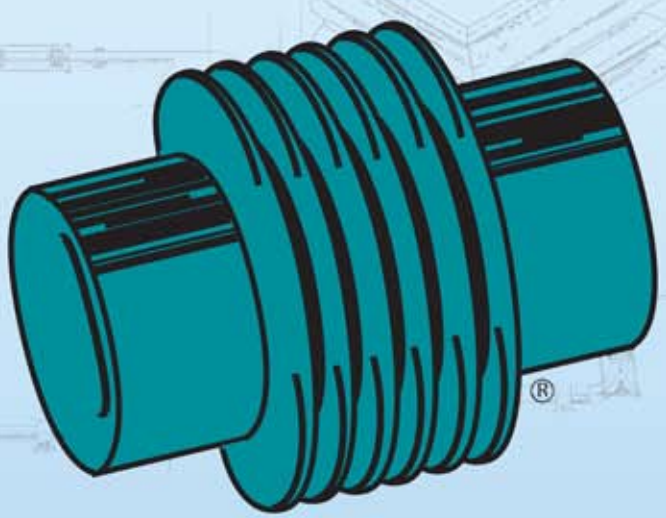

U.S. Bellows

2nd Edition

A Worldwide Leader in Expansion Joints

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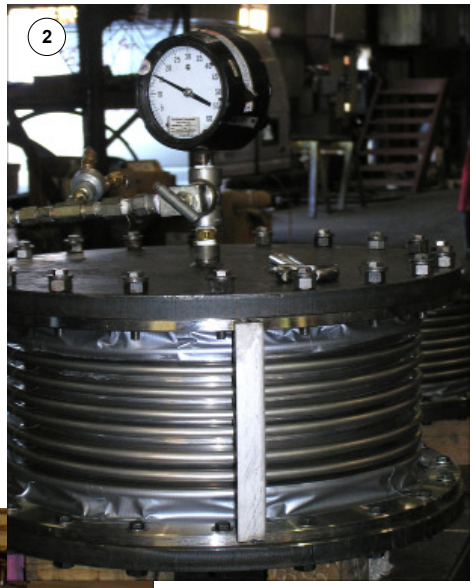

1. COMPRESSION TEST ON A SINGLE METALLIC EXPANSION JOINT
2. HELIUM LEAK TESTING ON EXPANSION JOINTS DUE TO CRITICAL SERVICE REQUIREMENTS
3. QUALITY CHECKING A SINGLE METALLIC EXPANSION JOINT
4. ROUND FABRIC EXPANSION JOINTS
5. UNIVERSAL GIMBAL METALLIC EXPANSION JOINT
6. GROUP PHOTO OF U.S. BELLOWS ENGINEERS AND DESIGNERS

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PRODUCT SHOWCASE INDEX

DESCRIPTION

INTRODUCTION TO EXPANSION JOINTS

U.S. Bellows has designed and manufactured a variety of expansion joints since the 1960's. In 1995, U.S. Bellows' parent company, Piping Technology and Products, purchased the metal expansion joint business of RM Engineered Products, in Ladson, South Carolina. This acquisition has significantly increased our manufacturing capabilities since we can now produce the bellows components required for many piping system applications.

This catalog is devoted to expansion joints and related products. There are five sections covering the classes of expansion joints including four sections on metal joints and one on fabric joints. The last section includes related items such as dampers and duct work. The four classes of metal expansion joints considered are; (1) those which use round thin metal bellows, (2) those which are fabricated from thin metals in a rectangular shape, (3) those which are fabricated from thicker metals for specific applications, (4) slip-type designed for large axial movement. Rubber expansion joints are not included.

In addition to manufacturing expansion joints, U.S. Bellows, Inc. can assist in design of units to meet your specific needs. We will also build and test prototypes prior to final production. We have the latest computer software to speed the design process when standard products do not meet your specific requirements.

In many cases you are simply replacing an existing joint which has performed for its expected life. We may suggest that you consider alternatives which based on our experience would be cost-effective. Our production and inventory systems will support timely manufacture of replacements at a competitive price.

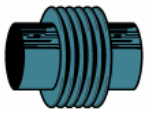
The parameters which govern the specification of an expansion joint include the temperatures and pressures of the materials flowing in the system (solids, liquids, gases and combinations of these), the mechanical linkage to the system where they are installed, and the movement and forces the system will exert on the expansion joint. Each section of this catalog provides information about the parameters to be selected to order the expansion joint you require.

Facilities

In 1995 we added a new 101,000 square feet building to our manufacturing facility. The expansion joint equipment obtained from RM Engineered Products is located in the Southeast part of this building. A new crane way has been installed in this area 21 feet above the floor. Structural components for fabric expansion joints and slip-type joints are fabricated in the Sweco Fab area. A Beatty Quickwork Head Shear, with Circle Cutting Attachment, is used for Thick-Wall joints. Special sewing machines are used to produce the fabric components required.

Aerial View of U.S. Bellows / PT&P Facility

From Left to Right: Randy Bailey - Vice President; Dr. Durga Agrawal - President; John T. Demusz - U.S. Bellows Manager



MANUFACTURING CAPABILITIES

Metal Forming

- Hydraulic shears to handle 10 foot plate up to 1 inch mild steel.
- Break presses to handle 14 foot plate up to 3/4 inch mild steel.
- Miscellaneous forming, cutting and punching machines including a 50-ton Mubea iron-worker, a 75-ton Scotchman hydraulic iron-worker and a 100-ton mechanical machine.
- Two pyramid plate rollers handle 10 foot plate up to 5/8 inch.
- 350-ton radial expander.
- Angle rolling to diameters in excess of 12 feet.
- Plasma cutting up to 2 inch.
- Flame cutting 8 torch, computer controlled.
- Horizontal and vertical band saws.

Bellows Forming

- Roll forming from 24 inches through 15 feet diameter.
- Expanding mandrel forming from 2 inches through 120 inch diameter.
- Automatic TIG flat bed welders.
- Bellows reroll and planishing machines.

Machining

- End Mill Machine - 36 inch travel.
- Bridgeport Machine - Lateral boring to 6 inch diameter and milling with a tilt head on a 36 inch bed.
- Drill presses with 48 inch bed height.
- Surface tables.
- General ability to mill, grind, turn, tap, thread, bore and chamfer material up to 12 inches in diameter and 36 inches in length.

WELDING

- TIG
- MIG (Pulse Arc)
- SMAW
- SUB-ARC
- Aluminum

MATERIALS

- Carbon Steel
- Stainless
- Alloy Steel
- High nickel alloys
- Aluminum

QUALIFICATIONS

- ASME Section IX
- AWS D1.1
- MIL-STD-248

NON-DESTRUCTIVE EXAMINATION

- Magnetic particle --dry method.
- Liquid penetrant --visible and fluorescent.
- Ultrasonic and radiography --subcontracted.
- Hydrostatic testing and Pneumatic testing

QUALITY STANDARDS

Sweco Fab, Inc. has an ASME U stamp and R stamp for pressure vessels.

Our quality assurance and quality control practices are designed to meet the following codes and standards as applicable:

ASME Section VIII	ANSI B31.3	ANSI B31.1
API 620	AISI	AISC
MIL-Q-9858A	MIL-STD-276	MIL-STD-271
MIL-STD-410	AMCA	DNMEJ (FSA)
EJMA		

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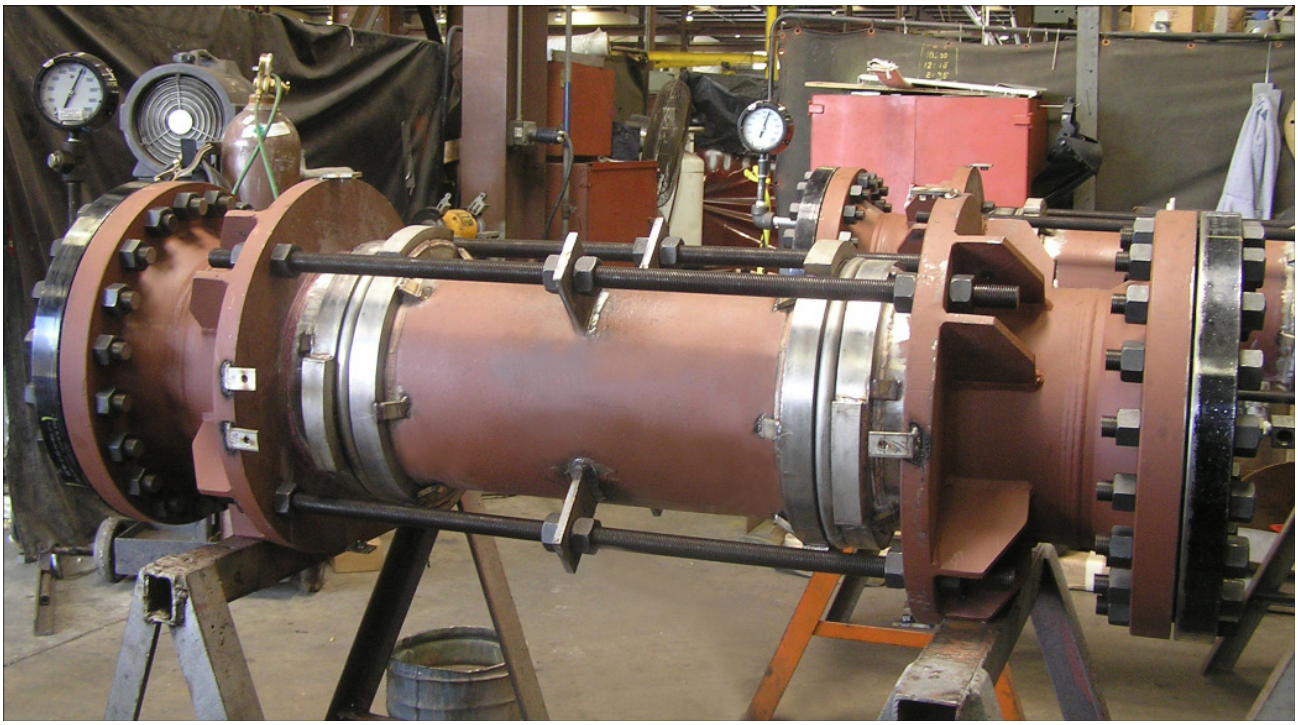


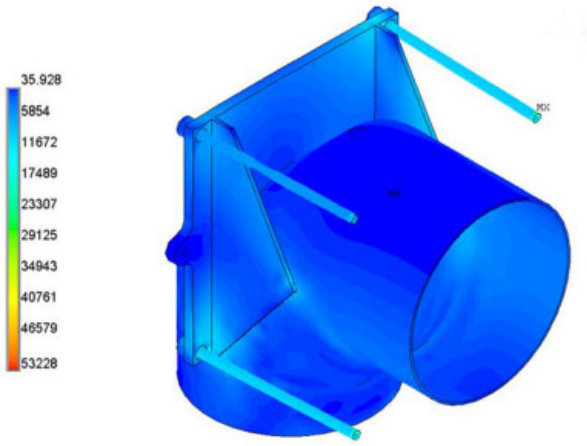
A hydro test is being performed on a universal metallic expansion joint. The bellows are pressurized for 30 minutes to proof test the design.

AERIAL VIEW

U.S. Bellows, Inc., along with its parent company Piping Technology & Products, Inc. and fellow subsidiaries, share engineering and manufacturing resources at our 35-acre manufacturing facility in Houston, Texas. U.S. Bellows' manufacturing facilities are located near the Port of Houston, the largest port in the United States, for fast and convenient shipping around the world. We have 450,000 square feet of covered shop space at our manufacturing facility in Houston.

U.S. Bellows extends an invitation to all its customers to come to Houston and visit the plant. This is the best way to see our people, our facilities, and the many capabilities we have to serve your needs.

Pressure Balanced Metallic Expansion Joints During Fabrication in the U.S. Bellows Shop



Finite Element Depiction Of A 36" Tied Universal Expansion Joint to Verify the Design

THE BELLOWS

Bellows Design

The bellows is the flexible element of the expansion joint. It must be strong enough circumferentially to withstand the pressure and flexible enough longitudinally to accept the deflections for which it was designed, and as repetitively as necessary with a minimum resistance. This strength with flexibility is a unique design problem that is not often found in other components in industrial equipment.

Most engineered structures are designed to inhibit deflection when acted upon by outside forces. Since the bellows must accept deflections repetitively, and deflections result in stresses, these stresses must be kept as low as possible so that the repeated deflections will not result in premature fatigue failures. Reducing bending stress resulting from a given deflection is easily achieved by simply reducing the thickness of the bending member, which in the case of the bellows, is the convolution. However, in order to withstand the pressure, the convolution, which is also a pressure vessel, must have a thickness great enough that the pressure induced membrane stresses are equal to or less than the allowable stress levels of the materials at the design temperatures. This conflicting need for thickness for pressure and thinness for flexibility is the unique design problem faced by the expansion joint designer.

Bellows are not springs, in that most of their deflections produce bending stresses in excess of the materials' yield strength. Understanding how various materials perform and their capabilities in this "plastic" deformation region requires years of experience and design equations based upon this empirical understanding.

That bellows routinely operate "plastically" should not be a cause for concern, since most of the materials from which bellows are made share similar highly ductile characteristics. In particular, the endurance limit of these materials, which can be loosely described as the stress at which failure will occur at ten million cycles of repeated stressing, is nearly the same as their yield stress, or the point at which permanent deformation will occur. A bellows which is required to withstand 3000 cycles of a given deflection and pressure, and which ultimately fails after 10,000 cycles, has certainly demonstrated more than acceptable performance. However, it has experienced, during each and every cycle, bending stresses far in excess of the endurance limit and therefore the yield stress, and once deflected, would not have returned on their own to their original undeflected length or shape, as a spring is expected to do. In other words, they would have "taken a set."

Most bellows fail by circumferential cracking resulting from cyclic bending stresses, or fatigue. Since the best design is a compromise, or balance, between pressure strength and flexibility considerations, it can be concluded that their designs have had lower margins of safety regarding fatigue than they had regarding pressure strength. The years of experience of the engineers who developed these bellows assures that the designs contained in this catalog and those offered to satisfy customer specifications, will have the performance reliability which yields trouble free, safe use.

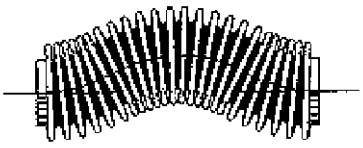
Occasionally, a bellows will appear to develop a fatigue crack prematurely, i.e., after being subjected to fewer cycles than analysis indicates they should. These premature failures usually are the result of one or more of the following causes:

- Insufficient margin of safety in the design permitting acceptance of a unit manufactured within a portion of the dimensional tolerance range to yield a part which will not satisfy the design - Metallic bellows bending stresses are extremely sensitive to changes in some dimensions, such as the thickness and the height of the convolution. These dimensional characteristics often affect the various bending stresses by the square or cube of their differences. An understanding of these dimensional factors and how they can be controlled during design and manufacture is the key to preventing this cause of early failure. A poorly manufactured bellows, or one that is made to the "wrong" side of the dimensional tolerances will disappoint the best design and analysis.
- Insufficient margin of safety regarding stability under pressure - Squirm, described in more detail below, is a characteristic of all bellows subjected to internal pressure. Each bellows has a critical pressure at which the convolution side walls begin to deform or the actual bellows shape begins to change. These deformations cause the bellows to accept the imposed deflections differently than they are normally expected to and they can no longer perform according to the design equations. The critical pressure is a function of the bellows' shape and actually can change during deflection. If the basic design is close to its stability limit, the beginnings of instability may not be visible to the eye, but the higher than expected bending stresses will occur during each cycle. Stresses are higher particularly at convolutions near its attachments where the flexible element transitions to the highly rigid end connection.

SQUIRM OR INSTABILITY

As described above, all bellows have a critical pressure at which they become unstable. Instability can occur in either of two modes, column instability (or squirm), or inplane deformation of the convolution side wall.

Squirm is the phenomena whereby the centerline of a straight bellows develops a sideways or lateral bow.



The critical pressure at which this instability occurs is a direct function of the diameter and spring rate, and an inverse function of the length. If the bellows is bent, or angulated, the centerline can begin to move away from the center of curvature. In each case, the effective length of the bellows increases, lowering the material available to withstand the pressure, thereby increasing the hoop stresses. As the length increases, the tendency to squirm increases and the stresses become higher and higher until catastrophic failure occurs. A simple way to visualize this phenomena is to remember that the bellows is a cylinder of given volume. Internal pressure tries to increase a vessel's volume. Since a bellows is flexible in the axial direction, it can increase its volume by increasing the length of its centerline. With the ends fixed, it does so by simulating the appearance of a buckling column.

TYPE OF DEFLECTIONS

In order to properly apply expansion joints to piping systems, it is necessary that both the piping specialist and the expansion joint designer each understand not only how the piping flexes, but how the various expansion joint types function and what they are capable of doing. It may be relatively easy to visualize that deflections may result from thermal expansion or the movements and vibrations of equipment and structures; however, all expansion joints do not accept the same types of deflection. Many can accept certain loads and moments, while others are incapable of resisting externally applied forces. Understanding the type, magnitude, and direction of these forces and deflections is critical, not only to the safety of the system, but to its cost.

With today's piping flexibility computer programs, determining where stresses are excessive, and therefore that expansion joints may be necessary, is a simple task. The placement of expansion joints, and their proper selection, still depends upon the designer's experience and understanding of how expansion joints work, and how the piping must be anchored and supported when expansion joints are used. This section describes the different types of expansion joints available, how they function, what types of deflections they can accept, and what types of forces and movements they can and cannot resist.

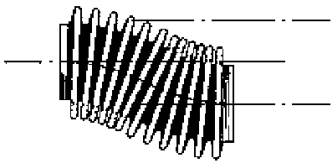
To aid in the explanations the following description of the types of movements are given.

Axial Deflection

Axial refers to being parallel to the centerline of the expansion joint. COMPRESSION is the AXIAL deflection which will shorten the bellows length. Often confusion occurs because thermal EXPANSION in the piping will cause the expansion joint to be compressed. The specification for an expansion joint should always state the movements as they affect the expansion joint, and not as they are produced by the system. EXTENSION is the AXIAL deflection which stretches the expansion joint. Piping which is operating at temperatures lower than ambient, such as in cryogenic systems, will contract, causing the expansion joint to stretch or experience EXTENSION.

View our online catalog section for deflections at:
www.usbellows.com/deflections

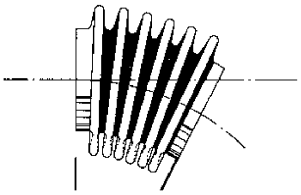
Lateral Deflection



Lateral refers to the direction perpendicular to the centerline of the expansion joint (in any plane). Other terms for this deflection are PARALLEL OFFSET and TRANSVERSE. This movement occurs with both of the ends of the expansion joint remaining parallel to each other, with their centerlines being displaced, or no longer coincident. When analyzing the deflections in a piping system, it is not uncommon to find that different lateral deflections can occur in more than one plane. Since an expansion joint is round, these various deflections must be resolved into a single resultant lateral deflection, in order for the bellows to be properly selected in terms of the rated LATERAL DEFLECTION shown in this catalog. The magnitude of the resultant LATERAL DEFLECTION is the square root of the sum of the squares of the individual deflections. The planes of the various deflections must also be clearly understood if the expansion joint is to contain structural components such as hinges, which may inhibit movements in certain directions, and if the individual deflections can occur separately during the life of the expansion joint.

Elbow Pressure Balanced Expansion Joints

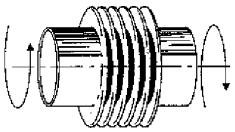
Angular Deflection



When an expansion joint experiences bending about its center, which is on the centerline and halfway between the ends of the bellows, this deflection is referred to as ANGULAR. It can occur in any plane that passes through the centerline, but the plane should be clearly indicated if the expansion joint is more complicated than the simplest type, i.e., only a bellows with flanges or pipe ends. As in lateral movements, piping analyses may reveal angular deflections occurring in more than one plane. With ANGULAR DEFLECTION, the basis for the proper selection is the maximum of the various deflections, and not the vector sum as in the lateral case. Multiple ANGULAR DEFLECTIONS in multiple planes produce a single ANGULAR DEFLECTION in a single resultant plane. As in lateral deflection, this plane must be understood if structural components are to be used.

12" Universal Metallic Expansion Joint

Torsional Deflection



Torsion refers to twisting one end of the bellows with respect to the other end, about the bellows centerline. Expansion joints are not normally expected to accept torsional deflection, since the bellows is essentially inflexible in this direction. The piping designer should carefully provide the system with restraints so that the expansion joint is not expected to accept TORSIONAL DEFLECTION. This catalog contains the calculated torsional spring rate for each expansion joint so that piping designers and analysts can provide the proper inputs for piping flexibility computer programs. If it is not possible or economically practical to relieve the expansion joint of excessive torsional loading, then U.S. Bellows' designers can provide anti-torsion features to the expansion joints which prevent these loads from damaging the bellows elements.

Combined Deflections

Very often an expansion joint must accept a combination of some or all of the above deflections, most often because of space limitations in the system. In order to clearly understand whether the proper expansion joint is selected, the movements should, if possible, be broken down into the above various types and stated that way in the specification. Then U.S. Bellows' expansion joint designer will confirm that the offered expansion joint can accept each of these types of movements, when combined. Most catalogs, including this one, give the movement capability of each expansion joint in an uncombined form, or "non-concurrent." Page 43 of this catalog shows the method by which various movements should be combined when determining a single equivalent deflection which can then be used for the proper expansion joint selection.

Cyclic Deflections And Cycle Life

Most deflections are repeated a number of times during the life of the piping system, since the deflections usually are produced by changes in temperature which occur each time the system is started and stopped, and from predictable variations in the way the system is used. Repetitions can also occur as a result of repetitive mechanical movements and from vibrations. Each time a deflection occurs it is a CYCLE. The number of cycles is important to assure the proper design of the expansion joint, since each design has a finite, but predictable life. Vibrations which cause repetitive deflections can cause a premature failure of an expansion joint. Even though these deflections may be small in magnitude, they usually accumulate huge numbers of cycles in a short period of time. Since the bellows are metallic structures, they have specific and predictable resonant frequencies, like the pitch of a tuning fork. When driven by outside vibrations of the same frequencies (or harmonics of them), they can magnify the incoming deflections until they exceed the yield strength of the bellows material and induce early fatigue failure. When a piping system is known to have equipment which can produce vibrations, such as pumps, fans, and other motor or turbine driven devices, their rotational speeds or frequencies should be stated so that designers can assure that the proper expansion joint does not have a resonant or harmonic frequency that is close to those.

INSTALLATION MISALIGNMENT

During the erection of piping systems, the accuracy of the location of equipment, pipe supports, structure and the piping itself is never perfect. Since the expansion joint is usually far more easily deflected than any of these other components, it is tempting for piping installers to use it to correct for misalignment. The installation instructions of U.S. Bellows' expansion joints, as well as other manufacturers, require that the piping be aligned to the expansion joint during installation. The expansion joints will arrive from the factory with rigid restraints which maintain their length and ends in the position and dimensions of the specification in this catalog.

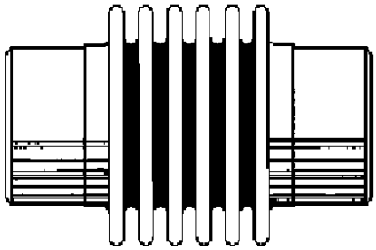
If some misalignment must be accepted by the expansion joint, this can be accommodated by the addition of devices such as limit rods which can be used during the installation to adjust the expansion joints to fit. Any proposed misalignment should be clearly stated to U.S. Bellows so that the amount of deflection possible can be considered in the total deflection capability of the proper selection. As an example, one would not want to have a needed cyclic axial compression capability of 0.5 inch (12.7 mm) cut in half by a compression due to pipe misalignment of .025 inch (6.4 mm).

TYPES AND DESIGN STYLES

U.S. Bellows offers all of the types of metal expansion joints. Each type has advantages and limitations, which when applied correctly, can provide the flexibility, load reduction, structural integrity and reliability desired in a piping system.

Expansion joints, besides acting as sections of a pipe, capable of withstanding the design temperatures, pressures, and media, also provide the flexibility that makes them necessary. That flexibility can be axial, lateral or angular. However, in many installations, some rigidity or structural strength is needed to support piping loads or to control the motion of the bellows and the pipe. Features are then added to the expansion joint to limit the modes or degrees of freedom, or the types of deflections, and to resist shear, or tension, or compression loads and/or bending moments. The most common types are presented in this catalog. This section describes how they work, in what ways they are flexible, and what piping applied loads and moments they can accept. The section entitled Applications contains discussions and examples of how various types of expansion joints can be used to solve piping expansion problems.

Single Bellows (U.S. Bellows' Style S)

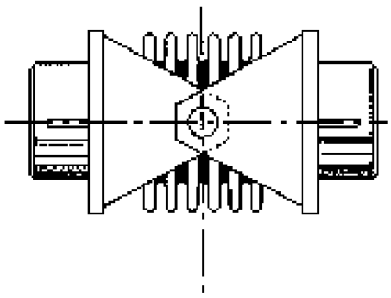


This expansion joint is simply a bellows element with end connections. Regardless of accessories, such as liners and covers, it will deflect in any direction or plane that the bellows will. It is the least expensive type, but requires that the piping be controlled as to the direction of the movements required of the unit.

View online catalog section for single expansion joints:
www.usbellows.com/single

The expansion joint should not be expected to control the movement of the pipe. If the piping analysis shows that the expansion joint must accept axial compression, then the piping must be guided and constrained so that only that movement will occur. This expansion joint will not resist any deflections with any force other than the resistance of the bellows, which is a function of the spring rate times the deflection amount. It is incapable of resisting the pressure thrust along its axis, which is the product of the pressure times the effective, or cross sectional, area of the bellows. Large diameter units, even with low pressures, can generate very large axial pressure thrust forces, which must be reacted by main and directional anchors. Otherwise the expansion joint will extend with disastrous results.

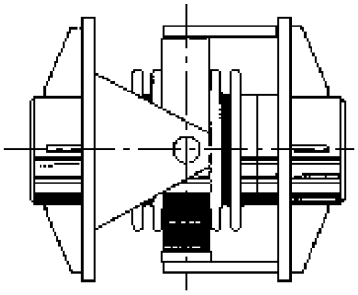
Hinged Expansion Joints (U.S. Bellows' Style H)



These expansion joints contain hinges or pivots which cause the unit to bend in a single plane. Normally these units are prevented by their design from deflecting axially, either in extension or compression. Their hinge mechanisms are usually designed to accept the full pressure thrust. Also, because of the hinge mechanism's design, shear loads, such as from the weight of adjacent piping, can be accepted by this expansion joint, relieving the piping designer of having to provide additional supports and anchors required by the single type.

Some hinge types can be provided with hinge pin holes which are slotted to permit limited axial travel. These "slotted hinge" types will not resist pressure thrust forces, and anchoring must be provided. This catalog only depicts the fully restrained hinged type. If axial travel is desired, the piping designer should clearly state that the slotted hinge type is wanted in the design requirements, and they should provide for pressure thrust anchoring. On the other hand, if the full axial restraint of the hinged type is desired, the piping designer should understand that there is no allowance in the expansion joint for any axial travel, including none for any installation misalignment.

Gimbal Expansion Joints (U.S. Bellows' Style G)

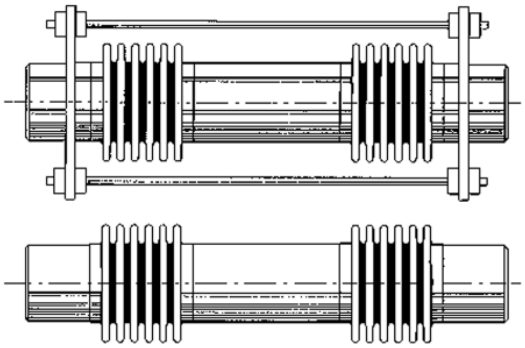


The gimbal expansion joint is basically the same as the hinge type, except that instead of being limited to deflection in only one plane, it can accept bending or angulation in any plane. It contains two sets of hinge pins or pivots, the axis of each set perpendicular to the other. Each set of pins is connected to each other with a central gimbal ring, in much the same way that a universal joint on an automobile works.

This unit provides the same type of restraint and resistance to axial forces, such as the pressure thrust, and to shear forces as the hinge type.

View online catalog section for gimbal expansion joints: www.usbellows.com/gimbal

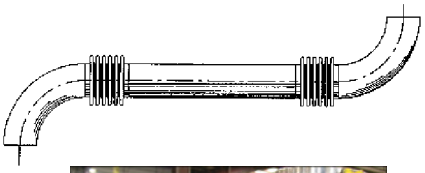
UNIVERSAL EXPANSION JOINTS (U.S. BELLOWS' STYLE U)



The universal expansion joint consists of two bellows separated by a pipe section or spool. The primary purpose of this arrangement is to have a unit which will accept large amounts of lateral deflection. The amount of lateral deflection they can accept is a function of the amount of angulation each bellows can absorb and the distance between the bellows. For a given bellows element, the amount of lateral deflection capability can be increased or decreased by simply changing the length of the center spool. In this catalog three standard overall lengths are given with their lateral movement capability. If the piping problem requires greater capability, then the overall length can be increased to suit.

Since deflections are usually the result of piping thermal expansion, and universal expansion joints are usually long, our units are designed so that the thermal expansion of the entire unit's length is accepted as compression by the two bellows elements. In this way, the overall length of the unit does not change when the piping is heated. The standard units in this catalog have all been designed to accept the thermal expansion of their length when the temperature is up to the design temperature shown.

Universal types can be supplied with or without tie rods. Tie rods connect the ends of the unit to each other and restrain the pressure thrust load. This unit is normally not expected to accept any externally applied axial deflections. The thermal expansion of the distance between the tie rods ---within the expansion joint--- will be handled by the bellows element, as described above. The tie rods usually come in sets of two or more, equally distributed around the circumference of the expansion joint. When only two are provided, 180 degrees apart, the expansion joint is free to bend, or deflect angularly, as well as laterally. With three or more tie rods, since rods are loaded equally by the pressure thrust, only lateral deflections are possible without significant forces being applied by the adjacent piping. Without tie rods, the universal expansion joint will accept all of the deflections that a single type will, and the pipe guiding and anchoring needs discussed for the single type above also apply.

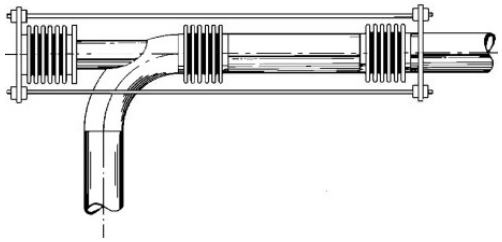


Universal Metallic Expansion Joints

View online catalog section for universal expansion joints: www.usbellows.com/universal

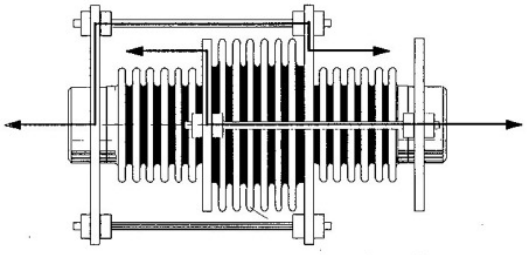
Many times the universal expansion joints will be attached directly to pipe elbows as shown on page 12. As discussed in more detail in the Applications section, this arrangement, because of the large lateral deflection capability, accepts the thermal expansion of relatively long runs of heated pipe. So that the distance between the elbows does not change due to thermal expansion, the tie rods can be connected to the elbows themselves. This catalog offers this type of arrangement as one of the standards, and can be seen on each of the universal expansion joint pages, along with their dimensions and performance characteristics.

Pressure Balanced Elbow Expansion Joints
(U.S. Bellows' Style PBE)



This type of expansion joint is really a combination of some of the above types. Its purpose is to retain and balance the pressure thrust so that main anchoring of the pipe or adjacent equipment is not required, and forces and movements on attachment flanges of delicate equipment, such as turbines, are kept to acceptably low levels. Briefly, the deflections to be accepted are handled by the proper type of expansion joint, which normally, and as shown in the above sketch, is a tied universal type to accept lateral movements. However, the pressure balanced elbow is usually required because axial deflections are also present. In order to accept these movements, a bellows is added beyond the elbow with the same cross-sectional area as the ones in the universal section. This balancing bellows is connected by the tie rods to the pipe beyond the universal section; in this way the pressure thrust is contained as tension in the tie rods. The section of the expansion joint between the tie rods, which includes the elbow, is now free to move axially, with the only resistance being a function of the spring rates of the bellows. Because of their arrangement, however, the spring rate of the entire expansion joint is the sum of the spring rates of the balancing and the universal bellows. This is a constant volume system, in that when the universal end compresses, the balancing end extends the same amount. All of the lateral deflection is absorbed by the universal end, and there is no lateral deflection imposed on the balancing end. Therefore, the balancing bellows is almost always a single bellows type.

In-Line Pressure Balanced Expansion Joints
(U.S. Bellows' Style IPB)

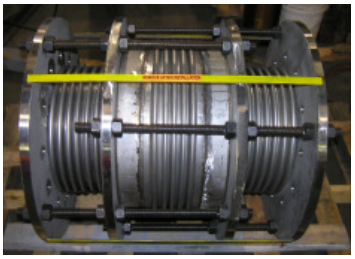


When axial deflections exist, and anchoring is impractical for structural or economic reasons, such as high in the air or short straight pipe runs between two large vessels, the in-line pressure balanced expansion joint is a powerful solution to a difficult design problem.

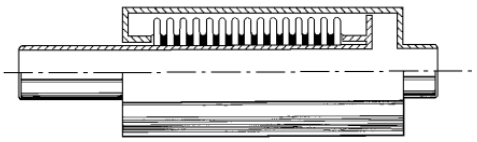
View online catalog section for in-line pressure balanced expansion joints: www.usbellows.com/inline

The principle of this type of unit is essentially the same as the pressure balanced elbow type, in that the axial pressure thrust is reacted by the pressure acting on a cross-sectional area equal to the area of the working or primary bellows. Since this unit is entirely axial, and there are no directional changes in the pipe, such as with the elbow in the previous discussion, the cross-sectional area needed to balance the pressure is placed around the outside of the unit. Since the pressure forces are generated by the pressure acting on the annular surface between the primary and outer, or balancing bellows, the arrangement of the tie rods transfers and balances the pressure thrust created in the pipe on each end. Now the forces needed to compress or extend the unit are only the result of the spring resistance of the bellows, and main anchoring of the pipe or vessels is not required. This expansion joint is obviously more expensive than the simpler types described earlier; however, they may result in a lower overall system cost when the elimination of main anchoring is considered. This expansion joint can also be used to replace pipe loops, and its cost advantage may be seen in reduced pumping energy by the elimination of the loop's elbow-generated pressure losses. This may also allow reducing the pipe size for the entire system.

Externally Pressurized Expansion Joints
(U.S. Bellows' Style X-Flex)



14" I.D. In-line Pressure Balanced Expansion Joint



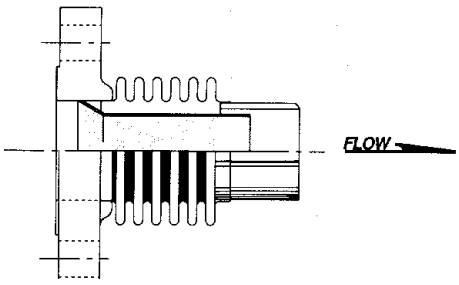
When large amounts of axial deflection are required in piping systems of relatively high pressure, bellows which are internally pressurized have limitations due to the phenomenon called squirm. The X-Flex type expansion joint, in which the bellows elements are arranged so that they are exposed to the media on their external surface, and are therefore externally pressurized, is an ideal unit. As discussed in more detail in the X-Flex section of this catalog, externally pressurizing a bellows eliminates squirm as a limitation to the design and permits the safe acceptance of large amounts of axial thermal expansion. This type of expansion joint has many other inherent advantages over internally pressurized bellows. Please refer to the Safety Recommendation section as well as the X-Flex discussion.

Externally Pressurized Expansion Joints

ACCESSORIES

The metallic bellows is by necessity one of the thinnest pressure-carrying components in the piping system. U.S. Bellows offers as optional accessories a series of devices designed to protect the bellows element. Each of the single expansion joint pages shows the accessories that can be specified as standard additions to each expansion joint. The individual bellows elements in the universal expansion joint series can also have these accessories provided. This section describes the accessories and their benefits. The How-to-Order section of each series describes how to specify accessories when ordering a U.S. Bellows standard part number.

Internal Liner (L)



Internal liners or baffles are a recommended accessory to extend the life of many metallic expansion joints because of their ability to protect the convolutions from direct flow impingement, which can cause erosion and flow-induced vibration. Internal liners should be used when internal flow conditions exceed the following criteria:

- Internal sleeves shall be specified for all expansion joints, regardless of the metal of the bellows in the following cases:
- Where it is necessary to hold friction losses to a minimum and smooth flow is desired. Where flow velocities are high and could produce resonant vibration of the bellows. Sleeves are recommended when flow velocities exceed the following values:

Air, Steam and other Gases

1) up to 6-inch dia. - 4 ft/sec per inch of dia.
2) over 6-inch dia. - 25 ft/sec.

Water and other Liquids

1) up to 6-inch dia. - 1-2/3 ft/sec per inch of dia.
2) over 6-inch dia. - 10 ft/sec.

When turbulent flow is generated within ten pipe diameters of the expansion joint by changes in flow direction, valves, tee or elbow sections, cyclic devices, etc., the actual flow velocity should be multiplied by four prior to utilizing the criteria of *The Standards of the Expansion Joint Manufacturers Association* Sections C-3.1.2 and C-3.1.4.

- Where there is a possibility of erosion, such as in lines carrying catalyst or other abrasive media, heavy gauge sleeves should be used. At no time should the relatively thin bellows be directly exposed to erosion.
- Where there is reverse flow, heavy gauge sleeves may be required.
- For high temperature applications to decrease the temperature of the bellows, heavy gauge sleeves may be required. (To obtain a maximum effect, the expansion joint should not be externally insulated.)

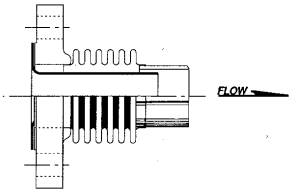
View online catalog section for expansion joint accessories: www.usbellows.com/accessories

- Internal sleeves should not be used where high viscosity fluids such as tars, etc., are being transmitted, since these fluids may cause "packing up," "coking" and "caking" which, in turn, may cause premature expansion joint failure. Where the fluid is such that purging will effectively prevent the "packing up," internal sleeves may be used in conjunction with purge connections.

The standard U.S. Bellows internal liner is made of 300 Series stainless steel. If corrosion or temperature considerations dictate, the liner can be made of the same material specified for the bellows.

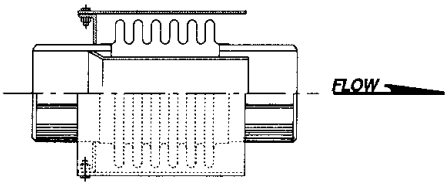
The liner is a longitudinally welded tube attached at one end to the upstream end connection. The diameter of the liner is small enough that the free, downstream end will not interfere or contact the downstream end connection during lateral or angular deflections. When a standard expansion joint is selected from this catalog with the internal liner accessory, the expected lateral deflection should be stated so that the liner diameter can be properly sized.

If expected flow rates will be very high, such as at steam safety relief valves or in turbine exhaust and extraction steam applications, the internal liner should be of heavier construction. Usually, the liner material can be the same as the system pipe material, such as carbon steel, with liner thickness' of 1/8-inch and greater depending upon flow rate and diameter.



Internal liners are almost always welded into the expansion joint. However, if the Van-Stone flange end connection is specified, the U.S. Bellows liner will have its own flange and will be captured between the flanges at the upstream connection into the piping.

Protective Cover (C)

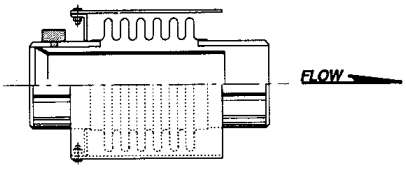


Being relatively thin, the bellows element should be protected on the outside from damage during plant construction and later maintenance activities. Falling tools, standing on the bellows, contact with pipes, hangers and equipment, and weld and burning spatter can render a bellows unsafe or unusable. U.S. Bellows offers, as an accessory, standard carbon steel removable covers attached to the upstream end connection, and sized to permit free flexing of the expansion joint.

In certain applications where fluids can impurge on the bellows exterior, such as in steam extraction piping in turbine exhaust systems, special thick wall, welded type covers should be specified.

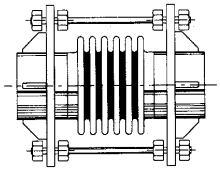
Installation of a Protective Cover on an Expansion Joint

Purge Connector (P)

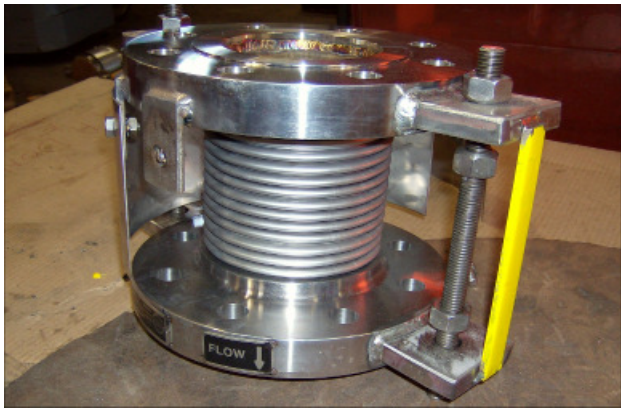


In systems where sediments can collect between the outside of the internal liner and the inside of the bellows element, a threaded purge connector can be added to the upstream end connection as shown. Clear gas or liquid can be injected to periodically blow collected material out, or can be continuously supplied during system operation.

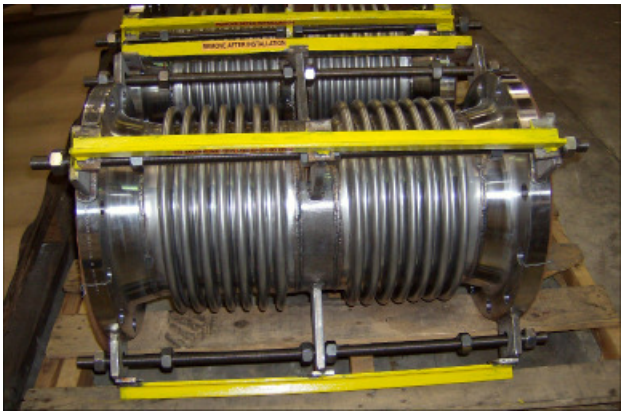
Limit Rods (LR)



It is sometimes desirable to limit the axial expansion or compression of the expansion joint. Limit rods, shown above, provide freedom of movement over a range determined by the location of nut stops along the rods. In the event of a main anchor failure, limit rods are designed to prevent bellows over-extension while restraining the full pressure thrust of the system.



