MEGA FLEXON

EXPANSION JOINT & FLEXIBLE PRODUCTS

ISO 9001
ISO 14001
ISO 45001

METAL

EXPANSION JOINTS

TECHNICAL DESIGN CATALOG

SHARING OUR TECHNOLOGY AND EXPERIENCES PROVIDING THE VERIFIED SOLUTIONS

Expansion Joints are crucial to the successful operation of pipelines and are used extensively in power plants, steel plants, refineries, petrochemical, chemical, desulphurization, pulp and paper, mining and other sectors.

With these expansion joints, the plant life will be much extended by reducing stress in the pipelines and protecting the equipment and systems there.

Megaflexon has specially engaged in expansion joint industry and devoted ourselves to research, development, and manufacture of the high level of expansion joints in quality and reliability. Based on our accumulated technology and experience, all of our staff have an in-depth understanding of each industrial application and have done our utmost to meet customers' specific needs and requirements.

As an expert in expansion joint industry, we never stop exploring new solutions for expansion joint applications, and will continuously provide high-quality products and on-site service to our customers.

▲ *RAPID P1 PROJECT EXPANSION JOINTS SUPPLY VIEW*

INDEX

Megaflexon

EXPANSION JOINTS & FLEXIBLE PRODUCTS

Milestones

1986

Founded
Manufacturing Metallic and
Rubber Expansion Joints

2002

Obtained CE and PED mark
issued by Bureau Veritas

2006

Obtained Patents,

- Expansion Joints with Automatic Pressure Control Device
- 2Ply Bellows Expansion Joint & Process

1997

Obtained ISO 9001 issued
by TUV

ISO 9001

2003

Developed expansion joint
design for GRP/FRP pipelines

2007

Achieved US Ten Million
Dollars Export Records

2009

· Obtained ASME “U” “S” “PP” Stamp

· Won the Presidential Citation at the 39th Industrial Technology Contest of Korea

2010

Obtained ISO 14001 issued by ICR

ISO 14001

2012

Contracted to supply GIS bellows to Hyundai Heavy Industry (1,700~2000 sets per year)

2013

Obtained Patents, Design and Process of Dismantling Joints

2015

Made a contract for Petronas RAPID P1 RFCC project which reaches about US Ten Million Dollars

Renewal CE and PED mark issued by HPi Verification Services (Ireland) Ltd.

2020

Obtained ISO 45001 issued by ABS

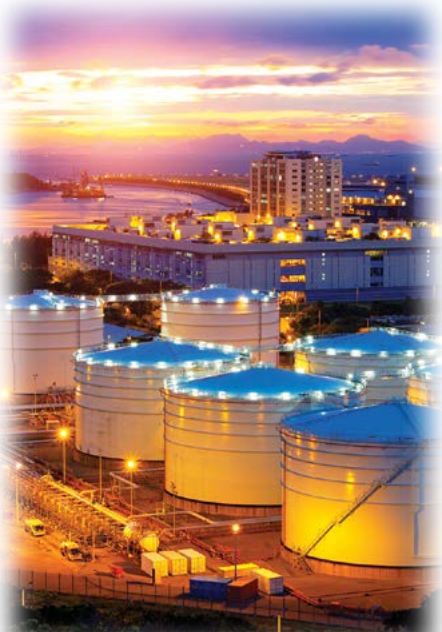
ISO 45001

Samsung Heavy Industries Succeeds in Building World's largest FLNG and Megaflexon supplied boiler system expansion joints.

ENGINEERING APPLICATIONS

Expansion joints have a wide range of applications, and each expansion joint is designed based on its unique environmental and installation conditions - pressure, temperature, movements, space, and/or corrosion, etc. The applications of our expansion joints include the following:

- ***Oil Refineries Industry***
- ***Chemical and Pharmaceutical Industry***
- ***Fossil Fuel Power Generation***
- ***Nuclear Power Plant***
- ***Desalination Power Plant***
- ***Petrochemical Industry***
- ***District Heating***
- ***Iron-And Steel mills***
- ***Pressure Vessel Manufacturing***
- ***Automotive Industry***
- ***Instrumentation Industry***
- ***Waste Water Treatment***
- ***Cryogenics Industry***
- ***Marine Applications***
- ***Pulp and Paper***



OUR STAGE IS THE WORLD

Megaflexon has supplied our quality products to worldwide leading partners located in America, Europe, Middle East and Asia. As an expansion joint specialist, we do every possible effort to produce the very best products which meet customers' demands and requirements. As usual, we will do our best to be the benchmark of this industry.

Major Customers

OVERSEAS

uop A Honeywell Company
CB&I
CTCI Discover Reliable
DOLPHIN ENERGY
FLUOR
ADNOC
GE Power
HITACHI Inspire the Next
IHI
JGC
Kawasaki
KIPIC
Maire Tecnimont
MCDERMOTT
PETRONAS
ptt
SAIPEM
Saudi Electricity Company
SIEMENS
Sinopec
Taiwan Power Company
Technip
TECNICAS REUNIDAS
TOYO ENGINEERING

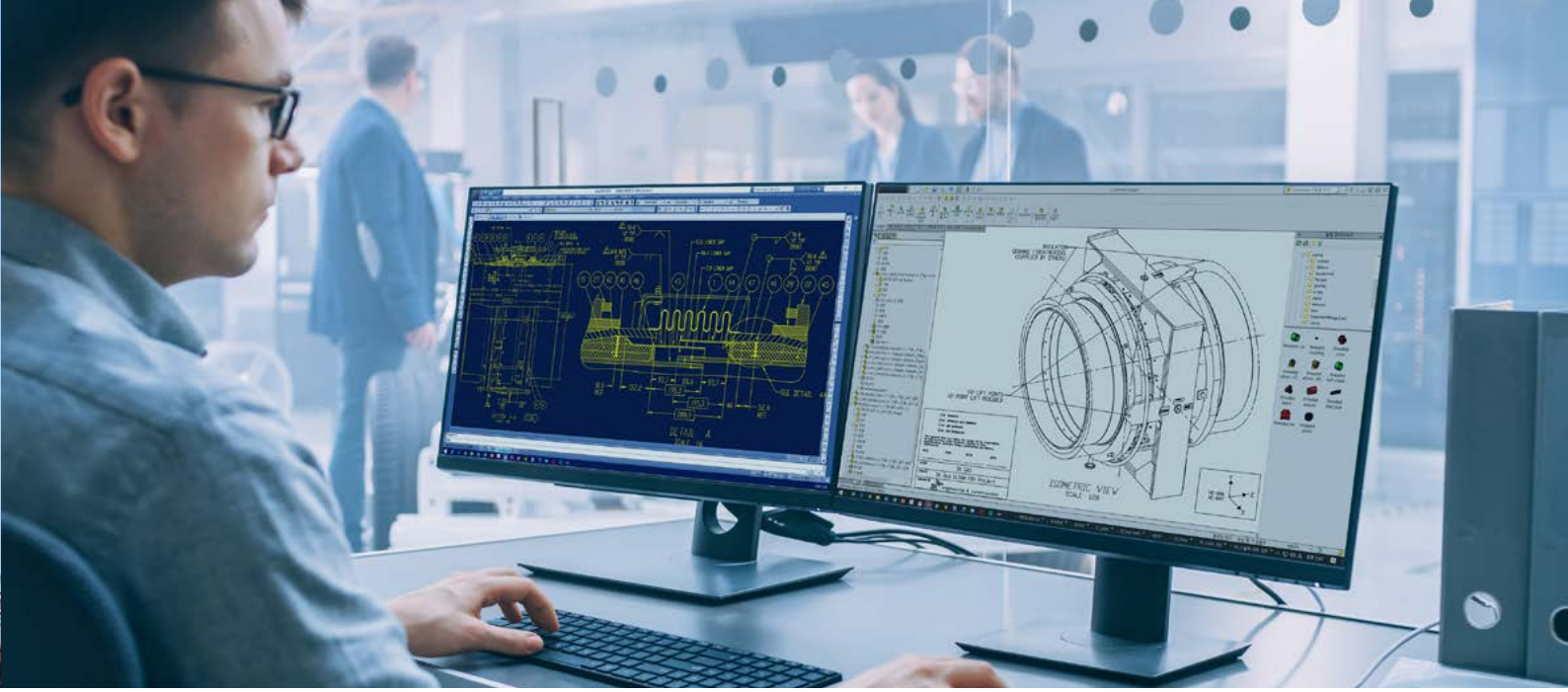
DOMESTIC

SK E&C
SK innovation
DAEWOO E&C
DL E&C
DOOSAN Heavy Industries & Construction
GS Caltex
GS E&C
Hanwha Chemical
Hanwha Engineering&Construction
HYUNDAI ENGINEERING CO., LTD.
HYUNDAI ENGINEERING & CONSTRUCTION
HYUNDAI HEAVY INDUSTRIES
HYUNDAI ELECTRIC
Hyundai Oilbank
icepco
LOTTE E&C
LOTTE CHEMICAL
posco
SAMSUNG C&T
SAMSUNG ENGINEERING
S-OIL
stx Heavy Industries
KOREA DISTRICT HEATING CORP.
HYOSUNG HEAVY INDUSTRIES

PROVIDING EXPANSION JOINT RELIABILITY AND EFFICIENCY

As one of the world's leading expansion joint manufacturers, Megaflexon supplies a wide variety of metal, rubber and fabric expansion joints and related field services for projects worldwide. Through continuous support and the development of progressive expansion joint technology. Megaflexon has become a leading source for our customers offering long-term solutions to problems associated with expansion joints, related components and services.

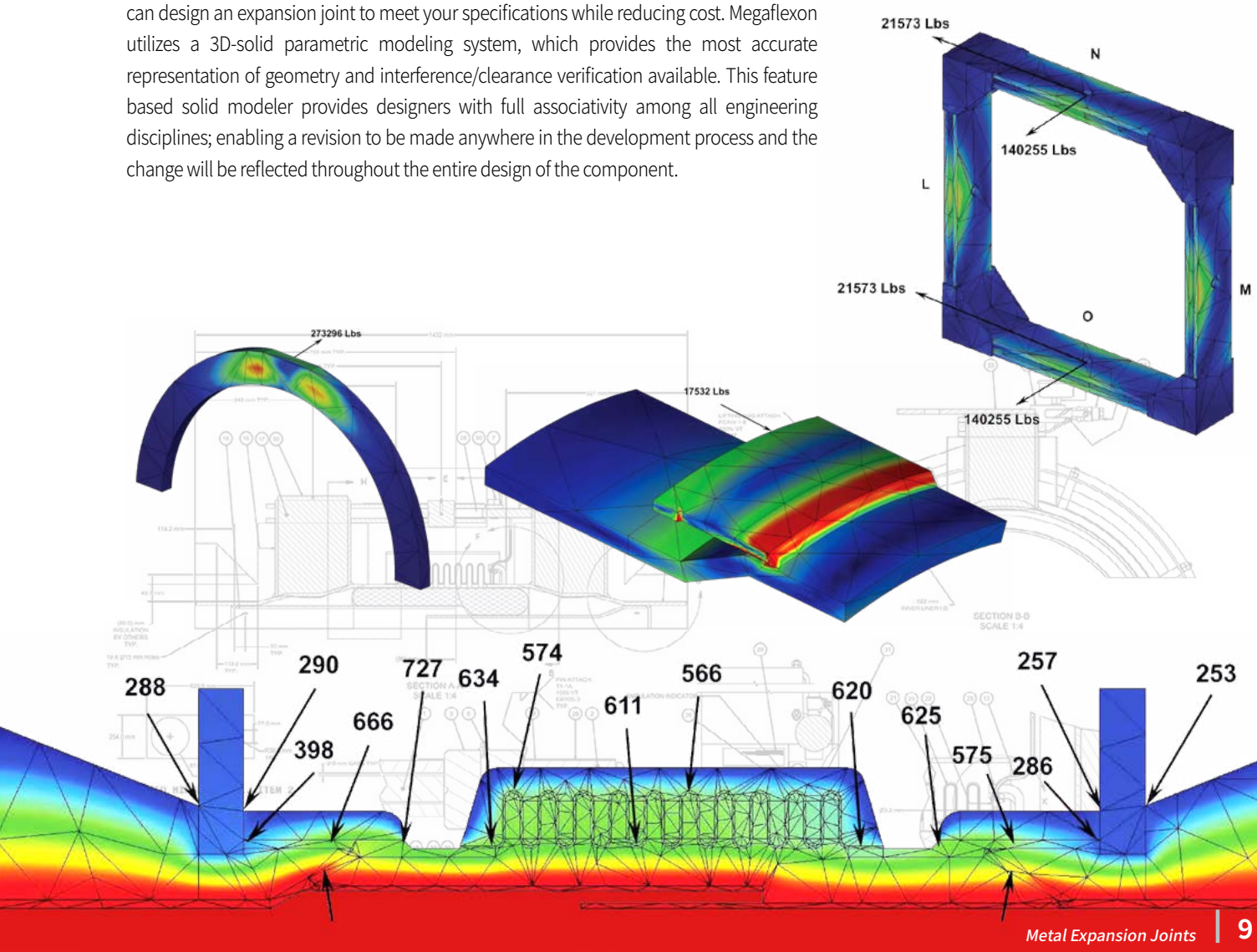
Megaflexon has designed, manufactured and supplied custom and standard expansion joints for piping and ducting systems in the chemical, foundry, marine, mining, oil & gas, petrochemical, power generation, water & waste water system industries as well as many related original equipment manufacturers (ie; gas/steam turbine, HRSG boiler, heat exchanger and fuel cell manufacturers).



