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Standard Specification for Circular Metallic Bellows Type Expansion Joints for Piping Applications[1]

This standard is issued under the fixed designation F 1120; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification establishes the minimum requirements for the mechanical design, manufacture, inspection, and testing of circular metallic bellows-type expansion joints used to absorb the dimensional changes resulting from piping thermal expansion or contraction, as well as the movement of terminal equipment and supporting structures.

1.2 Additional or better features, over and above the minimum requirements set by this specification, are not prohibited by this specification.

1.3 The layout of many piping systems provides inherent flexibility through natural changes in direction so that any displacements produce primarily bending or torsional strains, within acceptable limits. Where the system lacks this inherent flexibility the designer should then consider adding flexibility through the use of metallic bellows-type expansion joints.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 *ANSI Standards:*
B16.5 Pipe Flanges and Flanged Fittings[2]
B16.25 Butt Welding Ends[2]
B31.1 Power Piping Code[2]
2.2 *ASME Standards:*
Section VIII, Division 1, Pressure Vessels[3]
Section IX, Welding and Brazing Qualifications[3]
2.3 *EJMA Standard:*
Standards of the Expansion Joint Manufacturer's Association[4]
2.4 *Pipe Fabrication Institute Standard:*
ES-3 Fabrication Tolerances[5]

3. Terminology Definitions

3.1 Expansion joint definitions shall be in accordance with those in the EJMA standards.

3.2 *double expansion joint*—expansion joint consisting of two bellows joined by a common connector.

3.3 *Discussion*—The common connector is anchored to some rigid part of the installation by means of an anchor base. The anchor base may be attached to the common connector either at installation or at time of manufacture. Each bellows acts as a single expansion joint and absorbs the movement of the pipe section in which it is installed independently of the other bellows.

3.4 *gimbal expansion joint*—expansion joint designed to permit angular rotation in any plane by the use of two pairs of hinges affixed to a common floating gimbal ring.

3.5 *Discussion*—The gimbal ring, hinges, and pins are designed to restrain the thrust of the expansion joint as a result of internal pressure and extraneous forces, where applicable.

3.6 *hinged expansion joint*—expansion joint containing one bellow designed to permit angular rotation in one plane only by the use of a pair of pins through hinge plates attached to the expansion joint ends.

3.7 *Discussion*—The hinges and hinge pins are designed to restrain the thrust of the expansion joint as a result of internal pressure and extraneous forces. Hinged expansion joints should be used in sets of two or three to function properly.

3.8 *pressure balanced expansion joint*—expansion joint designed to absorb axial movement or lateral deflection, or both, while restraining the pressure thrust by means of tie devices interconnecting the flow bellows with an opposed bellows also subjected to line pressure.

3.9 *Discussion*—This type of expansion joint is intended for use where a change of direction occurs in a run of piping. The flow end of a pressure balanced expansion joint sometimes contains two bellows separated by a common connector, in which case it is called a universal pressure balanced expansion joint.

3.10 *single expansion joint*—simplest form of expansion joint, consisting of single bellows construction, designed to

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[2] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.
[3] Available from American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017.
[4] Available from Expansion Joint Manufacturer's Association, 25 N. Broadway, Tarrytown, NY 10591. The Standards of the Expansion Joint Manufacturer's Association are a collection of standards developed by this industry and published in one volume, herein called EJMA Standards.
[5] Available from Pipe Fabrication Institute, 1326 Freeport Rd., Pittsburgh, PA 15238.

absorb all movement of the pipe section in which it is installed.

3.11 *swing expansion joint*—expansion joint designed to absorb lateral deflection or angular rotation, or both, in one plane.

3.12 *Discussion*—Pressure thrust and extraneous forces are restrained by the use of a pair of swing bars, each of which is pinned to the expansion joint ends.

3.13 *universal expansion joint*—expansion joint containing two bellows joined by a common connector for the purpose of absorbing any combination of axial movement, lateral deflection, and angular rotation.

3.14 *Discussion*—Universal expansion joints are usually furnished with control rods to distribute the movement between the two bellows of the expansion joint and stabilize the common connector.

4. Ordering Information

4.1 An expansion joint is a unique product and must be specifically designed for the intended service. It is the responsibility of the piping system designer to supply sufficient engineering data necessary for the complete design. The information compiled by the piping system designer must be complete and contain all pertinent data detailing the conditions under which the expansion joint is expected to operate.

4.2 Orders for each expansion joint shall include the following information:

4.2.1 Title, designation number, and latest revision of this specification.

4.2.2 *Size*—The nominal pipe diameter or specific ducting diameter.

4.2.3 *Type of Expansion Joint*—single, double, universal, guided, hinged, gimbal, swing, or pressure balanced.

4.2.4 *Flow Characteristics*:

4.2.4.1 *Flow Medium*—indicate whether the medium is gas or liquid.

4.2.4.2 Flow velocity, medium density, or viscosity, or combination thereof.

4.2.4.3 Flow direction.

4.2.5 *Pressure in psig (N/mm^2)*—design, operating, and test pressures.

4.2.6 *Temperature in °F (°C)*—design, operating, and installation temperatures.

4.2.7 *Movement*—axial (extension, compression); lateral (single plane, multiplane); angular; torsional (to be avoided). Differentiate between start-up, operational, or field installation tolerance movements.

4.2.8 *Materials*—Material types (including that for the bellows) shall be specified by the purchaser (see 5.1 for material restrictions).

4.2.9 *Internal Liner*—Liner shall be specified when needed because of flow velocity or other flow conditions. Specific criteria for liners is shown in Section C-3 of the EJMA Standards (see 6.6).

4.2.10 *External Cover*—To protect personnel having close access to the bellows, when thermal insulation is to be added in the field, or when external mechanical damage is possible (see 6.5).