Single Metallic Expansion Joint with Two Limit Rods



Universal Metallic Expansion Joints with Limit Rods

Rectangular Metallic Expansion Joint with Protective Covers

48" Universal Expansion Joints with Protective Covers

GLOSSARY OF TERMS

U.S. Bellows, Inc. has adopted and encourages the use of the definitions of expansion joint components and related equipment as published by *The Expansion Joint Manufacturers Association*. The definitions are taken, in part, from the Fifth Edition of the EJMA Standards.

ANCHOR, DIRECTIONAL. A directional or sliding anchor, is one which is designed to absorb loading in one direction while permitting motion in another. It may be either a main or intermediate anchor, depending upon the application involved. When designed for this purpose, a directional anchor may also function as a pipe alignment guide. In the design of a directional anchor, an effort should be made to minimize the friction between its moving or sliding parts, since this will reduce the loading on the piping and equipment and insure proper functioning of the anchor.

ANCHOR, INTERMEDIATE. An intermediate anchor is one which must withstand the bellows thrust due to flow, spring forces, etc., but not the thrust due to pressure.

ANCHOR, MAIN. A main anchor is one which must withstand the full bellows thrust due to pressure, flow, spring forces, etc.

BELLOWS. The flexible element of an expansion joint consisting of one or more convolutions and the end tangents, if any.

CONTROL ROD. Devices, usually in the form of rods or bars, attached to the expansion joint assembly whose primary function is to distribute movement between the two bellows of a universal expansion joint. Control rods are not designed to restrain pressure thrusts.

CONVOLUTION. The smallest flexible unit of a bellows. The total movement capacity of a bellows is proportional to the number of convolutions.

COVER. A device used to provide limited protection of the exterior surface of the bellows of an expansion joint from foreign objects or mechanical damage. A cover is sometimes referred to as a shroud.

DOUBLE EXPANSION JOINT. A double expansion joint consists of two bellows joined by a common connector which is anchored to some rigid part on 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. Double expansion joints should not be confused with universal expansion joints.

EQUALIZING AND REINFORCING RING. Devices used on some expansion joints fitting snugly in the roots of the convolutions. The primary purpose of these devices is to reinforce the bellows against internal pressure. Equalizing rings are made of cast iron, carbon steel, stainless steel or other suitable alloys and are approximately "T" shaped in cross section. Reinforcing rings are fabricated from tubing or solid round bars of carbon steel, stainless steel, or other suitable alloys.

A Refurbished 54" Pressure Balanced Elbow Turbine Crossover Expansion Joint Being Shipped

EXPANSION JOINT. Any device containing one or more bellows used to absorb dimensional changes, such as those caused by thermal expansion or contraction of a pipeline, duct, or vessel.

FLANGED ENDS. The ends of an expansion joint equipped with flanges for the purpose of bolting the expansion joint to the mating flanges of adjacent equipment or piping.

GIMBAL EXPANSION JOINT. A gimbal expansion joint is designed to permit angular rotation in any plane by the use of two pairs of hinges affixed to a common floating gimbal ring. The gimbal ring, hinges and pins must be designed to restrain the thrust of the expansion joint due to internal pressure and extraneous forces, where applicable.

HINGED EXPANSION JOINT. A hinged expansion joint contains one bellows and is 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. The hinges and hinge pins must be designed to restrain the thrust of the expansion joint due to internal pressure and extraneous forces, where applicable. Hinged expansion joints should be used in sets of two or three to function properly.

INTERNAL SLEEVE. A device which minimizes contact between the inner surface of the bellows of an expansion joint and the fluid flowing through it. These devices have also been referred to as liners, telescoping sleeves, etc.

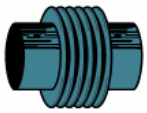
INTERNALLY GUIDED EXPANSION JOINT. An internally guided expansion joint is designed to provide axial guiding within the expansion joint by incorporating a heavy internal guide sleeve, with or without the use of bearing rings. The use of such expansion joints will assure installation without initial lateral or angular misalignment and can be installed in pipelines where reverse flow will be encountered. NOTE: The use of an internally guided expansion joint does not eliminate the necessity of using adequate external pipe guides.

LIMIT ROD. Devices, usually in the form of rods or bars, attached to the expansion joint assembly whose primary function is to restrict the bellows movement range (axial, lateral and angular) during normal operation. They are designed to prevent over-extension or over-compression of the bellows while restraining the full pressure loading and dynamic forces generated by a main anchor failure.

PANTOGRAPH LINKAGE. A scissor-like device. A special form of control rod attached to the expansion joint assembly whose primary function is to positively distribute the movement equally between the two bellows of the universal joint throughout its full range of movement. Pantograph linkages, like control rods, are not designed to restrain pressure thrusts.

PIPE ALIGNMENT GUIDE. A pipe alignment guide is a form of framework fastened to some rigid part of the installation which permits the pipeline to move freely along the axis of the pipe. Pipe alignment guides are designed primarily for use in applications involving lateral deflection and angular rotation.

PIPE SECTION. A pipe section is that portion of a pipeline between two anchors. All dimensional changes in a pipe section must be absorbed between these two anchors.



PLANAR PIPE GUIDE. A planar pipe guide is one which permits transverse movement and/or bending of the pipeline in one plane. It is commonly used in applications involving lateral deflection or angular rotation resulting from "L" or "Z" shaped piping configurations.

PRESSURE BALANCED EXPANSION JOINT. A pressure balanced expansion joint is designed to absorb axial movement and/or lateral deflection while restraining the pressure thrust by means of tie devices interconnecting the flow bellows with an opposed bellows also subjected to line pressure. This type of expansion joint is normally used where a change of direction occurs in a run of piping but can be designed as an in-line device where no change of direction is necessary. 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.

PURGE CONNECTION. Purge connections, where required, are usually installed at the sealed end of each internal sleeve of an expansion joint for the purpose of injecting a liquid or gas between the bellows and the internal sleeve to keep the area clear of erosive and corrosive media and/or solids that could pack the convolutions. Purging may be continuous, intermittent or just on start-up or shut- down, as required. These are sometimes called aeration connections.

SHIPPING DEVICE. Rigid support devices installed on an expansion joint to maintain the overall length of the assembly for shipment. These devices may also be used to pre-compress, pre-extend or laterally offset the bellows.

SINGLE EXPANSION JOINT. The simplest form of expansion joint, of single bellows construction, designed to absorb all of the movements of the pipe section in which it is installed.

SWING EXPANSION JOINT. A swing expansion joint is designed to absorb lateral deflection and/or angular rotation in one plane. 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.

TANGENT. The straight unconvoluted portions at the end of the bellows.

TIE ROD. Devices, usually in the form of rods or bars, attached to the expansion joint assembly whose primary function is to continuously restrain the full pressure thrust during normal operation while permitting only lateral deflection. Angular rotation can be accommodated only if two tie rods are used and located 90 degrees opposed to the direction of rotation.

UNIVERSAL EXPANSION JOINT. A universal expansion joint is one containing two bellows joined by a common connector for the purpose of absorbing any combination of the three basic movements, i.e. axial movements, lateral deflection, and angular rotation. 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. This definition does not imply that only a universal expansion joint can absorb combined movements.

WELD END. The ends of an expansion joint equipped with pipe suitably beveled for welding to adjacent equipment or piping.

SAFETY RECOMMENDATIONS

U.S. Bellows highly recommends that our customers thoroughly understand the uniqueness of expansion joints and their application. The following safety recommendations are paraphrased from the Fifth Edition of *The Standards of the Expansion Joint Manufacturers Association, 1980.*

SAFETY RECOMMENDATIONS FOR PIPING SYSTEMS CONTAINING BELLOWS EXPANSION JOINTS

Bellows expansion joints are employed in piping systems to absorb differential thermal expansion while containing the system pressure. They are being successfully used in refineries, chemical plants, fossil and nuclear power plants, shipboard applications, heating and cooling systems, pulp and paper plants, and cryogenic plants. Typical service conditions range from pressures of full vacuum to 1,000 psig (70 kg/cm3) and -420F to +1,800 F (-251C to +968 C). Thus, expansion joints must be specified as a highly engineered product. They cannot and should not be purchased and used as commodity items if the expansion joints are to perform their intended function safely and reliably. The system operating requirements, the expansion joint design and manufacturing quality, the installation, test and operating procedures must all be considered for all expansion joint installations.

Unlike most commonly used piping components, a bellows is constructed of relatively thin gauge material in order to provide the flexibility needed to absorb mechanical and thermal movements expected in service. This requires design, manufacturing quality, non-destructive examination, handling, installation and inspection procedures which recognize the unique nature of this product.

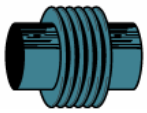
In general, the most reliable and safe bellows expansion joint installations have always involved a high degree of understanding between the user and manufacturer. With this basic concept in mind, the following recommendations are given in order to better inform the user of those factors which many years of experience have shown to be essential for the successful installation and performance of piping systems containing bellows expansion joints.

DESIGN SPECIFICATION

A design specification shall be prepared for each expansion joint application. Prior to writing the expansion joint design specification it is imperative that the system designer completely review the piping system layout, flowing medium, pressure, temperature, movements, and other items which may effect the performance of the expansion joint. Particular attention shall be given to the following items.

- The piping system should be reviewed to determine the location and type of expansion joint most suitable for the application. Both the EJMA Standards and most reliable expansion joint manufacturers' catalogs provide numerous examples to assist the user in this effort. The availability of supporting structures for anchoring and guiding of the piping, and the direction and magnitude of thermal movements to be absorbed must be considered when selecting the type and location of the expansion joint. Torsional rotation of the bellows should be avoided or special hardware should be incorporated into the design to limit the amount of torsional shear stress in the bellows.

View online catalog section for safety recommendations: www.usbellows.com/safety



- The bellows material shall be specified by the user and must be compatible with the flowing medium, the external environment and the operating temperature. Consideration shall be given to possible corrosion and erosion. The 300 Series stainless steels may be subject to chloride ion stress corrosion. High nickel alloys are subject to caustic induced stress corrosion. The presence of sulfur may also be detrimental to nickel alloys. The material chosen shall also be compatible with the environment surrounding the expansion joint, water treatment and cleaning materials. In some cases, leaching of corrodents from insulating materials can be a source of corrosion.
- Internal sleeves shall be specified in all applications involving flow velocities which could induce resonant vibration in the bellows or cause erosion of the convolutions resulting in premature failure.
- The system design pressure and test pressure shall be specified realistically without adding arbitrary safety factors. Excess bellows material thickness required for unrealistic pressures will often produce an adverse effect on the bellows fatigue life or increase the number of convolutions required which may reduce the stability of the bellows. In the case of high temperature applications, it may not be possible to test the expansion joint to 1.5 times the equivalent cold pressure rating of the system. This results from the various materials employed in the construction of the expansion joint, temperature gradient utilized in the design, pressure stability criteria, anchor strength, etc. The manufacturer must be consulted.
- The maximum, minimum and installation temperatures shall be accurately stated. Where the ambient temperature can vary significantly during pipeline construction, pre-positioning of the expansion joint at installation may be required.
- The manufacturer shall be advised if the expansion joint will be insulated. Insulation details shall be furnished to the manufacturer in order to properly design the component parts.
- The movements which are to be absorbed by the expansion joint shall include not only piping elongation or contraction, but also movement of attached vessels, anchors, etc. and the possibility of misalignment during installation. Unless included in the design requirements, misalignment of the expansion joint must be avoided. Where movements are cyclic, the number of cycles expected shall be specified. Similar to pressure, the movements specified must be realistic. An excessive safety factor can often result in an expansion joint which is unnecessarily flexible; thus its stability under pressure is unnecessarily reduced.
- If the flowing medium can pack or solidify, provisions shall then be made to prevent the entrapment or solidification of the material in the convolutions which could result in damage to the expansion joint or pipeline.
- Internal sleeves are usually installed in the direction of flow. If stagnant flow medium trapped behind the sleeve is undesirable, drain holes in sleeve, purge connections, or packing shall be specified. Where backflow will be encountered, an extra-heavy sleeve shall be specified to prevent buckling of sleeve and possible damage to the bellows.

- The predicted amplitude and frequency of external mechanical vibrations to be imposed on the bellows, such as those caused by reciprocating or pulsating machinery, shall be specified. A resonant condition in the bellows will result in a grossly reduced fatigue life and must be avoided. The expansion joint designer will attempt to provide a non-resonating design; however, the ability to always assure non-resonance is impossible. Therefore, field modifications to the expansion joint or other system components may be necessary.

The piping system drawings shall specify the location of all anchors, guides, supports and fixed points. Both the anchors and guides must be suitable for the highest pressures to be applied to the system. IN MOST CASES THE TEST PRESSURE WILL BE SIGNIFICANTLY HIGHER THAN THE SYSTEM OPERATING PRESSURE.

The system designer shall specify those special features which best accomplish personnel protection in his particular system. Piping systems containing high pressure and/or hazardous materials which are located in close proximity to personnel shall be provided with additional safety features which will protect such personnel in the event of a failure in the system. Expansion joints can be furnished with special features including, but not limited to, the following:

- Extra-heavy covers which could serve to impede the effect of a jet flow produced by a failure; however, such covers will not prevent the escaping medium from expanding and filling the surroundings in which it is located.
- Limit rods designed for dynamic loading can be employed to restrain the longitudinal pressure thrust in the event of an anchor failure. Such rods would normally remain completely passive until the anchor restraint is removed.
- A two-ply or two concentric bellows design may be employed with each ply or bellows designed to contain the full line pressure. The annular space between the plies or concentric bellows can be monitored continuously for leakage by means of suitable instrumentation. A change in pressure in the annulus could be used to detect bellows leakage.

The system designer shall provide for the accessibility of components (anchors, expansion joints, guides, etc.) in the piping system for periodic inspection after initial start up.

EXPANSION JOINT DESIGN

The expansion joint design shall conform to the requirements of the EJMA Standards, the ANSI Piping Codes and the ASME Boiler and Pressure Vessel Codes as applicable. The design of structural attachments shall be in accordance with accepted methods, based on elastic theory.

EXPANSION JOINT MANUFACTURING QUALITY

The expansion joint manufacturer shall be required to furnish, on request, a copy of their Quality Assurance Manual.

QUALITY STATEMENT

U.S. Bellows, Inc. is committed to continuous improvement of our products and services. We will work to understand and meet requirements of our external and internal customers. Viewing ourselves as part of a team which includes our customers and our suppliers, we will understand our role in meeting the teams goals. We will plan and execute our work to meet our customers' specifications. Working together we will strive to..."DO IT RIGHT THE FIRST TIME".

INSTALLATION

The necessary steps for installing all expansion joints shall be pre-planned. The installers shall be made aware of these steps as well as the installation instructions furnished by the manufacturer. The most critical phases of the expansion joint installation are as follows.

- Care shall be exercised to prevent any damage to the thin bellows section, such as dents, scores, arc strikes and weld spatter.
- No movement of the expansion joint (compression, extension, offset, rotation and especially torsion) due to piping misalignment, for example, shall be imposed which has not been anticipated and designed into the movement capability of the expansion joint. If such movements are imposed, they can result in system malfunction, damage to the bellows or other components in the system. Specifically, cycle life can be substantially reduced, forces imposed on adjacent equipment may exceed their design limits, internal sleeve clearances may be adversely affected, and the pressure capacity and stability of the bellows may be reduced.
- Any field pre-positioning shall be performed in accordance with specific instructions which include both the direction and magnitude of the movement.
- Anchors, guides and pipe supports shall be installed in strict accordance with the piping system drawings. Any field variances from planned installation may affect proper functioning of the expansion joint and must be brought to the attention of a competent design authority for resolution.
- The expansion joint, if provided with internal sleeves, shall be installed with the proper orientation with respect to flow direction.
- After the anchors or other fixed points are in place and the piping is properly supported and guided, the expansion joint shipping devices should normally be removed in order to allow the expansion joint to compensate for changes in ambient temperature during the remainder of the construction phase.

POST INSTALLATION INSPECTION PRIOR TO SYSTEM PRESSURE TEST

A careful inspection of the entire piping system shall be made with particular emphasis on the following:

- Are the anchors, guides and supports installed in accordance with the system drawings?
- Is the proper expansion joint in the proper location?
- Are the expansion joint flow direction and positioning correct?
- Have all the expansion joint shipping devices been removed?
- Are all guides, pipe supports and the expansion joints free to permit pipe movement?
- If the system has been designed for a gas, and is to be tested with water, have provisions been made for proper support of the additional dead weight load on the piping and expansion joint? Some water may remain in the bellows convolutions after the test. If this is detrimental to the bellows or system operation, means shall be provided to remove such water.
- Has any expansion joint been damaged during handling and installation?

- Is any expansion joint misaligned? This can be determined by measuring the expansion joints' overall length, inspection of the convolution geometry, and checking clearances at critical points on the expansion joint and at other points in the system.
- Are the bellows and other movable portions of the expansion joint free of foreign material?

INSPECTION DURING AND IMMEDIATELY AFTER SYSTEM PRESSURE TESTS

WARNING: EXTREME CARE MUST BE EXERCISED WHILE INSPECTING ANY PRESSURIZED SYSTEM OR COMPONENT.

A visual inspection of the system shall include checking for the following:

- Evidence of leakage or loss of pressure.
- Distortion or yielding of anchors, expansion joint hardware, the bellows and other piping components.
- Any unanticipated movement of the piping due to pressure.
- Evidence of instability (squirm) in the bellows.
- The guides, expansion joints and other moveable parts of the system shall be inspected for evidence of binding.
- Any evidence of abnormality or damage shall be reviewed and evaluated by competent design authority.

PERIODIC INSERVICE INSPECTION

WARNING: EXTREME CARE MUST BE EXERCISED WHILE INSPECTING ANY PRESSURIZED SYSTEM OR COMPONENT.

Immediately after placing the system in operation, a visual inspection shall be conducted to insure that the thermal expansion is being absorbed by the expansion joints in the manner for which they were designed. The bellows shall be inspected for evidence of unanticipated vibration.

A program of periodic inspection shall be planned by the system designer and conducted throughout the operating life of the system. The frequency of these inspections will be determined by the service and environmental conditions involved. These inspections should include the items noted previously as well as an examination for signs of external corrosion, loosening of threaded fasteners and deterioration of anchors, guides and other hardware. IT MUST BE UNDERSTOOD THAT THIS INSPECTION PROGRAM, WITHOUT ANY OTHER BACKUP INFORMATION, CANNOT GIVE EVIDENCE OF DAMAGE DUE TO FATIGUE, STRESS CORROSION OR GENERAL INTERNAL CORROSION. THESE CAN BE THE CAUSE OF SUDDEN FAILURES AND GENERALLY OCCUR WITHOUT ANY VISIBLE OR AUDIBLE WARNING. Where the critical nature of the system warrants, it may be necessary to devise means for minimizing the probability of this type failure, including periodic preventative replacement of critical system components.

Where any inspection reveals evidence of malfunction, damage or deterioration, this shall be reviewed by a competent design authority for resolution.

SYSTEM OPERATION

A record shall be maintained of any changes in system operating conditions (i.e. pressure, temperature, thermal cycling, water treatment) and piping modifications. Any such change shall be reviewed by a competent design authority to determine its effect on the performance of the anchor, guides and expansion joints.

TYPICAL CAUSES OF EXPANSION JOINT FAILURE

Bellows expansion joints which have been properly designed and manufactured for specified piping system conditions have given many years of satisfactory service. Failures, of course, have occurred which are of concern both to users and to reputable expansion joint manufacturers. Failures can occur for many reasons, but experience has shown that certain causes of failure fall into fairly distinct categories. The following list, which shows some typical causes but is by no means all-inclusive, is presented with the intent that, as knowledge of the causes of failure becomes more widespread, action can be taken to prevent or minimize these occurrences.

- Shipping and handling damage.

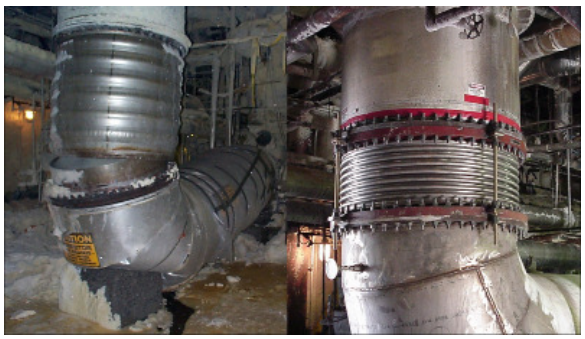
  Examples: Denting or gouging of bellows from being struck by hard objects (tools, chain falls, forklifts, adjacent structures, etc.); improper stacking for shipping or storage; insufficient protection from weather or other adverse environmental conditions.

- Improper installation and insufficient protection during and after installation.

  Examples: Joints with internal liners installed in the reverse direction with respect to flow; installing an expansion joint in a location other than as prescribed by the installation drawings; premature removal of shipping devices; springing of bellows to make up for piping misalignment; insufficient protection from mechanical damage due to work in the surrounding area; insufficient protection of bellows during nearby welding operations and failure to remove shipping devices before placing system in operation.

- Improper anchoring, guiding and supporting of the system.
- Anchor failure in service.
- Bellows corrosion, both internal and external.
- System over-pressure (in-service or hydrostatic test).
- Bellows vibration (mechanical or flow induced resulting in high cycle fatigue).
- Excessive bellows deflection (axial, lateral, angular deflections greater than design values).
- Torsion.
- Bellows erosion.
- Packing of particulate matter in the bellows convolutions which inhibits proper movement of the bellows.

Refurbished Single 4" Diameter Expansion Joint in One Day



Replacement Metallic Expansion Joint Fabricated and Installed Within Two Days

View online catalog section for expansion joint failures: www.usbellows.com/failures

PIPE GUIDE SPACING TABLE

Pipe guides are necessary to assure that the thermal expansion of the pipeline is properly directed into the expansion joint and to prevent buckling of the line. Additional guides located adjacent to the expansion joint are necessary because of the inherent flexibility of the bellows and the compressive loading on the pipe caused by the pressure thrust of the expansion joint. The first guide must be located within a distance of four pipe diameters from the expansion joint and the second guide within fourteen pipe diameters of the first guide. Additional guides should be located in accordance with the Pipe Guide Spacing Chart shown below for standard weight carbon steel pipe or calculated from the following formula:

$$L = 0.131 \left[\frac{EI}{pa \pm \Delta R_A} \right]^{1/2}$$

Where:

L = maximum intermediate guide space, (feet)

E = modulus of elasticity of pipe material, (psi)

I = moment of inertia of pipe, (in^4)

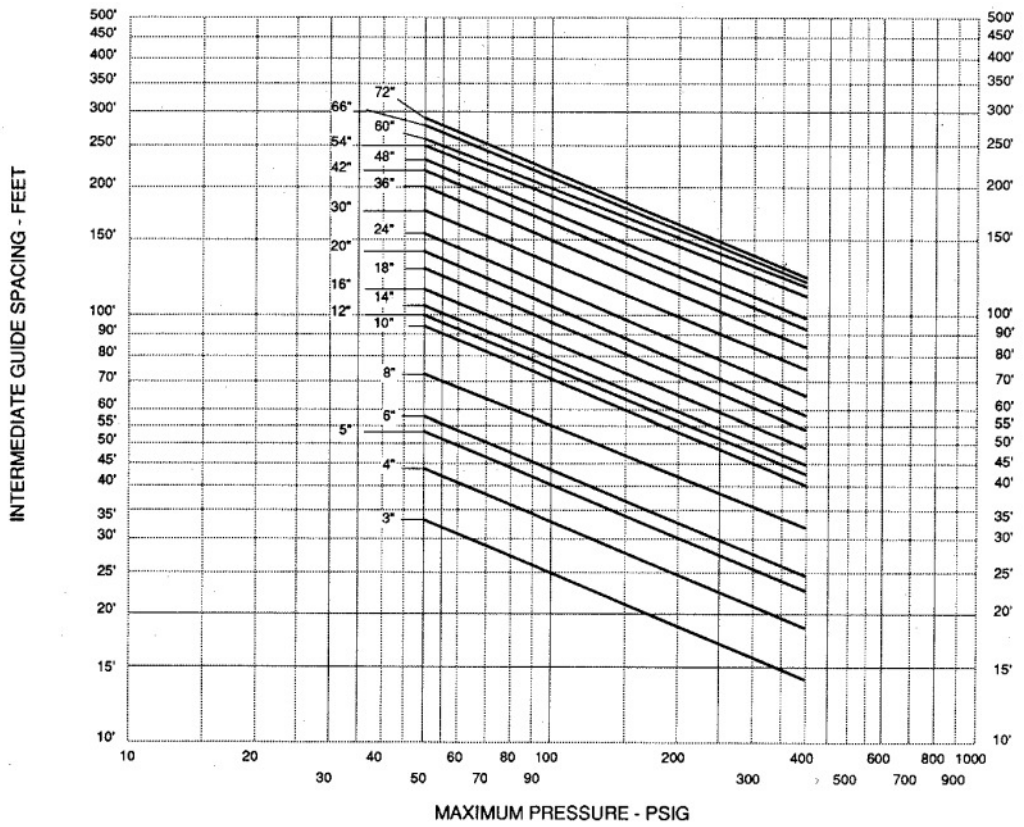
P = design pressure, (psig)

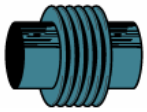
a = bellows effective area, (in^2)

R_A = bellows spring rate, (lb/in)

Δ = axial stroke of bellows, (in)

Note: When a bellows is compressed in operation, use (+) $|\Delta R_A|$; when extended, use (-) $|\Delta R_A|$.





ROUND EXPANSION JOINT DATA SHEET Use our online quote form: www.usbellows.com/quote

Customer:			Date:		Page
Project:			Prepared By:		
Applicable Codes and Standards: B31.1, B31.3, Sect 8 Div 1					
Item or Tag Number:					
Quantity:					
Size:					
Orientation:					
Style or Type (single, universal, hinged, gimbal, etc.):					
End Connections	Thickness/Flange Rating				
	Material				
Pressure (psi/inches water)	Design				
	Operating				
	Test				
Temperature	Design				
	Operating				
	Installation				
Media	Media				
	Flow Velocity				
	Flow Direction				
Movements and Cycle Life	Installation	Axial Extension			
		Axial Compression			
		Lateral			
		Angular			
		Number of Cycles			
	Design	Axial Extension			
		Axial Compression			
		Lateral			
		Angular			
		Number of Cycles			
	Operating	Axial Extension			
		Axial Compression			
		Lateral			
		Angular			
		Number of Cycles			
Materials	Bellows				
	Liner				
	Cover				
Dimensions	Overall Length				
	Maximum O.D.				
	Minimum I.D.				
Spring Rates	Maximum Axial Spring Rate				
	Maximum Lateral Spring Rate				
	Maximum Angular Spring Rate				
Quality Assurance	Bellows Long Seam Weld				
	Bellows Attachment Weld				
	Piping				
	U-2 Forms				

SAMPLE EXPANSION JOINT SPECIFICATION

1.0 General

This specification along with the purchase order, expansion joint data sheet, and drawings delineate the requirements for the design, fabrication, and testing of the expansion joint.

2.0 Design

2.1 The bellows shall be designed in accordance with the design equations for unreinforced and reinforced bellows as specified in *Section C of The Standards of the Expansion Joint Manufacturers, Fifth Edition, 1980* including all current addenda.

2.2 If reinforcement of the bellows is necessary for pressure, the reinforcing rings shall be formed integrally with the bellows. No bolted-on control devices such as equalizing rings shall be used.

2.3 Expansion joints weighing more than 500 pounds shall be provided with lifting lugs.

3.0 Materials

3.1 Expansion joint materials shall be as specified on the expansion joint data sheet. Material certifications shall be available for inspection.

4.0 Fabrication

4.1 Bellows shall be formed from seamless or longitudinally butt welded cylinders. If welded, the butt weld must be planished to within 10% of the original sheet thickness.

4.2 Bellows convolutions shall be "U" shaped and formed with an even pitch and height. Circumferential welds joining one convolution to another aren't permitted.

4.3 Bellows shall be provided in the as formed unannealed condition.

4.4 End connections are to match the adjacent piping as specified on the data sheet.

4.5 All welding shall be in accordance with ASME Section IX or AWS Dl.l.

5.0 Quality Assurance

5.1 The expansion joint manufacturer must maintain a quality assurance system. A copy of the Quality Assurance Manual must be made available upon request.

5.2 All of the non-destructive examination requirements are specified on the expansion joint data sheet. The manufacturer must have written procedures for each type of non-destructive examination specified.

6.0 Additional Requirements

6.1 Each expansion joint shall be provided with a stainless steel nameplate indicating the date of manufacture, design rating of the expansion joint and any other information required by the purchase order.

6.2 When the expansion joint is supplied with an internal sleeve, the flow direction must be indicated and be plainly visible on the outside of the joint.

6.3 All surfaces of the expansion joint shall be thoroughly cleaned of dirt, grease, oil and all foreign matter.

6.4 Shipping bars shall be installed on the expansion joint to maintain the proper shipping length. Shipping bars are to be painted yellow.

6.5 Each expansion joint shall be tagged with recommended installation instructions.

EXPANSION JOINT INSTALLATION INSTRUCTIONS

- Inspect for damage during shipment. Check for dents, broken hardware, damage to crate, etc.
- Store in a clean dry area where the expansion joint will not be exposed to heavy traffic or damaging environment.
- Use only designated lifting lugs.
- Do not use chains or any lifting device directly on the bellows or protective cover.
- Remove any foreign material that may have become lodged between the convolutions.
- Make the piping system fit the expansion joint. Do not remove shipping bars nor stretch, compress, or offset the joint to fit the piping
- Install expansion joint with flow arrow pointing in the direction of flow.
- Do not force-rotate (torque) one end of the expansion joint for the alignment of flange bolt holes. It is desirable to leave one of the connecting flanges loose for bolt hole alignment.
- Do not use graphite impregnated gaskets in contact with stainless steel facings or sleeves.
- Prior to welding, cover the bellows element with a fire retardant non-asbestos blanket.
- Remove all shipping devices only after the installation is complete and prior to any pressure test of the system. Only chloride free water should be used for hydrostatic test.
- Do not use cleaning agents that contain chlorides.
- Do not use steel wool or wire brushes on the bellows element.

FAILURE TO FOLLOW THESE INSTRUCTIONS MAY VOID OUR WARRANTY. IF ADDITIONAL INFORMATION IS REQUIRED, PLEASE CALL (713) 731-0030 AND ASK FOR HELP.

63" In-Line Pressure Balanced Expansion Joint with Refractory Lining

Metallic Expansion Joint with Refractory Lining

In-Line Pressure Balanced Expansion Joint with Refractory Lining

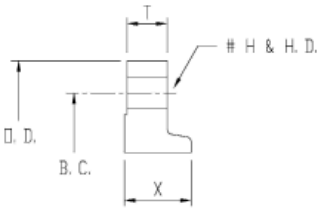
CATALOG FLANGE DATA

The summary of flange data listed below is offered as a guide to assist designers in selecting the most economical flanges for their piping system. When selecting a bellows from the catalog data pages that will have flanged connections, it is important that the system designer confirm that the flanges they have selected have an adequate pressure rating for the given temperature. There may be instances where the bellows has a higher pressure rating than the flange does at the design temperature.

The service temperature ratings shown below have been taken from *Taylor Forge Catalog #571*. Where elevated temperature data was not available, the service pressure ratings were obtained by down rating the ambient pressure rating in accordance with ASME Code strength versus temperature correction factors.

PRESSURE-TEMPERATURE RATINGS CARBON STEEL A-105/A-181

FLANGE	NOMINAL DIAMETER	SERVICE PRESSURE RATING (PSIG) AT TEMPERATURE (DEG F)						
		20-100	200	300	400	500	600	650
Class 125LW FFSO AWWA C207-54T Class D*	14" to 96"	150	131	115	99	83	67	59
150# RFSO ANSI B16.5	3" to 24"	275	240	210	180	150	130	120
300# RFSO ANSI B16.5	3" to 24"	720	700	680	665	625	555	515



*Class 125 LW flanges do not include a raised face.

NOM	CLASS 125 LW						
DIA	OD	X	T	BC	#H	HD	WT (LB)
14	21	1-1/4	3/4	18-3/4	12	1-1/8	44
16	23-1/2	1-1/4	3/4	21-1/4	16	1-1/8	58
18	25	1-1/4	3/4	22-3/4	16	1-1/4	59
20	27-1/2	1-1/4	3/4	25	20	1-1/4	69
22	29-1/2	1-3/4	1	27-1/4	20	1-3/8	76
24	32	1-3/4	1	29-1/2	20	1-3/8	115
26	34-1/4	1-3/4	1	31-3/4	24	1-3/8	125
28	36-1/2	1-3/4	1	34	28	1-3/8	140
30	38-3/4	1-3/4	1	36	28	1-3/8	150
32	41-3/4	1-3/4	1-1/8	38-1/2	28	1-5/8	205
34	43-3/4	1-3/4	1-1/8	40-1/2	32	1-5/8	215
36	46	1-3/4	1-1/8	42-3/4	32	1-5/8	235
38	48-3/4	1-3/4	1-1/8	45-1/4	32	1-5/8	265
40	50-3/4	1-3/4	1-1/8	47-1/4	36	1-5/8	280
42	53	1-3/4	1-1/4	49-1/2	36	1-5/8	330
44	55-1/4	2-1/4	1-1/4	51-3/4	40	1-5/8	350
46	57-1/4	2-1/4	1-1/4	53-3/4	40	1-5/8	365
48	59-1/2	2-1/2	1-3/8	56	44	1-5/8	425
50	61-3/4	2-1/2	1-3/8	58-1/4	44	1-7/8	450
52	64	2-1/2	1-3/8	60-1/2	44	1-7/8	475
54	66-1/4	2-1/2	1-3/8	62-3/4	44	1-7/8	500
60	73	2-3/4	1-1/2	69-1/4	52	1-7/8	640
66	80	2-3/4	1-1/2	76	52	1-7/8	750
72	86-1/2	2-3/4	1-1/2	82-1/2	60	1-7/8	850
84	99-3/4	3	1-3/4	95-1/2	64	2-1/8	1000
96	113-1/4	3-1/4	2	108-1/2	68	2-3/8	1650

NOM	CLASS 150 ANSI B16.6						
DIA	OD	X	T	BC	#H	HD	WT (LB)
3	7-1/2	1-3/16	15/16	6	4	3/4	8
3-1/2	8-1/2	1-1/4	15/16	7	8	3/4	11
4	9	1-5/16	15/16	7-1/2	8	3/4	13
5	10	1-7/16	15/16	8-1/2	8	7/8	15
6	11	1-9/16	1	9-1/2	8	7/8	19
8	13-1/2	1-3/4	1-1/8	11-3/4	8	7/8	30
10	16	1-15/16	1-3/16	14-1/4	12	1	43
12	19	2-3/16	1-1/4	17	12	1	64
14	21	2-1/4	1-3/8	18-3/4	12	1-1/8	90
16	23-1/2	2-1/2	1-7/16	21-1/4	16	1-1/8	98
18	25	2-11/16	1-9/16	22-3/4	16	1-1/4	130
20	27-1/2	2-7/8	1-11/16	25	20	1-1/4	165
22	29-1/2	3-1/8	1-13/16	27-1/4	20	1-3/8	185
24	32	3-1/4	1-7/8	29-1/2	20	1-3/8	220

	300 LB ANSI B16.5						
3	8-1/4	1-11/16	1-1/8	6-5/8	8	7/8	13
3-1/2	9	1-3/4	1-3/16	7-1/4	8	7/8	17
4	10	1-7/8	1-1/4	7-7/8	8	7/8	22
5	11	2	1-3/8	9-1/4	8	7/8	28
6	12-1/2	2-1/16	1-7/16	10-5/8	12	7/8	39
8	15	2-7/16	1-5/8	13	12	1	58
10	17-1/2	2-5/8	1-7/8	15-1/4	16	1-1/8	81
12	20-1/2	2-7/8	2	17-3/4	16	1-1/4	115
14	23	3	2-1/8	20-1/4	20	1-1/4	165
16	25-1/2	3-1/4	2-1/4	22-1/2	20	1-3/8	190
18	28	3-1/2	2-3/8	24-3/4	24	1-3/8	250
20	30-1/2	3-3/4	2-1/2	27	24	1-3/8	315
22	33	4	2-5/8	29-1/4	24	1-5/8	370
24	36	4-3/16	2-3/4	32	24	1-5/8	475

ANGLE FLANGES 5 PSIG Maximum Pressure

Low cost flanges for low pressure applications.
Materials: Carbon steel (other materials available upon request).

Note: To prevent field misalignment, we recommend purchasing companion angle flanges when the expansion joint is ordered with angle flanges (AF).

NOMINAL DIAMETER	ACTUAL INSIDE DIAMETER "I.D"	ANGLE THICKNESS "T"	ANGLE HEIGHT "H"	ANGLE WIDTH "W"	APPROXIMATE WEIGHT (LB)	DRILLING INFORMATION		
						BOLT CIRCLE DIAMETER	BOLT HOLE DIAMETER	NUMBER OF HOLES
14"	14-1/4"	3/16"	1-1/2"	1-1/2"	8	15-13/16"	7/16"	12
16"	16-1/4"	3/16"	1-3/4"	1-3/4"	10	18-1/8"	7/16"	16
18"	18-1/4"	3/16"	1-3/4"	1-3/4"	11	20-1/8"	7/16"	16
20"	20-1/4"	3/16"	1-3/4"	1-3/4"	12	22-1/8"	7/16"	20
22"	22-1/4"	3/16"	1-3/4"	1-3/4"	14	24-1/8"	7/16"	20
24"	24-1/4"	3/16"	1-3/4"	1-3/4"	15	26-1/8"	7/16"	20
26"	26-1/4"	3/16"	2"	2"	18	28-1/2"	9/16"	24
28"	28-1/4"	3/16"	2"	2"	20	30-1/2"	9/16"	24
30"	30-1/4"	3/16"	2"	2"	21	32-1/2"	9/16"	28
32"	32-1/4"	3/16"	2"	2"	22	34-1/2"	9/16"	28
34"	34-1/4"	3/16"	2"	2"	23	36-1/2"	9/16"	32
36"	36-1/4"	3/16"	2"	2"	25	38-1/2"	9/16"	32
38"	38-1/4"	3/16"	2"	2"	26	40-1/2"	9/16"	32
40"	40-1/4"	3/16"	2"	2"	27	42-1/2"	9/16"	36
42"	42-1/4"	3/16"	2"	2"	29	44-1/2"	9/16"	36
44"	44-1/4"	3/16"	2"	2"	30	46-1/2"	9/16"	40
46"	46-1/4"	3/16"	2"	2"	31	48-1/2"	9/16"	40
48"	48-1/4"	3/16"	2"	2"	32	50-1/2"	9/16"	40

PART NUMBER EXAMPLE	SIZE	PRESSURE	LENGTH	END CONNECTIONS	TYPE	ACCESSORIES	MATERIAL
	72	5	13-1/2	AF AF	S	L	321

BELLOWS MATERIAL

Bellows can be formed from most ductile materials that can be welded by the automatic T.I.G. welding process and result in a homogenous weld structure.

It is imperative that companies specifying and purchasing bellows give thorough consideration to the selection of the bellows material. Due to the fact that a given media will vary from system to system, and that most media specifications cannot accurately reflect what actually will occur during system operation, it is not appropriate for U.S. Bellows to make specific recommendations regarding bellows material.

If any doubt exists concerning proper material selection for the bellows, we recommend that a metallurgist with the appropriate basic material supplier be consulted.

CATALOG BELLOWS MATERIALS

Material Type	ASTM* Material Specification
304 S/S	A-240
304L S/S**	A-240
316 S/S	A-240
316 L S/S	A-240
321 S/S	A-240
Monel® 400**	B-127
Inconel® 600	B-168
Inconel® 625	B-443
Incoloy® 800/800H**	B-409
Incoloy® 825**	B-424
Hastelloy® C-276**	B-575

** ASME "SA" or "SB" materials are inventoried in limited gauges.

All bellows material purchased by U.S. Bellows is in "mill annealed" condition, in accordance with "A" or "B" specifications ("SA" or "SB" for ASME Code requirements). Any other heat treating operations before or after welding, and before or after forming the bellows convolutions will not be performed unless specified by the purchaser. It should be noted that heat treating the bellows after forming the bellows convolutions alters the bellows capabilities and performance characteristics, namely pressure capacity, spring rate, and cycle life. We will cooperate with our customers that specify post-form heat treatment of the bellows to determine the effects that the heat treatment will have on published bellows performance data.

COMMON BELLOWS MATERIAL FAILURES

Failure Mode	Typical Source
Stress Corrosion*	Chlorides (austenitic stainless steels) Caustics, high temperature sulfurous gas (nickel alloys)
Fatigue	Vibration
Carbide precipitation	Unstabilized materials at high temperatures
Squirm & Rupture	Over pressurization

* It is important to note that nickel alloys are typically specified per steam service to avoid chloride-induced stress corrosion. The steam must also be checked to avoid nickel alloy failures in steam lines which contain caustics.

View online catalog section for bellows materials: www.usbellows.com/bellows

APPLICATIONS AND PIPING ARRANGEMENTS

APPLICATIONS OF EXPANSION JOINTS IN TYPICAL PIPING SYSTEMS

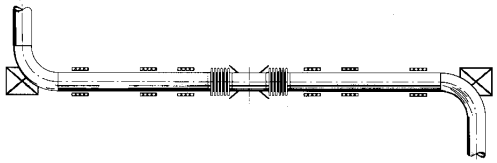
This section presents typical piping systems in which various movement and force limitation conditions are shown with suggested expansion joint solutions. In these examples, the various types of expansion joints are shown so that their operation and characteristics can be more clearly understood and demonstrated. Hopefully the piping designer will see in these examples enough similarity to his piping problem that the easiest and most economic solution would present itself quickly.

Axial Movements Only

EXAMPLE 1

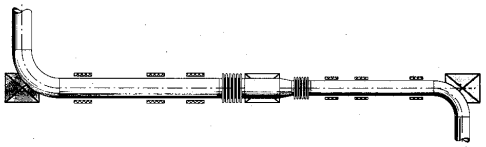
In this first example, a long straight pipe, anchored at each end, must expand thermally. A single type expansion joint is used with intermediate pipe guides. Good practice dictates that the expansion joint be located as close as possible to one of the anchors, in this case adjacent to the elbow. The first guide should be located as close as possible to the expansion joint, so that the deflection is limited to the expected axial direction. The second guide is located relatively close to the first to prevent any bowing of the pipe, and again to ensure that the end of the pipe at the expansion joint attachment moves in only the expected axial direction. The spacing of the remaining guides should follow the recommendations of the EJMA standards, which are contained in this design manual.

EXAMPLE 2



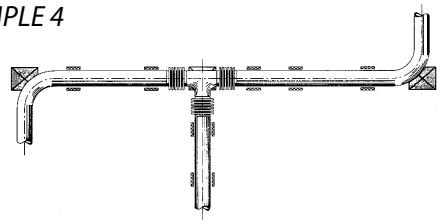
If the straight run of pipe is very long, good practice dictates that the expanding pipe be divided into smaller segments with intermediate anchors. In this way, the pipe's movement and direction of movement is more safely controlled. An expansion joint is placed between each set of anchors, to absorb the thermal growth of that section of pipe. The above diagram shows this arrangement and the recommended guiding, which is consistent with the discussion in Example 1.

