KE-BURGMANN EJS

Technology that expands with you...



Technical Design Manual

Asia-Pacific Canada Europe Middle East South America United States



New Name. Same Company. More Products. Better Service.

It is with great pleasure that we announce the acquisition of Expansion Joint Systems (EJS) by KE-Burgmann USA, Inc., a leading global manufacturer of fabric, metal and rubber expansion joints and metal hoses. KE-Burgmann is a member of the international EagleBurgmann Group, one of the largest manufacturers of mechanical seals and packings and the Freudenberg Group. EJS employees, general operations and location will remain the same. Our union will increase our product selection and improve services to our customers, partners and suppliers worldwide.

Everyone at EJS appreciate your longstanding relationship and thank you for your support over the past 25 years. We look forward to our new beginning as KE-Burgmann EJS and continuing our work with you and your organization.

For more information visit our website at www.ke-burgmann.com and www.keb-ejs.com

Sincerely,

Peter Lønborg Nielsen
CEO, KE-Burgmann Group
EJS

Neville J. Barber
General Manager, KE-Burgmann

EagleBurgmann.
Member of the EagleBurgmann Group

KE bredan EJS KE-Masterflex

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KE-Burgmann EJS: Providing Expansion Joint Reliability and Efficiency

As one of the world's leading expansion joint manufacturers, **KE-Burgmann EJS** (KEB-EJS) supplies a wide variety of metal and fabric joints. It serves companies in the oil refining, petrochemical, power utility, pulp & paper, mining, foundry, water & waste water systems, marine, and a variety of original equipment manufacturers worldwide. For over 25 years, KEB-EJS has been dedicated to providing high quality products at competitive prices.

The company's commitment to providing innovative expansion joint technology is supported by their participation as an active member of the Expansion Joint Manufacturer's Association (EJMA), with representation on both the technical and management committees. The company also holds a current ASME Boiler and Pressure Vessel Section VIII, Division 1 certification and is certified to manufacture in accordance to the European Pressure Equipment Directive (PED).





KEB-EJS Main Manufacturing Facility in Santee, CA



Customer Commitment

The KEB-EJS commitment to quality starts at the quotation stage, the very foundation of a reliable end product. Utilizing state-of the art equipment and software, engineers analyzes the effects on piping due to restraint loading and develops the most cost effective and thoroughly tested designs in the industry. As the company is continuously testing new methods of design and developing innovative bellows technology, the KEB-EJS team has the experience and tools to specify the correct joint for most applications.

Although ownership of the company may have changed, their commitment to ensure total satisfaction by providing expansion joints that are supported with advanced engineering and superior service has never changed. Additionally, KEB-EJS offers emergency services and repairs. Call anytime to get your plant or refinery up and running again quickly. The company is available 24 hours a day, 7 days a week at +1 (800) 826 3058 or +1 (619) 562-6083 for outside the USA.



CERTIFICATE OF WARRANTY

For KEB-EJS SO# Customer PO#

Issued to
Customer Name

KE-Burgamann KEB-EJS (KEB-EJS) warrants that the product furnished as referenced above will, at the time of delivery, be free from defects in material and workmanship. KE-Burgamann KEB-EJS will repair or replace any defects that occur within one year from the date of installation or eighteen months from the date of shipment (reflects date on the Bill of Lading), whichever occurs first.

Examination and repair or replacement of the products purchased will be on location or in KEB-EJS's facilities, at KEB-EJS's option. Products to be examined, and replaced or repaired by KEB-EJS must be returned to KEB-EJS by Purchaser within the warranty period. KEB-EJS must be notified of the complaint prior to the transport of the product(s) and prior to the start of any repairing work unless otherwise specified. If the examined equipment is found not to be defective or is not for some other reason within warranty coverage, KEB-EJS service time expended on and off location will be charged to the Purchaser. Purchaser shall be responsible for proper installation of the units and operation within the design limits of the furnished unit(s).

Correction of defects by repair or replacement shall constitute KEB-EJS's sole and exclusive responsibility to Purchaser under this Certificate of Warranty and KEB-EJS shall in no circumstance be liable for injuries to persons or property or direct, incidental, liquidated or consequential damages caused by use of the product.

Date Issued: KE-BURGMANN EJS (A Division of KE-Burgmann USA, Inc.) Authorized Signature

10035 Prospect Avenue, Ste 202 Santee, CA 92071 USA (800) 482-2808 / (619) 562-6083

KEB-EJS expansion joint are sold with a standard one-year warranty, however longer warranty terms are available upon request.

Manufacturing Capabilities

KEB-EJS manufactures a wide variety of bellows, expansion Joints and piping assemblies from 3" nominal diameter to 200" with process temperatures from -325°F to 2,500°F. Pressures fort hese designs range from full vacuum to 2000 psig. Single-ply, multi-ply, root ring, equalizer ring and toroid bellows designs are all available and as a minimum, all KEB-EJS expansion joints are designed to the latest EJMA standards.

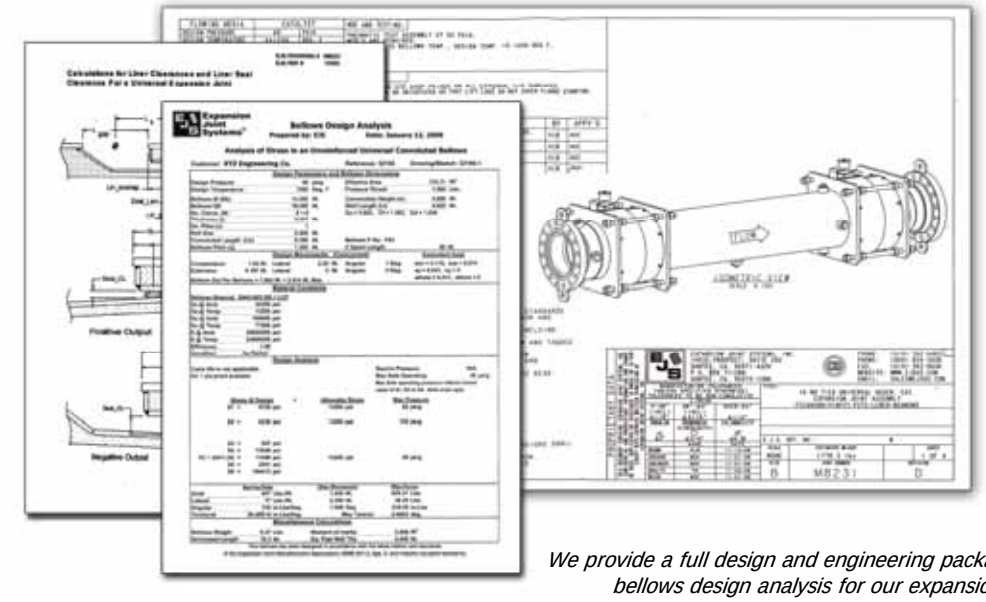


KEB-EJS utilizes a 3D-solid parametric modeling system

Design and Engineering Capabilities

Our engineers use innovative design technology such as F.E.A. (Finite Element Analysis) and 3D Modeling computer programs to analyze the performance of the bellows element and supporting hardware. The forming and welding equipment used in the manufacture of KEB-EJS expansion joints incorporates computer aided tooling to produce components faster, at a lower cost, and with the highest quality available. Also, as an active member of the Expansion Joint Manufacturers Association, KEB-EJS designs every expansion joint in compliance with EJMA standards. Visit www.ejma.org for more information about the organization. In addition to the EJMA standards, they will also design in accordance with ASME Sec. VIII, Div. 1, ASME B31.3 and ASME B31.1 upon request.

KEB-EJS uses the most advanced tools necessary to design safe and reliable expansion joints. Using state of the art software, KEB-EJS can design an expansion joint to meet your specifications while reducing cost. KEB-EJS utilizes a 3D-solid parametric modeling system, which provides the most accurate representation of geometry and interference/clearance verification available. This feature based solid modeler provides their designers with full associativity among all engineering disciplines; enabling a revision to be made anywhere in the development process and the change will be reflected throughout the entire design of the component.

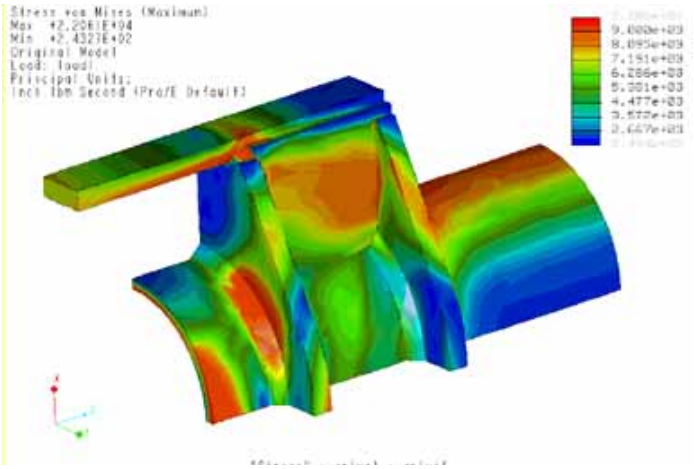


We provide a full design and engineering package including a bellows design analysis for our expansion joints

Finite Element Analysis

Once the expansion joint is modeled, a Finite Element Analysis (FEA) is performed to validate the structural integrity of any critical areas. To compliment the stress analysis, a thermal analysis can also be completed either in a transient or steady state condition.

From a simple bolted flanged unit to the most complex refractory lined catalytic cracking unit, KEB-EJS is able to ensure clearances and structural integrity before we go to production. Last minute design changes are no problem; they can be made in minutes without sacrificing quality. The result - you get the data to confirm your expansion Joints are designed exactly within your required specifications.



Our designers use finite element analysis to validate the structural integrity of any critical areas of the expansion joint

Testing and Quality Assurance

KEB-EJS is a company dedicated to providing quality products and solutions backed with a complete guarantee. With one of the most comprehensive quality assurance programs in the industry, our products are inspected and evaluated extensively through each stage of production. The KEB-EJS quality team is capable of performing all types of non-destructive testing such as radiography, ultrasound, mass spectrometer, magnetic particle, hydrostatic and liquid penetrate inspection. We can also include x-ray testing, cycle testing, spring rate testing, hardness testing, impact testing, pneumatic testing, leak detection and positive material identification (PMI) as part of our program. All inspectors are certified to ASNT-TC-1A with multiple Level II and III inspectors in house. KEB-EJS also holds an ASME “U” and “R” stamp allowing repair and fabrication of expansion joints requiring a U-2A partial data report.



Dimensional Inspection of a U-2 aircraft expansion joint for NASA

The design, quality assurance, and manufacturing practices at KE-Burgmann EJS are in compliance with the following codes and standards: EJMA, ASME Section VIII and IX, ANSI B31.1, B31.3 and other major industry standards such as UOP.



Well-used ASME “U” stamp

Bellows Manufacturing

The bellows element is the most important component of an expansion joint. This thin-walled, corrugated membrane allows flexibility in a piping system while containing the pressure and media. When complete, each bellows has a unique working pressure, spring rate, and cycle life that are entirely dependent on its geometry and material.

KEB-EJS uses software written in-house to design bellows to the latest edition of the EJMA standards*. The EJMA standard ensures that the expansion joint is designed and manufactured to a set of minimum requirements developed from empirical data and years of experience. All customers should insist that their bellows be manufactured in accordance with these standards.

KEB-EJS manufactures bellows using an expanding mandrel (punch forming) method followed by a finish rolling. A rectangular sheet is sheared and rolled into a tube. The tube is welded using an auto flat-bed welder with no filler metal added. The longitudinal seam weld is then "plannished" back down to the parent material thickness. Any dye penetrant, x-ray, or air testing is performed at this time. When testing is complete, the convolutions are punched individually drawing material from the top and bottom of the tube. This drawing process eliminates any thinning in the Bellows material. At this point, the convolutions have more of a "V" shape than the final "U" shape that is required. This is easily solved with the final re-rolling of the bellows between a series of aluminized bronze rolls After trimming the bellows attachment ends (skirts), the bellows is complete and ready to have attachment ends installed.



Automatic Longitudinal Seal Weld



Plannishing the seam weld



Forming the convolutions

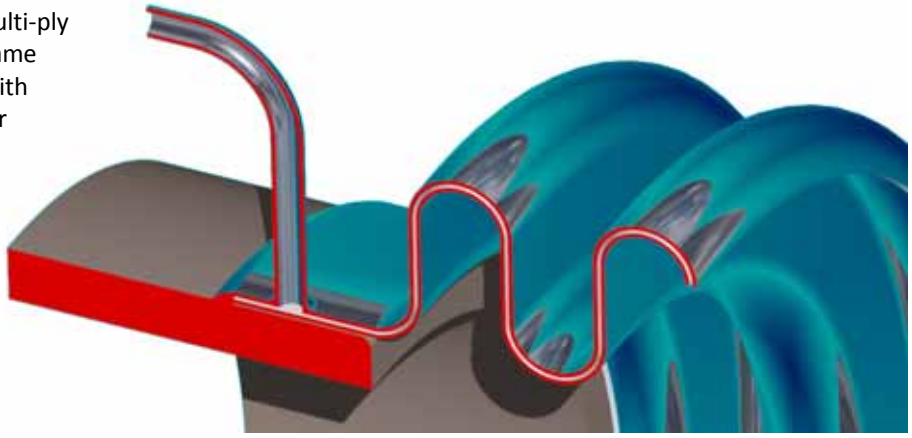


Final re-roll process

** To purchase a copy of the latest EJMA standard, contact Expansion Joint Manufacturers Association,* inquiries@ejma.org, *www.ejma.org*

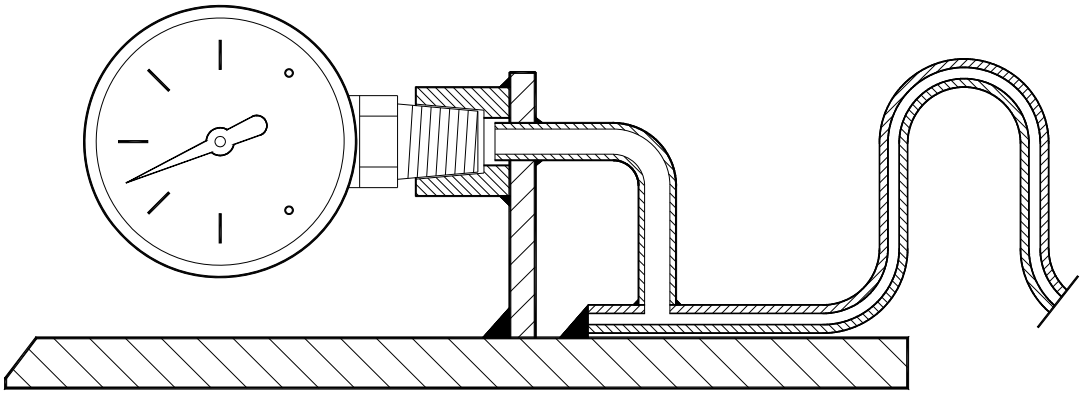
Multi-Ply Bellows

KEB-EJS has the ability to manufacture multi-ply bellows up to 6 plies. This is achieved by nesting thin tubes inside each other before the initial punch stage of manufacture. Multi-ply bellows have the distinct advantage of containing the same pressure as an equivalently thick single ply design but with much lighter spring rates and much higher cycle life. For example, a high pressure might require a 0.060" thick bellows to contain hoop stress. A single ply of 0.060" thick or three plies of 0.020" thick material will both handle the hoop stress in the bellows, but each ply in the multi-ply bellows will act individually where sidewall bending is concerned. This drops the spring rate and significantly increases cycle life.



Two ply testable design

Sometimes referred to as a two ply testable bellows, redundant ply designs are used when it is necessary to monitor the integrity of the bellows inner or outer ply. Not to be confused with the multi-ply design, both bellows plies are designed for the full pressure and temperature cycles. If one ply fails, the second one will take its place until a scheduled repair can be made. The first style, referred to as "passive", only monitors the pressure between the bellows plies. If the inner ply is breached, then the incident is detected as an increase in pressure on the measuring device. Pressure gauges and pressure transducers are the most common types of measuring devices. The second style, referred to as "active", requires a vacuum between the plies. Depending on the pressure reading, an inner or outer ply failure can be detected.



Gauge monitors pressure between plies

Bellows Movements and Spring Rates

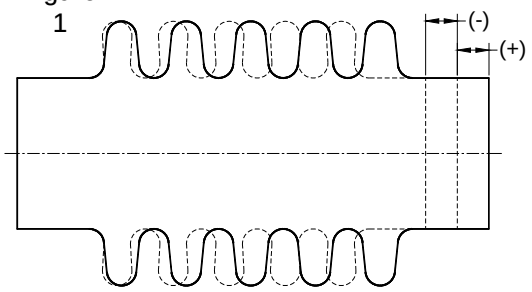
Movement Capabilities

There are four basic movements that can be applied to a bellows. These are Axial, Lateral, Angular and Torsional. Figures 1 through 5 illustrate these movements. Bellows behave like springs in a piping system. When they are compressed, the bellows resist the movement the same as a spring would. The spring rate of a bellows is entirely dependant on bellows geometry and material properties. KEB-EJS is able to vary bellows geometry such as convolution height, pitch, thickness and number of plies to provide a bellows to satisfy any customer's needs.

- **Axial Movement (+/- IN)**

Axial movement is the change in dimensional length of the bellows from its free length in a direction parallel to its longitudinal axis. Compression is always expressed as negative (-) and extension as positive (+). The units for axial spring rates displayed in this catalog are Lbs/in.

Figure 1



- **Lateral Movement (+/- IN)**

Lateral movement is the relative displacement of one end of the bellows to the other end in a direction perpendicular to its longitudinal axis (shear). Lateral movement can be imposed on a single bellows as depicted below but to a limited degree. A better solution is to incorporate two bellows in a universal arrangement as shown. This results in greater offset movements and much lower offset forces. The units for lateral spring rates displayed in this catalog are Lbs/in.

Figure 3

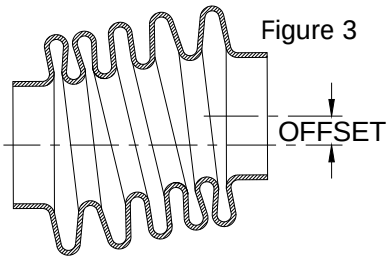
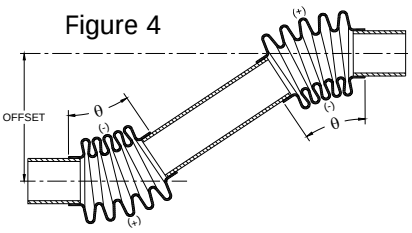


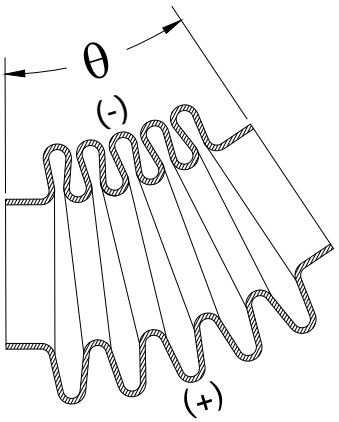
Figure 4



- **Angular Movement (+/- Degrees)**

Angular movement is the rotational displacement of the longitudinal axis of the bellows toward a point of rotation. The convolutions at the inner most point are in compression (-) while those furthest away are in extension (+). The angular capability of a bellows is most often used with a second bellows. (See Figures 2 and 3 on page 22). The units for angular spring rates displayed in this catalog are in-Lbs/deg.

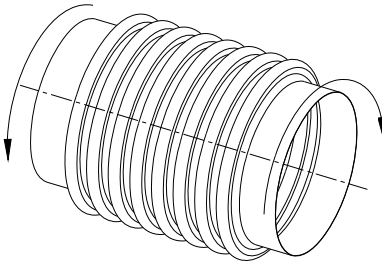
Figure 2



- **Torsional Movement (+/- Degrees)**

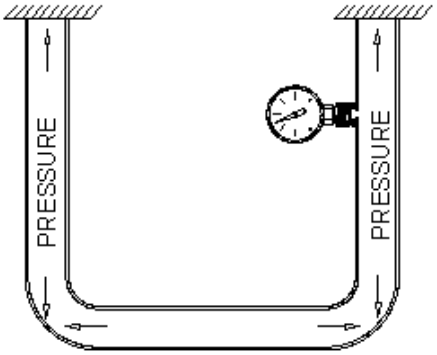
Torsional movement is the rotation about the axis through the center of a bellows (twisting). **KEB-EJS DISCOURAGES ANY TORSIONAL ROTATION OF METAL BELLOWS EXPANSION JOINTS.** Torsion destabilizes an expansion joint reducing its ability to contain pressure and absorb movement. If torsion is present in a piping system, hinges, slotted hinges or gimbals are recommended to combat the torsion. This catalog supplies torsional spring rates (page 69) in Lbs/deg and maximum torsional limits in degrees for computational modeling only. Piping software such as CAESAR II and COADE often require these spring rates for nodal input.

Figure 5

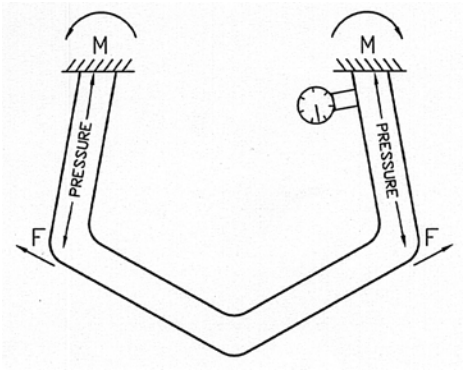


Pressure Thrust

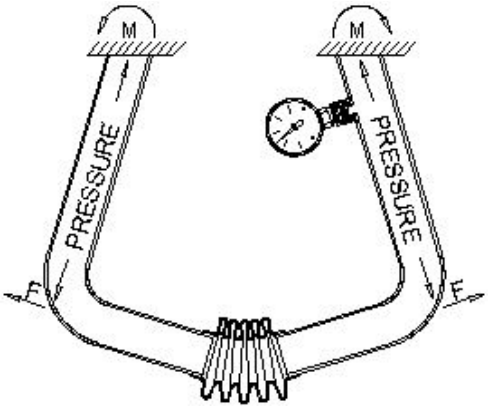
Figure 1



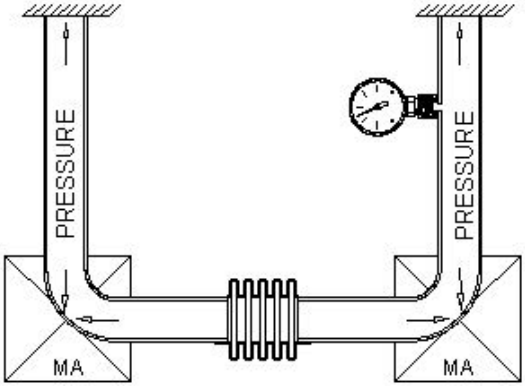
Pressure thrust contained by pipe



Pressure thrust no longer contained by pipe



Pressure thrust after adding a bellows into the pipe system



System required main anchors

Pressure thrust is the force created by pressure acting on a bellows. This force is the system pressure times the effective area of the bellows. When a piping system without expansion joints is pressurized, the system will not move because the pipe is countering the force in tension. When an unrestrained expansion joint is introduced in the network, the force tends to pull the ends away from the expansion joint causing damage to itself and the pipe. This pressure thrust must be contained with either main anchors or restrained expansion joints designed to carry pressure thrust loads. The main anchors must be able to resist the pressure thrust force and a small amount of force due to the deflection of the bellows.

Example: Pipe size = 12" nominal
P = System Pressure = 300 psig
A = Effective Area of 12" part = 151 in^2
δ = Pipe growth between anchors = 0.5 in compression
SR = Axial Spring Rate of the 12" part = 6,255 Lbs/in

First find the force due to the pressure:
PRESSURE THRUST = P X A = 300 psig X 151 in^2 = 45,300 Lbs

Next find the force due to the bellows deflection:
BELLOWS SPRING FORCE = δ X SR = 0.5 in X 6,255 Lbs/in = 3,128 Lbs

The main anchors must resist the sum of these two forces:
PRESSURE THRUST + BELLOWS SPRING FORCE = 45,300 Lbs + 3,128 Lbs = 48,428 Lbs

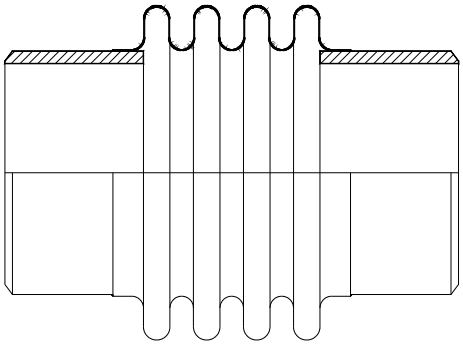
Basic Types of Expansion Joints

Unrestrained Assemblies

Definition: Assemblies not capable of restraining the pressure thrust of the system. The pressure thrust must be contained using main anchors or equipment.

- **Single Bellows**

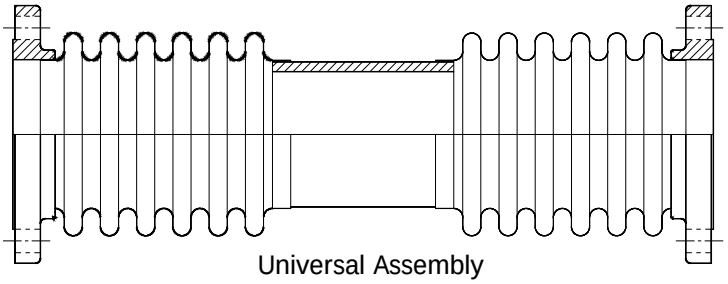
The simplest type of expansion joint consists of a single Bellows element welded to end fittings, normally flange or pipe ends. The single bellows can absorb small amounts of axial, lateral and angular movement with ease, but adequate anchors and guides must be provided.



Single Assembly

- **Universal Expansion Joint**

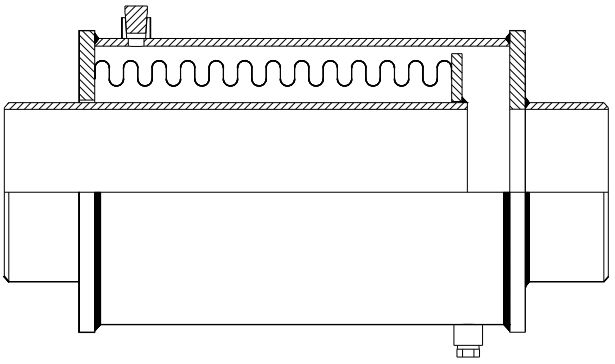
This expansion joint consists of two bellows connected by a center spool piece with flange or pipe ends. The universal arrangement allows greater axial, lateral and angular movements than a Single Bellows . Increasing the center spool length produces increased movement capability. Like the single, adequate anchors and guides must be provided.



Universal Assembly

- **Externally Pressurized Expansion Joint**

Line pressure acts externally on the bellows by means of a Pressure chamber. This allows a greater number of convolutions to be used for large axial movements, without fear of bellows instability. Externally Pressurized Expansion Joints have the added benefit of self-draining convolutions if standing media is a concern. Anchors and guides are an essential part of a good installation.



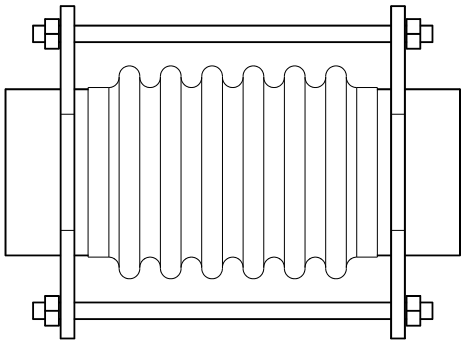
Externally Pressurized Assembly

Restrained Assemblies

Definition: Assemblies capable of restraining the pressure thrust of the system. Intermediate anchors are required to withstand the spring force generated when the expansion joint is deflected. The need for main anchors is eliminated

- **Tied Single Bellows**

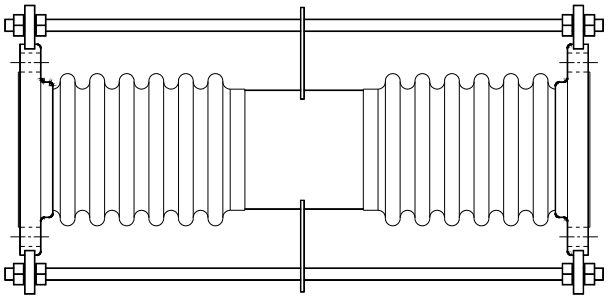
The addition of tie rods to a Single Bellows Assembly adds design flexibility to a piping system. The tie rods are attached to the pipe or flange with lugs that carry the pressure thrust of the system, eliminating the need for main anchors. With the assembly tied, the ability to absorb axial growth is lost. Only lateral and angular movement can be absorbed with the tied expansion joint. The addition of tie rods does not eliminate the need for a well-planned guide system for the adjacent piping.



Tied Single Assembly

- **Tied Universal Expansion Joint**

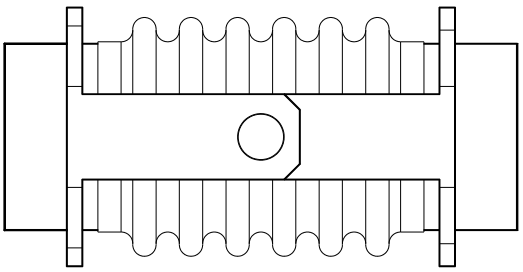
Similar in construction to a Universal Assembly except that tie rods absorb pressure thrust and limit movements to lateral offset and angulation. Large offset movements are possible in a Universal Assembly by increasing the distance between the two bellows.



Tied Universal Assembly

- **Hinged Expansion Joint**

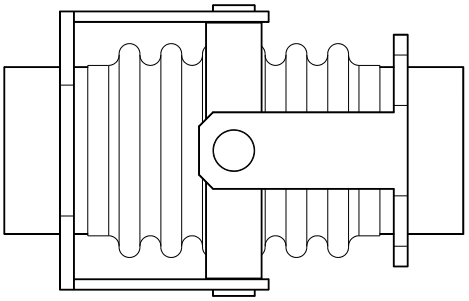
When a Hinged Expansion Joint is used, movement is limited to Angulation in one plane. Hinged Assemblies are normally used in sets of two or three to absorb large amounts of expansion in high pressure piping systems. Only low spring forces are transmitted to the equipment. The hinge hardware is designed to carry the pressure thrust of the system, and often times, used to combat torsional movement in a piping system. Slotted Hinged Expansion Joints are a variant of the standard Hinged Expansion Joints that allow axial and angular movement. **Important note**: Once a Slotted Hinge is introduced, torsion in the piping system is still resisted but the hinge no longer carries pressure thrust.



Hinged Assembly

- **Gimbal Expansion Joint**

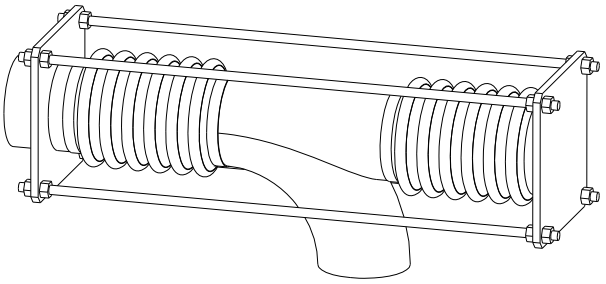
The gimbal restraint is designed to absorb system pressure thrust And torsional twist while allowing angulation in any plane. Gimbal Assemblies, when used in pairs or with a Single Hinged unit, have the advantage of absorbing movements in multi-planer piping systems. The gimbal works the same as an automobile's universal drive shaft.



Gimbal Assembly

- **Pressure Balanced Elbow Expansion Joint**:

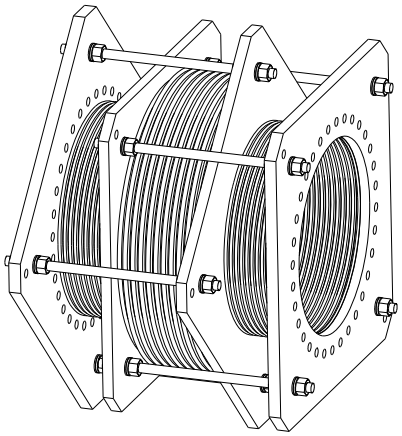
These assemblies are used in applications where space limitations preclude the use of main anchors. Pressure thrust acting on the line bellows (bellows in the media flow) is equalized by the balancing bellows through a system of tie rods or linkages. The only forces transmitted to equipment are low spring forces created by the axial, lateral, or angular movements. An elbow must be present in the piping network to install this style of expansion joint.



Pressure Balanced Elbow Assembly

- **In-Line Pressure Balanced Expansion Joint**:

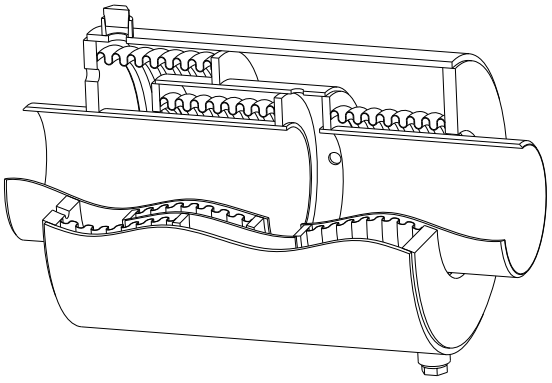
If an elbow is not present in a piping network and pressure thrust Must be absorbed by the expansion joint, an In-Line Pressure Balanced expansion joint is the solution. An equalizing bellows with twice the effective area as the line bellows is tied in the expansion joint through a series of tie rods. The opposing pressure forces cancel each other leaving only the low spring forces generated from the bellows deflection.



In-line Pressure Balanced Assembly

- **Externally Pressurized Pressure Balanced Expansion Joint**:

If large amounts of axial movement in a system are needed and the expansion joint must absorb pressure thrust, an Externally Pressurized Pressure Balanced expansion joint is the solution. The opposing force balancing theory is similar to the In-Line Pressure Balanced Assembly except the opposing forces are generated from pressure acting on the outside of the bellows.

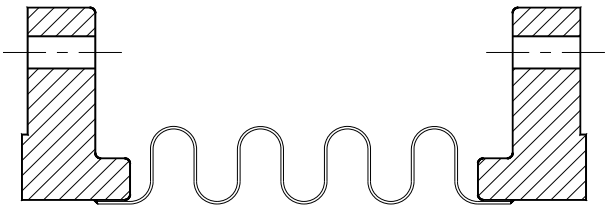


Externally Pressurized Pressure Balanced Assembly

END CONNECTIONS & ACCESSORIES

- **Flanges**

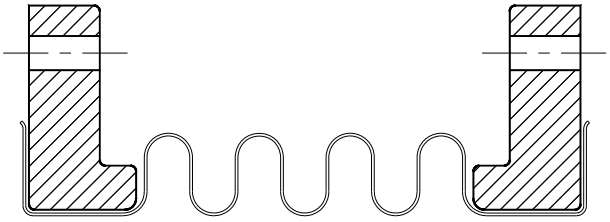
Any flange style can be added to a bellows for bolting into a system. Forged steel or plate flanges to match the pressure and temperature ratings of ANSI Class 150 or ANSI Class 300 are standard from 3 in. nominal diameter to 24 in. nominal diameter. Special flanges, slip-on, or angle style are available in sizes from 12 in. diameter to 72 in. diameter. These flange dimensions are listed on page 66.



Flanged

- **Vanstone Ends**

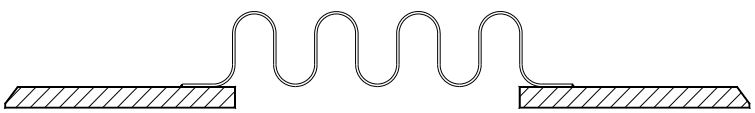
Vanstone ends are modified flanged ends with the added flexibility for resolving bolt-hole misalignment or wetted surface corrosion. Because KEB-EJS discourages torsional twisting of the bellows, this is an economical solution without compromising the integrity of the expansion joint. Use the code **V** when creating a part number for ordering.



Vanstoned

- **Weld Ends**

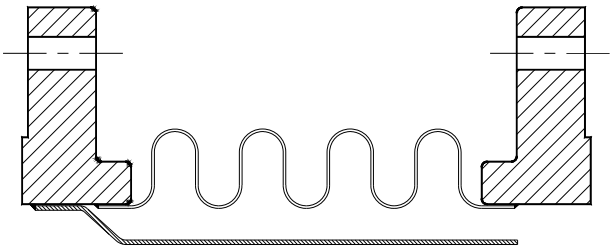
Any pipe or duct can be attached to a bellows for welding into a system. Pipe in accordance with ASTM A53 Gr. B or A106 Gr. B is used for standard sizes 3 in. to 24 in. nominal diameter. Plate to ASTM A36 or A516 Gr. 70 rolled and welded is used for custom sizes 26 in. through 18 ft. in diameter. Stainless steel or other alloy pipe can also be provided. All piping dimensions are listed on page 74.