DESIGN AND ENGINEERING CAPABILITIES

Our engineers use innovative design technology 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 expansion joints incorporates computer aided tooling to produce components faster, at a lower cost, and with the highest quality available. MEGAFLEXON designs every expansion joint in compliance with EJMA standards and also designs in accordance with ASME Sec. VIII, Div. 1, ASME B31.3 or ASME B31.1 upon request.

Our team uses the most advanced tools necessary to design safe and reliable expansion joints. Using state of the art software, MEGAFLEXON can design an expansion joint to meet your specifications while reducing cost. Megaflexon 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 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.



TESTING AND QUALITY ASSURANCE

As an approved ISO 9001, ISO 14001, ISO 45001 organization, Megaflexon is dedicated to providing quality products and solutions backed with a complete guarantee. With our comprehensive quality assurance program, our products are inspected and evaluated extensively through each stage of production.

Megaflexon quality team is capable of performing all types of nondestructive testing such as radiography, ultrasound, mass spectrometer, magnetic particle, hydrostatic or pneumatic test 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 quality assurance program. Megaflexon also holds an ASME “U”, “S”, “PP” stamps and CE PED certificate.

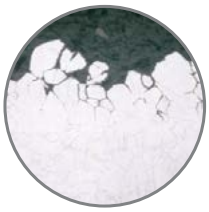
▲ *Well-used ASME Stamp*

▲ *Positive Material Identification (PMI)*

▲ *Pneumatic Testing*

Metallography Test

Metallography can identify the characteristics and composition of metal structure through research and observation in association with mechanical and physical properties in metals and alloys.



Intergranular corrosion. (200X)

▲ *Metallurgical Microscope*

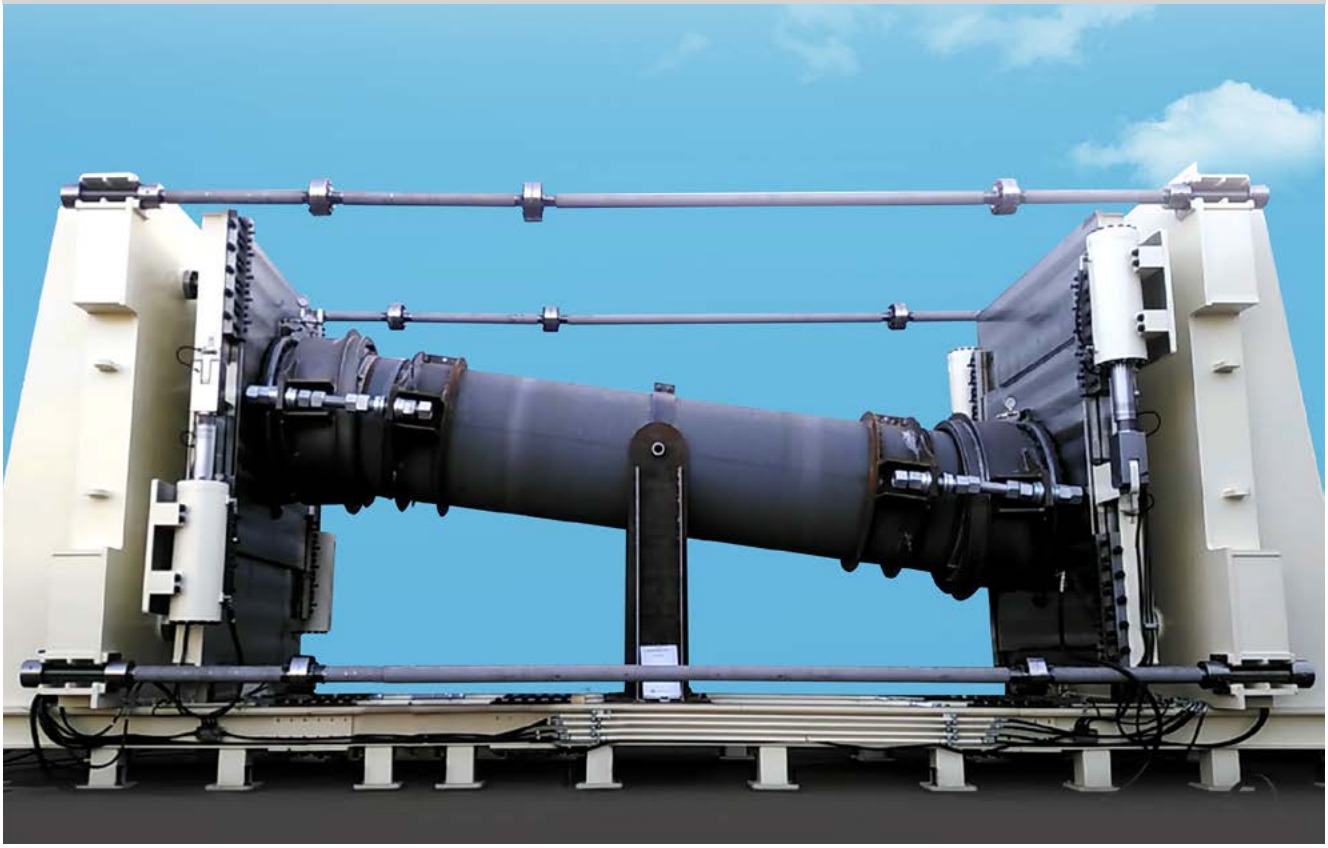
Mechanical Test

Material properties such as strength, ductility, crack, etc can be easily determined through a mechanical test.

▲ *Mechanical Testing Equipment*

Performance Test [Axial & Lateral Movement]

[CAPACITY]				
	· Diameter	: Max. 4,500mm	· Axial Movements	: Max. ± 200mm
	· Length	: Max. 20,000mm	· Lateral Movements	: Max. 1500mm



▲ *Functional Test On DN 1400 (56") X 8500mmL (Lateral Deflection 800mm)*

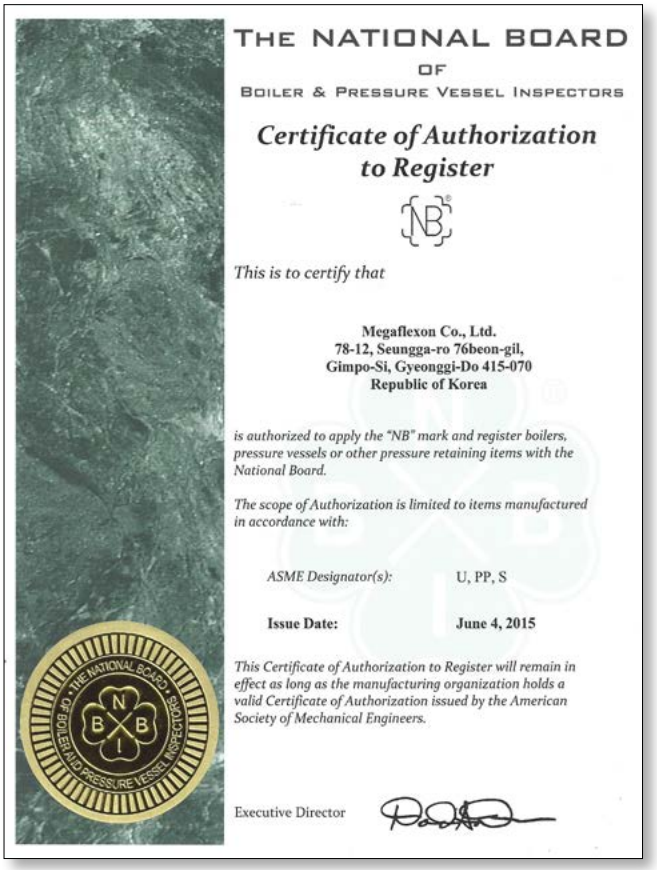
According to customer requirements, the functional test was carried out on DN 1400 (56") X 8500mmL under test pressure 15 Kgf/㎠ in the presence of customers. The purpose of the functional test is to check the lateral movement and axial movement can reach to the designed 800mm and +/- 50mm, respectively.

CERTIFICATIONS

Megaflexon declares that Quality and Service are our most TOP priority. We always put quality and service on our most top priority and will make sure to deliver zero-defect products and service on time to our customers.

In order to ensure our quality commitment, our degreed quality specialists do strictly carry out all required activities for quality assurance.

The National Board of Boiler and Pressure Vessel Inspectors



THE NATIONAL BOARD
OF
BOILER & PRESSURE VESSEL INSPECTORS

Certificate of Authorization to Register

This is to certify that

Megaflexon Co., Ltd.
78-12, Seungga-ro 76beon-gil,
Gimpo-Si, Gyeonggi-Do 415-070
Republic of Korea

is authorized to apply the "NB" mark and register boilers, pressure vessels or other pressure retaining items with the National Board.

The scope of Authorization is limited to items manufactured in accordance with:

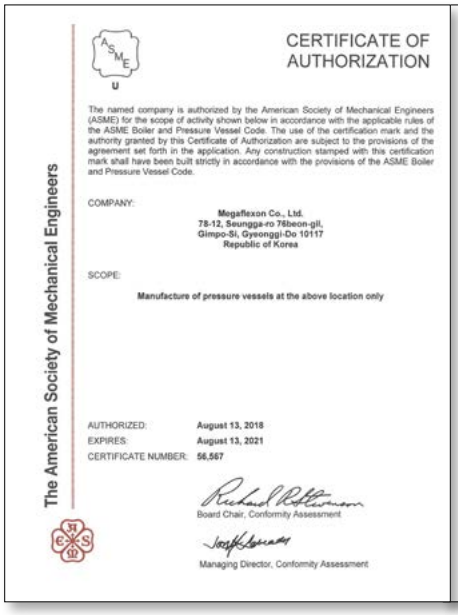
ASME Designator(s): U, PP, S

Issue Date: **June 4, 2015**

This Certificate of Authorization to Register will remain in effect as long as the manufacturing organization holds a valid Certificate of Authorization issued by the American Society of Mechanical Engineers.