EXAMPLE 3



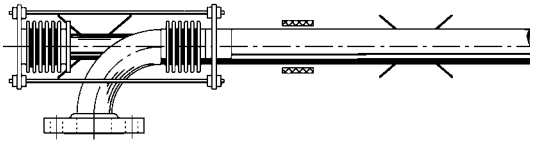
In this example, the same line contains a reducer, and therefore, the pipe run consists of two different diameters. Since the pressure thrust on the main anchors is a function of the pressure times the cross-sectional area of the expansion joints, if only one expansion joint of either pipe size were to be used, a portion of the pressure thrust would exist in the pipe wall as a compression force, tending to buckle or bow the pipe. By locating a main anchor at the reducer, the thermal expansion of each pipe section is confined to that pipe section, and an expansion joint is provided for each section. In this case, the expansion joints are located on either side of the reducer, which satisfies the need to locate them near an anchor. The rules for pipe guiding should be the same as mentioned above.

EXAMPLE 4



When another pipe is branching off a long section of straight pipe, the configuration shown above utilizes the Example 2 arrangement for the main pipe section; however, instead of an intermediate anchor, a main anchor should be used at the tee. This main anchor resists the pressure thrust of the branch line. In the direction of the main line the anchor must resist any dynamic pressure thrust imbalance resulting from the changing flow conditions caused by the branch line. Again, all the expansion joints are located near the anchor, and the guiding of all the pipes follows that of Example 1.

EXAMPLE 5



In this example the pipe takes a change in direction with an elbow. The axial thermal expansion of the horizontal pipe is absorbed with a pressure balanced elbow expansion joint, so that a main anchor is not required at the elbow. An intermediate anchor is located at the elbow such that the vertical leg does not need to even resist the spring forces of the expansion joint when it deflects. With pressure balanced expansion joints, the pipe wall is in tension, since the pressure thrust is balanced within the pipe and expansion joint. As a result, the extensive guiding provided for the previous examples can be eliminated. Usually, it is good practice to provide at least one guide near the expansion joint, as shown.

View online catalog section for axial movements:
www.usbellows.com/axial

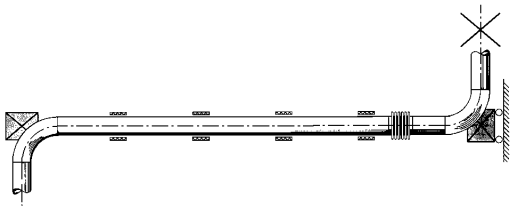
LATERAL, ANGULAR AND COMBINED MOVEMENTS

Often the piping arrangement, force limitations, number of operating cycles, and economics, dictate that deflections may not be simple axial motions as described above, but will be lateral, angular or combinations of all three. The following examples show how various piping problems are solved with different types of expansion joints, anchoring and guiding arrangements.

43" Hinged Expansion Joints with 5" Thick Refractory Lining

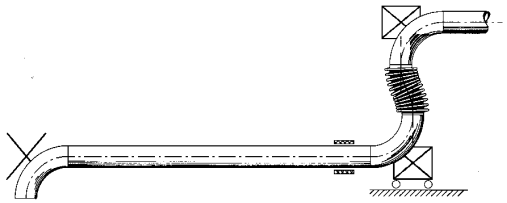
Rectangular Metallic Universal Expansion Joint with Cor-Ten Bellows

EXAMPLE 6

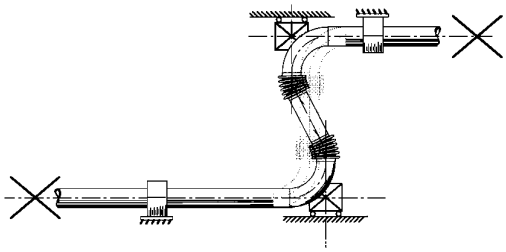


In this example, if the pressure and deflections are low enough, an inexpensive single expansion joint is able to absorb the thermal expansion of both the pipe run in which the expansion joint is located, and the perpendicular pipe. The growth of the perpendicular pipe produces lateral deflection in the expansion joint, while axial deflection absorbs the growth of the horizontal run. This combination of movements is, therefore, handled by a single expansion joint. The pressure thrust cannot be resisted by the expansion joint and a "directional" anchor must be provided at the elbow to permit the elbow to deflect vertically. The pipe guiding required follows that of Example 1.

EXAMPLE 7

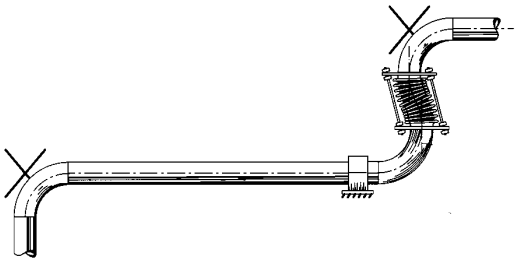


As in Example 6, a single expansion joint absorbs, as lateral deflection, the thermal expansion of the long horizontal pipe run. The benefit of this arrangement is that the anchoring to restrain the pressure thrust is confined to the short pipe leg that contains the expansion joint. The long pipe is in tension from its pressure thrust and does not require extensive guiding. A directional anchor is located at the lower elbow, with the freedom to permit the growth of the horizontal pipe. The upper elbow is attached to a main anchor, and is the fixed point from which all the deflections are calculated. At the left elbow, an intermediate anchor is added to fix the end of the portion of pipe from which the expansion joint is accepting movement.



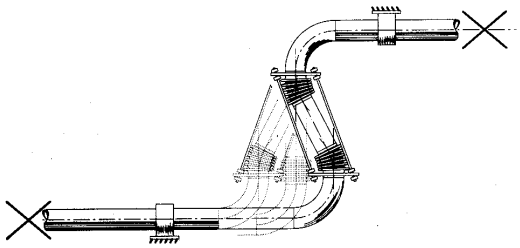
If lateral deflections will be larger than a single expansion joint can accept, a universal type can be used as shown above.

EXAMPLE 8



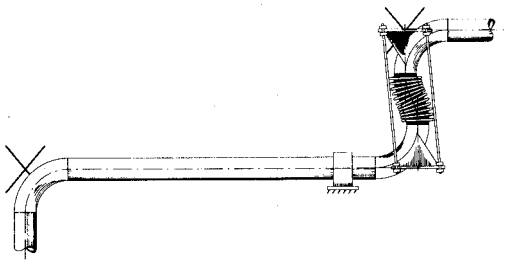
When anchoring to absorb the pressure thrust shown in the previous example is impractical, or uneconomical, an arrangement using a tied single expansion joint can be used as shown above. The

tie rods are tension devices which act the same as the pipe wall in resisting or carrying the pressure thrust. As a result, the length of the expansion joint becomes fixed, and the unit cannot absorb the axial deflection produced by the thermal expansion of the pipe in which it is installed. The expansion joint will absorb, as lateral deflection, the thermal expansion of the long horizontal pipe. Since the short vertical pipe length will change due to the rotation of the tie rods and the thermal expansion of its elbows and hot pipe, the horizontal pipe will bend. Therefore a planar guide is provided as shown. This arrangement will only work if the horizontal pipe can accept the bending. Usually it is practical and economical for small vertical movements and/or long horizontal pipe runs.



As in Example 7, if large lateral deflections must be absorbed, tied universal expansion joints should be provided as shown above.

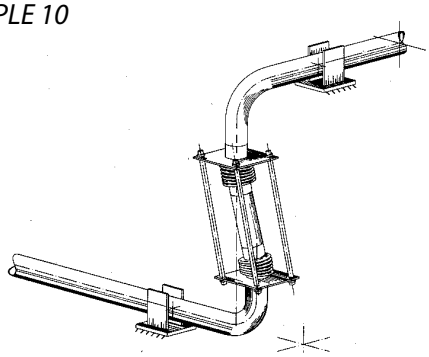
EXAMPLE 9



This arrangement is similar to Example 8, except that the need for the long horizontal pipe to accept bending is reduced or eliminated, by the attachment of the tie rods from elbow to elbow. Thus, the length of the vertical pipe between the elbows, including the expansion joint, is fixed.

All the thermal expansion of the vertical leg is absorbed by the bellows within the tie rods. Some bending of the long pipe will occur due to the rotation of the tie rods during the lateral deflection. However, since the rods now cover a longer distance, the angle they must rotate for a given lateral deflection is considerably reduced.

EXAMPLE 10



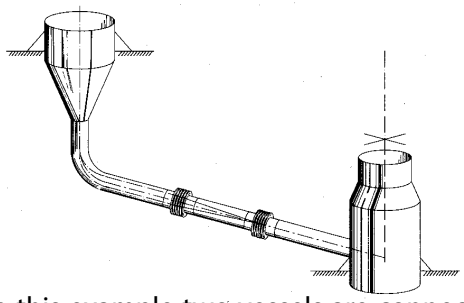
The previous examples dealt with all the piping and deflections in a single plane. Often, however, pipe runs change planes as well as direction, and the resulting thermal expansion can appear to be complicated. In this example, a tied universal expansion joint is shown accepting the thermal

60" Diameter Pressure Balanced Expansion Joint with Turning Vanes

growth of two horizontal pipes in two different planes. The example is almost identical to Example 8, except that the lateral deflections must be analyzed as vectors. The real deflection of the expansion joint is a single resultant lateral deflection in a single resultant plane. The axial thermal expansion of the pipe length that includes the expansion joint is absorbed within the expansion joint and by bending the pipes just as in Example 8.

The expansion joint can also have the tie rods attached to the elbows, as in Example 9, and achieve the same benefits, but the deflections must still be determined as vectors, as above.

EXAMPLE 11



In this example two vessels are connected by a straight inclined or horizontal pipe. As shown, each vessel is assumed to be an anchor, wherein the vessel supports must be capable of accepting the pressure thrust developed in the pipe, in the direction of the axis of the pipe. The purpose of the expansion joint is to accept the thermal expansion of the distance between the centerlines of the vessels. Even though the pipe is attached to the right vessel at its wall, the growth of the diameter of the vessel itself adds to the connecting pipe growth. The growth from anchor point to anchor point must be used for the thermal expansion calculation.

Here we have used an untied universal expansion joint, since the growth of the pipe is accepted as axial compression by the bellows. When the pipe is inclined, or the elevation of the anchor of each vessel is different, the vertical thermal expansion creates a lateral deflection vector, which is easily accepted by the universal type of expansion joint.

In this application, because the pipe and expansion joint are horizontal, or inclined, the weight of pipe spool between the bellows must be considered in the final design. Tie rods which do not restrain the thrust or control rods, can be added to suspend the center spool. Similarly, slotted hinges can be added over each bellows. Another mechanism for the same purpose is a pantographic linkage.

The advantage of the pantograph is that it automatically distributes the axial deflection equally between the two bellows without the addition of other devices.

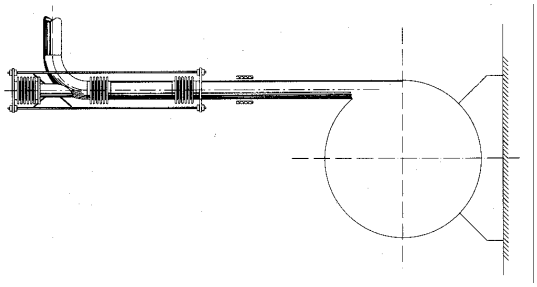
View online catalog section for lateral, angular and combined movements: www.usbellows.com/lateral

PRESSURE BALANCING EXAMPLES

The pressure thrust produced by low pressures can be tremendous in large diameter systems, just as it can be at normal pressure ratings in small pipes. To avoid expensive anchors, to keep long pipe runs in tension, to prevent buckling, or reduce reaction forces on equipment, the pressure in the pipe can be used to generate balancing forces within the expansion joint. These combinations of bellows and thrust restraining structural components can accept almost any combination of movements, as shown in the following examples.

View online catalog section for pressure balancing movements: www.usbellows.com/pressure-balancing

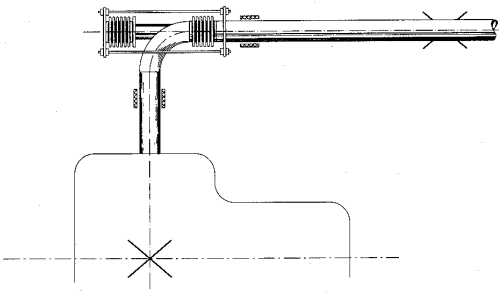
EXAMPLE 12



The pressure balanced elbow is ideal for absorbing the thermal expansion of equipment, such as turbines, pumps and compressors, which rely upon low reaction forces on their inlet and exhaust flanges. In this example, only an intermediate anchor is provided at the elbow, to isolate the equipment from any forces produced in the remaining piping. The pressure thrust force produces tension on the equipment flange, but the only forces produced by the deflection, are the spring resistance of the bellows within the expansion joint. The spring rate of these units is the sum of the spring rates of the bellows on each side of the elbow, and care must be taken to provide a unit which produces spring forces low enough to satisfy the equipment maximums as stated by the equipment manufacturer. Bellows may also be cold sprung to reduce these forces even lower.

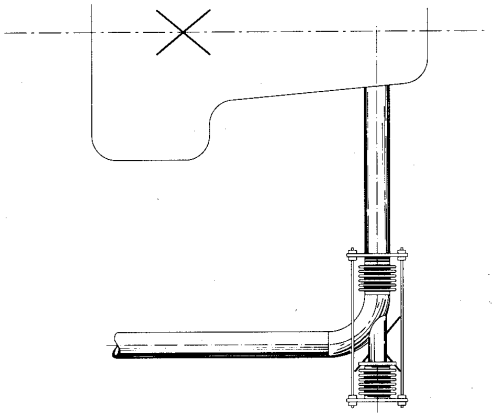
36" Pressure Balanced Expansion Joint

EXAMPLE 13



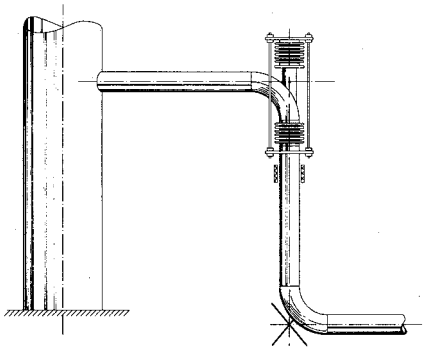
In this example, which may be typical for a turbine exhaust application, the force on the machine's flange is the spring reaction of the bellows in lateral deflection, as described in Example 12. Again, the flange is also subjected to an axial force equal to the pressure thrust, as if it were capped, but the turbine's mounts are not. The pipe guide between the expansion joint and the equipment flange absorbs the forces produced by the thermal expansion of the pipe, along its axis.

When the expansion joint must be located adjacent to the equipment flange, the elbow of the expansion joint can be used as an intermediate anchor point as shown below.



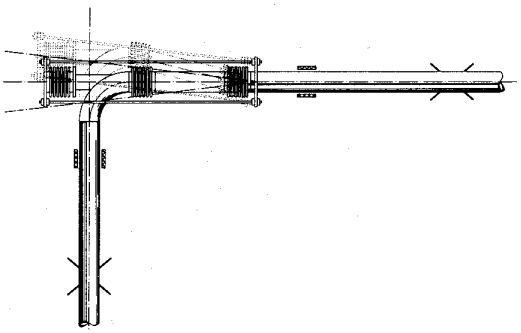
Now, all radial growth of the machine is absorbed by the expansion joint as axial deflection. Axial machine growth creates lateral deflection.

EXAMPLE 14



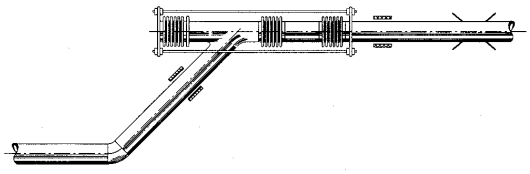
The vertical growth of a tank or vessel is handled easily as shown. The advantage of pressure balancing is that the vessel is not subjected to an unbalanced side load from the pressure thrust at the nozzle. Radial growth of the vessel is accepted by the expansion joint as lateral deflection. With an intermediate anchor at the pipe elbow near the ground to isolate downstream pipe movement from the vessel, a guide is added near the expansion joint to eliminate or limit pipe bending.

EXAMPLE 15



In the previous examples, a single bellows was shown as the primary, or working bellows. When lateral movements are large, or lateral spring forces must be minimized, the primary bellows is a universal type as shown above.

EXAMPLE 16



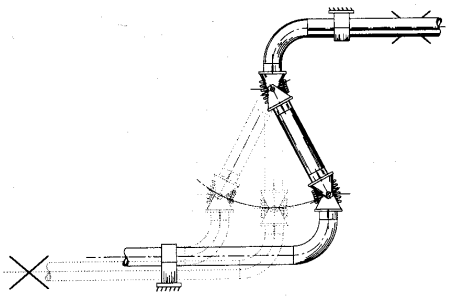
Most often the elbows in pressure balanced expansion joints are 90 degrees. They can be provided with any degree angle elbow and they will function the same way as is shown with the 45 degree pressure balanced elbow above.

EXAMPLES USING HINGED OR GIMBAL EXPANSION JOINTS

When thermal expansion or other movements want to bend a pipe, in order to lower stresses, a controlled bending point can be added with a hinge or gimbal expansion joint. The hinged unit will limit bending to only one plane, and the gimbal will permit bending in all planes. The piping is always in tension because the pressure thrust is contained within the system, and main pressure thrust anchors are not required. Generally, only guides and intermediate anchors are needed, as shown in the examples. The full weight of the pipe between these expansion joints can be carried by them. With proper hinge and gimbal structure, the weight of additional pipes can also be supported as well as wind loading.

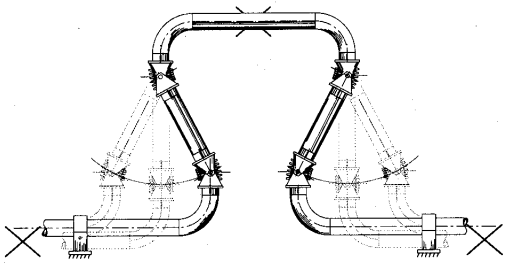
View online catalog section for hinged and gimbal expansion joint movements:
www.usbellows.com/hinged-and-gimbal-movements

EXAMPLE 17



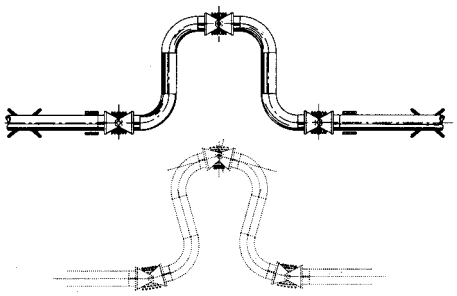
Two hinged expansion joints in a straight pipe run will permit lateral deflection of the pipe, just as a universal expansion joint will. However, the axial thermal growth will not be absorbed within the expansion joints. This example uses a flexible straight pipe section between two elbows to accept the large thermal expansion of long pipe runs on either side. Planar guides, or guides which permit movement in a plane perpendicular to the pipe as well as axially, should be added because some pipe bending may occur.

EXAMPLE 18



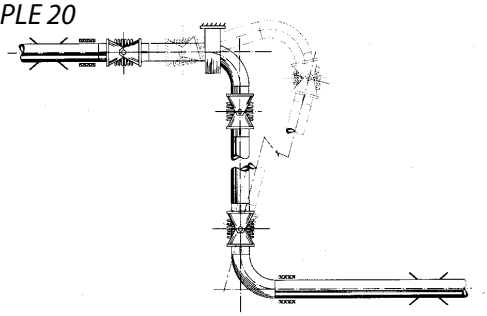
In this example a highly flexible pipe loop is created with a double set of the arrangement shown in Example 17. The top of the loop is anchored with an intermediate anchor, and each side operates independently of the other.

EXAMPLE 19



A highly efficient replacement for a rigid pipe loop is depicted here with three hinged expansion joints. Using four 90 degree elbows, this "loop" has only two "legs" with short pipe lengths. These features develop much lower flow losses than a common pipe loop for the same axial travel. Pipe guides should be used near the outer expansion joints. Only intermediate anchors are needed.

EXAMPLE 20



The three pin arch system shown in this example accepts deflections in all directions and operates in the same manner as the loop shown in Example 19. Because the movement of each bellows is highly controlled, and limited to bending only, it is one of the most reliable arrangements for large pipe and vessel deflections. When hinged expansion joints are used, the movements are confined to a single plane. When at least two gimbal joints are used, the movements accepted can be in all directions and in any plane.

SINGLE EXPANSION JOINTS

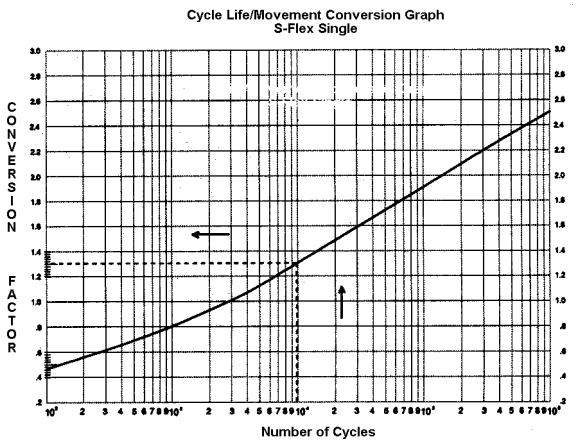
CYCLE LIFE AND RATED MOVEMENT

Single Expansion Joints

U.S. Bellows' single expansion joints are designed for 3000 cycles for any one tabulated movement shown. Cycle life may be increased, or movement may be increased (decreasing the cycle life) by utilizing the graph located on this page. The graph may also be used for superimposing more than one movement condition on the bellows at one time. It is important to remember that the movements shown in the bellows data pages do not allow for any installation misalignment. A proper specification for a bellows expansion joint should reflect what the actual system movements will be. To insure the highest quality bellows for the least cost, all movement conditions must be taken into account. Refer to the HOW TO ORDER section on page 43 for an example of the proper analysis and selection of a single expansion joint.

Examples of movement conditions that typically occur in a piping system are:

- **Installation:** Allow one cycle installation misalignment.
- **Start-Up/Shut-Down:** Movements produced between the minimum ambient temperature and the maximum start-up temperature. This is normally a very low number of cycles.
- **Operating**: Movements produced due to temperature fluctuations during system operation. This is typically a very small movement for a very large number of cycles.
- **Excursion:** Movement resulting from a worst case/ upset scenario, occurring during system operation. This is normally a very low number of cycles.



How To Use Graph

- Enter the graph horizontally at the number of anticipated cycles or the movement condition being considered.
- Move vertically until the graph is intercepted
- Move horizontally and read conversion factor.

Example:
Enter graph at 1,000 cycles; read C. F. of 1.30.

Single Expansion Joints for a Refinery in Asia

- Note: Maximum increase in movements for combined movement conditions shall not exceed 110% of catalog rated movements.

HOW TO SELECT AND ORDER

The first step in selecting the proper expansion joint assembly is to collect and organize as much information regarding the design and operating parameters of the system as possible. As a minimum the following information should be provided:

- Size of the line.
- Design pressure.
- Design temperature.
- Design movements and required cycle life.
- Overall length requirement, if any.
- Type of end connections.
- Bellows material.
- Pipe material.
- Flange specification and material.
- Type of expansion joint.
- Accessories.

Please refer to the data sheet on page 28.

EXAMPLE

1. Assume the following expansion joint design criteria:
   a) Line size: 16-inch nominal diameter.
   b) Design/operating pressure: 160 psig.
   c) Design/operating temperature: 450° F.
   d) Movements/cycle life:
   Installation: 0.25-inch compression; 0.125-inch extension; 0.0625-inch lateral; 0° angulation. Start-up/shut-down: 1.0-inch compression; 0.25-inch lateral; 0°angulation; 300 cycles. Operating: 0.25-inch compression; 0.063-inch lateral; 1.0° angulation; 10,000 cycles.
   e) End connections: 150 lb ANSI raised face slip-on flanges; ASTM A-105 (carbon steel).
   f) Bellows material: A-240-T316.
   g) Type: Single; unrestrained (i.e. no tie rods, hinge, or gimbal hardware).
   h) Accessories: Liner and cover.

2. Turn to the Conversion Factor Graph and calculate equivalent catalog movements.

Condition	No. Cycles	Axial	Lat.	Ang.	C.F.	Equivalent		
						Axial	Lat.	Ang
Install	1	.375	.063	0	.49	.18	.03	0
Start-Up/ Shut-Down	300	1.0	.25	0	.62	.62	.16	0
Excursion	10,000	.25	.063	1.0	1.3	.33	.08	1.3

Total = 1.13 0.27 1.3

3. Refer to page 54, 16-inch nominal diameter single expansion joints, and go to the lowest pressure rating that is equal to or greater than specified design pressure (160 psig). Compare the total equivalent catalog movements to those shown in the catalog, keeping in mind that the tabulated movements in the catalog are for 3000 cycles for one movement only.

4. Select the shortest overall length that by inspection would appear to meet the movement criteria. Use the following formula to determine if the selected overall length is acceptable.

$$\frac{\text{EQUIV. AXIAL}}{\text{RATED AXIAL}} + \frac{\text{EQUIV. LATERAL}}{\text{RATED LATERAL}} + \frac{\text{EQUIV. ANGULAR}}{\text{RATED ANGULAR}} \leq 1.0$$

200 psig rating/18-inch O.A.L.

$$\frac{1.13}{2.75} + \frac{0.27}{0.69} + \frac{1.30}{10.0} = 0.93$$

5. Since 0.93 is less than 1.0, the 200 psig/18-inch O.A.L. will meet the criteria for all the movement conditions specified in Step 1.

6. Include the designations for the type (S for single), and liner (L), and cover (C) in the part number. All of the actual movements must be specified when combination ends or covers are specified.

7. On combination end units, the direction of flow must be specified.

8. The resulting U.S. Bellows part number would then be as follows (see table):

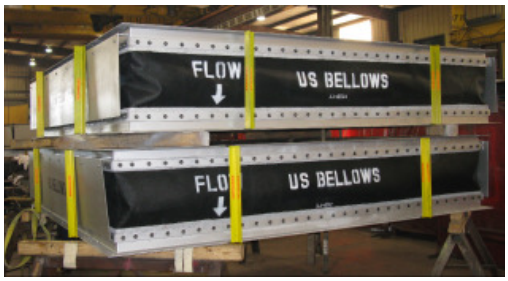
24" Single Tied Metallic Expansion Joints

Part Number Example	Size	Pressure	Length	End Connections	Type	Accessories	Material
	16	200	18	FF	S	L C	316

44" Expansion Joint for a Petrochemical Plant

66" I.D. Tied Universal Metallic Expansion Joint and Single Metallic Expansion Joints

78" Diameter Thick-Wall Flanged and Flued Head Expansion Joint



10' Square Fabric Expansion Joints for a Flue Gas Application

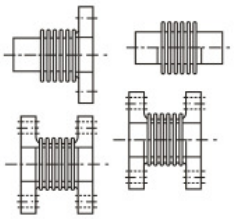
View our online catalog at: www.usbellows.com/catalog

3-Inch Nominal Diameter

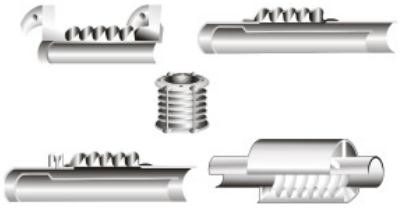
Effective (Thrust) Area: 12.76 in^2 (82.32 cm^2)

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
3	170	6	7	12	6	9	7	0.92	0.28	10	304	560	11	0.0087
	11.9	152	3.18	305	2.73	229	3.18	23.4	7.11	11	5	10	1.1	0.0088
	90	9	7	15	7	12	7	1.87	1.03	10	169	93	6	0.0048
	6.3	229	3.18	381	3.18	305	3.18	47.5	26.2	11	3	2	0.6	0.0049
	40	12	8	18	7	15	8	2.84	2.27	10	117	31	4	0.0033
	2.8	305	3.64	457	3.18	381	3.64	72.1	57.7	11	2	1	0.4	0.0034
3	500	6	27	12	6	9	17	0.36	0.08	10	2020	7142	72	0.0214
	35.1	152	12.3	305	2.73	229	7.73	9.14	2.03	11	36	128	7.3	0.0217
	500	9	28	15	7	12	18	0.77	0.36	10	943	726	33	0.0100
	35.1	229	12.7	381	3.18	305	8.18	19.6	9.14	11	17	13	3.4	0.0101
	250	12	29	18	8	15	19	1.3	0.93	10	615	201	22	0.0065
	17.6	305	13.2	457	3.64	381	8.64	33	23.6	11	11	4	2.2	0.0066

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
40-170 psig Series: 150 lb ANSI B16.5 RFSO.
250-500 psig Series: 300 lb ANSI B16.5 RFSO
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
40-70 psig Series: Std. Wt. Pipe.
250-500 psig Series: Std. Wt. Pipe.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

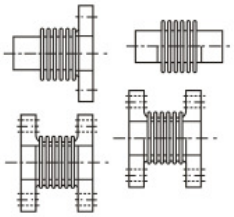
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 16.12 in^2 (104 cm^2)

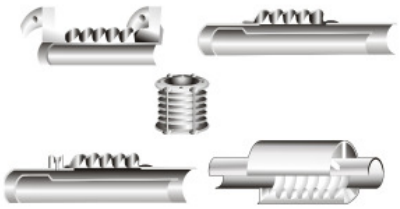
3-1/2-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
3.5	170	6	23	12	8	9	15	0.9	0.23	10	349	873	16	0.0130
	11.9	152	10.5	305	3.64	229	6.82	22.9	5.84	11	6	16	1.6	0.0132
	100	9	24	15	8	12	16	1.75	0.84	10	194	141	9	0.0072
	7.0	229	10.9	381	3.64	305	7.27	44.5	21.3	11	3	3	0.9	0.0073
	40	12	24	18	9	15	17	2.69	1.89	10	134	46	6	0.0049
	2.8	305	10.9	457	4.09	381	7.73	68.3	48	11	2	1	0.6	0.0050
3.5	500	6	35	12	8	9	21	0.32	0.06	8	2710	13345	121	0.0361
	35.1	152	15.9	305	3.64	229	9.55	8.13	1.52	9	48	239	12.3	0.0367
	500	9	36	15	9	12	22	0.72	0.29	10	1161	1182	52	0.0157
	35.1	229	16.4	381	4.09	305	10	18.3	7.37	11	21	21	5.3	0.0160
	300	12	37	18	10	15	23	1.23	0.77	10	739	315	33	0.0100
	21.1	305	16.8	457	4.55	381	10.5	31.2	19.6	11	13	6	3.4	0.0102

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

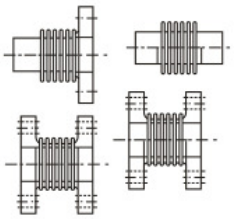
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
40-170 psig Series: 150 lb ANSI B16.5 RFSO.
300-500 psig Series: 300 lb ANSI B16.5 RFSO
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
40-70 psig Series: Std. Wt. Pipe.
300-500 psig Series: Std. Wt. Pipe
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

4-Inch Nominal Diameter

Effective (Thrust) Area: 20.87 in^2 (134.64 cm^2)

TYPES

END CONNECTIONS



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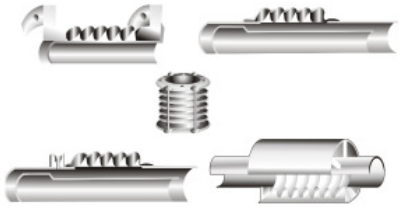


DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
4	100	6	27	12	9	9	18	1.23	0.27	10	222	774	13	0.0168
	7.0	152	12.3	305	4.09	229	818	31.2	6.96	11	4	14	1.3	0.0170
	65	9	28	15	10	12	19	2.49	1.03	10	118	115	7	0.0089
	4.6	229	12.7	381	4.55	305	8.64	63.2	26.2	11	2	2	0.7	0.0090
	30	12	29	18	11	15	20	3.89	2.36	10	80	36	5	0.0060
	2.1	305	13.2	457	5	381	9.09	98.8	59.9	11	1	1	0.5	0.0061
4	275	6	45	10	9	8	27	0.46	0.07	10	1549	12199	90	0.0433
	19.3	152	20.5	254	4.09	203	12.3	11.7	1.78	11	28	218	9.2	0.0441
	275	9	47	13	11	11	29	1.07	0.36	10	664	960	38	0.0186
	19.3	229	21.4	330	5	279	13.2	27.2	9.14	11	12	17	3.9	0.0189
	175	12	48	16	12	14	30	1.81	0.96	10	423	247	24	0.0118
	12.3	305	21.8	406	5.45	356	13.6	46	24.4	11	8	4	2.4	0.0120

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
30-100 psig Series: 150 lb ANSI B16.5 RFSO.
175-275 psig Series: 300 lb ANSI B16.5 RFSO
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
30-100 psig Series: Std. Wt. Pipe.
175-275 psig Series: Std. Wt. Pipe.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

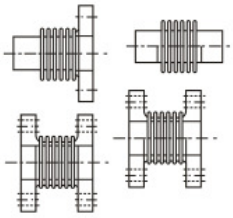
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 30.36 in^2 (195.82 cm^2)

5-Inch Nominal Diameter

TYPES

END CONNECTIONS



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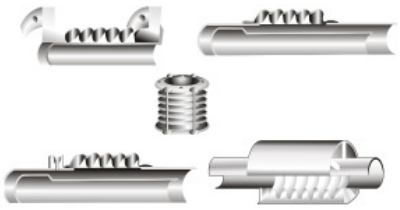


DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
5	100	6	31	12	12	9	22	1.17	0.2	10	277	1641	23	0.0319
	7.0	152	14.1	305	5.45	229	10	29.7	5.08	11	5	29	2.3	0.0325
	85	9	32	15	13	12	23	2.28	0.75	10	147	226	12	0.0168
	6.0	229	14.5	381	5.91	305	10.5	57.9	19.1	11	3	4	1.2	0.0171
	35	12	34	18	14	15	24	3.76	1.85	10	100	69	8	0.0114
	2.5	305	15.5	457	6.36	381	10.9	95.5	47	11	2	1	0.8	0.0116
5	275	6	57	10	12	8	35	0.39	0.04	7	2320	33633	196	0.0963
	19.3	152	25.9	254	5.45	203	15.9	9.91	1.02	8	42	602	19.9	0.0980
	275	9	59	13	14	11	36	1.01	0.27	10	892	2070	75	0.0373
	19.3	229	26.8	330	6.36	279	16.4	25.4	6.86	11	16	37	7.6	0.0380
	235	12	61	16	15	14	38	1.66	0.71	10	552	500	47	0.0232
	16.5	305	27.7	406	6.82	356	17.3	42.2	18	11	10	9	4.8	0.0235

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

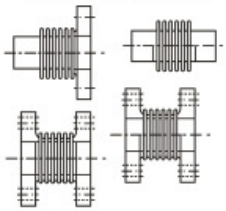
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
35-100 psig Series: 150 lb ANSI B16.5 RFSO.
235-275 psig Series: 300 lb ANSI B16.5 RFSO
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
35-100 psig Series: Std. Wt. Pipe.
235-275 psig Series: Std. Wt. Pipe.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

6-Inch Nominal Diameter

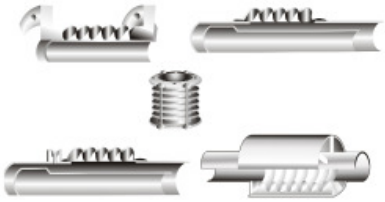
Effective (Thrust) Area: 43.28 in^2 (279.16 cm^2)

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
6	70	6	39	11	15	9	27	1.21	0.16	10	286	2841	34	0.0652
	4.9	152	17.7	279	6.82	229	12.3	30.7	4.06	11	5	51	3.5	0.0664
	60	10	41	15	17	13	29	2.95	0.92	10	123	213	15	0.0278
	4.2	254	18.6	381	7.73	330	13.2	74.9	23.4	11	2	4	1.5	0.0283
	25	14	43	19	18	17	30	5.04	2.47	10	78	54	9	0.0177
	1.8	356	19.5	483	8.18	432	13.6	128	62.7	11	1	1	0.9	0.0180
6	200	6	40	11	16	9	28	0.68	0.09	10	1330	13237	159	0.1116
	14.1	152	18.2	279	7.27	229	12.7	17.3	2.29	11	24	237	16.2	0.1135
	200	10	43	15	19	13	31	1.63	0.5	10	570	992	68	0.0476
	14.1	254	19.5	61	8.64	330	14.1	40.4	12.4	11	10	18	6.9	0.0484
	105	14	45	19	21	17	33	2.79	1.37	10	363	252	43	0.0303
	7.4	356	20.5	483	9.55	432	15	70.9	34.8	11	6	5	4.4	0.0308
6	500	6	80	10	16	8	48	0.23	0.02	4	10945	257320	1316	0.3506
	35.1	152	36.4	254	7.27	203	21.8	5.84	0.51	4	196	4605	133.8	0.3566
	500	10	84	14	19	12	51	0.73	0.19	10	3284	7863	395	0.1067
	35.1	254	38.2	356	8.64	305	23.2	18.5	4.83	11	59	141	40.2	0.1085
	500	14	87	18	23	16	55	1.24	0.55	10	1932	1637	232	0.0629
	35.1	356	39.5	457	10.5	406	25	31.5	14	11	35	29	23.6	0.0640

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
25-70 psig Series: 150 lb ANSI B16.5 RFSO.
105-200 psig Series: 150 lb ANSI B16.5 RFSO.
500 psig Series: 300 lb ANSI B16.5 RFSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
25-70 psig Series: Std. Wt. Pipe.
105-200 psig Series: Std. Wt. Pipe.
500 psig Series: Std. Wt. Pipe
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

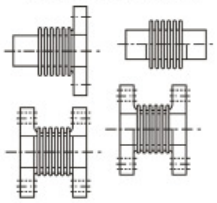
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 69.74 in² (449.82 cm²)

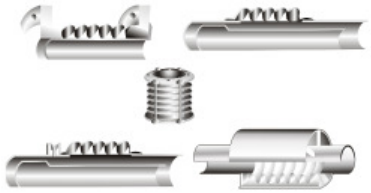
8-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM²	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
8	75	8	63	13	23	10	43	1.81	0.29	10	251	1643	48	0.0948
	5.3	203	28.6	330	10.5	254	19.5	46	7.37	11	4	29	4.9	0.0965
	50	12	65	17	25	14	45	3.65	1.1	10	133	244	26	0.0502
	3.5	305	29.5	432	11.4	356	20.5	92.7	27.9	11	2	4	2.6	0.0511
	25	16	67	21	27	18	47	5.69	2.53	10	90	77	17	0.0341
	1.8	406	30.5	533	12.3	457	21.4	145	64.3	11	2	1	1.7	0.0347
8	200	8	64	13	25	19	44	1.02	0.16	10	1166	7641	225	0.1618
	14.1	203	29.1	330	11.4	254	20	26.9	4.32	11	21	137	22.9	0.1646
	200	12	68	17	28	14	48	1.93	0.58	10	617	1134	119	0.0857
	14.1	305	30.9	432	12.7	356	21.8	49	14.7	11	11	20	12.1	0.0871
	105	16	71	21	32	18	51	3.1	1.37	10	420	357	81	0.0583
	7.4	406	32.3	533	14.5	457	23.2	78.7	34.8	11	8	6	8.2	0.0592
8	400	8	120	12	25	10	72	0.39	0.04	5	8627	117663	1671	0.4596
	28.1	203	54.5	305	11.4	254	32.7	9.91	1.02	5	154	2106	169.9	0.4674
	400	12	125	16	29	14	77	0.91	0.23	10	3595	9431	696	0.1938
	28.1	305	56.8	406	13.2	356	35	23.1	5.84	11	64	169	70.8	0.1971
	400	16	130	20	34	20	82	1.41	0.56	10	2270	2443	440	0.1228
	28.1	406	59.1	508	15.5	508	37.3	35.8	14.2	11	41	44	44.7	0.1249

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

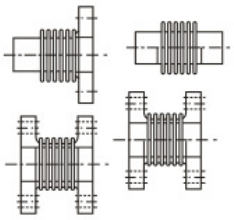
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
25-70 psig Series: 150 lb ANSI B16.5 RFSO.
105-200 psig Series: 150 lb ANSI B16.5 RFSO.
400 psig Series: 300 lb ANSI B16.5 RFSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
25-70 psig Series: Std. Wt. Pipe.
105-200 psig Series: Std. Wt. Pipe.
400 psig Series: Std. Wt. Pipe
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

10-Inch Nominal Diameter

Effective (Thrust) Area: 112.55 in^2 (725.95 cm^2)

TYPES

END CONNECTIONS



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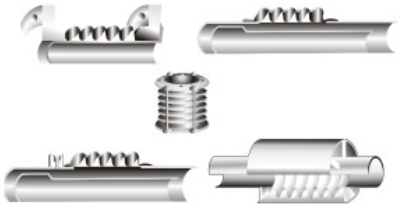


DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
10	100	12	94	16	37	14	66	2.74	0.62	10	427	1374	132	0.1975
	7.0	305	42.7	406	16.8	356	30	69.6	15.7	11	8	25	13.4	0.2009
	60	18	99	22	43	20	71	5.08	2.01	10	256	273	79	0.1174
	4.2	457	45	559	19.5	508	32.3	129	51.1	11	5	5	8.0	0.1194
	30	24	104	28	48	26	76	7.58	4.27	10	183	96	57	0.0835
	2.1	610	47.3	711	21.8	660	34.5	193	108	11	3	2	5.8	0.0849
10	275	12	172	15	40	14	106	1.23	0.23	10	2254	10547	699	0.4100
	19.3	305	78.2	381	18.2	356	48.2	31.2	5.84	11	40	189	71.1	0.4170
	275	18	180	21	48	20	114	2.3	0.82	10	1214	1592	376	0.2199
	19.3	457	81.8	533	21.8	508	51.8	58.4	20.8	11	22	28	38.2	0.2236
	325	24	213	27	80	26	147	3.4	1.78	10	1673	1023	523	0.1604
	22.8	610	96.8	686	36.4	660	66.8	86.4	45.2	11	30	18	53.2	0.1631

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
30-100 psig Series: 150 lb ANSI B16.5 RFSO.
275-325 psig Series: 300 lb ANSI B16.5 RFSO
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
30-100 psig Series: Std. Wt. Pipe.
275-325 psig Series: Std. Wt. Pipe.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

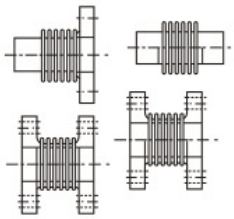
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 156.06 in^2 (1006.59 cm^2)

