JSPE)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently, **JIS B 2352:2005** is replaced with this Standard.

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Bellows type expansion joints

Introduction

This Japanese Industrial Standard has been prepared based on the first edition of **ISO 15348** published in 2002, with some modifications of the technical contents to fit them to the actual situation in Japan.

Annex JC contains instruction notes and installation regulations for the design and execution of piping using the bellows type expansion joints. The portions given continuous sidelines or dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with the explanations is given in Annex JE.

1 Scope

This Standard specifies characteristics of bellows type expansion joints (hereafter referred to as “expansion joints”).

It applies to metal expansion joints equipped with one or more corrugated bellows of circular cross-section.

NOTE : The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 15348:2002 *Pipework—Metal bellows expansion joints—General* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 0151 *Iron and steel pipe fittings—Vocabulary*

JIS B 0202 *Parallel pipe threads*

NOTE : Corresponding International Standard: ISO 228-1:1994 *Pipe threads where pressure-tight joints are not made on the threads—Part 1: Dimensions, tolerances and designation* (MOD)

JIS B 0203 *Taper pipe threads*

NOTE : Corresponding International Standard: ISO 7-1:1994 *Pipe threads where pressure-tight joints are made on the threads—Part 1: Dimensions, tolerances and designation* (MOD)

JIS B 2220 *Steel pipe flanges*

JIS B 2311 *Steel butt-welding pipe fittings for ordinary use*

JIS B 2312 Steel butt-welding pipe fittings

JIS B 2313 Steel plate butt-welding pipe fittings

JIS B 8265 Construction of pressure vessel—General principles

JIS G 4305 Cold-rolled stainless steel plate, sheet and strip

JIS G 4902 Corrosion-resisting and heat-resisting superalloy plates and sheets

ISO 7268 Pipe components—Definition of nominal pressure

ISO 9328-5 Steel flat products for pressure purposes—Technical delivery conditions—Part 5: Weldable fine grain steels, thermomechanically rolled

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in the following and **JIS B 0151** apply.

3.1 expansion joint

pipe joint used to absorb axial, angular, lateral and/or other movements by means of expansion, contraction and/or bend of one or more bellows (see **4201** of **JIS B 0151**)

3.2 corrugation

element of the bellows to flexibly expand, contract and bend

3.3 bellows

expansion element made from one or more plies, with one or more corrugations/convolutions and with or without end cuffs

NOTE : It can be reinforced with rings.

3.4 ply

constituent element of the wall of the bellows

NOTE : The wall can be made from one or more plies.

3.5 cuff

cylindrical section situated at one or both of the ends of the bellows integrated with the corrugations

To be used for the portion of welding attachment.

3.6 cuff reinforcement collar

ring placed around the cuff to reinforce it against the effect of internal pressure and hence reduce deformation

3.7 root-reinforcing ring

element fitted outside or inside a bellows in a corrugation/convolution root, conforming to the shape of the root, to prevent its deformation under internal or external pressure

NOTE 1 When placed between two corrugation/convolutions, it is called an intermediate reinforcing ring. When placed at the end, it is called an end corrugation/convolution-reinforcing ring.

NOTE 2 The adjusting ring mentioned in **JB.3.4.4** is also included in root-reinforcing rings.

3.8 welding ring

ring placed around the cuff to facilitate welding

NOTE 1 Where the bellows has a thickness sufficient for welding, it is not required to be provided with welding rings.

NOTE 2 Although this term is not used in this Standard, the definition is given here for conformity with the corresponding International Standard.

3.9 internal sleeve

element which allows a satisfactory flow of medium and protects the bellows from erosion and flow-induced vibrations

NOTE : It is designed so that it does not restrict the movement of the expansion joint.

3.10 pressure thrust

axial force arising from internal pressure (see F_s in **JC.2**)

3.11 end fittings

fittings (usually weld ends or flanged ends) by means of which expansion joints are connected to the piping system or to equipment

For expansion joints for small size pipes, threaded fittings may be used as end fittings.

3.12 restraining components

mechanical components (tie-rods, tie-bars, hinges, gimbal rings, etc.) designed to resist pressure thrust and external loads

NOTE : They are attached to end fittings with carrier flanges, brackets or reinforcing gussets.