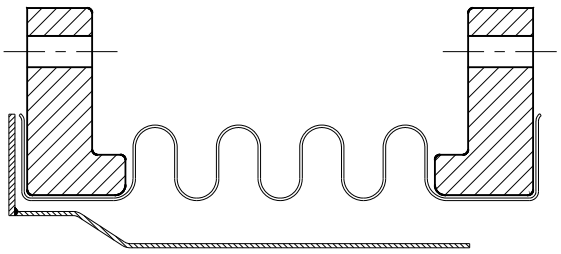
Weld End

- **Liners (Internal Sleeves)**

when any of the following conditions exist:
A. When pressure drop must be minimized and smooth flow is essential.
B. When turbulent flow is generated upstream of the expansion joint by changes in flow direction.
C. When it is necessary to protect the bellows from media carrying abrasive materials such as catalyst or slurry.
D. In high temperature applications to reduce the temperature of the bellows. The liner is a barrier between the media and the bellows.
E. For Air, Steam and other Gases
Up to 6 in. diameter - 4 ft/sec/in. of diameter
Over 6 in. diameter - 25 ft/sec.
For Water and other Liquids
Up to 6 in. diameter - 2 ft/sec/in. of diameter
Over 6 in. diameter - 10 ft/sec.
Flow liners can trap liquid if the expansion joint is installed with the flow vertical up. All KEB-EJS catalog parts are provided with drain holes to prevent liquid buildup under the liner. For custom designs, flow direction should always be provided. Use the code **L** when creating a part number for ordering.



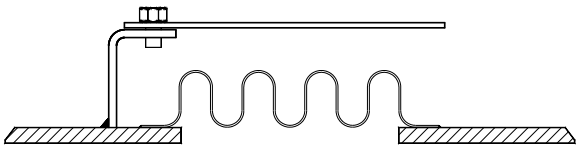
Flanged joint with Liner



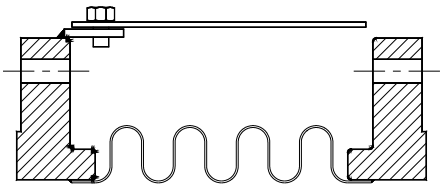
Vanstone joint with liner

- **Protective Covers and Shrouds**

Covers and shrouds can be provided either fixed or removable. Fixed types are used where high velocity external steam conditions exist such as in condenser heater connections. The removable type is the KEB-EJS catalog standard and permits periodic in service inspection. They are also used to prevent damage during installation and operation or when welding is going to be performed in the immediate vicinity. If the expansion joint is going to be externally insulated, a cover should be considered. KEB-EJS always recommends covers for any expansion joint. The small cost increase is just economical insurance when compared to a complete joint replacement. Use the code **C** when creating a part number for ordering.



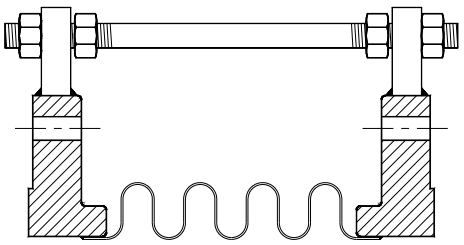
Weld end joint with cover



Flanged joint with cover

- **Tie Rods**

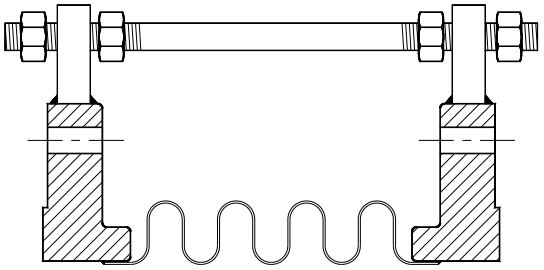
Ties rods are devices, usually in the form of bars or rods, attached to the expansion joint assembly and are designed to absorb pressure loads and other extraneous forces like dead weight. When used on a **Single** or **Universal Style Expansion Joint**, the ability to absorb axial movement is lost. Use the code **TR** when creating a part number for ordering.



Tie Rods Installed

- **Limit Rods**

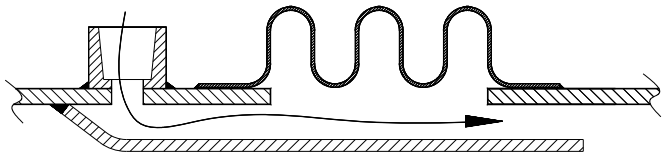
Limit rods are used to protect the bellows from movements in excess of design that occasionally occurs due to plant malfunction or the failure of an anchor. LIMIT RODS DO NOT CONTAIN THE PRESSURE THRUST DURING NORMAL OPERATION. Limit rods are designed to prevent bellows over-extension or over-compression while restraining the full pressure loading and dynamic forces generated by an anchor failure. During normal operation the rods have no function. Use the code **LR** when creating a part number for ordering.



Limit Rods Installed

- **Purge Connections**

Purge connections are used in conjunction with internal liners to lower the skin temperature of the bellows in high temperature applications such as catalytic cracker bellows. The purge media can be air or steam which helps flush out particulate matter between bellows and the liner. This also prevents the build up of harmful solids in the convolutions that may stop the bellows from performing.



Air or Steam Purge Under Bellows

MATERIAL SELECTION GUIDELINES

Bellows Material

Selection of the bellows material is the single most important factor to be considered in the design of an expansion joint. Some of the factors, which influence the selection process, are as follows:

Factors	Considerations
• Corrosion Properties	Process media Surrounding environment Internal cleaning agents
• Mechanical Properties	High temperature service Cryogenic service Operating stresses
• Manufacturing properties	Forming and cold working capabilities Cost and material availability

It is important for our engineers to have access to all the facts surrounding the bellows application before a material is selected.





Air Force Base Engine Test Facility, Tennessee, USA

Left: 72” Diameter Stainless Steel Hinge and Gimbal System

BELLOWS MATERIAL

- **Stainless Steel- Type 300 austenitic series**

304 (ASTM A240-304) Catalog code M1
Services a wide range of applications. It resists organic chemicals, dye stuff, and a wide variety of inorganic chemicals. Type 304 resists nitric acid and sulfuric acids at moderate temperatures and concentrations. It is used extensively in piping systems conveying petroleum products, compressed air, steam, flue gas, and liquefied gases at cryogenic temperatures. The temperature range varies from -324 to 1200 degrees F.

304L (ASTM A-240-304L)
Has a maximum carbon content of 0.03% versus 0.08% for type 304. This lower carbon content eliminates the problem of chromium carbide precipitation and makes it more resistant to intergranular corrosion. It is preferred over 304 for nitric acid service.

316 (ASTM A-240-316) Catalog Code M2
This alloy contains more nickel than the 304 types. The addition of 2% to 3% molybdenum gives it improved corrosion resistance compared to 304 especially in chloride environments that tend to cause pitting. Some typical uses are flue gas ducts, crude oil systems high in sulfur, heat exchangers, and other critical applications in the chemical and petrochemical industries.

316L (ASTM A-240-316L)
With its low carbon content of 0.03% maximum, it lends itself to highly corrosive applications where intergranular corrosion is a hazard.

321 (ASTM A240-321) Catalog Code M3
The addition of titanium to this stainless steel acts as a carbide stabilizing element that prevents carbide precipitation when the material is heated and cooled through the temperature range of 800 to 1650 degrees F. 321 finds uses in many of the same applications as Type 304, where the added safeguard from intergranular corrosion is desired. The standard catalog exhaust joints are made from this material because of the high operating temperatures they withstand.

347 (ASTM A240-347)
This is another of the stabilizing grades with columbium acting as the carbide-stabilizing element. It is more difficult to obtain than 321 with only slightly better corrosion qualities. Welding of 347 is more difficult and takes additional care.

- **Nickel Alloys**

Nickel 200 (ASTM B162-200)
A commercially pure nickel (99.5% Ni), nickel 200 has good mechanical properties and excellent corrosion resistance to salt water attack and chloride cracking.

Alloy 400 (ASTM B127-400)
This copper-nickel alloy (66.5% Ni, 31.5 Cu) is a higher strength material than Nickel 200 with excellent corrosion resistance over a wider range of temperatures and operating conditions.

Alloy 600 (ASTM B168-600)
This nickel-chromium alloy (76% Ni, 15.5% Cr) has very desirable properties for the manufacture of expansion joints. It has a very high strength over a wide range of temperatures and a good resistance to a variety of corrosive environments. It finds wide use in steam and salt water services where it is virtually immune to chloride stress corrosion.

Alloy 625 Gr.1 (ASTM B443-625)
This alloy contains a higher chromium content (21.5%) than alloy 600. With the addition of 9% molybdenum, it produces an alloy of superior strength and corrosion resistance over a wider range of temperatures and environments. It is used on many critical applications such as heat exchangers and catalytic cracker expansion joints. When exposed to temperatures above 1000 deg F for prolonged periods, it may become embrittled.

Alloy 625 LCF (ASTM B443-625 LCF)
Similar to straight grade 625, this alloy has a slight change in material composition to enhance low-cyclic fatigue properties at elevated temperatures.

Alloy 800 (ASTM B409-800)
This nickel-iron-chrome alloy is less expensive than alloy 600. It has good corrosion resistance properties and high temperature strength over a wide variety of difficult service conditions.

Alloy 825 (ASTM B424-825)
This is a copper-chrome nickel alloy that exhibits excellent corrosion resistance to the most severe acids, in particular hot concentrated sulfuric acid and sulfur bearing environments.

Alloy 20 or 20Cb-3 (ASTM B463)
This nickel-iron-chrome alloy was specifically designed to resist hot sulfuric acid. It is able to resist intergranular corrosion in the as-welded condition and is practically immune to chloride stress corrosion cracking.

Other Materials
In addition to the materials listed above, KEB-EJS has successfully manufactured bellows from Hastelloy C22 and C276, Waspoloy, Corten, AL6XN, duplex 2205, alloys 230, 253 MA, 330, 617, 718, 800H/HT, 3CR12, HR120 and others. Many grades of “SA” and “SB” materials are stocked for expansion joints requiring ASME partial data reports. Please consult KEB-EJS for any material not listed or for ordering catalog parts with alternate materials

KEB-EJS manufactures bellows from mill-annealed material only and no annealing is performed after the forming process is complete. KEB-EJS must know if the customer requires annealing of the material after forming. Occasionally, annealing will enhance material properties or corrosion resistance. KEB-EJS discourages post-formed annealing because it hinders the bellow’s ability to contain pressure and may also lower cycle life.

Common Material Problems

Problem	Cause	Solution
Pitting Corrosion	Galvanic reaction caused holes in a bellows. Common in acidic medium.	Use A240-316, B443-625 or B42-825. Any other material that contains molybdenum will also help.
Chloride Stress Corrosion Cracking	Chlorides attacking austenitic stainless steel bellows (A240-304, A240-316, A240-321)	Use a high nickel alloy (B168-600, B443-625, B409-800)
Carbide Precipitation	At temperatures over 700 deg F, chromium carbides form in unstabilized grades of stainless steels (A240-304, A240-316). Corrosion is the result.	Use a stabilized grade of stainless steel (A240-321, A240-347), low carbon materials (A240-304L, A240-316L) or carbide precipitation resistant high alloy.

Shipping & Handling

Every expansion joint that leaves the factory is provided with installation instructions. These instructions describe the simple, straightforward requirements that must be followed to insure a trouble-free installation.

Shipping Bars - These are temporary attachments that "hold" the expansion joint at its correct installed length during shipping and installation. Angle iron or channel section is used and is always painted bright yellow. Shipping bars must never be removed until after the unit has been correctly welded or bolted into the piping system. Caution: Tie rods or limit rods are sometimes mistaken for shipping bars. **NEVER TAMPER WITH THESE ATTACHMENTS.**

NOTE: Great care must be taken when removing the shipping bars. If a welding or burning torch is used, ALWAYS protect the bellows element from burn splatter with a flame-retardant cloth or other shielding material.

Liners - When expansion joints are fitted with liners or internal sleeves, the unit is marked with an arrow indicating the direction of flow. The expansion joint must be installed in the system with flow in the correct direction.

Flanged Assemblies - These should be correctly aligned with their mating flanges (vanstone flanges permit some rotational misalignment). If a bellows is subjected to torosional forces due to hole misalignment, then reduced cycle life and/or bellows failure can occur.

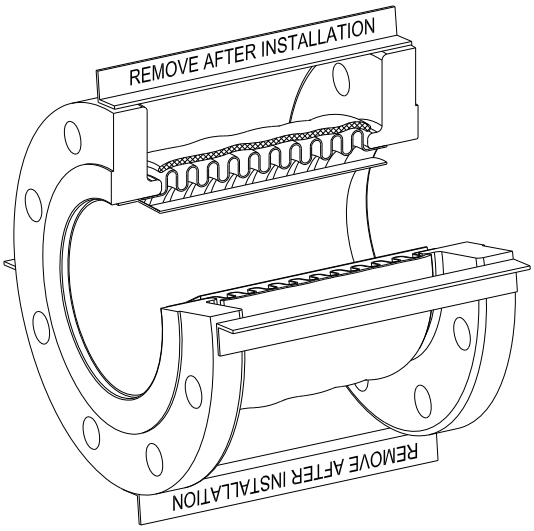
Weld End Assemblies - The bellows elements should always be protected during the welding process with flame retardant cloth or other shielding material. Weld splatter, arc strikes, or cutting torch sparks can cause serious damage to the thin bellows element.

Final System Check - After installation has been completed and shipping bars removed, check all anchors, guides, and pipe supports. Slowly apply test pressure to the system, checking for any unusual movement of the bellows anchors or guides. If movement is observed, immediately lower the pressure and re-examine the system for damage.

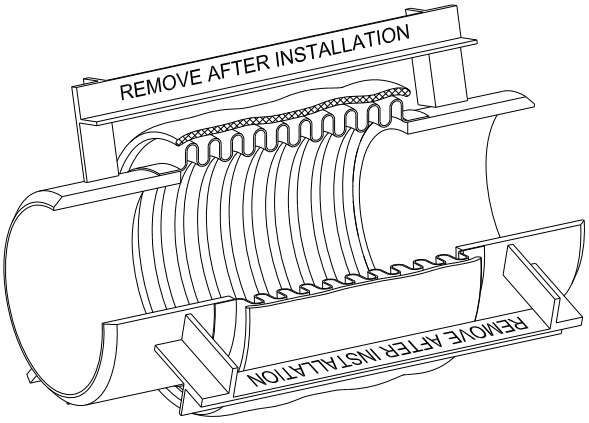
NOTE: Unless otherwise specified, all expansion joints are designed for a test pressure of 1.5 times the design pressure.



Yellow shipping bars on a rectangular expansion joint



Flanged expansion joint with shipping bars



Weld end expansion joint with shipping bars

UNRESTRAINED EXPANSION JOINTS: INSTALLATION GUIDELINES

Axial Movement

Single Bellows Assembly axial unrestrained expansion joints are not provided with attachments such as tie rods or hinges to restrain pressure thrust. Therefore, they can be used only in a piping system that incorporates correctly designed anchors and pipe alignment guides. These components prevent the bellows from over extension and damage due to distortion under operating conditions.

The diagram below shows the essential elements of a typical axial expansion joint installation that must be followed at all times.

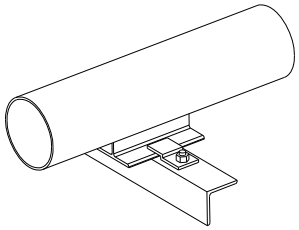
- **Types of Anchors**

MAIN ANCHORS are the most important to consider from a design standpoint. They must resist the effects of all forces acting upon them. These are pressure thrust, bellows spring resistance, frictional resistance of pipe guides, and inertial forces at bends and elbows.

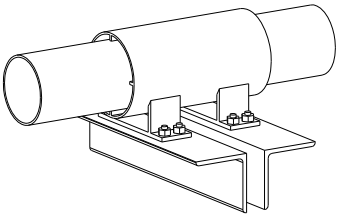
INTERMEDIATE ANCHORS are used to divide a long pipe run into shorter individual expanding sections, and should be structurally capable of withstanding bellows spring resistance and frictional forces only. Pressure thrust forces at this juncture are completely balanced and have no influence on the design of the anchor.

DIRECTIONAL ANCHORS permit movement in one direction only. The movement is often parallel to the direction of the lateral movement in installations where combinations of axial and lateral movements are encountered.

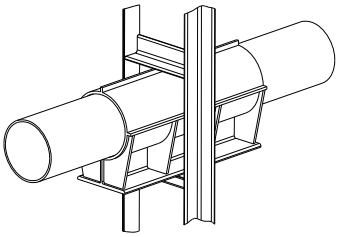
PIPE ALIGNMENT GUIDES are another essential part of a properly designed piping system. Thermal expansion in the system must be controlled so that the movement applied to the bellows assembly is axial only. Pipe alignment guides must be designed so they prevent bowing and buckling of the pipe. They should also keep frictional forces resulting from movement of pipe across the guide to a minimum.



Pipe Alignment Guide Style 1

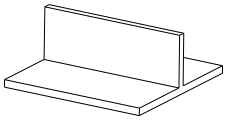


Pipe Alignment Guide Style 2

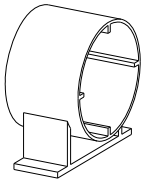


Pipe Alignment Guide Style 3

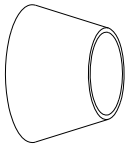
KEY TO SYMBOLS



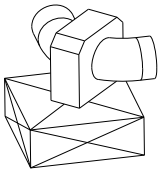
INTERMEDIATE ANCHORS



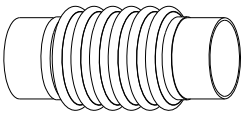
PIPE ALIGNMENT GUIDE



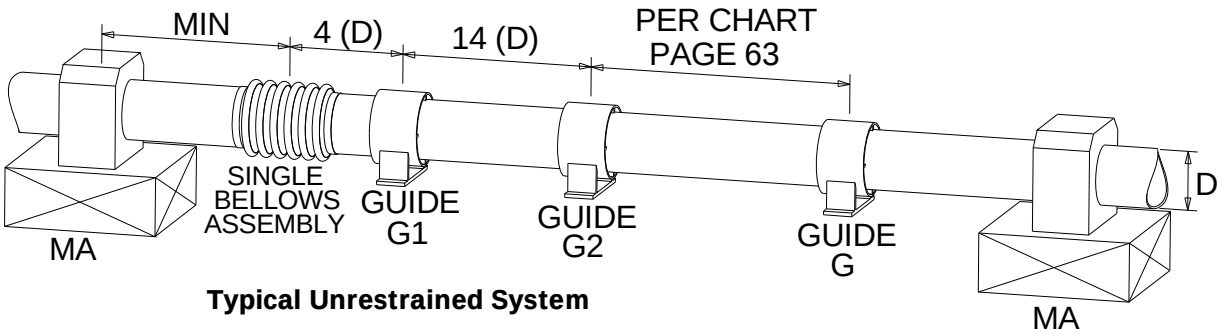
PIPE REDUCER



MAIN ANCHOR



SINGLE BELLOWS ASSEMBLY



Typical Unrestrained System

Application Engineering: Single Bellows Assembly

Figure 1 - This diagram shows the most basic application of a single bellows unrestrained type expansion joint. Installation sequence is as follows:

1. Install one expansion joint between main anchors (MA).
2. Locate main anchors at change in direction of piping.
3. Locate expansion joint immediately adjacent to a main anchor.
4. Space first pipe alignment guide (G1) within four pipe diameters of expansion joint.
5. The remaining guides (G) should be spaced in accordance with the pipe guide spacing chart as shown on page 64.

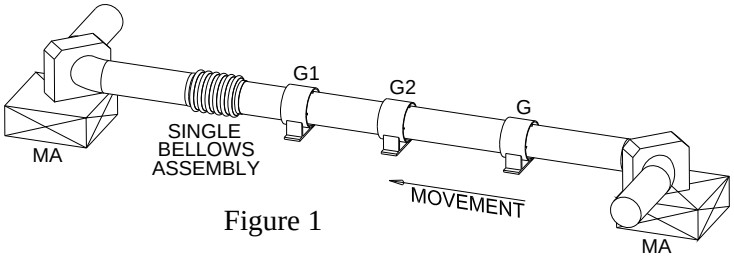


Figure 1

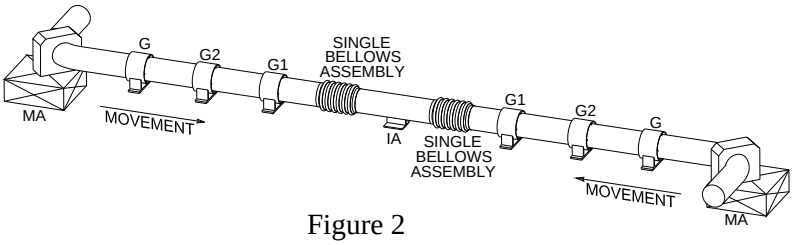


Figure 2

Figure 2 - When thermal expansion between the main anchors (MA) exceeds the capacity of a **Single Bellows Assembly**, then the pipe system must be divided into smaller sections. The use of an intermediate anchor (IA) located between two **Single Bellows Assemblies** or as an integral part of a **Universal Bellows Assembly** provides the best solution. Intermediate anchors, unlike main anchors, are designed to withstand spring resistance and frictional forces only. Pressure thrust at this juncture is canceled out because the effective areas of each of the bellows in the piping system are equal. Pipe alignment guides must be installed in accordance with the guidelines established above.

Figure 3 - If two expansion joints of different pipe diameters are used in the same section of pipe, such as a line containing a reducer, the pressure thrusts are no longer equal. In this case, the anchor dividing the expansion joints must be a main anchor designed to withstand the difference in pressure thrust generated by the different size expansion joints. Pipe alignment guides (G1) and (G2) and intermediate guides must be provided in the locations as shown in the diagram.

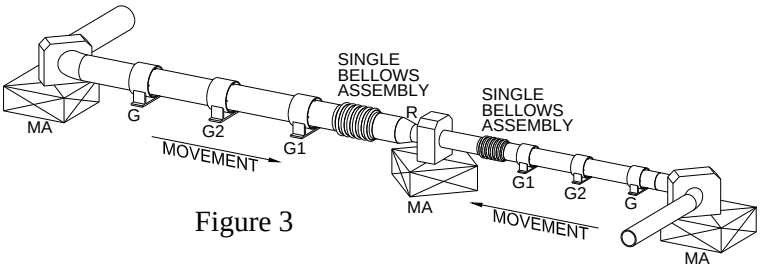


Figure 3

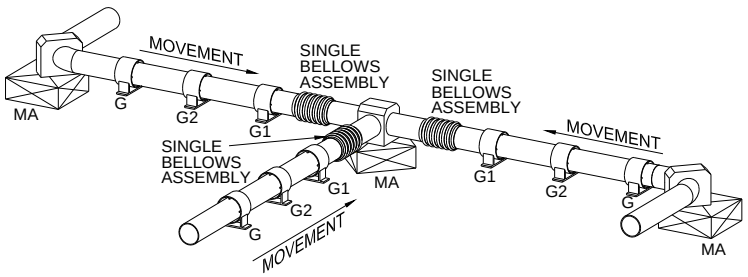


Figure 4

Figure 4 - A tee piece located in a pipeline makes a convenient location for dividing the pipe system into three separate expanding sections. The branch connection at this point is isolated from the effects of the thermal expansion present in the main pipe run. If an expansion joint is located in the branch line as depicted, then the fixed point at this location must be a main anchor. It is designed to absorb the pressure thrust of the branch line expansion joint. Pipe alignment guides must be provided in the locations as illustrated in the diagram.

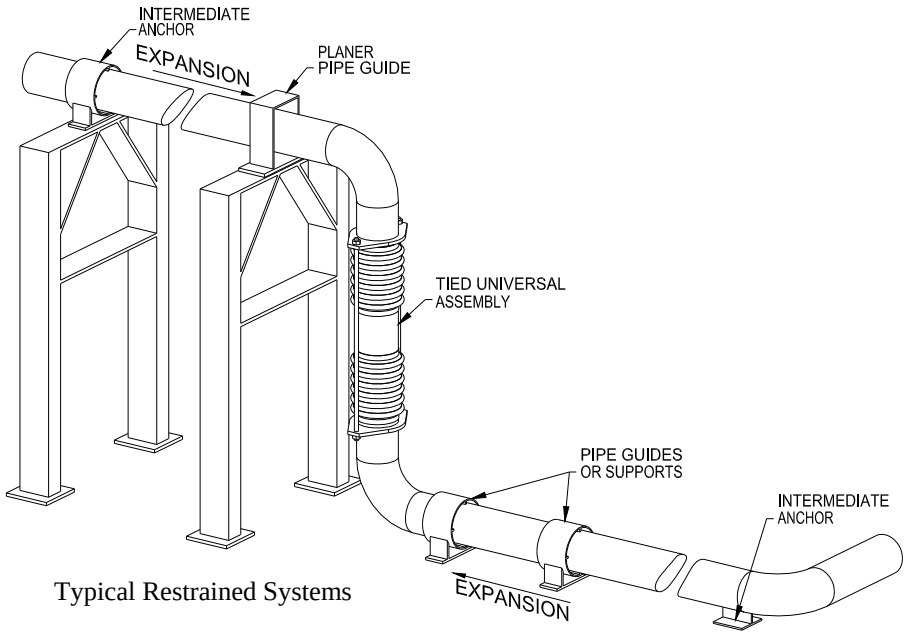
Restrained Expansion Joints: Installation Guidelines

Tied Expansion Joints

Tied expansion joints can be of the **Single** or **Universal Type** provided with restraints such as tie rods, hinges or gimbals. Tie rods and gimbals allow the expansion joint to move in all planes. Hinges allow movement in a single plane only. These restraints are designed to absorb the pressure thrust and other external loads like pipe dead weight. For restraints to remain effective, the expansion joint can absorb only lateral offset or angulation in directional changes in the piping system, such as "Z" bends, "U" bends, or "S" bends. Tied units are used where the equipment or adjacent structures cannot accommodate pressure thrust. The only forces experienced are low offset forces resulting from the lateral spring rate of the expansion joint and friction forces of the pipe guides. Tied units are frequently used to protect the nozzles of pumps, turbines and condensers, and to absorb expansion of ducting in elevated locations. Large amounts of expansion can be accommodated with resultant low offset forces by providing a long center-to-center distance between the two sets of bellows.

Installation Requirements

Although the initial cost of a Tied Expansion Joint is greater than a Single Bellows Type, considerable savings on anchors and guides can be achieved in certain applications.



Typical Restrained Systems

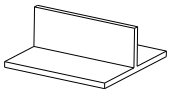
Anchors

Anchors used are the intermediate type, because the pressure thrust is absorbed by the expansion joint structural restraint. The location of the intermediate anchor is not as critical as that of a main anchor. The forces acting on the intermediate anchors are usually low offset forces resulting from the lateral spring resistance of the bellows, plus friction in guides. For this reason, a much lighter structure can be utilized to support the anchor, such as pipe racks, roof trusses, or elevated structures found in refineries and petrochemical plants.

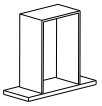
Pipe Alignment Guides

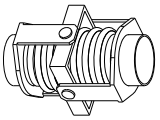
The weight of the pipe should be adequately supported along its length and, in particular, adjacent to the expansion joint. The pipe guides located nearest to the Tied Expansion Joint are planer pipe guides, which allow for the change in length of the offset leg as it swings through its movement arc. The diagram below shows the essential features in the correct use of Tied Expansion Joints.

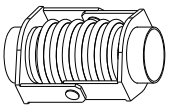
KEY TO SYMBOLS

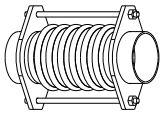

INTERMEDIATE ANCHOR

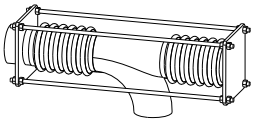

PIPE ALIGNMENT GUIDE


PLANER PIPE GUIDE


GIMBAL BELLOWS ASSEMBLY


HINGED BELLOWS ASSEMBLY


TIED OR UNIVERSAL BELLOWS ASSEMBLY


PRESSURE BALANCED ASSEMBLY

Application Engineering:
Tied Single Assembly
Tied Universal Assembly

Figure 1 - Tied **Single Assemblies** are often used to protect rotating equipment from the effects of thermal expansion in a piping system as shown. The tie rod restraint is designed to absorb pressure thrust, which in turn, allows the use of intermediate anchors rather than main anchors. A planer pipe guide or spring support hanger is used in the system as shown, allowing the thermal growth present in the vertical pipe leg to be taken as natural flexibility in the long horizontal pipe run.

Figure 1

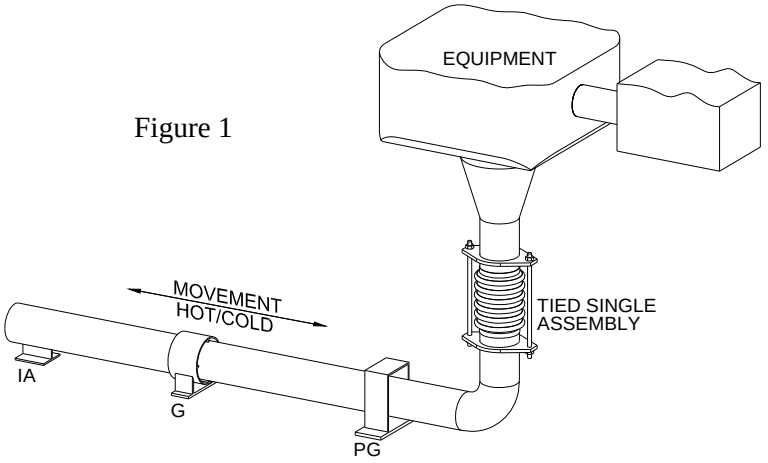


Figure 2

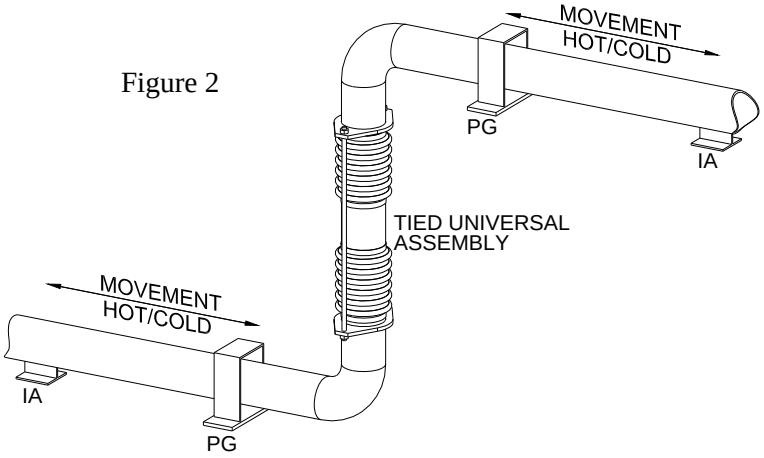
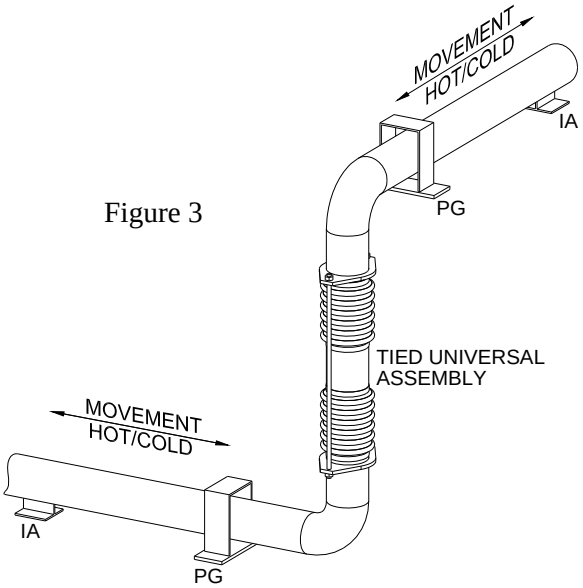


Figure 2 - There are many applications where thermal movement in the piping system is too great for a Tied **Single Assembly**. In these instances, a **Tied Universal Assembly** is the correct choice. The expansion joint assembly should be designed to fill the offset leg as shown so that axial movement within this pipe leg is absorbed by the bellows assembly. It is good practice to keep the maximum distance possible between the bellows. This results in low offset forces on adjacent equipment and structures. The center spool is usually supported by the tie rods or spring hangers when center spools are long and diameters large.

Figure 3 - A **Tied Universal Assembly** is often used to absorb thermal expansion in a multi-planer piping system as shown. This feature allows their use in a wide variety of different installations where main anchors and pipe alignment guides cannot be provided. The same design requirements as mentioned above also apply in this case. **Tied Universal Assemblies** are generally used to protect compressors, pumps, and turbines. They are also used to absorb thermal expansion in elevated piping systems found in oil refineries, power plants, and petrochemical installations.

Figure 3



Application Engineering:
Hinged Bellows Assembly
Gimbal Bellows Assembly

Figure 1 - When two **Hinged Bellows Assemblies** are installed in a "Z" offset, as shown, they can absorb large amounts of thermal movement in a piping system. The expansion joints should be cold sprung (pre-set in a deflected position) in order to maximize their movement capability. The thermal expansion in the offset leg is absorbed by the natural flexibility of the horizontal pipe runs. Pressure thrust is contained by the hinge restraint, allowing intermediate type anchors to be used. Planer pipe guides should permit the offset leg to swing through its movement arc as shown. It is good practice to make (L1) the maximum possible and (L2) a minimum.

Figure 1

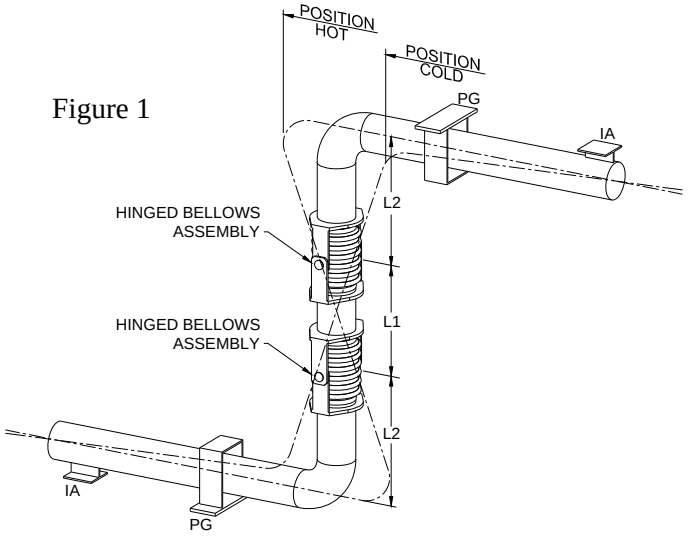


Figure 2

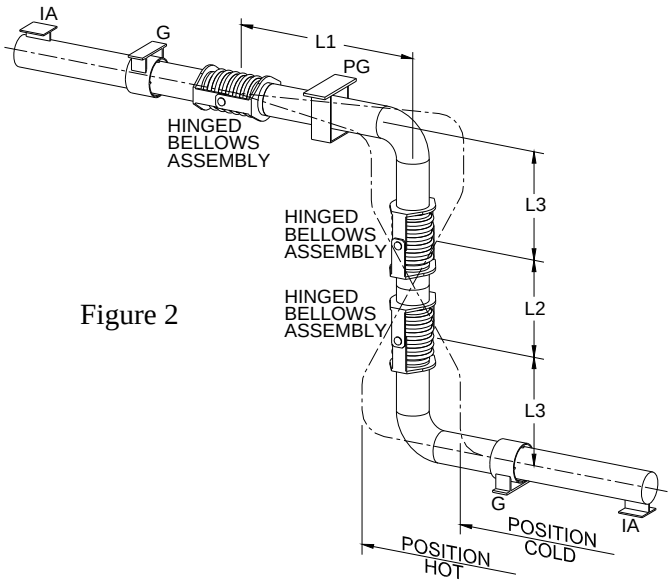


Figure 2 - This system of **Hinged Bellows Assemblies** is designed to absorb thermal movement in both the horizontal leg and vertical offset leg. Location of the expansion joints should be as follows: Make distance (L1) and (L2) the maximum possible, (L3) minimum possible. The hinge restraint is designed to absorb pressure thrust and weight of the pipe between the two **Hinge Units**. Forces on anchors and equipment connections are reduced to friction and low offset forces.