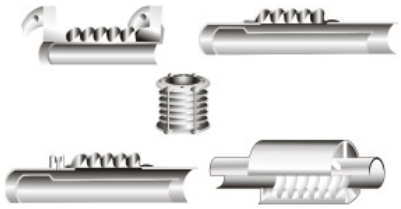
12-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
12	80	12	137	16	45	14	91	2.94	0.53	10	416	2113	179	0.3358
	5.6	305	62.3	406	20.5	356	41.4	74.7	13.5	11	7	38	18.2	0.3415
	60	18	144	22	52	20	98	5.41	1.75	10	238	378	102	0.1910
	4.2	457	65.5	559	23.6	508	44.5	137	44.5	11	4	7	10.4	0.1943
	25	24	151	28	58	26	104	8.57	4	10	166	128	71	0.1335
	1.8	610	68.6	711	26.4	660	47.3	218	102	11	3	2	7.2	0.1357
12	210	12	243	16	49	14	146	1.41	0.21	10	1952	14794	840	0.6363
	14.8	305	110	406	22.3	356	66.4	35.8	5.33	11	35	265	85.4	0.6471
	210	18	253	22	59	20	156	2.68	0.78	10	1051	2074	453	0.3387
	14.8	457	115	559	26.8	508	70.9	68.1	19.8	11	19	37	46.1	0.3445
	300	24	296	28	101	26	198	3.97	1.71	10	1447	1295	627	0.2447
	21.1	610	135	711	45.9	660	90	101	43.3	11	26	23	63.8	0.2488

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

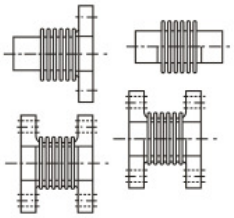
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
25-80 psig Series: 150 lb ANSI B16.5 RFSO.
210-300 psig Series: 300 lb ANSI B16.5 RFSO
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
25-80 psig Series: Std. Wt. Pipe.
210-300 psig Series: Std. Wt. Pipe
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

14-Inch Nominal Diameter

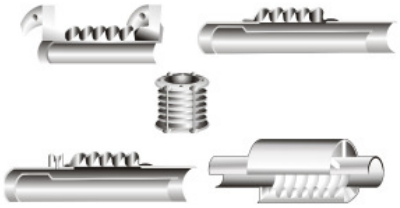
Effective (Thrust) Area: 184.96 in^2 (1193 cm^2)

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
14	80	12	190	16	50	14	120	2.9	0.49	10	459	2639	234	0.4418
	5.6	305	86.4	406	22.7	356	54.5	73.7	12.4	11	8	47	23.8	0.4493
	65	18	198	22	57	20	127	5.27	1.55	10	262	503	133	0.2531
	4.6	457	90	559	25.9	508	57.7	134	39.4	11	5	9	13.5	0.2574
	30	24	205	28	64	26	134	8.14	3.46	10	183	169	93	0.1767
	2.1	610	93.2	711	29.1	660	60.9	207	87.9	11	3	3	9.5	0.1797
14	225	12	393	16	52	14	222	1.25	0.16	9	2509	24470	1281	0.9569
	15.8	305	179	406	23.6	356	101	31.8	4.06	10	45	438	130.3	0.9731
	225	18	404	22	64	20	234	2.5	0.65	10	1255	3059	641	0.4784
	15.8	457	184	559	29.1	508	106	63.5	16.5	11	22	55	65.2	0.4866
	350	24	449	28	108	26	279	3.72	1.46	10	1682	1834	864	0.3374
	24.6	610	204	711	49.1	660	127	94.5	37.1	11	30	33	87.9	0.3431

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
30-80 psig Series: 150 lb ANSI B16.5 RFSO.
225-350 psig Series: 300 lb ANSI B16.5 RFSO
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
30-80 psig Series: Std. Wt. Pipe.
225-350 psig Series: Std. Wt. Pipe.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

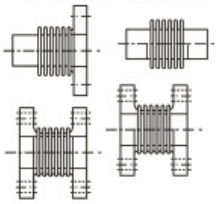
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 236.31 in^2 (1524.20 cm^2)

16-Inch Nominal Diameter

TYPES

END CONNECTIONS



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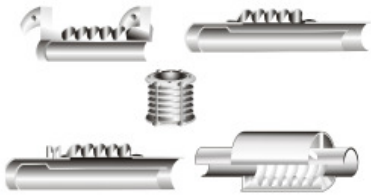


DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
16	75	12	131	18	60	15	95	3.52	0.65	10	421	2090	274	0.5297
	5.3	305	59.5	457	27.3	381	43.2	89.4	16.5	11	8	37	27.9	0.5387
	50	18	139	24	68	21	103	6.04	1.8	10	263	491	171	0.3297
	3.5	457	63.2	610	30.9	46.8	1.53	45.7	11	11	5	9	17.4	0.3353
	25	24	147	30	76	27	112	8.95	3.71	10	191	186	125	0.2393
	1.8	610	66.8	762	34.5	686	50.9	22.7	94.2	11	3	3	12.7	0.2434
16	200	12	213	15	62	14	137	1.40	0.2	10	2469	22616	1612	1.2211
	14.1	305	96.8	381	28.2	356	62.3	37.6	5.08	11	44	405	163.9	1.2419
	200	18	226	21	75	20	150	2.75	0.69	10	1329	3531	868	0.6575
	14.1	457	103	533	34.1	508	68.2	69.9	17.5	11	24	63	88.3	0.6687
	150	24	239	27	88	26	163	4.21	1.54	10	910	1131	594	0.4499
	10.5	610	109	686	40	660	74.1	107	39.1	11	16	20	60.4	0.4575
16	400	12	408	14	73	13	240	1.15	0.12	8	5789	86365	3800	1.5335
	28.1	305	185	356	33.2	330	109	29.2	3.05	8	104	1546	386.5	1.5596
	400	18	433	20	98	19	265	2.36	0.52	10	2894	9877	1900	0.7591
	28.1	457	197	508	44.5	483	120	59.9	13.2	11	52	177	193.2	0.7720
	400	24	458	26	123	25	291	3.6	1.21	10	1930	2844	1267	0.5044
	28.1	610	208	660	55.9	635	132	91.4	30.7	11	35	51	128.9	0.5130

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
25-75 psig Series: 150 lb ANSI B16.5 RFSO.
150-200 psig Series: 150 lb ANSI B16.5 RFSO.
400 psig Series: 300 lb ANSI B16.5 RFSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
25-75 psig Series: Std. Wt. Pipe.
150-200 psig Series: Std. Wt. Pipe.
400 psig Series: Std. Wt. Pipe
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

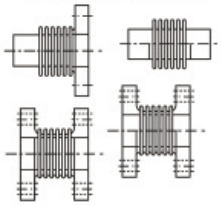
SINGLE EXPANSION JOINTS

18-Inch Nominal Diameter

Effective (Thrust) Area: 293.95 in^2 (1896 cm^2)

TYPES

END CONNECTIONS



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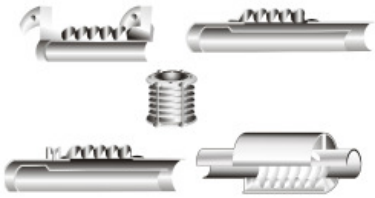


DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
18	75	12	134	18	67	15	101	3.49	0.57	10	476	2938	386	0.7533
	5.3	305	60.9	457	30.5	381	45.9	88.6	14.5	11	9	53	39.3	0.7
	50	18	144	24	77	21	110	5.93	1.59	10	297	690	241	0.4688
	3.5	457	65.5	610	35	533	50	151	40.4	11	5	12	24.5	0.4768
	25	24	153	30	86	27	119	8.81	3.27	10	216	261	175	0.3403
	1.8	610	69.5	762	39.1	686	54.1	224	83.1	11	4	5	17.8	0.3461
18	200	12	279	15	70	14	174	1.42	0.16	9	2787	35476	2265	1.7567
	14.1	305	127	381	31.8	356	79.1	36.1	4.06	10	50	635	2304	1.7866
	200	18	293	21	84	20	189	2.72	0.59	10	1501	5260	1219	0.9406
	14.1	457	133	533	38.2	508	85.9	69.1	15	11	27	94	124.0	0.9566
	175	24	308	27	99	26	203	4.07	1.31	10	1027	1654	834	0.6422
	12.3	610	140	686	45	660	92.3	103	33.3	11	18	30	84.8	0.6531
18	400	12	527	13	78	13	302	0.99	0.09	6	7834	176001	6400	2.5583
	28.1	305	240	330	35.5	330	137	25.1	2.29	7	140	3150	650.9	2.6018
	400	18	555	19	106	19	331	2.18	0.41	10	3563	16529	2909	1.1629
	28.1	457	252	483	48.2	483	150	55.4	10.4	11	64	296	295.8	1.1827
	400	24	584	25	135	25	359	3.37	0.99	10	2305	4478	1882	0.7525
	28.1	610	265	635	61.4	635	163	85.6	25.1	11	41	80	191.4	0.7652

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
25-75 psig Series: 125 lb ANSI B16.5 RFSO.
175-200 psig Series: 150 lb ANSI B16.5 RFSO.
400 psig Series: 300 lb ANSI B16.5 RFSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
25-75 psig Series: Std. Wt. Pipe.
175-200 psig Series: Std. Wt. Pipe.
400 psig Series: Std. Wt. Pipe
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

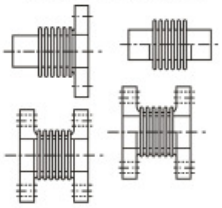
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 357.87 in^2 (2308.26 cm^2)

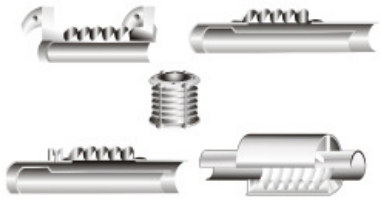
20-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
20	70	12	156	18	75	15	116	3.5	0.52	10	530	3989	524	1.0323
	4.9	305	70.9	457	34.1	381	52.7	88.9	13.2	11	9	71	53.3	1.0499
	70	18	166	24	85	21	126	5.6	1.36	10	331	937	327	0.6424
	4.9	457	75.5	610	38.6	533	57.3	142	34.5	11	6	17	33.3	0.6534
	35	24	177	30	96	27	136	8.53	2.87	10	241	354	238	0.4663
	2.5	610	80.5	762	43.6	686	61.8	217	72.9	11	4	6	24.2	0.4743
20	200	12	350	14	77	13	214	1.39	0.14	8	3106	54098	3074	2.4362
	14.1	305	159	356	35	330	97.3	35.3	3.56	9	56	968	312.6	2.4776
	200	18	367	20	94	19	230	2.64	0.51	10	1672	7583	1655	1.2968
	14.1	457	167	508	42.7	483	105	67.1	13	11	30	136	1683	1.3188
	200	24	383	26	110	25	246	3.86	1.1	10	1144	2338	1132	0.8835
	14.1	610	174	660	50	635	112	98	27.9	11	20	42	115.1	0.8985
20	400	12	659	13	105	13	382	0.94	0.07	5	8729	294625	8677	3.5831
	28.1	305	300	330	47.7	330	174	23.9	1.78	6	156	5272	882.5	3.6441
	400	18	691	19	136	19	413	2.13	0.35	10	3968	24597	3944	1.6074
	28.1	457	314	483	61.8	483	188	54.1	8.89	11	71	440	401.1	1.6348
	400	24	722	25	168	25	445	3.37	0.87	10	2567	6445	2552	1.0361
	28.1	610	328	635	76.4	635	202	85.6	22.1	11	46	115	259.5	1.0537

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
35-70 psig Series: 125 lb ANSI B16.5 RFSO.
200 psig Series: 150 lb ANSI B16.5 RFSO.
400 psig Series: 300 lb ANSI B16.5 RFSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
35-70 psig Series: Std. Wt. Pipe.
200 psig Series: Std. Wt. Pipe.
400 psig Series: Std. Wt. Pipe
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

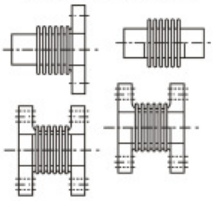
SINGLE EXPANSION JOINTS

22-Inch Nominal Diameter

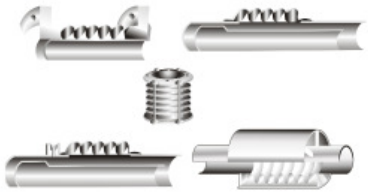
Effective (Thrust) Area: 432.67 in^2 (2790.72 cm^2)

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
22	60	12	171	17	82	15	127	3.64	0.44	10	487	5534	582	1.4134
	4.2	305	77.7	432	37.3	381	57.7	92.5	11.2	11	9	99	59.2	1.4374
	60	18	184	23	94	21	139	6.07	1.25	10	292	1141	349	0.8441
	4.2	457	83.6	584	42.7	533	63.2	154	31.8	11	5	20	35.5	0.8584
	30	24	196	29	107	27	151	9.48	2.77	10	209	408	249	0.6017
	2.1	610	89.1	737	48.6	686	68.6	2.41	70.4	11	4	7	25.3	0.6119
22	165	12	391	14	84	13	237	1.45	0.12	7	2994	74513	3583	3.4407
	11.6	305	178	356	38.2	330	108	36.8	3.05	8	54	1333	364.4	3.4992
	165	18	411	20	103	19	257	2.41	0.49	10	1497	8922	1792	1.7127
	11.6	457	187	508	46.8	483	117	73.9	12.4	11	27	160	182.2	1.7419
	165	24	430	26	123	25	276	4.36	1.1	10	998	2606	1194	1.1401
	11.6	610	195	660	55.9	635	125	111	27.9	11	18	47	121.4	1.1595
22	350	12	769	12	112	12	441	0.92	0.05	5	9012	465407	10831	5.3572
	24.6	305	350	305	50.9	305	200	23.4	1.27	5	161	8329	1101.5	5.4483
	350	18	807	18	150	18	478	2.3	0.33	10	3605	29786	4332	2.1429
	24.6	457	367	457	68.2	457	217	58.4	8.38	11	65	533	440.6	2.1793
	350	24	844	24	187	24	516	3.69	0.84	10	2253	7272	2708	1.3393
	24.6	610	384	610	85	610	235	93.7	21.3	11	40	130	275.4	1.3621

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
30-60 psig Series: 125 lb Lt. Wt. FFSO.
165 psig Series: 150 lb ANSI B16.5 RFSO.
350 psig Series: 300 lb ANSI B16.5 RFSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106/285-C.
30-60 psig Series: 0.375-inch wall.
165 psig Series: 0.375-inch wall.
350 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

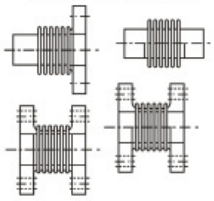
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 509.54 in^2 (3286.53 cm^2)

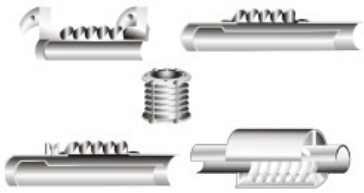
24-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
24	60	12	251	17	90	15	170	3.6	0.4	10	532	7129	749	1.8337
	4.2	305	114	432	40.9	381	77.3	91.4	10.2	11	10	128	76.2	1.8649
	60	18	265	23	103	21	184	6.06	1.15	10	319	1470	449	1.0951
	4.2	457	120	584	46.8	533	83.6	154	29.2	11	6	26	45.7	1.1137
	35	24	278	29	116	27	197	9.27	2.49	10	228	525	321	0.7806
	2.5	610	126	737	52.7	686	89.5	235	63.2	11	4	9	32.6	0.7939
24	160	12	463	14	92	13	277	1.42	0.1	6	3273	104888	4615	4.5021
	11.2	305	210	356	41.8	330	126	36.1	2.54	7	59	1877	469.3	4.5787
	160	18	484	20	113	19	298	2.89	0.44	10	1636	11996	2307	2.2311
	11.2	457	220	508	51.4	483	135	73.4	11.2	11	29	21.5	234.6	2.2690
	160	24	505	26	134	25	319	4.37	1	10	1091	3454	1538	1.4830
	11.2	610	230	660	60.9	635	145	1.11	25.4	11	20	62	156.4	1.5082
24	350	12	981	12	122	12	551	0.88	0.04	4	9849	729392	13940	7.0853
	24.6	305	446	305	55.5	305	250	22.4	1.02	4	176	13053	1417.7	7.2057
	350	18	1022	18	163	18	592	2.24	0.28	10	3940	41384	5576	2.7990
	24.6	457	465	457	74.1	457	269	56.9	7.11	11	71	741	567.1	2.8466
	350	24	1063	24	204	24	633	3.65	0.75	10	2462	9815	3485	1.7440
	24.6	610	483	610	92.7	610	288	92.7	19.1	11	44	176	354.4	1.7736

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

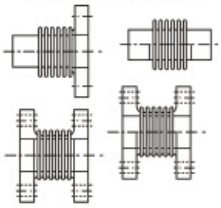
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
35-60 psig Series: 125 lb ANSI B16.5 RFSO.
160 psig Series: 150 lb ANSI B16.5 RFSO.
350 psig Series: 300 lb ANSI B16.5 RFSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106/A285-C.
35-60 psig Series: Std. Wt. Pipe.
160 psig Series: Std. Wt. Pipe.
350 psig Series: Std. Wt. Pipe
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

26-Inch Nominal Diameter

Effective (Thrust) Area: 592.71 in^2 (3822.98 cm^2)

TYPES

END CONNECTIONS



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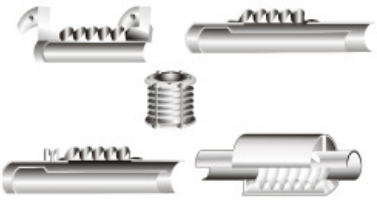


DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
26	60	12	273	16	97	14	185	3.57	0.37	10	577	9005	946	2.3301
	4.2	305	124	406	44.1	356	84.1	90.7	9.4	11	10	161	96.2	2.3697
	60	18	287	22	112	20	200	5.99	1.06	10	346	1857	568	1.3915
	4.2	457	130	559	50.9	508	90.9	152	26.9	11	6	33	57.8	1.4152
	40	24	302	28	126	26	214	9.11	2.27	10	247	663	406	0.9919
	2.8	610	137	711	57.3	660	97.3	231	57.7	11	4	12	41.3	1.0088
26	165	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	107	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		1.93	0.19	8	2664	46954	4371	4.2135
	11.6			406	48.6			49	4.83	9	48	840	444.5	4.2852
	165			22	130			3.37	0.57	10	1522	8761	2498	2.4077
	11.6			559	59.1			85.6	14.5	11	27	157	254.0	2.4487
	165			28	153			4.82	1.17	10	1066	3005	1748	1.6854
	11.6			711	69.5			122	29.7	11	19	54	177.8	1.7141
26	335			16	162			1.84	0.18	8	5343	94509	8797	4.4038
	23.5			406	73.6			46.7	4.57	9	96	1691	894.7	4.4786
	335			22	207			3.21	0.55	10	3053	17634	5027	2.5164
	23.5			559	94.1			81.5	14	11	55	316	511.2	2.5592
	335			28	251			4.59	1.11	10	2137	6049	3519	1.7615
	23.5			711	114			117	28.2	11	38	108	357.9	1.7915

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
40-60 psig Series: 125 lb Lt. Wt. FFSO.
For 165 psig and 335 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
40-60 psig Series: 0.375-inch wall.
165 psig Series: 0.375-inch wall.
335 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

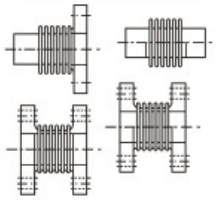
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 682.15 in^2 (4399.9 cm^2)

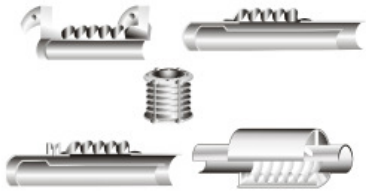
28-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
28	60	12	305	16	105	14	205	3.57	0.34	10	623	11183	1175	2.9088
	4.2	305	139	406	47.7	356	93.2	90.7	8.64	11	11	200	119.5	2.9582
	60	18	320	22	120	20	220	5.95	0.98	10	374	2306	705	1.7371
	4.2	457	145	559	54.5	508	100	151	24.9	11	7	41	71.7	1.7666
	40	24	336	28	136	26	236	9.04	2.1	10	267	824	504	1.2383
	2.8	610	153	711	61.8	660	107	230	53.3	11	5	15	51.3	1.2594
28	16	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	116	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		1.92	0.17	8	2873	58303	5427	5.2585
	11.2			406	52.7			48.8	4.32	8	51	1043	551.9	5.3479
	160			22	140			3.37	0.53	10	1642	10879	3101	3.0048
	11.2			559	63.6			85.6	13.5	11	29	195	315.4	3.0559
	160			28	165			4.81	1.09	10	1149	3731	2171	2.1034
	11.2			711	75			122	27.7	11	21	67	220.8	2.1391
28	315			16	175			1.81	0.16	7	5762	117299	10919	5.4916
	22.1			406	79.5			46	4.06	8	103	2099	1110.5	5.5849
	315			22	223			3.25	0.51	10	3293	21887	6239	3.1380
	22.1			559	101			82.6	13	11	59	392	634.5	3.1914
	315			28	271			4.64	1.05	10	2305	7507	4367	2.1966
	22.1			711	123			118	26.7	11	41	134	444.1	2.2340

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
40-60 psig Series: 125 lb Lt. Wt. FFSO.
For 160 psig and 315 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A285-C.
40-60 psig Series: 0.375-inch wall.
165 psig Series: 0.375-inch wall.
315 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

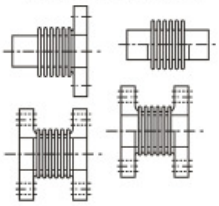
SINGLE EXPANSION JOINTS

30-Inch Nominal Diameter

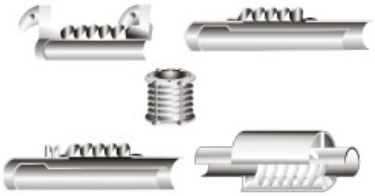
Effective (Thrust) Area: 784.07 in^2 (5057.25 cm^2)

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
30	50	12	328	16	114	14	221	3.98	0.36	10	514	10605	1114	3.3278
	3.5	305	149	406	51.8	356	100	101	9.14	11	9	190	113.3	3.3844
	50	18	346	22	132	20	239	6.8	1.04	10	308	2187	669	1.9880
	3.5	457	157	559	60	508	109	173	26.4	11	6	39	68.0	2.0218
	35	24	364	28	150	26	257	9.62	2.08	10	220	781	478	1.4174
	2.5	610	165	711	68.2	660	117	244	52.8	11	4	14	48.6	1.4415
30	135	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	127	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		2.27	0.19	8	2370	55283	5146	6.0143
	9.5			406	57.7			57.7	4.83	9	42	989	523.3	6.1165
	135			22	155			3.97	0.59	10	1354	10315	2941	3.4367
	9.5			559	70.5			101	15	11	24	185	299.1	3.4952
	135			28	183			5.67	1.2	10	948	3538	2058	2.4057
	9.5			711	83.2			144	30.5	11	17	63	209.3	2.4466
30	290			16	193			2.12	0.18	8	4752	111181	10349	6.2620
	20.4			406	87.7			53.8	4.57	9	85	1990	1052.5	6.3684
	290			22	248			3.7	0.55	10	2715	20745	5914	3.5783
	20.4			559	113			94	14	11	48	371	601.5	3.6391
	290			28	303			5.29	1.12	10	1901	7116	4140	2.5048
	20.4			711	138			134	28.4	11	34	127	421.0	2.5474

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
35-50 psig Series: 125 lb Lt. Wt. FFSO.
For 135 psig and 290 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A285-C.
35-50 psig Series: 0.375-inch wall.
135 psig Series: 0.375-inch wall.
290 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

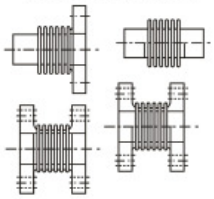
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 886.47 in^2 (5717.73 cm^2)

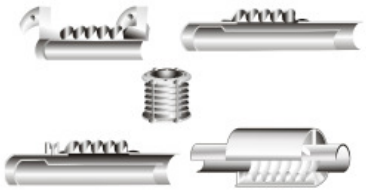
32-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
32	50	12	440	16	122	14	281	3.98	0.34	10	549	12811	1346	4.0372
	3.5	305	200	406	55.5	356	128	101	8.64	11	10	229	136.9	4.1059
	50	18	459	22	141	20	300	6.8	0.98	10	329	2641	808	2.4118
	3.5	457	209	559	64.1	508	136	173	24.9	11	6	47	82.2	2.4528
	35	24	478	28	160	26	319	9.62	1.96	10	235	944	577	1.7195
	2.5	610	217	711	72.7	660	145	244	49.8	11	4	17	58.7	1.7487
32	135	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	135	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		2.26	0.18	8	2531	66771	6215	7.2947
	9.5			406	61.4			57.4	4.57	9	45	1195	632.1	7.4168
	135			22	165			3.96	0.55	10	1446	12459	3552	4.1684
	9.5			559	75			101	14	11	226	223	361.2	4.2393
	135			28	196			5.66	1.13	10	1013	4273	2486	2.9179
	9.5			711	89.1			144	28.7	11	18	76	252.8	2.9675
32	290			16	206			2.11	0.17	7	5074	134238	12495	7.5907
	20.4			406	93.6			53.6	4.32	8	91	2402	1270.7	7.7197
	290			22	265			3.7	0.51	10	2900	25047	7140	4.3375
	20.4			559	120			94	13	11	52	448	726.1	4.4113
	290			28	323			5.28	1.05	10	2030	8591	4998	3.0363
	20.4			711	147			134	26.7	11	36	154	508.3	3.0879

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

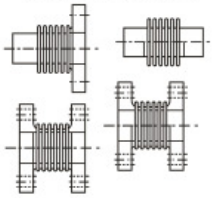
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
35-50 psig Series: 125 lb Lt. Wt. FFSO.
For 135 psig and 290 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A285-C.
35-50 psig Series: 0.375-inch wall.
135 psig Series: 0.375-inch wall.
290 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

34-Inch Nominal Diameter

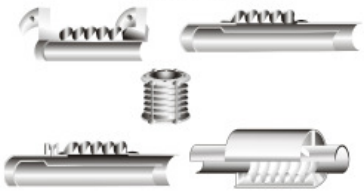
Effective (Thrust) Area: 995 in^2 (6420 cm^2)

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
34	50	12	462	16	130	14	296	3.98	0.32	10	584	15302	1608	4.8409
	3.5	305	210	406	59.1	356	135	101	8.13	11	10	274	163.5	4.9232
	50	18	482	22	150	20	316	6.8	0.93	10	350	3155	965	2.8919
	3.5	457	219	559	68.2	508	144	173	23.6	11	6	56	98.1	2.9411
	40	24	503	28	170	26	336	9.62	1.85	10	250	1127	689	2.0618
	2.8	610	229	711	77.3	660	153	244	47	11	4	20	70.1	2.0968
34	135	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	143	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		2.25	0.17	7	2693	79749	7423	8.7452
	9.5			406	65			57.2	4.32	8	48	1427	754.9	8.8938
	135			22	176			3.93	0.52	10	1539	14880	4242	4.9972
	9.5			559	80			99.8	13.2	11	28	266	431.4	5.0822
	135			28	208			5.62	1.05	10	1077	5104	2969	3.4981
	9.5			711	94.5			143	26.7	11	19	91	301.9	3.5575
34	275			16	219			2.12	0.16	7	5397	160280	14920	9.0951
	19.3			406	99.5			53.8	4.06	8	97	2868	1517.4	9.2498
	275			22	281			3.71	0.49	10	3084	29907	8525	5.1972
	19.3			559	128			94.2	12.4	11	55	535	867.0	5.2856
	344			24	344			5.3	0.99	10	2159	10258	5968	3.6381
	19.3			610	156			135	25.1	11	39	184	606.9	3.6999

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
40-50 psig Series: 125 lb Lt. Wt. FFSO.
For 135 psig and 275 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32
Pipe: ASTM A285-C.
40-50 psig Series: 0.375-inch wall.
135 psig Series: 0.375-inch wall.
275 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

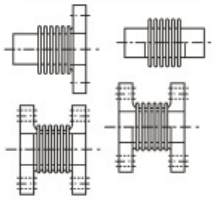
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 1110.13 in^2 (7160.34 cm^2)

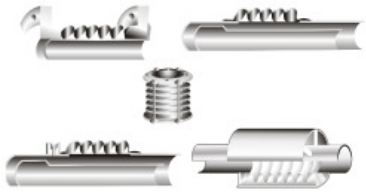
36-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
36	50	12	504	16	137	14	321	3.98	0.3	10	619	18098	1902	5.7447
	3.5	305	229	406	62.3	356	146	101	7.62	11	11	324	13.4	5.8424
	50	18	525	22	159	20	342	6.8	0.88	10	371	3731	1141	3.4318
	3.5	457	239	559	72.3	508	155	173	22.4	11	7	67	116.0	3.4902
	40	24	547	28	180	26	364	9.62	1.75	10	265	1333	815	2.4467
	2.8	610	249	711	81.8	660	165	244	44.5	11	5	24	82.9	2.4883
36	135	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	152	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		2.25	0.16	7	2854	94308	8779	10.3761
	9.5			406	69.1			57.2	4.06	8	51	1688	892.8	10.5525
	135			22	186			3.93	0.49	10	1631	17597	5016	5.9292
	9.5			559	84.5			99.8	12.4	11	29	315	510.1	6.0300
	135			28	220			5.61	1	10	1142	6036	3511	4.1504
	9.5			711	100			142	25.4	11	20	108	357.1	4.2210
36	250			16	232			2.15	0.15	7	5720	189490	17639	10.7863
	17.6			406	105			54.6	3.81	7	102	3391	1793.9	10.9697
	250			22	298			3.77	0.47	10	3269	35357	10079	6.1636
	17.6			559	135			95.8	11.9	11	59	633	1025.0	6.2684
	250			28	364			5.38	0.95	10	2288	12127	7055	4.3145
	17.6			711	165			137	24.1	11	41	217	717.5	4.3879

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

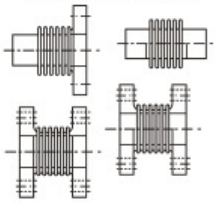
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
40-50 psig Series: 125 lb Lt. Wt. FFSO.
For 135 psig and 250 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A285-C.
40-50 psig Series: 0.375-inch wall.
135 psig Series: 0.375-inch wall.
250 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

38-Inch Nominal Diameter

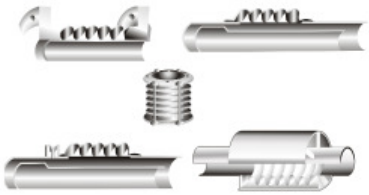
Effective (Thrust) Area: 1231.38 in^2 (7942.40 cm^2)

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
38	45	12	566	16	145	14	355	3.98	0.29	10	654	21214	2229	6.7546
	3.2	305	257	406	65.9	356	161	101	7.37	11	12	380	226.7	6.8694
	45	18	589	22	168	20	378	6.8	0.83	10	392	4374	1338	4.0351
	3.2	457	268	559	76.4	508	172	173	21.1	11	7	78	136.1	4.1037
	45	24	611	28	190	26	401	9.62	1.66	10	280	1563	955	2.8769
	3.2	610	278	711	86.4	660	182	244	42.2	11	5	28	97.1	2.9258
38	130	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	160	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		2.26	0.15	7	3015	110538	10289	12.1982
	9.1			406	72.7			57.4	3.81	7	54	1978	1046.4	12.4056
	130			22	196			3.96	0.47	10	1723	20625	5880	6.9704
	9.1			559	89.1			101	11.9	11	31	369	598.0	7.0889
	130			28	232			5.65	0.95	10	1206	7074	4116	4.8793
	9.1			711	105			144	24.1	11	22	127	418.6	4.9622
38	250			16	245			2.15	0.14	6	6043	222048	20669	12.6752
	17.6			406	111			54.6	3.56	7	108	3974	2102.0	12.8906
	250			22	315			3.77	0.44	10	3453	41432	11811	7.2429
	17.6			559	143			95.8	11.2	11	62	741	1201.2	7.3661
	250			28	384			5.38	0.91	10	2417	14211	8268	5.0701
	17.6			711	175			137	23.1	11	43	254	840.9	5.1563

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
45 psig Series: 125 lb Lt. Wt. FFSO.
For 130 psig and 250 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A285-C.
45 psig Series: 0.375-inch wall.
130 psig Series: 0.375-inch wall.
250 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

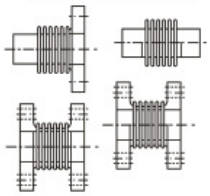
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 1358.92 in^2 (8771.48 cm^2)

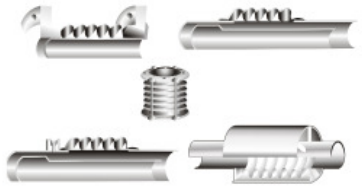
40-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
40	45	12	598	16	153	14	375	3.98	0.27	10	689	24670	2592	7.8763
	3.2	305	272	406	69.5	356	170	101	6.86	11	12	441	263.6	8.0102
	45	18	622	22	177	20	399	6.8	0.79	10	413	5086	1555	4.7052
	3.2	457	283	559	80.5	508	181	173	20.1	11	7	91	158.1	4.7852
	45	24	645	28	200	26	423	9.62	1.58	10	295	1818	1111	3.3546
	3.2	610	293	711	90.9	660	192	244	40.1	11	5	33	113.0	3.4117
40	120	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	169	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		2.29	0.15	6	3177	128531	11964	14.2220
	8.4			406	76.8			57.2	3.81	7	57	2300	1216.7	14.4638
	120			22	207			4.01	0.45	10	1815	23983	6837	8.1269
	8.4			559	94.1			102	11.4	11	32	429	695.3	8.2650
	120			28	245			5.73	0.92	10	1271	8226	4786	5.6888
	8.4			711	111			146	23.4	11	23	147	486.7	5.7855
40	225			16	258			2.19	0.14	6	6366	258136	24028	14.7725
	15.8			406	117			55.6	3.56	7	114	4619	2443.6	15.0237
	225			22	331			3.83	0.43	10	3637	48165	13731	8.4414
	15.8			559	150			97.3	10.9	11	65	862	1396.4	8.5849
	225			28	405			5.47	0.88	10	2546	16521	9611	5.9090
	15.8			711	184			139	22.4	11	46	296	977.4	6.0095

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

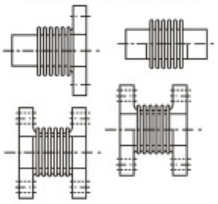
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
45 psig Series: 125 lb Lt. Wt. FFSO.
For 120 psig and 225 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A285-C.
45 psig Series: 0.375-inch wall.
120 psig Series: 0.375-inch wall.
225 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

42-Inch Nominal Diameter

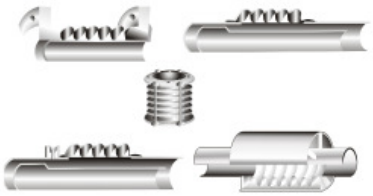
Effective (Thrust) Area: 1492.74 in^2 (9628.17 cm^2)

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
42	50	12	700	16	160	14	430	3.98	0.26	10	724	28481	2993	9.1159
	3.5	305	318	406	72.7	356	195	101	6.6	11	13	510	304.4	9.2709
	50	18	725	22	185	20	455	6.8	0.76	10	434	5872	1796	5.4457
	3.5	457	330	559	84.1	508	207	173	193	11	8	105	182.7	5.5383
	50	24	750	28	211	26	480	9.61	1.51	10	310	2098	1283	3.8826
	3.5	610	341	711	95.9	660	218	244	38.4	11	6	38	130.5	3.9486
42	120	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	177	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		2.29	0.14	6	3338	148378	13812	16.4581
	8.4			406	80.5			58.2	3.56	7	60	2655	1404.7	16.7379
	120			22	217			4.01	0.43	10	1908	27686	7892	9.4046
	8.4			5.59	98.6			102	10.9	11	34	495	802.6	9.5645
	120			28	257			5.73	0.88	10	1335	9496	5525	6.5832
	8.4			711	117			146	22.4	11	24	170	561.9	6.6952
42	225			16	231			2.18	0.13	6	6688	297936	27733	17.0894
	15.8			406	105			55.4	3.3	6	120	5332	2820.4	17.3799
	225			22	308			3.08	0.41	10	3822	55592	15848	9.7654
	15.8			559	140			97	10.4	11	68	995	1611.7	9.9314
	225			28	385			5.46	0.84	10	2675	19068	11093	6.8358
	15.8			711	175			139	21.3	11	48	341	1128.2	6.9520

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
50 psig Series: 125 lb Lt. Wt. FFSO.
For 120 psig and 225 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A285-C.
50 psig Series: 0.375-inch wall.
120 psig Series: 0.375-inch wall.
225 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

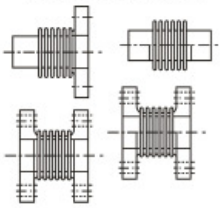
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 1629 in^2 (10,508 cm^2)

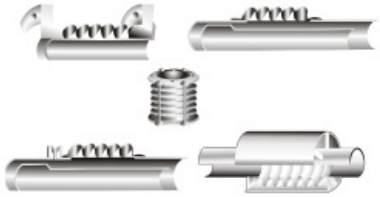
44-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
44	50	12	737	16	164	14	450	3.51	0.19	9	854	47202	3862	11.8051
	3.5	305	335	406	74.5	356	205	89.2	4.83	10	15	845	392.8	12.0058
	50	18	763	20	190	14	477	6.33	0.63	10	488	8325	2207	6.7104
	3.5	457	347	508	86.4	356	217	161	16	11	9	149	224.5	6.8245
	50	24	790	28	216	26	503	9.15	1.31	10	342	2793	1545	4.6874
	3.5	610	359	711	98.2	660	229	232	33.3	11	6	50	157.1	4.7671
44	115	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	185	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		2.25	0.12	6	3500	193614	15840	19.1526
	8.1			406	84.1			57.2	3.05	6	63	3465	1610.9	19.4782
	115			22	227			3.94	0.39	10	2000	34147	9051	10.8863
	8.1			559	103			100	9.91	11	36	611	920.5	11.0713
	115			28	255			5.06	0.65	10	1555	15715	7040	8.4492
	8.1			711	116			129	16.5	11	28	1	716.0	8.5928

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

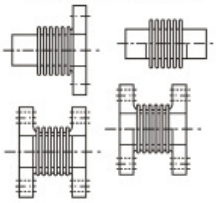
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
50 psig Series: 125 lb Lt. Wt. FFSO.
115 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A53/A106.
50 psig Series: 0.375-inch wall.
115 psig Series: 0.375-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

46-Inch Nominal Diameter

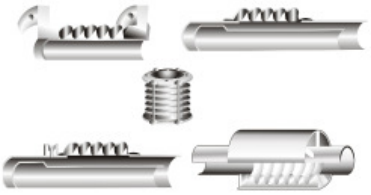
Effective (Thrust) Area: 1794 in^2 (11,575 cm^2)

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
46	35	12	774	16	176	14	475	3.51	0.18	8	561	34157	2794	11.8403
	2.5	305	352	406	80	356	216	89.2	4.57	9	10	611	284.1	12.0416
	35	18	805	22	207	20	506	6.33	0.6	10	321	6024	1597	6.7347
	2.5	457	366	559	94.1	508	230	161	15.2	11	6	108	162.4	6.8492
	35	22	826	26	228	24	527	8.21	1	10	249	2788	1242	5.2309
	2.5	559	375	660	104	610	240	209	25.4	11	4	50	126.3	5.3199
46	95	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	202	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		2.84	0.15	7	2300	140096	11462	19.1806
	6.7			406	91.8			72.1	3.81	8	41	2507	1165.7	19.5067
	95			22	251			5.1	0.48	10	1314	24708	6549	10.9093
	6.7			559	114			130	12.2	11	24	442	666.0	11.0848
	95			26	284			6.55	0.8	10	1022	11436	5094	8.4734
	6.7			660	129			166	20.3	11	18	205	518.1	8.6174

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
35 psig Series: 125 lb Lt. Wt. FFSO.
95 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A285-C.
35 psig Series: 0.375-inch wall.
95 psig Series: 0.375-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

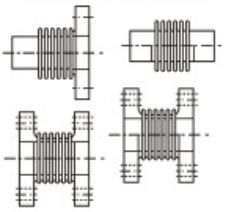
SINGLE EXPANSION JOINTS

Effective (Thrust) Area: 1947 in^2 (12,561 cm^2)

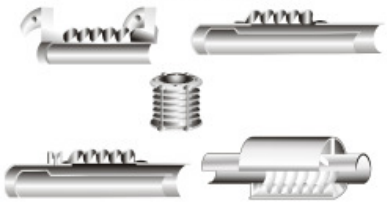
48-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
48	35	12	891	16	179	14	535	3.29	0.15	8	670	50793	3620	15.2078
	2.5	305	405	406	81.4	356	243	83.6	3.81	8	12	909	368.2	15.4663
	35	18	923	22	212	20	567	6.11	0.53	10	361	7930	1949	8.1888
	2.5	457	420	559	96.4	508	258	155	13.5	11	6	142	198.2	8.3280
	35	22	945	26	233	24	589	7.99	0.91	10	276	3546	1491	6.2620
	2.5	559	430	650	106	610	268	203	23.1	11	5	63	151.6	6.3685
48	95	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	203	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		2.55	0.12	6	2744	208321	14847	24.6308
	6.7			406	92.3			64.8	3.05	7	49	3728	1509.9	25.0495
	95			22	225			4.73	0.41	10	1478	32523	7994	13.2627
	6.7			559	116			120	10.4	11	26	582	813.0	13.4882
	95			26	289			6.19	0.7	10	1130	14544	6113	10.1421
	6.7			660	131			157	17.8	11	20	260	621.7	10.3145

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

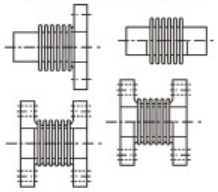
Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
35 psig Series: 125 lb Lt. Wt. FFSO.
95 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A285-C.
35 psig Series: 0.375-inch wall.
95 psig Series: 0.375-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

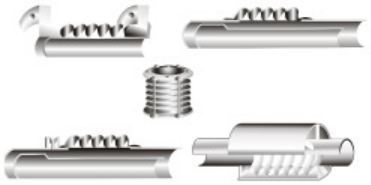
50- / 52- / 54-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