Executive Director

· The National Board Certificate



CERTIFICATE OF AUTHORIZATION

U

The named company is authorized by the American Society of Mechanical Engineers (ASME) for the scope of activity shown below in accordance with the applicable rules of the ASME Boiler and Pressure Vessel Code. The use of the certification mark and the authority granted by this Certificate of Authorization are subject to the provisions of the agreement set forth in the application. Any construction stamped with this certification mark shall have been built strictly in accordance with the provisions of the ASME Boiler and Pressure Vessel Code.

COMPANY:
Megaflexon Co., Ltd.
78-12, Seungga-ro 76beon-gil,
Gimpo-Si, Gyeonggi-Do 10117
Republic of Korea

SCOPE:
Manufacture of pressure vessels at the above location only

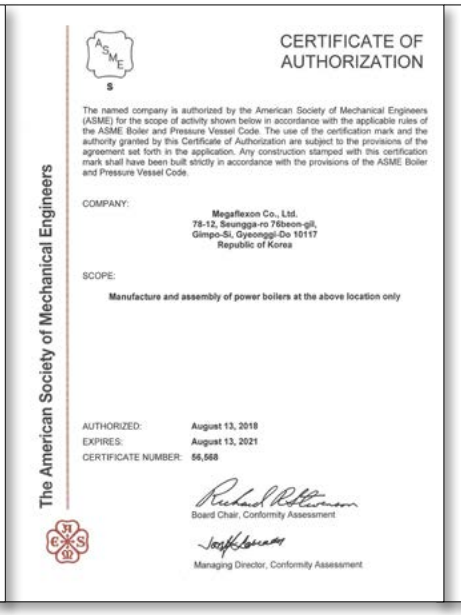
AUTHORIZED: **August 13, 2018**
EXPIRES: **August 13, 2021**
CERTIFICATE NUMBER: **56,567**

Board Chair, Conformity Assessment

Managing Director, Conformity Assessment

The American Society of Mechanical Engineers

· ASME "U" Stamp



CERTIFICATE OF AUTHORIZATION

S

The named company is authorized by the American Society of Mechanical Engineers (ASME) for the scope of activity shown below in accordance with the applicable rules of the ASME Boiler and Pressure Vessel Code. The use of the certification mark and the authority granted by this Certificate of Authorization are subject to the provisions of the agreement set forth in the application. Any construction stamped with this certification mark shall have been built strictly in accordance with the provisions of the ASME Boiler and Pressure Vessel Code.

COMPANY:
Megaflexon Co., Ltd.
78-12, Seungga-ro 76beon-gil,
Gimpo-Si, Gyeonggi-Do 10117
Republic of Korea

SCOPE:
Manufacture and assembly of power boilers at the above location only

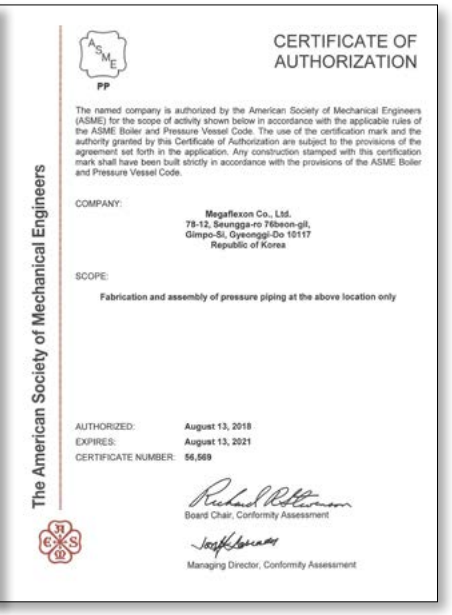
AUTHORIZED: **August 13, 2018**
EXPIRES: **August 13, 2021**
CERTIFICATE NUMBER: **56,568**

Board Chair, Conformity Assessment

Managing Director, Conformity Assessment

The American Society of Mechanical Engineers

· ASME "S" Stamp



CERTIFICATE OF AUTHORIZATION

PP

The named company is authorized by the American Society of Mechanical Engineers (ASME) for the scope of activity shown below in accordance with the applicable rules of the ASME Boiler and Pressure Vessel Code. The use of the certification mark and the authority granted by this Certificate of Authorization are subject to the provisions of the agreement set forth in the application. Any construction stamped with this certification mark shall have been built strictly in accordance with the provisions of the ASME Boiler and Pressure Vessel Code.

COMPANY:
Megaflexon Co., Ltd.
78-12, Seungga-ro 76beon-gil,
Gimpo-Si, Gyeonggi-Do 10117
Republic of Korea

SCOPE:
Fabrication and assembly of pressure piping at the above location only

AUTHORIZED: **August 13, 2018**
EXPIRES: **August 13, 2021**
CERTIFICATE NUMBER: **56,569**

Board Chair, Conformity Assessment

Managing Director, Conformity Assessment

The American Society of Mechanical Engineers

· ASME "PP" Stamp

HPi Verification Services

Certificate of Quality System Approval

This is to certify that the product listed below conforms to the requirements of the
Pressure Equipment Directive 2014/68/EU
Annex III Module H

Certificate Number	HPiVS/IP1093-041-Q-03-00
Date of Issue	22-Jan-2021
Date of Expiry	09-Oct-2022
Surveillance due:	09-Oct-2021
Manufacturer	Megaflexon Co., Ltd. #78 12, Seungga ro 76beon gil, Gimpo si, Gyeonggi do , Korea
Description of Pressure Equipment	Metallic expansion joints – PS up to 50 bar - DN up to 2740mm Metal flexible joints - PS up to 110 bar - DN up to 762mm Rubber expansion joints - PS up to 30 bar - DN up to 3650mm Fluid: Gr.1 gases
Equipment Identification	CE data plate
Type of material	see description
Other Certification	ISO 9001 certificate No. 58078 issued by ABSQE
Standards Applied	ASME VIII Div.1:2017, ASME B31.3-2016, ASME B16.5-2017 EJMA 10th Ed.
Report Reference	HPiVS/IP1093-041-4

This Certificate is valid in any European Economic Area Member State.

This Report has been issued by HPi Verification Services (Ireland) Ltd. which is a body notified to the European Commission according to the provisions of the Pressure Equipment Directive (Notified Body number 2810).

This Report is issued following the assessment of the documentation and implementation of the Quality System in accordance with the provisions of the quoted Conformity Assessment Module of the above directive. The CE Mark may be affixed to the Pressure Equipment within the scope of approval as described above once the EU 'declaration of conformity' has been signed by the responsible person. The number '2810', being HPi Verification Services (Ireland) Ltd. Notified Body number should also be placed

Check this certificate is genuine

Managing Director

Technical Manager

EU Notified Body No. 2810
Company registered in Ireland #577786

© HPi Verification Services (Ireland) Ltd. 2021

Tel +353 (0)1 8017008
Email enquiries@hpivs.ie
www.hpivs.ie

HPi Verification Services (Ireland) Ltd.
Clonross
Dunshaughlin, Co.Meath
A85 XN58, Ireland

· CE PED Certificate

ABS Quality Evaluations

Certificate Of Conformance

This is to certify that the Quality Management System of:

MEGAFLEXON Co., Ltd.
78-12, Seungga-ro 76beon-gil, Gimpo-si
Gyeonggi-do
Korea

has been assessed by ABS Quality Evaluations, Inc. and found to be in conformance with the requirements set forth by:

ISO 9001:2015

The Quality Management System is applicable to:

DESIGN, DEVELOPMENT, PRODUCTION AND SERVICING OF METAL, RUBBER & FABRIC EXPANSION JOINTS AND FLEXIBLE HOSE & QUICK COUPLER

This certificate may be found on the ABS QE Website (www.abs-qe.com). For certificates issued in the People's Republic of China information may also be verified on the CNCA website (www.cnca.gov.cn).

Certificate No:	58078
Effective Date:	05 October 2018
Expiration Date:	04 October 2021
Issue Date:	05 October 2018

Alex Weisselberg, President

Validity of this certificate is based on the successful completion of the periodic surveillance audits of the management system defined by the above scope and is contingent upon prompt written notification to ABS Quality Evaluations, Inc. of significant changes to the management system or components thereof.

ABS Quality Evaluations, Inc. 1701 City Plaza Drive, Spring, TX 77389, U.S.A.
Validity of this certificate may be confirmed at www.abs-qe.com/cert_validation.

· ISO 9001 Certificate

ABS Quality Evaluations

Certificate Of Conformance

This is to certify that the Environment Management System of:

MEGAFLEXON Co., Ltd.
78-12, Seungga-ro 76beon-gil, Gimpo-si
Gyeonggi-do
Korea

has been assessed by ABS Quality Evaluations, Inc. and found to be in conformance with the requirements set forth by:

ISO 14001:2015

The Environment Management System is applicable to:

DESIGN, DEVELOPMENT, PRODUCTION AND SERVICING OF METAL, RUBBER & FABRIC EXPANSION JOINTS AND FLEXIBLE HOSE & QUICK COUPLER

This certificate may be found on the ABS QE Website (www.abs-qe.com). For certificates issued in the People's Republic of China information may also be verified on the CNCA website (www.cnca.gov.cn).

Certificate No:	60930
Certification Date:	09 April 2020
Effective Date:	06 April 2021
Expiration Date:	12 April 2024
Revision Date:	06 April 2021

Dominic Townsend, President

Validity of this certificate is based on the successful completion of the periodic surveillance audits of the management system defined by the above scope and is contingent upon prompt written notification to ABS Quality Evaluations, Inc. of significant changes to the management system or components thereof.

ABS Quality Evaluations, Inc. 1701 City Plaza Drive, Spring, TX 77389, U.S.A.
Validity of this certificate may be confirmed at www.abs-qe.com/cert_validation.

· ISO 14001 Certificate

ABS Quality Evaluations

Certificate Of Conformance

This is to certify that the Health and Safety Management System of:

MEGAFLEXON Co., Ltd.
78-12, Seungga-ro 76beon-gil, Gimpo-si
Gyeonggi-do
Korea

has been assessed by ABS Quality Evaluations, Inc. and found to be in conformance with the requirements set forth by:

ISO 45001:2018

The Health and Safety Management System is applicable to:

DESIGN, DEVELOPMENT, PRODUCTION AND SERVICING OF METAL, RUBBER & FABRIC EXPANSION JOINTS AND FLEXIBLE HOSE & QUICK COUPLER

This certificate may be found on the ABS QE Website (www.abs-qe.com). For certificates issued in the People's Republic of China information may also be verified on the CNCA website (www.cnca.gov.cn).

Certificate No:	60841
Effective Date:	12 March 2020
Expiration Date:	11 March 2023
Revision Date:	10 April 2020

Dominic Townsend, President

Validity of this certificate is based on the successful completion of the periodic surveillance audits of the management system defined by the above scope and is contingent upon prompt written notification to ABS Quality Evaluations, Inc. of significant changes to the management system or components thereof.

ABS Quality Evaluations, Inc. 1701 City Plaza Drive, Spring, TX 77389, U.S.A.
Validity of this certificate may be confirmed at www.abs-qe.com/cert_validation.

· ISO 45001 Certificate

BELLOWS MANUFACTURING

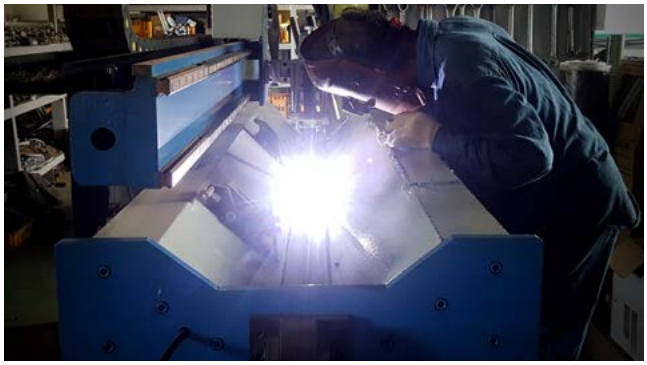
Megaflexon manufactures bellows using an expanding mandrel (punch forming) method followed by a finish rolling. A rectangular sheet is sheared and rolled into a tube. The tube is welded using an auto flat-bed welder with no filler metal added.