3.13 guide elements

components used for maintaining coaxiality during movement

3.14 external shroud

cover around the bellows, which provide limited protection of the bellows against mechanical shock, and spark or spatter of welding

3.15 stroke indicator

device that, in normal service, indicates the movement of the bellows

NOTE 1 If the design movement is exceeded, the device may distort permanently to indicate that an abnormal function of the system has occurred.

NOTE 2 Although this term is not used in this Standard, the definition is given here for conformity with the corresponding International Standard.

3.16 movement distributor

device mounted on an expansion joint containing several bellows that limits each of them to work within their designed movements

NOTE : Although this term is not used in this Standard, the definition is given here for conformity with the corresponding International Standard.

3.17 adjusting device

device to enable the bellows to be pre-set to given dimensions, or to meet special installation requirements

NOTE : It may also serve as shipping bars.

3.18 shipping bar

device that secures the expansion joint in a position determined by the manufacturer, so that the face-to-face length does not change during the period of shipment, handling and installation

3.19 movements

3.19.1 axial movement

movement causing axial extension (expressed in positive number) or compression (expressed in negative number) of an expansion joint

Its magnitude is regarded as the quantity of axial movement (see x_e and x_c in **JB.3.2**).

3.19.2 angular movement

movement causing bending of axis of an expansion joint in positive (expressed in negative number) or reverse (expressed in positive number) side

Its magnitude is regarded as the quantity of angular movement (see θ_n and θ_o in **JB.3.2**).

3.19.3 lateral movement

movement normal to the axis of an expansion joint in positive (expressed in negative number) or reverse (expressed in positive number) side

Its magnitude is regarded as the quantity of lateral movement (see y_n and y_o in **JB.3.2**).

3.20 spring rate

force, axial, angular or lateral in nature, or moment necessary to produce a unit deflection (1 mm or 1 rad) of the expansion joint

NOTE : For the calculation of reaction force and reaction bending moment of expansion joints, the spring rate per convolution of bellows is to be used (see **JB.3.4.1.3**).

3.21 cycle

full movement, from an initial position to the given working position and back, under the working conditions specified

NOTE : The number of the full movements cycled under the designated working conditions is regarded as the cycle life.

3.22 width of bellows convolution

outer width of convolution at the mean diameter of bellows

3.23 tie rod

part that serves as a guide to allow expansion or contraction in the axial direction, serves the role of self-weight receptacle, prevents joint damage due to anchor failure, or serves the role in charge of thrust caused by internal pressure

4 Types of expansion joints

4.1 General

There are four principal types of expansion joint, which are designated according to the movements absorbed (see 4.2 to 4.5 and table 1).

4.2 Axial expansion joint

This type mainly absorbs axial movement. Pressure thrust will act for the loading onto main anchor.

When pressure-balanced, it restrains pressure thrust.

4.3 Angular expansion joint

This type absorbs angular movement. When fitted with hinges, it allows movement in a single plane and normally be used in a set of two or three joints. When fitted with gimbal rings, it allows movement in any plane.

These restrain pressure thrust.

NOTE : Normally used in a set of two gimbal and single hinged expansion joints.

4.4 Lateral expansion joint

This type absorbs lateral movement. An angular movement is also permissible when the joint is fitted with two tie rods.

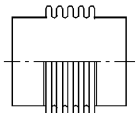
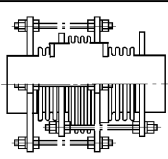
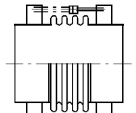
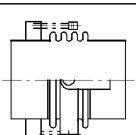
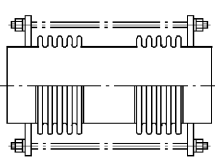
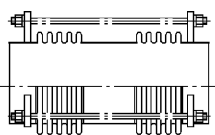
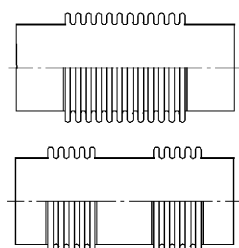
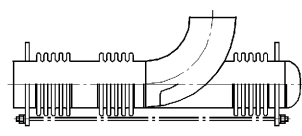
The tie-rod fitted expansion joint restrains pressure thrust.

NOTE : Those fitted with three or more tie rods allow lateral movement, with its two end faces capable of shifting in parallel.