Diameter	Pressure	Overall Length and Weight						Non-Concurrent Movements			Spring Rates			
		Flanged Ends		Weld Ends		Combination Ends		Axial	Lateral	Angular	Axial	Lateral	Angular	Torsional
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	Comp						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
50	75	13	953	16	197	15	575	2.1	0.11	5	2786	177720	1643	35.9278
	5.2	330	433	406	89.5	381	261	53.3	2.79	5	50	3180	1682.4	36.5386
Effective		21	1002	24	246	23	624	5.4	0.55	10	1393	22215	8271	17.9639
Area		533	455	610	112	584	284	137	14	11	25	398	841.2	18.2693
2138 in^2		29	1050	32	294	31	672	8.1	1.24	10	929	6582	5514	11.9759
13,792 cm^2		737	477	813	134	787	305	206	31.5	11	17	118	560.8	12.1795
52	70	13	1005	16	205	15	605	2.72	0.13	6	2899	199415	18562	40.4050
	4.9	330	457	406	93.2	381	276	69.1	3.3	6	52	3569	1887.8	41.0919
Effective		21	1056	24	256	23	656	5.44	0.54	10	1450	24927	9281	20.2025
Area		533	480	610	116	584	298	138	13.7	11	26	446	943.9	20.5459
2305 in^2		29	1106	32	306	31	706	8.16	1.2	10	966	7386	6187	13.4683
14,870 cm^2		737	503	813	139	787	321	207	30.5	11	17	132	629.2	13.6973
54	70	13	1057	16	213	15	635	2.72	0.13	6	3013	222807	20740	45.2394
	4.9	330	480	406	96.8	381	289	69.1	3.3	6	54	3987	2109.3	46.0085
Effective		21	1110	24	266	23	688	5.44	0.52	10	1506	27851	10370	22.6197
Area		533	505	610	121	584	313	138	13.2	11	27	498	1054.6	23.0043
2478 in^2		29	1162	32	318	31	740	8.15	1.16	10	1004	8252	6913	15.0798
15,989 cm^2		737	528	813	145	787	336	207	29.5	11	18	148	703.1	15.3362

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

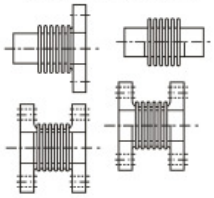
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
70-75 psig Series: 125 lb Lt. Wt. FFSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A285-C.
70-75 psig Series: 0.375-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

SINGLE EXPANSION JOINTS

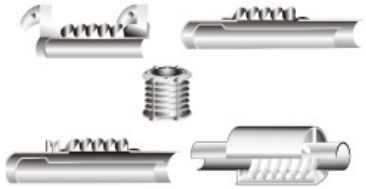
60- / 66- / 72-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
60	60	13	1343	16	236	15	789	2.65	0.11	5	3353	345665	28280	63.0276
	4.2	330	610	406	107	381	359	67.3	2.79	5	60	6186	2876.1	64.0991
Effective		21	1401	24	294	23	848	5.31	0.44	10	1677	40465	14140	31.2608
Area		533	637	610	134	584	385	135	11.2	11	30	724	1438.0	31.7923
3036 in^2		29	1459	32	353	31	906	8.14	1.03	10	1118	11736	9427	20.7850
19,587 cm^2		737	663	813	160	787	412	207	26.2	11	20	210	958.7	21.1383
66	55	13	1569	16	260	15	914	2.67	0.1	5	3694	457820	37455	83.8532
	3.8	330	713	406	118	381	415	67.8	2.54	5	66	8193	3809.2	85.2787
Effective		21	1633	24	324	23	978	5.45	0.41	9	1847	53595	18728	41.5901
Area		533	742	610	147	584	445	1.38	10.4	10	33	959	1904.6	42.2971
3650 in^2		29	1697	32	388	31	1043	8.17	0.94	10	1231	15544	12485	27.6527
23,550 cm^2		737	771	813	176	787	474	208	23.9	11	22	278	1269.7	28.1228
72	50	13	1775	16	283	15	1029	2.7	0.09	4	4035	591934	48428	108.8247
	3.5	330	807	406	129	381	468	68.6	2.29	5	72	10593	4925.1	110.6748
Effective		21	1845	24	53	23	1099	5.51	0.38	9	2017	69295	24214	53.9756
Area		533	839	610	160	584	500	140	9.65	9	36	1240	2462.6	54.8932
4321 in^2		29	1915	32	423	31	1169	8.26	0.87	10	1345	20097	16143	35.8877
27,877 cm^2		737	870	813	192	787	531	210	22.1	11	24	360	1641.7	36.4978

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

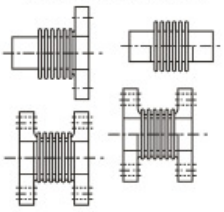
Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
50-60 psig Series: 125 lb Lt. Wt. FFSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A285-C.
50-60 psig Series: 0.375-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

84- / 96-Inch Nominal Diameter

TYPES

END CONNECTIONS



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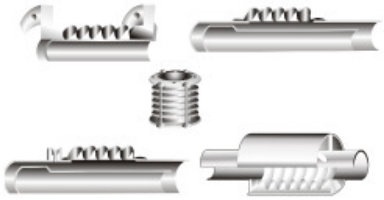


DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
84	45	14	2089	16	332	15	1210	2.82	0.09	4	4716	820804	76404	169.9604
	3.1	356	950	406	151	381	550	71.6	2.29	4	84	14689	7770.3	172.8497
Effective		22	2171	24	414	23	1292	5.65	0.35	8	2358	102601	38202	84.9802
Area		559	987	610	188	584	587	144	8.89	8	42	1836	3885.1	86.4249
16,781 in^2		30	2252	32	495	31	1374	8.47	0.79	10	1572	30400	25468	56.6535
108,264 cm^2		762	1024	813	225	787	625	215	20.1	11	28	544	2590.1	57.6166
96	40	14	3400	16	378	15	1889	2.73	0.07	3	5398	1387244	113494	257.6974
	2.8	356	1546	406	172	381	859	69.3	1.78	4	97	24825	11542.3	262.0783
Effective		22	3494	24	471	23	1982	5.56	0.29	7	2699	162399	56747	127.8144
Area		559	1588	610	214	584	901	141	7.37	7	48	2906	5771.2	129.9873
19,743 in^2		30	3587	32	565	31	2076	8.35	0.67	10	1799	47100	37831	84.9823
125,632 cm^2		762	1630	814	257	787	944	212	17	11	32	843	3847.4	86.4270

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials

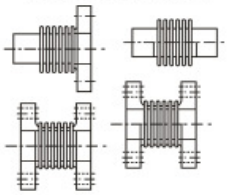
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
40-45 psig Series: 125 lb Lt. Wt. FFSO. Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A285-C.
40-45 psig Series: 0.375-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

SINGLE EXPANSION JOINTS

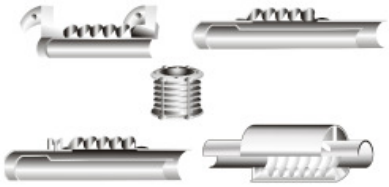
108- / 120- / 132-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
108	35	Customer to specify flange configuration Weights and O.A.L. will be furnished upon receipt of this information.		16	427	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		2.87	0.07	3	6079	1729417	160982	360.9530
	2.4			406	194			72.9	1.78	3	109	30949	16371.9	367.0892
Effective Area 9533 in^2 61,505 cm^2				24	532			5.74	0.28	6	3040	216177	80491	180.4765
				610	242			146	7.11	7	54	3869	8185.9	183.5446
				32	637			8.6	0.62	9	2026	64052	53661	120.3177
				813	290			218	15.7	10	36	1146	5457.3	122.3631
120	30			16	475			2.9	0.06	3	6761	2365085	220152	495.0025
	2.1			406	216			73.7	1.52	3	121	42324	22389.6	503.4175
Effective Area 11,723 in^2 75,632 cm^2				24	591			5.79	0.25	5	3380	295636	110076	247.5012
				610	269			147	6.35	6	60	5291	11194.7	251.7088
				32	708			8.69	0.57	8	2254	87596	73384	165.0008
				813	322			221	14.5	9	40	1568	7463.2	167.8058
132	25			16	522			2.91	0.06	3	7442	3140065	292291	658.7047
	1.7			406	237			73.9	1.52	3	133	56193	29726.0	669.9027
Effective Area 14,139 in^2 91,219 cm^2				24	651			5.82	0.23	5	3721	392508	146145	329.3523
				610	296			148	5.85	6	67	7024	14862.9	334.9513
				32	779			8.73	0.52	7	2481	116299	97430	219.5682
				813	354			222	13.2	8	44	2081	9908.6	223.3009

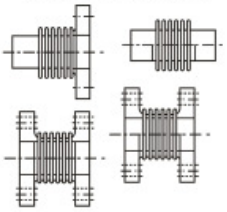
General Notes
1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

Materials
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
Customer to specify actual flanges required.
Pipe: ASTM A285-C.
25-35 psig Series: 0.375-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

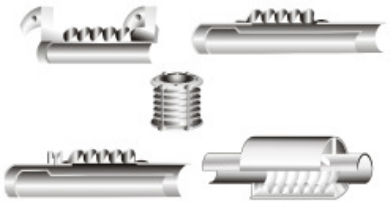
144- / 156-Inch Nominal Diameter

TYPES

END CONNECTIONS



ACCESSORIES



DIAMETER	PRESSURE	OVERALL LENGTH AND WEIGHT						NON-CONCURRENT MOVEMENTS			SPRING RATES			
		FLANGED ENDS		WELD ENDS		COMBINATION ENDS		AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	TORSIONAL
		O.A.L	WT.	O.A.L	WT.	O.A.L	WT.	COMP						
	PSIG	IN	LB	IN	LB	IN	LB	IN	IN	DEG	LB/IN	LB/IN	IN-LB/DEG	IN-LB/DEG x 10^6
	KG/CM^2	MM	KG	MM	KG	MM	KG	MM	MM	GRAD	KG/MM	KG/MM	N-M/GRAD	N-M/GRAD x 10^5
144	25	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		16	570	Customer to specify flange configuration. Weights and O.A.L. will be furnished upon receipt of this information.		2.91	0.05	2	8124	4068158	378682	855.0225
	1.7			406	259			73.9	1.27	3	145	72802	38512.0	869.5578
Effective Area				24	710			5.82	0.21	5	4062	509520	189341	427.5112
16,781 in^2				610	323			148	5.33	5	73	9100	19256.0	434.7789
				32	850			8.73	0.48	7	2708	150673	126227	285.0075
108,264 cm^2				813	386			222	12.2	8	48	2696	12837.3	289.8526
156	25			16	638			3.69	0.06	3	5401	3182115	296205	957.6637
	1.7			406	290			93.7	1.52	3	97	56946	30124.0	973.9440
Effective Area				24	810			7.38	0.25	5	2701	397764	148102	478.8319
				610	368			187	6.35	6	48	7118	15062.0	486.9720
19,743 in^2				30	939			10.1	0.47	7	1964	153009	107711	348.2414
125,632 cm^2				762	427			258	11.9	8	35	2738	10954.2	354.1615

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 43.
3. To increase cycle life or movements, please refer to graph on page 42.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Maximum test pressure: 1.5 X rated working pressure.
6. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
7. Torsional spring rate data provided only for modeling expansion joints on computer stress programs. Please consult factory for allowable torsional loadings.
8. Overall lengths and weights for unrestrained expansion joints only. Consult factory for information regarding tied, hinged, or gimbal expansion joints.
9. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.

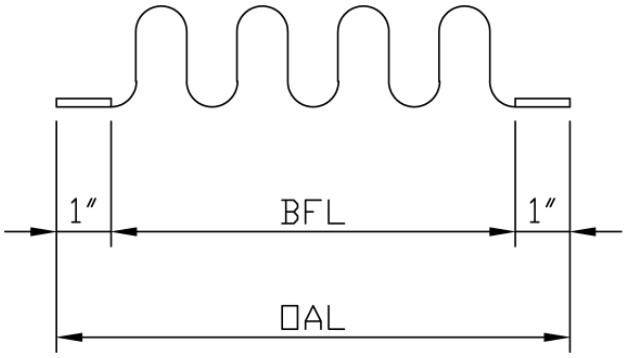
Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
Customer to specify actual flanges required.
Pipe: ASTM A285-C.
25 psig Series: 0.375-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

SINGLE AND MULTI-PLY STAINLESS STEEL

85 PSIG

321 S.S. Bellows with Welding Aide
Monel® and Inconel® available on request.



Notes:

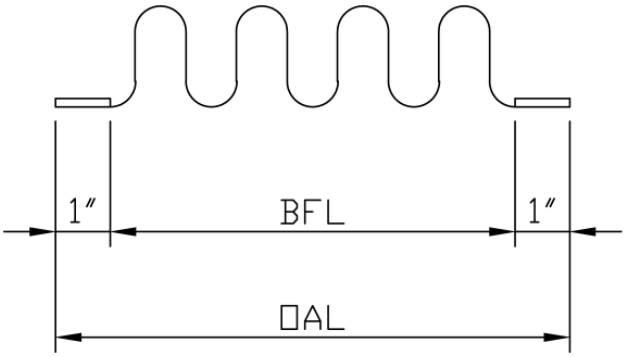
1. Pressure Range: Vacuum to 50 PSIG for 3/4" to 1 1/2", 85 PSIG for 2" and over.
2. Temperature Range: -20 °F to 800 °F.
3. Rated cycle life is 3,000 cycles per EJMA for any one tabulated movement.
4. Maximum axial extension movement is 50% of the tabulated axial movement.
5. Rated extension movement is equal to rated axial movement provided the bellows is pre-compressed the amount of design extension.
6. Maximum test pressure: 1.5 x design pressure
7. Materials: Bellows - ASTM A240-T321SS
   Welding Aides - ASTM A240-T321SS
8. Flanges or welds ends can be attached to the bellows 1/16" thk (min.) Welding Aide.

ND (in.)	PART NUMBER	MAX. AXIAL MOVEMENT (in.)	MAX. LATERAL MOVEMENT (in.)	MAX. ANGULAR MOVEMENT (deg.)	B.F.I. (in.)	NUMBER OF CORRUGATIONS	O.A.L. (in.)	WEIGHT EACH (lb.)	AXIAL SPRING RATE (lb./ in.)	LATERAL SPRING RATE (lb./ in.)	ANGULAR SPRING RATE (in./lb./deg.)
3/4	S007050C	0.59	0.47	10	2.75	13	3.50	0.08	392	95	3
	L007050C	0.79	0.71	10	3.56	17	4.31	0.09	302	39	3
1	S010050C	0.59	0.27	10	2.19	9	2.94	0.10	386	274	3
	L010050C	0.87	0.59	10	3.00	13	3.75	0.12	269	90	3
1 1/2	S015050C	0.59	0.24	10	2.38	10	3.13	0.15	515	622	3
	L015050C	0.94	0.59	10	3.63	16	4.38	0.19	325	151	3
2	US-2-8-85S	0.64	0.24	10	3.00	8	5.00	0.60	643	2068	27
	US-2-12-85L	0.95	0.53	10	4.50	12	6.50	1.00	693	462	14
2 1/2	US-2.5-8-85S	1.33	0.39	10	3.00	8	5.00	1.00	580	1052	21
	US-2.5-12-85L	1.12	0.50	10	4.50	12	6.50	1.00	386	312	14
3	US-3-8-85S	0.71	0.17	10	3.00	8	5.00	1.00	855	2887	38
	US-3-12-85L	1.07	0.40	10	4.50	12	6.50	1.00	570	855	25
4	US-4-8-85S	0.96	0.18	10	3.00	8	5.00	1.00	547	3016	39
	US-4-12-85L	1.45	0.42	10	4.50	12	6.50	2.00	365	894	26
5	US-5-8-85S	0.95	0.15	10	3.00	8	5.00	1.00	684	5295	69
	US-5-12-85L	1.42	0.34	10	4.50	12	6.50	2.00	456	1569	46
6	US-6-8-85S	1.10	0.19	10	4.00	8	6.00	3.00	926	5729	133
	US-6-12-85L	1.65	0.44	10	6.00	12	8.00	4.00	617	1698	89
8	US-8-8-85S	1.07	0.15	10	4.00	8	6.00	3.00	1220	2930	273
	US-8-12-85L	1.61	0.34	10	6.00	12	8.00	5.00	813	868	182
10	US-10-8-85S	1.99	0.45	10	8.00	8	10.00	7.00	1664	6095	567
	US-10-12-85L	2.38	0.82	10	12.00	12	14.00	12.00	1110	1806	378
12	US-12-8-85S	2.09	0.40	10	8.00	8	10.00	11.00	1077	5585	520
	US-12-12-85L	3.14	0.91	10	12.00	12	14.00	15.00	718	1655	347
14	US-14-8-85S	2.05	0.36	10	8.00	8	10.00	12.00	1187	7231	673
	US-14-12-85L	3.08	0.81	10	12.00	12	14.00	17.00	791	2143	449
16	US-16-8-85S	2.04	0.31	10	8.00	8	10.00	21.00	2000	16042	1493
	US-16-12-85L	3.06	0.71	10	12.00	12	14.00	28.00	1333	4753	996
18	US-18-8-85S	2.03	0.28	10	8.00	8	10.00	23.00	2259	22250	2071
	US-18-12-85L	3.05	0.63	10	12.00	12	14.00	32.00	1506	6593	1381
20	US-20-8-85S	2.01	0.25	10	8.00	8	10.00	26.00	2518	29879	2781
	US-20-12-85L	3.02	0.57	10	12.00	12	14.00	36.00	1679	8853	1854
22	US-22-8-85S	2.28	0.26	10	8.00	8	10.00	26.00	2059	26363	3775
	US-22-12-85L	3.42	0.58	10	12.00	12	14.00	36.00	1372	7811	2517
24	US-24-8-85S	2.26	0.23	10	8.00	8	10.00	32.00	2251	37757	3515
	US-24-12-85L	3.39	0.53	10	12.00	12	14.00	47.00	1501	11187	2343

EXPANSIONJOINTS.XLS-09/07/09

150 PSIG

321 S.S. Bellows with Welding Aide
Monel® and Inconel® available on request.



Notes:

1. Pressure Range: Vacuum to 150 PSIG.
2. Temperature Range: -20 °F to 800 °F.
3. Rated cycle life is 3,000 cycles per EJMA for any one tabulated movement.
4. Maximum axial extension movement is 50% of the tabulated axial movement.
5. Rated extension movement is equal to rated axial movement provided the bellows is pre-compressed the amount of design extension.
6. Maximum test pressure: 1.5 x design pressure
7. Materials: Bellows - ASTM A240-T321SS
   Welding Aides - ASTM A240-T321SS
8. Flanges or welds ends can be attached to the bellows 1/16” thk (min.) Welding Aide.

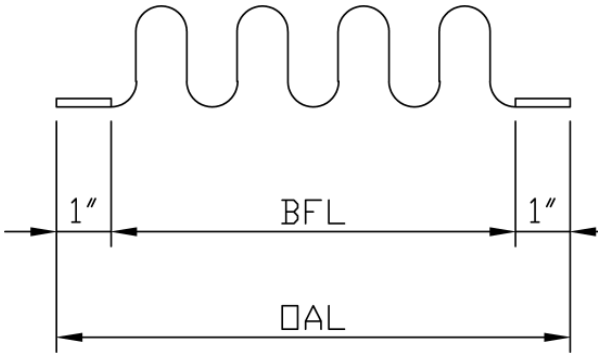
ND (in.)	PART NUMBER	MAX. AXIAL MOVEMENT (in.)	MAX. LATERAL MOVEMENT (in.)	MAX. ANGULAR MOVEMENT (deg.)	B.F.I. (in.)	NUMBER OF CORRUGATIONS	O.A.L. (in.)	WEIGHT EACH (lb.)	AXIAL SPRING RATE (lb./ in.)	LATERAL SPRING RATE (lb./ in.)	ANGULAR SPRING RATE (in./lb./deg.)
3/4	S007150C	0.33	0.14	10	1.63	7	2.38	0.06	734	633	13
	L007150C	0.47	0.25	10	2.19	10	2.94	0.07	510	218	13
1	S010150C	0.39	0.12	10	1.56	6	2.31	0.08	582	930	13
	L010150C	0.53	0.19	10	1.94	8	2.69	0.09	437	392	13
1 1/2	S015150C	0.41	0.10	10	1.75	7	2.50	0.13	739	1815	13
	L015150C	0.59	0.19	10	2.38	10	3.13	0.15	515	622	13
2	US-2-8-150S	0.34	0.12	10	3.00	8	5.00	0.60	2911	3153	41
	US-2-12-150L	0.51	0.28	10	4.50	12	6.50	1.00	1940	934	28
2 1/2	US-2.5-8-150S	0.69	0.20	10	3.00	8	5.00	1.00	1441	2615	53
	US-2.5-12-150L	0.78	0.34	10	4.50	12	6.50	1.00	961	775	35
3	US-3-8-150S	0.66	0.16	10	3.00	8	5.00	1.00	950	2281	30
	US-3-12-150L	0.82	0.31	10	4.50	12	6.50	1.00	974	1007	30
4	US-4-8-150S	0.70	0.13	10	3.00	8	5.00	1.00	1224	4822	63
	US-4-12-150L	1.05	0.30	10	4.50	12	6.50	2.00	816	1429	42
5	US-5-8-150S	0.69	0.11	10	3.00	8	5.00	2.00	1531	8791	115
	US-5-12-150L	1.03	0.25	10	4.50	12	6.50	3.00	1021	2605	77
6	US-6-8-150S	0.83	0.15	10	4.00	8	6.00	3.00	1823	8364	195
	US-6-12-150L	1.25	0.34	10	6.00	12	8.00	4.00	1215	2478	130
8	US-8-8-150S	0.81	0.11	10	4.00	8	6.00	5.00	2401	17807	414
	US-8-12-150L	1.22	0.26	10	6.00	12	8.00	7.00	1601	5276	276
10	US-10-8-150S	1.48	0.33	10	8.00	8	10.00	11.00	2985	8692	809
	US-10-12-150L	2.22	0.75	10	12.00	12	14.00	17.00	1990	2575	539
12	US-12-8-150S	1.54	0.29	10	8.00	8	10.00	20.00	3532	14601	1359
	US-12-12-150L	2.31	0.66	10	12.00	12	14.00	29.00	2354	4326	906
14	US-14-8-150S	1.53	0.26	10	8.00	8	10.00	23.00	3894	19100	1778
	US-14-12-150L	2.30	0.60	10	12.00	12	14.00	31.00	2596	5659	1185
16	US-16-8-150S	1.52	0.23	10	8.00	8	10.00	25.00	4473	28074	2613
	US-16-12-150L	2.28	0.52	10	12.00	12	14.00	36.00	2982	8318	1742
18	US-18-8-150S	1.50	0.20	9	8.00	8	10.00	29.00	5052	39491	3676
	US-18-12-150L	2.26	0.47	10	12.00	12	14.00	40.00	3368	11701	2451
20	US-20-8-150S	1.49	0.18	8	8.00	8	10.00	32.00	5632	53644	4993
	US-20-12-150L	2.24	0.42	10	12.00	12	14.00	45.00	3755	15895	3329
22	US-22-8-150S	1.49	0.17	8	8.00	8	10.00	32.00	4132	52913	7578
	US-22-12-150L	2.23	0.38	10	12.00	12	14.00	45.00	2755	15678	5052
24	US-24-8-150S	1.47	0.11	5	8.00	8	10.00	39.00	6792	91337	8502
	US-24-12-150L	2.21	0.26	8	12.00	12	14.00	54.00	4528	27063	5668

EXPANSIONJOINTS.XLS-09/07/09

SINGLE AND MULTI-PLY STAINLESS STEEL

300 PSIG

321 S.S. Bellows with Welding Aide
Monel® and Inconel® available on request.



Notes:

1. Pressure Range: Vacuum to 300 PSIG.
2. Temperature Range: -20 °F to 800 °F.
3. Rated cycle life is 3,000 cycles per EJMA for any one tabulated movement.
4. Maximum axial extension movement is 50% of the tabulated axial movement.
5. Rated extension movement is equal to rated axial movement provided the bellows is pre-compressed the amount of design extension.
6. Maximum test pressure: 1.5 x design pressure
7. Materials: Bellows - ASTM A240-T321SS
   Welding Aides - ASTM A240-T321SS
8. Flanges or welds ends can be attached to the bellows 1/16” thk (min.) Welding Aide.

ND (in.)	PART NUMBER	MAX. AXIAL MOVEMENT (in.)	MAX. LATERAL MOVEMENT (in.)	MAX. ANGULAR MOVEMENT (deg.)	B.F.I. (in.)	NUMBER OF CORRUGATIONS	O.A.L. (in.)	WEIGHT EACH (lb.)	AXIAL SPRING RATE (lb./ in.)	LATERAL SPRING RATE (lb./ in.)	ANGULAR SPRING RATE (in./lb./deg.)
3/4	S007300C	0.23	0.10	10	1.63	7	2.38	0.07	1607	1394	13
	L007300C	0.35	0.25	10	2.38	11	3.13	0.09	1025	358	13
1	S010300C	0.29	0.12	10	1.94	8	2.69	0.13	1387	1647	13
	L010300C	0.43	0.27	10	2.75	12	3.50	0.17	1226	487	13
1 1/2	S015300C	0.35	0.13	10	2.38	10	3.13	0.22	2279	2733	13
	L015300C	0.51	0.29	10	4.06	15	4.81	0.29	1518	806	13
2	US-2-8-300S	0.32	0.12	10	3.00	8	5.00	0.60	2511	3022	40
	US-2-12-300L	0.48	0.27	10	4.50	12	6.50	1.00	693	462	14
2 1/2	US-2.5-8-300S	0.77	0.30	10	4.00	8	6.00	2.00	1441	1471	53
	US-2.5-12-300L	0.89	0.52	10	6.00	12	8.00	3.00	961	436	35
3	US-3-8-300S	0.57	0.19	10	4.00	8	6.00	2.00	4230	6345	148
	US-3-12-300L	0.85	0.42	10	6.00	12	8.00	3.00	2820	1880	98
4	US-4-8-300S	0.77	0.20	10	4.00	8	6.00	4.00	2573	6336	147
	US-4-12-300L	1.16	0.45	10	6.00	12	8.00	4.50	1715	1877	98
5	US-5-8-300S	0.74	0.16	10	4.00	8	6.00	4.00	3217	11536	268
	US-5-12-300L	1.11	0.36	10	6.00	12	8.00	4.50	2144	3418	179
6	US-6-8-300S	0.84	0.15	10	4.00	8	6.00	6.30	2809	14080	328
	US-6-12-300L	1.26	0.34	10	6.00	12	8.00	7.50	1872	4172	218
8	US-8-8-300S	0.82	0.11	10	4.00	8	6.00	7.50	3697	30059	700
	US-8-12-300L	1.23	0.26	10	6.00	12	8.00	10.00	2465	8906	466
10	US-10-8-300S	1.52	0.38	10	9.00	8	11.00	23.00	6274	20302	1890
	US-10-12-300L	2.28	0.87	10	13.50	12	15.50	34.00	4183	6015	1260
12	US-12-8-300S	1.57	0.33	10	9.00	8	11.00	40.00	7424	26948	3175
	US-12-12-300L	2.36	0.76	10	13.50	12	15.50	56.00	4950	7985	2116
14	US-14-8-300S	1.55	0.30	10	9.00	8	11.00	45.00	8185	35251	4153
	US-14-12-300L	2.32	0.68	10	13.50	12	15.50	62.00	5457	10445	2769
16	US-16-8-300S	1.53	0.26	10	9.00	8	11.00	51.00	9403	51812	6104
	US-16-12-300L	2.30	0.60	10	13.50	12	15.50	71.00	6268	15352	4069
18	US-18-8-300S	1.53	0.23	9	9.00	8	11.00	55.00	10621	72883	8586
	US-18-12-300L	2.29	0.53	10	13.50	12	15.50	80.00	7081	21595	5724
20	US-20-8-300S	1.51	0.21	8	9.00	8	11.00	60.00	11839	99004	11664
	US-20-12-300L	2.27	0.48	10	13.50	12	15.50	89.00	7893	29335	7776
22	US-22-8-300S	1.40	0.16	6	8.00	8	10.00	60.00	9507	121742	17434
	US-22-12-300L	2.11	0.36	10	12.00	12	14.00	89.00	6338	36072	11623
24	US-24-8-300S	1.60	0.15	6.85	8.00	8	10.00	80.00	10396	156893	14604
	US-24-12-300L	2.41	0.35	10	12.00	12	14.00	112.00	6931	46487	9736

EXPANSIONJOINTS.XLS-09/07/09

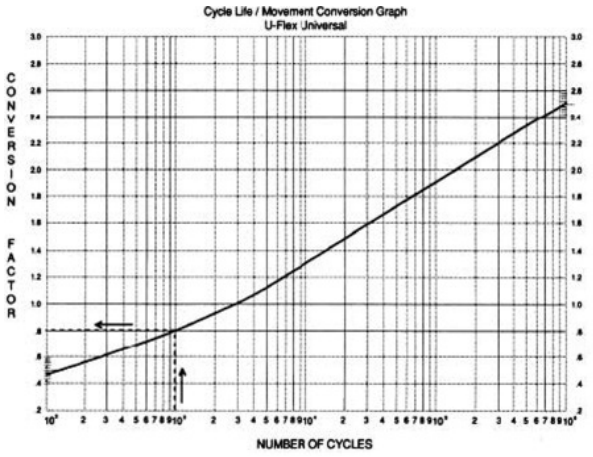
CYCLE LIFE AND RATED MOVEMENT

Universal Expansion Joints

U.S. Bellows' universal expansion joints are designed for 3000 cycles for any one tabulated movement shown. Cycle life may be increased, or movement may be increased (decreasing the cycle life) by utilizing the graph shown on this page. The graph may also be used for superimposing more than one movement condition on the bellows at one time. It is important to remember that the movements shown in the bellows data pages do not allow for any installation misalignment. A proper specification for a bellows expansion joint should reflect what the actual system movements will be. To insure the highest quality bellows for the least cost, all movement conditions must be taken into account. Refer to the HOW TO ORDER section on page 80 for an example on the proper analysis and selection of a universal expansion joint.

Examples of movement conditions that typically occur in a piping system are:

- **Installation:** Allow one cycle installation misalignment.
- **Start-Up/Shut-Down:** Movements produced between the minimum ambient temperature and the maximum start-up temperature. This is normally a very low number of cycles.
- **Operating:** Movements produced due to temperature fluctuations during system operation. This is typically a very small movement for a very large number of cycles.
- **Excursion**: Movement resulting from a worst case/ upset scenario, occurring during system operation. This is normally a very low number of cycles.



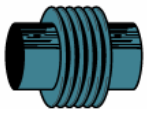
How To Use the Graph

- Enter the graph horizontally at the number of anticipated cycles or the movement condition being considered.
- Move vertically until the graph is intercepted.
- Move horizontally and read conversion factor. Example: Enter graph at 1,000 cycles; read C. F. of 0.80

44" Double Gimbal Universal Expansion Joint

Note: Maximum increase in movements for combined movement conditions shall not exceed 110% of catalog rated movements.

View catalog section for cycle life:
www.usbellows.com/cycle



HOW TO SELECT AND ORDER

The first step in selecting the proper expansion joint assembly is to collect and organize as much information regarding the design and operating parameters of the system as possible. As a minimum the following information should be provided:

- Size of the line.
- Design pressure.
- Design temperature.
- Design movements and required cycle life.
- Overall length requirement, if any.
- Type of end connections.
- Bellows material.
- Pipe material.
- Flange specification and material.
- Type of expansion joint.
- Accessories.

EXAMPLE

1. Assume the following expansion joint design criteria:

a) Line size: 18-inch nominal diameter.
b) Design/operating pressure: 300 psig.
c) Design/operating temperature: 550°F.
d) Movements/cycle life
Installation: 0.25-inch lateral; 0° angulation, 0-inch axial. Start-up/Shut-Down: 1.13-inch lateral; 0°angulation, 0-inch axial, 1,000 cycles.
Excursion: 2.05-inches lateral, 0°angulation; 0-inch axial, 200 cycles.

The thermal growth of the pipe between the tie rods must be considered when designing the bellows of an expansion joint with 60-inches O.A.L. The thermal expansion of carbon steel pipe at 550°F is 0.21-inch. The corresponding expansion for the excursion conditions is 0.38-inch.

e) End connections: Weld ends (standard bevel); 18-inches standard weight pipe (0.375-inch wall).
f) Bellows material: A-240-T321.
g) Type: Tied.
h) Accessories: Liner.

2. Turn to the Conversion Factor Graph and calculate equivalent catalog movements.

Condition	No. Cycles	Axial	Lat.	Ang.	C.F.	Equivalent		
						Axial	Lat.	Ang
Install	1	0	.25	0	.49	0	.12	0
Start-Up/ Shut-Down	1000	.21	1.13	0	.80	.17	.90	0
Excursion	200	.38	2.05	0	.55	.21	1.13	0
				Total =		0.38	2.15	0

3. Refer to page 85, 18-inch nominal diameter universal expansion joints, and go to the lowest pressure rating that is equal to or greater than specified design pressure (300 psig). Compare the total equivalent catalog movements to those shown in the catalog, keeping in mind that the tabulated movements in the catalog are for 3000 cycles for one movement only.

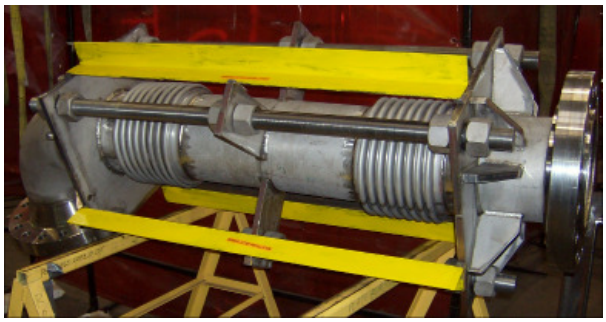
4. Select the shortest overall length that by inspection would appear to meet the movement criteria. Use the following formula to determine if the selected overall length is acceptable.

$$\frac{\text{EQUIV. AXIAL}}{\text{RATED AXIAL}} + \frac{\text{EQUIV. LATERAL}}{\text{RATED LATERAL}} + \frac{\text{EQUIV. ANGULAR}}{\text{RATED ANGULAR}} \leq 1.0$$

400 psig rating/60-inch O.A.L.

$$\frac{0.38}{1.98} + \frac{2.15}{3.16} + \frac{0.00}{0.00} = 0.87$$

5. Since 0.87 is less than 1.0, the 400 psig/60-inch O.A.L. will meet the criteria for all the movement conditions specified in Step 1.
6. Include the designations for the type (TU for tied universal), and liner (L), in the part number. All of the actual movements must be specified when combination ends are specified.
7. On combination end units, the direction of flow must be specified.
8. The resulting U.S. Bellows part number would then be as follows:

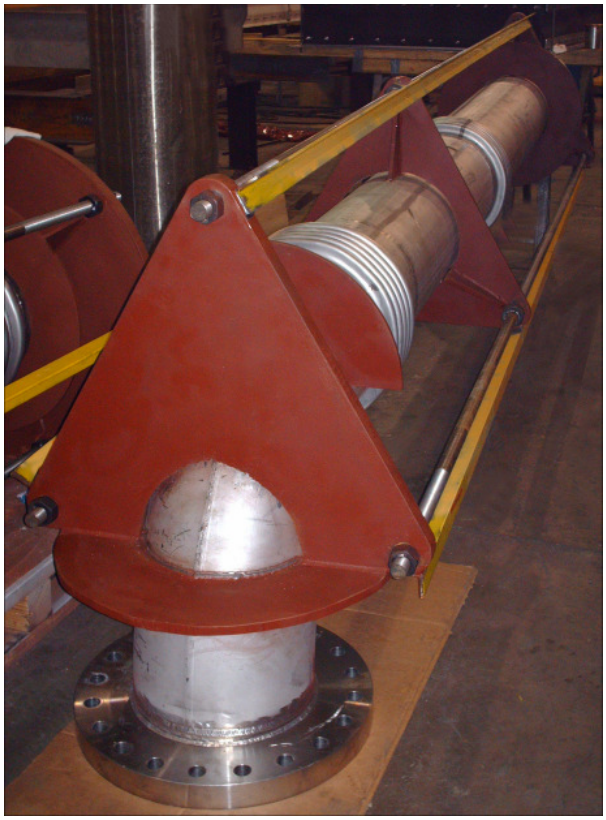


10" Tied Universal Expansion Joint

Part Number Example	Size	Pressure	Length	End Connections	Type	Accessories	Material
	18	400	60	WE WE	TU	L	321

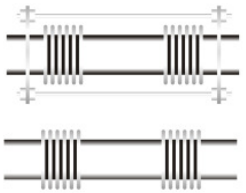
Round Metallic Universal Expansion Joint with Limit Rods

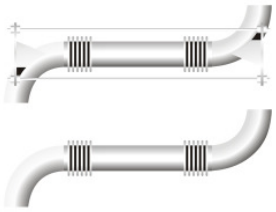
8" Universal Expansion Joints for an Air Force Base in Mexico



14" Tied Universal Expansion Joint for a Nitrogen Plant

3- / 3-1/2- / 4-Inch Nominal Diameter





SIZE	PRESSURE	NON-CONCURRENT MOVEMENTS/SPRING RATES							
		LATERAL MOVEMENT/SPRING RATES						AXIAL	
		24 IN O.A.L		36 IN O.A.L		48 IN O.A.L		MOVEMENT	SPRING RATE
		610 MM O.A.L		914 MM O.A.L		1219 MM O.A.L			
		MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE		
	PSIG	IN	LB/IN	IN	LB/IN	IN	LB/IN	IN	LB/IN
	KG/CM²	MM	KG/MM	MM	KG/MM	MM	KG/MM	MM	KG/MM
3	75	3.17	16	8.93	3	14.93	1	2.05	152
	5.3	81	0.3	227	0.05	379	0.02	52	3
	500	1.33	91	3.39	18	5.49	7	0.71	1010
	35.1	34	1.6	86	0.32	139	0.13	18	18
3.5	75	2.81	23	7.82	4	13.03	2	2	175
	5.3	71	0.4	199	0.07	331	0.04	51	3
	500	1.10	151	2.77	30	4.48	12	0.65	1355
	35.1	28	2.7	70	0.54	114	0.21	17	24
4	50	3.43	19	9.41	3	15.61	1	2.71	111
	3.5	87	0.3	239	0.05	396	0.02	69	2
	275	1.44	106	3.53	22	5.66	9	0.92	775
	19.3	37	1.9	90	0.39	144	0.16	23	14

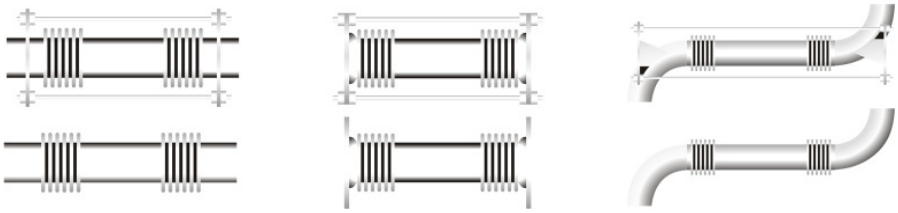
General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 80.
3. To increase cycle life or movements, please refer to graph on page 79.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Tabulated values are for tied joints, with butt weld ends. Performance of joints with flanged ends, and unrestrained joints, will exceed tabulated values.
6. Maximum test pressure: 1.5 X rated working pressure.
7. Bellows are rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
8. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.
9. Please refer to page 81 for part number example.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
50-75 psig Series: 150 lb ANSI B16.5 RPSO.
275-500 psig Series: 300 lb ANSI B16.5 RPSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A-53/A-106.
50-75 psig Series: Std. Wt. pipe.
275-500 psig Series: Std. Wt. pipe.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

UNIVERSAL EXPANSION JOINTS



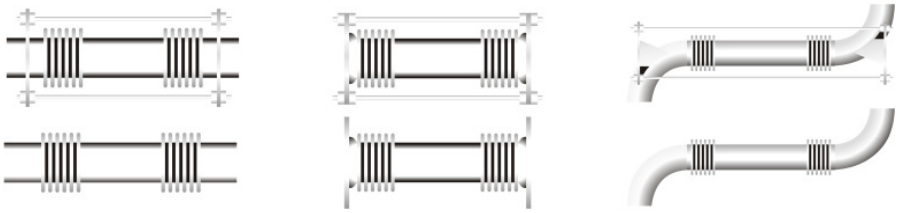
5- / 6- / 8-Inch Nominal Diameter

SIZE	PRESSURE	NON-CONCURRENT MOVEMENTS/SPRING RATES							
		LATERAL MOVEMENT/SPRING RATES						AXIAL	
		30 IN O.A.L		42 IN O.A.L		54 IN O.A.L		MOVEMENT	SPRING RATE
		762 MM O.A.L		1067 MM O.A.L		1372 MM O.A.L			
		MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE		
	PSIG	IN	LB/IN	IN	LB/IN	IN	LB/IN	IN	LB/IN
	KG/CM²	MM	KG/MM	MM	KG/MM	MM	KG/MM	MM	KG/MM
5	75	4.96	12	9.61	4	14.33	2	2.47	139
	5.3	126	0.2	244	0.07	364	0.04	63	2
	275	1.78	87	3.26	29	4.75	14	0.77	1160
	19.3	45	1.6	83	0.52	121	0.25	20	21
6	70	3.59	22	7.44	6	11.34	3	2.43	143
	4.9	91	0.4	189	0.11	288	0.05	62	3
	200	2.01	104	4.17	29	6.36	13	1.36	665
	14.1	51	1.9	106	0.52	162	0.23	35	12
	500	0.65	1017	1.38	259	2.12	115	0.46	5473
	35.1	17	18.2	35	4.63	54	2.06	12	98
8	45	3.62	40	8.31	10	13.19	4	3.91	126
	3.2	92	0.7	211	0.18	335	0.07	99	2
	200	1.89	186	4.34	46	6.89	20	2.05	583
	14.1	48	3.3	110	0.82	175	0.36	52	10
	400	0.71	1576	1.66	364	2.64	157	0.77	4314
	28.1	18	28.2	42	6.51	67	2.81	20	77

General Notes
1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 80.
3. To increase cycle life or movements, please refer to graph on page 79.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Tabulated values are for tied joints, with butt weld ends. Performance of joints with flanged ends, and unrestrained joints, will exceed tabulated values.
6. Maximum test pressure: 1.5 X rated working pressure.
7. Bellows are rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
8. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.
9. Please refer to page 81 for part number example.