Figure 3 - In a long piping system, the number of expansion joints can be reduced by incorporating four **Hinged Assemblies** in a "U" bend system as shown. Pressure drop in the system is kept to a minimum, and pipe supports reduced in number when compared to a system using pipe loops. An intermediate anchor at the "U" bend Divides the system in two equal expanding pipe sections. Cold springing is used to increase the movement capability of the expansion joints.

Figure 3

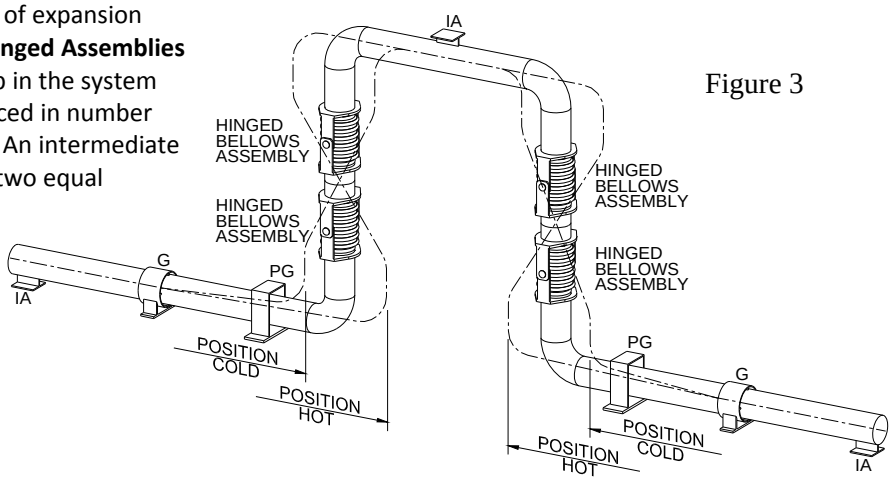


Figure 4 - The **Two-Hinged Bellows Assembly** system shown is often used where a pipeline crosses a roadway or rail line that is supported by a pipe bridge or trellis. The hinge restraint is designed to support the center spool between the expansion joints in addition to the pressure thrust generated by the system pressure. The **Hinged Assemblies** can be cold sprung, which further increases the overall movement capability of the expansion joints. Offset forces are usually low, hence loads on the bridge structure are kept to a minimum.

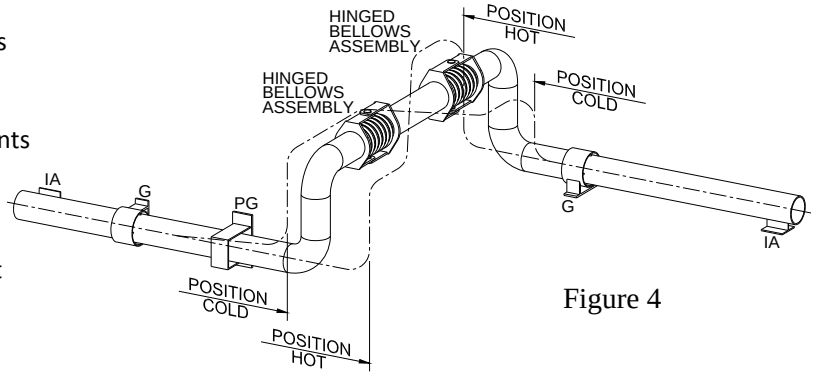


Figure 4

Figure 5

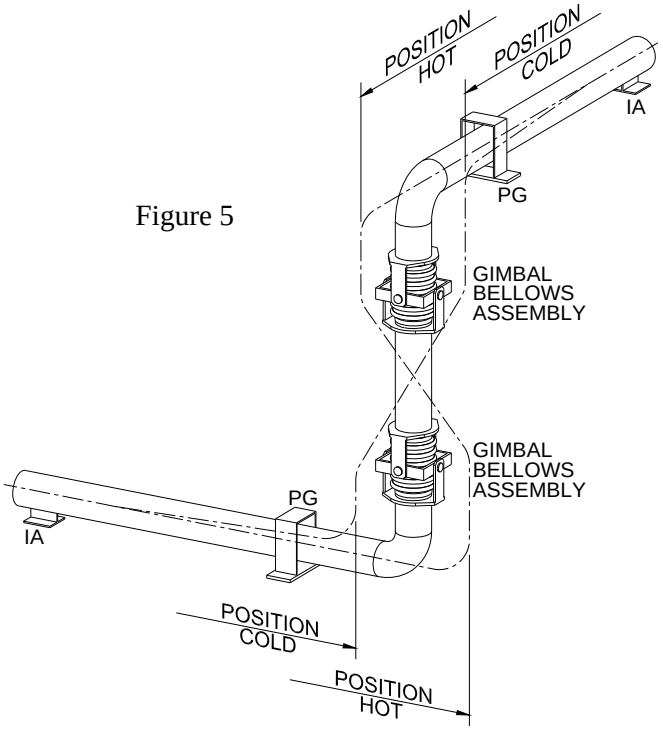


Figure 5 - In a multi-planer piping system the use of two **Gimbal Bellows Assemblies** in a multi-plane "Z" bend is the best solution. The gimbal restraint allows thermal expansion in two planes as shown, while still absorbing the pressure thrust. The thermal expansion in the offset leg is taken by the flexibility in the long horizontal pipe runs. The planer pipe guides shown control the direction of this vertical movement. Intermediate anchors are used to contain the resultant low offset forces.

Figure 6

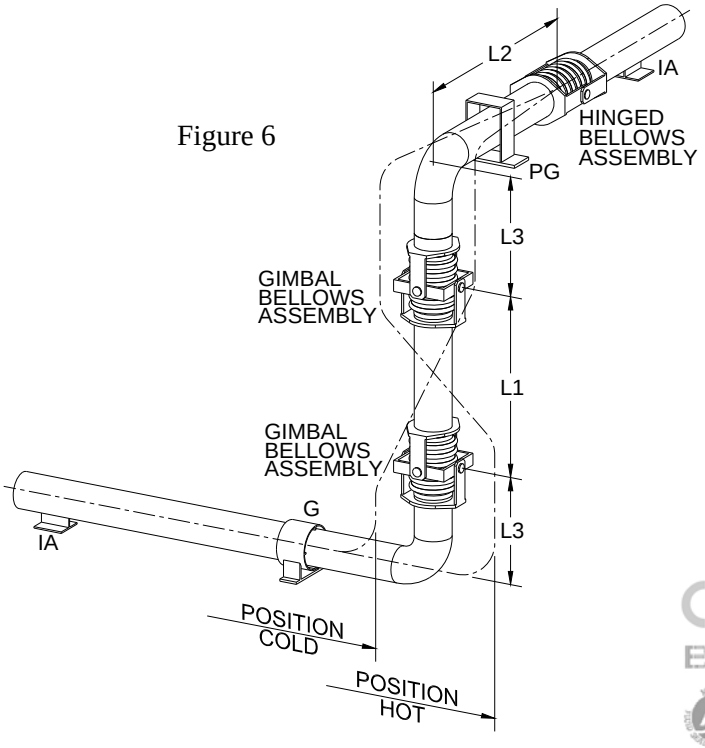


Figure 6 - There are many applications in a multi-planer piping system where the horizontal pipe leg is in-sufficiently flexible to absorb the thermal expansion in the offset leg. To accommodate this movement, a **Single Hinged Bellows Assembly** is used in conjunction with the two **Gimbal Bellows Assemblies** in the locations shown. It is good practice to make (L1) and (L2) the maximum possible with (L3) a minimum. A regular pipe guide must be used on the lower pipe leg, while a planer pipe guide is used on the upper leg.

Externally Pressurized Assembly



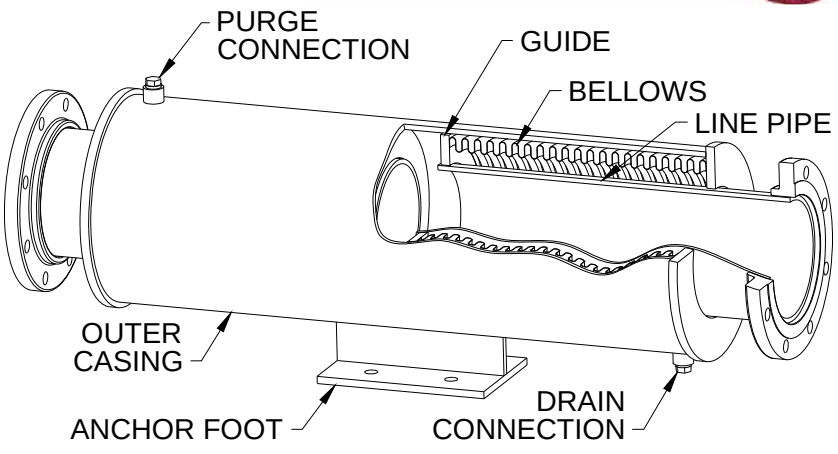
There are certain expansion joint applications that call for large axial movements. These are frequently encountered in steam distribution mains found in hospital, schools, or military installations. Internally pressurized assemblies become unstable even at low pressures when the number of convolutions reaches a certain limit; therefore, the problems created by these requirements cannot be solved using a **Single Bellows Assembly**. (If continually under pressure, an internally pressurized bellows will act as an unstable column under compression, and squirm.) In cases like these, an **Externally Pressurized Assembly** provides the most viable solution. When pressure is applied externally to the bellows, as shown in the diagram **below**, the bellows are placed under tension. In this condition squirm does not become a factor. A greater number of convolutions can be added to the bellows even at higher pressures, resulting in increased movement capability. This style joint has the added benefit of self-draining convolutions. All the trapped liquid media can be purged from the outer casing eliminating the possibility of liquid "flashing" to vapor.



An anchor foot can be added to the **Single Externally Pressurized Style** allowing it to act as an intermediate anchor. The anchor foot is designed to withstand any loads produced by the deflection of the bellows. **Dual Style Externally Pressurized** designs are equipped with an anchor foot as a standard. The internal and external rings on both styles act as a pipe guide so no first guide (G1) is necessary.

Design Features

* Bellows protection
* Smooth flow - oversize bellows
* Drain connection
* Purge connection
* Fail-safe design
* Self-Draining convolutions
* Joint acts as first guide



Pressure Balanced Assembly

A **Pressure Balanced Assembly** is designed to absorb axial movement and/or lateral deflection, while absorbing pressure thrust. This is achieved by means of tie rod devices interconnecting a line bellows with an opposed balanced bellows also subjected to line pressure. This type of expansion joint can be used at a change in direction of the piping system or directly in the line as an **In-Line Pressure Balanced Assembly**.



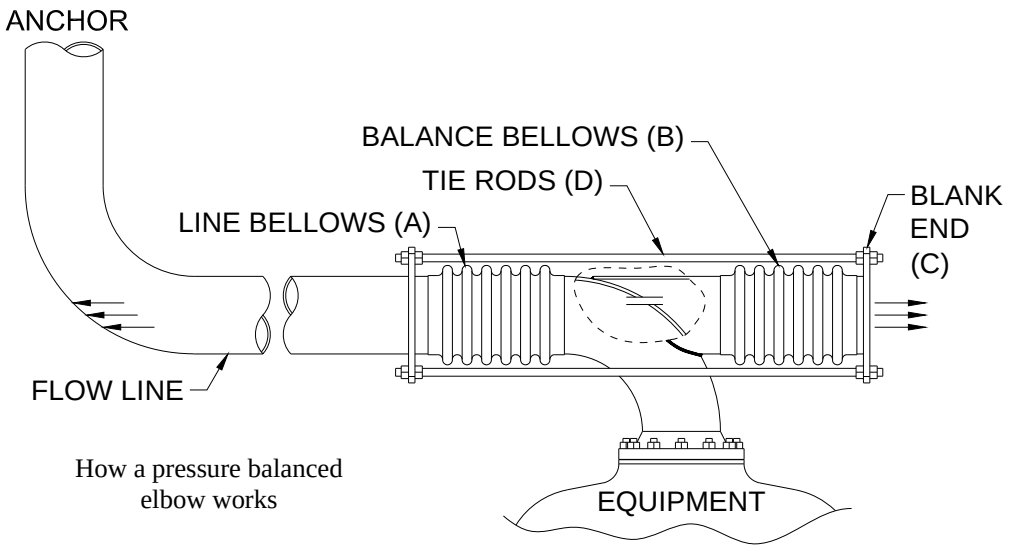
Pressure Balanced Unit with Manufactured Elbow

Principle of Operation

Reference to the diagram below shows that during the movement cycle, internal pressure acting on the bellows element (A), which is in the flow line, is balanced by the same pressure in the balancing bellows element (B). The force exerted by the internal pressure against the line elbow is balanced by an equal and opposite force transmitted to the line through the tie rods (D) from the blank end (C) of the balancing section.

This type of expansion joint is usually seen at a turbine casing or other piece of rotating equipment where minimum forces and moments are required. It is also used in installations where the application of a main anchor would not be practical. The only loads seen by the turbine are the sum of the axial force required to compress or extend the line bellows and balancing bellows in the expansion joint.

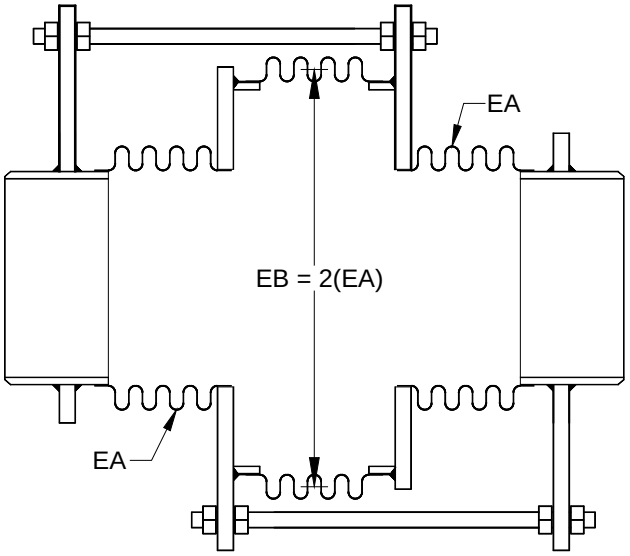
Example: In a pipeline with unrestrained expansion joints, the maximum load on the anchors always occurs at the change of direction in the piping system. Such an anchor is always a main anchor. The load exerted at this point is composed of the internal pressure acting over the effective area of the bellows plus the force required to flex the expansion joint (see Pressure Thrust **page 8**). In a large expansion joint, or one operating under extremely high pressure, the resultant pressure thrust is considerable. To eliminate the thrust, a **Pressure Balanced Assembly** is the most practical solution.



How a pressure balanced elbow works

In-Line Pressure Balanced Assembly

An In-Line Pressure Balanced Assembly is designed to absorb small amounts of axial and lateral movement while counteracting the pressure thrust in a system. This is achieved with a series of rods similar to the Pressure Balanced Elbow Assembly and a balancing bellows with twice the effective area as the line bellows. The elimination of the elbow is what makes this expansion joint unique.



EA = SMALL BELLOWS EFFECTIVE AREA
EB = LARGE BELLOWS EFFECTIVE AREA

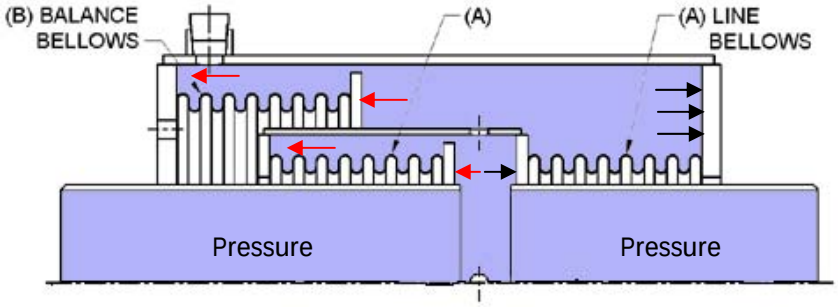
Principle of Operation

Reference to the diagram below shows that the effective area of the balancing bellows (EB) is twice that of the line bellows (EA). These forces act across the tie rods that are attached to the tie plates. There is no change in pressure when the system is moved because the volume does not change. As the line bellows are compressed, the balancing bellows is extended causing no volume change.

This type of expansion joint is usually seen between two Pieces of load sensitive equipment where minimum forces And moments are required. It is also used in installations where the application of a main anchor would not be practical. The only loads seen by the equipment are the sum of the Axial force required to compress or extend the line bellows And balancing bellows in the expansion joint.

Externally Pressurized Pressure Balanced Assembly

An Externally Pressurized Pressure Balanced Assembly is very similar to an In-Line Pressure Balanced assembly but it is capable of large amounts of axial movement. This is achieved by pressurizing the bellows externally eliminating the possibility of bellows squirm. This design has the added benefit of being self guided with self draining convolutions. Again, no elbow is need in this system.



How an externally pressurized pressure balanced assembly works

Principle of Operation

Reference to the diagram bellows shows a series of opposing forces. The different color arrows act against each other to balance the system eliminating the need for main anchors. There is no change in pressure when the system is moved because the volume does not change. As the line bellows (A) are compressed, the balancing bellows (B), which has twice the effective area as (A), is extended causing no volume change.

This type of expansion joint is also seen between two pieces of load sensitive equipment where minimum forces and movements are required. It is also used in steam line installations where pipe main anchors are far apart. The only loads seen by the equipment are the sum of the axial force required to compress or extend the line bellows and balancing bellows in the expansion joint. Modified versions of this style are used in direct burial applications.

Application Engineering
Pressure Balanced Assembly

Figure 1 - This example shows a single **Pressure Balanced Assembly** used to protect rotating equipment from the effects of thermal expansion between two intermediate anchors (IA). In operation, the thermal growth in the system compresses the line bellows (A). Internal pressure acting through the tie rods instantaneously elongates the balancing bellows (B) an equal amount, providing a completely balanced system.

If no lateral movement is present, the number of convoluti in bellows (A) and (B) are equal. **Pressure Balanced Assemblies** are frequently used on gas and steam turbines pumps, and condenser installations.

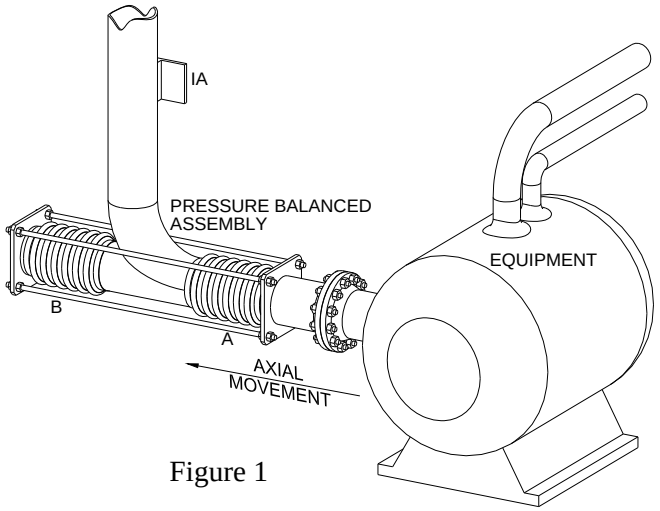


Figure 1

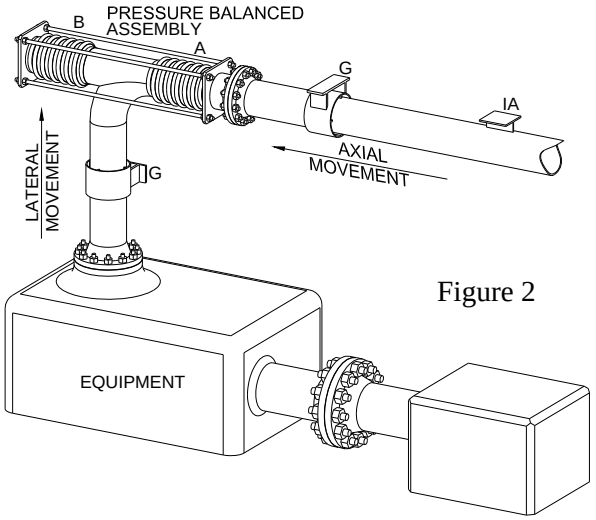


Figure 2

Figure 2 - A single **Pressure Balanced Assembly** can be used to absorb lateral and axial movement. In the example shown, bellows (A) has sufficient convolutions to absorb both the axial and lateral movement present in the piping system. The balancing bellows (B) requires only sufficient convolutions to compensate for the axial movement present in the horizontal line. Intermediate anchors (IA) and pipe alignment guides (G) should be installed in the locations shown.

Figure 3 - There are many installations where the lateral movement present in the system exceeds the capability of a single **Pressure Balanced Bellows Assembly**. This problem is best overcome by the use of a **Universal Pressure Balanced Assembly** as shown. The line bellows (A1) and (A2) are linked by a section of pipe that allows greater lateral movement in addition to the axial movement present. The balancing bellows (B) is designed to compensate for axial movement only. Tie rods link both sets of bellows and absorb the pressure thrust, resulting in low forces on adjacent equipment and structures. This design finds wide application on turbine/condenser crossovers, boiler feed water pumps, and other critical applications.

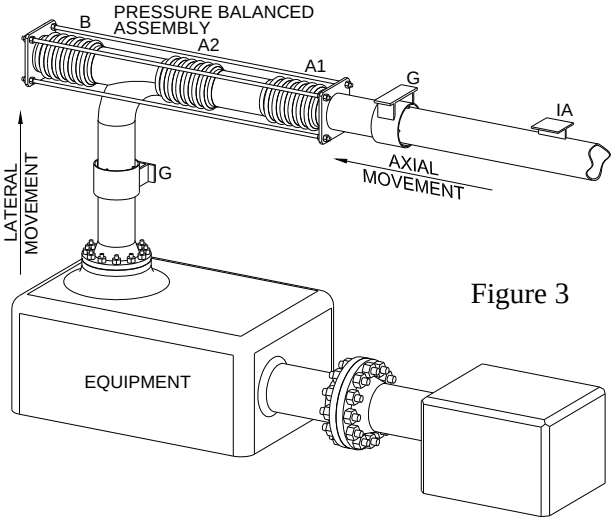
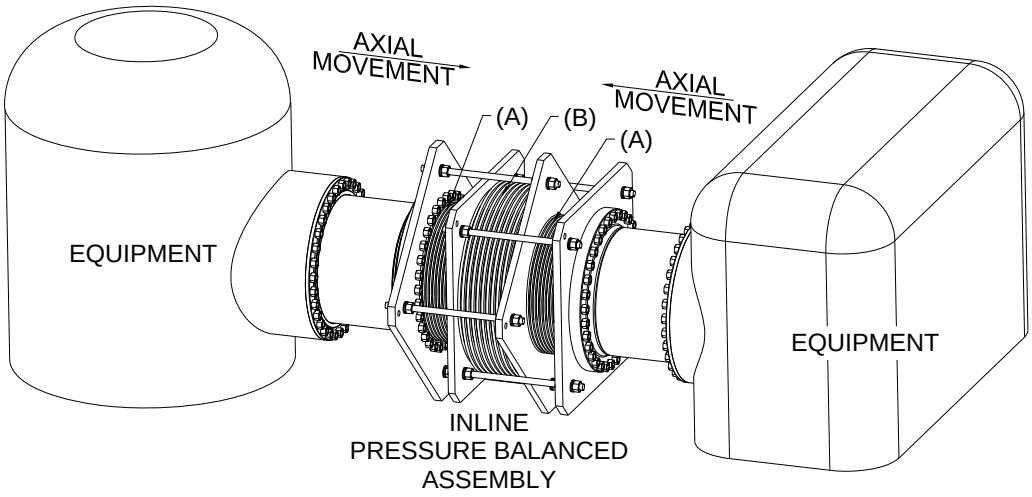


Figure 3

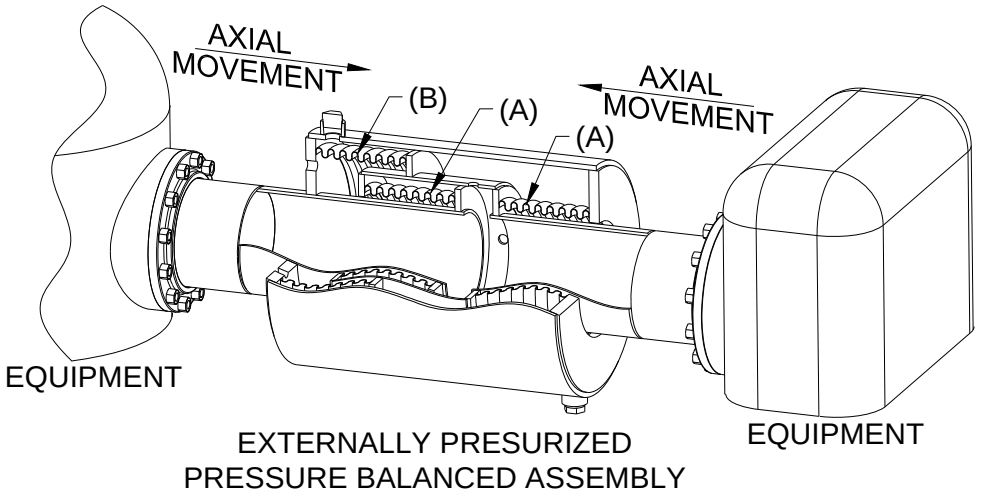
Application Engineering
In-Line Pressure Balanced Assembly

Figure 1 - This example shows an In-Line Pressure Balanced unit in a typical installation. The two pieces of equipment are load sensitive requiring very low forces and moments at the flanged attachments. Both pieces of equipment are allowed to expand due to temperature while the In-Line Pressure Balanced Assembly absorbs all the axial growth. This style of expansion joint should be guided if the lengths of pipe between the equipment and the expansion joint exceed four times the diameter of the pipe.



Externally Pressurized Pressure Balanced Assembly

Figure 2 - This example shows an Externally Pressurized Pressure Balanced Assembly in a typical installation. The two pieces of equipment are very load sensitive requiring low forces and moments at the flanged attachments. Both pieces of equipment are allowed to expand due to temperature while the Externally Pressurized Pressure Balanced Assembly absorbs all the axial growth. The first pipe guide is internal to the expansion joint so the next set of guides start at 14 times the diameter of the line pipe. This type of system can absorb much larger amounts of axial growth than the In-Line Pressure Balanced Assembly.



Specifying Standard Expansion Joints

Before a part number can be created, certain information about the expansion joint must be known. The following list shows the minimum data required to specify an KEB-EJS standard catalog part:

1. Nominal Diameter
2. Design Temperature
3. Design Pressure
4. Movements
5. End Type

Required Number				Options											
ES -	**40043**	**-**	**083**	**-**	**M1**	**-**	**TR**	**-**	**L**	**-**	**C**	**-**	**V**		
	Product Code: located at the top of the page		Part Code: 3 or 4 Options per diameter		Bellows Material: M1-304 SS M2-316 SS M3-321SS Ref: pg. 14		Rods: TR-Tie Rods LR-Limit Rods Ref. Pg 13		Liners Ref. Page 13		Covers Ref. Pg 13		Vanstone Ends: Flanged Only Ref. Pg.12		

Example 1:

Nominal Diameter = 6", Design Temperature = 750 Deg F, Design Pressure = 236 psig, 0.75" of axial compression, flanged ends required, the line will be insulated and main anchors are present. Corrosion from carbide precipitation is a problem due to the temperature in this system.

The movement for this expansion joint is small, so try a Single Style Expansion Joint first. Page 36 contains the 6" single expansion joints rated for 300 psig. Note 1, at the bottom of the page shows a maximum operating temperature of 800 Deg F that is greater than the required 750 Deg F. The image at the top of the data page (36) shows that ES-40023 is the Product Code for Single Flanged Units at 300 psig. There are four Part Code choices in the 6" nominal rows (-061,-062,-063,-064). The -062 will accept 0.88" of compression which is greater than the required 0.75". 321 Stainless Steel is chosen for the bellows (M3) because of its resistance to carbide precipitation (see page 15). A cover C is selected as an option because of the external insulation. No rods are necessary because of the main anchors.

ES - 40023 - 062 - M3 - C

Finished Part Number for Example 1

Example 2:
Nominal Diameter = 20", Design Temperature = 290 Deg F, Design Pressure = F.V to 25 psig. The joint will be welded in a high flow, saturated steam system that requires 3.25" of lateral offset. There are no main anchors in the system. First, try a Single Expansion Joint for this pressure on page 33. The maximum lateral movement a 20" Single Expansion Joint can take is 0.75" (Part Code -204). Next, try a Universal Style Expansion Joint for this pressure on page 39. Part Code -203 will absorb 3.75" of lateral movement. The Product Code at the top of the page for a weld end expansion joint for FV/50 psig is ES-40030. 304 stainless steel (M1) is chosen for the bellows material because of the temperature and medium (see page 15). The tie rod TR will be necessary because there are no main anchors to absorb the pressure thrust. The liner option L will be added because of the high flow steam and a cover option C will be added to guard against bellows damage during installation.

ES - 40030 - 203 - M1 – L - C - TR

Finished Part Number for Example 2

Example 3:
Nominal Diameter = 3", Design Temperature = 6500 F, Design Pressure = 300 psig. Axial movement is 12" of compression in a long straight pipe run between main anchors and flanged ends are required. This is a large amount of axial so try a Single Externally Pressurized
Expansion Joint. Page 49 shows the ES-40073, 300 psig Single Externally Pressurized Joints; but the -032 can only accept 8" of axial compression. The next step is to try a Dual Externally Pressurized Expansion Joint. Page 51 shows an ES-40103, 300 psig expansion joint with Part Code -032 that will absorb 16" of axial compression. 304 stainless steel (M1) is chosen for the bellows material because of the temperature and medium (see page 15). The Dual Externally Pressurized Expansion Joint will be used as an intermediate anchor half way between the two main anchors. This will force the movement to be distributed evenly on both sides of the joint.

ES - 40103 - 032 - M1

Finished Part Number for Example 3

Notes:
1. All movements listed in the various data sheets are maximum non-concurrent. For combining movements, refer to page 64.
2. If customer design requirements exceed the parameters for the standard catalog parts, KEB-EJS will be pleased to quote custom parts. Complete the Design Data sheet on page 76 and return to KEB-EJS by fax (619) 562-0636, call 1-800-826-3058/+1 (619)562-6083,
E-mail: sales@Keb-ejs.com or visit us on the web at www.keb-ejs.com

Standard Metal Expansion Joints

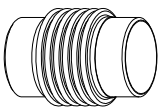
Data Sheets

- Single Assembly
- Universal Assembly
- Low Pressure/Large Diameter
- Externally Pressurized
- Exhaust Assembly

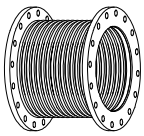
KE-Burgmann EJS offers the following standard metal expansion joint as well as many customer types that are not features in the section. Please contact one of our product specialists at (800) 482-2808 or (619) 562-6083 for a design not included in this catalog or visit **www.keb-ejs.com**

FV/ 50 PSIG

SINGLE ASSEMBLY



ES-40010
WELD END



ES-40020
FLANGED

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40010			ES-40020	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	TIED OAL	WEIGHT	OAL*	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	IN	LBS	IN	LBS
3 INCH 13 SQ. IN.	-031	0.61	0.09	10	418	2856	15	7.63	10.88	4/22	3.13	8/17
	-032	1.23	0.39	10	214	341	7	9.63	14.13	4/24	5.13	11/21
	-033	1.47	0.72	10	281	196	10	11.63	16.63	5/25	7.13	13/24
	-034	1.39	0.87	10	505	215	18	13.25	18.00	5/26	8.75	16/28
3 1/2 INCH 16 SQ. IN.	-351	0.60	0.08	10	459	3965	20	7.63	10.88	5/25	3.13	12/21
	-352	1.23	0.35	10	233	472	10	9.63	14.13	5/27	5.13	15/25
	-353	1.59	0.75	10	286	214	13	12.13	17.38	6/29	7.63	17/29
	-354	1.48	0.87	10	525	249	23	13.75	18.75	6/29	9.25	20/33
4 INCH 21 SQ. IN.	-041	1.51	0.32	10	152	525	9	9.13	14.13	6/32	4.63	16/26
	-042	1.78	0.56	10	215	356	12	10.63	16.13	7/34	6.13	18/30
	-043	1.63	0.69	10	389	363	22	12.25	17.50	7/35	7.75	21/34
	-044	2.01	1.04	10	316	195	18	13.75	19.75	8/36	9.25	24/37
5 INCH 30 SQ. IN.	-051	1.34	0.20	10	182	1276	15	8.63	13.38	8/40	4.13	17/28
	-052	1.76	0.46	10	229	560	19	10.63	16.13	9/42	6.13	20/32
	-053	1.82	0.68	10	383	453	32	12.75	18.50	10/44	8.25	23/37
	-054	1.82	0.89	10	580	404	49	14.88	20.63	12/46	10.38	27/42
6 INCH 43 SQ. IN.	-061	1.28	0.19	10	382	2734	45	9.00	14.25	11/73	4.75	19/34
	-062	2.07	0.51	10	241	649	29	11.13	17.88	11/77	6.88	22/38
	-063	2.43	0.92	10	355	413	42	14.00	21.50	13/80	9.75	26/43
	-064	2.46	1.18	10	535	387	64	16.25	24.00	15/83	12.00	29/48
8 INCH 70 SQ. IN.	-081	1.46	0.17	10	371	4347	72	9.00	14.50	16/97	4.75	24/45
	-082	2.34	0.38	10	233	1028	45	11.13	18.38	17/103	6.88	27/50
	-083	2.33	0.62	10	393	903	77	13.25	20.50	19/105	9.00	31/56
	-084	2.51	0.94	10	555	657	108	16.25	24.00	22/110	12.00	36/63
10 INCH 106 SQ. IN.	-101	1.49	0.14	10	369	6572	109	9.00	14.75	22/114	4.75	34/73
	-102	2.43	0.30	10	231	1547	68	11.13	18.63	23/123	6.88	38/80
	-103	2.29	0.46	10	428	1771	127	12.63	19.88	25/125	8.38	42/87
	-104	2.90	0.94	10	517	811	153	17.00	25.50	30/137	12.75	49/102

Weights: Untied/Tied

Notes:

1. Max Temperature - 800 deg F
2. Movements are maximum non-concurrent. See page 65 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 3,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 50 psig.
7. Refer to page 68 for torsional spring rates.
8. Liners are not available for 3",3.5" and 4" diameters
9. TR option movement limitations: 8" and below, angular and lateral only. For 10" and above, only lateral movemenet.
10. Refer to page 66 for flange dimensions and drillings.

Materials

- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- Plate C.S. 150# Drilling
- Liner- same as bellows (w/ drain holes)*
- Cover- C.S.

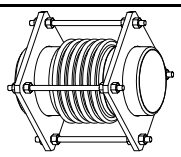
* Add 0.25" to OAL for vanstone option with liner.

Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Rod	-	Liner	-	Cover	-	Vanstone
	ES-40010	-	083	-	M1	-	LR	-	L	-	C	-	-

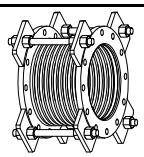
See page 29 for details on part number options.