4.5 Universal expansion joint

This type absorbs movements in all planes. Pressure thrust acts on main anchor. In the case of pressure-balanced expansion joint, it does not act on main anchor.

Table 1 Types of bellows type expansion joint

Type	Design	Pressure thrust restraint	Movement ^{a)}				
			Axial	Angular		Lateral	
				Single plane	Multi-plane	Single plane	Multi-plane
Axial	Unrestrained 	No	○	(○)	(○)	(○)	(○)
	For straight run pipe Balanced 	Yes	○	—	—	(○)	(○)
Angular	Hinged 	Yes	—	○	—	—	—
	Gimbals 	Yes	—	○	○	—	—
Lateral	Two tie rods (tie bars) 	Yes	—	○	—	○	○
	Three or more tie rods (tie bars) 	Yes	—	—	—	○	○
Universal	Unrestrained, with one or two bellows 	No	○	○	○	○	○
	For curved pipe Balanced 	Yes	○	○	—	○	○
Note ^{a)} ○: Applicable (○): Limited use —: Not applicable							

5 Information to be supplied by the purchaser

The purchaser shall state, as a minimum, the following in all enquiries and orders:

- a) the expansion joint type (see table 1);
- b) the nominal size;
- c) the maximum working pressure (the design pressure);
- d) the maximum working temperature (the design temperature);
- e) the movements;
- f) the materials;
- g) the fittings.

Dependent on the application, the relevant details listed in Annex A shall also be given.

6 Materials

The selection of materials for use in an expansion joint shall take into consideration the information provided in clause 5 and technical-data sheet in Annex A.

When the purchaser specifies the materials, the manufacturer shall approve them.

A table of materials of expansion joints and relation between strength and temperature is given in Annex B.

When selecting materials, they shall whenever possible conform to Japanese Industrial Standards.

However, the materials given in overseas standards as shown in Annex JA that are equivalent to these may be used.

NOTE 1 The resistance to corrosion of the material used for the bellows is of particular importance as the bellows wall is usually much thinner than the wall of the connecting pipe. It is advisable to choose a material with sufficiently high resistance to corrosion rather than to increase the wall thickness.

MOTE 2 A risk of bellows corrosion may originate not only from the internal flow medium, but also from the external environment surrounding the expansion joint.

7 Dimensions and tolerances

7.1 End fitting dimensions

The dimensions and tolerances of end fittings, when the test is performed in accordance with 11.4, shall be in accordance with the following:

- a) Flanges: JIS B 2220.
- b) Welding ends: JIS B 2311, JIS B 2312 and JIS B 2313.
Further, they may also be with the groove form required by the purchaser.
- c) Threaded ends:
 - 1) taper pipe threads: **JIS B 0203**;
 - 2) parallel pipe threads: **JIS B 0202**.

7.2 Overall length

The overall length of an expansion joint, when the test is performed in accordance with 11.4, shall be within the tolerance defined in table 2.

Table 2 Tolerances on overall length

Unit: mm

Nominal size	Overall length			
	up to 500	501 to 1 000	1 001 to 4 000	greater than 4 000
	Tolerance			
up to 100A	± 3	± 4	± 6	± TL
125A to 400A	± 4	± 5	± 8	± TL
450A to 1 000A	± 6	± 8	± 10	± TL
greater than 1 050A	± TL	± TL	± TL	± TL
TL: To be agreed by the purchaser.				

8 Design

8.1 Design conditions

Expansion joints shall be designed for the conditions stated in clause 5 and the technical-data sheet Annex A.

8.2 Nominal size

Nominal size of expansion joints shall be selected from Annex C.

8.3 Pressure

Expansion joints shall be designed to be in accordance with the nominal pressure (PN or K) defined in **ISO 7268** or **JIS B 2220** as shown in Annex D.

For expansion joints to be designed not in accordance with the nominal pressure, the pressures indicated in clause 5 (maximum working pressure or design pressure) shall apply.

8.4 Maximum permissible pressure at working temperature

The maximum permissible pressure of the expansion joint at the working temperature, when it is designed according to nominal pressure (PN or K), shall be the nominal pressure PN, reduced by the factors given in table B.1, or the nominal pressure K specified in **JIS B 2220**.

For expansion joints to be designed not according to the nominal pressure, the stress restrictions by every temperature given in tables B.2 and B.3 shall apply. For those in the table without the stress restriction, the alternative materials listed in Annex JA, that are equivalent materials specified in ASME, shall be used.