Materials
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
40-75 psig Series: 150 lb ANSI B16.5 RFSO.
200-275 psig Series: 150 lb ANSI B16.5 RFSO.
400-500 psig Series: 300 lb ANSI B16.5 RFSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A-53/A-106.
40-75 psig Series: Std. Wt. pipe.
200-275 psig Series: Std. Wt. pipe.
400-500 psig Series: Std. Wt. pipe.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

10- / 12- / 14-Inch Nominal Diameter



SIZE	PRESSURE	NON-CONCURRENT MOVEMENTS/SPRING RATES							
		LATERAL MOVEMENT/SPRING RATES						AXIAL	
		42 IN O.A.L		54 IN O.A.L		66 IN O.A.L		MOVEMENT	SPRING RATE
		1067 MM O.A.L		1372 MM O.A.L		1676 MM O.A.L			
		MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE		
	PSIG	IN	LB/IN	IN	LB/IN	IN	LB/IN	IN	LB/IN
	KG/CM²	MM	KG/MM	MM	KG/MM	MM	KG/MM	MM	KG/MM
10	45	6.26	49	11.80	18	17.63	9	6.08	213
	3.2	159	0.9	300	0.32	448	0.16	154	4
	260	2.72	256	5.04	92	7.45	47	2.48	1127
	18.3	69	4.6	128	1.65	189	0.84	63	20
12	45	5.07	80	10.01	27	15.23	13	6.4	208
	3.2	129	1.4	254	0.48	387	0.23	163	4
	200	2.41	369	4.67	123	7.02	60	2.85	976
	14.1	61	6.6	119	2.20	178	1.07	72	17
14	50	4.80	95	9.24	33	13.90	16	6.23	229
	3.5	122	1.7	235	0.59	353	0.29	158	4
	200	2.04	548	3.92	184	5.87	91	2.56	1255
	14.1	52	9.8	100	3.29	149	1.63	65	22

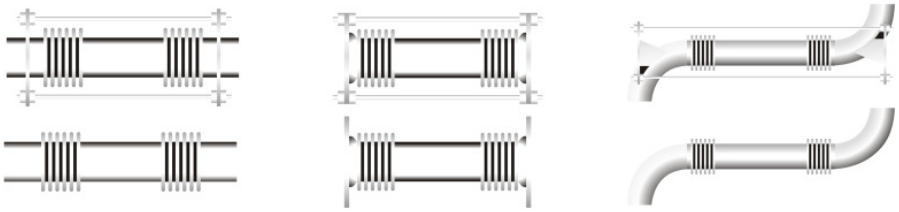
General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 80.
3. To increase cycle life or movements, please refer to graph on page 79.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Tabulated values are for tied joints, with butt weld ends. Performance of joints with flanged ends, and unrestrained joints, will exceed tabulated values.
6. Maximum test pressure: 1.5 X rated working pressure.
7. Bellows are rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
8. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.
9. Please refer to page 81 for part number example.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
45-50 psig Series: 150 lb ANSI B16.5 RPSO.
200-260 psig Series: 300 lb ANSI B16.5 RPSO
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A-53/A-106.
45-50 psig Series: Std. Wt. pipe.
200-260 psig Series: Std. Wt. pipe.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

UNIVERSAL EXPANSION JOINTS



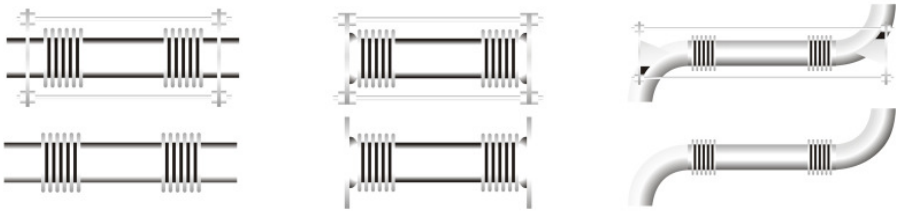
16- / 18- / 20-Inch Nominal Diameter

SIZE	PRESSURE	NON-CONCURRENT MOVEMENTS/SPRING RATES							
		LATERAL MOVEMENT/SPRING RATES						AXIAL	
		48 IN O.A.L		60 IN O.A.L		72 IN O.A.L		MOVEMENT	SPRING RATE
		1219 MM O.A.L		1524 MM O.A.L		1829 MM O.A.L			
		MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE		
	PSIG	IN	LB/IN	IN	LB/IN	IN	LB/IN	IN	LB/IN
	KG/CM²	MM	KG/MM	MM	KG/MM	MM	KG/MM	MM	KG/MM
16	35	6.73	70	11.60	29	16.70	16	7.75	211
	2.5	171	1.3	295	0.52	424	0.29	197	4
	200	3.11	339	5.06	149	7.05	83	2.96	1235
	14.1	79	6.1	129	2.67	179	1.49	75	22
	400	2.45	843	3.98	363	5.54	200	2.3	2894
	28.1	62	15.1	101	6.50	141	3.58	58	52
18	40	5.91	98	10.18	41	14.66	22	7.59	238
	2.8	150	1.8	259	0.73	372	0.39	193	4
	200	2.48	550	4.16	230	5.88	125	2.85	1394
	14.1	63	9.8	106	4.12	149	2.24	72	25
	400	1.97	1365	3.16	595	4.37	331	1.98	3919
	28.1	50	24.4	80	10.65	111	5.92	50	70
20	45	5.24	133	9.03	55	12.99	30	7.43	265
	3.2	133	2.4	229	0.98	330	0.54	189	5
	200	2.26	725	3.75	306	5.27	167	2.77	1533
	14.1	57	13.0	95	5.48	134	2.99	70	28
	400	1.59	2120	2.62	881	3.66	479	1.88	4365
	28.1	40	37.9	67	15.77	93	8.57	48	78

General Notes
1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 80.
3. To increase cycle life or movements, please refer to graph on page 79.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Tabulated values are for tied joints, with butt weld ends. Performance of joints with flanged ends, and unrestrained joints, will exceed tabulated values.
6. Maximum test pressure: 1.5 X rated working pressure.
7. Bellows are rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
8. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.
9. Please refer to page 81 for part number example.

Materials
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
35-45 psig Series: 125 lb Lt/Wt FFSO.
200 psig Series: 150 lb ANSI B16.5 RFSO.
400 psig Series: 300 lb ANSI B16.5 RFSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A-53/A-106.
35-45 psig Series: Std. Wt. pipe.
200 psig Series: Std. Wt. pipe.
400 psig Series: Std. Wt. pipe.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

22- / 24- / 26-Inch Nominal Diameter

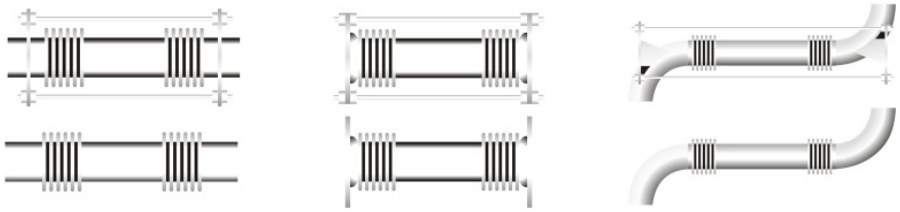


SIZE	PRESSURE	NON-CONCURRENT MOVEMENTS/SPRING RATES							
		LATERAL MOVEMENT/SPRING RATES						AXIAL	
		48 IN O.A.L		60 IN O.A.L		72 IN O.A.L		MOVEMENT	SPRING RATE
		1219 MM O.A.L		1524 MM O.A.L		1829 MM O.A.L			
		MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE		
	PSIG	IN	LB/IN	IN	LB/IN	IN	LB/IN	IN	LB/IN
	KG/CM²	MM	KG/MM	MM	KG/MM	MM	KG/MM	MM	KG/MM
22	45	5.28	137	8.88	58	12.62	32	7.62	243
	3.2	134	2.5	226	1.04	321	0.57	194	4
	165	2.24	811	3.66	347	5.12	191	2.9	1497
	11.6	57	14.5	93	6.21	130	3.42	74	27
	350	1.48	2536	2.40	1069	3.33	585	1.84	4506
	24.6	38	45.4	61	19.13	85	10.47	47	81
24	50	4.74	177	7.98	75	11.34	41	7.43	266
	3.5	120	3.2	203	1.34	288	0.73	189	5
	160	2.06	1024	3.36	441	4.68	243	2.85	1636
	11.2	52	18.3	85	7.89	119	4.35	72	29
	350	1.34	3163	2.15	1347	2.97	741	1.75	4925
	24.6	34	56.6	55	24.11	75	13.26	44	88
26	50	3.88	268	6.83	107	9.91	57	7.37	289
	3.5	99	4.8	173	1.91	252	1.02	187	5
	165	1.87	1450	3.41	544	5.02	281	3.85	1332
	11.6	47	25.9	87	9.74	128	5.03	98	24
	335	1.55	3635	2.99	1252	4.52	622	3.67	2672
	23.5	39	65.1	76	22.41	115	11.13	93	48

General Notes
1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 80.
3. To increase cycle life or movements, please refer to graph on page 79.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Tabulated values are for tied joints, with butt weld ends. Performance of joints with flanged ends, and unrestrained joints, will exceed tabulated values.
6. Maximum test pressure: 1.5 X rated working pressure.
7. Bellows are rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
8. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.
9. Please refer to page 81 for part number example.

Materials
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
45-50 psig Series: 125 lb Lt/Wt FFSO.
160-165 psig Series: 150 lb ANSI B16.5 RFSO.
335-350 psig Series: 300 lb ANSI B16.5 RFSO.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A-53/A-106/A-285-C.
45-50 psig Series: Std. Wt. pipe/0.375-inch wall.
160-165 psig Series: Std. Wt. pipe/0.375-inch wall.
335-350 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

UNIVERSAL EXPANSION JOINTS



28- / 30- / 32-Inch Nominal Diameter

SIZE	PRESSURE	NON-CONCURRENT MOVEMENTS/SPRING RATES							
		LATERAL MOVEMENT/SPRING RATES						AXIAL	
		48 IN O.A.L		60 IN O.A.L		72 IN O.A.L		MOVEMENT	SPRING RATE
		1219 MM O.A.L		1524 MM O.A.L		1829 MM O.A.L			
		MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE		
	PSIG	IN	LB/IN	IN	LB/IN	IN	LB/IN	IN	LB/IN
	KG/CM²	MM	KG/MM	MM	KG/MM	MM	KG/MM	MM	KG/MM
28	50	3.61	333	6.36	132	9.22	70	7.36	311
	3.5	92	6.0	162	2.36	234	1.25	187	6
	160	1.74	1801	3.17	675	4.67	348	3.85	1437
	11.2	44	32.2	81	12.08	119	6.23	98	26
	315	1.45	4512	2.82	1554	4.25	772	3.71	2881
	22.1	37	80.7	72	27.81	108	13.82	94	52
30	50	3.65	316	6.41	126	9.30	67	7.96	257
	3.5	93	5.7	163	2.25	236	1.20	202	5
	135	1.91	1708	3.48	640	5.13	330	4.53	1185
	9.5	49	30.6	88	11.45	130	5.91	115	21
	290	1.55	4276	3.00	1473	4.52	731	4.23	2376
	20.4	39	76.5	76	26.36	115	13.08	107	43
32	50	3.43	382	6.03	152	8.75	80	7.96	274
	3.5	87	6.8	153	2.72	222	1.43	202	5
	135	1.79	2062	3.27	773	4.82	399	4.53	1266
	9.5	45	36.5	83	13.83	122	7.14	115	23
	290	1.45	5163	2.81	1778	4.25	883	4.23	2537
	20.4	37	92.4	71	31.82	108	15.80	107	45

General Notes
1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 80.
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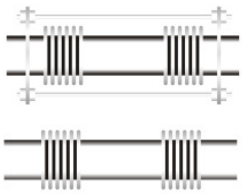
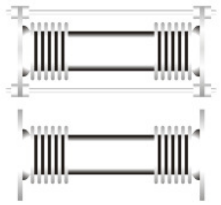
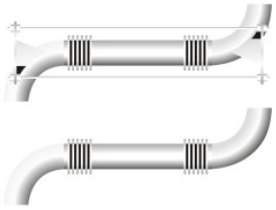
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Tabulated values are for tied joints, with butt weld ends. Performance of joints with flanged ends, and unrestrained joints, will exceed tabulated values.
6. Maximum test pressure: 1.5 X rated working pressure.
7. Bellows are rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
8. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.
9. Please refer to page 81 for part number example.

Materials
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
50 psig Series: 125 lb Lt/Wt FFSO.
For 135-160 psig Series and 290-315 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A-53/APJ-5L/A-285-C.
50 psig Series: 0.375-inch wall.
135-160 psig Series: 0.375-inch wall.
290-315 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

34- / 36- / 38-Inch Nominal Diameter

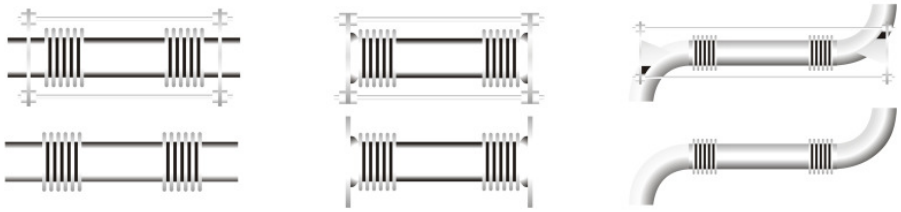




SIZE	PRESSURE	NON-CONCURRENT MOVEMENTS/SPRING RATES							
		LATERAL MOVEMENT/SPRING RATES						AXIAL	
		54 IN O.A.L		66 IN O.A.L		78 IN O.A.L		MOVEMENT	SPRING RATE
		1372 MM O.A.L		1676 MM O.A.L		1981 MM O.A.L			
		MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE		
	PSIG	IN	LB/IN	IN	LB/IN	IN	LB/IN	IN	LB/IN
	KG/CM²	MM	KG/MM	MM	KG/MM	MM	KG/MM	MM	KG/MM
34	50	4.44	273	6.97	129	9.56	74	7.96	292
	3.5	113	4.9	177	2.31	243	1.32	202	5
	135	2.13	1683	3.54	723	5.01	398	4.5	1346
	9.5	54	30.1	90	12.94	127	7.12	114	24
	275	1.58	4951	2.89	1856	4.25	958	4.24	2699
	19.3	40	88.6	73	33.21	108	17.14	108	48
36	50	4.21	323	6.59	152	9.05	88	7.96	309
	3.5	107	5.8	167	2.72	230	1.57	202	6
	135	2.02	1991	3.35	854	4.74	471	4.49	1427
	9.5	51	35.6	85	15.28	120	8.43	114	26
	250	1.52	5853	2.78	2194	4.09	1132	4.31	2860
	17.6	39	104.7	71	39.26	104	20.26	109	51
38	50	3.99	379.0	6.26	179	8.59	103	7.96	327
	3.5	101	6.8	159	3.20	218	1.84	202	6
	130	1.93	2333.0	3.21	1001	4.53	552	4.52	1508
	9.1	49	41.8	82	17.91	115	9.88	115	27
	250	1.44	6859	2.64	2571	3.88	1327	4.3	3021
	17.6	37	122.7	67	46.01	99	23.75	109	54

General Notes
1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 80.
3. To increase cycle life or movements, please refer to graph on page 79.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Tabulated values are for tied joints, with butt weld ends. Performance of joints with flanged ends, and unrestrained joints, will exceed tabulated values.
6. Maximum test pressure: 1.5 X rated working pressure.
7. Bellows are rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
8. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.
9. Please refer to page 81 for part number example.

Materials
Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
50 psig Series: 125 lb Lt/Wt FFSO.
For 130-135 psig Series and 250-275 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A-285-C.
50 psig Series: 0.375-inch wall.
130-135 psig Series: 0.375-inch wall.
250-275 psig Series: 0.500-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

UNIVERSAL EXPANSION JOINTS



40- / 42-Inch Nominal Diameter

SIZE	PRESSURE	NON-CONCURRENT MOVEMENTS/SPRING RATES							
		LATERAL MOVEMENT/SPRING RATES						AXIAL	
		54 IN O.A.L		66 IN O.A.L		78 IN O.A.L		MOVEMENT	SPRING RATE
		1372 MM O.A.L		1676 MM O.A.L		1981 MM O.A.L			
		MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE		
	PSIG	IN	LB/IN	IN	LB/IN	IN	LB/IN	IN	LB/IN
	KG/CM²	MM	KG/MM	MM	KG/MM	MM	KG/MM	MM	KG/MM
40	50	3.45	515	5.59	231	7.80	130	7.96	344
	3.5	88	9.2	142	4.13	198	2.33	202	6
	120	1.66	3254	2.88	1312	4.15	700	4.58	1588
	8.4	42	58.2	73	23.48	105	12.53	116	28
	225	1.21	9928	2.35	3419	3.55	1698	4.37	3183
	15.8	31	177.7	60	61.18	90	30.39	111	57
42	50	3.29	595	5.34	267	7.45	150	7.96	362
	3.5	84	10.6	136	4.78	189	2.68	202	6
	115	1.59	3756	2.77	1514	3.99	809	4.61	1669
	8.1	40	67.2	70	27.09	101	14.48	117	30
	225	1.16	11459	2.24	3946	3.39	1960	4.37	3344
	15.8	29	205.1	57	70.62	86	35.08	111	60

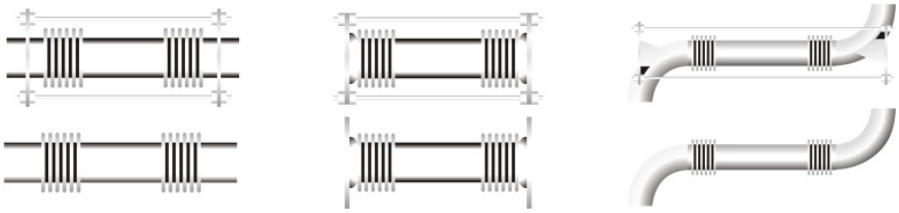
General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 80.
3. To increase cycle life or movements, please refer to graph on page 79.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Tabulated values are for tied joints, with butt weld ends. Performance of joints with flanged ends, and unrestrained joints, will exceed tabulated values.
6. Maximum test pressure: 1.5 X rated working pressure.
7. Bellows are rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
8. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.
9. Please refer to page 81 for part number example.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
50 psig Series: 125 lb Lt/Wt FFSO.
For 115-120 psig Series and 225 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A-53/A-106.
50-75 psig Series: Std.Wt. pipe.
275-500 psig Series: Std. Wt. pipe.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

44- / 46- / 48-Inch Nominal Diameter



SIZE	PRESSURE	NON-CONCURRENT MOVEMENTS/SPRING RATES							
		LATERAL MOVEMENT/SPRING RATES						AXIAL	
		48 IN O.A.L		60 IN O.A.L		72 IN O.A.L		MOVEMENT	SPRING RATE
		1219 MM O.A.L		1524 MM O.A.L		1829 MM O.A.L			
		MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE		
	PSIG	IN	LB/IN	IN	LB/IN	IN	LB/IN	IN	LB/IN
	KG/CM²	MM	KG/MM	MM	KG/MM	MM	KG/MM	MM	KG/MM
44	50	2.42	1008	4.14	412	5.93	221	7.02	427
	3.5	61	18.0	105	7.37	151	3.95	178	8
	115	1.20	6238	2.28	2184	3.41	1094	4.5	1750
	8.1	30	111.6	58	39.08	87	19.58	114	31
46	35	2.30	729	3.95	298	5.65	160	7.02	281
	2.5	58	13.0	100	5.33	144	2.86	178	5
	95	1.44	4513	2.75	1581	4.11	792	5.69	1150
	6.7	37	80.8	70	28.29	104	14.17	145	21
48	35	2.16	907	3.65	375	5.19	203	6.58	335
	2.5	55	16.2	93	6.71	132	3.63	167	6
	95	1.30	5572	2.44	1984	3.62	1002	5.09	1372
	6.7	33	99.7	62	35.50	92	17.93	129	25

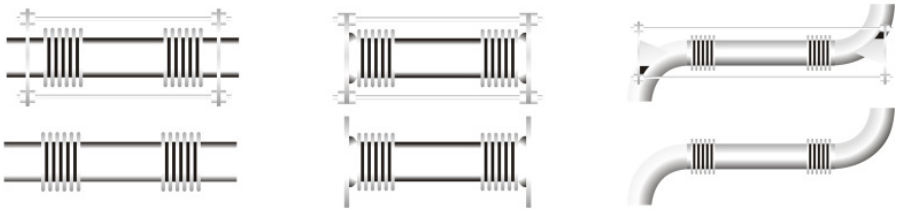
General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 80.
3. To increase cycle life or movements, please refer to graph on page 79.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Tabulated values are for tied joints, with butt weld ends. Performance of joints with flanged ends, and unrestrained joints, will exceed tabulated values.
6. Maximum test pressure: 1.5 X rated working pressure.
7. Bellows are rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
8. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.
9. Please refer to page 81 for part number example.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
35-50 psig Series: 125 lb Lt/Wt FFSO.
95-115 psig Series: Customer to specify actual flanges required.
Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A-285-C.
35-50 psig Series: 0.375-inch wall.
95-115 psig Series: 0.375-inch wall.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

UNIVERSAL EXPANSION JOINTS



50- THRU 72-INCH NOMINAL DIAMETER

SIZE	PRESSURE	NON-CONCURRENT MOVEMENTS/SPRING RATES							
		LATERAL MOVEMENT/SPRING RATES						AXIAL	
		50 IN O.A.L		66 IN O.A.L		78 IN O.A.L		MOVEMENT	SPRING RATE
		1270 MM O.A.L		1676 MM O.A.L		1981 MM O.A.L			
		MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE		
	PSIG	IN	LB/IN	IN	LB/IN	IN	LB/IN	IN	LB/IN
	KG/CM²	MM	KG/MM	MM	KG/MM	MM	KG/MM	MM	KG/MM
50	75	1.74	3751	2.90	1610	4.10	887	5.4	1393
	5.3	44	67.1	74	28.81	104	15.87	137	25
52	70	1.69	4209	2.81	1807	3.97	995	5.44	1450
	4.9	43	75.3	71	32.34	101	17.81	138	26
54	70	1.46	5641	2.53	2274	3.64	1214	5.44	1506
	4.9	37	100.9	64	40.69	92	21.73	138	27
60	60	1.26	8122	2.21	3205	3.20	1696	5.31	1677
	4.2	32	145.3	56	57.36	81	30.35	135	30
66	55	1.16	10757	2.03	4245	2.93	2246	5.34	1847
	3.9	29	192.5	52	75.97	74	40.19	136	33
72	50	1.01	15372	1.82	5845	2.66	3041	5.4	2017
	3.5	26	275.1	46	104.65	68	54.42	137	36

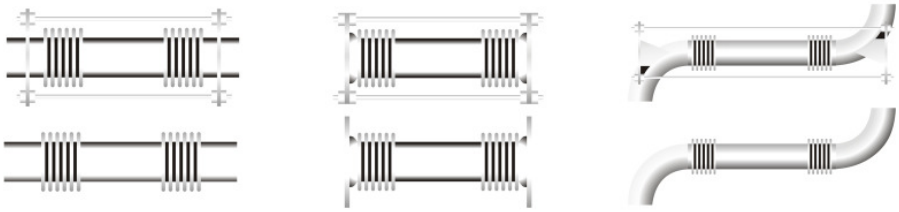
GENERAL NOTES

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 80.
3. To increase cycle life or movements, please refer to graph on page 79.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Tabulated values are for tied joints, with butt weld ends. Performance of joints with flanged ends, and unrestrained joints, will exceed tabulated values.
6. Maximum test pressure: 1.5 X rated working pressure.
7. Bellows are rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
8. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.
9. Please refer to page 81 for part number example.

MATERIALS

BELLOWS: A240-T304. Alternate materials available upon request. Refer to page 33.
FLANGES: ASTM A105.
50-75 psig Series: 125 lb Lt/Wt FFSO. Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
PIPE: ASTM A-285-C.
50-75 psig Series: 0.375-inch wall.
LINERS: A240-T304.
COVERS: Carbon steel.
TIE RODS, HINGES, GIMBALS: Carbon steel

84- thru 144-Inch Nominal Diameter



SIZE	PRESSURE	NON-CONCURRENT MOVEMENTS/SPRING RATES							
		LATERAL MOVEMENT/SPRING RATES						AXIAL	
		60 IN O.A.L		72 IN O.A.L		84 IN O.A.L		MOVEMENT	SPRING RATE
		1524 MM O.A.L		1829 MM O.A.L		2134 MM O.A.L			
		MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE	MOVEMENT	SPRING RATE		
	PSIG	IN	LB/IN	IN	LB/IN	IN	LB/IN	IN	LB/IN
	KG/CM²	MM	KG/MM	MM	KG/MM	MM	KG/MM	MM	KG/MM
84	45	1.10	17326	1.84	7437	2.59	4096	5.65	2358
	3.2	28	310.1	47	133.09	66	73.30	144	42
96	40	0.97	24772	1.60	10757	2.24	5963	5.45	2699
	2.8	25	443.3	41	192.50	57	106.71	138	48
108	35	0.88	36505	1.46	15669	2.06	8631	5.74	3040
	2.5	22	653.3	37	280.40	52	154.46	146	54
120	30	0.67	65983	1.19	25681	1.74	13488	5.79	3380
	2.1	17	1180.8	30	459.57	44	241.37	147	60
132	25	0.61	87604	1.09	34096	1.59	17908	5.82	3721
	1.8	15	1567.7	28	610.16	40	320.47	148	67
144	25	0.46	156468	0.89	53883	1.34	26764	5.82	4062
	1.8	12	2800.1	23	964.26	34	478.95	148	73

General Notes

1. Rated life cycle at 650°F is 3000 cycles for any one tabulated movement.
2. To combine axial, lateral and angular movements, please refer to page 80.
3. To increase cycle life or movements, please refer to graph on page 79.
4. Rated bellows extension is equal to rated axial movement. Provided bellows is precompressed the amount of design extension. Installed O.A.L. will decrease by the amount of precompression.
5. Tabulated values are for tied joints, with butt weld ends. Performance of joints with flanged ends, and unrestrained joints, will exceed tabulated values.
6. Maximum test pressure: 1.5 X rated working pressure.
7. Bellows are rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
8. Pressure thrust load applied to adjacent pipe anchors/equipment when unrestrained expansion joints are used.
9. Please refer to page 81 for part number example.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105.
40-45 psig Series: (96" and 84" dia) 125 lb Lt/Wt/FFSO.
25-30 psig Series: (108" and 144" dia) customer to specify actual flanges required. Plate flanges and angle flanges available for low pressure systems. Please refer to page 32.
Pipe: ASTM A-285-C.
25-45 psig Series: 0.375-inch walll.
Liners: A240-T304.
Covers: Carbon steel.
Tie Rods, Hinges, Gimbals: Carbon steel

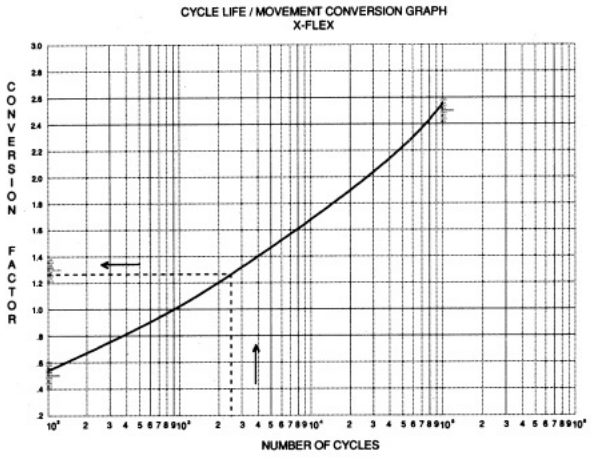
CYCLE LIFE AND RATED MOVEMENT

X-Flex Externally Pressurized Expansion Joints

U.S. Bellows' X-Flex externally pressurized expansion joints are designed for 1,000 cycles for any one tabulated movement shown. Cycle life may be increased, or movement may be increased (decreasing the cycle life) by utilizing the graph shown on this page. The graph may also be used for superimposing more than one movement condition on the bellows at one time. It is important to remember that the movements shown in the bellows data pages do not allow for any installation misalignment. A proper specification for a bellows expansion joint should reflect what the actual system movements will be. To insure the highest quality bellows for the least cost, all movement conditions must be taken into account. Refer to the HOW TO ORDER section on page 91 for an example on the proper analysis and selection of an X-Flex expansion joint.

Examples of the movement conditions that typically occur in a piping system are:

- **Installation:** Allow one cycle for installation misalignment.
- **Start-Up/Shut-Down:** Movements produced between the minimum ambient temperature and the maximum start-up temperature. This is normally a very low number of cycles.
- **Operating:** Movements produced due to temperature fluctuations during system operation. This is typically a very small movement for a very large number of cycles.
- **Excursion:** Movement resulting from a worst case/upset scenario, occurring during system operation. This is normally a very low number of cycles.



How To Use Graph

- Enter the graph horizontally at the number of anticipated cycles or the movement condition being considered.
- Move vertically until the graph is intercepted.
- Move horizontally and read conversion factor.

Example:

Enter graph at 2500 cycles; read C.F. of 1.23

Pressure Relief Valve Connectors for a Power Generation Facility

Note: Maximum increase in movements for combined movement conditions shall not exceed 130% of catalog rated movements.

HOW TO SELECT AND ORDER

The first step in selecting the proper expansion joint assembly is to collect and organize as much information regarding the design and operating parameters of the system as possible. As a minimum the following information should be provided:

- Size of the line.
- Design pressure.
- Design temperature.
- Design movements and required cycle life.
- Overall length requirement, if any.
- Type of end connections.
- Bellows material.
- Pipe material.
- Flange specification and material.
- Type of expansion joint.
- Accessories.

EXAMPLE

1. Assume the following expansion joint design criteria:

a) Line size: 12-inch nominal diameter.
b) Design/operating pressure: 125 psig.
c) Design/operating temperature: 353°F.
d) Movements/cycle life
Installation: 0.25-inch compression;
0.25-inch extension.
Start-Up/Shut-Down: 6.0 inches compression;
250 cycles.
Operating: 1.0-inch compression;
2500 cycles.
e) End connections: 150 lb ANSI raised face slip-on flanges: ASTM A-105 (carbon steel).
f) Bellows material: B-168/Inconel® 600.
g) Type: Single.
h) Accessories: Drain and purge.

2. Turn to the Conversion Factor Graph, and calculate equivalent catalog movements.

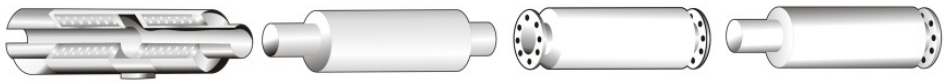
Condition	No. Cycles	Axial	Lat.	Ang.	C.F.	Equivalent		
						Axial	Lat.	Ang
Install	1	.50	N/A	N/A	.49	.25	N/A	N/A
Start-up/ Shut-Down	250	6.00	N/A	N/A	.72	4.32	N/A	N/A
Excursion	2500	1.00	N/A	N/A	1.23	1.23	N/A	N/A

Total = 5.80

3. Refer to page 96, 12-inch nominal diameter single X-Flex expansion joints, and go to the lowest pressure rating that is equal to or greater than specified design pressure (125 psig) which will be the 150 psig rated expansion joints. Compare the total equivalent catalog movements to those shown in the catalog, keeping in mind that the tabulated movements shown in the catalog are for 1,000 cycles for one movement only.
4. Select the appropriate expansion joint that meets the movement criteria. Since the total equivalent axial movement is 5.80-inches, the unit that is rated for eight inches is the correct selection.
5. Include the designations for the type (XS for X-Flex/single), drain connection (D), and purge connection (P).
6. The resulting U.S. Bellows part number would then be as follows:

How to Select & Order: www.usbellows.com/order

Part Number Example	Size	Pressure	Length	End Connections	Type	Accessories	Material
	12	150	49	FF	XS	DP	INC. 600



SINGLE X-FLEX 150# DESIGN

SIZE	AXIAL MOVEMENT	SPRING RATE	O.A.L	WEIGHT		EFF AREA	SHELL O.D.	ANCHOR FOOT HEIGHT	ANCHOR FOOT TYPE
				FLANGED ENDS	WELD ENDS				
	IN	LB/IN	IN	LB	LB	IN^2	IN	IN	
	MM	KG/MM	MM	KG	KG	CM^2	MM	MM	
3	4	140	24	81	65	30.24	8.625		
	102	2.5	610	37	30	195.05	219		
	8	70	40	120	104	30.24	8.625		
	203	1.3	1016	55	47	195.05	219		
4	4	140	25	94	68	30.24	8.625		
	102	2.5	635	43	31	195.05	219		
	8	70	42	130	104	30.24	8.625		
	203	1.3	1067	59	47	195.05	219		
5	4	328	28	153	123	53.85	10.750		
	102	5.9	711	70	56	347.33	273		
	8	164	46	226	196	53.85	10.750		
	203	2.9	1168	103	89	347.33	273		
6	4	328	28	163	125	53.85	10.750		
	102	5.9	711	74	57	347.33	273		
	8	164	46	240	202	53.85	10.750		
	203	2.9	1168	109	92	347.33	273		
8	4	403	28	243	183	87.09	14.000		
	102	7.2	711	110	83	561.73	356		
	8	210	44	332	272	87.09	14.000		
	203	3.8	1118	151	124	39.59	356		
10	4	502	29	224	138	128.28	16.00		
	102	9.0	737	102	63	58.31	406		
	8	262	45	425	339	128.28	16.00		
	203	4.7	1143	193	154	58.31	406		

PLEASE CONSULT FACTORY REGARDING ANCHOR FOOT USAGE ON SINGLE X-FLEX

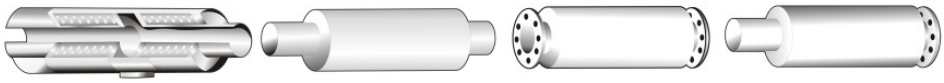
GENERAL NOTES

1. Rated life cycle at 650°F is 1000 cycles for full rated movement shown above.
2. To increase cycle life, please refer to graph on page 93.
3. Expansion joint is capable of taking 10% of rated movement as extension, with remaining 90% as axial compression.
4. Maximum test pressure: 1.5 X rated working pressure.
5. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
6. Maximum installation misalignment is ±1/4-inch axial and 1/16-inch lateral.

MATERIALS

BELLOWS: A240-T304. Alternate materials available upon request. Refer to page 33.
FLANGES: ASTM A105. 50 lb ANSI B16.5 RFSO.
PIPE: ASTM A53/A106.
SHELL: ASTM A53/A106; API-5L.
RINGS: ASTM A285-C.

Single X-Flex 150# Design



SIZE	AXIAL MOVEMENT	SPRING RATE	O.A.L	WEIGHT		EFF AREA	SHELL O.D.	ANCHOR FOOT HEIGHT	ANCHOR FOOT TYPE
				FLANGED ENDS	WELD ENDS				
	IN	LB/IN	IN	LB	LB	IN^2	IN	IN	
	MM	KG/MM	MM	KG	KG	CM^2	MM	MM	
12	4	922	30	436	308	180.81	18.000		
	102	16.5	762	198	140.00	82.19	457		
	8	461	49	611	483	180.81	18.000		
	203	82	1245	278	220	82.19	457		
14	4	1010	30	516	336	211.83	20.000		
	102	18.1	762	235	153	96.29	508		
	8	505	49	711	531	211.83	20.000		
	203	9.0	1245	323	241	96.29	508		
16	4	962	30	610	414	270.20	24.000		
	102	17.2	762	277	188	122.82	610		
	8	481	48	810	614	270.20	24.000		
	203	8.6	1219	368	279	122.82	610		
18	4	1080	30	661	401	331.61	24.000		
	102	19.3	762	300	182	150.73	610		
	8	540	48	877	617	331.61	24.000		
	203	9.7	1219	399	280	150.73	610		
20	4	1196	31	985	685	399.31	30.00		
	102	21.4	787	448	311	181.50	762		
	8	598	49	1240	910	399.31	30.00		
	203	10.7	1245	564	413	181.50	762		
24	4	1430	32	1074	634	553.55	30.00		
	102	25.6	813	488	288	251.61	762		
	8	725	50	1304	864	553.55	30.00		
	203	13.0	1270	593	393	251.61	762		

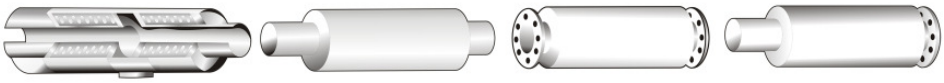
PLEASE CONSULT FACTORY REGARDING ANCHOR FOOT USAGE ON SINGLE X-FLEX

General Notes

1. Rated life cycle at 650°F is 1000 cycles for full rated movement shown above.
2. To increase cycle life, please refer to graph on page 93.
3. Expansion joint is capable of taking 10% of rated movement as extension, with remaining 90% as axial compression.
4. Maximum test pressure: 1.5 X rated working pressure.
5. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
6. Maximum installation misalignment is ±1/4-inch axial and 1/16-inch lateral.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105. 150 lb ANSI B16.5 RFSO.
Pipe: ASTM A53/A106.
Shell: ASTM A53/A106; API-5L.
Rings: ASTM A285-C.



SINGLE X-FLEX 300# DESIGN

SIZE	AXIAL MOVEMENT	SPRING RATE	O.A.L	WEIGHT		EFF AREA	SHELL O.D.	ANCHOR FOOT HEIGHT	ANCHOR FOOT TYPE
				FLANGED ENDS	WELD ENDS				
	IN	LB/IN	IN	LB	LB	IN^2	IN	IN	
	MM	KG/MM	MM	KG	KG	CM^2	MM	MM	
3	4	280	24	94	68	30.24	8.625		
	102	5.0	610	43	30.91	13.83	219		
	8	140	40	136	110	30.42	8.625		
	203	2.5	1016	62	50.00	13.83	219		
4	4	280	25	115	71	30.42	8.625		
	102	5.0	635	52	32.27	13.83	219		
	8	140	42	154	110	30.42	8.625		
	203	2.5	1067	70	50.0	13.83	219		
5	4	662	28	186	130	54.24	10.750		
	102	11.8	711	85	59.09	24.65	273		
	8	331	46	266	210	54.24	10.750		
	203	5.9	1168	121	95.45	24.65	273		
6	4	662	28	210	132	54.24	10.750		
	102	11.8	711	95	60.00	24.65	273		
	8	331	46	294	216	54.24	10.750		
	203	5.9	1168	134	98.18	24.65	273		
8	4	810	28	191	307	87.58	14.000		
	102	14.5	711	87	139.55	39.81	356		
	8	423	44	403	287	87.58	14.000		
	203	7.6	1118	183	130.45	39.81	356		
10	4	931	29	408	246	128.88	16.00		
	102	16.7	737	185	112	58.58	406		
	8	504	45	527	365	128.88	16.00		
	203	9.0	1143	240	166	58.58	406		

PLEASE CONSULT FACTORY REGARDING ANCHOR FOOT USAGE ON SINGLE X-FLEX

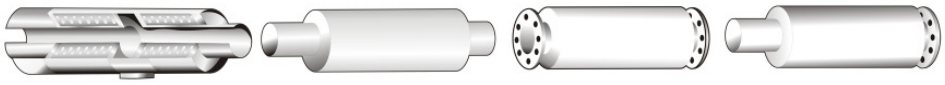
GENERAL NOTES

1. Rated life cycle at 650°F is 1000 cycles for full rated movement shown above.
2. To increase cycle life, please refer to graph on page 93.
3. Expansion joint is capable of taking 10% of rated movement as extension, with remaining 90% as axial compression.
4. Maximum test pressure: 1.5 X rated working pressure.
5. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
6. Maximum installation misalignment is ±1/4-inch axial and 1/16-inch lateral.

MATERIALS

BELLOWS: A240-T304. Alternate materials available upon request. Refer to page 33.
FLANGES: ASTM A105. 300 lb ANSI B16.5 RFSO.
PIPE: ASTM A53/A106.
SHELL: ASTM A53/A106; API-5L.
RINGS: ASTM A285-C.

Single X-Flex 300# Design



SIZE	AXIAL MOVEMENT	SPRING RATE	O.A.L	WEIGHT		EFF AREA	SHELL O.D.	ANCHOR FOOT HEIGHT	ANCHOR FOOT TYPE
				FLANGED ENDS	WELD ENDS				
	IN	LB/IN	IN	LB	LB	IN^2	IN	IN	
	MM	KG/MM	MM	KG	KG	CM^2	MM	MM	
12	4	1854	30	563	333	181.96	18.000		
	102	33.2	762	256	151.36	82.71	457		
	8	927	49	763	533	181.96	18.000		
	203	16.6	1245	347	242.27	82.71	457		
14	4	2028	30	695	365	213.07	20.000		
	102	36.3	762	316	165.91	96.85	508		
	8	1014	49	919	589	213.07	20.000		
	203	18.1	1245	418	267.73	96.85	508		
16	4	1770	30	836	456	271.60	24.000		
	102	31.7	762	380	207.27	123.45	610		
	8	885	48	1078	698	271.60	24.000		
	203	15.8	1219	490	317.27	123.45	610		
18	4	1986	26	948	448	333.16	24.000		
	102	35.5	660	431	203.64	151.44	610		
	8	993	30	1211	711	333.16	24.000		
	203	17.8	762	550	323.18	151.44	610		
20	4	2200	31	1338	708	401.01	30.00		
	102	39.4	787	608	322	182.28	762		
	8	1100	49	1645	1015	401.01	30.00		
	203	19.7	1245	748	461	182.28	762		
24	4	2630	32	1594	644	555.55	30.00		
	102	47.1	813	725	293	252.52	762		
	8	1315	50	1936	986	555.55	30.00		
	203	23.5	1270	880	448	252.52	762		

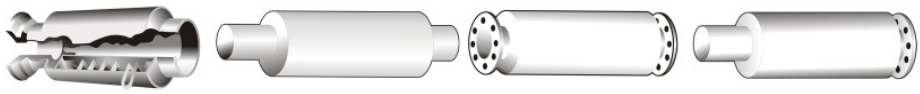
PLEASE CONSULT FACTORY REGARDING ANCHOR FOOT USAGE ON SINGLE X-FLEX

General Notes

1. Rated life cycle at 650°F is 1000 cycles for full rated movement shown above.
2. To increase cycle life, please refer to graph on page 93.
3. Expansion joint is capable of taking 10% of rated movement as extension, with remaining 90% as axial compression.
4. Maximum test pressure: 1.5 X rated working pressure.
5. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
6. Maximum installation misalignment is ±1/4-inch axial and 1/16-inch lateral.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105. 300 lb ANSI B16.5 RFSO.
Pipe: ASTM A53/A106.
Shell: ASTM A53/A106; API-5L.
Rings: ASTM A285-C.



DOUBLE X-FLEX 150# DESIGN

SIZE	AXIAL MOVEMENT	SPRING RATE	O.A.L	WEIGHT		EFF AREA	SHELL O.D.	ANCHOR FOOT HEIGHT	ANCHOR FOOT TYPE
				FLANGED ENDS	WELD ENDS				
	IN	LB/IN	IN	LB	LB	IN^2	IN	IN	
	MM	KG/MM	MM	KG	KG	CM^2	MM	MM	
3	4	140	40	140	124	30.24	8.625	7.313	A
	203	2.5	1016	64	56	195.05	219	186	
	16	70	73	220	204	30.24	8.625	7.313	
	406	1.3	1854	100	93	195.05	219	186	
4	8	140	41	155	129	30.24	8.625	8.313	A
	203	2.5	1041	70	59	195.05	219	211	
	16	70	74	241	215	30.24	8.625	8.313	
	406	1.3	1880	110	98	195.05	219	211	
5	8	312	45	257	227	53.85	10.750	9.375	B
	203	5.6	1143	117	103	347.33	273	238	
	16	156	82	401	371	53.85	10.750	9.375	
	406	2.8	2083	182	169	347.33	273	238	
6	8	328	45	262	232	53.85	10.750	9.375	B
	203	5.9	1143	119	105	347.33	273	238	
	16	164	82	418	388	53.85	10.750	9.375	
	406	2.9	2083	190	176	347.33	273	238	
8	8	403	45	412	352	87.09	14.000	11.000	C
	203	7.2	1143	187	160	561.73	356	279	
	16	210	77	591	531	87.09	14.000	11.000	
	406	3.8	1956	269	241	39.59	356	279	
10	8	502	48	519	433	128.28	16.00	12.000	C
	203	9.0	1219	236	197	58.31	406	305	
	16	262	80	738	652	128.28	16.00	12.000	
	406	4.7	2032	335	296	58.31	406	305	

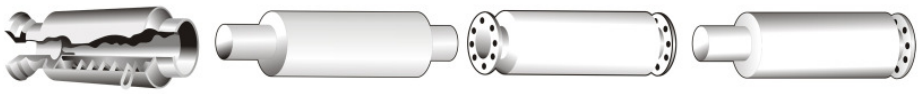
GENERAL NOTES

1. Rated life cycle at 650°F is 1000 cycles for full rated movement shown above.
2. To increase cycle life, please refer to graph on page 93.
3. Expansion joint is capable of taking 10% of rated movement as extension, with remaining 90% as axial compression.
4. Maximum test pressure: 1.5 X rated working pressure.
5. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
6. Maximum installation misalignment is ±1/4-inch axial and 1/16-inch lateral.