FV/ 50 PSIG

SINGLE ASSEMBLY



ES-40010
WELD END W/ RODS



ES-40020
FLANGED W/RODS

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40010			ES-40020	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	TIED OAL	WEIGHT	OAL*	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	IN	LBS	IN	LBS
12 INCH 151 SQ. IN.	-121	2.48	0.32	10	402	4014	169	10.88	18.63	30/160	7.00	46/101
	-122	3.30	0.43	10	301	1712	127	12.63	22.13	31/171	8.75	49/108
	-123	3.10	0.82	10	670	1564	282	16.63	25.88	39/179	12.75	59/124
	-124	3.20	1.24	10	1112	1235	468	21.63	30.88	51/194	17.75	73/147
14 INCH 183 SQ. IN.	-141	1.78	0.17	10	763	13145	388	10.00	16.50	33/179	6.38	49/127
	-142	2.51	0.35	10	545	4676	277	11.88	19.88	36/191	8.25	53/138
	-143	3.28	0.72	10	593	2019	302	15.63	25.13	43/210	12.00	62/159
	-144	3.32	1.03	10	1023	1758	521	19.75	29.25	55/226	16.13	77/186
16 INCH 234 SQ. IN.	-161	1.73	0.15	10	863	19031	562	10.00	16.25	38/189	6.50	106/191
	-162	2.44	0.30	10	616	6767	401	11.88	19.63	41/202	8.38	111/202
	-163	3.20	0.62	10	672	2926	438	15.63	24.88	49/223	12.13	121/224
	-164	3.40	0.93	10	1177	2588	766	19.75	29.50	63/244	16.25	137/253
18 INCH 291 SQ. IN.	-181	1.69	0.13	10	963	26439	781	10.00	16.25	43/198	6.63	135/220
	-182	2.38	0.26	10	687	9398	557	11.88	19.63	46/213	8.50	140/231
	-183	3.75	0.64	10	437	2431	355	15.50	26.00	52/240	12.13	148/250
	-184	4.28	0.90	10	550	1588	446	19.38	30.88	62/261	16.00	160/275
20 INCH 359 SQ. IN.	-201	1.53	0.08	8.22	1018	53078	1017	9.13	15.13	47/202	5.88	143/227
	-202	2.31	0.19	10	678	15352	677	11.00	18.50	51/219	7.75	148/240
	-203	3.42	0.49	10	706	5654	705	14.75	24.50	61/249	11.50	161/264
	-204	3.66	0.75	10	1198	4677	1198	18.75	29.00	80/275	15.50	181/297
22 INCH 429 SQ. IN.	-221	1.57	0.08	7.72	1123	70065	1343	9.13	15.13	52/253	6.00	177/310
	-222	2.27	0.17	10	741	20079	886	11.00	18.50	56/274	7.88	183/329
	-223	3.78	0.49	10	445	4379	532	14.63	25.13	63/312	11.50	192/356
	-224	4.74	0.87	10	553	2737	662	18.38	30.88	77/348	15.25	208/390
24 INCH 506 SQ. IN.	-241	1.56	0.07	7.07	1222	89792	1721	9.13	15.63	57/304	6.13	200/333
	-242	2.36	0.17	10	813	25957	1145	11.00	19.25	61/328	8.00	206/354
	-243	3.92	0.47	10	488	5662	688	14.63	25.88	69/370	11.63	216/382
	-244	4.71	0.79	10	602	3509	848	18.38	31.13	84/403	15.38	233/417

Weights: Untied/Tied

Notes:

1. Max Temperature - 800 deg F
2. Movements are maximum non-concurrent. See page 65 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 3,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 50 psig.
7. Refer to page 68 for torsional spring rates.
8. TR option movement limitations: 8" and below, angular and lateral only. For 10" and above, only lateral movemenet.
9. Refer to page 66 for flange dimensions and drillings.

Materials

- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- Plate C.S. 150# Drilling
- Liner- same as bellows (w/ drain holes)*
- Cover- C.S.

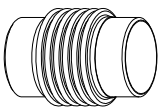
* Add 0.25" to OAL for vanstone option with liner.

Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Rod	-	Liner	-	Cover	-	Vanstone
	ES-40020	-	162	-	M3	-	TR	-	L	-	C	-	V

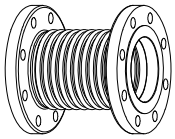
See page 29 for details on part number options.

150 PSIG

SINGLE ASSEMBLY



ES-40011
WELD END



ES-40021
FLANGED

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40011			ES-40021	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	TIED OAL	WEIGHT	OAL*	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	IN	LBS	IN	LBS
3 INCH 13 SQ. IN.	-031	0.45	0.07	10	852	5113	30	7.75	11.50	4/26	4.38	16/23
	-032	0.90	0.19	10	420	671	15	9.63	14.13	4/27	6.25	17/24
	-033	1.06	0.37	10	631	421	22	11.75	16.50	5/28	8.38	17/25
	-034	1.01	0.64	10	989	408	35	13.38	18.13	6/29	10.00	18/26
3 1/2 INCH 16 SQ. IN.	-351	0.45	0.06	10	937	7119	42	7.75	11.75	5/34	4.50	22/29
	-352	0.89	0.25	10	463	937	21	9.63	14.38	5/35	6.38	23/30
	-353	1.14	0.19	10	647	465	29	12.25	17.50	6/37	9.00	24/31
	-354	1.05	0.63	10	1045	481	46	13.88	18.88	7/38	10.63	24/32
4 INCH 21 SQ. IN.	-041	0.81	0.18	10	723	2325	42	9.25	13.75	7/40	6.13	27/35
	-042	1.15	0.13	9.1	506	797	29	10.75	16.00	7/42	7.63	28/36
	-043	1.20	0.51	10	756	679	43	12.38	17.88	8/43	9.25	29/37
	-044	1.22	0.66	10	1063	597	61	14.13	19.63	9/45	11.00	30/38
5 INCH 30 SQ. IN.	-051	0.71	0.11	10	893	5759	76	8.75	13.75	9/65	5.88	31/41
	-052	0.96	0.26	10	1043	2305	88	10.88	16.38	10/67	8.00	33/43
	-053	1.10	0.42	10	1293	1428	109	13.00	18.75	11/69	10.13	34/45
	-054	1.42	0.65	10	1005	664	85	15.13	21.38	13/72	12.25	35/46
6 INCH 43 SQ. IN.	-061	0.71	0.11	10	1647	10970	196	9.13	13.88	11/89	6.63	40/55
	-062	1.14	0.29	10	1030	2655	122	11.25	17.00	12/93	8.75	41/57
	-063	1.84	0.70	10	669	755	80	14.13	21.38	14/98	11.63	42/59
	-064	1.68	0.77	10	1008	802	120	15.75	22.50	15/99	13.25	44/61
8 INCH 70 SQ. IN.	-081	0.76	0.09	9.23	1667	18180	325	9.13	14.13	17/113	7.00	63/81
	-082	1.22	0.24	10	1042	4398	203	11.25	17.25	18/118	9.13	64/83
	-083	1.42	0.40	10	1300	2714	253	13.63	19.88	21/122	11.50	66/86
	-084	1.44	0.57	10	2262	2388	441	16.88	23.38	26/129	14.75	72/92
10 INCH 106 SQ. IN.	-101	0.69	0.07	6.83	2849	43955	842	9.25	14.00	24/150	7.50	90/135
	-102	1.10	0.18	10	1783	10932	527	11.38	17.13	27/159	9.63	92/140
	-103	1.38	0.28	10	1425	5494	421	12.88	19.13	28/164	11.13	94/142
	-104	1.75	0.59	10	2165	3112	640	17.50	24.50	37/180	15.75	102/155

Weights: Untied/Tied

Notes:

1. Max Temperature - 800 deg F
2. Movements are maximum non-concurrent. See page 65 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 3,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 150 psig.
7. Refer to page 68 for torsional spring rates.
8. Liners are not available for 3", 3.5" and 4" diameters
9. TR option movement limitations: 8" and below, angular and lateral only. For 10" and above, only lateral movemenet.
10. Refer to page 66 for flange dimensions and drillings.

Materials

- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- 150# RFSO A105
- Liner- same as bellows (w/ drain holes)*
- Cover- C.S.

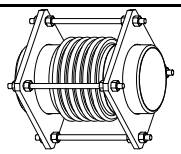
* Add 0.25" to OAL for vanstone option with liner.

Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Rod	-	Liner	-	Cover	-	Vanstone
	ES-40011	-	083	-	M1	-	LR	-	L	-	C	-	-

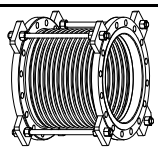
See page 29 for details on part number options.

150 PSIG

SINGLE ASSEMBLY



ES-40011
WELD END W/RODS



ES-40021
FLANGED W/RODS

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40011			ES-40021	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	TIED OAL	WEIGHT	OAL*	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	IN	LBS	IN	LBS
12 INCH 151 SQ. IN.	-121	1.05	0.14	8.67	3156	28806	1329	11.13	16.63	34/212	10.00	138/212
	-122	1.41	0.25	10	2362	11733	995	13.13	19.38	37/221	12.00	141/217
	-123	2.28	0.67	10	1456	2801	613	17.75	25.75	45/242	16.63	148/229
	-124	2.50	0.99	10	2212	2346	931	22.00	30.50	58/261	20.88	161/246
14 INCH 183 SQ. IN.	-141	1.01	0.10	7.62	3070	47461	1562	10.25	15.75	37/213	9.25	190/260
	-142	1.41	0.20	10	2194	17436	1116	12.13	18.38	41/222	11.13	194/266
	-143	1.90	0.44	10	2778	8583	1413	16.13	23.38	53/244	15.13	206/282
	-144	2.59	0.82	10	2037	3379	1036	20.00	28.75	62/265	19.00	215/294
16 INCH 234 SQ. IN.	-161	1.04	0.09	6.93	3532	69873	2299	10.25	16.25	43/262	9.75	207/284
	-162	1.45	0.18	9.69	2525	25675	1643	12.13	18.88	47/272	11.63	212/290
	-163	2.29	0.45	10	1608	6666	1046	15.88	24.38	55/295	15.38	220/302
	-164	2.57	0.72	10	2321	4927	1511	20.00	29.00	71/318	19.50	236/322
18 INCH 291 SQ. IN.	-181	1.03	0.08	6.16	3961	97571	3210	10.25	16.25	48/263	10.13	273/356
	-182	1.44	0.16	8.62	2831	35853	2295	12.13	18.88	53/275	12.00	277/363
	-183	2.27	0.40	10	1803	9309	1461	15.88	24.38	62/300	15.75	287/376
	-184	2.55	0.64	10	2604	6885	2111	20.00	29.00	80/326	19.88	305/398
20 INCH 359 SQ. IN.	-201	0.78	0.04	4.21	8254	376713	8249	9.38	14.88	55/275	9.63	346/432
	-202	1.18	0.10	6.35	5491	109019	5487	11.38	17.63	62/290	11.63	353/441
	-203	1.97	0.29	10	3297	23770	3295	15.25	23.25	76/322	15.50	367/460
	-204	2.75	0.58	10	2356	8698	2355	19.13	28.63	90/350	19.38	381/477
22 INCH 429 SQ. IN.	-221	0.78	0.04	3.83	9063	494661	10832	9.38	14.88	61/280	10.13	387/481
	-222	1.17	0.09	5.77	6028	143143	7205	11.38	17.63	68/297	12.13	395/491
	-223	1.96	0.27	9.61	3620	31212	4327	15.25	23.25	84/331	16.00	410/511
	-224	2.74	0.53	10	2587	11421	3092	19.13	28.63	99/362	19.88	426/530
24 INCH 506 SQ. IN.	-241	0.77	0.03	3.51	9870	634857	13902	9.38	15.38	66/386	10.38	459/580
	-242	1.17	0.09	5.29	6565	183703	9247	11.38	18.13	75/405	12.38	467/592
	-243	1.95	0.24	8.8	3943	40056	5553	15.25	23.75	91/445	16.25	484/616
	-244	2.72	0.48	10	2817	14657	3968	19.13	29.13	108/482	20.13	501/639

Weights: Untied/Tied

Notes:

1. **Max Temperature - 800 deg F**
2. **Movements are maximum non-concurrent. See page 65 for methods of combining movements.**
3. **Maximum axial extension is 50% of rated axial movement.**
4. **Rated cycle life is 3,000 EJMA cycles.**
5. **Maximum test pressure is 1.5 times rated working pressure.**
6. **Pressure thrust = Thrust Area X 150 psig.**
7. **Refer to page 68 for torsional spring rates.**
8. **TR option movement limitations: 8" and below, angular and lateral only. For 10" and above, only lateral movemenet.**
9. **Refer to page 66 for flange dimensions and drillings.**

Materials

- **Bellows- A240-304/316/321**
- **Pipe- A53 GR.B Sch. Std.**
- **Flanges- 150# RFSO A105**
- **Liner- same as bellows (w/ drain holes)***
- **Cover- C.S.**

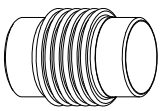
*** Add 0.25" to OAL for vanstone option with liner.**

Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Rod	-	Liner	-	Cover	-	Vanstone
	ES-40021	-	182	-	M2	-	LR	-	L	-	C	-	V

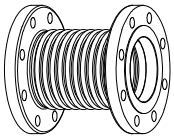
See page 29 for details on part number options.

300 PSIG

SINGLE ASSEMBLY



ES-40013
WELD END



ES-40023
FLANGED

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40013			ES-40023	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	TIED OAL	WEIGHT	OAL*	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	IN	LBS	IN	LBS
3 INCH 13 SQ. IN.	-031	0.32	0.05	9.44	1892	11355	66	7.75	13.00	4/41	5.38	26/35
	-032	0.65	0.21	10	946	1419	33	9.75	15.50	5/43	7.38	27/35
	-033	0.77	0.39	10	1236	791	43	11.88	17.88	5/44	9.50	28/37
	-034	0.80	0.52	10	1711	662	60	13.63	19.88	6/45	11.25	28/38
3 1/2 INCH 16 SQ. IN.	-351	0.32	0.04	8.35	2102	15959	93	7.75	13.00	5/46	5.50	35/43
	-352	0.65	0.19	10	1051	1995	47	9.75	15.50	6/48	7.50	35/44
	-353	0.81	0.35	10	1286	890	57	12.38	18.63	6/50	10.13	36/45
	-354	0.83	0.51	10	1810	784	80	14.13	20.38	7/51	11.88	37/47
4 INCH 21 SQ. IN.	-041	0.50	0.11	10	2433	7294	140	9.38	14.88	7/54	7.38	46/56
	-042	0.79	0.29	10	1547	1843	89	11.50	17.50	8/56	9.50	47/58
	-043	0.70	0.32	10	3145	2441	181	12.88	18.88	9/58	10.88	48/59
	-044	0.86	0.49	10	2556	13157	147	14.50	20.75	10/59	12.50	49/61
5 INCH 30 SQ. IN.	-051	0.44	0.07	8.22	3015	17915	255	8.88	14.88	9/93	7.13	58/75
	-052	0.74	0.21	10	1807	3804	153	11.00	17.50	10/95	9.25	59/76
	-053	0.96	0.34	10	1392	1773	118	12.50	19.50	11/97	10.75	60/78
	-054	1.07	0.56	10	2463	1466	208	15.63	22.88	14/101	13.88	63/82
6 INCH 43 SQ. IN.	-061	0.55	0.09	8.67	2822	17521	336	9.25	15.25	12/111	7.75	80/100
	-062	0.88	0.23	10	1764	4354	210	11.38	18.13	13/114	9.88	81/102
	-063	1.01	0.41	10	2782	2802	331	14.63	21.63	16/119	13.13	85/106
	-064	1.27	0.64	10	2226	1435	265	16.88	24.38	18/122	15.38	86/108
8 INCH 70 SQ. IN.	-081	0.45	0.06	5.54	6787	64483	1322	9.38	15.88	18/184	8.63	120/152
	-082	0.73	0.15	8.86	4242	15743	827	11.63	18.63	21/189	10.88	122/155
	-083	1.00	0.29	10	3085	6056	601	13.88	21.38	23/194	13.13	125/159
	-084	1.36	0.53	10	2262	2388	441	16.88	25.13	26/200	16.13	128/163
10 INCH 106 SQ. IN.	-101	0.52	0.05	5.12	6911	99628	2043	9.38	15.38	26/177	9.00	167/231
	-102	0.83	0.14	8.2	4320	24323	1277	11.63	18.38	29/186	11.25	170/236
	-103	1.04	0.22	10	3456	12454	1022	13.13	20.13	31/191	12.75	172/240
	-104	1.36	0.48	10	4293	5683	1269	18.00	25.75	41/209	17.63	182/254

Weights: Untied/Tied

Notes:

1. Max Temperature - 800 deg F
2. Movements are maximum non-concurrent. See page 64 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 3,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 300 psig.
7. Refer to page 68 for torsional spring rates.
8. Liners are not available for 3", 3.5" and 4" diameters
9. TR option movement limitations: 8" and below, angular and lateral only. For 10" and above, only lateral movemenet.
10. Refer to page 66 for flange dimensions and drillings.

Materials

- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- 300# RFSO A105
- Liner- same as bellows (w/ drain holes)*
- Cover- C.S.

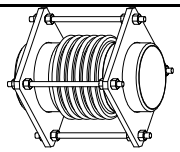
* Add 0.25" to OAL for vanstone option with liner.

Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Rod	-	Liner	-	Cover	-	Vanstone
	ES-40013	-	351	-	M1	-	TR	-	L	-	C	-	-

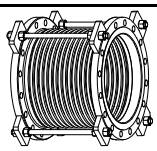
See page 29 for details on part number options.

300 PSIG

SINGLE ASSEMBLY



ES-40013
WELD END W/RODS



ES-40023
FLANGED W/RODS

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40013			ES-40023	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	TIED OAL	WEIGHT	OAL*	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	IN	LBS	IN	LBS
12 INCH 151 SQ. IN.	-121	0.83	0.11	6.88	6255	52329	2634	11.38	18.63	37/297	11.63	242/357
	-122	1.10	0.20	9.13	4702	22605	1980	13.25	21.00	41/305	13.50	246/363
	-123	1.79	0.54	10	2892	5239	1218	18.13	27.13	50/326	18.38	255/377
	-124	2.38	1.06	10	4976	4199	2096	24.00	34.25	91/378	24.25	296/423
14 INCH 183 SQ. IN.	-141	1.03	0.11	7.75	6759	85542	3438	10.75	18.25	47/319	11.25	350/482
	-142	1.43	0.22	10	4835	32087	2460	12.75	21.25	55/334	13.25	357/491
	-143	2.26	0.56	10	3074	8107	1564	17.00	27.00	69/360	17.50	372/510
	-144	2.64	1.01	10	4220	4807	2147	23.00	33.75	103/403	23.50	405/549
16 INCH 234 SQ. IN.	-161	1.00	0.10	6.68	7644	123786	4976	10.75	18.25	54/330	11.75	403/536
	-162	1.39	0.19	9.26	5470	46450	3561	12.75	21.00	62/345	13.75	411/547
	-163	2.20	0.49	10	3477	11733	2263	17.00	27.00	79/377	18.00	428/567
	-164	2.69	0.91	10	4860	7083	3163	23.00	34.00	117/427	24.00	466/611
18 INCH 291 SQ. IN.	-181	0.98	0.08	5.86	8524	171906	6910	10.75	18.75	61/440	12.25	526/690
	-182	1.42	0.17	8.5	6197	65534	5023	12.75	21.75	70/461	14.25	535/703
	-183	2.15	0.42	10	3877	16296	3143	17.00	27.25	89/495	18.50	554/728
	-184	2.67	0.80	10	5447	9887	4416	23.00	34.50	132/556	24.50	597/780
20 INCH 359 SQ. IN.	-201	0.93	0.06	5	9110	366919	9105	9.63	17.63	64/442	11.63	655/831
	-202	1.40	0.13	7.53	6061	106343	6058	11.75	20.50	76/463	13.75	666/847
	-203	2.33	0.37	10	3640	23173	3638	15.88	26.63	98/508	17.88	689/876
	-204	2.71	0.64	10	5213	15361	5210	20.75	32.25	141/564	22.75	732/926
22 INCH 429 SQ. IN.	-221	0.96	0.07	4.73	15978	432900	19097	11.00	19.00	86/541	13.50	782/1011
	-222	1.34	0.14	6.6	11438	161240	13671	13.13	21.88	101/569	15.63	798/1032
	-223	1.92	0.29	9.42	8010	55508	9573	16.38	26.38	124/612	18.88	821/1064
	-224	2.69	0.58	10	5719	20155	6836	20.75	32.25	155/666	23.25	852/1105
24 INCH 506 SQ. IN.	-241	0.96	0.06	4.34	17389	555194	24492	11.00	19.50	94/607	13.88	996/1250
	-242	1.34	0.13	6.05	12449	206803	17534	13.13	22.38	110/636	16.00	1013/1273
	-243	1.91	0.27	8.64	8718	71194	12279	16.38	26.88	136/683	19.25	1038/1307
	-244	2.68	0.53	10	6224	25850	8767	20.75	32.75	170/741	23.63	1072/1350

Weights: Untied/Tied

Notes:

1. Max Temperature - 800 deg F
2. Movements are maximum non-concurrent. See page 64 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 3,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 300 psig.
7. Refer to page 68 for torsional spring rates.
8. TR option movement limitations: 8" and below, angular and lateral only. For 10" and above, only lateral movemenet.
9. Refer to page 66 for flange dimensions and drillings.

Materials

- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- 300# RFSO A105
- Liner- same as bellows (w/ drain holes)*
- Cover- C.S.

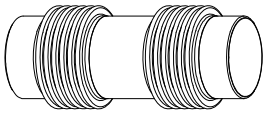
* Add 0.25" to OAL for vanstone option with liner.

Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Rod	-	Liner	-	Cover	-	Vanstone
	ES-40023	-	242	-	M1	-	LR	-	L	-	C	-	V

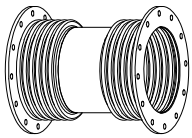
See page 29 for details on part number options.

FV/ 50 PSIG

UNIVERSAL ASSEMBLY



ES-40030
WELD END



ES-40040
FLANGED

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40030			ES-40040	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	TIED OAL	WEIGHT	OAL*	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	IN	LBS	IN	LBS
3	-031	1.19	1.44	10	204	42	7	13.75	16.00	7/26	9.25	12/19
INCH	-032	1.19	2.56	10	204	16	7	17.75	20.00	10/29	13.25	16/23
13 SQ. IN.	-033	1.19	3.75	10	204	8	7	21.75	24.00	12/32	17.25	21/29
3 1/2	-351	1.19	1.25	10	226	59	10	13.75	16.00	9/29	9.25	16/23
INCH	-352	1.19	2.31	10	226	22	10	17.75	20.00	12/33	13.25	21/28
16 SQ. IN.	-353	1.19	3.31	10	226	11	10	21.75	24.00	15/37	17.25	26/34
4	-041	1.44	1.38	7.1	191	65	11	13.75	16.00	10/35	9.25	20/28
INCH	-042	1.44	2.50	7.1	191	24	11	17.75	20.00	14/39	13.25	26/34
21 SQ. IN.	-043	1.44	3.63	7.1	191	13	11	21.75	24.00	18/43	17.25	31/40
5	-051	1.50	1.63	6.6	201	58	17	15.75	18.00	16/46	11.25	25/34
INCH	-052	1.50	2.63	6.6	201	26	17	19.75	22.00	21/52	15.25	32/42
30 SQ. IN.	-053	1.50	3.56	6.6	201	15	17	23.75	26.00	26/57	19.25	39/49
6	-061	2.00	2.00	4.5	237	73	28	17.63	20.38	22/82	13.38	31/43
INCH	-062	2.00	3.31	4.5	237	31	28	22.63	25.38	30/90	18.38	41/54
43 SQ. IN.	-063	2.00	4.69	4.5	237	17	28	27.63	30.38	38/99	23.38	51/65
8	-081	2.19	1.75	3.3	233	118	45	17.63	21.13	33/111	13.38	41/58
INCH	-082	2.19	2.88	3.3	233	51	45	22.63	26.13	45/124	18.38	55/74
70 SQ. IN.	-083	2.19	4.06	3.3	233	28	45	27.63	31.13	57/137	23.38	69/89
10	-101	2.19	1.50	10	527	318	156	19.50	23.00	49/138	15.38	62/94
INCH	-102	2.19	2.50	10	527	131	156	25.50	29.00	70/161	21.38	84/119
106 SQ. IN.	-103	2.19	3.69	10	527	70	156	31.50	35.00	90/184	27.38	106/144

Weights: Untied/Tied

Notes:

1. Max Temperature - 800 deg F
2. Movements are maximum non-concurrent. See page 64 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 3,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 50 psig.
7. Refer to page 68 for torsional spring rates.
8. Liners are not available for 3", 3.5" and 4" diameters
9. TR option movement limitations: 8" and below, angular and lateral only. For 10" and above, only lateral movemenet.
10. Refer to page 66 for flange dimensions and drillings.

Materials

- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- Plate C.S. 150# Drilling
- Liner- same as bellows (w/ drain holes)*
- Cover- C.S.
- Spool for ES-40040 with V option S.S. same as bellows

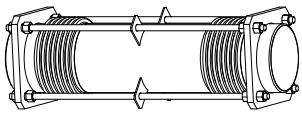
* Add 0.25" to OAL for vanstone option with liner.

Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Rod	-	Liner	-	Cover	-	Vanstone
	ES-40030	-	083	-	M2	-	LR	-	L	-	C	-	-

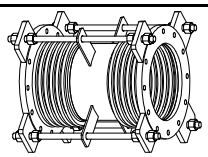
See page 29 for details on part number options.

FV/ 50 PSIG

UNIVERSAL ASSEMBLY



ES-40030
WELD END W/RODS



ES-40040
FLANGED W/RODS

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40030			ES-40040	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	TIED OAL	WEIGHT	OAL*	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	IN	LBS	IN	LBS
12	-121	2.75	1.63	7	433	378	185	19.50	23.00	64/179	15.63	80/124
INCH	-122	2.75	2.81	7	433	156	185	25.50	29.00	88/206	21.63	106/153
154 SQ. IN.	-123	2.75	4.06	7	433	84	185	31.50	35.00	113/234	27.63	133/183
14	-141	2.88	1.69	7.5	471	348	240	21.50	25.00	80/219	17.88	95/156
INCH	-142	2.88	2.94	7.5	471	160	240	27.50	31.00	107/251	23.88	124/190
183 SQ. IN.	-143	2.88	4.00	7.5	471	92	240	33.50	37.00	134/284	29.88	153/224
16	-161	2.81	1.56	10	534	504	347	21.50	26.00	91/241	18.00	159/226
INCH	-162	2.81	2.50	10	534	232	347	27.50	32.00	122/278	24.00	192/264
234 SQ. IN.	-163	2.81	3.50	10	534	133	347	33.50	38.00	154/314	30.00	226/304
18	-181	2.81	1.69	10	597	524	484	23.50	28.00	115/269	20.13	206/274
INCH	-182	2.81	2.50	10	597	264	484	29.50	34.00	150/310	26.13	244/318
291 SQ. IN.	-183	2.81	3.38	10	597	158	484	35.50	40.00	185/351	32.13	281/360
20	-201	3.19	2.00	10	511	429	511	25.50	30.00	142/300	22.25	237/310
INCH	-202	3.19	2.88	10	511	231	511	31.50	36.00	181/345	28.25	278/356
359 SQ. IN.	-203	3.19	3.75	10	511	144	511	37.50	42.00	220/390	34.25	320/404
22	-221	3.13	1.81	10	561	562	671	25.50	30.00	156/368	22.38	281/394
INCH	-222	3.13	2.63	10	561	304	671	31.50	36.00	199/420	28.38	326/448
429 SQ. IN.	-223	3.13	3.44	10	561	189	671	37.50	42.00	243/472	34.38	372/502
24	-241	2.13	1.94	10	611	575	860	27.50	32.50	186/447	24.50	329/446
INCH	-242	2.13	2.63	10	611	328	860	33.50	38.50	234/503	30.50	379/504
506 SQ. IN.	-243	2.13	3.38	10	611	212	860	39.50	44.50	281/558	36.50	428/562

Weights: Untied/Tied

Notes:

1. Max Temperature - 800 deg F
2. Movements are maximum non-concurrent. See page 64 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 3,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 50 psig.
7. Refer to page 68 for torsional spring rates.
8. TR option movement limitations: 8" and below, angular and lateral only. For 10" and above, only lateral movemenet.
9. Refer to page 66 for flange dimensions and drillings.

Materials

- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- Plate C.S. 150# Drilling
- Liner- same as bellows (w/ drain holes)*
- Cover- C.S.
- Spool for ES-40040 with V option S.S. same as bellows

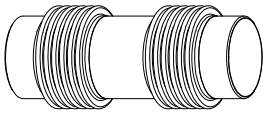
* Add 0.25" to OAL for vanstone option with liner.

Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Rod	-	Liner	-	Cover	-	Vanstone
	ES-40040	-	122	-	M3	-	LR	-	L	-	C	-	V

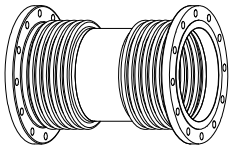
See page 29 for details on part number options.

150 PSIG

UNIVERSAL ASSEMBLY



ES-40031
WELD END



ES-40041
FLANGED

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40031			ES-40041	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	TIED OAL	WEIGHT	OAL*	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	IN	LBS	IN	LBS
3	**-031**	0.69	0.75	10	944	202	33	13.75	17.25	7/28	10.38	20/28
INCH	**-032**	0.69	1.44	10	944	75	33	17.75	21.25	10/31	14.38	22/31
13 SQ. IN.	**-033**	0.69	2.13	10	944	38	33	21.75	25.25	12/34	18.38	25/34
3 1/2	**-351**	0.63	0.69	10	1065	289	47	13.75	17.50	9/36	10.50	26/34
INCH	**-352**	0.63	1.25	10	1065	106	47	17.75	21.50	12/39	14.50	29/38
16 SQ. IN.	**-353**	0.63	1.81	10	1065	55	47	21.75	25.50	15/43	18.50	32/41
4	**-041**	0.88	0.81	10	626	220	36	13.75	17.50	11/41	10.63	31/40
INCH	**-042**	0.88	1.50	10	626	81	36	17.75	21.50	14/45	14.63	35/44
21 SQ. IN.	**-043**	0.88	2.19	10	626	42	36	21.75	25.50	18/50	18.63	38/48
5	**-051**	0.94	1.00	10	660	195	56	15.75	20.00	17/68	12.88	39/50
INCH	**-052**	0.94	1.56	10	660	88	56	19.75	24.00	22/74	16.88	44/56
30 SQ. IN.	**-053**	0.94	2.19	10	660	50	56	23.75	28.00	26/78	20.88	49/61
6	**-061**	1.13	1.13	10	1023	323	122	17.63	21.88	23/96	15.13	52/70
INCH	**-062**	1.13	1.88	10	1023	138	122	22.63	26.88	31/105	20.13	59/78
43 SQ. IN.	**-063**	1.13	2.63	10	1023	76	122	27.63	31.88	39/114	25.13	67/87
8	**-081**	1.25	0.94	10	1030	533	201	17.63	22.63	34/121	15.50	80/101
INCH	**-082**	1.25	1.56	10	1030	227	201	22.63	27.63	46/134	20.50	92/114
70 SQ. IN.	**-083**	1.25	2.19	10	1030	124	201	27.63	32.63	58/147	25.50	104/127
10	**-101**	1.56	1.06	10	1010	609	298	19.50	24.50	50/268	17.88	116/171
INCH	**-102**	1.56	1.81	10	1010	250	298	25.50	30.50	71/294	23.88	136/196
106 SQ. IN.	**-103**	1.56	2.63	10	1010	135	298	31.50	36.50	91/320	29.88	157/223

Weights: Untied/Tied

Notes:

1. Max Temperature - 800 deg F
2. Movements are maximum non-concurrent. See page 64 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 3,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 150 psig.
7. Refer to page 68 for torsional spring rates.
8. Liners are not available for 3", 3.5" and 4" diameters
9. TR option movement limitations: 8" and below, angular and lateral only. For 10" and above, only lateral movemenet.
10. Refer to page 66 for flange dimensions and drillings.

Materials

- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- 150# RFSO A105
- Liner- same as bellows (w/ drain holes)*
- Cover- C.S.
- Spool for ES-40041 with V option S.S. same as bellows

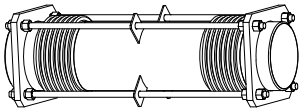
* Add 0.25" to OAL for vanstone option with liner.

Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Rod	-	Liner	-	Cover	-	Vanstone
	ES-40031	-	083	-	M1	-	LR	-	L	-	C	-	-

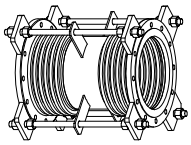
See page 29 for details on part number options.

150 PSIG

UNIVERSAL ASSEMBLY



ES-40031
WELD END W/RODS



ES-40041
FLANGED W/RODS

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40031			ES-40041	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	TIED OAL	WEIGHT	OAL*	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	IN	LBS	IN	LBS
12	-121	1.44	0.81	10	2353	2063	991	19.50	24.50	67/370	18.38	170/252
INCH	-122	1.44	1.38	10	2353	843	991	25.50	30.50	92/400	24.38	195/283
151 SQ. IN.	-123	1.44	2.00	10	2353	453	991	31.50	36.50	116/430	30.38	220/313
14	-141	1.69	1.25	10	1906	1067	970	23.50	28.50	94/393	22.50	246/328
INCH	-142	1.69	1.88	10	1906	534	970	29.50	34.50	121/425	28.50	274/362
183 SQ. IN.	-143	1.69	2.56	10	1906	320	970	35.50	40.50	148/457	34.50	301/394
16	-161	1.63	1.13	10	2169	1553	1412	23.50	30.00	107/481	23.00	272/361
INCH	-162	1.63	1.63	10	2169	778	1412	29.50	36.00	139/518	29.00	303/398
234 SQ. IN.	-163	1.63	2.25	10	2169	465	1412	35.50	42.00	170/554	35.00	335/435
18	-181	1.63	1.13	9.9	2430	1675	1970	25.50	32.00	133/493	25.38	357/454
INCH	-182	1.63	1.63	9.9	2430	901	1970	31.50	38.00	168/534	31.38	393/496
291 SQ. IN.	-183	1.63	2.13	9.9	2430	561	1970	37.50	44.00	203/574	37.38	428/536
20	-201	1.56	1.13	8.5	4073	2790	4070	27.50	34.00	167/541	27.75	458/562
INCH	-202	1.56	1.69	8.5	4073	1353	4070	35.50	42.00	220/601	35.75	510/621
359 SQ. IN.	-203	1.56	2.25	8.5	4073	796	4070	43.50	50.00	272/661	43.75	563/681
22	-221	1.56	1.13	7.7	4467	2976	5339	29.50	36.00	199/567	30.25	525/638
INCH	-222	1.56	1.63	7.7	4467	1533	5339	37.50	44.00	256/631	38.25	583/703
429 SQ. IN.	-223	1.56	2.19	7.7	4467	932	5339	45.50	52.00	314/696	46.25	641/769
24	-241	1.75	1.31	8	3850	2531	5477	31.50	38.50	235/793	32.50	628/782
INCH	-242	1.75	1.88	8	3850	1372	5477	39.50	46.50	298/867	40.50	691/857
511 SQ. IN.	-243	1.75	2.44	8	3850	858	5477	47.50	54.50	361/941	48.50	754/931

Weights: Untied/Tied

Notes:

1. Max Temperature - 800 deg F
2. Movements are maximum non-concurrent. See page 64 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 3,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 150 psig.
7. Refer to page 68 for torsional spring rates.
8. TR option movement limitations: 8" and below, angular and lateral only. For 10" and above, only lateral movemenet.
9. Refer to page 66 for flange dimensions and drillings.

Materials

- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- 150# RFSO A105
- Liner- same as bellows (w/ drain holes)*
- Cover- C.S.
- Spool for ES-40041 with V option S.S. same as bellows

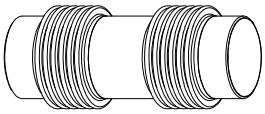
* Add 0.25" to OAL for vanstone option with liner.

Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Rod	-	Liner	-	Cover	-	Vanstone
	ES-40041	-	163	-	M2	-	TR	-	L	-	C	-	V

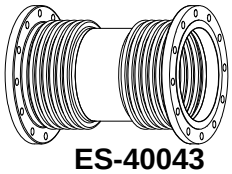
See page 29 for details on part number options.

300 PSIG

UNIVERSAL ASSEMBLY



ES-40033
WELD END



ES-40043
FLANGED

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40033			ES-40043	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	TIED OAL	WEIGHT	OAL*	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	IN	LBS	IN	LBS
3	-031	0.63	1.00	10	944	116	33	14.25	21.00	9/44	13.38	31/41
INCH	-032	0.63	1.63	10	944	52	33	18.25	25.00	11/47	17.38	33/43
13 SQ. IN.	-033	0.63	2.25	10	944	29	33	22.25	29.00	14/51	21.38	36/47
3 1/2	-351	0.63	0.88	10	1065	165	47	14.25	21.00	10/49	13.50	40/50
INCH	-352	0.63	1.44	10	1065	74	47	18.25	25.00	13/52	17.50	43/54
16 SQ. IN.	-353	0.63	1.94	10	1065	42	47	22.25	29.00	16/56	21.50	46/58
4	-041	0.56	0.94	10	2104	279	121	16.13	23.00	15/58	15.75	53/65
INCH	-042	0.56	1.63	10	2104	109	121	22.13	29.00	20/65	21.75	59/72
21 SQ. IN.	-043	0.56	2.31	10	2104	58	121	28.13	35.00	25/71	27.75	64/78
5	-051	0.63	0.81	10	2243	438	190	16.13	23.50	20/98	16.00	68/87
INCH	-052	0.63	1.38	10	2243	171	190	22.13	29.50	27/107	22.00	76/96
30 SQ. IN.	-053	0.63	2.00	10	2243	90	190	28.13	35.50	34/115	28.00	83/105
6	-061	0.88	0.81	10	1754	554	209	15.50	23.38	24/116	16.13	92/114
INCH	-062	0.88	1.56	10	1754	206	209	21.50	29.38	33/127	22.13	102/125
43 SQ. IN.	-063	0.88	2.25	10	1754	106	209	27.50	35.38	43/138	28.13	111/136
8	-081	0.75	0.69	9.2	4266	1532	831	17.38	26.63	41/196	18.88	143/180
INCH	-082	0.75	1.13	9.2	4266	651	831	23.38	32.63	55/213	24.88	157/196
70 SQ. IN.	-083	0.75	1.63	9.2	4266	357	831	29.38	38.63	69/230	30.88	171/213
10	-101	0.75	0.63	7.6	8153	3624	2410	18.63	28.00	61/204	21.25	203/278
INCH	-102	0.75	1.13	7.6	8153	1344	2410	26.63	36.00	88/238	29.25	230/312
106 SQ. IN.	-103	0.75	1.63	7.6	8153	692	2410	34.63	44.00	115/273	37.25	257/346

Weights: Untied/Tied

Notes:

1. Max Temperature - 800 deg F
2. Movements are maximum non-concurrent. See page 64 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 3,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 300 psig.
7. Refer to page 68 for torsional spring rates.
8. Liners are not available for 3", 3.5" and 4" diameters
9. TR option movement limitations: 8" and below, angular and lateral only. For 10" and above, only lateral movemenet.
10. Refer to page 66 for flange dimensions and drillings.