8.5 Cyclic life

Where the purchaser has not specified a requirement for cyclic life, the number of cycles shall be 1 000.

9 Performance

9.1 Pressure-tight

An expansion joint, when subjected to the pressure test according to **11.2**, shall be free from fracture, leakage or other faults.

9.2 Appearance

An expansion joint, when inspected for the appearance according to **11.2**, shall satisfy the following.

- a) When an expansion joint is provided with a reinforcing component and a restraining component, these shall be free from any abnormal deformation that obstructs movement of the expansion joint.
- b) In the appearance test after releasing the pressure, there shall be no deformation exceeding 7 % in the width of bellows convolution at the mean diameter and there shall be no permanent deformation, cracks of weld or flaws detrimental to use on end pipes, pipe flanges and pressure resistant components.
- c) The internal surface shall be clean and free from adhesion of foreign bodies.

9.3 Leakage

An expansion joint, when inspected for leakage according to **11.3**, shall be free from any leakage.

9.4 Strength

When a sample identical to the product is manufactured and subjected to the following strength verification tests which are destructive, it shall satisfy each of the specified performance requirements.

- a) **Cyclic performance** When the test is carried out according to **11.5**, there shall be no abnormalities such as leakage.
- b) **Corrugation deformation performance** When the test is carried out according to **11.6**, there shall be no deformation exceeding 7 % in rate in the width of bellows convolution.
- c) **Buckling-proof performance** When the test is carried out according to **11.7**, there shall be no change in pitch of the corrugations of bellows exceeding the specified rate of deformation. This shall not be applied to the bellows with a root-reinforcing ring.
- d) **Proof-pressure burst performance** When the test is carried out according to **11.8**, there shall be no leakage even if the bellows has undergone deformation.

10 Manufacture

The manufacturing methods used shall ensure that the expansion joint conforms to the requirements specified in clause **8**.

All welding procedures employed in the manufacture of expansion joints shall be performed by qualified welders in accordance with the welding regulation corresponding to the “applicable standard and regulations” as given in Annex A.

11 Test methods

11.1 General

Unless otherwise specified by the purchaser, the test shall be carried out at room temperature. The tests specified in **11.5** to **11.8** are type tests, which are carried out on the sample prior to the initial delivery of the products. The tested samples shall be clearly distinguished from the unused products and shall not be delivered.

11.2 Pressure test and appearance test

This test shall be carried out before the dimensional test in **11.4**. When the procedure of the pressure test is not otherwise specified, the following method shall be used.

- a) The test medium should preferably be water at ambient temperature.
If fluids other than water are to be used, additional precautions may be necessary.
- b) The test pressure shall be 1.5 times the design pressure selected in **8.3** and shall be held for 5 min or more.

The test medium may also be gas, with the test pressure being 1.25 times the pressure defined in **8.3** employed. In this case, however, before the pressure test, a non-destructive test shall be carried out to check the soundness of the weld subjected to pressure.

- c) The test pressure shall be applied and maintained for a sufficient length of time to permit a visual examination of all the surface and welded joints of an expansion joint. When the expansion joint is provided with a reinforcing component and restraining component, it shall be checked whether there is any abnormal deformation that obstructs movements of the expansion joint at the time of the pressure test.
- d) In the appearance test after releasing the pressure, the existence of any deformation exceeding 7 % in the width of bellows convolution at the mean diameter and any permanent deformation, crack of weld or flaws detrimental to use on end pipes, pipe flanges and pressure resistant components shall be checked.
- e) It shall be checked whether the internal surface is clean and free from adhesion of foreign bodies.

11.3 Leakage test

Apply the air pressure specified in **8.3** and immerse the sample in water for 1 min or longer with the sample held at a free length or a length after adjustment setting, and then examine for sign of leakage, i.e. presence of air bubbles. An alternative method which does not require immersion is to apply a foam agent on the sample, and after holding for 5 min or longer, check the presence of air bubbles which indicates leakage.

11.4 Dimensional test

It shall be checked by a suitable measuring instrument whether the overall length of the expansion joint and the dimensions of the end fittings are in the range of tolerance on dimensions specified in clause **7**.