The longitudinal seam weld is then planished back down to the base material thickness. Dye penetrant, X-ray, or air testing is performed at this stage.

After testing, the convolutions are punched individually drawing material from the top and bottom of the tube. The drawing process eliminates any possible thinning in the bellows material. Then, the re-rolling process and then trimming process will follow.

In addition to this, Megaflexon manufactures bellows using a variety of machines, including hydraulic forming machines and automatic hydraulic forming machines.

▲ *Hydraulic Forming Machine (Max. : 2,200mm)*



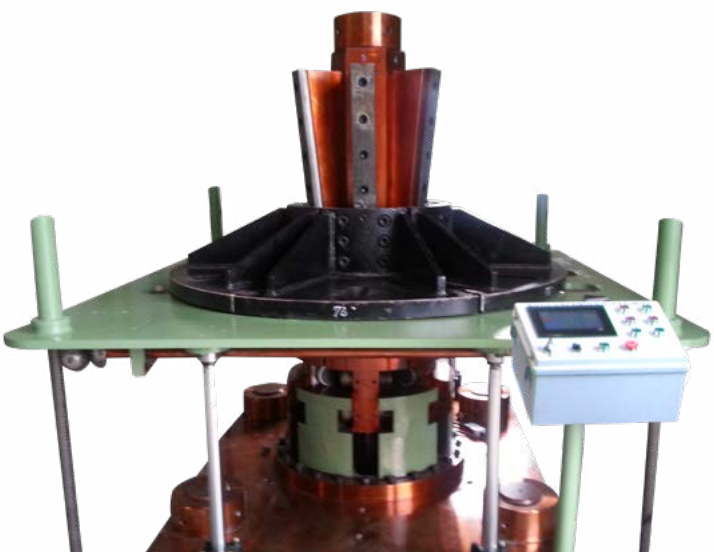
▲ *Automatic Longitudinal Seam Welding Machine*

▲ *Automatic Hydraulic Forming Machine (Max. 750mm)*

▲ *Hydraulic Mandrel Punch Forming Machine (Max. : 4,500mm)*

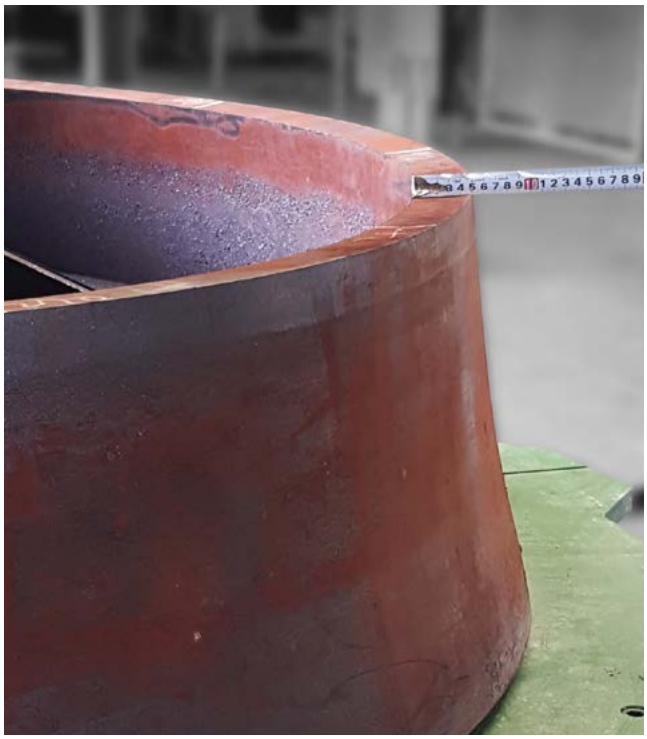
Pipe Expanding Machine

- ***1000 tons***
- ***MAX. 3500 mm / Thickness 50 t***



▲ *Expanding Machine*

▲ *Expanded Single Hinge Type Expansion Joints*



▲ *Thickness Measurement (52mm) / ASTM A516 Gr70*
50mm expanded from original diameter 1800mm

▲ *Expanded Pipe View / ASTM A240 TP 321H / 20T*
75mm expanded from original diameter 2400mm

VARIOUS TYPE OF BELLOWS

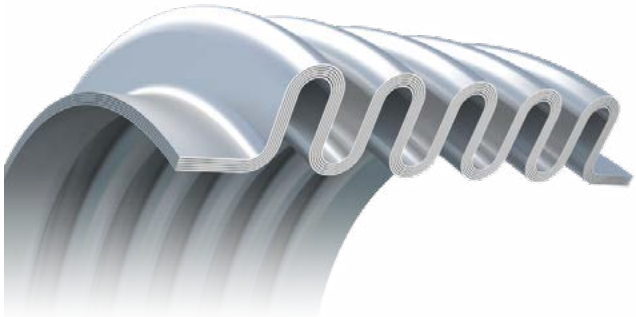
Bellows may be either U-shaped or toroidal (Ω-shaped) in cross-section. The U-shaped bellows is superior for great deflection but has a lower pressure capacity for the same material thickness. Conversely, toroidal (Ω-shaped) bellows is limited to small deflection but has a higher pressure capacity. The use of external reinforcement of the U-shaped can provide a combination of great deflection and high internal pressure capacity, and the pressure capacity can also be increased by the use of multi-ply construction or by increasing the material thickness of the bellows. The U-shaped bellows is mostly manufactured and used in industries, and the Ω-shaped bellows has limited application in case of high pressure and small deflection requirements.

Megaflexon manufactures bellows using a variety of methods, such as hydroforming and hydraulic mandrel punch forming etc. Hydroform process is used for relatively small bellows forming, and hydraulic mandrel punch forming process is used for relatively large bellows forming (up to 4500mm). Although the forming method is different, both ways are providing efficient ways of uniform structure with adequate dimensional accuracy.

▲ *HIGH CORRUGATION BELLOWS*

▲ *MIDDLE CORRUGATION BELLOWS*

▲ *OMEGA BELLOWS*



▲ *MULTI-PLY BELLOWS*

▲ *TOROIDAL BELLOWS*

High Corrugation Bellows

Nominal Dia	300A - 4500A
Materials	• Stainless Steel-Type 300 Austenitic Series • Super Duplex Stainless Steel • Nickel Alloys • Hastelloy • Titanium • Zirconium • Hayness 230 & etc.

Features

- Excellent flexibility comes from the high convolution and long fatigue life.
- Bellows forming method : Hydraulic forming & hydraulic mandrel punch forming

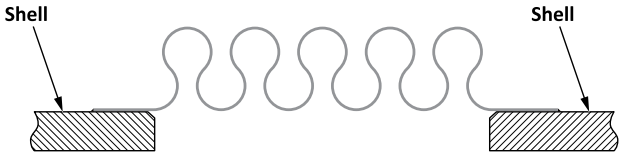
Middle Corrugation Bellows

Nominal Dia	1000A - 4500A
Materials	• Stainless Steel-Type 300 Austenitic Series • Super Duplex Stainless Steel • Nickel Alloys • Hastelloy • Titanium • Zirconium • Hayness 230 & etc.

Features

- Flexible & bellows in large size formed with 2ply of 0.3t ~ 1.2t plates.
- Bellows Forming Method : Hydraulic forming & Hydraulic Mandrel Punch Forming

Omega Bellows

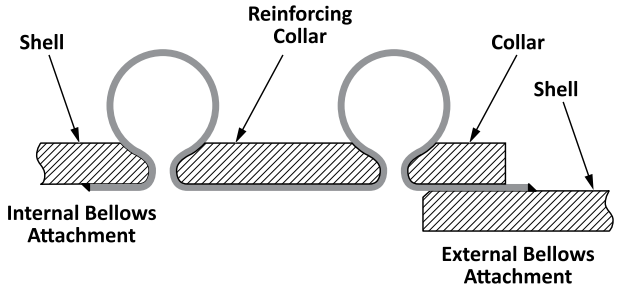


Nominal Dia	25A - 1800A
Materials	• Stainless Steel-Type 300 Austenitic Series • Super Duplex Stainless Steel • Nickel Alloys • Hastelloy • Titanium • Zirconium • Hayness 230 & etc.

Features

- The convolution configuration is Omega shape which is circles connected continuously and has superior fatigue life.
- Bellows Forming Method : Hydraulic forming

Toroidal Bellows

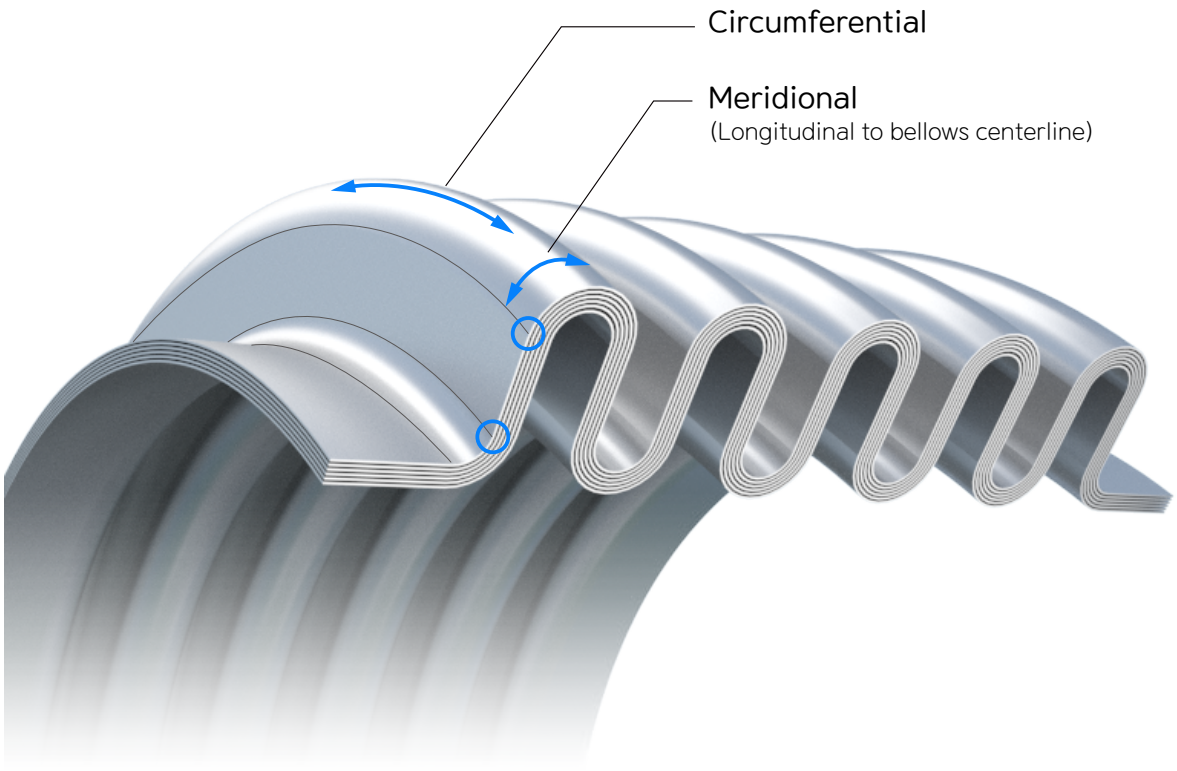


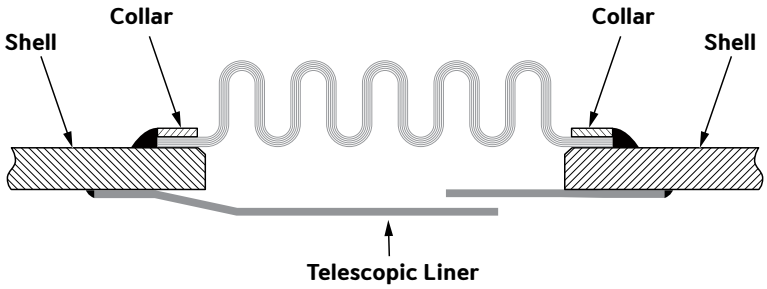
Features

The Toroidal Bellows are mainly designed for high-pressure application where needs small amounts of movement. The majority of these joints are designed for Heat Exchanger in accordance with ASME Sec VIII, Div-1, Appendix 26, and also as per EJMA for other applications. The natural stability of a circle under internal pressure allows the thin-walled toroid element to withstand pressures that an apparently more stable multi-ply, reinforced bellows could not. The advantage of this design is its easy to manufacture with a low material cost of bellows element and the stability of the expansion joint even at pressures well beyond the design conditions. The only drawback is the small amount of movement the joints can absorb, which when dealing with heat exchanger designs, is all that is required.