Materials

- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- 300# RFSO A105
- Liner- same as bellows (w/ drain holes)*
- Cover- C.S.
- Spool for ES-40043 with V option S.S. same as bellows

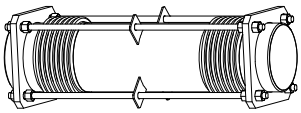
* Add 0.25" to OAL for vanstone option with liner.

Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Rod	-	Liner	-	Cover	-	Vanstone
	ES-40033	-	083	-	M3	-	LR	-	L	-	C	-	-

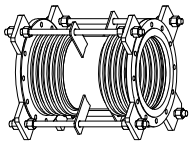
See page 29 for details on part number options.

300 PSIG

UNIVERSAL ASSEMBLY



ES-40033
WELD END W/RODS



ES-40043
FLANGED W/RODS

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40033			ES-40043	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	TIED OAL	WEIGHT	OAL*	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	IN	LBS	IN	LBS
12	-121	1.06	0.75	9.2	4635	2935	1952	18.63	28.50	77/316	21.75	283/407
INCH	-122	1.06	1.38	9.2	4635	1088	1952	26.63	36.50	110/357	29.75	316/448
13 SQ. IN.	-123	1.06	2.00	9.2	4635	560	1952	34.63	44.50	144/398	37.75	349/488
14	-141	1.63	1.19	10	4202	2466	2138	20.38	30.50	107/356	24.00	409/553
INCH	-142	1.63	2.00	10	4202	1009	2138	28.38	38.50	143/399	32.00	446/597
16 SQ. IN.	-143	1.63	2.88	10	4202	544	2138	36.38	46.50	179/442	40.00	482/640
16	-161	1.63	1.00	10	4774	3584	3108	20.38	30.50	122/371	24.50	471/616
INCH	-162	1.63	1.75	10	4774	1467	3108	28.38	39.50	164/421	32.50	513/665
21 SQ. IN.	-163	1.63	2.50	10	4774	791	3108	36.38	47.50	206/470	40.50	554/714
18	-181	1.63	0.94	9.8	5344	4996	4332	20.38	32.00	138/490	25.00	602/786
INCH	-182	1.63	1.50	9.8	5344	2045	4332	28.38	40.00	185/549	33.00	649/844
30 SQ. IN.	-183	1.63	2.25	9.8	5344	1102	4332	36.38	48.00	232/607	41.00	696/902
20	-201	1.63	1.13	10	4449	3944	4447	22.38	34.00	170/520	27.50	760/961
INCH	-202	1.63	1.81	10	4449	1765	4447	30.38	42.00	222/583	35.50	813/1025
43 SQ. IN.	-203	1.63	2.50	10	4449	995	4447	38.38	50.00	275/648	43.50	865/1088
22	-221	1.88	1.00	9.2	4875	5169	5827	22.38	34.00	187/617	28.00	884/1145
INCH	-222	1.88	1.63	9.2	4875	2314	5827	30.38	42.00	245/692	36.00	941/1218
70 SQ. IN.	-223	1.88	2.25	9.2	4875	1304	5827	38.38	50.00	302/765	44.00	999/1293
24	-241	1.50	0.88	7	10664	10830	15021	24.13	36.50	231/713	30.38	1134/1423
INCH	-242	1.50	1.31	7	10664	5178	15021	32.13	44.50	294/793	38.38	1197/1503
106 SQ. IN.	-243	1.50	1.81	7	10664	3020	15021	40.13	52.50	357/872	46.38	1260/1582

Weights: Untied/Tied

Notes:

1. Max Temperature - 800 deg F
2. Movements are maximum non-concurrent. See page 64 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 3,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 300 psig.
7. Refer to page 68 for torsional spring rates.
8. TR option movement limitations: 8" and below, angular and lateral only. For 10" and above, only lateral movemenet.
9. Refer to page 66 for flange dimensions and drillings.

Materials

- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- 300# RFSO A105
- Liner- same as bellows (w/ drain holes)*
- Cover- C.S.
- Spool for ES-40043 with V option S.S. same as bellows

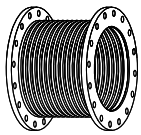
* Add 0.25" to OAL for vanstone option with liner.

Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Rod	-	Liner	-	Cover	-	Vanstone
	ES-40043	-	223	-	M3	-	LR	-	L	-	C	-	V

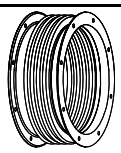
See page 29 for details on part number options.

FV/ 25 PSIG

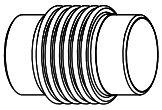
LOW PRESSURE
SINGLE ASSEMBLY



ES-40050
Plate Flange



ES-40051
Angle Flange



ES-40060
Weld End

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40050		ES-40051		ES-40060	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	WGT	OAL	WGT	OAL	WGT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	LBS	IN	LBS	IN	LBS
12	-121	2.54	0.32	10	402	4014	169	7.00	46	8.38	13	10.88	18
	-122	3.37	0.57	10	301	1712	127	8.75	49	10.13	16	12.63	20
INCH	-123	5.08	0.55	10	201	502	85	12.38	54	13.75	21	16.25	23
151 SQ. IN.	-124	5.53	0.83	10	277	333	117	17.13	63	18.50	30	21.00	30
14	-141	2.12	0.20	10	397	6839	202	6.38	48	7.50	14	10.00	20
	-142	2.95	0.40	10	284	2532	144	8.13	51	9.25	18	11.75	22
INCH	-143	4.16	0.91	10	347	1209	176	11.88	60	13.00	27	15.50	28
183 SQ. IN.	-144	4.67	1.41	10	435	788	221	15.75	70	16.88	37	19.38	36
16	-161	2.12	0.18	10	448	9879	292	6.50	105	7.50	22	10.00	23
	-162	2.95	0.35	10	320	3659	208	8.25	109	9.25	26	11.75	25
INCH	-163	4.05	0.78	10	392	1750	255	12.00	118	13.00	35	15.50	32
234 SQ. IN.	-164	5.52	1.20	10	288	691	187	15.63	125	16.63	42	19.13	37
18	-181	2.12	0.16	10	499	13700	405	6.63	134	7.50	23	10.00	26
	-182	2.95	0.32	10	357	5075	289	8.38	138	9.25	28	11.75	28
INCH	-183	4.67	0.79	10	227	1293	184	12.00	145	12.88	34	15.38	32
291 SQ. IN.	-184	5.39	1.27	10	321	960	260	15.75	156	16.63	46	19.13	42
20	-201	1.71	0.09	9.19	527	27462	526	5.88	141	6.63	25	9.13	28
	-202	2.53	0.21	10	351	8334	351	7.63	146	8.38	30	10.88	30
INCH	-203	4.25	0.59	10	211	1783	211	11.25	153	12.00	38	14.50	36
359 SQ. IN.	-204	5.78	1.14	10	291	1225	290	15.00	166	15.75	50	18.25	47
22	-221	1.71	0.08	8.4	575	35883	688	6.00	175	6.63	28	9.13	30
	-222	2.53	0.19	10	384	10892	459	7.75	180	8.38	33	10.88	33
INCH	-223	4.25	0.54	10	230	2330	275	11.38	188	12.00	42	14.50	39
429 SQ. IN.	-224	5.68	1.03	10	318	1603	380	15.13	202	15.75	55	18.25	51

Notes:

1. **Max Temperature - 800 deg F**
2. **Movements are maximum non-concurrent. See page 65 for methods of combining movements.**
3. **Maximum axial extension is 50% of rated axial movement.**
4. **Rated cycle life is 3,000 EJMA cycles.**
5. **Maximum test pressure is 1.5 times rated working pressure.**
6. **Pressure thrust = Thrust Area X 25 psig.**
7. **Refer to page 68 for torsional spring rates.**
8. **Refer to page 66 for flange dimension and drilling.**

Materials

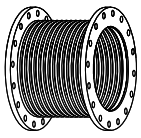
- **Bellows- A240-304/316/321**
- **Flanges- C.S.**
- **Duct- 0.188 thk A36**
- **Liner- same as bellows (w/ drain holes)**
- **Cover- C.S.**

Part Number Example	Product Code - Part Code - Bellows Material - Liner Option - Cover
	ES-40050 - 164 - M1 - L - C

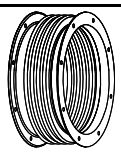
See page 29 for details on part number options.

FV/ 25 PSIG

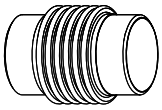
LOW PRESSURE
SINGLE ASSEMBLY



ES-40050
Plate Flange



ES-40051
Angle Flange



ES-40060
Weld End

Nominal Size / Thrust Area	Part Code	Movements Axial IN	Movements Lateral IN	Movements Angular deg	Spring Rates Axial LBS/IN.	Spring Rates Lateral LBS/IN	Spring Rates Angular IN-LBS/DEG	ES-40050 OAL IN	ES-40050 WGT LBS	ES-40051 OAL IN	ES-40051 WGT LBS	ES-40060 OAL IN	ES-40060 WGT LBS
24 INCH 506 SQ. IN.	-241	1.71	0.08	7.75	624	45857	879	6.13	198	6.63	30	9.13	33
	-242	2.53	0.17	10	416	13922	587	7.88	203	8.38	36	10.88	36
	-243	4.25	0.50	10	250	2978	352	11.50	212	12.00	45	14.50	43
	-244	5.88	0.98	10	349	2072	491	15.25	227	15.75	59	18.25	56
26 INCH 594 SQ. IN.	-261	1.63	0.06	7	1047	90367	1732	6.25	282	7.63	44	9.13	38
	-262	2.50	0.13	10	695	26076	1150	8.13	289	9.50	51	11.00	43
	-263	3.75	0.38	10	464	7726	767	10.88	298	12.25	60	13.75	51
	-264	5.25	0.75	10	555	4369	918	14.63	317	16.00	78	17.50	67
28 INCH 683 SQ. IN.	-281	1.63	0.06	6.5	1126	111855	2144	6.25	309	7.63	48	9.13	41
	-282	2.50	0.13	10	748	32372	1424	8.13	317	9.50	55	11.00	47
	-283	3.75	0.31	10	499	9562	949	10.88	326	12.25	65	13.75	55
	-284	5.25	0.69	10	597	5409	1136	14.63	346	16.00	85	17.50	72
30 INCH 779 SQ. IN.	-301	1.63	0.06	6.1	1205	136492	2616	6.38	358	7.63	52	9.13	44
	-302	2.50	0.13	9.3	800	39376	1737	8.25	366	9.50	59	11.00	50
	-303	3.75	0.31	10	534	11667	1158	11.00	376	12.25	70	13.75	59
	-304	5.25	0.63	10	638	6599	1386	14.75	397	16.00	91	17.50	77
32 INCH 881 SQ. IN.	-321	1.63	0.03	5.7	1284	164491	3152	6.63	458	7.63	53	9.13	47
	-322	2.50	0.13	8.7	853	47448	2093	8.50	466	9.50	61	11.00	53
	-323	3.75	0.31	10	568	14059	1395	11.25	477	12.25	72	13.75	62
	-324	5.25	0.63	10	679	7939	1667	15.00	499	16.00	95	17.50	83
34 INCH 990 SQ. IN.	-341	1.63	0.03	5.4	1363	196066	3757	6.63	478	7.63	59	9.13	50
	-342	2.50	0.13	8.2	905	56551	2495	8.50	487	9.50	68	11.00	57
	-343	3.75	0.25	10	603	16756	1663	11.25	498	12.25	79	13.75	66
	-344	5.13	0.56	10	720	9448	1984	15.00	522	16.00	103	17.50	88

Notes:

1. Max Temperature - 800 deg F
2. Movements are maximum non-concurrent. See page 65 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 3,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 25 psig.
7. Refer to page 68 for torsional spring rates.
8. Refer to page 66 for flange dimension and drilling.

Materials

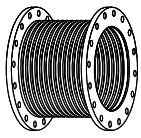
- Bellows- A240-304/316/321
- Flanges- C.S.
- Duct- 0.188 thk A36
- Liner- same as bellows (w/ drain holes)
- Cover- C.S.

Part Number Example	Product Code - Part Code - Bellows Material - Liner Option - Cover
	ES-40060 - 302 - M2 - L - C

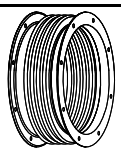
See page 29 for details on part number options.

FV/ 25 PSIG

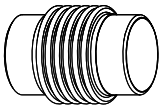
LOW PRESSURE
SINGLE ASSEMBLY



ES-40050
Plate Flange



ES-40051
Angle Flange



ES-40060
Weld End

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40050		ES-40051		ES-40060	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	WGT	OAL	WGT	OAL	WGT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	LBS	IN	LBS	IN	LBS
36	**-361**	2.50	0.13	7.8	957	66712	2943	8.75	571	9.50	68	11.00	60
INCH	**-362**	3.75	0.25	10	638	19767	1962	11.50	583	12.25	80	13.75	70
1104 SQ. IN.	**-363**	5.13	0.50	10	760	11136	2338	15.25	608	16.00	105	17.50	93
38	**-381**	2.50	0.06	7.4	757	59334	2618	8.75	657	9.50	72	11.00	63
INCH	**-382**	4.00	0.25	10	472	14204	1632	12.13	672	12.88	86	14.38	76
1241 SQ. IN.	**-383**	5.75	0.56	10	343	5416	1185	15.50	687	16.25	101	17.75	88
40	**-401**	2.50	0.06	7.1	796	68810	3036	8.75	683	9.50	75	11.00	66
INCH	**-402**	4.13	0.25	10	496	16471	1892	12.13	698	12.88	91	14.38	80
1369 SQ. IN.	**-403**	5.75	0.56	10	360	6280	1374	15.50	713	16.25	106	17.75	93
42	**-421**	2.50	0.13	6.8	835	79240	3496	9.00	791	9.50	78	11.00	70
INCH	**-422**	4.13	0.25	10	520	18967	2179	12.38	807	12.88	94	14.38	84
1503 SQ. IN.	**-423**	5.75	0.50	10	378	7231	1582	15.75	823	16.25	110	17.75	98
44	**-441**	3.00	0.13	7.7	829	61604	3796	10.00	842	10.50	83	11.88	74
INCH	**-442**	4.25	0.25	10	592	22310	2709	12.63	854	13.13	95	14.50	84
1644 SQ. IN.	**-443**	6.25	0.56	10	413	7534	1893	16.63	871	17.13	112	18.50	99
46	**-461**	3.00	0.13	7.4	865	69990	4312	10.00	880	10.50	86	11.88	77
INCH	**-462**	4.25	0.25	10	617	25347	3078	12.63	892	13.13	98	14.50	87
1791 SQ. IN.	**-463**	6.25	0.56	10	431	8559	2150	16.63	910	17.13	116	18.50	103
48	**-481**	2.50	0.06	5.7	789	107375	4316	9.00	1162	9.25	88	10.63	77
INCH	**-482**	4.25	0.25	10	452	20352	2471	12.88	1182	13.13	108	14.50	96
1963 SQ. IN.	**-483**	5.50	0.44	10	351	9542	1921	15.50	1196	15.75	122	17.13	108
50	**-501**	2.50	0.06	5.5	821	120800	4856	9.00	1029	9.25	91	10.63	81
INCH	**-502**	4.25	0.25	9.5	470	22897	2780	12.88	1050	13.13	113	14.50	100
2124 SQ. IN.	**-503**	5.50	0.38	10	365	10736	2162	15.50	1065	15.75	127	17.13	112
52	**-521**	2.50	0.06	5.3	853	135295	5438	9.00	1209	9.25	96	10.63	84
INCH	**-522**	4.25	0.19	9.2	488	25646	3114	12.88	1228	13.13	118	14.50	104
2290 SQ. IN.	**-523**	5.50	0.38	10	380	12024	2421	15.50	1242	15.75	133	17.13	117
54	**-541**	3.25	0.13	6.7	835	83092	5727	11.13	1324	10.88	101	12.00	88
INCH	**-542**	4.88	0.25	10	557	24919	3818	14.50	1341	14.25	117	15.38	103
2463 SQ. IN.	**-543**	7.38	0.63	10	371	7383	2545	19.63	1364	19.38	141	20.50	124

Notes:

1. **Max Temperature - 800 deg F**
2. **Movements are maximum non-concurrent. See page 65 for methods of combining movements.**
3. **Maximum axial extension is 50% of rated axial movement.**
4. **Rated cycle life is 3,000 EJMA cycles.**
5. **Maximum test pressure is 1.5 times rated working pressure.**
6. **Pressure thrust = Thrust Area X 25 psig.**
7. **Refer to page 68 for torsional spring rates.**
8. **Refer to page 66 for flange dimension and drilling.**

Materials

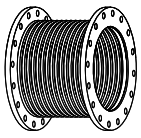
- **Bellows- A240-304/316/321**
- **Flanges- C.S.**
- **Duct- 0.188 thk A36**
- **Liner- same as bellows (w/ drain holes)**
- **Cover- C.S.**

Part Number Example	Product Code - Part Code - Bellows Material - Liner Option - Cover
	ES-40051 - 523 - M3 - L - C

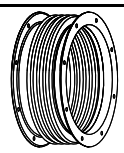
See page 29 for details on part number options.

FV/ 25 PSIG

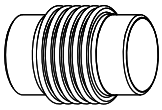
LOW PRESSURE
SINGLE ASSEMBLY



ES-40050
Plate Flange



ES-40051
Angle Flange



ES-40060
Weld End

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			ES-40050		ES-40051		ES-40060	
		Axial	Lateral	Angular	Axial	Lateral	Angular	OAL	WGT	OAL	WGT	OAL	WGT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN	LBS	IN	LBS	IN	LBS
56	**-561**	3.25	0.13	6.5	862	92046	6345	11.38	1452	10.88	105	12.00	92
INCH	**-562**	4.88	0.25	9.7	575	27621	4232	14.75	1469	14.25	122	15.38	107
2642 SQ. IN.	**-563**	7.38	0.63	10	383	8184	2821	19.88	1494	19.38	146	20.50	129
58	**-581**	3.25	0.13	6.3	891	101744	7013	11.38	1504	10.88	108	12.00	95
INCH	**-582**	4.88	0.25	9.4	594	30532	4678	14.75	1522	14.25	126	15.38	110
2827 SQ. IN.	**-583**	7.38	0.63	10	396	9047	3119	19.88	1547	19.38	151	20.50	134
60	**-601**	3.25	0.06	6.1	919	112095	7727	11.38	1643	10.88	113	12.00	99
INCH	**-602**	4.88	0.25	9.1	613	33639	5154	14.75	1661	14.25	131	15.38	115
3019 SQ. IN.	**-603**	7.38	0.56	10	409	9967	3436	19.88	1687	19.38	157	20.50	139
62	**-621**	3.25	0.06	5.9	947	123122	8487	11.38	1698	10.88	116	12.00	102
INCH	**-622**	4.88	0.25	8.8	632	36949	5661	14.75	1717	14.25	135	15.38	119
3217 SQ. IN.	**-623**	7.38	0.56	10	421	10948	3774	19.88	1743	19.38	162	20.50	144
64	**-641**	3.25	0.06	5.7	975	134844	9295	11.88	1944	10.88	121	12.00	106
INCH	**-642**	4.88	0.25	8.5	651	40467	6200	15.25	1963	14.25	140	15.38	123
3421 SQ. IN.	**-643**	7.38	0.56	10	434	11990	4133	20.38	1991	19.38	167	20.50	148
66	**-661**	3.25	0.06	5.5	1004	147283	10152	11.88	2193	10.88	124	12.00	109
INCH	**-662**	4.88	0.19	8.3	670	44201	6772	15.25	2212	14.25	144	15.38	127
3632 SQ. IN.	**-663**	7.38	0.50	10	446	13097	4515	20.38	2241	19.38	172	20.50	153
68	**-681**	3.25	0.06	5.4	1032	160460	11060	11.88	2259	10.88	128	12.00	112
INCH	**-682**	4.88	0.19	8	688	48156	7378	15.25	2279	14.25	148	15.38	130
3848 SQ. IN.	**-683**	7.38	0.50	10	459	14268	4919	20.38	2308	19.38	177	20.50	158
70	**-701**	3.25	0.06	5.2	1060	174395	12021	12.13	2508	10.88	132	12.00	116
INCH	**-702**	4.88	0.19	7.8	707	52339	8019	15.50	2529	14.25	152	15.38	134
4072 SQ. IN.	**-703**	7.38	0.50	10	471	15508	5346	20.63	2559	19.38	182	20.50	162
72	**-721**	3.25	0.06	5.1	1088	189110	13035	12.13	2580	10.88	135	12.00	119
INCH	**-722**	4.88	0.19	7.6	726	56756	8696	15.50	2601	14.25	156	15.38	138
4301 SQ. IN.	**-723**	7.38	0.50	10	484	16816	5797	20.63	2632	19.38	187	20.50	167

Notes:

1. **Max Temperature - 800 deg F**
2. **Movements are maximum non-concurrent. See page 65 for methods of combining movements.**
3. **Maximum axial extension is 50% of rated axial movement.**
4. **Rated cycle life is 3,000 EJMA cycles.**
5. **Maximum test pressure is 1.5 times rated working pressure.**
6. **Pressure thrust = Thrust Area X 25 psig.**
7. **Refer to page 68 for torsional spring rates.**
8. **Refer to page 66 for flange dimension and drilling.**

Materials

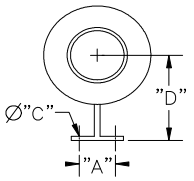
- **Bellows- A240-304/316/321**
- **Flanges- C.S.**
- **Duct- 0.188 thk A36**
- **Liner- same as bellows (w/ drain holes)**
- **Cover- C.S.**

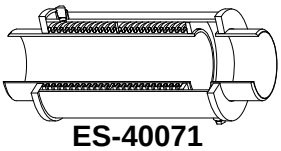
Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Liner Option	-	Cover
	ES-40060	-	701	-	M1	-	L	-	C

See page 29 for details on part number options.

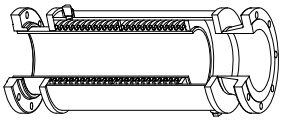
150 PSIG

SINGLE EXTERNALLY PRESSURIZED





ES-40071
WELD END



ES-40081
FLANGED

Nominal Size	Part Code	Thrust Area Sq. In.	Max. Axial IN.	Axial S/R Lbs/IN	OD IN.	ANCHOR FOOT (OPTIONAL) A IN.	B IN.	C IN.	D IN.	ES-40071 OAL IN	ES-40071 WEIGHT LBS	ES-40081 OAL IN	ES-40081 WEIGHT LBS
1	-011	13	4	130	7.38	2.75	4	0.5	7.50	23.125	40	23	49
	-012	13	8	64	7.38	2.75	4	0.5	7.50	41	67	40.875	75
2	-021	13	4	130	7.38	2.75	4	0.5	8.00	23.125	42	23.625	56
	-022	13	8	64	7.38	2.75	4	0.5	8.00	41	71	41.5	85
3	-031	16	4	139	7.38	2.75	4	0.5	8.38	23.125	46	24.125	67
	-032	16	8	69	7.38	2.75	4	0.5	8.38	41	80	42	100
3 1/2	-351	20	4	156	9.38	2.75	4	0.5	8.38	22.25	66	23.375	91
	-352	20	8	78	9.38	2.75	4	0.5	8.38	39.25	111	40.375	136
4	-041	30	4	218	9.38	2.75	4	0.5	8.38	21.875	67	23.25	99
	-042	30	8	109	9.38	2.75	4	0.5	8.38	38.5	114	39.875	146
6	-061	60	4	319	11.50	2.75	4	0.5	9.38	22.75	107	24.875	151
	-062	60	8	159	11.50	2.75	4	0.5	9.38	39.875	178	42	223
8	-081	110	4	591	14.75	3.5	9	0.75	11.00	23	169	25.75	248
	-082	110	8	296	14.75	3.5	9	0.75	11.00	40.125	274	42.875	352
10	-101	154	4	824	18.75	3.5	9	0.75	13.00	23.25	224	26.25	328
	-102	154	8	412	18.75	3.5	9	0.75	13.00	40.75	374	43.75	477
12	-121	183	4	894	18.75	3.5	9	0.75	13.00	23.25	249	27	401
	-122	183	8	447	18.75	3.5	9	0.75	13.00	40.75	412	44.5	564
14	-141	234	4	1005	20.75	3.5	9	0.75	14.00	23.5	297	27.75	511
	-142	234	8	503	20.75	3.5	9	0.75	14.00	41	479	45.25	692
16	-161	291	4	1118	24.75	3.5	9	0.75	16.00	23.5	385	28	636
	-162	291	8	559	24.75	3.5	9	0.75	16.00	41	602	45.5	854
18	-181	361	4	1450	25.25	3.5	9	1	16.00	24	397	29.25	693
	-182	361	8	727	25.25	3.5	9	1	16.00	41.75	636	47	932
20	-201	431	4	1590	27.13	5.5	13	1.5	16.63	24	449	29.625	834
	-202	431	8	797	27.13	5.5	13	1.5	16.63	41.75	715	47.375	1100
22	-221	508	4	1729	29.13	5.5	13	1.5	17.63	24.5	532	30.5	993
	-222	508	8	866	29.13	5.5	13	1.5	17.63	42.25	821	48.25	1283
24	-241	591	4	1867	31.13	5.5	13	1.5	18.63	24.5	575	30.75	1107
	-242	591	8	936	31.13	5.5	13	1.5	18.63	42.25	888	48.5	1420

Notes:

1. Max Temperature - 800 deg F
2. Rated cycle life is 1,000 EJMA cycles.
3. Maximum axial extension is 100% of rated axial movement.
4. Maximum test pressure is 1.5 times rated working pressure.
5. Pressure thrust = Thrust Area X 150 psig.
6. A purge and drain port are provided for low point drainage.
7. Refer to page 68 for torsional spring rates.
8. Refer to page 66 for flange dimensions and drilling.

Materials

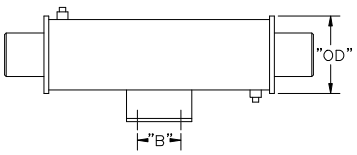
- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- 150# RFSO A105

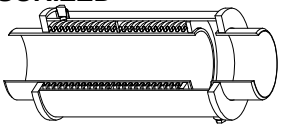
Part Number Example	Product Code	-	Part Code	-	Bellows Material	-	Anchor Foot Option
	ES-40071	-	062	-	M1	-	AF

See page 29 for details on part number options.

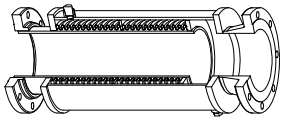
300 PSIG

SINGLE EXTERNALLY PRESSURIZED





ES-40073
WELD END



ES-40083
FLANGED

Nominal Size	Part Code	Thrust Area Sq. In.	Max. Axial IN.	Axial S/R Lbs/IN	OD IN.	ANCHOR FOOT (OPTIONAL) A IN.	B IN.	C IN.	D IN.	ES-40073 OAL IN	ES-40073 WEIGHT LBS	ES-40083 OAL IN	ES-40083 WEIGHT LBS
1	-011	13	4	215	7.38	2.75	4	0.5	7.50	26.75	47	27.25	54
	-012	13	8	107	7.38	2.75	4	0.5	7.50	48	80	48.5	87
2	-021	13	4	215	7.38	2.75	4	0.5	8.00	26.75	49	27.875	65
	-022	13	8	107	7.38	2.75	4	0.5	8.00	48	85	49.125	101
3	-031	16	4	235	7.38	2.75	4	0.5	8.38	26.75	55	28.625	82
	-032	16	8	117	7.38	2.75	4	0.5	8.38	48	97	49.875	124
3 1/2	-351	20	4	268	9.38	2.75	4	0.5	8.38	26.625	83	28.625	117
	-352	20	8	134	9.38	2.75	4	0.5	8.38	47.5	142	49.5	176
4	-041	31	4	426	9.38	2.75	4	0.5	8.38	27.25	91	29.5	137
	-042	31	8	213	9.38	2.75	4	0.5	8.38	48.75	159	51	205
6	-061	60	4	608	11.50	2.75	4	0.5	9.38	27.75	137	30.75	216
	-062	60	8	304	11.50	2.75	4	0.5	9.38	49.625	238	52.625	318
8	-081	110	4	1263	14.75	3.5	9	0.75	11.00	28.375	214	32.25	338
	-082	110	8	631	14.75	3.5	9	0.75	11.00	50.875	370	54.75	494
10	-101	157	4	1778	18.75	3.5	9	0.75	12.00	28.25	324	32.5	494
	-102	157	8	889	18.75	3.5	9	0.75	12.00	50.5	548	54.75	719
12	-121	186	4	1944	18.75	3.5	9	0.75	13.00	28.25	326	33.25	580
	-122	186	8	972	18.75	3.5	9	0.75	13.00	50.5	566	55.5	821
14	-141	237	4	2209	20.75	3.5	9	0.75	14.00	28.25	375	33.875	720
	-142	237	8	1104	20.75	3.5	9	0.75	14.00	50.5	645	56.125	990
16	-161	295	4	2473	24.75	3.5	9	1	16.00	28.75	508	34.75	949
	-162	295	8	1236	24.75	3.5	9	1	16.00	51	827	57	1269
18	-181	359	4	2736	25.25	3.5	9	1	16.00	29	573	35.75	1147
	-182	359	8	1367	25.25	3.5	9	1	16.00	51.25	962	58	1535
20	-201	430	4	2808	27.38	5.5	13	1.5	16.88	29	635	36.125	1355
	-202	430	8	1402	27.38	5.5	13	1.5	16.88	51.25	1063	58.375	1783
22	-221	518	4	4212	29.88	5.5	13	1.5	18.38	26.375	710	33.875	1553
	-222	518	8	2106	29.88	5.5	13	1.5	18.38	45.5	1138	53	1981
24	-241	602	4	4552	31.88	5.5	13	1.5	19.75	26.375	767	34.25	1832
	-242	602	8	2276	31.88	5.5	13	1.5	19.75	45.5	1229	53.375	2293

Notes:

1. Max Temperature - 800 deg F
2. Rated cycle life is 1,000 EJMA cycles.
3. Maximum axial extension is 100% of rated axial movement.
4. Maximum test pressure is 1.5 times rated working pressure.
5. Pressure thrust = Thrust Area X 300 psig.
6. A purge and drain port are provided for low point drainage.
7. Refer to page 68 for torsional spring rates.
8. Refer to page 66 for flange dimensions and drilling.

Materials

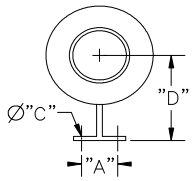
- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- 300# RFSO A105

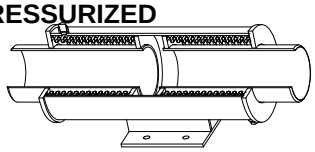
Part Number Example	Product Code - Part Code - Bellows Material - Anchor Foot Option
	ES-40083 - 181 - M3 - AF

See page 29 for details on part number options.

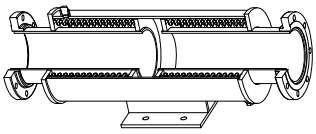
150 PSIG

DUAL EXTERNALLY PRESSURIZED





ES-40091
WELD END



ES-40101
FLANGED

Nominal Size	Part Code	Thrust Area	Max. Axial	Axial S/R	OD	ANCHOR FOOT A	B	C	D	ES-40091 OAL	ES-40091 WEIGHT	ES-40101 OAL	ES-40101 WEIGHT
		Sq. In.	IN.	Lbs/IN	IN.	IN.	IN.	IN.	IN.	IN	LBS	IN	LBS
1	-011	13	8	130	7.38	2.75	4	0.5	7.50	40	74	40.375	78
	-012	13	16	64	7.38	2.75	4	0.5	7.50	75.75	127	76.125	131
2	-021	13	8	130	7.38	2.75	4	0.5	8.00	40	78	41	88
	-022	13	16	64	7.38	2.75	4	0.5	8.00	75.75	135	76.75	145
3	-031	16	8	139	7.38	2.75	4	0.5	8.38	40	86	41.375	102
	-032	16	16	69	7.38	2.75	4	0.5	8.38	75.75	153	77.125	169
3 1/2	-351	20	8	156	9.38	2.75	4	0.5	8.38	38.25	119	39.75	141
	-352	20	16	78	9.38	2.75	4	0.5	8.38	72.25	208	73.75	231
4	-041	30	8	218	9.38	2.75	4	0.5	8.38	37.5	123	39.125	150
	-042	30	16	109	9.38	2.75	4	0.5	8.38	70.75	216	72.375	243
6	-061	60	8	319	11.50	2.75	4	0.5	9.38	39	189	41.125	229
	-062	60	16	159	11.50	2.75	4	0.5	9.38	73.25	332	75.375	372
8	-081	110	8	591	14.75	3.5	9	0.75	11.00	39.25	298	41.75	362
	-082	110	16	296	14.75	3.5	9	0.75	11.00	73.5	507	76	571
10	-101	154	8	824	18.75	3.5	9	0.75	13.00	39.75	396	42.625	488
	-102	154	16	412	18.75	3.5	9	0.75	13.00	74.75	695	77.625	788
12	-121	183	8	894	18.75	3.5	9	0.75	13.00	39.75	434	43.125	572
	-122	183	16	447	18.75	3.5	9	0.75	13.00	74.75	760	78.125	898
14	-141	234	8	1005	20.75	3.5	9	0.75	14.00	40	507	43.5	700
	-142	234	16	503	20.75	3.5	9	0.75	14.00	75	870	78.5	1063
16	-161	291	8	1118	24.75	3.5	9	0.75	16.00	40	637	44	850
	-162	291	16	559	24.75	3.5	9	0.75	16.00	75	1071	79	1284
18	-181	361	8	1450	25.25	3.5	9	1	16.00	41	684	45.375	964
	-182	361	16	727	25.25	3.5	9	1	16.00	76.5	1162	80.875	1442
20	-201	431	8	1590	27.13	5.5	13	1.5	16.63	41	790	45.75	1146
	-202	431	16	797	27.13	5.5	13	1.5	16.63	76.5	1322	81.25	1678
22	-221	508	8	1729	29.13	5.5	13	1.5	17.63	41.5	911	46.75	1313
	-222	508	16	866	29.13	5.5	13	1.5	17.63	77	1490	82.25	1893
24	-241	591	8	1867	31.13	5.5	13	1.5	18.63	41.5	980	47	1457
	-242	591	16	936	31.13	5.5	13	1.5	18.63	77	1606	82.5	2083

Notes:

1. Max Temperature - 800 deg F
2. Rated cycle life is 1,000 EJMA cycles.
3. Maximum axial extension is 100% of rated axial movement.
4. Maximum test pressure is 1.5 times rated working pressure.
5. Pressure thrust = Thrust Area X 150 psig.
6. A purge and drain port are provided for low point drainage.
7. Refer to page 68 for torsional spring rates.
8. Axial spring rate is given per side.
9. Refer to page 66 for flange dimensions and drilling.

Materials

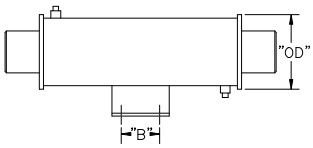
- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- 150# RFSO A105

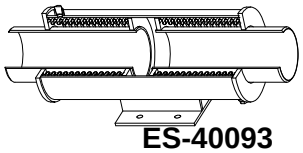
Part Number Example	Product Code - Part Code - Bellows Material
	ES-40091 - 122 - M2

See page 29 for details on part number options.