11.5 Cyclic test

The movement specified in clause 5 shall be actuated repeatedly with the pressure specified in 8.3 applied to the expansion joint. The test speed shall be in the range not exceeding 20 cycles per min, and it shall be checked whether there are any abnormalities such as leakage at 1 000 cycles or the number of cycles agreed with the purchaser.

For the application of the pressure specified in 8.3, non-pressure (atmospheric pressure) may be applied as agreed with the purchaser.

11.6 Corrugation deformation test

A pressure at least 1.5 times the pressure specified in 8.3 shall be applied to the expansion joint for 5 min. It shall be checked whether, after releasing the pressure, the width of bellows convolution at its mean diameter has any deformation at any point on its circumference.

11.7 Buckling test

A pressure of 2.25 times the pressure specified in 8.3 shall be applied to the expansion joint for 5 min. It shall be checked whether, after releasing the pressure, there is any change in pitch of the corrugations of the bellows exceeding 15 % of its initial value at the time of non-pressure.

In addition, for the expansion joint designed in accordance with Annex JB, 1.5 times the pressure may be applied as agreed with the purchaser.

11.8 Burst test

A pressure of 4 times the pressure specified in 8.3 shall be applied to the expansion joint for 5 min. It shall be checked whether, after releasing the pressure, there is any leakage in the expansion joint. There shall be no leakage even if the joint has undergone deformation.

12 Inspection methods

12.1 In-process inspection during production

The manufacturer shall be responsible for carrying out the in-process inspection of products during production. The in-process inspection shall be carried out in the production process, and in the following order: the material acceptance inspection in which the conformance of the material to the requirements in clause 6 is checked, the welding inspection in which the matter specified in clause 10 is checked, the pressure inspection, the appearance inspection, the leakage inspection and the dimensional inspection.

12.2 Delivery inspection

The delivery inspection is an inspection to be carried out by the manufacturer before the delivery of the products, on the inspection items described in 12.3 to 12.6 unless otherwise specified by the purchaser. The delivery inspection need not overlap with the in-process inspection.

12.3 Pressure inspection and appearance inspection

When the pressure and appearance inspections are carried out in accordance with **11.2**, requirements in **9.1** and **9.2** shall be satisfied.

12.4 Leakage inspection

When the leakage inspection is carried out in accordance with **11.3**, requirements in **9.3** shall be satisfied.

12.5 Dimensional inspection

When the dimensional inspection is carried out in accordance with **11.4**, requirements in **9.4** shall be satisfied.

12.6 Type inspection

12.6.1 General

The type inspection is required to be carried out by the manufacturer only once before the first delivery of the products.

12.6.2 Inspection procedure

The type inspection shall be carried out according to either of the following procedures. However, the type inspection may be omitted upon agreement between the purchaser and the manufacturer if the calculated results by the strength evaluative regulation of expansion joints given in Annex JB are confirmed to meet the requirements defined in the technical-data sheet of Annex A.

In both instances of **a)** and **b)**, the same tests are applicable, and they differ only in the number of test specimens subjected to each of the tests.

- a) Range of expansion joints (expansion joints of continuous lot production)**
A range of expansion joints with different bore diameters shall be inspected in accordance with **12.6.5** to **12.6.8**. Examples of product specifications of expansion joints of maximum working pressure 1 MPa are shown in Annex JD for information.
- b) Individual expansion joints (expansion joints of individual production)**
A number of identical expansion joints shall be inspected in accordance with **12.6.5** to **12.6.8**. Examples of product specifications of expansion joints of maximum working pressure 1 MPa are shown in Annex JD for information.

12.6.3 Range of expansion joints—Test quantities and inspection parameters

- 25 expansion joints for the cyclic inspection (see **12.6.5**);
- 5 expansion joints for the corrugation deformation inspection (see **12.6.6**);
- 10 expansion joints for the buckling inspection (see **12.6.7**).
- 5 expansion joints for the burst inspection (see **12.6.8**);

The expansion joints shall be chosen so that at least two of the following parameters are different:

- pressure;

- diameter;
- corrugation profile (height, pitch and thickness);
- movement.

12.6.4 Individual expansion joints—Test quantities and inspection parameters

Three expansion joints shall be used for each of the four inspections specified in 12.6.2 b).

The test quantities and inspection parameters may be determined as agreed with the purchaser.