4.2.11 *End Fittings*—The type of end connections such as flanged, threaded, or others to match the mating piping or terminal equipment.

4.2.12 *Accessories*—Specify what accessories are required and the conditions under which they operate. Consider items such as insulation lugs, tie, limit, or control rods, pantographic linkages, trunions, gimbals, drains, purge connections, anchor bases, and interply monitoring devices.

4.2.13 *Dimensional Limitations*—If space limitations exist, specify the maximum overall length, maximum outside diameter, minimum inside diameter, and installation tolerances.

4.2.14 *Operating Forces*—Specify calculated bellows spring forces and pressure thrust forces if they are required for subsequent anchor design or other piping systems analysis. If there are maximum allowable values, these must also be specified.

4.2.15 *Installation Position*—horizontal, vertical (flow up or down). Specify if liner drainage holes are required.

4.2.16 *Cycle Life Requirements*—Specify an anticipated number of thermal cycles over the intended life of the expansion joint.

4.2.17 *Testing Requirements*—Specify testing requirements in addition to the hydrostatic test required by 9.4 (for example, vacuum testing, testing at operating temperature).

4.2.18 *Inspection Requirements*—Specify inspection requirements in addition to the inspection required by Section 9 (that is, radiographic, fluorescent penetrant, or mass spectrometer).

4.2.19 *Piping Code Requirements*—Specify any piping or design code that must be used as the basis for design in addition to those specified in 5.2.

4.2.20 *Special Requirements*—Specify the magnitude of special system conditions such as vibration, shock, or hydraulic surge.

4.2.21 *Shipping Requirements*—Specify whether special packing is required including protection for extended outside storage, export handling, or special lifting considerations for heavy or large assemblies.

4.2.22 *Piping Drawing*—In addition to specifying the above information it would be beneficial to provide a drawing of the proposed piping system.

4.2.23 *Supplementary Requirements*—Specify any additional requirements not identified herein.

4.3 Fig. 1 and Fig. 2 should be used as a guide in ordering expansion joints to this specification.

5. Materials and Manufacture

5.1 *Materials*:

5.1.1 Pressure-containing parts shall be manufactured from material specifications and grades listed in Section VIII, Division 1, of the ASME Code or ANSI B31.1. End connection material shall have in service properties similar to the bellows material. Flanges shall meet ANSI B16.5.

5.1.2 All other materials of construction shall be of the type specified by the user and shall conform to an ASTM or ASME material specification. Materials not identified by the ordering data shall be of the manufacturer's standard and of the same quality used for the intended purpose in commercial practice.

5.1.3 Materials used shall be free from defects that would adversely affect the performance of the expansion joint.

COMPANY:	DATE / /
	SHEET OF
PROJECT:	INQUIRY NO.
	JOB NO.

	ITEM NO./EJ TAG NO.		EJMA PAGE REFERENCE			
1	QUANTITY					
2	NOMINAL SIZE/I.D./O.D. (IN.)					
3	EXPANSION JOINT TYPE		1			
4a	FLUID INFORMATION	MEDIUM GAS/LIQUID	5, 6, 147 77			
4b		VELOCITY (FT./SEC)				
4c		FLOW DIRECTION				
5	DESIGN PRESSURE, PSIG		6, 19, 83, 135			
6	TEST PRESSURE, PSIG					
7a	TEMPERATURE	DESIGN (°F)	6, 13			
7b		MAXIMUM/MINIMUM (°F)				
7c		INSTALLATION (°F)				
8a	MAXIMUM INSTALLATION MOVEMENT	AXIAL COMPRESSION (IN.)	6, 7, 8, 141			
8b		AXIAL EXTENSION (IN.)				
8c		LATERAL (IN.)				
8d		ANGULAR (DEG.)				
9a	MAXIMUM DESIGN MOVEMENTS	AXIAL COMPRESSION (IN.)	6, 7, 13, 47			
9b		AXIAL EXTENSION (IN.)				
9c		LATERAL (IN.)				
9d		ANGULAR (DEG.)				
9e		NO. OF CYCLES				
10a	OPERATING FLUCTUATIONS	AXIAL COMPRESSION (IN.)	84			
10b		AXIAL EXTENSION (IN.)				
10c		LATERAL (IN.)				
10d		ANGULAR (DEG.)				
10e		NO. OF CYCLES				
11a	MATERIALS OF CONSTRUCTION	BELLOWS	5, 6, 45			
11b		LINERS	77, 78			
11c		COVER	3, 7, 72			
11d		PIPE SPECIFICATION				
11e		FLANGE SPECIFICATION	3, 43			
12	RODS (TIE/LIMIT/CONTROL)		3, 4, 41			
13	PANTOGRAPHIC LINKAGE		4			
14	ANCHOR BASE (MAIN/INTERMEDIATE)		1, 2, 17			
15a	DIMENSIONAL LIMITATIONS	OVERALL LENGTH (IN.)				
15b		OUTSIDE DIAMETER (IN.)				
15c		INSIDE DIAMETER (IN.)				
16a	SPRING RATE LIMITATIONS	AXIAL (LBS./IN.)	54			
16b		LATERAL (LBS./IN.)				
16c		ANGULAR (IN.-LBS./DEG.)				
17	INSTALLATION POSITION HORIZ./VERT.		8, 141			
18a	QUALITY ASSURANCE REQUIREMENTS	BELLOWS WELD NDE — LONG. SEAM	133			
18b		BELLOWS WELD NDE — ATTACH.				
18c		PIPING NDE				
18d		DESIGN CODE REQRD.				
18e		PARTIAL DATA REQRD.				
18f						
18g						
19	VIBRATION AMPLITUDE/FREQUENCY					

FIG. 1 Standard Expansion Joint Specification Sheet