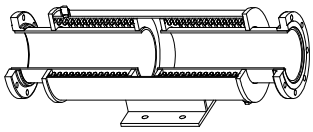
300 PSIG

DUAL EXTERNALLY PRESSURIZED





ES-40093
WELD END



ES-40103
FLANGED

Nominal Size	Part Code	Thrust Area	Max. Axial	Axial S/R	OD	ANCHOR FOOT (OPTIONAL) A	B	C	D	ES-40093 OAL	ES-40093 WEIGHT	ES-40103 OAL	ES-40103 WEIGHT
		Sq. In.	IN.	Lbs/IN	IN.	IN.	IN.	IN.	IN.	IN	LBS	IN	LBS
1	-011	13	8	215	7.375	2.75	4	0.5	7.50	47	84	48.125	90
	-012	13	16	107	7.375	2.75	4	0.5	7.50	89.5	152	90.625	158
2	-021	13	8	215	7.375	2.75	4	0.5	8.00	47	89	48.625	103
	-022	13	16	107	7.375	2.75	4	0.5	8.00	89.5	162	91.125	176
3	-031	16	8	235	7.375	2.75	4	0.5	8.38	47	100	49.375	127
	-032	16	16	117	7.375	2.75	4	0.5	8.38	89.5	184	91.875	211
3 1/2	-351	20	8	268	9.375	2.75	4	0.5	8.38	46.5	144	49	179
	-352	20	16	134	9.375	2.75	4	0.5	8.38	88.25	261	90.75	297
4	-041	31	8	426	9.375	2.75	4	0.5	8.38	47.75	162	50.5	208
	-042	31	16	213	9.375	2.75	4	0.5	8.38	90.75	297	93.5	343
6	-061	60	8	608	11.5	2.75	4	0.5	9.38	48.75	243	51.875	325
	-062	60	16	304	11.5	2.75	4	0.5	9.38	92.5	447	95.625	528
8	-081	110	8	1263	14.75	3.5	9	0.75	11.00	50	391	53.875	514
	-082	110	16	631	14.75	3.5	9	0.75	11.00	95	704	98.875	827
10	-101	157	8	1778	18.75	3.5	9	0.75	12.00	49.5	563	53.75	737
	-102	157	16	889	18.75	3.5	9	0.75	12.00	94	1012	98.25	1186
12	-121	186	8	1944	18.75	3.5	9	0.75	13.00	49.5	580	54.25	827
	-122	186	16	972	18.75	3.5	9	0.75	13.00	94	1061	98.75	1308
14	-141	237	8	2209	20.75	3.5	9	0.75	14.00	49.5	667	54.5	1017
	-142	237	16	1104	20.75	3.5	9	0.75	14.00	94	1208	99	1557
16	-161	295	8	2473	24.75	3.5	9	1	16.00	50	849	55.5	1254
	-162	295	16	1236	24.75	3.5	9	1	16.00	94.5	1488	100	1893
18	-181	359	8	2736	25.25	3.5	9	1	16.00	50.5	993	56.5	1524
	-182	359	16	1367	25.25	3.5	9	1	16.00	95	1770	101	2301
20	-201	430	8	2808	27.375	5.5	13	1.5	16.88	50.5	1126	57	1794
	-202	430	16	1402	27.375	5.5	13	1.5	16.88	95	1983	101.5	2650
22	-221	518	8	4212	29.875	5.5	13	1.5	18.38	44.75	1209	51.75	1994
	-222	518	16	2106	29.875	5.5	13	1.5	18.38	83	2065	90	2850
24	-241	602	8	4552	31.875	5.5	13	1.5	19.75	44.75	1301	52.125	2303
	-242	602	16	2276	31.875	5.5	13	1.5	19.75	83	2225	90.375	3226

Notes:

1. Max Temperature - 800 deg F
2. Rated cycle life is 1,000 EJMA cycles.
3. Maximum axial extension is 100% of rated axial movement.
4. Maximum test pressure is 1.5 times rated working pressure.
5. Pressure thrust = Thrust Area X 300 psig.
6. A purge and drain port are provided for low point drainage.
7. Refer to page 68 for torsional spring rates.
8. Axial spring rate is given per side.
9. Refer to page 66 for flange dimensions and drilling.

Materials

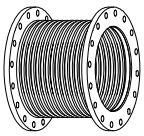
- Bellows- A240-304/316/321
- Pipe- A53 GR.B Sch. Std.
- Flanges- 300# RFSO A105

Part Number Example	Product Code - Part Code - Bellows Material
	ES-40103 - 011 - M1

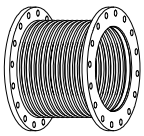
See page 29 for details on part number options.

FV/ 15 PSIG

SINGLE EXHAUST ASSEMBLY



ES-40110
CARBON STEEL



ES-40111
STAINLESS STEEL

Nominal Size / Thrust Area	Part Code	Movements			Spring Rates			Vanstone OD	ES-40110/ES-40111	
		Axial	Lateral	Angular	Axial	Lateral	Angular		OAL	WEIGHT
		IN	IN	deg	LBS/IN.	LBS/IN	IN-LBS/DEG	IN.	IN	LBS
3	-031	0.88	0.19	10	371	988	13	4.50	4.375	9
INCH	-032	1.25	0.50	10	257	288	9	4.50	6	11
13 SQ. IN.	-033	1.75	0.88	10	191	122	7	4.50	7.5	14
3 1/2	-351	0.88	0.19	10	389	1312	17	5.13	4.375	13
INCH	-352	1.38	0.44	10	268	381	12	5.13	6	15
16 SQ. IN.	-353	1.88	0.75	10	199	162	9	5.13	7.5	18
4	-041	1.13	0.19	10	347	1400	20	5.88	4.5	17
INCH	-042	1.75	0.50	10	233	407	13	5.88	6.125	19
21 SQ. IN.	-043	2.38	0.94	10	174	175	10	5.88	7.625	22
5	-051	1.25	0.19	10	353	2097	30	7.00	4.5	18
INCH	-052	1.88	0.50	10	236	608	20	7.00	6.125	21
30 SQ. IN.	-053	2.50	0.88	10	176	262	15	7.00	7.625	24
6	-061	1.63	0.31	10	338	1441	40	8.25	5.875	21
INCH	-062	2.50	0.69	10	223	430	26	8.25	8	24
43 SQ. IN.	-063	3.38	1.25	10	166	182	20	8.25	10.125	27
8	-081	1.75	0.25	10	457	3188	89	10.63	5.875	27
INCH	-082	2.63	0.63	10	306	931	60	10.63	8.125	31
70 SQ. IN.	-083	3.50	1.06	10	228	399	45	10.63	10.25	35
10	-101	2.13	0.31	10	503	3225	149	12.75	7.125	38
INCH	-102	3.25	0.75	10	333	962	98	12.75	9.875	43
106 SQ. IN.	-103	4.25	1.31	10	252	403	74	12.75	12.75	48

Notes:

1. Max Temperature - 1200 deg F
2. Movements are maximum non-concurrent. See page 65 for methods of combining movements.
3. Maximum axial extension is 50% of rated axial movement.
4. Rated cycle life is 10,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 15 psig.
7. Refer to page 68 for torsional spring rates.
8. Ends are fixed flange x floating flange.
9. Liners are not available for 3",3.5" and 4" diameters
10. Refer to page 66 for flange dimensions and drilling.

Materials

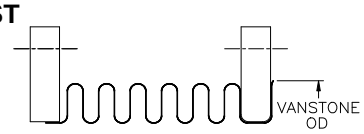
- Bellows- Multi ply A240-321 only
- Flanges-
  (ES-40110) Plate C.S. 150# Drilling
  (ES-40111) Plate 304 S.S. 150# Drilling
- Liner- A240-304 (w/ drain holes)
- Cover-
  (ES-40110) C.S.
  (ES-40111) 304 S.S.

Part Number Example	Product Code - Part Code - Liner Option - Cover
	ES-40110 - 083 - L - C

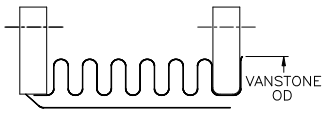
See page 29 for details on part number options.

FV/ 15 PSIG

SINGLE EXHAUST ASSEMBLY



ES-40110
CARBON STEEL



ES-40111
STAINLESS STEEL (LINER SHOWN)

Nominal Size Thrust Area	Part Code	Movements			Spring Rates			Vanstone OD IN.	ES-40110/ES-40111	
		Axial IN	Lateral IN	Angular deg	Axial LBS/IN.	Lateral LBS/IN	Angular IN-LBS/DEG		OAL IN	WEIGHT LBS
12	-121	2.50	0.31	10	375	3425	158	15.00	7.375	50.00
INCH	-122	3.75	0.75	10	251	1003	106	15.00	10.25	57.00
SQ. IN.	-123	5.00	1.38	10	188	421	79	15.00	13.125	63.00
14	-141	2.50	0.25	10	296	3260	150	16.25	7.625	54.00
INCH	-142	3.75	0.69	10	198	954	101	16.25	10.5	62.00
SQ. IN.	-143	5.00	1.25	10	148	400	76	16.25	13.375	69.00
16	-161	2.50	0.25	10	635	8213	413	18.50	8	116.00
INCH	-162	3.75	0.63	10	423	2466	275	18.50	10.875	126.00
SQ. IN.	-163	5.00	1.13	10	317	1047	206	18.50	13.75	136.00
18	-181	2.50	0.25	10	701	11292	568	21.00	8.125	146.00
INCH	-182	3.75	0.56	10	467	3391	379	21.00	11	157.00
SQ. IN.	-183	5.00	1.00	10	350	1441	284	21.00	13.875	168.00
20	-201	2.50	0.19	10	583	11567	582	23.00	8.25	157.00
INCH	-202	3.75	0.50	10	388	3476	388	23.00	11.125	170.00
SQ. IN.	-203	5.00	0.88	10	291	1477	291	23.00	14	182.00
22	-221	2.50	0.19	10	634	15056	758	25.25	8.375	193.00
INCH	-222	3.75	0.44	10	423	4526	505	25.25	11.25	207.00
SQ. IN.	-223	5.00	0.81	10	317	1923	379	25.25	14.125	220.00
24	-241	2.50	0.19	10	685	19178	965	27.25	8.5	218.00
INCH	-242	3.75	0.44	10	457	5767	644	27.25	11.375	232.00
SQ. IN.	-243	5.00	0.75	10	343	2451	483	27.25	14.25	247.00

Notes:

1. Max Temperature - 1200 deg F
2. Movements are maximum non-concurrent. See page 64 for methods of combining movements.
3. Maximum axial extension is %50 of rated axial movement.
4. Rated cycle life is 10,000 EJMA cycles.
5. Maximum test pressure is 1.5 times rated working pressure.
6. Pressure thrust = Thrust Area X 15 psig.
7. Refer to page 68 for torsional spring rates.
8. Ends are fixed flange x floating flange.

Materials

- Bellows- Multi ply A240-321 only
- Flanges-
  (ES-40110) Plate C.S. 150# Drilling
  (ES-40111) Plate 304 S.S. 150# Drilling
- Liner- A240-304 (w/ drain holes)
- Cover-
  (ES-40110) C.S.
  (ES-40111) 304 S.S.

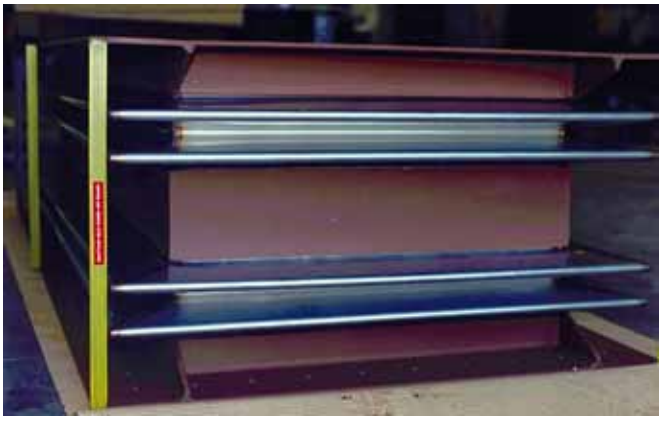
Part Number Example	Product Code - Part Code - Liner Option - Cover
	ES-40111 - 222 - L - C

See page 29 for details on part number options.

Rectangular Bellows Assembly

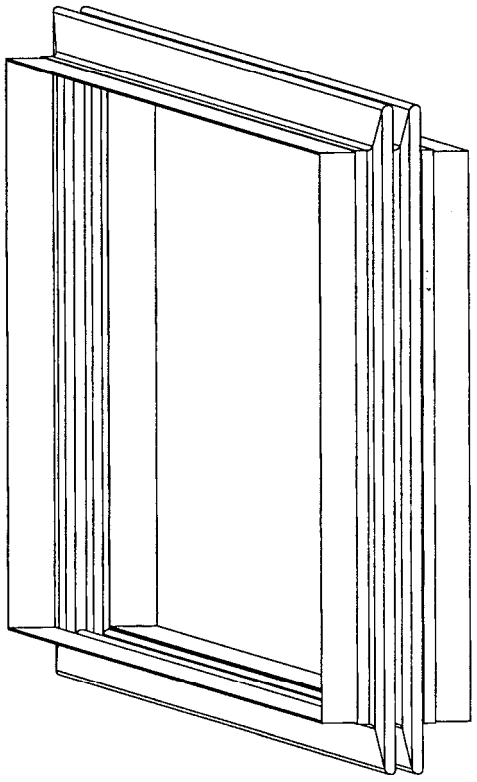
Expansion Joint Systems also designs and manufactures a wide range of **Single** and **Universal Rectangular Bellows Assemblies** to compensate for axial and lateral movements over a broad cross section of different operating conditions.

Single and **Universal Rectangular Bellows Assemblies** are available in four different corner configurations and two basic span shapes. Size is governed only by transportation limitation. Oversized assemblies can be shipped in sections for field installation.



Applications

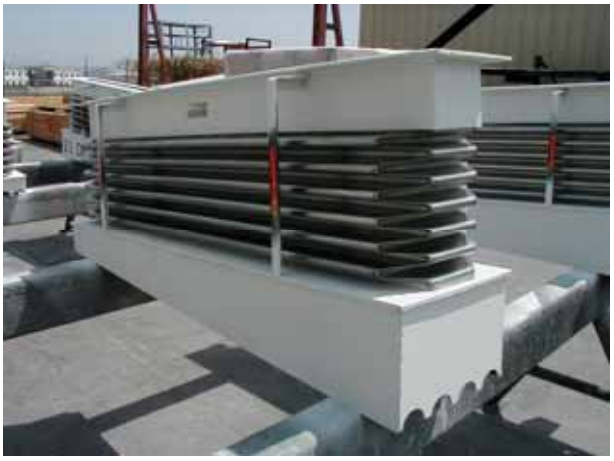
Rectangular bellows assemblies are used in gas turbine exhaust systems, turbine/condenser connections, boiler breaching, forced draft fans, flue gas ducts, regenerators, precipitators and other hot gas, large volume ducting systems.



Design Notes

It is very important when specifying lateral movement to indicate in which direction the movement is applied to the expansion joint. This is especially true on large rectangular ducts. The equivalent axial movement required when lateral movement is applied the hard way is much greater than when lateral movement is applied the easy way. In many instances, a long **Universal Expansion Joint Assembly** is the only practical solution.

Rectangular assemblies can be manufactured from a wide variety of different materials, including Type 300 Series stainless steels, high nickel alloys and Corten Steel. See page 15-16 for more detailed information.



Rectangular Expansion Joint with Camera Corners

Corner Configuration Types

The application and operating conditions will dictate the correct choice of span shape and corner configuration. For low-pressure applications "V" span is used. For higher-pressure applications up to 30 P.S.I.G., "U" span is preferred.

Single Mitre "V" span: This is the most common and economical type used to compensate for thermal expansion, and can readily be bolted or welded into the connecting duct work. These are preferred in low cycle and vibration -free applications



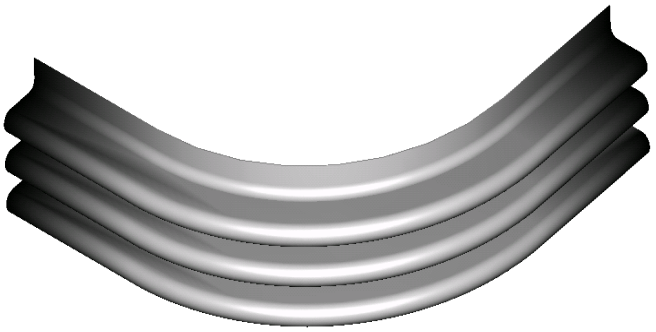
Camera Corners "V" Span: Are used mainly on low-pressure applications. They have good cycle life characteristics and are less costly than the double miter corner design.



Double Miter "V" Span: This type is slightly more expensive to manufacture than the single miter design. However, they do provide a greater cycle life under the same set of operating conditions.



Rounded Corners "U" Span: Should be considered in applications up to 30 P.S.I.G., and where vibration and cycle life are important factors. Rounded corners are the most costly to manufacture.



Specialty Products for Fluid Catalytic Cracking Units

Along with our standard expansion joint product line, KEB-EJS manufactures various specialty metal and fabric expansion joints.

Fluid Catalytic Cracking Units (FCCU) Expansion Joints
Metallic expansion joints are an integral component of these complex refinery processes and their reliability can be significant to the refinery's productivity and performance. An unexpected joint failure can represent millions of dollars in losses to a refinery.

Expansion joints used in FCCU service are some of the most critical and complex expansion joints manufactured. Fluid Catalytic Cracking Units (FCCU) or Cat Crackers, operate at very high pressures and temperatures, consequently resulting in large thermal offsets for the installed expansion joint. Furthermore, the introduction of abrasive media (catalyst) requires additional protection to avoid gradual deterioration and premature failure of the expansion joint.

The bellows membrane is the most critical element of the expansion joint assembly. Its relatively thin wall construction is designed for maximum flexibility, but must be protected against erosive catalyst and other corrosive media. Refractory lining is used to prevent erosion of the bellows and the attached piping from catalyst flowing through the assembly while in service



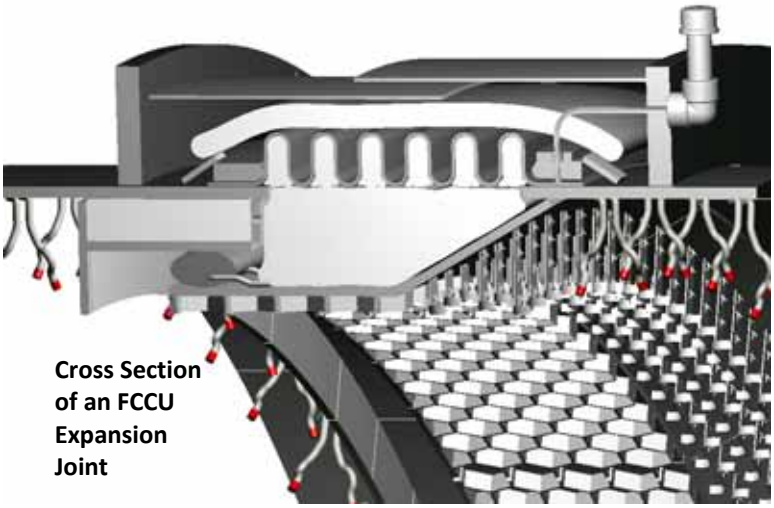
Various performance analysis calculations are used to determine the theoretical life expectancy for a given design. EJMA (Expansion Joint Manufactures Association) is the predominant standard used. EJMA is an association of experienced manufacturers who establish and test design standards for the expansion joint industry.



There are various types of expansion joints used in FCCU applications: tied universals, hinged, gimbal, and pressure balanced. All of these fall into 3 major categories: Cold Wall, Hot Wall, and Unlined FCCU joints. The bellows membrane design for all three categories is basically the same, although the bellows membrane can be single ply, multi-ply, redundant ply and reinforced.

Today the material of choice for most FCCU applications is Inconel 625LCF (low cycle fatigue). Almost identical to the original Inconel 625, this special bellows grade of Inconel 625 that was introduced in 1990, provides tighter controls over the carbon, silicon and nitrogen contents. This produces a microstructure that enhances low-cycle fatigue.

KEB-EJS has specialized in building FCCU expansion joints for over 25 years. Along with CAD and 3D modeling, KEB-EJS also incorporates finite element and pipe stress analysis in the design of these complex units. We offer a 24-hour emergency assistance that will put you in touch with one of our engineers at anytime. An expense only inspection and evaluation of your system, including thermal mapping, movement analysis and a complete evaluation of the bellows and is available upon request.



Cross Section of an FCCU Expansion Joint

Specialty Products for Gas Turbine Exhaust (GTX)

Metal expansion joints have been successfully used in a wide range of applications since 1940. As a pressure vessel, their most important feature is that they can withstand very high pressures while absorbing thermal growth. Our metal turbine expansion joints are used predominantly by Siemens Power Corporation: the largest diameter used in 16'-0 on the V94.3A engine.

KE-Burgmann EJS (KEB-EJS) has installed turbine exhaust units on V64.3, V84.2 (U.S. only), V84.3 and V.94.3 turbines, including their respective "A" options. We also supply expansion joints for the fuel and air intake systems.

The exhaust joints are supplied in one piece, complete with internal spiders and lifting shackles. Removable insulation jackets can be provided with the expansion joint as well. The exhaust expansion joints are shipped completely boxed in canted shipping boxes that can be stored outside on the job site.



Metal Expansion Joint for Gas Turbine Application



Since the development of the very first steam turbine in 1831 and the initial exploitation of natural gas as a source of fuel, the power generation industry has taken giant steps in the development of advanced and thermally efficient gas turbines. New, improved types are continuously being developed to meet the demands for greater efficiency and output from gas turbine and combined cycle systems. Commercial demands to minimize fuel costs and improve performance coupled with environmental responsibility to reduce emissions and noise will continue to compel turbine manufacturers and operating companies to seek more innovative solutions in modern gas turbine technology.

In both single cycle and combined cycle systems, expansion joints help ensure the stability and reliability of any given gas turbine system. As a global leader in fabric expansion joint technology, KE-Burgmann has a long history of providing products that match the advances of major gas turbine manufacturers worldwide. We are continuously developing new types of fabric expansion joints specifically suited to meet the needs of today's gas turbine systems.

From our experience, we believe the frame designs have been the cause of most of problems related to GTX fabric expansion joints. Our expertise in developing expansion joints for other critical applications that involve temperatures far higher than those seen in GTX service has enabled us to develop a line of quality products that provide good performance and a longer life for the end user. For more information, please request our expansion joints for gas turbine brochure. See page 77 for a list of all our specialized products.

Specialty Products for HRSGs & Boilers





PenSeal Plus® penetration seals were developed by KE-Burgmann EJS to address the many problems associated with penetrating the shell of a boiler or similar pressure casing. Traditionally when a tube or pipe penetrates the casing, a slip joint packed type seal is often used to allow the tube or pipe to thermally expand and contract without damaging the surrounding shell or pressure casing. The packing material in this joint is used to help reduce the escape of heat and gas from the boiler. However, these designs have many drawbacks. They require constant adjusting to keep the seal from leaking excessively. Because slip joint type packed seals can not be insulated, imposed stress on the tubes will eventually cause the unit to leak and become so hot that maintenance personnel are unable to get close enough to adjust them. PenSeal Plus® penetration seals are the solution to these problems.

PenSeal Plus® is a state of the art bellows expansion joint that offers a complete seal that eliminates the leakage of heat and other emissions, reduces noise, and protects maintenance personnel.

These seals can be completely insulated which ensures the least amount of heat loss at the point of penetration as well as helping to cool the casing area around it. Because PenSeal Plus® is a true expansion joint, it is designed to accept axial, lateral and angular movements therefore, lowering the stress on the tubes and pipes they are attached to.

PenSeal Plus ™ seals have been used by leading OEMs in the industry and now they are available to everyone. These seals are available in one piece and clamshell models to accommodate almost any application from original manufacturers to retrofits of existing installations.

Fabric PenSeal Plus® In addition to our metal product line, we also provide a complete line of fabric penetration seals. Our fabric seals will accommodate large movements and can be used when space is limited. The close proximity of hot surfaces or other fabric seals can be detrimental to the life of a fabric seal and typically a metal seal is recommended for high temperature and is less costly.

The design of this seal has evolved from many years of field-testing and today our Series feature longevity characteristics combined with a competitive price. Although there are no fabric that are 100% gas tight, fabric seals give more flexibility in the lateral movement mode than their metal counter-parts and you can expect a life span of up to 7 years. Nevertheless, fabric seals are easy to replace without utilizing specialized installation technicians.

If a replacement seal is required, a clamshell bellows or our penetration slider seals may be the ideal solution to keep your plant running efficiently. Clamshell bellows seals can be installed directly over your installed seals for quick and easy replacement. PS Seals® or slider seals can significantly lower energy loss, while reducing the maintenance load and risk of an unplanned outage. These seals may be disassembled and repaired without cutting metal piping or welds; there is no need for specially trained welders to install the replacements.



Clamshell Bellows

Specialty Products for Heat Exchangers & Silencers

Expansion Joints for Heat Exchangers

As an ASME certified Section VIII manufacturer, our expansion joints for heat exchangers are ideal for manufacturers and owners. Our CODEFLEX program is available 24-hours a day for instant online specification and pricing of our standards expansion joint products specifically designed for shell and tube or floating head heat exchangers. Appendix 26 required a special code analysis that is provided with these high-pressure expansion joints and a third-party inspection ensures the expansion joint is manufactured in accordance to this code.



The convulsions on the bellow may be U shaped or torodial depending on the design conditions. As a minimum, all code products require 100% dye penetration examination of the bellows longitudinal seams and attachments welds with complete hydrotest of the unit. Visit www.keb-ejs.com to get instant pricing for your expansion joints or complete our custom expansion joint form for your specific design specifications.

Silencer Bellows Seals (SBS) These expansion joints are designed to reduce the cost of accommodating large thermal growth which is a common problem on safety relief steam and vent piping. Steam Relief Valve piping is typically a high-pressure steam application which involves daily boiler movements and larger thermal movements when the valve is opened. The typical expansion joints used in these piping systems are very expensive and complex. When the SBS is integrated into the exhaust silencer, pressure is reduced dramatically. This integration allows a simple, yet effective bellows seal to be used. The seal, located at the inlet to the silencer, supports all boiler and piping thermal movements. KEB-EJS also provides the sound attenuation jacket that surrounds the seal ensuring that little noise escapes from the SBS unit.

Silencer Bellows Seals (SBS) are integrated directly with the silencer and because they are part of the silencer itself, the resulting pressure they are exposed to is very low. Although the inlet line pressure can exceed 1000 PSIG, silencer internal pressures are normally maintained between 1 PSIG and 15 PSIG. These seals will accommodate 1" axial extension and 2" of lateral movement that are generally large enough for equipment and piping thermal growth.

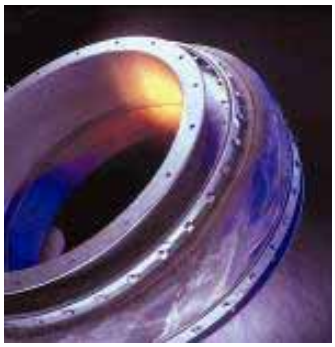


Silencer Bellows Seals (SBS) are integrated directly with the silencer and because they are part of the silencer itself, the resulting pressure they are exposed to is very low.



The SBS units can either be installed by the silencer manufacturer or bolted together on site. Whichever type is chosen, the inlet diffuser pipe has must be modified to accommodate the SBS unit. KEB-EJS can put you in contact with a silencer manufacturer who uses the SBS system with their silencers and the resulting cost saving can be substantial.

Specialty Products – Non Metallic Expansion Joints



Fabric Expansion Joints Since manufacturing their first fabric expansion joints in 1963, KE-Burgmann has been a leader in developing fabric expansion joint technology and products. Today's advancements in processing and generating technologies are being combined with high demands for efficiency and environmental protection put a higher demand on expansion joint designs. In the last few years, advanced materials and design improvements have made it possible for us to meet these demands while increasing functionality, operating reliability and service life of our expansion joints.

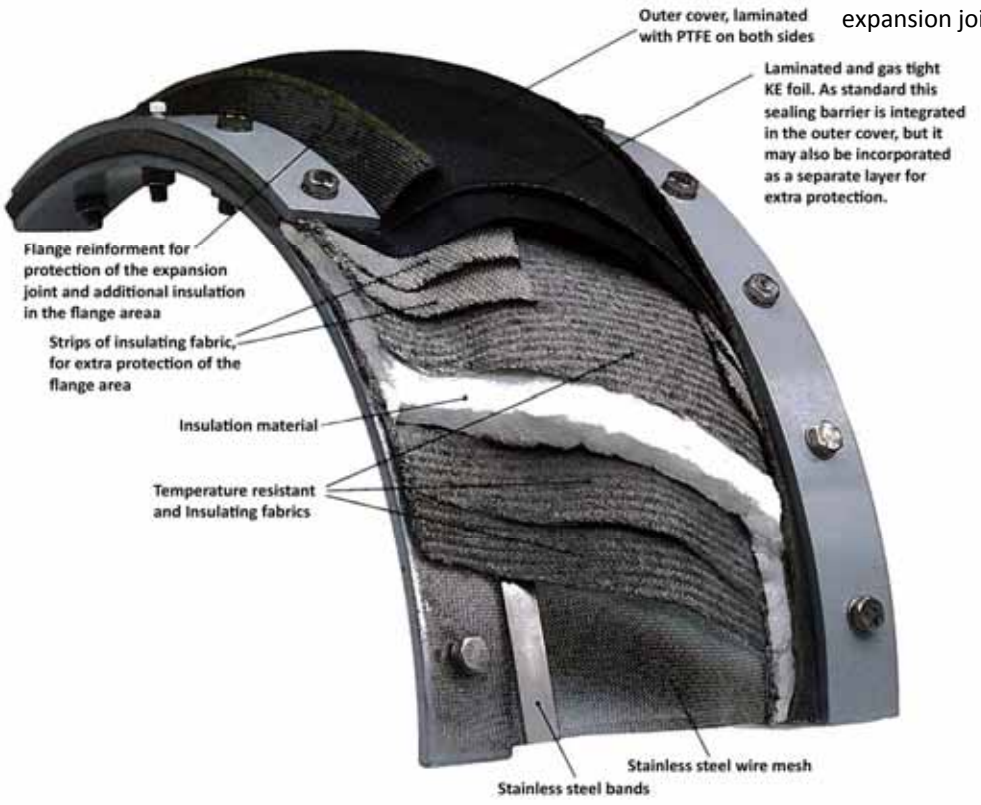
Regardless of whether flexible expansion joints are manufactured from elastomers or fabrics, they offer different benefits and features from their metal counterparts. The introduction of fabric expansion joints has changed the way engineers solve thermal growth problems in gas transfer applications. Generally fabric joints will accommodate large movements over relatively short installation lengths. Their use in large ducting systems in place of metallic units reduces cost, weight, and provides quick, easy replacements.

Fabric expansion joints offer solutions for a broad range of industrial applications. In addition to power generating systems, these expansion joints are used in all industries where one or more thermal processes take place. Although we have standardized expansion joints, we also provide customized designs to meet your application's requirements. To offer you the most optimal solution, technically and economically, we encourage you to contact us at earliest stage of the project. Our vast expereince, dedication to improving technology and our technical knowledge ensures expansion joints that are cost-effective reliable, and safe.



KE-MASTERFLEX Rubber Expansion Joints
Rubber expansion joints are flexible connectors made from natural or synthetic elastomers in which special fabrics are embedded to provide physical reinforcement. These types of expansion joints provide a proven flexible solution to accommodate many types of movement and requirements of industrial plants and equipment.

With over 40 years experience, KE-Burgmann uses only the highest quality elastomers and fabrics for our KE-MASTERFLEX and other specialized rubber expansion joints.



For more information, please request our fabric expansion joint catalogue. See page 77 for a list of all our specialized products.

Onsite & Emergency Services

Onsite & Emergency Services For nearly three decades, **KEB-EJS** has meant quality, state of the art technology and worldwide services in the expansion joint industry. Our engineers and designers utilize advanced design software such as 3D Modeling, finite element analysis (F.E.A.), proprietary bellows design analysis and pipe and pipe stress analysis software to develop and test our products. Along with keeping up with the latest technology, we also continue our commitment to our customers to provide onsite installation and repair services. **KEB-EJS** can supply anything from a Technical Supervisor to a full team to remove, repair, or replace your metal or fabric expansion joint for emergencies or scheduled outages



Our expansion joints are designed and built to help you reduce operating and maintenance costs as well as improve reliability and safety. The decision to include **KEB-EJS** for your next project will save you time and money. Regardless of the scope of work in your project from planning to completion, the earlier our team can be involved the better we are able to help you maximize your budget and install reliable and safe expansion joints.

KEB-EJS has the experience and manpower to pre-plan and staff your project. **KEB-EJS** can save you hundreds of man-hours in getting the job done correctly, on time, the first time, safely.



KEB-EJS can perform all types of welding and uses a variety of materials including exotic alloys. **KEB-EJS** is fully certified to meet codes ASME, Section V, Section VIII division 1, Section IX, U and R stamps. A 30-foot fully contained transportable trailer is stocked with welding equipment to support a team of ten people and is available in as little as 24 hours. Our 24-hour emergency hotline will put you in contact with an experienced engineer within one hour. There is no charge for our advice.

KEB-EJS provides emergency repair, refurbishment, evaluations, and replacement of any metal and fabric expansion joints regardless of the brand or manufacturer. Call us today to discuss your project with one of our specialist.