12.6.5 Cyclic inspection

When the cyclic inspection is carried out in accordance with 11.5, all the samples tested shall satisfy the requirements in 9.4 a).

12.6.6 Corrugation deformation inspection

When the corrugation deformation test is carried out in accordance with 11.6, all the samples tested shall satisfy the requirements in 9.4 b).

12.6.7 Buckling inspection

When the buckling test is carried out in accordance with 11.7, requirements in 9.4 c) shall be satisfied.

12.6.8 Burst inspection

When the burst test is carried out in accordance with 11.8, requirements in 9.4 d) shall be satisfied.

13 Designation of products

Products shall be designated by the number or title of this Standard, bellows construction, the coupling type, symbol of use, nominal pressure and nominal diameter of expansion joint (see examples 1 and 2 below).

Example 1 **JIS B 2352** With rod, without root-reinforcing ring, double bellows, welding type B10-200

Example 2 Bellows type expansion joints, with outer cylinder, single bellows, flange type A10-100

14 Marking

Each expansion joint found to conform to all the requirements of this Standard shall be marked with the following information or bear a nameplate marked with the following information:

- a) the number or title of this Standard: Example **JIS B 2352**;
- b) the manufacturer's name or trademark;
- c) the nominal size;

- d) the pressure (nominal pressure, maximum working pressure or design pressure);
- e) the date of manufacture or their abbreviation
- f) the arrow indicating the direction of the flow (when provided with inner cylinder)
(applicable only to the main body)
- g) additional information may be added at the purchaser's request or to ensure traceability.

Annex A (normative)

Technical-data sheet of expansion joints

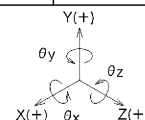
The data sheet specified in this Annex is to be filled out by the purchaser and presented to the manufacturer.

Customer's name:
Title of works:
No. of works:
Document No.:

History			
Recognition			
Verification			
Preparation			
Date			

1	Symbol				
2	Type				
3	Nominal size				
4	Number of units				
5-1	Pressure	Maximum working		MPa	
5-2		Normal working		MPa	
6-1	Temperature	Maximum working		°C	
6-2		Max./min.		°C	
6-3		Attaching temperature		°C	
7-1	Medium	Name of medium			
7-2		Velocity of medium	V	m/s	
7-3		Direction of medium			
8-1	Strength evaluative regulation	Calculation formulae (I, II), others			
8-2	Design movement	Axial contraction	Xc	mm	
8-3		Axial extension	Xe	mm	
8-4		Lateral movement	Y	mm	
8-5		Lateral movement	Z	mm	
8-6		Angular movement	θ	rad.	
8-7		Cycle life	Ns	cycle	
9-1	Test pressure	Pressure test		MPa	
9-2		Leakage test		MPa	
10-1	End fittings	Flange fittings	Standard		
10-2		End pipe	Outer diam./thickness		
10-3		Others			
11-1	Materials	Bellows			
11-2		Flange			
11-3		End pipe			
11-4		Internal sleeve			
11-5					
12-1	Accessories	With/without rods (tie rod/limit rod)			
12-2					
13-1	Load restrictions	Axial		N	
13-2		Lateral		N	
13-3		Bending moment		N • m	
14	Installation (vertical/horizontal)				
15	Vibrations (amplitude/frequency)	μm	Hz		
16	Applicable standard and regulations				
17-1	Inspection and test	Material • RT • PT			
17-2		Dimensions, appearance			
17-3		Other tests required by the purchaser			
18-1	Painting	External (with/without specifications)			
18-2		Internal (with/without specifications)			
19	Submitted documents				
20	Others				

* Besides application of this table, supplementary specifications, drawings, etc. are to be appended separately.



Annex B (normative)

Materials and relationship between the strength and temperature

The materials used for expansion joints and the relationship between the strength and temperature shall be as given in table B.1, table B.2 and table B.3.