MATERIALS

BELLOWS: A240-T304. Alternate materials available upon request. Refer to page 33.
FLANGES: ASTM A105.
150 lb ANSI B16.5 RFSO.
PIPE: ASTM A53/A106.
SHELL: ASTM A53/A106; API-5L.
RINGS: ASTM A285-C.

Double X-Flex 150# Design



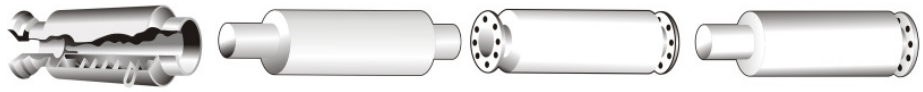
SIZE	AXIAL MOVEMENT	SPRING RATE	O.A.L	WEIGHT		EFF AREA	SHELL O.D.	ANCHOR FOOT HEIGHT	ANCHOR FOOT TYPE
				FLANGED ENDS	WELD ENDS				
	IN	LB/IN	IN	LB	LB	IN²	IN	IN	
	MM	KG/MM	MM	KG	KG	CM²	MM	MM	
12	8	922	49	691	563	180.81	18.000	13.000	C
	203	16.5	1245	314	256	82.19	457	330	
	16	461	87	1041	913	180.81	18.000	13.000	
	406	8.2	2210	473	415	82.19	457	330	
14	8	1010	49	792	612	211.83	20.000	14.000	C
	203	18.1	1245	360	278	96.29	508	356	
	16	505	87	1180	1000	211.83	20.000	14.000	
	406	9.0	2210	536	455	96.29	508	356	
16	8	962	47	950	754	270.20	24.000	16.000	D
	203	17.2	1194	432	343	122.82	610	406	
	16	481	83	1358	1162	270.20	24.000	16.000	
	406	8.8	2108	617	528	122.82	610	406	
18	8	1080	47	1002	742	331.61	24.000	16.000	D
	203	19.3	1194	455	337	150.73	610	406	
	16	540	83	1433	1173	331.61	24.000	16.000	
	406	9.7	2108	651	533	150.73	610	406	
20	8	1196	49	1435	1105	399.31	30.00	19.000	D
	203	21.4	1245	652	502	181.50	762	483	
	16	598	85	1947	1617	399.31	30.00	19.000	
	406	10.7	2159	885	735	181.50	762	483	
24	8	1430	50	1463	1023	533.55	30.00	19.000	D
	203	25.6	1270	665	465	251.61	762	483	
	16	725	86	2025	1585	553.55	30.00	19.000	
	406	13.0	2184	920	720	251.61	762	483	

General Notes

1. Rated life cycle at 650°F is 1000 cycles for full rated movement shown above.
2. To increase cycle life, please refer to graph on page 93.
3. Expansion joint is capable of taking 10% of rated movement as extension, with remaining 90% as axial compression.
4. Maximum test pressure: 1.5 X rated working pressure.
5. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
6. Maximum installation misalignment is ±1/4-inch axial and 1/16-inch lateral.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105. 150 lb ANSI B16.5 RFSO.
Pipe: ASTM A53/A106.
Shell: ASTM A53/A106; API-5L.
Rings: ASTM A285-C.



DOUBLE X-FLEX 300# DESIGN

SIZE	AXIAL MOVEMENT	SPRING RATE	O.A.L	WEIGHT		EFF AREA	SHELL O.D.	ANCHOR FOOT HEIGHT	ANCHOR FOOT TYPE
				FLANGED ENDS	WELD ENDS				
	IN	LB/IN	IN	LB	LB	IN^2	IN	IN	
	MM	KG/MM	MM	KG	KG	CM^2	MM	MM	
3	8	280	40	156	130	30.42	8.625	7.313	A
	203	5.0	1016	71	59.09	13.83	219	186	
	16	140	73	242	216	30.42	8.625	7.313	
	406	2.5	1845	110	98.18	13.83	219	186	
4	8	280	41	179	135	30.42	8.625	8.313	A
	203	5.0	1041	81	61.36	13.83	219	211	
	16	140	74	271	227	30.42	8.625	8.313	
	406	2.5	1880	123	103.16	13.83	219	211	
5	8	662	45	297	241	54.24	10.750	9.375	B
	203	11.8	1143	135	109.55	24.65	273	238	
	16	331	82	457	401	54.24	10.750	9.375	
	406	5.9	2083	208	182.27	24.65	273	238	
6	8	662	45	324	246	54.24	10.750	9.375	B
	203	11.8	1143	147	111.82	24.65	273	238	
	16	331	82	494	416	54.24	10.750	9.375	
	406	5.9	2083	226	189.09	24.65	273	238	
8	8	810	45	484	368	87.58	14.000	11.000	C
	203	14.5	1143	220	167.27	39.81	356	279	
	16	423	77	677	561	87.58	14.000	11.000	
	406	7.6	1956	308	255.00	39.81	356	279	
10	8	931	48	629	467	128.88	16.00	12.000	C
	203	16.7	1219	286	212	58.58	406	305	
	16	504	80	867	705	128.88	16.00	12.000	
	406	9.0	2032	394	320	58.58	406	305	

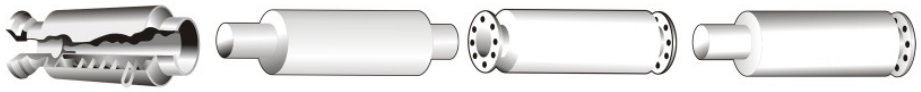
GENERAL NOTES

1. Rated life cycle at 650°F is 1000 cycles for full rated movement shown above.
2. To increase cycle life, please refer to graph on page 93.
3. Expansion joint is capable of taking 10% of rated movement as extension, with remaining 90% as axial compression.
4. Maximum test pressure: 1.5 X rated working pressure.
5. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
6. Maximum installation misalignment is ±1/4-inch axial and 1/16-inch lateral.

MATERIALS

BELLOWS: A240-T304. Alternate materials available upon request. Refer to page 33.
FLANGES: ASTM A105.
300 lb ANSI B16.5 RFSO.
PIPE: ASTM A53/A106.
SHELL: ASTM A53/A106; API-5L.
RINGS: ASTM A285-C.

Double X-Flex 300# Design



SIZE	AXIAL MOVEMENT	SPRING RATE	O.A.L	WEIGHT		EFF AREA	SHELL O.D.	ANCHOR FOOT HEIGHT	ANCHOR FOOT TYPE
				FLANGED ENDS	WELD ENDS				
	IN	LB/IN	IN	LB	LB	IN^2	IN	IN	
	MM	KG/MM	MM	KG	KG	CM^2	MM	MM	
12	4	1854	49	843	613	181.96	18.000	13.000	C
	102	33.2	1245	383	279	82.71	457	330	
	16	927	87	1243	1013	181.96	18.000	13.000	
	406	16.6	2210	565	460	82.71	457	330	
14	8	2028	49	1000	670	213.07	20.000	14.000	C
	203	36.3	1245	455	305	96.85	508	356	
	16	1014	87	1446	1116	213.07	20.000	14.000	
	406	18.1	2210	657	507	96.85	508	356	
16	8	1770	47	1217	837	271.60	24.000	16.000	D
	203	31.7	1194	553	381	123.45	610	406	
	16	885	83	1710	1330	271.60	24.000	16.000	
	406	15.8	2108	777	605	123.45	610	406	
18	8	1986	47	1335	835	333.16	24.000	16.000	D
	203	35.5	1194	607	380	151.44	610	406	
	16	993	83	1861	1361	333.16	24.000	16.000	
	406	17.8	2108	846	619	151.44	610	406	
20	8	2200	49	1841	1211	401.01	30.00	19.000	D
	203	39.4	1245	837	550	182.28	762	483	
	16	1100	85	2458	1828	401.01	30.00	19.000	
	406	19.7	2159	1117	831	182.28	762	483	
24	8	2630	50	2095	1145	555.55	30.00	19.000	D
	203	47.1	1270	952	520	252.52	762	483	
	16	1315	86	2778	1828	555.55	30.00	19.000	
	406	23.5	2184	1263	831	252.52	762	483	

General Notes

1. Rated life cycle at 650°F is 1000 cycles for full rated movement shown above.
2. To increase cycle life, please refer to graph on page 93.
3. Expansion joint is capable of taking 10% of rated movement as extension, with remaining 90% as axial compression.
4. Maximum test pressure: 1.5 X rated working pressure.
5. Bellows rated for 650°F: See page 31 for appropriate flange temperature/pressure ratings.
6. Maximum installation misalignment is ±1/4-inch axial and 1/16-inch lateral.

Materials

Bellows: A240-T304. Alternate materials available upon request. Refer to page 33.
Flanges: ASTM A105. 300 lb ANSI B16.5 RFSO.
Pipe: ASTM A53/A106.
Shell: ASTM A53/A106; API-5L.
Rings: ASTM A285-C.

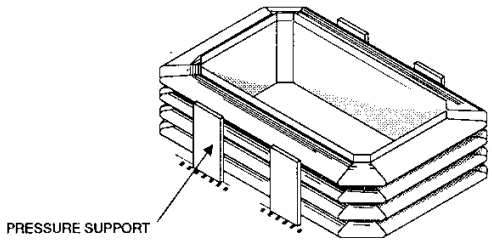
RECTANGULAR METALLIC EXPANSION JOINTS

View online catalog section for rectangular metallic expansion joints: www.usbellows.com/rectangular

Rectangular metal expansion joints have a variety of applications in the power, petrochemical, refining, chemical, and steel industries. U.S. Bellows is fully prepared to service our customer's needs on these applications. Since there are no standardized duct sizes, and due to the wide range of pressure and temperature combinations, each rectangular metal expansion joint is customer engineered to provide the most economical design that will not sacrifice the integrity of the expansion joint or the system in which it is installed.

Like circular expansion joints, rectangular expansion joints absorb three types of movement: axial, lateral and angular. For the purpose of designing rectangular bellows, it is critical to know in which direction the lateral and angular movements will occur, i.e. parallel to the long and/or short side of the bellows. It is important to understand, however, that due to the large sizes that rectangular expansion joints frequently are, lateral deflection of single bellows is often impossible. The proper design for a rectangular bellows for these types of movement is a universal expansion joint, in which two bellows elements connected with a center duct section (centerspool) are used in tandem. Due to the relatively long overall lengths and high costs associated with universal rectangular metal designs, it is recommended that U.S. Bellows' non-metallic expansion joints be considered for applications involving lateral movements, and also those that might possibly involve torsional movements.

Unlike circular bellows where the pressure stress is a circumferential membrane (hoop) stress, the rectangular metallic bellows must be designed for longitudinal (beam) bending stresses. Long unsupported lengths must frequently be supported to prevent excessive deflection and stresses of the bellows element. In certain applications, covers and liners can perform the function of pressure supports.



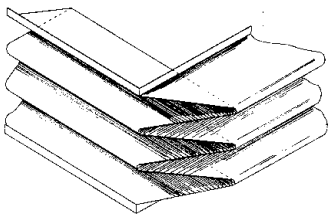
(2) TWO MITER CORNER SHOWN

General arrangement of rectangular expansion joints with supported sides.

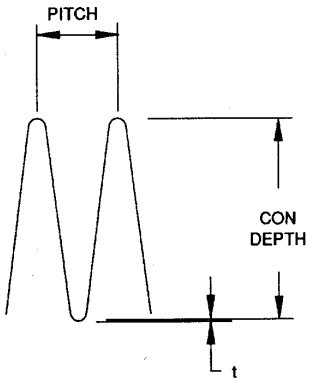
U.S. Bellows designs rectangular metallic expansion joints in accordance with the criteria published in Section C-8 of the *Standards of the Expansion Joints Manufacturers Association*. U.S. Bellows strongly encourages that customer to become familiar with the *Standards of the Expansion Joints Manufacturers Association* when specifying

and purchasing all metallic expansion joints, and require them to be designed and fabricated in full accordance with those standards.

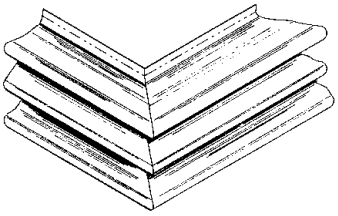
Typical convolution geometries and corner construction details are shown on this page. The "V" convolution profile will be supplied with single miter corners, unless otherwise specified. Round corner bellows will always be constructed using the "U" convolution profile.



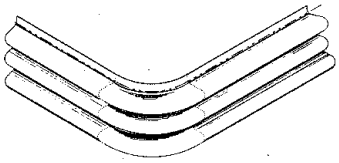
Camera Corner



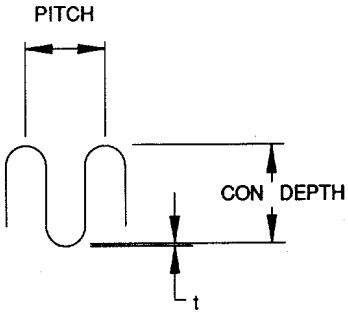
"V" Profile



Single Miter Corner

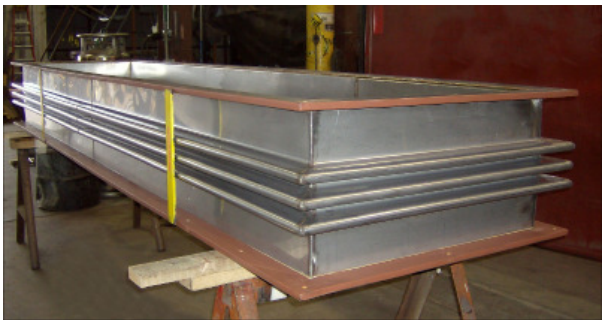


Rounded Corner



"U" Profile

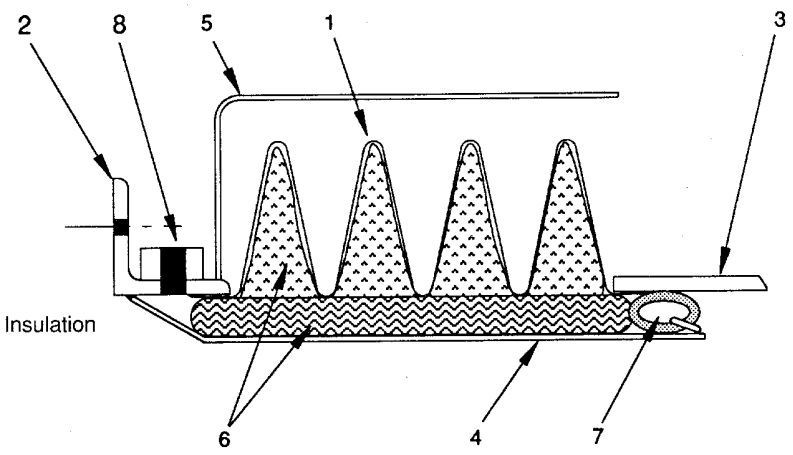
240" x 80" Rectangular Metal Bellows with Round Corners



84" Long Rectangular Metallic Expansion Joint with Mitered Corners

ACCESSORIES

1. Bellows
2. Angle Flange
3. Weld End
4. Liner (Baffle)
5. Cover
6. Particulate Barrier/Insulation
7. Liner Seal
8. Purge



Liners

Internal liners are used to reduce turbulence across the bellows, and to protect the bellows from erosion. They are necessary when particulate barriers and purges are specified. Liners are normally required when ducts are refractory lined, as they become refractory lined as well. Applicable lateral and angular movements should be specified, in order that adequate clearance is provided in the liner design. Flow direction should be specified on expansion joints with combination ends.

Covers

External covers are recommended to protect the bellows from mechanical damage. They may also be utilized for the application of insulation when the ductwork is insulated as well. Covers may be provided in removable and non-removable configurations.

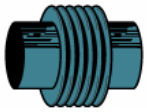
Particulate Barrier/Purge Connections

In systems that have a media with significant particulate content (i.e. fly ash or catalyst), a barrier of ceramic fiber can be utilized to prevent corrosion and restricted bellows flexibility resulting from the accumulation of the particulate. Purging systems may also be used to perform this function. Liners must be installed when a particulate barrier or purge connection is specified.

Hardware

Rectangular expansion joints may come equipped with hinges, tie rods, etc., that can be used to control movements, restrain pressure thrust, or support external loads. This hardware may be installed internally or externally.

View online catalog section for expansion joint accessories: www.usbellows.com/accessories



RECTANGULAR METALLIC EXPANSION JOINT DATA SHEET

Use our online quote form: www.usbellows.com/quote

Customer:		Date:		Page
Project:		Prepared By:		
Applicable Codes and Standards: B31.1, B31.3, Sect 8 Div 1				
Item or Tag Number:				
Quantity:				
Size (Specify inside or outside duct dimensions):				
Orientation (Horizontal/Vertical/Inclined):				
Style or Type (single, universal, hinged, gimbal, etc.):				
Corner Type:				
End Connections	Thickness/Flange Size			
	Material			
Pressure (psi/inches water)	Design			
	Operating			
Temperature	Design			
	Operating			
	Installation			
Media	Media			
	Flow Velocity			
	Flow Direction			
Movements	Axial Extension			
	Axial Compression			
	Lateral (Parallel to Short Side)			
	Lateral (Parallel to Long Side)			
	Angular (Parallel to Short Side)			
	Angular (Parallel to Long Side)			
Materials	Bellows			
	Liner			
	Cover			
Dimensions	Overall Length			
Maximum Spring Rates	Axial			
	Lateral (Parallel to Short Side)			
	Lateral (Parallel to Long Side)			
	Angular (Parallel to Short Side)			
	Angular (Parallel to Long Side)			
Quality Assurance	Bellows Corner Weld			
	Bellows Attachment Weld			

THICK-WALL EXPANSION JOINTS

These may be cost-effective for large-diameter piping systems which operate at low pressure. Metals can be selected to satisfy different temperature conditions. The distribution of axial, angular, and lateral forces will be different when thick-wall expansion joints are used. We can provide your design engineers with the potential forces and movements for proper design of the structural members supporting the system. These joints have a long life which justifies the initial investment. See Figure 1 below

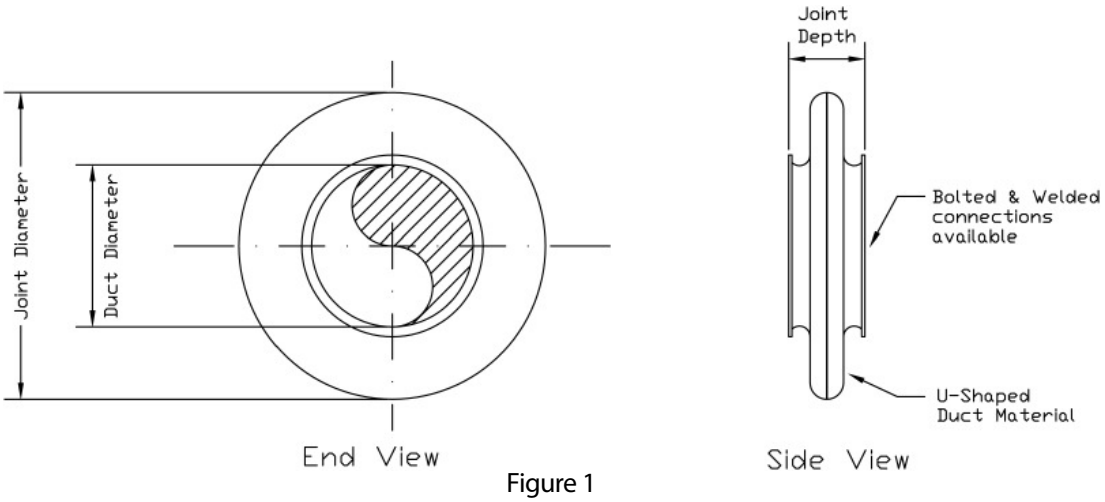


Figure 1

72" Diameter Thick-Wall Expansion Joint Being Shipped to a Sulfuric Acid Plant

View online catalog section for thick-wall expansion joints: www.usbellows.com/thick-wall

SLIP-TYPE EXPANSION JOINTS

These are used when the primary problem is a large axial movement. Materials can be selected to accommodate high temperatures and pressures. Design details include selection of packing and seals and perhaps resistance to abrasive solids. Some applications may require surfaces to minimize abrasive wear. Special features such as "wipers" can be included to prevent potential clogging of the space provided for slip movement. See Figure 2 below

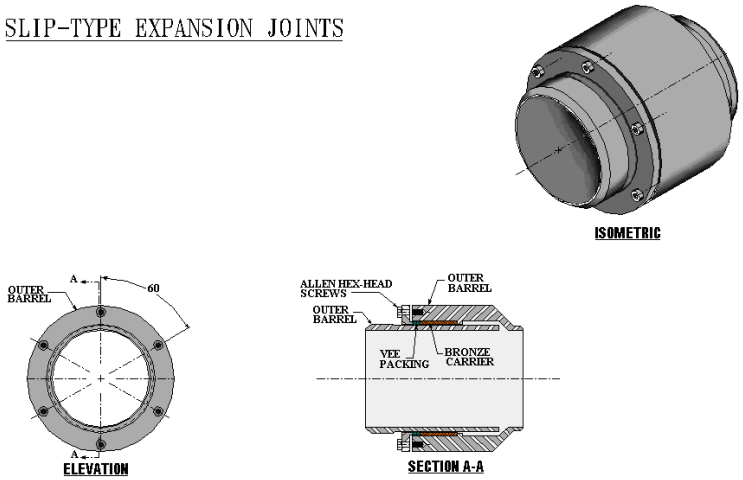


Figure 2

Inside View of a Slip-Type Expansion Joint

30" Slip-Type Expansion Joint

View online catalog section for slip-type expansion joints: www.usbellows.com/slip-type

HINGED EXPANSION JOINTS

Hinged Expansion Joints contain hinges or pivots which allow the unit to bend in a single plane. These units are designed to restrict axial deflection, either in extension or compression. The hinge mechanism is typically designed to accept full pressure thrust. Also, because of the hinge mechanism's design, shear loads, such as from the weight of adjacent piping, can be accepted by this expansion joint, relieving the piping designer of having to provide additional supports and anchors required by the single type.

Some hinge types can be provided with hinge pin holes which are slotted to permit limited axial travel. These "slotted hinge" types will not resist pressure thrust forces, and anchoring must be provided. This catalog only depicts the fully restrained hinged type. If axial travel is desired, the piping designer should clearly state that the slotted hinge type is wanted in the design requirements, and he should provide for pressure thrust anchoring. On the other hand, if the full axial restraint of the hinged type is desired, the piping designer should understand that there is no allowance in the expansion joint for any axial travel, including none for any installation misalignment.

Hinged and Universal Expansion Joints with Refractory Lining

GIMBAL EXPANSION JOINTS

The gimbal expansion joint is basically the same as the hinge type, except that instead of being limited to deflection in only one plane, it can accept bending or angulation in any plane. It contains two sets of hinge pins or pivots, the axis of each set perpendicular to the other. Each set of pins is connected to each other with a central gimbal ring, in much the same way that a universal joint on an automobile works. This unit provides the same type of restraint and resistance to axial forces, such as the pressure thrust, and to shear forces as the hinge type.

Gimbal Metallic Universal Expansion Joint

REFRACTORY-LINED EXPANSION JOINTS

Depending on the temperature, pressure, movement and flow media conditions, refractory-lined expansion joints can be hinged, in-line pressure balanced, gimbal, tied-universal and can also include pantographic linkage. For hot applications (up to 1400°F), the bellows is packed with KO wool and lined with insulating refractory.

The refractory lining allows for the use of carbon steel pipe instead of 300 series stainless steel. It can reduce the pipe wall temperature to between 300-450°F and also protect the bellows from abrasion caused by the flow of abrasive particles. Refractory lined expansion joints are used in Fluid Catalytic Cracking Units (FCCU), furnaces, hot gas turbines, styrene plants, fluidized bed boilers, kilns, power recovery trains and thermal oxidizers. Refractory-lined expansion joints are custom designed for each application due to the extreme environments.

Universal Expansion Joint with Refractory Lining

Close Up of Refractory Lining for a FCCU Expansion Joint

Refractory-Lined Expansion Joint about to be Shipped

FABRIC EXPANSION JOINTS

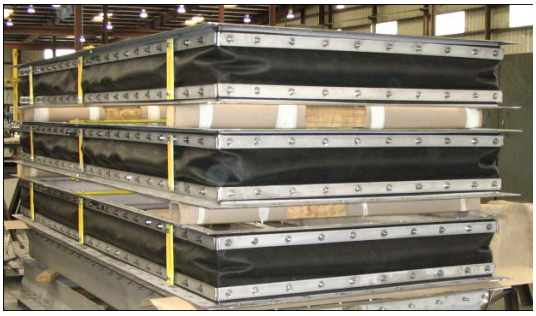
These are often used in ducts which carry hot gases at low pressures. The major design parameters are the temperatures and flow rates of the gases and the amount and abrasiveness of solids suspended in the gases. Layers of different fabrics, insulation, and metal foils can be combined to accommodate the temperatures and pressures in the system. The fabric belt may need to be replaced periodically.

DUCT EXPANSION JOINT

(Low Temperature)

128" x 129" Rectangular Fabric Expansion Joints

68" Long Air Duct Fabric Expansion Joint



Fabric Expansion Joints for a Gas Turbine Power Plant

Rectangular & Round					
Pressure:	3 p.s.i. (Max.), Positive Pressure only				
Temperature:	400° F (Max.) -- 40° F (Min.)				
Movements:	Flange-to-Flange Dimension				
	10"	12"	14"	16"	18"
Axial Compression	1/2"	1"	1 1/2"	2 1/2"	3"
Axial Extension	1/2"	1/2"	1/2"	1/2"	1/2"
Lateral offset	1/4"	1/2"	3/4"	1"	1"

View online catalog section for fabric expansion joints: www.usbellows.com/fabric

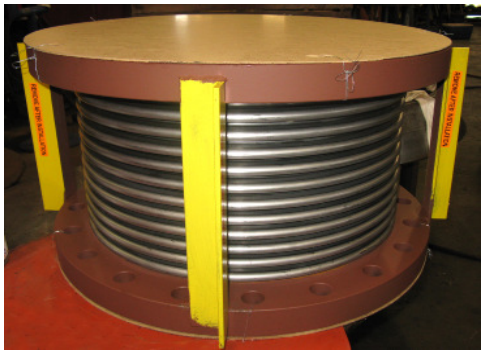
DUCT EXPANSION JOINT

(High Temperature - Up To 1200° F)

24" Diameter Fabric Expansion Joints for a Hot Air Blower

Rectangular & Round					
Pressure:	3 p.s.i. (Max.), 27" H_2O (Vacuum Max.)				
Temperature:	600° F (Max.), -- 40° F (Min.) specify				
Movements:	Flange-to-Flange Dimension				
	10"	12"	14"	16"	18"
Axial Compression	1/2"	3/4"	1 1/4"	1 1/2"	2 "
Axial Extension	1/2"	1/2"	1/2"	1/2"	1/2"
Lateral offset	1/4"	3/8"	1/2"	3/4"	1"

PRODUCT SHOWCASE



Single Flanged Expansion Joint for an Exhaust Duct

This single flanged metallic expansion joint was manufactured from 304 stainless steel bellows with carbon steel flanges. It has a diameter of 200" and an overall length of 150". It will be used in an exhaust duct application in a power plant. A hydro-test was performed prior to shipping to Orlando, Florida.

76" Diameter Single Expansion Joints with Refractory Lining

U.S. Bellows, Inc. fabricated several expansion joints composed of 321 stainless steel and A588-A COR-TEN angle flanges. The expansion joints measure 76" in diameter and have an overall length of 27¾". Each expansion joint is also lined with 4" thick refractory lining. The bellows long seams were 100% x-rayed and dye-penetrant tested. The bellows will be used in flue gas service associated with a clean fuels project at an oil refinery.

Same-Day Turn Around Service by Refurbishing an 8" Single Expansion Joint for an Emergency Shutdown

U.S. Bellows, Inc. received this single expansion joint in the morning, refurbished it by adding new bellows and limit rods, and then shipped it the very same day. The existing expansion joint had 321 stainless steel bellows with a 1,500 lb. flange on one side and a 150 lb. flange on the other side. U.S. Bellows, Inc. manufactured new 321 stainless steel bellows and reused the existing flanges by sandblasting and then painting them for protection. Same day delivery enabled the customer to resume operations with minimum loss of time and production.

18" Single Expansion Joints for an Offshore Oil Platform in Korea

These expansion joints measure 18" in diameter x 11" in overall length. Each expansion joint is fabricated with 300 lb. stainless steel raised face slip on flanges. The liner, cover, and tie-rods are fabricated from 316L stainless steel. The design pressure is 403 PSI, and the design temperature is 200°F. Dye-penetrant tests, hydro-tests at 604 PSIG, and 100% x-ray tests of the bellows' longitudinal weld seams were performed to assure quality.

PRODUCT SHOWCASE

Single Tied Metallic Expansion Joints with Two-Ply Alloy Bellows

This single tied metallic expansion joint was designed with two-ply alloy bellows for a design pressure of 243 PSIG at 108°F. The expansion joint has an axial compression of 0.020" and a lateral movement of 0.200". The axial spring rate is 13,320 lb./in. and the lateral spring rate is 121,202 lb./in. The bellows and flanges were 100% x-ray tested and the bellows were 100% dye-penetrant tested for quality before being shipped to the customer.

Flanged Expansion Joints for a Thermal Power Plant

These 6" and 8" in diameter flanged expansion joints were shipped to the customer a month ahead of schedule. The bellows are stock 321 stainless steel and the flanges are 150 carbon steel. They can take 1.22" axial deflection, plus or minus 0.26" lateral deflection and are designed to handle temperatures ranging from -24˚F to 800˚F. These expansion joints are rated up to 150 PSI and come equipped with an internal flow liner to allow for smooth fluid flow. They were 100% dye-penetrant tested and air & soap bubble tested to ensure quality.

18" Expansion Joints that Required Helium Leak Testing

This order required custom engineering to design and manufacture these expansion joints due to their critical service condition requirements. U.S. Bellows manufactured and tested these expansion joints to the customer specifications, EJMA Standards and U.S. Bellows quality standards. The expansion joints were designed for a pressure of 176 PSIG at 500˚F. The axial extension is .5" and the axial compression is 1.5." The 18" expansion joints were fabricated from 304 stainless steel with specially designed and machined flange faces with a gasket groove. Each expansion joint was helium leak tested and 100% x-rayed and dye-penetrant examined.

5 Expansion Joints for a Heat Exchanger Company in Japan

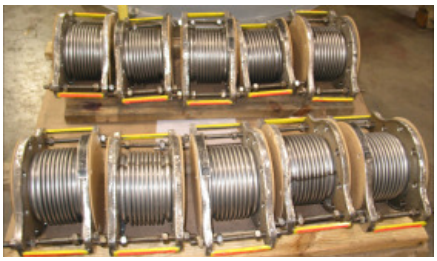
These expansion joints were fabricated from ASTM-A-240 Type 321 stainless steel bellows and liners. The shell material is ASTM-A-516 Grade 70. They are 32" diameter with an overall length of 26". Each joint weighs 280 lb. They were designed for 150 PSIG at 650˚F with a travel capacity of 0.33" axial compression and 0.08" lateral deflection. They absorb differential expansion between the shell side and tube side of a heat exchanger. They were hydrostatically tested to 208 PSIG to comply with the Japanese code, Ministry of Health, Labor and Welfare (MHLW) and the ASME Pressure Vessel Codes.

PRODUCT SHOWCASE

Single Expansion Joint Assembly for an Oil Refinery in South Africa

This single expansion joint assembly was fabricated with a single-ply 304 stainless steel bellows, and carbon steel pipe, miter bends, and limit rods. It measured 12 feet 2 inches from the center to center of the elbows. These bellows were designed with a low spring rate to meet the allowable forces and movements on the compressor inlet nozzle. All welds were air tested and spot x-rayed to assure quality and performance. This unit was completed in 3 weeks to meet the customer's construction schedule.

188 Single Tied Expansion Joints for a Construction Company



These products are single tied expansion joints with 150 lb. flange drilling. They were fabricated completely of 316 stainless steel. They range in size from 6" to 18" in diameter and weigh between 40 lb. to 140 lb. each. Their travel capacity ranges from 0.88" to 1.2" at 25 PSIG and 180°F. The expansion joints are used in a water treatment piping system facility. The bellows longitudinal and attachment weld seams were 100% dye-penetrant examined. The expansion joints were pneumatically tested at 15 PSIG for performance and quality assurance.

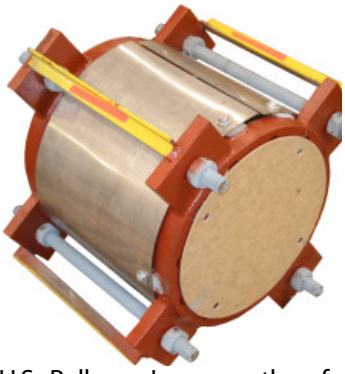
14 Single Reinforced Metal Expansion Joints

These single reinforced expansion joints with equalizing rings are used in heat exchangers. The bellows are fabricated from ASTM B 443 Inconel® 625 LCF. The weld ends and the reinforcing rings/root rings are carbon steel. The expansion joints are 52" and 57" diameter with an overall length of 15 ½" and 16 ½". They are capable of moving 0.6" in extension at 158 PSIG at 300°F. The units were fabricated to ASME Section VIII. The bellows and pipe longitudinal weld seams were 100% x-rayed. In addition, they were 100% dye-penetrant examined and hydrostatic tested to 205 PSIG.

4 Convolution Expansion Joints for an Oil Company in India

This high pressure expansion joint is a single four convolution SB-443 INCO 625LCF bellow with 3 equalizing rings, 2 neck bands, 1 internal liner and 2 weld ends all fabricated from SA-240 type 347 stainless steel. The equalizing rings enable the joint to withstand a maximum allowable pressure of 1,170 PSIG at 815°F. The equalizing rings allow the use of a thinner more compact and flexible bellow thereby saving space and increasing the expansion joint cycle life. It is 14.25" long with a calculated cycle life of 772 cycles.

PRODUCT SHOWCASE

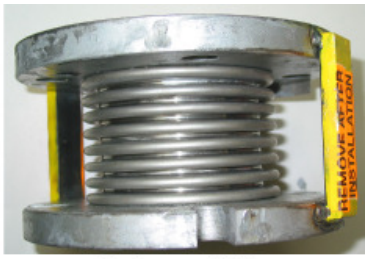


Single Tied Expansion Joints for an Oil Refinery

This single tied expansion joint was designed to withstand 400 PSIG and 200°F. The bellow was manufactured using B443 material (Inconel® 625) with a 300 lb. carbon steel flange. It measures 8" x 16" with 3/16" lateral movement. Pressure testing and 100% dye-penetrant tests were performed to ensure quality. The final product was shipped to a customer in Bakersfield, California.

Immediate Refurbishment of a 3" O.A.L Single Bellows

Failed Bellows

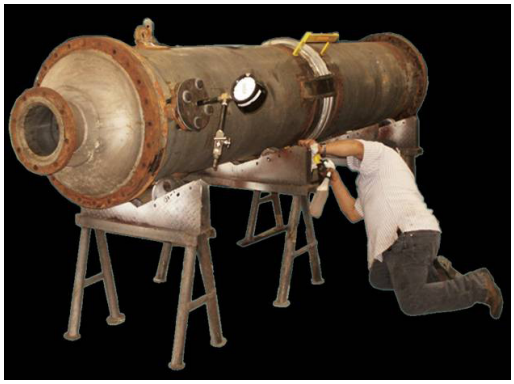


Replacement Bellows

U.S. Bellows, Inc. recently refurbished a 3" O.A.L. single bellows with flanges for a marine vessel in Texas. Within a two day span, the replacement bellows was fabricated, welded to the existing 5/8" flanges, and shipped to the marine vessel to resume operation. The replacement bellows, fabricated from 321 stainless steel, is designed for 150 PSIG and 800°F with 0.66" of axial movement. To ensure quality, a 100% dye-penetrant test and a soap leak test were performed prior to delivery.

Clamshell Bellows for a Shell and Tube Heat Exchanger

This clamshell bellows was fabricated for a shell and tube heat exchanger. The clamshell bellows is designed and fabricated per ASME VIII Div. 1 appendix 26. It has a 14" diameter and was designed at 150°F and 150 PSIG. In order to detect any leaks, prior to and following forming, the heat exchanger and its welds were subjected to a series of tests such as the dye-penetrant test (100%), x-ray test (100%) and air test.



Three-day Emergency Fabrication of a 40" I.D. Expansion Joint

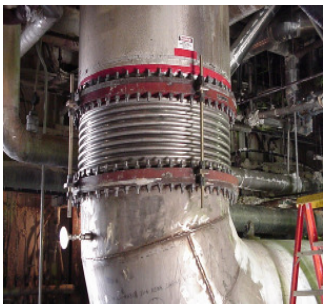
Within a three day span, this 40" I.D., single coded, clamshell expansion joint was fabricated for a chemical plant in Beaumont, Texas. Following contact by an employee at the plant, the U.S Bellows' on-call team was immediately paged. Three days later, the bellows had been successfully fabricated, welded to an A516-70 heat exchanger shell and shipped to the chemical plant to resume operation. The bellows was fabricated from A240 tp 321SS and designed at 50 PSIG and 750°F. In order to detect any leaks in the weld, the bellows' long seam weld was 100% x-rayed and the unit was 100% dye-penetrant tested.

PRODUCT SHOWCASE

10" Single Tied Titanium Expansion Joints

These 10" single tied titanium expansion joints were manufactured to be utilized in a chemical plant in Kingsport, Tennessee. These single expansion joints are bellows elements with end connections that allow movement in any direction or plane. However, the piping must also be guided in the same direction of the movement. The tie rods restrain the full pressure thrust. They were 100% dye-penetrant examined before being shipped to the customer.

Emergency Order for a 48" Diameter Expansion Joint



U.S. Bellows, Inc. rushed to an emergency call of an Alaskan petroleum firm. The firm called upon U.S. Bellows' 24 x 7 Quick-Turn/Emergency service to aid them in the immediate replacement of a defective, 48" diameter expansion joint when their G417 Pump failed suddenly during the plant startup. U.S. Bellows received the emergency call on Friday at 5:30 p.m. It was built and shipped to the location on the same day. On Sunday, the expansion joint was installed at the customer's location.

66" Hinged Expansion Joint Designed for Gas Service

This single hinged expansion joint was designed for sulphur dioxide service in a sulphuric acid plant. It was fabricated with 321 stainless steel bellows and liner, and A-516 GR 70 carbon steel hinge plates and pipe. The pipe has a 66" outside diameter and 35-1/4" overall length. The expansion joint was designed for 6° angular movement and 3 PSIG at 680°F. The bellows and pipe long seams were 100% x-rayed, and all the welds were 100% dye-penetrant tested. A soap and air test at 15 PSIG was conducted prior to shipment.

24" Universal Hinged Expansion Joint

This universal hinged expansion joint includes elbows on both ends for an overall length of 125 5/8". It is designed with Inconel® 625 bellows, a 304 stainless steel liner, and carbon steel 150 lb. flanges. The hinges allow for up to 5 degrees of angular movement. The longitudinal weld seams were 100% dye-penetrant examined prior to being formed. The expansion joint was hydro-tested at 188 PSIG.

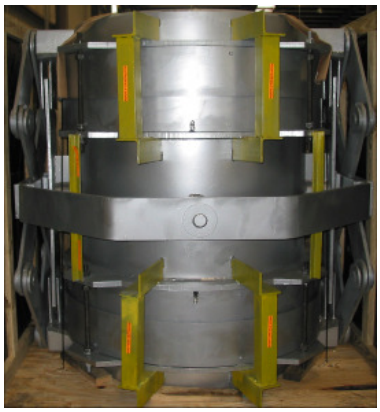
PRODUCT SHOWCASE

Hinged and Universal Expansion Joints with Refractory Lining

U.S. Bellows, Inc. designed and fabricated refractory lined single-hinged and universal expansion joints for a design pressure of 75.4 PSIG and 1400°F temperature. Each expansion joint was 100% x-ray tested along the weld seams and pneumatically tested to 83 PSIG.

48" Diameter Refractory Lined Expansion Joint for a Chemical Plant in Ecuador

This refractory lined expansion joint was designed with pentographic linkages for a chemical plant. It was designed for 60 PSIG and 1450°F with a 4" thick refractory installed per UOP specifications. The bellows was constructed from SB-443 Inconel® 625, and the weld ends, hinges, pantographic linkages, and floating ring were made from A516-70. The bellows, weld ends, and spool long seam welds were 100% x-rayed and 100% dye-penetrant tested per ASME standards. A pneumatic test was performed at 15 PSIG for the entire expansion joint assembly prior to shipping.



24" In-line Pressure Balanced Expansion Joint

U.S. Bellows, Inc. fabricated three 24" in-line pressure balanced expansion joints for a petrochemical plant in Venezuela. In order to absorb partial axial and lateral movements, these expansion joints were designed at 175 PSIG and 610°F. The bellows are composed of Inconel® 625LCF material and the flanges and liners are constructed from SA516 Grade 70 material.

26" Diameter Pressure Balanced Elbow Expansion Joint

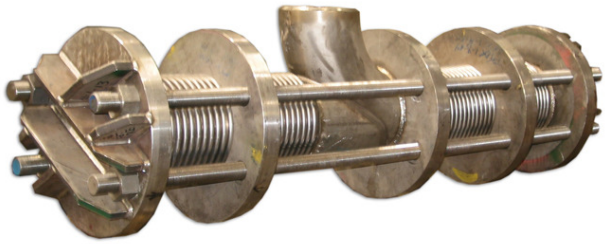
This 26" diameter pressure balanced elbow expansion joint was received for a complete refurbishment. New SA-240 type 321 stainless steel bellows were used to replace the original bellows, and the tie rods and flow liners were also replaced. All carbon steel parts were painted with a universal primer. This expansion joint measures over 17 feet long center to center of elbows, and is currently being used in an effluent header at Cedar Bayou plant.

PRODUCT SHOWCASE

60" Diameter Universal Pressure Balanced Elbow Expansion Joint

This universal pressure balanced elbow expansion joints was fabricated with 304 stainless steel bellows and carbon steel reinforcing root rings. The expansion joint was designed for an axial compression of .25", extension of .75", and lateral of 1". It has an overall length of 237" from center line or elbow to face of the weld end. All expansion joints were designed for 100 PSIG and hydro-tested at 150 PSIG.