- Bellows Forming Method : Hydroforming

Multi-Ply Bellows





Nominal Dia	50A - 4500A
Materials	• Stainless Steel-Type 300 Austenitic Series • Super Duplex Stainless Steel • Nickel Alloys • Hastelloy • Titanium • Zirconium • Hayness 230 & etc.

Features

- Form up to 6 layers of thin stainless sheets layerd & laminated flexible ultrahigh pressure bellows.
- Bellows Forming Method : Hydraulic forming & Hydraulic Mandrel Punch Forming

BELLOWS MONITORING

Bellows Monitoring

The use of multi-ply bellows on FCCU expansion joints or high temperature application expansion joints are widespread today. Various reasons exist for the use of multi-ply bellows, ranging from redundant ply design to simple monitoring for early warning of failure.

Multi-ply Bellows

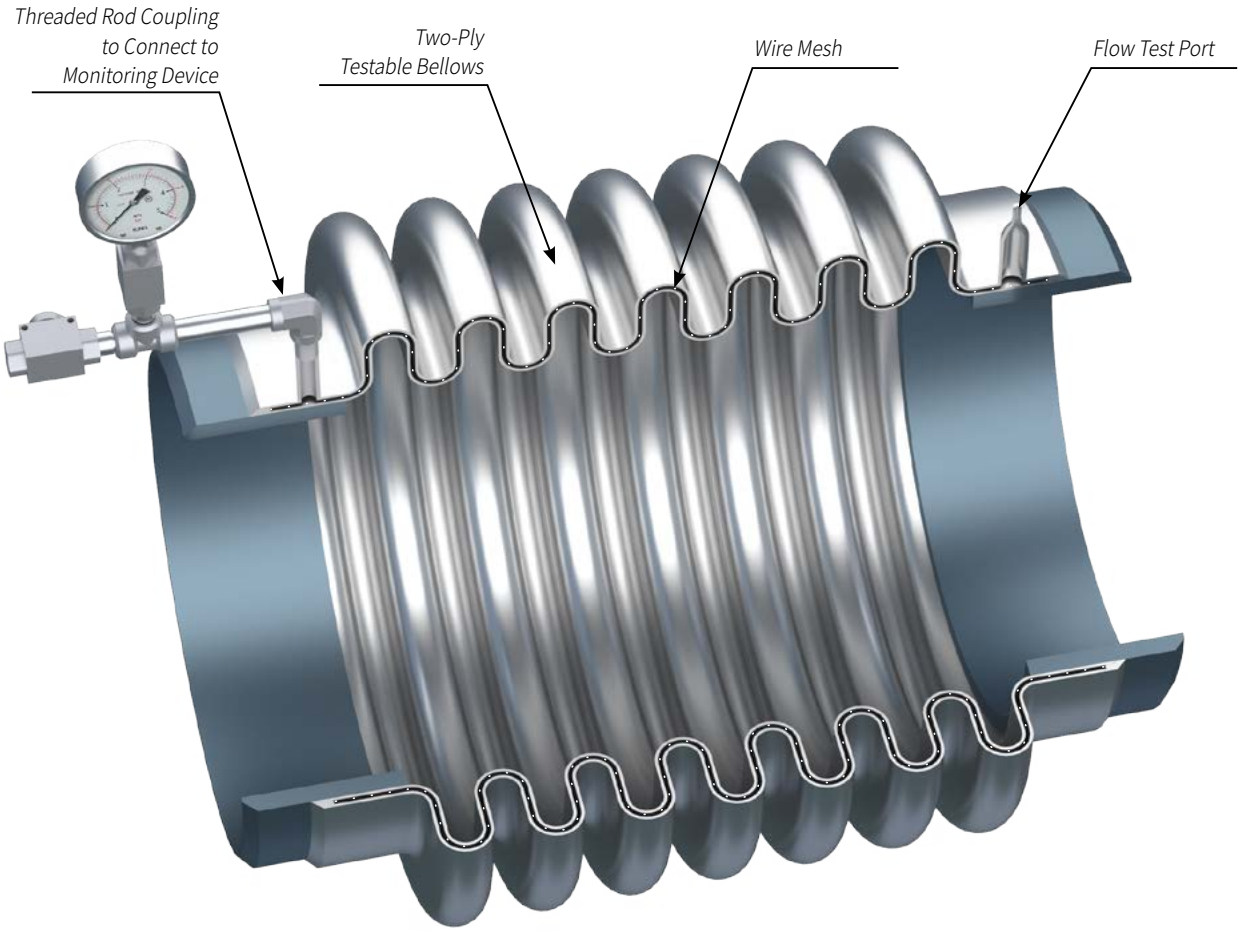
Multi-ply bellows in themselves allow the bellows designer to design for higher movements combined with high pressure and still achieve good cycle life. In laymen's terms the thicker the bellows wall thickness the lower the cycle life for a given movement. By using two plies of a thinner material the cycle life will increase for the same movement without a dramatic drop in pressure capability. A simple two ply bellows is designed to use the strength of both plies to ensure pressure capability. Redundant ply bellows are designed so that each ply is strong enough to withstand the operating conditions even after one ply fails. These types of multi-ply designs are usually monitored to alert the user when one ply fails.

Normal Two-Ply Monitoring

Monitoring a normal two-ply design still offers great advantages for the operator. A very small leak through the inner ply will normally not cause a catastrophic failure. The indicator will show the leak and the unit can be shut down for repairs without a total failure of the unit.

Redundant Ply

Redundant ply designs offer safety and outage scheduling benefits. The intent is to enable the unit to continue to operate until the next scheduled outage even after one ply has failed. The inner ply typically fails before the outer ply. The operators can see the failure and plan for changing the unit at the next scheduled outage.



▲ *Two-Ply Testable Bellows Design*

≫TWO-PLY TESTABLE BELLOWS MONITORING SOLUTION

The two-ply testable bellows (also referred to as a redundant ply design) can, in the majority of cases, provide early warning about bellows failure. Alt-hough a representative sample performs in a statistically predictable way, any single expansion joint's exact fatigue life is unpredictable. Installation of two-ply testable bellows can, in a majority of cases, provide early warning about bellows failure.
Many refineries use two-ply testable bellows especially in critical process equipment such as the FCC unit, but they are also used in the spent catalyst standpipe, regenerated catalyst stand-pipe, recirculation cooled catalyst flue gas piping and the turbo expander. Gas and steam turbine applications also find these bellows ideal in the exhaust, crossover and flue gas piping.

What is a two-ply testable bellows?

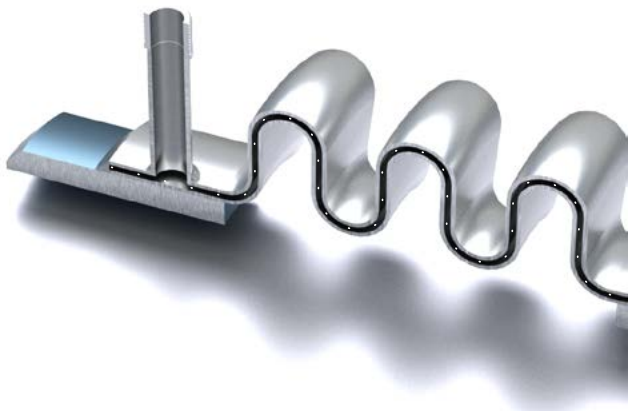
A two-ply testable bellows consists of two plies of identical thickness, with a small cavity between the plies.
The two-ply design is used when it is necessary to monitor the integrity of the bellows inner or outer ply. Both plies are designed for the full pressure and temperature cycles required. If one ply fails, the second will ensure pressure integrity and take over until a scheduled repair or replacement can be facilitated. This allows maintenance personnel to take action and plan solutions accordingly to minimize downtime.

Active and passive monitors

There are various methods to monitor a two-ply testable bellows, from simple pressure gauges to electronic sensing devices. Overall they are cat-egorized as active and passive monitors. Passive monitors utilize the line pressure to indicate an inner ply failure. When the inner ply fails, the inter-nal pressure between the plies activate the moni-toring device. Passive monitors will only sense an inner ply failure. Active monitors will detect both inner and outer ply failures. A vacuum is created between the plies before the monitoring device is installed. In case the inner ply fails, the pres-sure between the plies will increase to the line pressure. If the outer ply fails, the vacuum will be lost. In both cases the monitoring device will be activated.
Monitoring devices used are most commonly pres-sure gauges, pressure transducers and pop up detectors. Direct monitoring to the control room is also an option and can be attached directly to the test ports.
In case the monitoring device indicates pressure between the plies, our recommendation is (1) dur-ing operation, use the bleeder valve to evacuate the pressure and close valve immediately. Then check for pressure build up. (2) If pressure builds up again, the inner ply may have cracks that allow the system pressure to fill the space between the two plies. A replacement bellows should then be considered.

Technical characteristics

Two cylindrical tubes are formed with thin wire mesh between, to generate a cavity between the plies in the two-ply testable bellows. The purpose of the mesh is to ensure that there is a flow path between the plies.
The test ports are placed at each end of the bel-lows, 180° apart; a test port tube is welded to the outer bellows ply. Typically, one test port will be blinded off with a pipe cap and the other con-nected to the desired monitoring device.
Note: When installing an expansion joint with two-ply testable bellows, test ports/valves must be kept open the first 24 hours to release any moisture or condensate that may have collected between the plies during storage or manufacturing.



Benefits of Two-Ply Testable Bellows

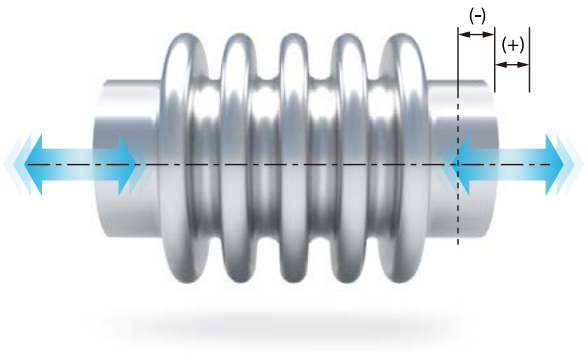
- *Bellows monitoring (deterioration & leakage)*
- *Early warning of leak detection*
- *Two (2) plies designed for the full system design conditions*
- *Minimizing the risk of unplanned shutdowns*
- *The system can maintain operation while a suitable repair or replacement can be arranged*
- *Reduced downtime in services where the bellows failure could cause a forced outage*

BELLOWS MOVEMENTS AND SPRING RATES

There are four basic movements that can be applied to a bellows. These are Axial, Lateral, Angular and Torsional. The below figures 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. We are 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

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 N/mm.