Table B.1 Derating factors and limiting temperatures for materials given in ISO 9328-5

Material (ISO 9328-5)	Temperature °C													
	-200	20	50	100	150	200	250	300	350	400	450	500	550	600
	Correction factor													
X2CrNi1810	1	1	0.93	0.81	0.7	0.64	0.6	0.57	0.54	0.51	0.5	0.49	0.47	0.47
X5CrNi189	1	1	0.93	0.81	0.7	0.64	0.6	0.57	0.54	0.52	0.51	0.5	0.49	0.47
X6CrNiNb1810	1	1	0.95	0.88	0.8	0.76	0.72	0.69	0.68	0.66	0.65	0.65	0.64	0.63
X6CrNiTi1810	1	1	0.94	0.86	0.76	0.73	0.7	0.67	0.65	0.63	0.61	0.6	0.59	0.57
X2CrNiMo1712	1	1	0.93	0.83	0.72	0.66	0.62	0.59	0.56	0.55	0.53	0.51	0.5	0.49
X5CrNiMo1712	1	1	0.93	0.83	0.72	0.66	0.63	0.6	0.57	0.55	0.54	0.52	0.5	0.5
X6CrNiMoTi1712	1	1	0.94	0.84	0.75	0.69	0.65	0.62	0.6	0.58	0.56	0.54	0.53	0.52

Table B.2 Stress restriction by every temperature

Material (JIS G 4305)	Stress restriction
SUS304 SUS304L SUS316 SUS316L SUS316Ti	Permissible tensile strength (S_{hb}) Table B.1 of JIS B 8265 Young's modulus (E_{bc} E_{bh}) Table D.1 of JIS B 8265
SUS321 SUS347	0.2 % proof stress (S_y) Table D.4 of JIS B 8265

Table B.3 Stress restriction by every temperature

Material (JIS G 4902)	Stress restriction
NCF600P NCF625P(A) NCF625(S) NCF800P NCF800HP NCF825P	Permissible tensile strength (S_{hb}) Table B.1 of JIS B 8265 Young's modulus (E_{hc} E_{hh}) Table D.1 of JIS B 8265 0.2 % proof stress (S_y) Table D.6 of JIS B 8265 ^{a)}
Note ^{a)} For materials not given in table D.6 of JIS B 8265, equivalent materials of ASME or other overseas standards shown in Annex JA shall be used.	

NOTE : The symbols of stress restriction in tables B.2 and B.3 are defined in **JB.3.2.**

Annex C (normative)

Nominal sizes

The nominal sizes of expansion joints shall be as given in table C.1. If other nominal sizes are to be used, designation shall be made in accordance with clause 5.

Table C.1 Nominal sizes

Unit: mm

Nominal size (A)			
15	80	350	700
20	100	400	<u>750</u>
25	125	450	800
32	150	500	<u>850</u>
40	200	<u>550</u>	900
50	250	600	1 000
65	300	<u>650</u>	

Annex D (normative)

Nominal pressures

The nominal pressure of expansion joints shall be as follows. If the maximum working pressure is designated, designation shall be made in accordance with clause 5.

- Nominal pressures in **ISO 7268** (PN) 2.5, 6, 10, 16, 20, 25, 40, 50, 100, 150, 250
- Nominal pressures in **JIS B 2220** (K) 2, 5, 10, 16, 20, 30, 40, 63

Annex JA (normative)

Overseas standards corresponding to JIS standards of materials for expansion joints

Tables JA.1 and JA.2 show the International Standards, foreign regional and national standards corresponding to **JIS** standards of materials for expansion joints.

Table JA.1 Cold rolled stainless steel sheet/plate and strip

JIS G 4305	International Standards, foreign regional and national standards corresponding to JIS		
	ISO 9328-5	EN 10088-2	ASME SA-240
SUS304	X5CrNi189	1.4301	Type 304
SUS304L	X2CrNi1810	1.4306	Type 304L
SUS316	X5CrNiMo1712	1.4401	Type 316
SUS316L	X2CrNiMo1712	1.4404	Type 316L
SUS316Ti	X6CrNiMoTi1712	1.4571	Type 316Ti
SUS321	X6CrNiTi1810	1.4541	Type 321
SUS347	X6CrNiNb1810	1.4550	Type 347

Table JA.2 Corrosion and heat resisting superalloy plate

JIS G 4902	Foreign national standard corresponding to JIS
	ASME standards
NCF600P	SB-168 UNS N06600
NCF625P(A)	SB-443 UNS N06625Gr.1
NCF625(S)	SB-443 UNS N06625Gr.2
NCF800P	SB-409 UNS N08800
NCF800HP	SB-409 UNS N08810
NCF825P	SB-424 UNS N08825