8" Diameter Pressure Balanced Expansion Joint



This 770 lb. pressure balanced expansion joint was designed for a company in Ohio. The expansion joint, designed for 450 PSIG and 1350°F, will be used for wind tunnel testing of airplanes and engines. With an overall length of 70 ", it consists of four 8 " diameter bellows with 3 plies of Inco 625 Gr1 material, an 8" diameter Inco 800 HT elbow, four 74 A193 B8 tie rods, and four 2" thick A240 tp304H rings. To ensure quality, 100% x-ray and 100% dye-penetrant tests were performed on the bellows. A pneumatic test at 550 PSIG was conducted on the entire assembly prior to shipping.

Elbow Pressure Balanced Expansion Joints for a Power Station in Canada

These joints are designed at 150 PSIG and 450°F to allow lateral and axial movements in a 42" steam line. The expansion joints were designed and fabricated per EJMA and B31.1 code. The expansion joints were hydro-tested at 225 PSIG and 75°F. In order to detect any leaks in the weld, prior to and following forming, bellows long seam welds and attachment welds were 100% dye-penetrant tested. The expansion joints were shipped to a power station in Canada.

72" Universal Pressure Balanced Expansion Joint

This 72-inch universal pressure balanced expansion joint was designed for a chemical plant in Pasadena, Texas. The expansion joint is designed for 30 PSIG at 200°F and full vacuum. All materials in the "wetted surface" are TP-316/316L stainless steel. Design movements are 3-inch axial compression and 5 ¾ -inch lateral offset. The assembly is approximately 24-feet long and 14,150 lb.

PRODUCT SHOWCASE

30" Spent Catalyst Standpipe Metallic Expansion Joint with Pantographic Linkage

This 30" spent standpipe catalyst metallic expansion joint was fabricated for a refinery in Montana. The overall installed length of the expansion joint is 89". The design pressure was 19 PSIG and the design temperature was 1050°F. The expansion joint is fabricated entirely from 321 stainless steel, except for the carbon steel flanges to match the existing nozzle material and drilling. The assembly is lined with abrasion resistant refractory which prevents erosion of the 321 stainless steel piping. The pantographic linkage, shown in the photo, is designed to distribute the axial compression between the two bellows and support the weight of the center pipe between the bellows.

80" Refractory Lined Tied Universal Expansion Joint

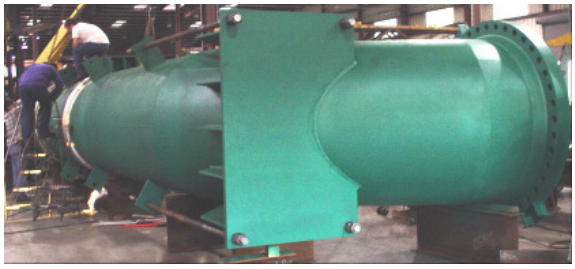
This 36'-0" long refractory lined tied universal expansion joint weighs 54,000 lb. and has two-ply Inconel® 625 LCF bellows, tie rods, slotted hinges, insulation bags and liner seals. It is designed to operate at 58 PSIG and temperatures up to 1,450°F. The expansion joint was preset for 6" lateral travel and is capable of lateral travel up to 13".

60" Diameter Tied Refractory Lined Universal Expansion Joints

These refractory lined universal expansion joints were fabricated for a carbon monoxide ducting system at a chemical refinery. The expansion joints are lined with a 3/4" thick abrasion resistant refractory lining with hexagonal mesh reinforced anchor. A240 TP 304 material was used to fabricate the bellows and flanges and A240 TP 310 material was used for the spool. Designed for 2 PSIG, the joints were air tested at 5 PSIG to ensure quality. A dye-penetrant test was also implemented on the bellows' long seam and attachment welds. These expansion joints were fabricated and designed per B31.3 and EJMA standards.

60" Diameter Double Hinged Refractory Lined Expansion Joint

This expansion joint with an overall length of 40'-0" has a 4" thick refractory lining installed per UOP specifications. It also consists of testable two plies SB-443/Inco 625LCF bellows, 5/8" thick, A516-70 mitered elbows, 5/8" thick, A516-70 spool, A240-304 liners, A516-70 hinges, A193, GR 7 tie rods, and A516-70 lugs. It was designed for 50 PSIG and 1440°F with 3" of lateral movement per B31.3 and EJMA standards. A 100% x-ray and 100% dye-penetrant tests and a pneumatic test at 75 PSIG were conducted on the assembly prior to shipping.



PRODUCT SHOWCASE

55" O.D. Refractory Lined Universal Gimbal Expansion Joint

Two 55" O.D. refractory lined universal gimbal expansion joints were custom designed for a refinery in Joliet. They are equipped with slotted hinges with an overall length of 163" and 286" respectively. The 163" O.A.L. expansion joint, designed for 60 PSIG and 1020°F, will be used at the reactor stand pipe of the refinery. The 286"O.A.L. expansion joint will be used for the regenerator stand pipe of the refinery and it is designed for 57 PSIG and 1300°F. Both expansion joints consist of a A516 Gr70 pipe, two SB-443 two-ply bellows and a slotted hinge. To ensure quality, 100% dye-penetrant, 100% x-ray and pressure tests were performed on the bellows. Pneumatic and vacuum tests were also conducted on the assemblies and between bellows dry plies prior to shipping.

44" Universal Refractory Lined Expansion Joint

U.S. Bellows, Inc. specially designed and fabricated a 44-inch, O.D Universal, refractory lined expansion joint for a chemical plant in Venezuela. The expansion joint was designed for 100 PSIG at 1,000°F and fabricated with 321 SS two-ply tested bellows, A-387 GR11 weld ends, 14 Ga. 304 SS, Hexmesh anchoring system and Resco 17 EMC refractory. The expansion joint was also designed and fabricated per B31.3 and EJMA Standards.

Stainless Steel Expansion Joint for Catalytic Cracker Application

The expansion joint that is being prepared for shipping at right is a stainless steel, universal expansion joint. This unit was refractory lined before being shipped to a refinery for installation in their piping system for a catalytic cracker application.

92" I.D. Toroidal Bellow Expansion Joint for an ASME "U" Stamp Heat Exchanger Shell

The toroidal shape gives the bellow the unique ability to carry high pressures; conversely, it also permits modest deflection ability. The expansion joint was designed for 400 PSIG at 500°F and an extension stroke of 5/16" and the bellows' element was fabricated from .060" Inconel® 600 with A-516 gr 70 weld ends. The 92-inch toroidal expansion joint was also designed per ASME Sec. VIII rules as well as the Expansion Joint Manufacturer EJMA Standards. Upon fabrication completion, a hydrotest was conducted at 600 PSIG to detect leaks.

PRODUCT SHOWCASE

48" Diameter, Thick-Wall Expansion Joint for a Refinery

This 48-inch diameter thick-wall expansion joint was fabricated for a refinery in Louisiana. The joint was fabricated from carbon steel with a 1/8" minimum thickness. It is designed for an axial force of 2,500 lb./in. with a 1.15-inch axial deflection and a lateral force of 30,000 lb./in. with a 0.002-inch lateral deflection.

5' x 22' Thick-Wall Tied Universal Expansion Joint

This 5' x 22' stainless steel, thick-wall, tied, universal expansion joint was designed and manufactured for a major producer of agricultural chemicals in Louisiana. A special in-house CAD program was utilized in the design effort for these expansion bellows to meet the process parameters. Also, special guides and anchors were provided to facilitate proper operation of this critical unit within the system.

72" Diameter Thick-Wall Expansion Joint

The 72" diameter thick-wall expansion joint pictured at left is for SO2 service. It has 8 3/16" thick, 10 1/2" high 304H bellows to allow 4" of axial compression and 2 1/2" of lateral deflection. These thick-wall joints are designed with indefinite cycle life.

12' Diameter Thick-Wall Duct Expansion Joint

A twelve foot diameter 304 stainless steel thick-wall duct expansion joint is shown supported and braced ready for shipment. Special equipment had rolled the knuckles from ¼" material which is then circumferentially welded. This results in an expansion joint with the minimum stresses possibly exerted and, at the high point of the convolution, its most vulnerable area.

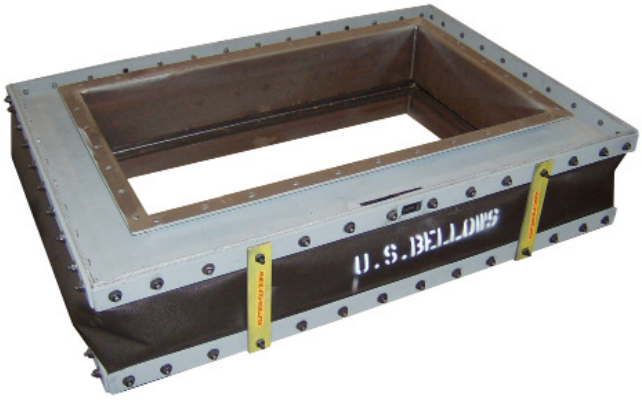
PRODUCT SHOWCASE

Thick-Wall Expansion Joints for Texas Refinery

The three pictures at right show thick wall expansion joints being installed in a Texas refinery. Workers are covering the expansion joints with insulation, and then covering the insulation with aluminum. The 72" expansion joints, which are fabricated from 1/4" carbon steel plate, have a 10" convolution.

Thick-Wall Expansion Joint

The photograph at left shows thick wall expansion joints. Thick wall joints are cost effective for large diameter piping systems which operate at low pressures. Metals can be selected to satisfy different temperature conditions and combinations of axial, angular and lateral forces.

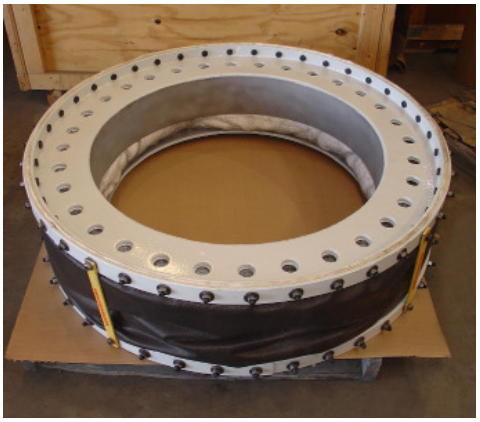


Rectangular Fabric Expansion Joint

The frame and liner of this rectangular fabric expansion joint are fabricated from 304 stainless steel. The three layer fabric belt consists of an inner layer of silica cloth, a middle layer of mineral wool and an outer layer of PTFE/ coated fiber glass. Dye-penetrant examination was performed on all welds of the expansion joint's frame prior to shipping.

36" x 10" Face-to-Face Fabric Expansion Joints

This 36" diameter fabric expansion joint, with a three layer fabric belt, includes 150 lb. flat face flanges with carbon steel backing bars and liner. The fabric belt consists of silica fabric, fiberglass fabric and mineral wool insulation.



PRODUCT SHOWCASE

60" Ductwork and a Fabric Expansion Joint

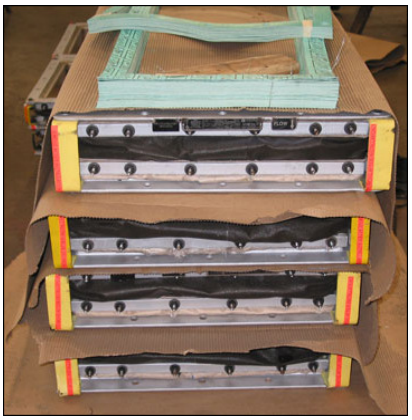
This fabric expansion joint is furnished with acid resisting fabric and also a duct work measuring 34' long and 60" in diameter which was fabricated from ASTM A 516GR 70 carbon steel. The expansion joint was completed within 6 weeks in time for a plant shutdown. A computerized pipe stress analysis, utilizing the Caesar II stress program, was performed to obtain the forces and moments imposed on the equipment nozzles and weights to be carried by the spring supports.

3 Fabric Expansion Joints for a Power Company in Texas

These fabric expansion joints are made of a stainless steel liner, flanged ends, backing bars, and Nomex® Fabric Cloth. They weigh between 370 lb.–380 lb. and measure 81.15" long, 18.44" wide, and 16" high. They are used in high temperature air ducts to allow for expansion. Its thermal growth consists of +/- 1/8" X-Y-Z directions. It is capable of withstanding 400°F at +/- 0.8 PSIG at a maximum flow of 130,650 ACFM. Standard testing was performed for quality assurance.

17 Fabric Expansion Joints for a Gas Turbine Power Plant

These rectangular fabric expansion joints measure 136"x 54"with a weight of 135 lb. each. They were fabricated out of fiberglass fabric with stainless steel frames and are designed for ± 5 PSIG and 400°F. The expansion joints were manufactured according to specific customer specifications.



48 Multi-Layer High Temperature Rectangular Fabric Expansion Joints

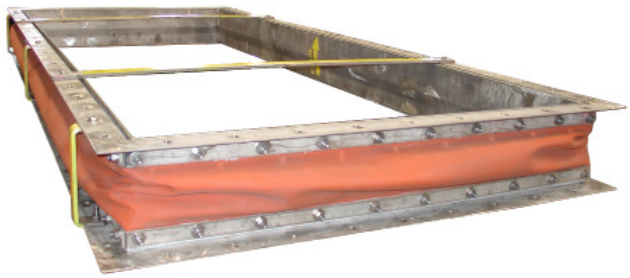
These rectangular fabric expansion joints consisted of two carbon and stainless steel frames separated by a high temperature Silica fabric. The frames measured 13" × 37" × 6", 14½" × 20½" × 6" and 17¼" × 17¼" × 4" and weighed 90, 115, and 170 lb. Each expansion joint was designed for a 15"Water Column (W.C.) with a temperature of 750°F and allowed for movement ranging from ±½" to ±1" in both the axial and lateral directions.

PRODUCT SHOWCASE

54" x 136" Fabric Expansion Joints for a Power System Company

These 17 rectangular fabric expansion joints were custom designed and fabricated for a company in Texas. The expansion joints measure 54" x 136" and weigh 135 lb. each. They are designed for operation up to 5 PSIG and temperatures up to 400˚F. The expansion joints are made of fiberglass fabric and have stainless steel frames.

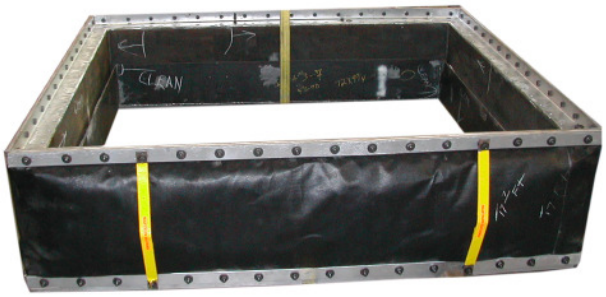
Fabric Expansion Joints for Power System Company in Texas

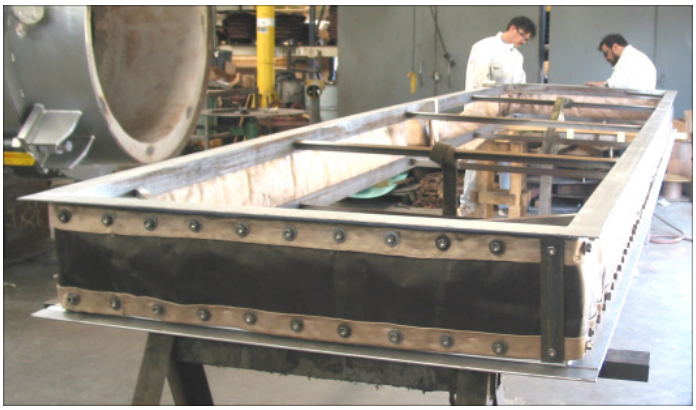


These expansion joints range in size from 30" to 62" in diameter and the rectangular expansion joints measure 81" x 18" and 136" x 54". They are designed to operate from 0.8 to 5 PSIG and in temperatures ranging from -40˚F to 400˚F. The products were fabricated using neoprene and fiberglass fabric with carbon and stainless steel frames. A special paint system was applied per customer's request.

78" x 39" Rectangular Fabric Expansion Joint

This 315 lb. 78" x 39" multi-layer fabric expansion joint was designed for a power company in Texas. This fabric expansion joint will be mounted inside a turbine enclosure and allows for a 15,000 cfm air flow through the enclosure. It is designed for 27 1/2"W.C. and 930°F with 0.27" axial and ± 0.12" lateral movements. The expansion joint is equipped with a stainless steel frame and a 6" thick insulated pillow which is enclosed in a stainless steel woven wire mesh.



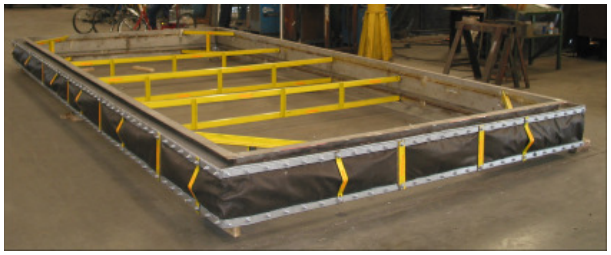


5" x 12" Fabric Expansion Joint

This 5'–0"x 12'–0" fabric expansion joint was designed and manufactured for a hot air ducting system in a power plant in Tulsa, OK. It is designed at 15"W.C. and 600°F for 3/4" axial movement and 1/2" lateral movement. The fabric belts are composed of three layers with the outer layer serving as a waterproof barrier.

PRODUCT SHOWCASE

Rectangular Fabric Expansion Joint for Coal Fired Power Plant



This 21′ x 14‴ expansion joint was designed at 1 PSIG and 1200°F for an air duct at the power plant. The frame is all A-240 and 304 stainless steel construction. This expansion joint is equipped with 6″ thick insulation pillows. Telescoping liners hold the insulation pillows between the liner and the fabric belt to reduce heat transfer and prevent ash accumulation.

87 Fabric Expansion Joints for a Furnace Application

U.S. Bellows, Inc. manufactured 87, rectangular fabric expansion joints for a furnace application at a chemical plant in Texas. The joints were designed at 11″ W.C. and 750°F for ½″ axial and lateral movements. The fabric belts on these joints are composed of three layers. They were equipped with a telescoping liner and 2″ thick insulation pillows to reduce the heat transfer.

Fabric Expansion Joints Up to 32' x 12'

These expansion joints reach sizes up to 32′ x 12′ for a power station in New York. The largest of the expansion joints that are to support the air ducts of the power station, was designed at 32′ x 12′, while the others measured at 10′ x 12′. The expansion joints were fabricated with high temperature fabric belts and 4″ thick insulation pillows. The design conditions were at 30″ WC and 950°F.

12' x 30' x 12" High Temperature Fabric Expansion Joint

This expansion joint was fabricated with a 3-layered fabric belt, A516 Gr. 70 telescoping liners / frame and insulation pillows. It was designed at 650°F and 30″ WC for 1/2″ compression and 1/4″ lateral. This expansion joint will be installed in an exhaust system at a power plant in New York. EJMA standards, Fluid Sealing Association standards and B31.3 code were used in the design and fabrication of these joints.

PRODUCT SHOWCASE

Fabric Expansion Joint for Duct System

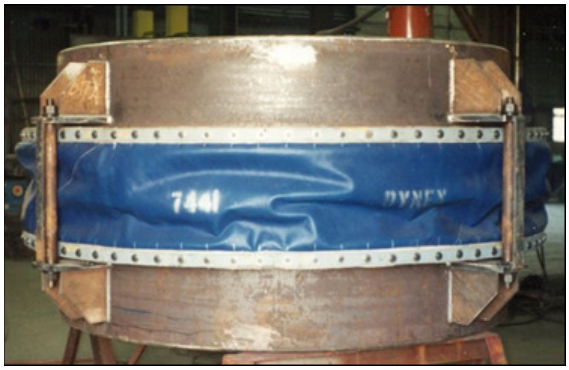
The photograph at left shows a fabric expansion joint designed and built for installation in a duct system. These joints can be fabricated from a variety of metals, in a variety of shapes, depending on the particular application. They are used where ducts carry hot gases at low pressures. The fabric "belt" is a combination of layers of different materials selected to withstand the high temperatures.

Replacement Fabric Expansion Joint for a Methanol Plant

The photograph at right shows rectangular expansion joints being prepared for shipment to Russia. These were fabricated to replace units in a methanol plant duct system. The fabric belt is constructed of layers of material selected to handle the hot gases at low pressures. The frames can be fabricated from a variety of metals in a variety of shapes depending on the particular application.

High-Temp Fabric Expansion Joint

This high-temperature fabric expansion joint was designed and manufactured by U.S. Bellows, Inc. The fabric "belt" is attached between two short sections of pipe. These expansion joints are inserted in metal pipes which carry hot gases at low pressures. Layers of different materials are selected to make a belt which will function at the high temperatures required.



84" Long Rectangular Metallic Expansion Joint

This rectangular metallic expansion joint measures 22" x 84" x 11" face-to-face and is fabricated from 316 stainless steel bellows and carbon steel flanges. This expansion joint is designed to absorb axial compression in a hot air duct system to a fan inlet. The bellows have three convolutions with mitered corners. The unit was 100% dye-penetrant examined and soap and air tested prior to being shipped to a power plant.

PRODUCT SHOWCASE

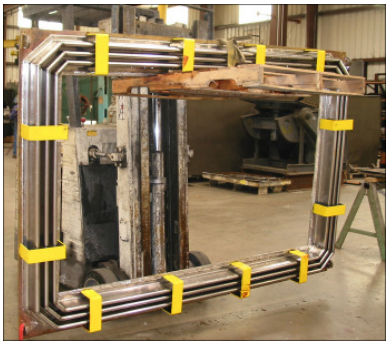
55' Long by 14'6" Rectangular Metal Expansion Joint

U.S. Bellows, Inc. fabricated two metallic expansion joints on an expedited schedule. The expansion joints were fabricated from COR-TEN ASTM 588 carbon steel and are designed for 1.2 PSIG at temperatures up to 748°F. The expansion joints were designed for an axial compression of 1.5" and a lateral resultant movement of 1.84". The entire expansion joint was shipped to the job site in one piece. This avoided having to splice weld the expansion joint into one piece, which saved the customer countless assembly man hours in the field.

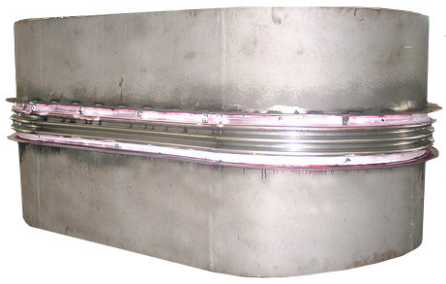
Tandem Rectangular Expansion Joint for Turbine Exhaust

This expansion joint weighs more than 1,700 lb. and is capable of +/- 1/4" axial movement and +/- 1/8" lateral movement. It is designed to operate under design pressures ranging from full vacuum to 15 PSIG at 250°F. The bellows and liner of the expansion joint are made of 304 stainless steel with a carbon steel flange and duct. To ensure quality, the product was 100% dye-penetrant tested prior to shipping.

57" x 96" Rectangular Seal Expansion Joints



Designed at 2 PSIG for 1350°F, the seal joints provide for one inch of axial movement to prevent damage to flange connections. EJMA Standards and B31.3 code were used in the design and fabrication of these joints. The purpose of the rectangular seal expansion joint is to prevent leakage to outside of the burney windbox. The corners are double mitered to reduce stress. Inconel® 625LCF material was used in fabricating the bellows while A240 tp 310 material was used for the frame. An air test at 5 PSIG was implemented as well as dye-penetrant testing on the bellows.



Three 12' x 8' Rectangular Expansion Joints with Full Radius Corners

These rectangular expansion joints were designed at 5 PSIG and 650°F. They are fabricated with full radius corners which allow for an increased cycle life. The bellows are formed from Inconel® 625 SB-443 GR. 1 and the rest of the assembly is fabricated from A516-70. The long seam welds were 100% x-rayed. A 100% dye-penetrant test was performed on the attachment welds.

PRODUCT SHOWCASE

28"x 66" Rectangular Expansion Joint

This stainless steel rectangular expansion joint, 28" x 66", was manufactured for an exhaust system at a chemical plant in South Carolina. This joint is equipped with a liner, tie rods system and mitered corner bellows design. The expansion joint was designed for 15 PSIG at 600°F and leak tested. A 100% dye-penetrant test was also performed on all the welds.

48" Tied Universal Expansion Joint with Two-ply Bellows

This tied universal expansion joint will be installed in an oil refinery in Louisiana. The assembly is 48" in diameter and 150" long. The bellows are fabricated from two plies of Inconel® 625 LCF with stainless steel mesh between the plies and the weld ends and all hardware are A 516 GR 70 carbon steel. The design temperature is 500°F at 38 PSIG with 5" lateral movement. The bellows were 100% x-rayed and hydro-tested to 76 PSIG. A pneumatic test between the plies at 15 PSIG was performed prior to shipping.

Tied Universal Expansion Joint with a 45 Degree Mitered Elbow

This tied universal expansion joint with a 45 degree mitered elbow will be installed in a flue gas system. The assembly is 60" in diameter and 215" long. The pipe is fabricated from A 516 GR 70 carbon steel and the bellows are Inconel® 625 LCF. The bellows were 100% x-rayed and hydro-tested to 15 PSIG prior to shipping.

66" Diameter Tied Universal Expansion Joint

This tied universal expansion joint is designed to carry hot gas up to temperatures of 1022°F and pressure up to 5 PSIG. It has a 66" inside diameter and is 126" in overall length. The design movements are 3" lateral and 4.5" axial compression. The bellows material is Inconel® 825 with 316 L SS flow liners, carbon steel weld ends and limit rods. The bellows and pipe longitudinal weld seams were 100% water clear x-rayed and dye-penetrant tested prior to a 5 PSIG air test.

PRODUCT SHOWCASE

15' Tied Universal Expansion Joint with Slotted Hinges

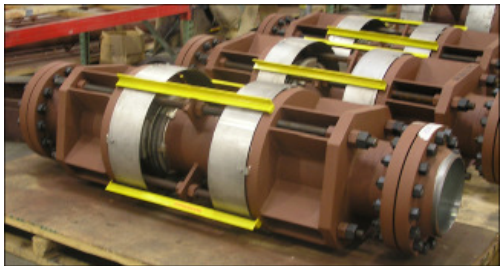
This tied universal expansion joint is 18″ in diameter and 15′ in overall length. The expansion joint is fabricated with an Inconel® 800 bellows, 316H stainless steel pipe and 304H stainless steel tie rods and slotted hinges. The design pressure is 65 PSIG at 1076°F. A hydro-test at 127 PSIG was performed as well as dye-penetrant testing to ensure product quality.

Metallic Universal Expansion Joint for an Emergency Shut Down

One of U.S. Bellows' customer's existing expansion joint failed and caused a plant shut down. They required an immediate replacement joint. This universal expansion joint order was placed, designed and fabricated in just one day. The order came in at 8:30 am on Saturday, Labor Day weekend and was shipped at 4:00 pm, which minimized the time of the plant shut down. This universal expansion joint is 96″ in overall length, 20″ inside diameter and can absorb 3.25″ lateral movement. A 100% dye-penetrant test and a hydro-test were performed to ensure quality.

Expansion Joints for an Engineering and Construction Company

These expansion joints weigh 1,600 lb. each and are 10″ in diameter. They are designed for 611 PSIG and temperatures up to 180°F. These expansion joints are fabricated from 321 carbon steel pipe, tie rods and 300 lb. RF weld neck flanges. The bellows weld seams were 100% x-rayed and the complete assembly was hydro-tested to 917 PSIG to ensure a quality product and performance. The units were shipped with the mating flanges bolted to the end of the assembly.



5,165 lb. Tied Universal Expansion Joint

This 60″ diameter and 120″ long universal expansion joint was custom designed for a chemical plant in Louisiana. It was fabricated from 304 stainless steel bellows and carbon steel. It was designed for 10 PSIG and 550°F. To ensure quality, a 100% dye-penetrant, radiography and soap leak test was performed prior to shipment.

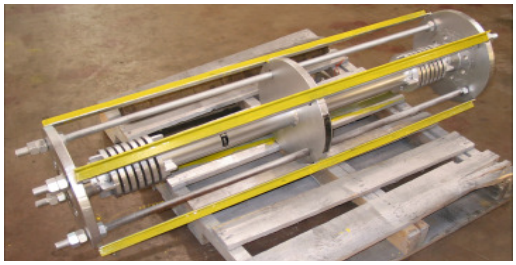
PRODUCT SHOWCASE

48" Diameter Tied Universal Expansion Joints

Five tied universal expansion joints ranging in size from 30" to 48" were designed and manufactured for an oil and gas company in France. These expansion joints weigh between 2400 lb. and 3200 lb. and are fabricated from 304-321 SS bellows. They are designed for pressures ranging from 55 to 650 PSIG and 148°F to 300°F operating temperatures. To ensure quality, the joints were 100% x-rayed, 100% dye-penetrant, and hydro-tested at 83 to 975 PSIG.

3,212 lb. Tied Universal Joint for an Oil Piping System

This 5" nominal diameter and 60" long universal expansion joint was designed for an oil piping system application in Nevada. The assembly consists of high strength Inconel® 625LCF bellows and A105 flanges. It is designed for 1400 PSIG and 120°F per B 31.3 and the latest revision of EJMA standards. It is also designed to allow 4 1/2" of lateral movement during operation. A 100% dye-penetrant and hydro-test at 2100 PSIG were preformed prior to shipment.



6" Diameter Tied Universal Expansion Joints

These eight 6" diameter tied universal expansion joints measuring 24" F-F were manufactured for a steam reformer project in Virginia. These expansion joints are made from two-ply Inconel® 625 bellows, A312 TP 304 spool, and A105 flange. They are designed for FV/50 PSIG and 300°F with axial and lateral movements of +/- 0.25" and 0.70", respectively. The joints were 100% x-rayed, 100% dye-penetrant examined, and hydro-tested at 75 PSIG. Flanges, tie rods, and spherical nuts were hot dip galvanized per customer specifications.

Three 23' – 1/3" Expansion Joints for a Refinery in New Jersey

Three 2'–6" OD x 23'–1/3" long expansion joints were designed and manufactured for a refinery in New Jersey. The bellows, pipes, and lugs were fabricated from Inco 800H high nickel alloy, A312tp 316H stainless steel, and A240tp 316H stainless steel, respectively. The expansion joints are designed for 60 PSIG, 1100°F, and with 47,000 lb. of thrust to accommodate for a high temperature application.

PRODUCT SHOWCASE

Expansion Joint Exhaust Assembly for an Oil Refinery in Texas

U.S. Bellows, Inc. designed and fabricated this expansion joint exhaust assembly for an oil refinery in Texas. This expansion joint is offset for an offshore platform and weighs approximately 8,000 lb. It has a design pressure and temperature of 1 PSIG and 1000°F, respectively. The air test was conducted to detect any leaks.

Tied Universal Expansion Joints for a Chemical Plant

These expansion joints were designed at 170 PSIG and 450°F to absorb lateral movements and tested per B31.3. They were made with Inconel® 625LCF bellows and A105 300 lb. RFSO flanges. The entire assembly was hydro-tested at 255 PSIG and held under pressure for four hours. In order to detect any leaks, each expansion joint and its welds were subjected to the 100% dye-penetrant test and the 100% x-ray test prior to and following forming.

14" Diameter, Tied Universal Expansion Joints

These 14" diameter, tied universal expansion joints were designed and manufactured for a steam application at a power plant in Illinois. The expansion joints were designed at 350 PSIG, 780°F and constructed from Inconel® 625 bellows, A105 300# RFSO flanges, A106 GR. B spool, and SA193 B7 tie rods. The expansion joints were hydro-tested at 525 PSIG.

54" Diameter Tied Universal Expansion Joint

This 54" diameter tied, universal expansion joint was designed and fabricated for the NASA Space Center. The expansion joint was designed at full vacuum and 450°F and constructed with 304 SS bellows, liner and A516 Gr. 70 spool, weld ends and carbon steel tie rods. The bellows' attachment welds were 100% dye-penetrant tested.

PRODUCT SHOWCASE

28" and 32" Tied Universal Expansion Joints

These 28-inch and 32-inch O.D tied universal expansion joints were fabricated for an oil refinery in China. The expansion joints were fabricated from 321 SS bellows, A105, 150#, RFSO. EJMA Standards and B31.3 code were used in the design and fabrication of these joints.

Elbow Tied Universal Expansion Joints

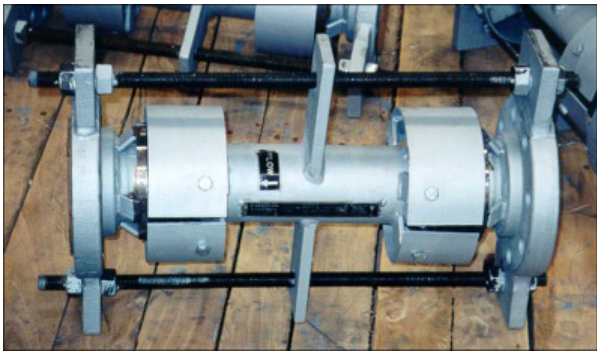
These 16-inch and 30-inch elbow tied universal expansion joints were manufactured for a power station in Florida. These expansion joints, which are used to transport hot steam, are designed at 150 PSIG and 350°F. The bellows material is fabricated from Inco 625 and elbows and spool from carbon steel.

47 ¼" I.D. Universal Expansion Joint

This picture shows a custom designed 47.25" I.D. universal expansion joint with SB-443 (Inco. 625) round corners bellows, and SA516-70 flanges that was fabricated for an ethylene plant in Saudi Arabia.

3" NPS Tied Universal Bellows For A Power Plant

Ninety-six 3" NPS tied universal bellows were manufactured for a power plant located in Saudi Arabia. The bellows' element is a unique design containing integral equalizing rings between the corrugations that provide excellent pressure resistance, as well as, anti-squirm resistance. The tear drop shape of the rings add little resistance to movement and cycle life is not compromised. Pressure design is based on 252 PSIG at 689°F with a lateral movement of 1.0".

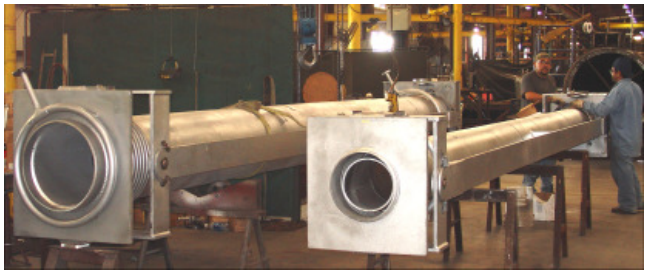


PRODUCT SHOWCASE

55" O.D. Universal Gimbal Expansion Joint with Floating Rings

This expansion joint was fabricated for a FCC overhead vapor line at a refinery. It has an overall length of 310" and is fabricated from A387 Gr 11 Cl2 spool and Inconel® 625 LCF bellows. It is designed for 50 PSIG and 1075°F with 13" of lateral movement. To ensure quality, 100% dye-penetrant, 100% x-ray and pressure tests were performed on the bellows. Pneumatic tests were also conducted on unit and between bellows dry plies at 55 and 15 PSIG, respectively, prior to shipping.

192" Double Gimbal Expansion Joints



Two 192" double gimbal expansion joints were manufactured for a chemical refinery in Channel View, Texas. These expansion joints consist of A240-321 bellows, A160 Gr. pipe, A516-70 gimbal rings, A516-70 liners and A106 Gr. purge connection rings. They were designed for 15 PSIG and 650°F per B 31.3 and the EJMA Standards. They were also designed to allow 8 degrees of angular movement during operation. To ensure quality, the expansion joints were air tested at 22 PSIG prior to delivery.

36" Expansion Joints for a Company in Singapore

Three expansion joints were fabricated for an E&C company in Singapore. The three included a 36" single hinged expansion joint, one 36" double hinged expansion joint and one 36" double gimbal expansion joint. These expansion joints will be used in a compressor application. Due to the critical applications of these expansion joints, they were tested per ASME Sect. VIII Div. 1 Appendix 26. The bellows together with the hinge assembly were hydro-tested. Additionally, a dry nitrogen test between the two plies was conducted to ensure that each of the two plies would withstand the design pressure.

Specially Designed Expansion Joints with 13" of Movement

These externally pressurized expansion joints were designed for 13" movement. They are capable of withstanding temperatures of 1100°F. Externally pressurizing a bellows eliminates squirm as a limitation to the design and permits the safe acceptance of large amounts of axial thermal expansion.

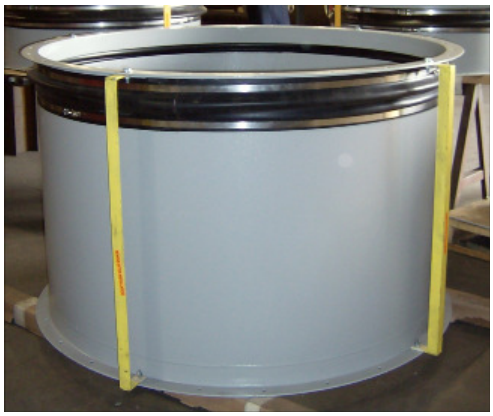
PRODUCT SHOWCASE

59" Neoprene Expansion Joint

This neoprene expansion joint measures 59″ x 7″ and is designed to be used in an air exhaust system. The flanges are fabricated from painted carbon steel angle flanges. The neoprene is fastened to the carbon steel angle flanges by stainless steel clamp rings. The expansion joint absorbs the vibration between the duct work and blower exhaust flange.

Two Expansion Joints for an Air Intake on a Generator Unit

These 59″ x 39.5″ fabric expansion joints were fabricated using a 1/8″ thick neoprene sheet. The joints were then bonded to the carbon steel angles and plates, and secured using stainless steel band clamps, with t-bolt latches. The carbon steel angles and plates were primed and finished at our in-house paint production facility. The expansion joints were designed to facilitate any vibration and movement during the generator units' normal operation.



42″ I.D. Rubber Expansion Joints

These expansion joints consist of bellows formed by a 1/8″ thick neoprene sheet and A36 carbon steel flanges coated with a special finish per customer's request. These expansion joints are 42″ x 7 ¾″. A dye-penetrant test was performed on the welds prior to shipping to ensure quality. The turn around for this product was four days.

EPDM Tied Expansion Joints for a Construction Company

Two EPDM tied expansion joints were designed and fabricated for a company in Texas. These expansion joints have an inside diameter of 29″. They are composed of A516 carbon steel grade 70 with a six-rod control assembly, EPDM, and plate flange. They were hydro-tested to 217 PSIG. These joints were ordered on a one-week rush basis to replace an existing joint that was leaking.

TERMS OF SALE

GUARANTEE: We guarantee for one year from date of delivery our manufactured products to the extent that we will replace those having manufacturing defects when used for the purpose which we recommend. If goods are defective, the amount of damage is the price of the damaged goods only and no allowance will be made for labor or expense of repairing defective goods or damages resulting from the same. We guarantee the other manufacturers' products we sell to the extent of the guarantees of their respective makers.
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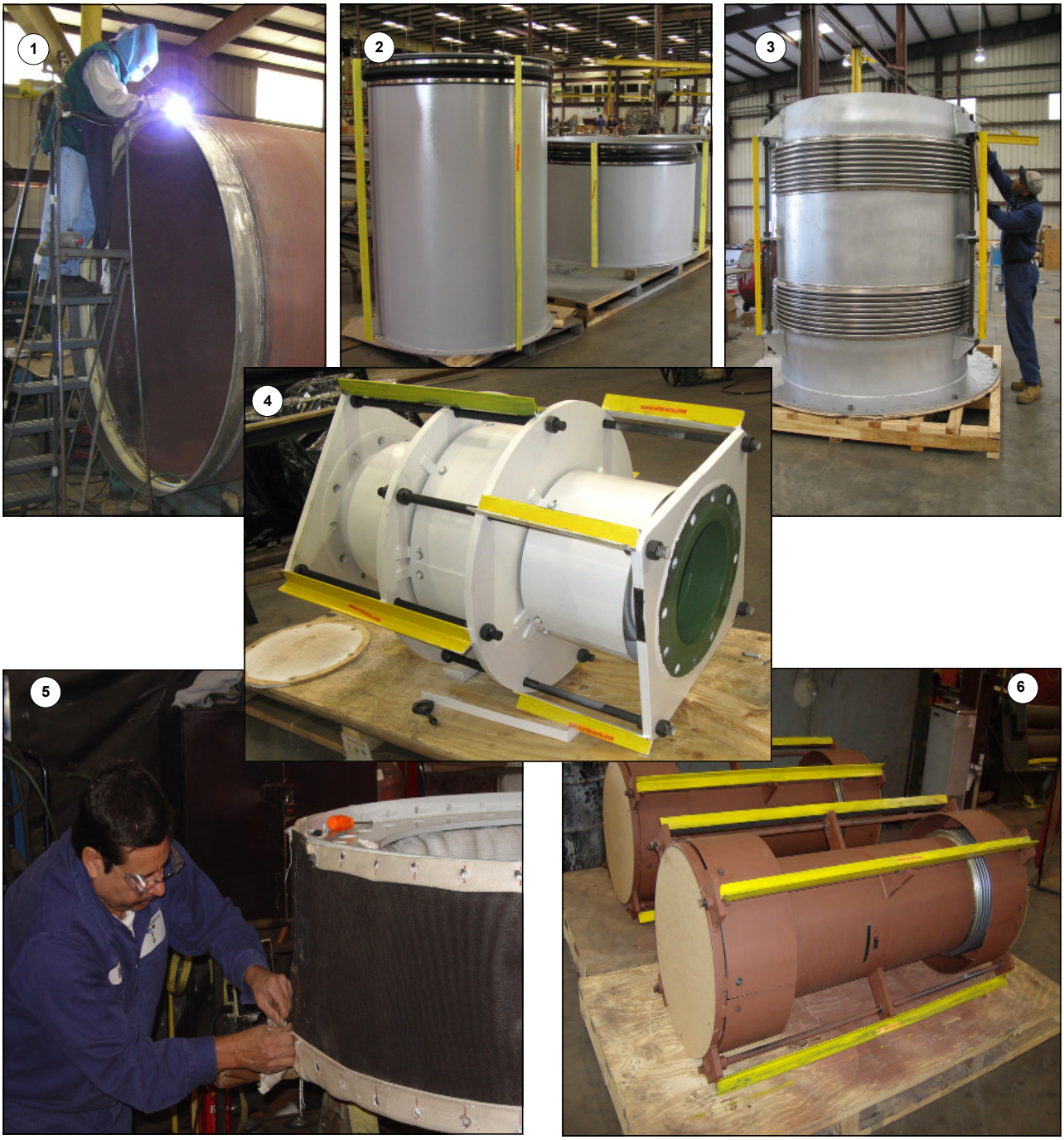
PRICES & DESIGNS: Prices and Designs are subject to change without notice and unless specifically stated on order, materials will be furnished of design in effect at the time the order is filled.

36" Refurbished Rectangular Metallic Expansion Joint

36" Tied Universal Expansion Joint for a Petrochemical Plant



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44" Double Gimbal Expansion Joint

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