Call 24 Hours 7-days a week
+ 1 (800) 826 3058 + 1 (619) 562 6083

KEB-EJS is an active members of these safety management companies & programs:

ISNetworld

PICS

PEC PREMIER

houston area safety council hasc

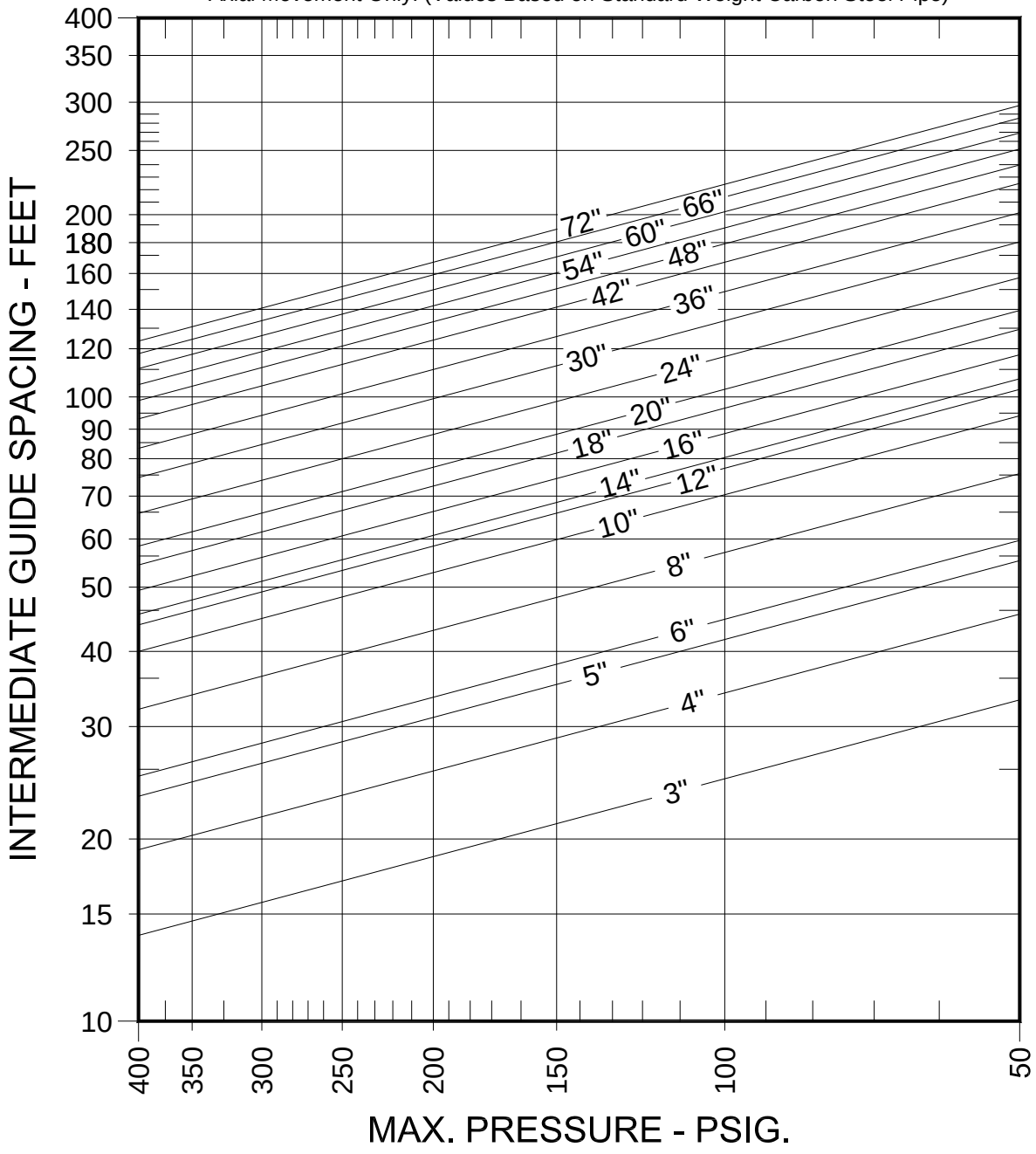
Engineering Data Resources
Datasheets & General Conversions

- Piping Guides Spacing
- Movements and Cycle Life Conversion
- Flange Data
- Torsional Properties
- Linear Thermal Expansion
- General Conversion
- Pipe Properties & Weights
- Literature Request Form
- Specific Form

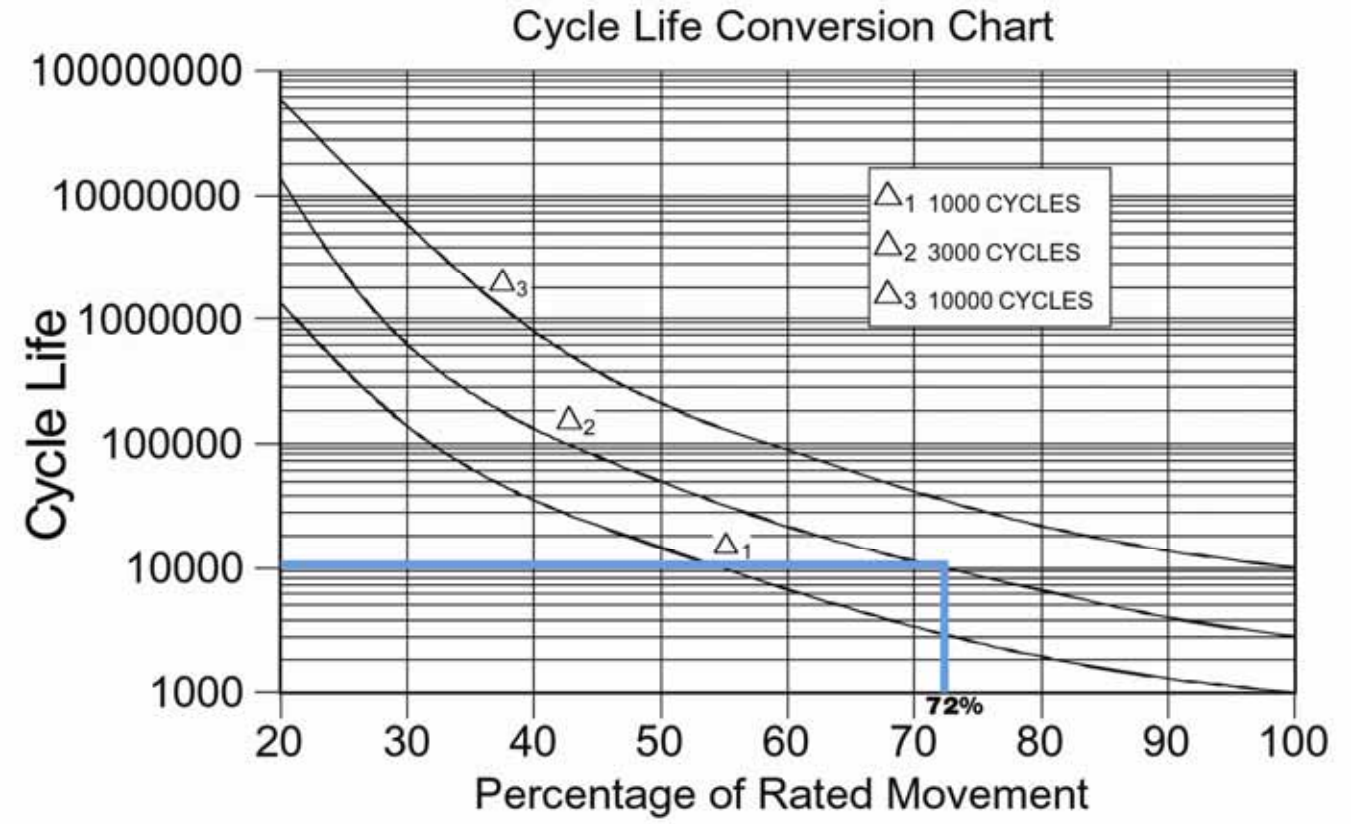
Pipe Guide Spacing

FIRST GUIDE: Locate within a distance of four pipe diameters from the expansion joints
SECOND GUIDE: Locate within a distance of fourteen pipe diameters from the first guide.
INTERMEDIATE GUIDE: Spacing as required per the chart below.

Recommended Maximum Spacing of Intermediate Pipe Guides for Applications Involving Axial Movement Only. (Values Based on Standard Weight Carbon Steel Pipe)



Combining Movements and Increased Cycle Life



Simultaneous Combined Movements:

Single and **Universal Unrestrained Bellows Assemblies** are capable of any combination of the three basic movements shown on the engineering data sheet, provided the maximum individual rated movements specified are not exceeded. Since all internally pressurized expansion joints are designed for a minimum of **3000 cycles** for each of the three basic movements, the sum of the percentages of each of these rated movements must not exceed 100 percent.

Note: In the case of **Externally Pressurized Expansion Joints**, the design cycle life is **1000 cycles**.

Example: Cycle life Conversion

Given: 14" nominal diameter **Universal Style Expansion Joint,** rated for 1.69" axial, 1.88 lateral and 10 deg angular. What is the new cycle life with the following concurrent movements: 0.375" axial, 0.75" lateral and 1.0 deg angular.

MOVEMENTS	REQUIRED	RATED	PERCENTAGE	% OF RATED
AXIAL	0.375	1.69	0.375/1.69 X 100	22 %
LATERAL	0.75	1.88	0.75/1.88 X 100	40%
ANGULAR	1.0	10	1.0/10 X 100	10%
				72 %

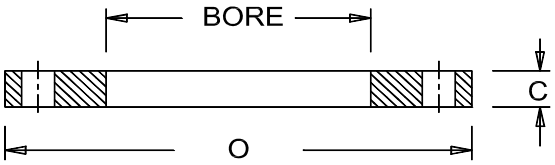
The expansion joint selected uses only 72% of its total rated movement. Therefore, an increase in cycle life will result. By substituting 72% in the cycle life conversion chart, the new cycle life can be determined. From the example, using 72% of the rated movements results in a new cycle life of 10000.

Thermal Expansion Data

Linear Thermal Expansion between 70°F and indicated Temperature, inches/100 feet

	MATERIAL												
Temp. deg F	Carbon-Steel, Carbon-Moly, Low Chrome (thru 3 Cr Mo)	5 Cr Mo thru 9 Cr Mo 18	Austenitic Stainless Steels 18 Cr 8 Ni	12 Cr 17 Cr 27 Cr	25 Cr 20 Ni	Monel 67 Ni 30 Cr	3-1/2 Nickel	Aluminum	Gray Cast Iron	Bronze	Brass	Wrought Iron	70 Cu 30 Ni
-325	-2.37	-2.22	-3.85	-2.04	-3.00	-2.62	-2.22	-4.68		-3.98	-3.88	-2.70	-3.15
-300	-2.24	-2.10	-3.63	-1.92	-2.83	-2.50	-2.10	-4.46		-3.74	-3.64	-2.55	-2.87
-275	-2.11	-1.98	-3.41	-1.80	-2.66	-2.38	-1.98	-4.21		-3.50	-3.40	-2.40	-2.70
-250	-1.98	-1.86	-3.19	-1.68	-2.49	-2.26	-1.86	-3.97		-3.26	-3.16	-2.25	-2.53
-225	-1.85	-1.74	-2.96	-1.57	-2.32	-2.14	-1.74	-3.71		-3.02	-2.93	-2.10	-2.36
-200	-1.71	-1.62	-2.73	-1.46	-2.15	-2.02	-1.62	-3.44		-2.78	-2.70	-1.95	-2.19
-175	-1.58	-1.50	-2.50	-1.35	-1.98	-1.90	-1.50	-3.16		-2.54	-2.47	-1.81	-2.12
-150	-1.45	-1.37	-2.27	-1.24	-1.81	-1.79	-1.38	-2.88		-2.31	-2.24	-1.67	-1.95
-125	-1.30	-1.23	-2.01	-1.11	-1.60	-1.59	-1.23	-2.57		-2.06	-2.00	-1.49	-1.74
-100	-1.15	-1.08	-1.75	-0.98	-1.39	-1.38	-1.08	-2.27		-1.81	-1.76	-1.31	-1.53
-75	-1.00	-0.94	-1.50	-0.85	-1.18	-1.18	-0.93	-1.97		-1.56	-1.52	-1.13	-1.33
-50	-0.84	-0.79	-1.24	-0.72	-0.98	-0.98	-.078	-1.67		-1.32	-1.29	-0.96	-1.13
-25	-0.68	-0.63	-0.98	-0.57	-0.78	-0.77	-0.62	-1.32		-1.25	-1.02	-0.76	-.089
0	-0.49	-0.46	-0.72	-0.42	-0.57	-0.57	-0.46	-0.97		-0.77	-0.75	-0.56	-0.66
25	-0.32	-0.30	-0.46	-0.27	-0.37	-0.30	-0.30	-0.63		-0.49	-0.48	-0.36	-0.42
50	-0.14	-0.13	-0.21	-0.12	-0.16	-0.20	-0.14	-0.28		-0.22	-0.21	-0.16	-0.19
70	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0.23	0.22	0.34	0.20	0.28	0.28	0.22	0.46	0.21	0.36	0.35	0.26	0.31
125	0.42	0.40	0.62	0.36	0.51	0.52	0.40	0.85	0.38	0.66	0.64	0.48	0.56
150	0.61	0.58	0.90	0.53	0.74	0.75	0.58	1.23	0.55	0.96	0.94	0.70	0.82
175	0.80	0.76	1.18	0.69	0.98	0.99	0.76	1.62	0.73	1.26	1.23	0.92	1.07
200	0.99	0.94	1.46	0.86	1.21	1.22	0.94	2.00	0.90	1.56	1.52	1.14	1.33
225	1.21	1.13	1.75	1.03	1.45	1.46	1.13	2.41	1.08	1.86	1.83	1.37	1.59
250	1.40	1.33	2.03	1.21	1.70	1.71	1.32	2.83	1.27	2.17	2.14	1.60	1.86
275	1.61	1.52	2.32	1.38	1.94	1.96	1.51	3.24	1.45	2.48	2.45	1.83	2.13
300	1.82	1.71	2.61	1.56	2.18	2.21	1.69	3.67	1.64	2.79	2.76	2.06	2.40
325	2.04	1.90	2.90	1.74	2.43	2.44	1.88	4.09	1.83	3.11	3.08	2.29	2.68
350	2.26	2.10	3.20	1.93	2.69	2.68	2.08	4.52	2.03	3.42	3.41	2.53	2.96
375	2.48	2.30	3.50	2.11	2.94	2.91	2.27	4.95	2.22	3.74	3.73	2.77	3.24
400	2.70	2.50	3.80	2.30	3.20	3.25	2.47	5.39	2.42	4.05	4.05	3.01	3.52
425	2.93	2.72	4.10	2.50	3.46	3.52	2.69	5.83	2.62	4.37	4.38	3.25	
450	3.16	2.93	4.41	2.69	3.72	3.79	2.91	6.28	2.83	4.69	4.72	3.50	
475	3.39	3.14	4.71	2.89	3.98	4.06	3.13	6.72	3.03	5.01	5.06	3.74	
500	3.62	3.35	5.01	3.08	4.24	4.33	3.34	7.17	3.24	5.33	5.40	3.99	
525	3.86	3.58	5.31	3.28	4.51	4.61	3.57	7.63	3.46	5.65	5.75	4.25	
550	4.11	3.80	5.62	3.49	4.79	4.90	3.80	8.10	3.67	5.98	6.10	4.50	
575	4.35	4.02	5.93	3.69	5.06	5.18	4.03	8.56	3.89	6.31	6.45	4.76	
600	4.60	4.24	6.24	3.90	5.33	5.46	4.27	9.03	4.11	6.64	6.80	5.01	
625	4.86	4.47	6.55	4.10	5.60	5.75	4.51		4.34	6.96	7.16	5.27	
650	5.11	4.69	6.87	4.31	5.88	6.05	4.75		4.57	7.29	7.53	5.53	
675	5.37	4.92	7.18	4.73	6.16	6.34	4.99		4.80	7.62	7.89	5.80	
700	5.63	5.14	7.50	4.73	6.44	6.64	5.24		5.03	7.95	8.26	6.06	
725	5.90	5.38	7.82	5.16	6.73	6.94	5.50		5.26	8.28	8.64	6.32	
750	6.16	5.62	8.15	5.38	7.02	7.25	5.76		5.50	8.62	9.02	6.59	
775	6.43	5.86	8.47	5.60	7.31	7.55	6.02		5.74	8.96	9.40	6.85	
800	6.70	6.10	8.80	5.82	7.60	7.85	6.27		5.98	9.30	9.78	7.12	
825	6.97	6.34	9.13	6.05	7.89	8.16	6.54		6.22	9.64	10.17	7.40	
850	7.25	6.59	9.46	6.27	8.19	8.48	6.81		6.47	9.99	10.57	7.69	
875	7.53	6.83	9.79	6.49	8.48	8.80	7.08		6.72	10.33	10.96	7.97	
900	7.81	7.07	10.12	6.71	8.78	9.12	7.35		6.97	10.68	11.35	8.25	
925	8.08	7.31	10.46	6.71	9.07	9.44	7.72		7.23	11.02	11.75	8.53	
950	8.35	7.56	10.80	6.94	9.37	9.77	8.09		7.50	11.37	12.16	8.81	
975	8.62	7.81	11.14	7.17	9.66	10.09	8.46		7.76	11.71	12.57	9.08	
1000	8.89	8.06	11.48	7.40	9.95	10.42	8.83		8.02	12.05	12.98	9.36	
1025	9.17	8.30	11.82	7.62	10.24	10.75	8.98			12.40	12.39		
1050	9.46	8.55	12.16	7.95	10.54	11.09	9.14			12.76	13.81		
1075	9.75	8.80	12.50	8.18	10.83	11.43	9.29			13.11	14.23		
1100	10.04	9.05	12.84	8.31	11.12	11.77	9.45			13.47	14.65		
1125	10.31	9.28	13.18	8.53	11.41	12.11	9.78						
1150	10.57	9.52	13.52	8.76	11.71	12.47	10.11						
1175	10.83	9.76	13.86	8.98	12.01	12.81	10.44						
1200	11.10	10.00	14.20	9.20	12.31	13.15	10.78						
1225	11.38	10.26	14.54	9.42	12.59	13.50							
1250	11.66	10.53	14.88	9.65	12.88	13.86							
1275	11.94	10.79	15.22	9.88	13.17	14.22							
1300	12.22	11.06	15.56	10.11	13.46	14.58							
1325	12.50	11.30	15.90	10.33	13.75	14.94							
1350	12.78	11.55	16.24	10.56	14.05	15.30							
1375	13.34	11.80	16.58	10.78	14.35	15.66							
1400		12.05	16.92	11.01	14.65	16.02							
1425			17.30										
1450			17.69										
1475			18.08										
1500			18.47										

Flange Data



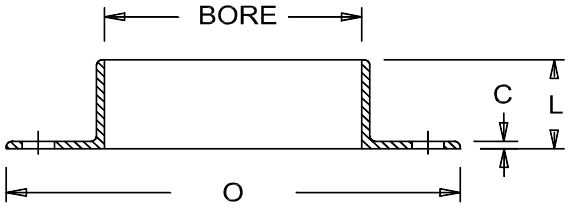
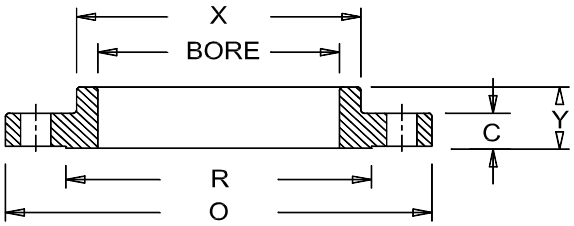


Plate Flange						
Nom Dia	O	BORE	C	Bolt Circle	Hole Dia	# Holes
2	6	2.438	0.625	4.75	0.75	4
3	7.5	3.57	0.625	6	0.75	4
3.5	8.5	4.07	0.625	7	0.75	8
4	9	4.57	0.625	7.5	0.75	8
5	10	5.66	0.625	8.5	0.875	8
6	11	6.72	0.688	9.5	0.875	8
8	13.5	8.72	0.688	11.75	0.875	8
10	16	10.875	0.688	14.25	1	12
12	19	12.875	0.812	17	1	12
14	21	14.188	0.938	18.75	1.125	12
16	23.5	16.188	1	21.25	1.125	16
18	25	18.188	1.062	22.75	1.25	16
20	27.5	20.188	1.125	25	1.25	20
22	29.5	22.188	1.188	27.25	1.375	20
24	32	24.188	1.25	29.5	1.375	20
26	34.25	26.25	1.312	31.75	1.375	24
28	36.5	28.25	1.312	34	1.375	28
30	38.75	30.25	1.375	36	1.375	28
32	41.75	32.25	1.5	38.5	1.625	28
34	43.75	34.25	1.5	40.5	1.625	32
36	46	36.25	1.625	42.75	1.625	32
38	48.75	38.25	1.625	45.25	1.625	32
40	50.75	40.25	1.625	47.25	1.625	36
42	53	42.25	1.75	49.5	1.625	36
44	55.25	44.25	1.75	51.75	1.625	40
46	57.25	46.25	1.75	53.75	1.625	40
48	59.5	46.25	1.875	56	1.625	44
50	61.75	50.25	1.875	58.25	1.875	44
52	64	52.25	1.875	60.5	1.875	44
54	66.25	54.25	2.125	62.75	1.875	44
56	68.25	56.25	2.25	64.75	1.875	44
58	70.25	58.25	2.25	66.75	1.875	44
60	73	60.25	2.25	69.25	1.875	52
62	75	62.25	2.25	71.25	1.875	52
64	77	64.25	2.5	73.25	1.875	52
66	80	66.25	2.5	76	1.875	52
68	82	68.25	2.5	78	1.875	52
70	84.5	70.25	2.625	80.5	1.875	60
72	86.5	72.25	2.625	82.5	1.875	60

Angle Flanges ES-40051							
Nom Dia	BORE	O	L	C	Bolt Circle	Hole Dia	# Holes
12	12.875	15.875	1.5	0.125	14.563	0.438	12
14	14.188	17.188	1.5	0.125	15.813	0.438	12
16	16.188	19.188	1.5	0.125	18.125	0.438	16
18	18.188	21.188	1.5	0.188	20.125	0.438	16
20	20.188	23.188	1.5	0.188	22.125	0.438	20
22	22.188	25.188	1.5	0.188	24.125	0.438	20
24	24.188	27.188	1.5	0.188	26.125	0.438	20
26	26.188	30.188	2.0	0.188	28.5	0.438	24
28	28.188	32.188	2.0	0.188	30.5	0.438	24
30	30.188	34.188	2.0	0.188	32.5	0.438	28
32	32.188	36.188	2.0	0.188	34.5	0.438	28
34	34.188	38.188	2.0	0.188	36.5	0.438	32
36	36.188	40.188	2.0	0.188	38.5	0.438	32
38	38.188	42.188	2.0	0.188	40.5	0.438	36
40	40.188	44.188	2.0	0.188	42.5	0.438	36
42	42.188	46.188	2.0	0.188	44.5	0.438	40
44	44.188	48.188	2.0	0.188	46.5	0.438	40
46	46.188	50.188	2.0	0.188	48.5	0.438	44
48	48.188	52.188	2.0	0.188	50.5	0.438	44
50	50.188	54.188	2.0	0.188	52.5	0.438	48
52	52.188	56.188	2.0	0.188	54.5	0.438	48
54	54.188	58.188	2.0	0.188	56.5	0.438	52
56	56.188	60.188	2.0	0.188	58.5	0.438	52
58	58.188	62.188	2.0	0.188	60.5	0.438	56
60	60.188	64.188	2.0	0.188	62.5	0.438	56
62	62.188	66.188	2.0	0.188	64.5	0.438	60
64	64.188	68.188	2.0	0.188	66.5	0.438	60
66	66.188	70.188	2.0	0.188	68.5	0.438	64
68	68.188	72.188	2.0	0.188	70.5	0.438	64
70	70.188	74.188	2.0	0.188	72.5	0.438	68
72	72.188	76.188	2.0	0.188	74.5	0.438	68

Flange Data



150# RFSO Flanges									
Nom Dia	O	C	R	X	BORE	Y	Bolt Circle	Hole Dia	# Holes
1/2	3.5	0.438	1.375	1.188	0.875	0.625	2.375	0.625	4
3/4	3.875	0.5	1.688	1.5	1.09	0.625	2.75	0.625	4
1	4.25	0.563	2	1.938	1.36	0.688	3.125	0.625	4
1 1/4	4.625	0.625	2.5	2.3125	1.7	0.8125	3.5	0.625	4
1 1/2	5	0.688	2.875	2.563	1.95	0.875	3.875	0.625	4
2	6	0.75	3.625	3.063	2.44	1	4.75	0.75	4
2 1/2	7	0.875	4.125	3.563	2.94	1.125	5.5	0.75	4
3	7.5	0.938	5	4.25	3.57	1.188	6	0.75	4
3 1/2	8.5	0.938	5.5	4.8125	4.07	1.25	7	0.75	8
4	9	0.938	6.188	5.3125	4.57	1.3125	7.5	0.75	8
5	10	0.938	7.3125	6.438	5.66	1.438	8.5	0.875	8
6	11	1	8.5	7.563	6.72	1.5625	9.5	0.875	8
8	13.5	1.125	10.625	9.688	8.72	1.75	11.75	0.875	8
10	16	1.188	12.75	12	10.88	1.938	14.25	1	12
12	19	1.25	15	14.375	12.88	2.188	17	1	12
14	21	1.375	16.25	15.75	14.14	2.25	18.75	1.125	12
16	23.5	1.438	18.5	18	16.16	2.5	21.25	1.125	16
18	25	1.563	21	19.875	18.18	2.688	22.75	1.25	16
20	27.5	1.688	23	22	20.2	2.875	25	1.25	20
22	29.5	1.813	25.25	24.25	22.22	3.125	27.25	1.375	20
24	32	1.875	27.25	26.125	24.25	3.25	29.5	1.375	20

300# RFSO Flanges									
Nom Dia	O	C	R	X	BORE	Y	Bolt Circle	Hole Dia	# Holes
1/2	3.75	0.56	1.375	1.5	0.875	0.875	2.625	0.625	4
3/4	4.625	0.625	1.688	1.875	1.09	1	3.25	0.75	4
1	4.875	0.688	2	2.125	1.36	1.0625	3.5	0.75	4
1 1/4	5.25	0.75	2.5	2.5	1.7	1.0625	3.875	0.75	4
1 1/2	6.125	0.813	2.875	2.75	1.95	1.188	4.5	0.875	4
2	6.5	0.875	3.625	3.125	2.44	1.3125	5	0.75	8
2 1/2	7.5	1	4.125	3.938	2.94	1.5	5.875	0.875	8
3	8.25	1.125	5	4.625	3.57	1.6875	6.625	0.875	8
3 1/2	9	1.188	5.5	5.25	4.07	1.75	7.25	0.875	8
4	10	1.25	6.188	5.75	4.57	1.875	7.875	0.875	8
5	11	1.375	7.3125	7	5.66	2	9.25	0.875	8
6	12.5	1.438	8.5	8.125	6.72	2.0625	10.625	0.875	12
8	15	1.625	10.625	10.25	8.72	2.438	13	1	12
10	17.5	1.875	12.75	12.625	10.88	2.625	15.25	1.125	16
12	20.5	2	15	14.75	12.88	2.875	17.75	1.25	16
14	23	2.125	16.25	16.75	14.14	3	20.25	1.25	20
16	25.5	2.25	18.5	19	16.16	3.25	22.5	1.375	20
18	28	2.375	21	21	18.18	3.5	24.75	1.375	24
20	30.5	2.5	23	23.125	20.2	3.75	27	1.375	24
22	33	2.625	25.25	25.25	22.22	4	29.25	1.625	24
24	36	2.75	27.25	27.625	24.25	4.188	32	1.625	24

Torsional Properties

The following torsional spring rates are provided for customers using piping analysis software that requires torsional stiffness.
No torsion should be applied to any part in this catalog. Torsion destabilizes a bellows and may cause premature failure.

Spring Rates (In-Lbs/deg)

Part Code	40010/ 40020	40011/ 40021	40013/ 40023	40030/ 40040	40031/ 40041	40033/ 40043	40050/51 40060	40110/ 40111
-031	11982	15439	20652	7690	13206	13206	--	19600
-032	6791	8753	11714	7690	13206	13206	--	13000
-033	6108	8175	10259	7690	13206	13206	--	9729
-034	6665	8365	10077	--	--	--	--	--
-351	17886	23046	30827	11479	19713	19713	--	29200
-352	10137	13066	17485	11479	19713	19713	--	19300
-353	8477	11347	14239	11479	19713	19713	--	14500
-354	9372	11762	14171	--	--	--	--	--
-041	13779	23742	35834	15587	23351	35172	--	41400
-042	12922	17284	23926	15587	23351	35172	--	27500
-043	13588	17041	27537	15587	23351	35172	--	20700
-044	11194	16904	22690	--	--	--	--	--
-051	28694	49428	74576	28267	42350	63779	--	75100
-052	23502	39412	47441	28267	42350	63779	--	49900
-053	23043	34784	37270	28267	42350	63779	--	37500
-054	22809	27459	36850	--	--	--	--	--
-061	62531	104726	125978	44775	74873	90434	--	105700
-062	41265	69128	83167	44775	74873	90434	--	70600
-063	37954	47569	76720	44775	74873	90434	--	53000
-064	38551	49514	62183	--	--	--	--	--
-081	130321	218201	351544	92566	154758	249910	--	256500
-082	85734	143581	231409	92566	154758	249910	--	170600
-083	85382	128709	172470	92566	154758	249910	--	128200
-084	79858	128748	128748	--	--	--	--	--
-101	239058	481245	644471	213353	268141	542254	--	441500
-102	156834	315823	423035	213353	268141	542254	--	294900
-103	170501	256943	344193	213353	268141	542254	--	220800
-104	136989	220762	277284	--	--	--	--	--
-121	358789	722649	906514	333920	587545	736116	358789	689100
-122	274945	553860	694834	333920	587545	736116	274945	458700
-123	282091	349676	438720	333920	587545	736116	187372	343800
-124	270036	338812	690589	--	--	--	167830	--
-141	647476	1040940	2108905	442075	711689	1444245	517157	834700
-142	475087	763892	1548166	442075	711689	1444245	379448	555700
-143	372636	625266	1010696	442075	711689	1444245	310009	416500
-144	369994	464077	887196	--	--	--	276550	--
-161	966495	1553823	3147986	659890	1062346	2155841	771965	1560000
-162	709168	1140270	2310965	659890	1062346	2155841	566407	1040000
-163	556238	744154	1508678	659890	1062346	2155841	462753	780400
-164	552294	692733	1324328	--	--	--	343424	--
-181	1376123	2212377	4482192	939570	1512599	3069548	1099146	2220000
-182	1009733	1623548	3290417	939570	1512599	3069548	806466	1480000
-183	658881	1059547	2148097	939570	1512599	3069548	526221	1110000
-184	587770	986333	1885615	--	--	--	488977	--
-201	2143945	4319166	6971702	1188391	2394936	3876116	1712675	2800000
-202	1481371	2985147	4819981	1188391	2394936	3876116	1183320	1870000
-203	1100309	1845279	2980315	1188391	2394936	3876116	731275	1400000
-204	1064936	1335372	2713588	--	--	--	662457	--
-221	2853590	5748811	9539975	1581749	3187660	5159110	2279570	3730000
-222	1971705	3973230	6990306	1581749	3187660	5159110	1574999	2490000
-223	1218540	2456067	4989896	1581749	3187660	5159110	973326	1870000
-224	1059736	1777380	3611786	--	--	--	881730	--
-241	3704736	7463519	12385483	2053540	3837091	8405297	2959502	4840000
-242	2559809	5158333	9075319	2053540	3837091	8405297	2044777	3230000
-243	1581996	3188642	6478242	2053540	3837091	8405297	1263643	2430000
-244	1375825	2307523	4689081	--	--	--	1144726	--

Part Code	40050/51 40060
-261	4800000
-262	3220000
-263	2150000
-264	1790000
-281	6050000
-282	4030000
-283	2680000
-284	2240000
-301	7440000
-302	4950000
-303	3300000
-304	2750000
-321	9030000
-322	6010000
-323	4010000
-324	3340000
-341	10830000
-342	7210000
-343	4810000
-344	4000000
-361	8560000
-362	5710000
-363	4750000
-381	10280000
-382	6420000
-383	4670000
-401	11990000
-402	7490000
-403	5440000
-421	13880000
-422	8670000
-423	6300000
-441	15530000
-442	11090000
-443	7750000
-461	17740000
-462	12670000
-463	8860000
-481	22470000
-482	12860000
-483	10000000
-501	25400000
-502	14530000
-503	11300000
-521	28570000
-522	16350000
-523	12710000
-541	30490000
-542	20350000
-543	13570000
-561	34000000
-562	22700000
-563	15130000
-581	37780000
-582	25220000
-583	16810000

Part Code	40050/51 40060
-601	41820000
-602	27920000
-603	18510000
-621	46150000
-622	30800000
-623	20530000
-641	50760000
-642	33880000
-643	22590000
-661	55670000
-662	37160000
-663	24770000
-681	60880000
-682	40640000
-683	27090000
-701	66420000
-702	44330000
-703	29550000
-721	72270000
-722	48240000
-723	32160000

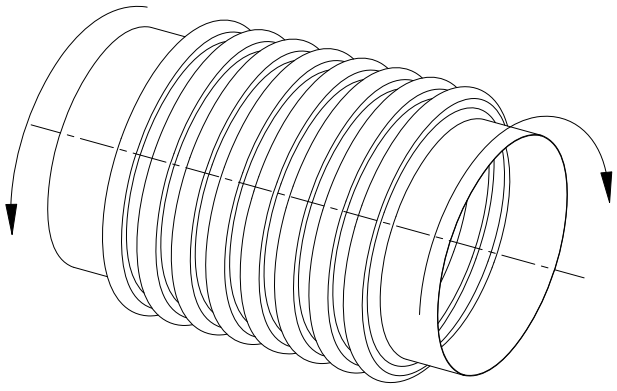
Torsional Properties

Spring Rates (in-Lbs./deg.)

Part Code	40071/ 40081	40073/ 40083	40091/ 40101 Each Side	40093/ 40103 Each Side
-011	5561	5669	5561	5669
-012	2784	2834	2784	2834
-021	5561	5669	5561	5669
-022	2784	2834	2784	2834
-031	8300	8462	8300	8462
-032	4156	4231	4156	4231
-351	13413	12861	13413	12861
-352	6707	6430	6707	6430
-041	28363	27493	28363	27493
-042	14182	13746	14182	13746
-061	97218	94885	97218	94885
-062	48690	47391	48690	47391
-081	327780	318727	327780	318727
-082	163890	159204	163890	159204
-101	598152	617186	598152	617186
-102	299076	308324	299076	308324
-121	791890	817089	791890	817089
-122	395945	408189	395945	408189
-141	1182063	1219679	1182063	1219679
-142	591032	609308	591032	609308
-161	1683055	1736613	1683055	1736613
-162	841527	867551	841527	867551
-181	2462655	2382185	2462655	2382185
-182	1232808	1190056	1232808	1190056
-201	3277794	3108536	3277794	3108536
-202	1640867	1552942	1640867	1552942
-221	4255468	7519618	4255468	7519618
-222	2130292	3759809	2130292	3759809
-241	5410453	9560533	5410453	9560533
-242	2708479	4780266	2708479	4780266

Max Torsion (deg)

Part Code	40071/ 40081	40073/ 40083	40091/ 40101 Each Side	40093/ 40103 Each Side
-011	0.316	0.413	0.316	0.413
-012	0.630	0.826	0.630	0.826
-021	0.316	0.413	0.316	0.413
-022	0.630	0.826	0.630	0.826
-031	0.276	0.361	0.276	0.361
-032	0.552	0.722	0.552	0.722
-351	0.252	0.338	0.252	0.338
-352	0.505	0.677	0.505	0.677
-041	0.208	0.323	0.208	0.323
-042	0.417	0.645	0.417	0.645
-061	0.126	0.193	0.126	0.193
-062	0.251	0.387	0.251	0.387
-081	0.101	0.156	0.101	0.156
-082	0.202	0.312	0.202	0.312
-101	0.097	0.151	0.097	0.151
-102	0.195	0.302	0.195	0.302
-121	0.089	0.137	0.089	0.137
-122	0.177	0.275	0.177	0.275
-141	0.078	0.120	0.078	0.120
-142	0.155	0.241	0.155	0.241
-161	0.069	0.107	0.069	0.107
-162	0.138	0.214	0.138	0.214
-181	0.070	0.096	0.070	0.096
-182	0.139	0.193	0.139	0.193
-201	0.063	0.089	0.063	0.089
-202	0.127	0.179	0.127	0.179
-221	0.058	0.066	0.058	0.066
-222	0.116	0.132	0.116	0.132
-241	0.054	0.061	0.054	0.061
-242	0.107	0.122	0.107	0.122



The following torsional spring rates are provided for customers using piping analysis software that required torsional stiffness. NO TORSION SHOULD BE APPLIED TO ANY PART IN THE MANUAL. Torsion destabilizes a bellows and may cause premature failure.

