



Standard Specification for Circular Metallic Bellows Type Expansion Joint for HVAC Piping Applications¹

This standard is issued under the fixed designation F2934; 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 movements 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 standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This specification is under the jurisdiction of ASTM Committee F25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.11 on Machinery and Piping Systems.

Current edition approved May 1, 2023. Published June 2023. Originally approved in 2012. Last previous edition approved in 2018 as F2934 – 12 (2018). DOI: 10.1520/F2934-12R23.

2. Referenced Documents

2.1 *ASME/ANSI Standards:*²

B16.25 Butt Welding Ends

B16.5 Pipe Flanges and Flanged Fittings

B31.1 Power Piping Code

2.2 *ASME Standard:*³

Section IX Welding and Brazing Qualifications

2.3 *EJMA Standard:*⁴

Standards of the Expansion Joint Manufacturers Association

2.4 *Pipe Fabrication Institute Standard:*⁵

ES-3 Fabrication Tolerances

3. Terminology

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

3.2 *Definitions:*

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

3.2.1.1 *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. This anchor base is an intermediate anchor and is not usually designed to withstand the full thrust load of the piping run. The dual expansion joint is installed in the middle of the piping run and the thrust is directed to the middle. 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.

² Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

³ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁴ Available from Expansion Joint Manufacturers Association (EJMA), 25 North Broadway Tarrytown, NY 10591, <http://www.ejma.org>.

⁵ Available from Pipe Fabrication Institute (PFI), 511 Ave. of Americas, #601, New York, NY 10011, <http://www.pfi-institute.org>.

3.2.2 *externally pressurized expansion joint*—typically used for straight runs of pipe accommodating axial movement, and incorporate an all stainless steel flexible bellows, an internal guide ring/sleeve, an enclosure with end plates at each end.

3.2.2.1 *Discussion*—Externally pressurized expansion joints are typically configured with a service pipe extending through the bellows, and the bellows attaching to the end of the service pipe and the end plate. The external side of the bellows is exposed to the pressure of the medium being conveyed by the service pipe and the inside of the bellows is exposed to atmosphere.

3.2.3 *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.

3.2.3.1 *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.

3.2.4 *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.

3.2.4.1 *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.

3.2.5 *internally pressurized expansion joint*—typically incorporates an all stainless steel flexible bellows containing the pressure on the internal side.

3.2.5.1 *Discussion*—Internally pressurized expansion joints can be configured to accommodate a wide range of movements.

3.2.6 *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.

3.2.6.1 *Discussion*—This type of expansion joint is usually 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. Inline pressure balanced expansion joints do not require a change in direction of the piping.

3.2.7 *single expansion joint*—simplest form of expansion joint, consisting of single bellows construction, designed to absorb all movement of the pipe section in which it is installed.

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

3.2.8.1 *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.

3.2.9 *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.

3.2.9.1 *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 when a universal expansion joint is used for lateral movement only and installed at a change in direction of the piping and is intended to absorb the thermal growth of that section of the piping, it must be designed with tie rods suitable to absorb the full pressure thrust of the expansion joint.

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/mm²)*—Design, operating, and test pressures.

4.2.6 *Temperate 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 interplay monitoring devices.