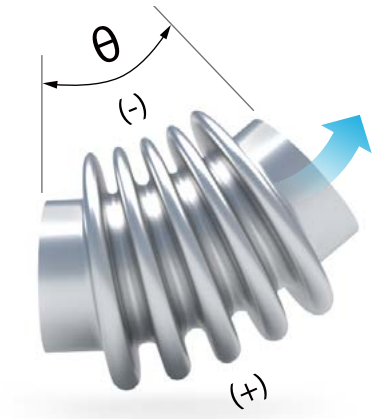


▲ *Axial Movement (+/- In)*

▲ *Single Tied Expansion Joint for Axial Movement*

Angular Movement

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. The units for angular spring rates displayed in Nm/deg.

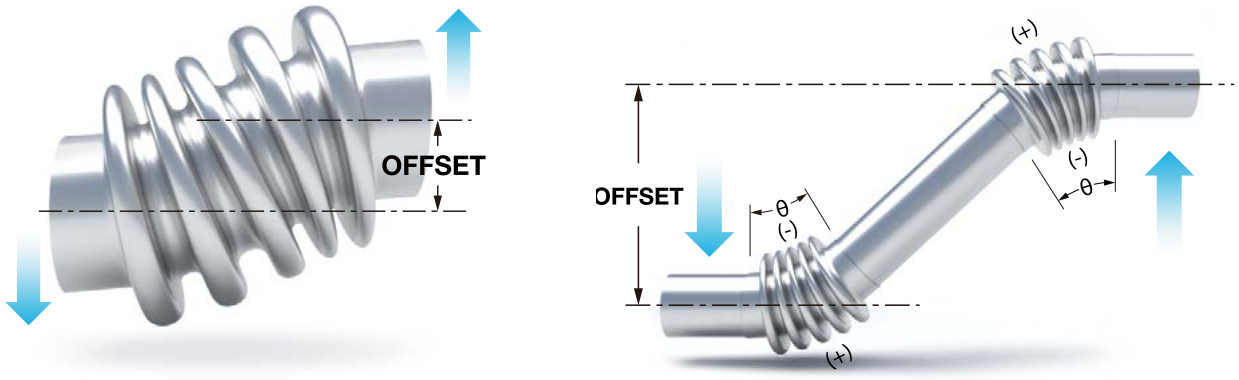


▲ *Angular Movement (+/- Degrees)*

▲ *Single Hinged Expansion Joint for Angular Movement*

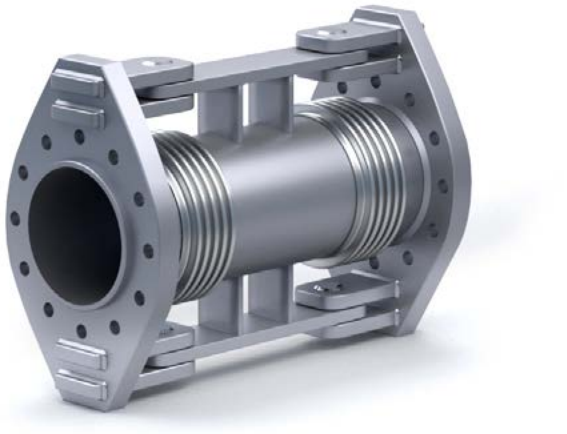
Lateral Movement

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 N/mm.



▲ *Lateral Movement (+/- Degrees)*

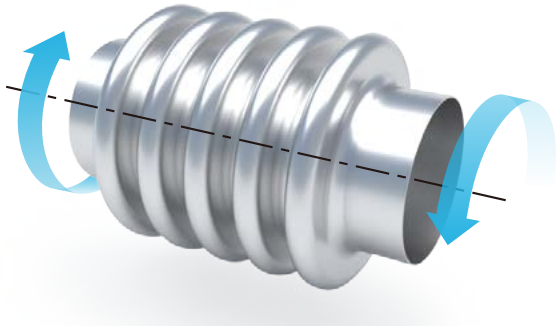
▲ *Tied Universal Expansion Joint for Lateral Movement*



▲ *Double Hinge Expansion Joint for Lateral Movement*

Torsional Movement

Torsional movement is the rotation about the axis through the center of a bellows (twisting). MEGAFLEXON expansion joints discourage 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 not to have any impact on bellows.



▲ *Torsional Movement (+/- Degrees)*

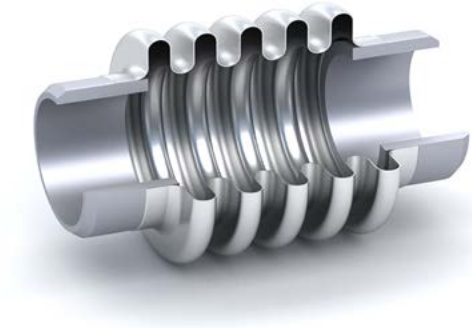
BASIC TYPES OF EXPANSION JOINTS

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*

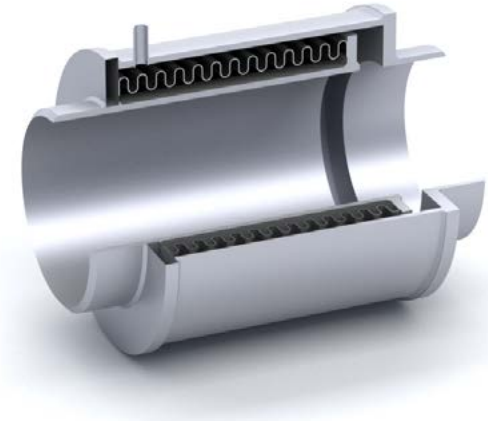
Universal Expansion Joint

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*

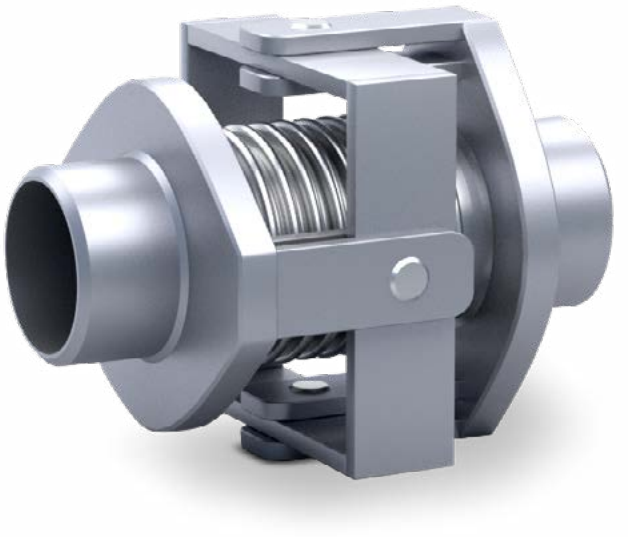
Hinged Expansion Joint

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 used to limit 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

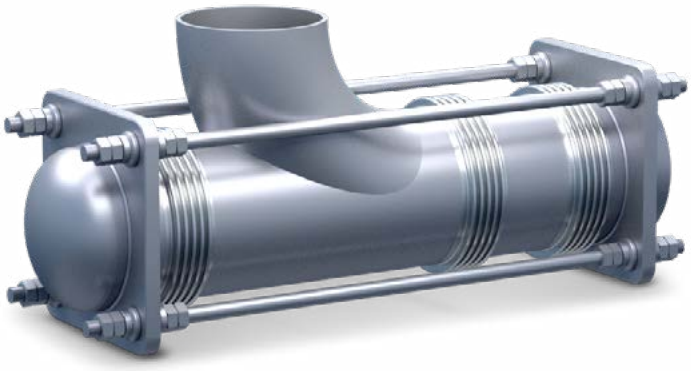
The gimbal restraint is designed to absorb system pressure thrust and torsional twist while allowing angulation in any plane. Gimbal Assemblies, when used in pairs or with a Single Hinged unit, have the advantage of absorbing movements in multi-planer piping systems. The gimbal works the same as an automobile's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

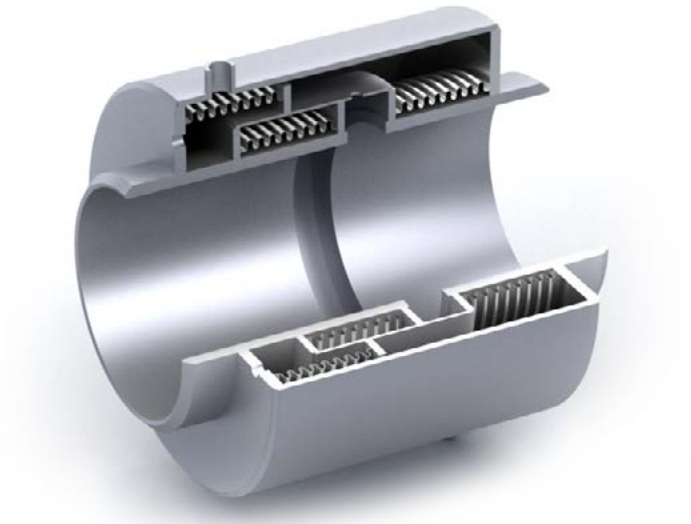
In-Line Pressure Balanced Expansion Joint

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.

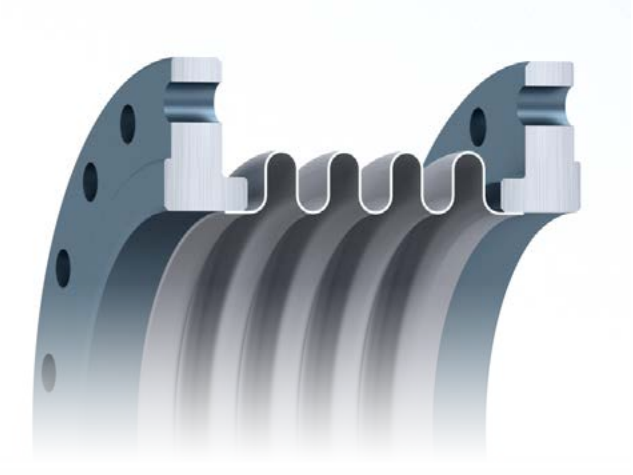


▲ *Externally Pressurized Pressure Balanced Assembly*

END CONNECTIONS & ACCESSORIES

Flanges

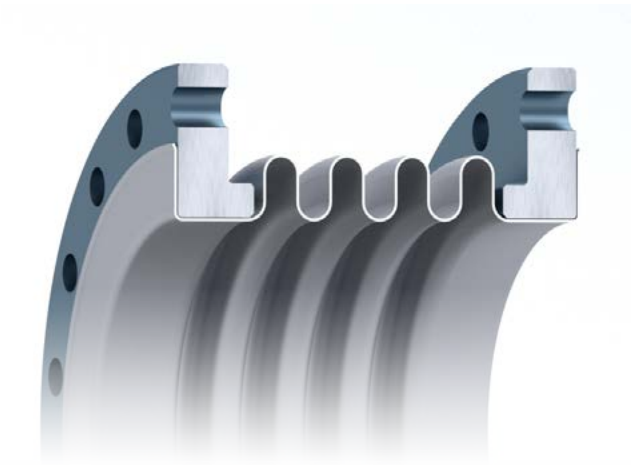
Any flange style can be added to a bellows for bolting into a system. Forged steel or plate flanges to match the pressure and temperature ratings of ANSI Class 150 or ANSI Class 300 are standard.