Torsional Properties

Max Torsion (deg)

Part Code	40010/ 40020	40011/ 40021	40013/ 40023	40030/ 40040	40031/ 40041	40033/ 40043	40050/51 40060	40110/ 40111
-031	0.067	0.067	0.066	0.133	0.133	0.133	--	0.099
-032	0.134	0.133	0.133	0.133	0.133	0.133	--	0.149
-033	0.200	0.199	0.198	0.133	0.133	0.133	--	0.198
-034	0.249	0.248	0.247	--	--	--	--	--
-351	0.058	0.059	0.058	0.116	0.116	0.116	--	0.086
-352	0.117	0.117	0.116	0.116	0.116	0.116	--	0.130
-353	0.190	0.189	0.188	0.116	0.116	0.116	--	0.174
-354	0.233	0.231	0.230	--	--	--	--	--
-041	0.109	0.109	0.108	0.124	0.124	0.124	--	0.092
-042	0.156	0.155	0.170	0.124	0.124	0.124	--	0.139
-043	0.202	0.201	0.199	0.124	0.124	0.124	--	0.185
-044	0.248	0.247	0.245	--	--	--	--	--
-051	0.079	0.079	0.078	0.105	0.105	0.104	--	0.078
-052	0.131	0.131	0.130	0.105	0.105	0.104	--	0.117
-053	0.183	0.182	0.169	0.105	0.105	0.104	--	0.156
-054	0.234	0.234	0.233	--	--	--	--	--
-061	0.066	0.065	0.065	0.105	0.105	0.104	--	0.078
-062	0.105	0.104	0.104	0.105	0.105	0.104	--	0.117
-063	0.157	0.157	0.156	0.105	0.105	0.104	--	0.156
-064	0.196	0.183	0.195	--	--	--	--	--
-081	0.054	0.054	0.053	0.086	0.086	0.085	--	0.064
-082	0.086	0.086	0.085	0.086	0.086	0.085	--	0.096
-083	0.118	0.118	0.117	0.086	0.086	0.085	--	0.128
-084	0.161	0.160	0.160	--	--	--	--	--
-101	0.046	0.046	0.045	0.078	0.077	0.076	--	0.058
-102	0.074	0.073	0.073	0.078	0.077	0.076	--	0.086
-103	0.092	0.091	0.091	0.078	0.077	0.076	--	0.115
-104	0.147	0.145	0.145	--	--	--	--	--
-121	0.060	0.059	0.059	0.087	0.079	0.079	0.060	0.059
-122	0.080	0.080	0.079	0.087	0.079	0.079	0.080	0.089
-123	0.120	0.129	0.129	0.087	0.079	0.079	0.120	0.119
-124	0.169	0.168	0.165	--	--	--	0.170	--
-141	0.050	0.049	0.049	0.079	0.079	0.078	0.050	0.059
-142	0.070	0.069	0.068	0.079	0.079	0.078	0.070	0.089
-143	0.109	0.108	0.107	0.079	0.079	0.078	0.109	0.119
-144	0.148	0.148	0.155	--	--	--	0.149	--
-161	0.043	0.043	0.043	0.069	0.069	0.068	0.044	0.052
-162	0.061	0.061	0.060	0.069	0.069	0.068	0.061	0.078
-163	0.095	0.095	0.094	0.069	0.069	0.068	0.096	0.103
-164	0.130	0.129	0.136	--	--	--	0.130	--
-181	0.039	0.038	0.038	0.062	0.061	0.060	0.039	0.046
-182	0.054	0.054	0.053	0.062	0.061	0.060	0.054	0.069
-183	0.085	0.084	0.083	0.062	0.061	0.060	0.085	0.092
-184	0.116	0.115	0.120	--	--	--	0.116	--
-201	0.030	0.030	0.030	0.060	0.060	0.059	0.030	0.045
-202	0.045	0.045	0.044	0.060	0.060	0.059	0.045	0.067
-203	0.075	0.075	0.074	0.060	0.060	0.059	0.076	0.090
-204	0.105	0.105	0.103	--	--	--	0.106	--
-221	0.027	0.027	0.034	0.055	0.054	0.054	0.027	0.041
-222	0.041	0.041	0.047	0.055	0.054	0.054	0.041	0.061
-223	0.069	0.068	0.067	0.055	0.054	0.054	0.069	0.082
-224	0.096	0.095	0.094	--	--	--	0.096	--
-241	0.025	0.025	0.031	0.050	0.054	0.049	0.025	0.037
-242	0.038	0.037	0.043	0.050	0.054	0.049	0.038	0.056
-243	0.063	0.062	0.061	0.050	0.054	0.049	0.063	0.075
-244	0.088	0.087	0.086	--	--	--	0.088	--

Part Code	40050/51 40060
-261	0.025
-262	0.038
-263	0.056
-264	0.081
-281	0.023
-282	0.035
-283	0.052
-284	0.075
-301	0.022
-302	0.033
-303	0.049
-304	0.070
-321	0.020
-322	0.031
-323	0.046
-324	0.066
-341	0.019
-342	0.029
-343	0.043
-344	0.062
-361	0.027
-362	0.041
-363	0.059
-381	0.025
-382	0.040
-383	0.055
-401	0.024
-402	0.038
-403	0.053
-421	0.023
-422	0.036
-423	0.050
-441	0.022
-442	0.031
-443	0.045
-461	0.021
-462	0.030
-463	0.043
-481	0.018
-482	0.032
-483	0.041
-501	0.018
-502	0.031
-503	0.040
-521	0.017
-522	0.030
-523	0.038
-541	0.017
-542	0.026
-543	0.038
-561	0.017
-562	0.025
-563	0.037
-581	0.016
-582	0.024
-583	0.036

Part Code	40050/51 40060
-601	0.015
-602	0.023
-603	0.035
-621	0.015
-622	0.022
-623	0.034
-641	0.014
-642	0.022
-643	0.032
-661	0.014
-662	0.021
-663	0.031
-681	0.014
-682	0.020
-683	0.031
-701	0.013
-702	0.020
-703	0.030
-721	0.013
-722	0.019
-723	0.029

General Conversion

Multiply	By	To Obtain
Atmospheres	33.9	Feet of water
Atmospheres	29.92	Inches of mercury
Atmospheres	103.3	Kilograms/sq.m.
Atmospheres	14.7	Pounds/sq.in.
Atmospheres	760	mm of mercury
Bars	0.9869	Atmospheres
Bars	1.0×10^{6}	Dynes/sq.cm.
Bars	1.020×10^{4}	Kgs./sq.meter
Bars	14.5	Pounds/sq.in.
Bars	0.01	Kilo-Pascals (kPa)
British Thermal Units	777.5	Foot-pounds
British Thermal Units	1054.6	Joules
British Thermal Units	0.2520	Kg.-calories
British Thermal Units	2.928×10^{-4}	K.W.-hours
B.T.U./hr.	0.2520	Kg.cal/hr.
B.T.U./hr./sq.ft.	2.712	Kg.cal/hr./sq.m.
B.T.U./hr./sq.ft./deg.F.	4.882	Kg.cal/hr./sq.m./deg. C
B.T.U./sq.ft.	2.712	Kg.cal/sq.m.
B.T.U./sq.ft./in.	6.892	Kg.cal/sq.m./cm.
Celsius	(^{o}C x 1.8) + 32	Fahrenheit
Centimeters	0.0328	Feet
Centimeters	0.3937	Inches
Centimeters	0.01	Meters
Centimeters	$1. X 10^{4}$	Microns
Centimeters/sec.	0.03281	Feet/sec..
Cubic centimeters	3.531×10^{-9}	Cubic Feet
Cubic centimeters	0.06102	Cubic Inches
Cubic centimeters	0.001	Liters
Cubic feet	1728	Cubic Inches
Cubic feet	0.03704	Cubic Yards
Cubic feet	7.481	Gallons
Cubic feet	28.32	Liters
Cubic feet/sec.	26915	Gallons/hour
Cubic inches	1.639×10^{-5}	Cubic meters
Cubic inches	4.329×10^{-3}	Gallons
Cubic meters	1.0×10^{6}	Cubic cm.
Cubic meters	35.31	Cubic Feet
Cubic meters	1.308	Cubic yards
Degrees (angle)	0.01745	Radians
Dynes	1.020×10^{-6}	Kilograms
Dynes	2.248×10^{-6}	Pounds
Dynes/sq.cm.	9.870×10^{-7}	Atmosphere
Dynes/sq.cm.	1×10^{-6}	Bars
Dynes/sq.cm.	0.0102	Kgs./sq.meter
Dynes/sq.cm.	2.089×10^{-3}	Pound/sq.ft.
Dynes/sq.cm.	1.450×10^{-5}	Pounds/sq.in.
Fahrenheit	5/9 (^{o}F -32)	Celsius
Feet	30.48	Centimeters
Feet	3.048×10^{-4}	Kilometers
Feet	0.3048	Meters
Feet	304.8	Millimeters
Feet/sec.	0.305	Meters/sec.
Feet/minute	0.01667	Feet/sec..
Foot-pounds	1.356	Joules
Foot-pounds	3.241×10^{-4}	Kg.-calories
Foot-pounds	0.1383	Kg.-meters
Gallons (U.S.)	0.1337	Cubic feet
Gallons (U.S.)	231	Cubic inches
Gallons (U.S.)	3.785×10^{-3}	Cubic meters
Gallons (U.S.)	3.785	Liters
Gallons of water	8.337	Pounds of water
Gallons/hour	3.71×10^{-5}	Cu.ft./sec..
Grams	980.7	Dynes
Grams	2.205×10^{-3}	Pounds
Grams/cubic cm.	0.03613	Lbs./cu.in.
Grams/sq.cm.	0.01422	Lbs./sq.in.
Inches	2.54	Centimeters
Inches	0.0254	Meters
Inches	25.4	Millimeters
Inches of mercury	0.03342	Atmospheres
Inches of mercury	0.03453	Kgs./sq.cm.
Inches of mercury	0.4912	Lbs./sq.in.
Inches of water	2.458×10^{-3}	Atmospheres
Inches of water	0.07355	Inches of mercury
Inches of water	0.03613	Lbs./sq.in.
Inches of water	0.1869	Cms. of mercury
Inches of water (at 4^{o}C)	0.00254	Kgs./sq.in.
Inch-pounds/deg.	0.66	Kilogram-meters/rad.
Inch-pounds/deg.	0.113	Newton-meters/deg.
Inch-pounds/deg.	0.012	Kilogram-meters/deg.

General Conversion

Multiply	By	To Obtain	Multiply	By	To Obtain
Joules	9.486×10^{-4}	B.T.U.	Millimeters	0.001	Meters
Joules	0.7376	Foot-pounds	Newtons	1.0×10^{5}	Dynes
Joules	2.39×10^{-4}	Kg.calories	Newtons	0.2248	Pounds
Kilograms	980665	Dynes	Newtons/cm	0.571	Pounds/inch
Kilograms	1000	Grams	Newtons/mm	5.71	Pounds/inch
Kilograms	2.205	Pounds	Newton-meters	8.8504	Inch-pounds
Kilogram-calories	3.968	B.T.U.	Newton-meters/deg	8.8496	Inch-pounds/deg
Kilogram-calories	3086	Foot-pounds	Newtons/sq.meter	1	Pascals
Kilogram-calories	4186	Joules	Ounces	28.35	Grams
Kilograms/cu.meters	3.613×10^{-5}	Pounds/cu.in.	Ounces (fluid)	0.02957	Liters
Kilogram-meters	7.233	Foot-pounds	Pounds	444823	Dynes
Kilogram-meter/deg	83.33	Inch-pounds/deg.	Pounds	453.6	Grams
Kilograms/mm.	55.866	Pounds/in.	Pounds	0.4536	Kilograms
Kilograms/sq.cm.	9.80665×10^{5}	Dynes/sq.cm.	Pounds	4.448	Newtons
Kilograms/sq.cm.	14.226	Pounds/sq.in.	Pounds of water	0.01602	Cubic feet
Kilograms/sq.meter	9.678×10^{-5}	Atmospheres	Pounds of water	27.68	Cubic inches
Kilograms/sq.meters	98.07	Bars	Pounds of water	0.1198	Gallons
Kilometers	1.0×10^{5}	Centimeters	Pounds/cubic foot	0.01602	Grams/cu.cm.
Kilometers	3281	Feet	Pounds/cubic foot	16.02	Kgs/cu.meter
Kilometers	3.937×10^{4}	Inches	Pounds/cubic foot	5.787×10^{4}	Pounds/cu.in.
KiloNewtons/sq.meter	0.145	Pounds/sq.in.	Pound/cu.in.	2.768×10^{4}	Kgs./cu.meter
KiloPascals (kPa)	0.145	Pounds/sq.in.	Pound/cu.in.	0.001728	Pounds/cu.ft.
KiloPascals (kPa)	100	Bars	Pounds/inch	17.86	Kilograms/meter
Liters	1000	Cubic centimeters	Pounds/inch	178.6	Grams/cm.
Liters	0.0351	Cubic feet	Pounds/inch	0.01786	Kgs./mm.
Liters	0.2642	Gallons (U.S.)	Pounds/inch	0.175	Newtons/mm.
Mega Pascals (mPa)	145	Pounds/sq.in.	Pounds/square inch	2.036	Inches of mercury
Meters	3.281	Feet	Pounds/square inch	51.7	mm of mercury
Meters	39.37	Inches	Pounds/square inch	703.1	Kgs./sq.meter
Meters	100	Centimeters	Pounds/square inch	6.895	KiloPascals (kPa)
Meters	0.001	Kilometers	Pounds/square inch	0.07	Kilograms/sq.cm.
Meters	1000	Millimeters	Radians	57.3	Degrees
Meters/sec.	3.281	Feet/sec..	Slugs	32.17	Pounds
Microns	3.94×10^{-5}	Inches	Square centimeters	0.1550	Square inches
Microns	0.03937	Mils	Square feet	929	Square cms.
Millimeters	0.1	Centimeters	Square feet	0.0929	Square meters
Millimeters	0.003281	Feet	Square inches	645.2	Square mms.
Millimeters	0.03937	Inches	Square inches	6.452	Square cms.
Millimeters	1.0×10^{-6}	Kilometers	Square meters	1.55×10^{3}	Square inches
Square millimeters	0.00155	Square inches	Square millimeters	0.01	Square cms.

Pipe Properties & Weights

Nominal Size Outside Diamter Inches d		Weight Designation and/or Schedule Number			Average Wall Thickness Inches t	Inside Diamter inches d	Cross Sectional Metal sq. inches A	Moment of Ineria inches^4 I	Section Modulus inches^3 Z	Radius of Gyration inches Tg	Pipe lb. Per ft.	Weight of Water lb. Per ft.
				10S	0.049	0.307	0.055	0.0009	0.0043	0.128	0.186	0.032
1/8"	0.405	Std.	40	40S	0.068	0.269	0.072	0.0011	0.0052	0.124	0.245	0.025
		XS	80	80S	0.095	0.215	0.002	0.0012	0.0060	0.775	0.315	0.016
				10S	0.065	0.410	0.097	0.0028	0.0103	0.170	0.330	0.057
1/4"	0.540	Std.	40	40S	0.088	0.364	0.125	0.0033	0.0123	0.162	0.425	0.045
		XS	80	80S	0.119	0.302	0.157	0.0038	0.0140	0.156	0.535	0.031
				10S	0.065	0.545	0.124	0.0059	0.0174	0.218	0.423	0.101
3/8"	0.675	Std.	40	40S	0.091	0.493	0.167	0.0073	0.0216	0.209	0.568	0.083
		XS	80	80S	0.126	0.423	0.217	0.0086	0.0255	0.199	0.739	0.061
				5S	0.065	0.710	0.158	0.0120	0.0285	0.275	0.538	0.171
				10S	0.083	0.674	0.197	0.0143	0.0341	0.269	0.671	0.154
1/2"	0.840	Std.	40	40S	0.109	0.622	0.250	0.0171	0.0407	0.262	0.851	0.132
		XS	80	80S	0.147	0.546	0.320	0.0201	0.0478	0.251	1.090	0.101
			160		0.188	0.466	0.384	0.0221	0.0527	0.240	1.300	0.074
		XXS			0.294	0.252	0.504	0.0243	0.0577	0.220	1.720	0.022
				5S	0.065	0.920	0.201	0.0245	0.0467	0.349	0.684	0.288
				10S	0.083	0.884	0.252	0.0297	0.0566	0.343	0.857	0.266
3/4"	1.050	Std.	40	40S	0.113	0.824	0.333	0.0370	0.0706	0.333	1.130	0.231
		XS	80	80S	0.154	0.742	0.434	0.0448	0.0853	0.321	1.470	0.187
			160		0.219	0.614	0.570	0.0527	0.1000	0.304	1.940	0.128
		XXS			0.308	0.434	0.718	0.0579	0.1100	0.284	2.440	0.064
				5S	0.065	1.185	0.255	0.0500	0.0760	0.443	0.863	0.478
				10S	0.109	1.097	0.413	0.0757	0.1150	0.428	1.400	0.409
1"	1.315	Std.	40	40S	0.133	1.049	0.494	0.0874	0.1330	0.421	1.680	0.374
		XS	80	80S	0.179	0.957	0.639	0.1060	0.1610	0.407	2.170	0.311
			160		0.250	0.815	0.836	0.1250	0.1900	0.387	2.840	0.226
		XXS			0.358	0.599	1.080	0.1410	0.2140	0.361	3.660	0.122
				5S	0.065	1.530	0.330	0.104	0.125	0.561	1.110	0.800
				10S	0.109	1.422	0.530	0.161	0.193	0.551	1.810	0.710
1-1/4"	1.660	Std.	40	40S	0.140	1.380	0.670	0.195	0.235	0.539	2.270	0.650
		XS	80	80S	0.191	1.278	0.880	0.242	0.291	0.524	3.000	0.560
			160		0.250	1.160	1.110	0.284	0.342	0.506	3.760	0.460
		XXS			0.382	0.896	1.530	0.341	0.411	0.472	5.220	0.270
				5S	0.065	1.770	0.380	0.158	0.166	0.645	1.270	1.070
				10S	0.109	1.682	0.610	0.247	0.260	0.636	2.090	0.960
1-1/2"	1.900	Std.	40	40S	0.145	1.610	0.800	0.310	0.326	0.622	2.720	0.880
		XS	80	80S	0.200	1.500	1.070	0.391	0.412	0.605	3.630	0.770
			160		0.281	1.338	1.430	0.483	0.508	0.581	4.870	0.610
		XXS			0.400	1.100	1.890	0.568	0.598	0.548	6.410	0.410
				5S	0.065	2.245	0.470	0.32	0.265	0.819	1.600	1.720
				10S	0.109	2.157	0.780	0.50	0.420	0.800	2.640	1.580
2"	2.375	Std.	40	40S	0.154	2.067	1.070	0.67	0.561	0.789	3.650	1.450
		XS	80	80S	0.218	1.939	1.480	0.87	0.731	0.766	5.020	1.280
			160		0.344	1.689	2.190	1.16	0.979	0.728	7.450	0.970
		XXS			0.436	1.503	2.660	1.31	1.100	0.702	9.030	0.770
				5S	0.083	2.709	0.730	0.71	0.494	0.986	2.480	2.500
				10S	0.120	2.635	1.040	0.99	0.687	0.975	3.530	2.360
2-1/2"	2.875	Std.	40	40S	0.203	2.469	1.700	1.53	1.060	0.949	5.790	2.080
		XS	80	80S	0.276	2.323	2.250	1.93	1.340	0.926	7.660	1.840
			160		0.375	2.125	2.950	2.35	1.640	0.893	10.000	1.540
		XXS			0.552	1.771	4.030	2.87	2.000	0.844	13.700	1.070
				5S	0.083	3.334	0.890	1.30	0.744	1.209	3.030	3.780
				10S	0.120	2.360	1.270	1.82	1.040	1.197	4.330	3.610
3"	3.500	Std.	40	40S	0.216	3.068	2.230	3.02	1.720	1.164	7.580	3.200
		XS	80	80S	0.300	2.900	3.020	3.90	2.230	1.136	10.300	2.860
			160		0.438	2.624	4.210	5.04	2.880	1.094	14.300	2.340
		XXS			0.600	2.300	5.470	5.99	3.430	1.046	18.600	1.800

Pipe Properties & Weights

Nominal Size Outside Diamter Inches d		Weight Designation and/or Schedule Number		Average Wall Thickness Inches t	Inside Diamter inches d	Cross Sectional Metal sq. inches A	Moment of Ineria inches⁴ I	Section Modulus inches³ Z	Radius of Gyration inches Tg	Pipe lb. Per ft.	Weight of Water lb. Per ft.
			5	5S	0.083	3.834	1.02	1.96	0.98	1.386	3.47	5.00
			10	10S	0.120	3.760	1.46	2.76	1.38	1.375	4.97	4.81
3-1/2"	4.000	Std.	40	40S	0.226	3.548	2.68	4.79	2.39	1.337	9.11	4.28
		XS	80	80S	0.318	3.364	3.68	6.28	3.14	1.306	12.50	3.85
		XXS			0.636	2.728	6.72	9.85	4.93	1.211	22.90	2.53
				5S	0.083	4.334	1.15	2.81	1.25	1.563	3.92	6.40
				10S	0.120	4.260	1.65	3.96	1.76	1.549	5.61	6.17
4"	4.500	Std.	40	40S	0.237	4.026	3.17	7.23	3.21	1.510	10.80	5.51
		XS	80	80S	0.337	3.826	4.41	9.61	4.27	1.476	15.00	4.98
			120		0.438	3.624	5.59	11.70	5.18	1.447	19.00	4.47
			160		0.531	3.438	6.62	13.30	5.90	1.417	22.50	4.02
		XXS			0.674	3.152	8.10	15.30	6.79	1.374	27.50	3.38
		Std.	40	40S	0.247	4.506	3.69	10.44	4.18	1.683	12.53	6.89
4-1/2"	5.000	XS	80	80S	0.355	4.290	5.18	14.05	5.62	1.647	17.61	6.24
		XXS			0.710	3.580	9.57	22.62	9.05	1.537	32.43	4.35
				5S	0.109	5.345	1.87	6.95	2.50	1.928	6.35	9.73
5"	5.563			10S	0.134	5.295	2.29	8.43	3.03	1.919	7.77	9.53
		Std.	40	40S	0.258	5.047	4.30	15.20	5.45	1.880	14.60	8.66
		XS	80	80S	0.375	4.813	6.11	20.70	7.43	1.841	20.80	7.88
			120		0.500	4.563	7.95	25.70	9.25	1.798	27.00	7.09
			160		0.625	4.313	9.70	30.00	10.80	1.759	33.00	6.33
		XXS			0.750	4.063	11.30	33.60	12.10	1.724	38.60	5.62
				5S	0.109	6.407	2.23	11.9	3.58	2.310	5.37	14.00
				10S	0.134	6.357	2.73	14.4	4.35	2.297	9.29	13.70
6"	6.625	Std.	40	40S	0.280	6.065	5.58	28.1	8.50	2.244	19.00	12.50
		XS	80	80S	0.432	5.761	8.40	40.5	12.20	2.196	28.60	11.30
			120		0.562	5.501	10.70	49.6	15.00	2.153	36.40	10.30
			160		0.719	5.189	13.30	59.0	17.80	2.106	45.30	9.16
		XXS			0.864	4.897	15.60	66.3	20.00	2.062	53.20	8.14
				5S	0.109	8.407	2.92	26.5	6.13	3.013	9.91	24.10
				10S	0.148	8.329	3.94	35.4	8.21	2.997	13.40	23.60
			20		0.250	8.125	6.58	57.7	13.40	2.961	22.40	22.50
			30		0.277	8.071	7.26	63.4	14.70	2.955	24.70	22.20
8"	8.625	Std.	40	40S	0.322	7.984	8.40	72.5	16.80	2.938	28.60	21.70
			60		0.406	7.813	10.50	88.3	20.60	2.900	35.60	20.80
		XS	80	80S	0.500	7.625	12.80	106.0	24.50	2.878	43.40	19.80
			100		0.594	7.439	15.00	121.0	28.10	2.840	50.90	18.80
			120		0.719	7.189	17.80	141.0	32.60	2.814	60.60	17.60
			140		0.812	7.001	19.90	154.0	35.60	2.782	67.80	16.70
		XXS			0.875	6.875	21.30	162.0	37.60	2.758	72.40	16.10
			160		0.906	6.813	22.00	166.0	38.50	2.747	74.70	15.80
				5S	0.134	10.482	4.52	64	11.90	3.754	15.20	37.40
				10S	0.165	10.420	5.49	77	14.30	3.743	18.70	36.90
			20		0.250	10.250	8.26	114	21.20	3.715	28.00	35.70
			30		0.307	10.136	10.10	138	25.60	3.696	34.20	34.90
10"	10.750	Std.	40	40S	0.365	10.020	11.90	161	29.90	3.678	40.50	34.10
		XS	60	80S	0.500	9.750	16.10	212	39.40	3.629	54.70	32.30
			80		0.594	9.564	18.90	245	45.50	3.600	64.30	31.10
					0.625	9.500	19.90	256	47.60	3.587	67.50	30.70
			100		0.719	9.314	22.60	286	53.20	3.557	76.90	29.50
					0.750	9.250	23.60	296	55.10	3.542	80.10	29.10
			120		0.844	9.064	26.20	324	60.30	3.517	89.20	27.90
					0.875	9.000	27.10	333	62.00	3.505	92.30	27.50
			140		1.000	8.750	30.60	368	68.40	3.468	104.00	26.00
			160		1.125	8.500	34.00	399	74.30	3.426	116.00	24.60

Pipe Properties & Weights

Nominal Size Outside Diamter Inches d		Weight Designation and/or Schedule Number		Average Wall Thickness Inches t	Inside Diamter inches d	Cross Sectional Metal sq. inches A	Moment of Ineria inches^4 I	Section Modulus inches^3 Z	Radius of Gyration inches Tg	Pipe lb. Per ft.	Weight of Water lb. Per ft.
			5S	0.165	12.420	6.52	129	20.3	4.448	19.6	52.5
			10S	0.180	12.390	7.11	141	22.0	4.453	24.2	52.2
		20		0.250	12.250	9.82	192	30.0	4.422	33.4	51.1
		30		0.330	12.090	12.90	249	29.0	4.393	43.8	49.7
12"	12.750	Std.	40S	0.375	12.000	14.60	279	43.8	4.371	49.6	49.0
		40		0.406	11.938	15.70	300	47.1	4.371	53.5	48.5
		XS	80S	0.500	11.750	19.20	362	56.7	4.342	65.4	47.0
		60		0.562	11.626	21.50	401	62.8	4.319	73.2	46.0
				0.625	11.500	32.80	439	68.8	3.658	80.9	45.0
		80		0.688	11.376	26.00	475	74.5	4.274	88.5	44.0
				0.750	11.250	28.30	511	80.2	4.249	96.2	43.0
		100		0.844	11.064	31.50	562	88.1	4.224	107.0	41.6
				0.875	11.000	32.60	579	90.8	4.214	111.0	41.1
		120		1.000	10.750	36.90	642	101.0	4.171	125.0	39.3
		140		1.125	10.500	41.10	701	110.0	4.130	140.0	37.5
		160		1.312	10.126	47.10	781	123.0	4.072	160.0	34.9
		10		0.250	13.500	10.80	255	36.5	4.859	36.7	62.0
		20		0.312	13.375	13.40	315	45.0	4.848	45.7	60.6
		Std.	30	0.375	13.250	16.10	373	53.3	4.813	54.6	59.7
14"	14.000		40	0.438	13.125	18.70	429	61.4	4.790	63.4	58.6
		XS		0.500	13.000	21.20	484	69.1	4.778	72.1	57.5
		60		0.594	12.814	25.00	562	80.3	4.741	84.9	55.9
				0.625	12.750	26.30	589	84.1	4.732	89.3	55.3
		80		0.750	12.500	31.20	687	98.2	4.692	106.0	53.1
				0.875	12.250	36.10	781	112.0	4.651	123.0	51.1
		100		0.938	12.125	38.40	825	118.0	4.635	131.0	50.0
		120		1.094	11.814	44.30	930	133.0	4.582	151.0	47.5
		140		1.250	11.500	50.10	1030	147.0	4.534	170.0	45.0
		160		1.406	11.188	55.60	1120	160.0	4.488	189.0	42.6
		10		0.250	15.500	12.40	384	48.0	5.565	42.1	81.7
		20		0.312	15.376	15.40	474	59.3	5.548	52.3	80.5
		Std.	30	0.375	15.250	18.40	562	70.3	5.527	62.6	79.1
16"	16.000	XS	40	0.500	15.000	24.40	732	91.5	5.477	82.8	76.5
				0.625	14.750	30.20	894	112.0	5.441	103.0	74.1
		60		0.656	14.688	31.60	933	117.0	5.434	108.0	73.4
				0.750	14.500	35.90	1050	131.0	5.408	122.0	71.5
		80		0.844	14.314	40.10	1160	145.0	5.378	136.0	69.7
				0.875	14.250	41.60	1190	149.0	5.348	141.0	69.1
		100		1.031	13.938	48.50	1370	171.0	5.315	165.0	66.1
		120		1.219	13.564	56.60	1560	195.0	5.250	192.0	62.6
		140		1.438	13.124	65.80	1760	220.0	5.172	224.0	58.6
		160		1.594	12.814	72.10	1890	237.0	5.120	245.0	55.9
		10		0.250	17.500	13.90	549	61.0	6.285	47.4	104.0
		20		0.312	17.376	17.30	679	75.5	6.265	59.0	103.0
		Std.		0.375	17.250	20.80	807	89.6	6.229	70.6	101.0
		30		0.438	17.124	24.20	932	104.0	6.206	82.2	99.7
18"	18.000	XS		0.500	17.000	27.50	1050	117.0	6.179	93.5	98.9
		40		0.562	16.876	30.80	1170	130.0	6.163	105.0	96.9
				0.625	16.750	34.10	1290	143.0	6.151	116.0	95.4
		60		0.750	16.500	40.60	1520	168.0	6.119	138.0	92.6
				0.875	16.250	47.10	1730	192.0	6.061	160.0	89.9
		80		0.938	16.126	50.20	1830	204.0	6.038	171.0	88.5
		100		1.156	15.688	61.20	2180	242.0	5.968	208.0	83.7
		120		1.375	15.250	71.80	2500	278.0	5.901	244.0	79.1
		140		1.562	14.876	80.70	2750	306.0	5.838	274.0	75.3
		160		1.781	14.438	90.80	3020	336.0	5.767	309.0	70.9
		10		0.250	19.500	15.50	757	75.7	6.988	52.7	129.0
		Std.	20	0.375	19.250	23.10	1110	111.0	6.932	78.6	126.0
		XS	30	0.500	19.000	30.60	1460	146.0	6.907	104.0	123.0
			40	0.594	18.814	36.20	1700	170.0	6.853	123.0	120.0
				0.625	18.750	38.00	1790	179.0	6.863	129.0	120.0
20"	20.000			0.750	18.500	45.40	2100	210.0	6.801	154.0	117.0
		60		0.812	18.376	48.90	2260	226.0	6.798	166.0	115.0
				0.875	18.250	52.60	2410	241.0	6.769	179.0	113.0
		80		1.031	17.938	61.40	2770	277.0	6.717	209.0	109.0
		100		1.281	17.438	75.30	3320	323.0	6.640	256.0	103.0
		120		1.500	17.000	87.20	3760	376.0	6.567	296.0	98.3
		140		1.750	16.500	100.00	4220	422.0	6.496	341.0	92.6
		160		1.969	16.064	112.00	4590	459.0	6.402	379.0	87.8

Pipe Properties & Weights

Nominal Size Outside Diamter Inches d		Weight Designation and/or Schedule Number	Average Wall Thickness Inches t	Inside Diamter inches d	Cross Sectional Metal sq. inches A	Moment of Ineria inches⁴ I	Section Modulus inches³ Z	Radius of Gyration inches Tg	Pipe lb. Per ft.	Weight of Water lb. Per ft.
		10	0.250	21.500	17.08	1010	91.8	7.690	58.1	156.8
		Std. 20	0.375	21.250	25.48	1490	135.4	7.647	86.6	153.2
		XS 30	0.500	21.000	33.77	1952	177.5	7.603	114.8	149.6
			0.625	20.750	41.97	2399	218.1	7.560	144.0	146.1
22"	22.000		0.750	20.500	50.07	2830	257.2	7.518	171.8	142.6
		60	0.875	20.250	58.07	3245	295.0	7.475	199.3	139.1
			1.000	20.000	65.97	3645	331.4	7.433	226.4	135.7
		80	1.125	19.750	73.78	4030	366.4	7.391	250.8	132.3
		100	1.375	19.250	89.09	4759	432.6	7.308	302.9	125.7
		120	1.625	18.750	104.02	5432	493.8	7.227	353.6	119.3
		140	1.875	18.250	118.55	6054	550.3	7.146	403.0	113.0
		160	2.125	17.750	132.68	6626	602.4	7.067	451.1	106.9
		10	0.250	23.500	18.70	1320	110.0	8.402	63.4	188.0
		Std. 20	0.375	23.250	27.80	1940	162.0	8.354	94.6	184.0
		XS	0.500	23.000	36.90	2550	213.0	8.313	125.0	180.0
		30	0.562	22.875	41.40	2840	237.0	8.282	141.0	178.0
			0.625	22.750	45.90	3140	261.0	8.271	156.0	176.0
		40	0.688	22.625	50.30	3420	285.0	8.246	171.0	174.0
			0.750	22.500	54.80	3710	309.0	8.228	186.0	172.0
24"	24.000	60	0.969	22.064	70.00	4650	388.0	8.150	238.0	166.0
		80	1.219	21.564	87.20	5670	473.0	8.064	296.0	158.0
		100	1.531	20.938	108.00	6850	571.0	7.964	367.0	149.0
		120	1.812	20.376	126.00	7820	652.0	7.878	429.0	141.0
		140	2.062	19.876	142.00	8630	719.0	7.796	483.0	134.0
		160	2.344	19.314	159.00	9460	788.0	7.713	542.0	127.0
		10	0.312	25.376	25.18	2077	159.8	9.083	85.6	218.5
26"	26.000	Std.	0.375	25.250	30.19	2478	190.6	9.061	102.6	216.3
		XS 20	0.500	25.000	40.06	3257	250.5	9.017	136.2	212.0
		10	0.312	27.376	27.14	2601	185.8	9.790	92.3	255.1
28"	28.000	Std.	0.375	27.250	32.54	3105	221.8	9.768	110.6	252.7
		20	0.500	27.000	43.20	4085	291.8	9.724	146.9	248.1
		30	0.625	26.750	53.75	5038	359.8	9.681	182.7	243.5
		10	0.312	29.376	29.10	3210	214.0	10.503	98.9	294.0
		Std.	0.375	29.250	34.90	3830	255.0	10.476	119.0	291.0
30"	30.000	XS 20	0.500	29.000	46.30	5040	336.0	10.433	157.0	286.0
			0.562	28.875	52.00	5640	376.0	10.414	177.0	284.0
		30	0.625	28.750	57.60	6220	415.0	10.392	196.0	281.0
			0.750	28.500	68.90	7380	492.0	10.349	234.0	277.0
		10	0.312	31.376	31.06	3899	243.7	11.204	105.6	334.0
		Std.	0.375	31.250	37.26	4658	291.2	11.182	126.7	331.3
32"	32.000	20	0.500	31.000	49.48	6139	383.7	11.138	168.2	326.0
		30	0.625	30.750	61.60	7583	474.0	11.095	209.4	320.8
		40	0.688	30.624	67.68	8298	518.6	11.073	230.1	318.2
		10	0.312	33.376	33.02	4685	275.6	11.911	112.3	377.9
		Std.	0.375	33.250	39.61	5599	329.4	11.889	134.7	375.1
34"	34.000	20	0.500	33.000	52.62	7383	434.3	11.845	178.9	369.4
		30	0.625	32.750	65.53	9128	536.9	11.802	222.8	363.9
		40	0.688	32.624	72.00	9992	587.7	11.780	244.8	361.1
		10	0.312	35.375	35.04	5578	309.9	12.618	118.9	424.5
36"	36.000	Std.	0.375	35.250	41.97	6659	369.9	12.596	142.7	421.5
		XS	0.500	35.000	55.76	8786	488.1	12.552	189.6	415.6
		Std.	0.375	41.250	49.04	10622	505.8	14.717	166.7	577.3
42"	42.000	XS 20	0.500	41.000	65.19	14036	668.4	14.674	221.6	570.3
		30	0.625	40.750	81.24	17388	828.0	14.630	276.2	563.3
		40	0.750	40.500	97.19	20679	984.7	14.586	330.4	556.5
48"	48.000	Std.	0.375	47.250	56.11	15908	662.8	16.839	190.7	757.4
		XS	0.500	47.000	74.61	21045	876.9	16.795	253.7	749.4

Expansion Joint Specification Sheet

Complete and fax this form to:
+ 1 (619) 562-0636 or sales@keb-ejs.com

Date:	
Ref.:	
Due Date:	

Customer:		**Tel:**
Contact Name:		**Fax:**
Project/Application Type:		**Title:**
Address:		
City:	**ST:**	**Zip:**

Item:					
Quantity					
Size					
Pressure					
Temperature					
Movement					
Axial					
Lateral					
Angular					
Ends					
Weld Ends Size, Mat'l					
Flanges Size, Mat'l					
Bellows Mat'l					
Liner Mat'l					
Cover Mat'l					
Code/Tests					
Media					
O.A.L. Restrictions (Overall Length)					

Notes/Comments:

KE-Burgmann EJS
Tel: + 1 (800) 482 2808
+ 1 (619) 562 6083
E-mail: sales@keb-ejs.com
Website; www.keb-ejs.com

Literature Request Form

For additional information about our product and services visit www.keb-ejs.com or www.ke-burgmann.com or complete this form and submit by fax or e-mail.



Metallic Expansion Joints

_____ Technical Design Manual: Expansion Joint Basics & Standard Products

_____ Expansion Joints for Gas Turbine Exhaust Applications

_____ Expansion Joints for Fluid Catalytic Cracking Units (FCCU)

_____ Expansion Joints for HRSGs & Boilers: Penetration Seals, Clamshells and Slider Seals

_____ ASME CODEFLEX® Expansion Joints



Non-Metallic Expansion Joints

_____ Fabric Expansion Joints: Engineering Manual

_____ Fabric Expansion Joints for Gas Turbine Exhaust Applications

_____ PTFE Expansion Joints for Flue Gas Ducts & Cleaning Systems

_____ Fabric Penetration Seals for HRSGs & Boilers

_____ KE-Masterflex® Rubber Expansion Joints for Liquids & Gases



Other Information

_____ Company Profile & Product Overview

_____ Field Services & Installation Support

_____ Online Clamshell Installation

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Attach your business card below or complete this form and send to our office

Fax +1 (619) 562 0636 E-mail: sales@keb-ejs.com

Name _____

Company _____

Mailing Address _____

Tel/Fax _____

E-mail _____

KE-Burgmann's Commitment to Customer Service

Our team is dedicated to providing innovative solutions, quality products to ensure long-term reliability and safety for our customers worldwide.



Your local contact:

KE-BURGMANN EJS

A Division of KE-Burgmann USA, Inc.
10035 Prospect Avenue Suite 202
Santee, CA 92071 USA
(800) 482-2808 • 1 (619) 562-6083
E-mail: sales@keb-ejs.com
Website: www.keb-ejs.com
Corporate: www.ke-burgmann.com