▲ *Flanged*

Vanstone Ends

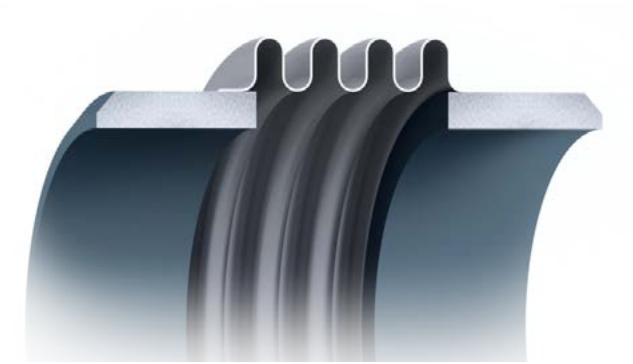
Vanstone ends are modified flanged ends with the added flexibility for resolving bolt-hole misalignment or wetted surface corrosion.



▲ *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. diameter. Stainless steel or other alloy pipe can also be provided.



▲ *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.

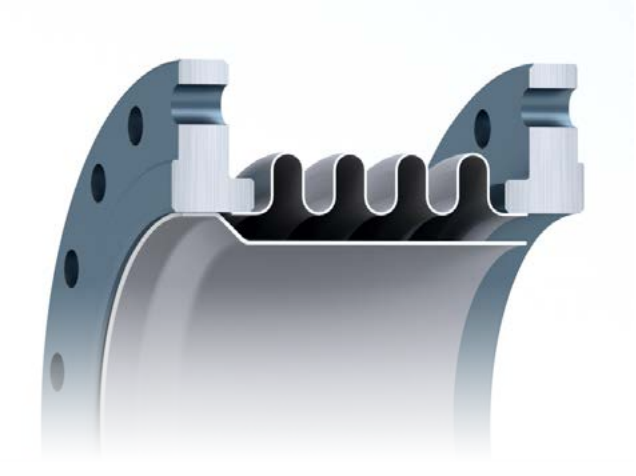
D. In high temperature applications to reduce the temperature of the bellows. The liner is a barrier between the media and the bellows.

E. Where an internal sleeve is not provided the allowable flow velocities shall not be greater than:

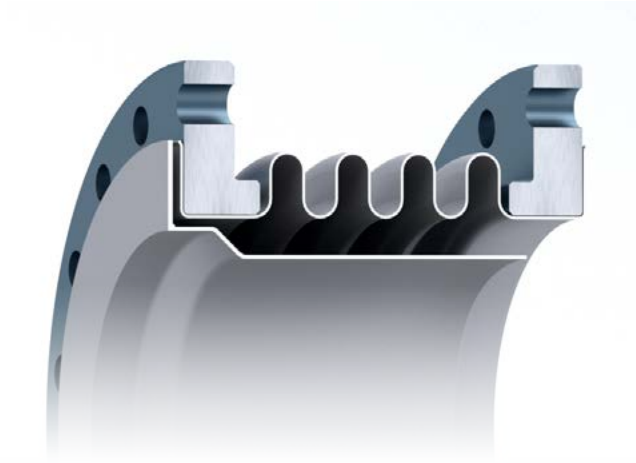
- 25 ft/sec (7.6 m/sec) for liquids
- 65 ft/sec (19.8 m/sec) for gases.

F. Drain holes should be provided for vertical installations where liquid could become trapped inside the sleeve.

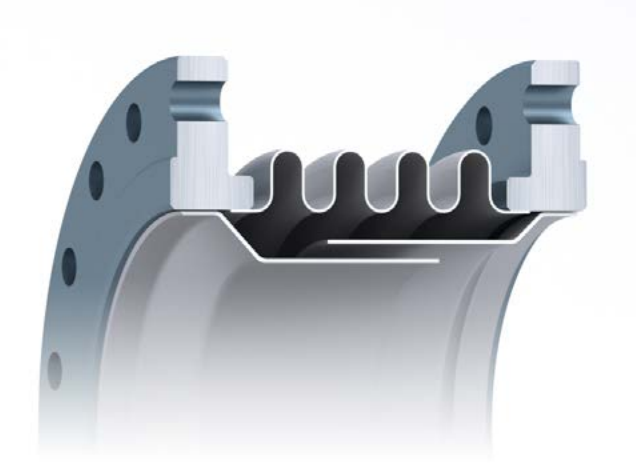
G. The internal sleeve material should normally be the same as the bellows material. Other materials may be used provided they are suitable for the application.



▲ *Flanged Joint with Liner*



▲ *Vanstone Joint with Liner*



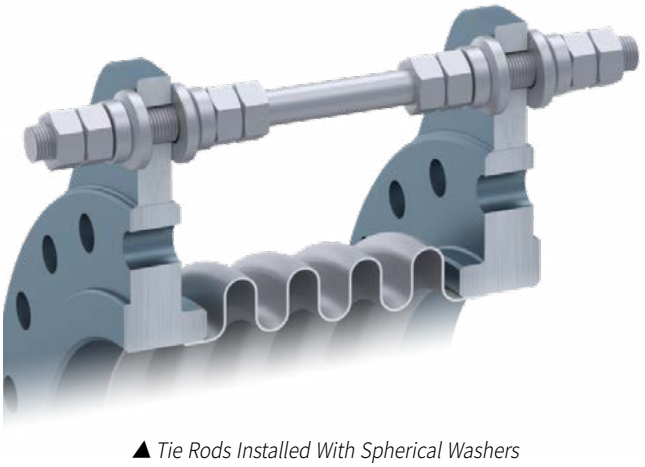
▲ *Telescopic Liner*

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.

*Spherical washer

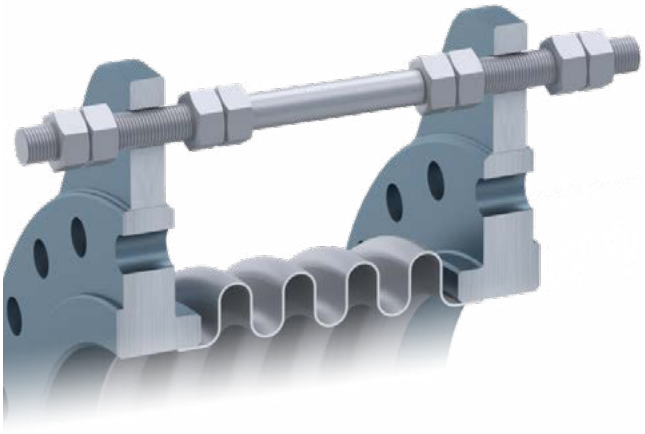
Spherical washers are designed to create an exact, parallel plane between the bolt head and the face of the nut. These washers automatically adjust and compensate for the angular deviation between the planes and prevent the bolt from bending.



▲ *Tie Rods Installed With Spherical Washers*

Limit Rods

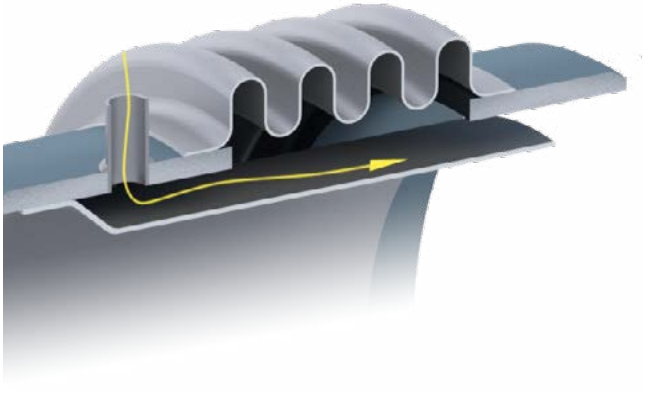
Limit rods are used to protect the bellows from movements in excess of design that occasionally occurs due to plant malfunction or the failure of an anchor. Limit rods do not contain the pressure thrust during normal operation. Limit rods are designed to prevent bellows over-extension or over-compression while restraining the full pressure loading and dynamic forces generated by an anchor failure. During normal operation the rods have no function.



▲ *Limit Rods Installed*

Purge Connections

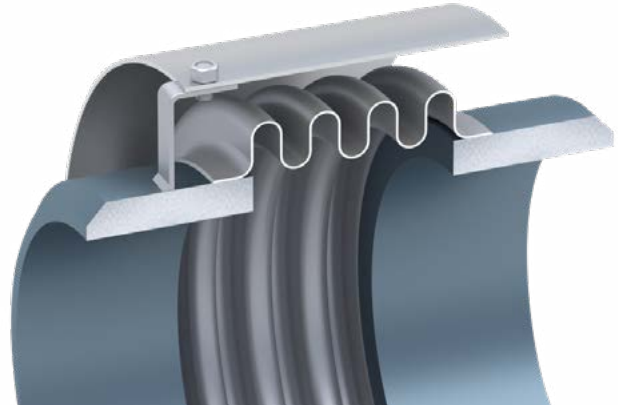
Purge connections are used in conjunction with internal liners to lower the skin temperature of the bellows in high temperature applications such as catalytic cracker bellows. The purge media can be air or steam which helps flush out particulate matter between bellows and the liner. This also prevents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



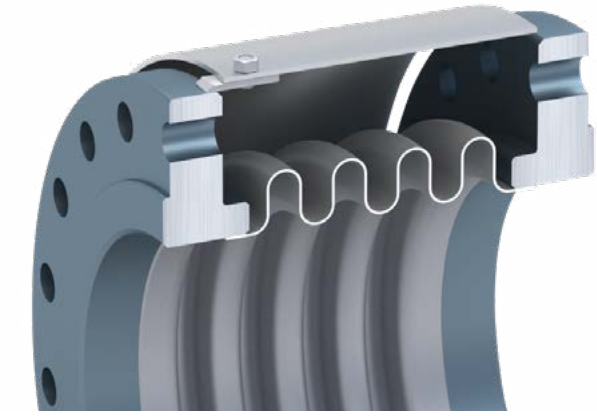
▲ *Air Or Steam Purge Under Bellows*

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 MEGAFLEXON 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. MEGAFLEXON always recommends covers for any expansion joint. The small cost increase is just economical insurance when compared to a complete joint replacement.



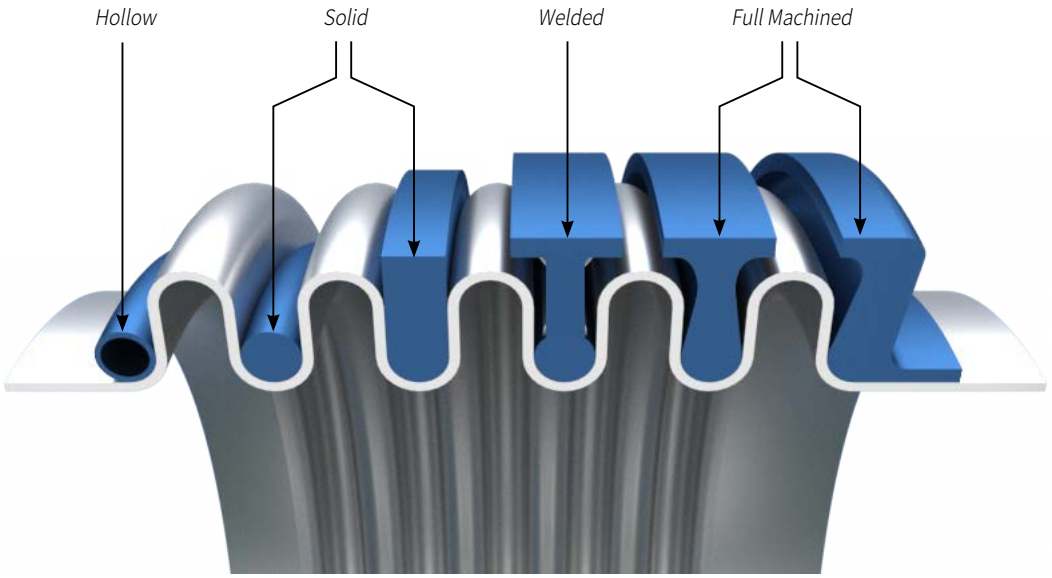
▲ *Weld End Joint with Cover*



▲ *Flanged Joint with Cover*

Reinforcing Rings

As design pressure, diameter and temperature increase for an EJ, convolutions often required reinforcement to contain the hoop stress in the thin-walled bellows. These reinforcing members are known as reinforcing rings (or root rings).
Reinforcing rings come in many forms and materials depending on the design conditions. The figure below shows several styles of root rings.



▲ *Various Reinforcing Ring Styles*

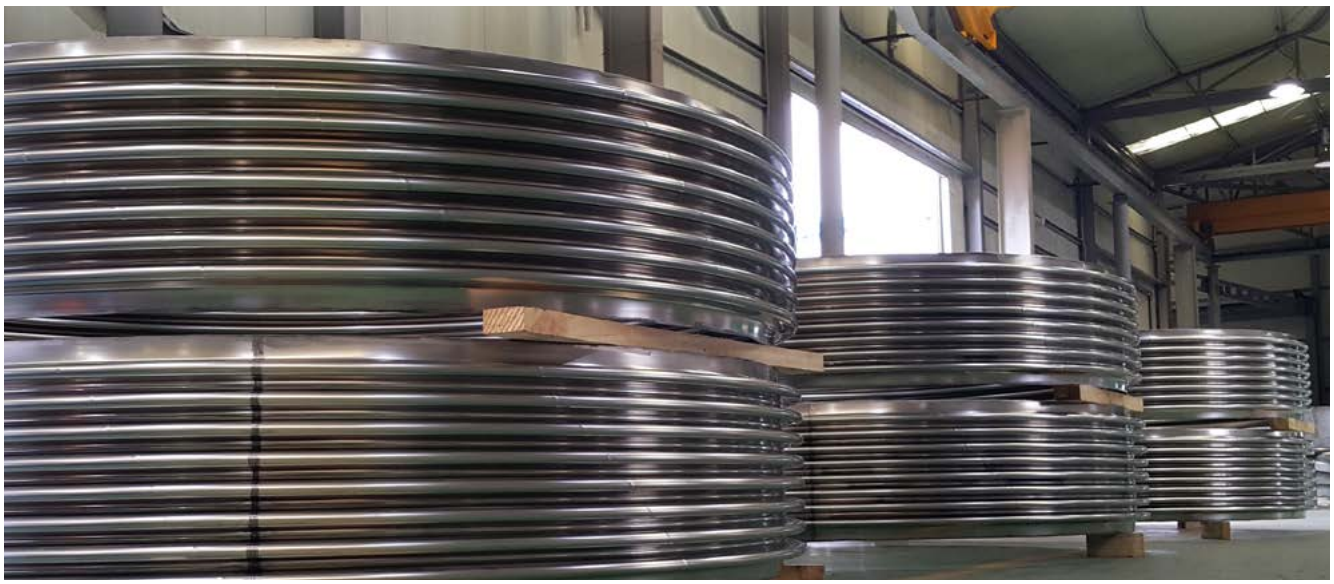
MATERIAL SELECTION GUIDELINES

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 enginners to have access to all the facts surrounding the bellows application before a material is selected.



▲ *Expansion joints are manufactured in a variety of austenitic stainless steels, nickel alloys and other materials such as Hastelloy and Corten. Selection of the bellows material is one of the single most important factors to consider in the design of an expansion joint.*

STAINLESS STEEL-TYPE 300 AUSTENITIC SERIES

304 / 304L

304/304L (UNS S30400/S30403) is the most widely utilized “18-8” chromium-nickel austenitic stainless steel. It is an economical and versatile corrosion resistant alloy suitable for a wide range of general purpose applications.

304H

304H (UNS S30400/ S30409) is a modification of the most widely utilized "18-8" chromium-nickel austenitic stainless steel. The carbon content is controlled in the range of 0.04-0.10% for increased strength at temperatures above 800°F (427°C). It is an economical and versatile corrosion resistant alloy suitable for a wide range of general purpose applications.

316 / 316L

316 (UNS S31600) and 316L (UNS S31603) are molybdenum-bearing austenitic stainless steels, which are more resistant to general corrosion and pitting/crevice corrosion than the conventional chromium-nickel austenitic stainless steels such as Alloy 304. These alloys also offer higher creep, stress-to-rupture, and tensile strength at elevated temperatures. In addition to excellent corrosion resistance and strength properties, the Alloys 316 and 316L Cr-Ni-Mo alloys also provide excellent fabricability and formability which are typical of the austenitic stainless steels.

316H

316H (UNS S31609) is a high carbon modification of Alloy 316 developed for use in elevated temperature service. The alloy has higher strength at elevated temperatures and is used for structural and pressure vessel applications at temperatures above 932°F (500°C). The higher carbon content of 316H also delivers higher tensile and yield strength than 316/316L and its austenitic structure provides excellent toughness down to cryogenic temperatures.

321

321 (UNS S32100) is titanium stabilized austenitic stainless steel plate with good general corrosion resistance. It has excellent resistance to intergranular corrosion after exposure to temperatures in the chromium carbide precipitation range of 800 - 1500°F (427 - 816°C). The alloy resists oxidation to 1500°F (816°C) and has higher creep and stress rupture properties than alloys 304 and 304L. It also possesses good low temperature toughness.

321H

321H (UNS S 32109) stainless steel plate is the higher carbon (0.04 - 0.10) version of the alloy. It was developed for enhanced creep resistance and for higher strength at temperatures above 1000oF (537°C). In most instances, the carbon content of the plate enables dual certification.

Others : Super Duplex Stainless Steel (UNS S31803, S32750, etc.)

NICKEL ALLOYS

Alloy 600

A Ni-Cr-Fe alloy with resistance to stress corrosion cracking and caustic corrosion, and with high-temperature strength and oxidation resistance. Used for chemical and petrochemical processing, nuclear and automobile engineering and thermal processing. Available as billet, rod and bar, flat products, seamless tubing and wire.

Alloy 625

A Ni-Cr-Mo Nb-stabilized alloy with resistance to aggressive media, particularly to crevice corrosion, pitting and high-temperature oxidation. Used in aerospace, chemical processing, oil and gas extraction, pollution control, and marine and nuclear engineering. Available as billet, rod and bar, flat products, seamless tubing and wire.

Alloy 625LCF
Similar to INCONEL alloy 625 but with composition and processing controlled for optimum resistance to mechanical and thermal fatigue up to 1200°F (650°C). Widely used for bellows expansion joints. Available as flat products, notably as sheet and strip.

Alloy 800
An alloy with strength and corrosion-resistance for use in chemical, petrochemical and food processing, for nuclear engineering and for the sheathing of electrical heating elements. For use, generally, at temperatures below 1200°F (650°C). Available as rod and bar, flat products, seamless tubing and wire.

Alloy 825
A Ni-Fe-Cr-Mo Ti-stabilized alloy with excellent resistance to sulfuric and phosphoric acids. Resistant to reducing and oxidizing acids, pitting, stress-corrosion cracking and intergranular corrosion, it is used in chemical and petrochemical processing, oil and gas extraction, pollution control, waste processing and pickling applications. Available as billet, rod and bar, flat products, seamless tubing and wire.

Alloy 400 (Monel)
An alloy with strength and corrosion-resistance for use in chemical, petrochemical and food processing, for nuclear engineering and for the sheathing of electrical heating elements. For use, generally, at temperatures below 1200°F (650°C). Available as rod and bar, flat products, seamless tubing and wire.

Alloy 200
Alloy 200 can be used with sulfuric acid solutions at low or moderate temperatures. Aeration increases corrosion rates, particularly in dilute acids. In concentrated acids, aeration decreases corrosion rates, possibly because of the formation of a passive film, but Alloy 200 is seldom used in this service because other, more resistant materials are adequate.

HASTELLOY - C (C-276)
Offers resistance to reducing and mildly oxidizing environments, and is resistant to localized attack and to stress-corrosion cracking. Used widely in the chemical and process industries and for aggressive environments in the pollution control industry. Available as rod and bar, flat products, seamless tubing and wire.

Others : TITANIUM, HAYNESS 230 & etc.

■ 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 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 torsional 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 the installation has been completed and shipping bars (yellow color) 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.

The test pressure can be changed according to the customer's request, design conditions, and test fluid application method.

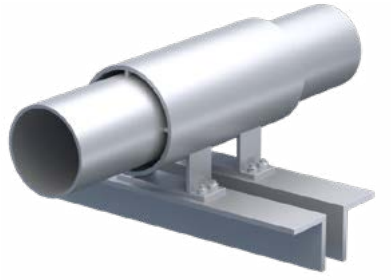
▶ *Yellow shipping bars and setting bars After installation these bars must be removed.*

UNRESTRAINED EXPANSION JOINTS:

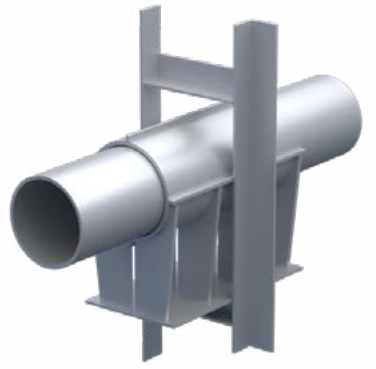
Installation Guidelines
AXIAL MOVEMENT

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.

▲ *Pipe Alignment Guide Style 1*



▲ *Pipe Alignment Guide Style 2*



▲ *Pipe Alignment Guide Style 3*

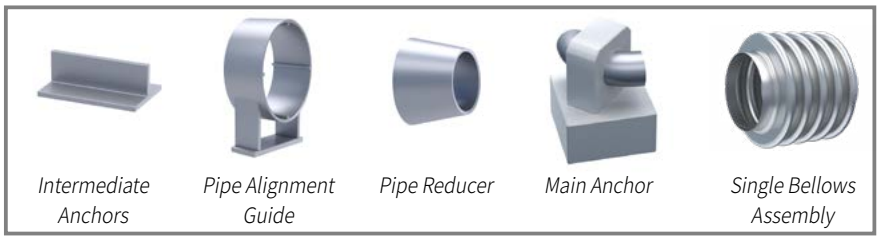
TYPES OF ANCHORS

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.

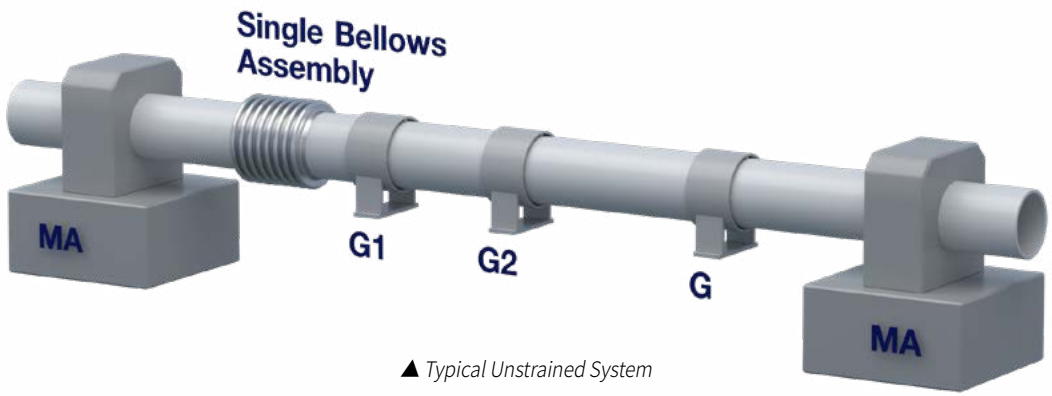
Intermediate Anchors are used to divide a long pipe run into shorter individual expanding sections, and should be structurally capable of withstanding bellows spring resistance and frictional forces only. Pressure thrust forces at this juncture are completely balanced and have no influence on the design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



Intermediate Anchors | *Pipe Alignment Guide* | *Pipe Reducer* | *Main Anchor* | *Single Bellows Assembly*



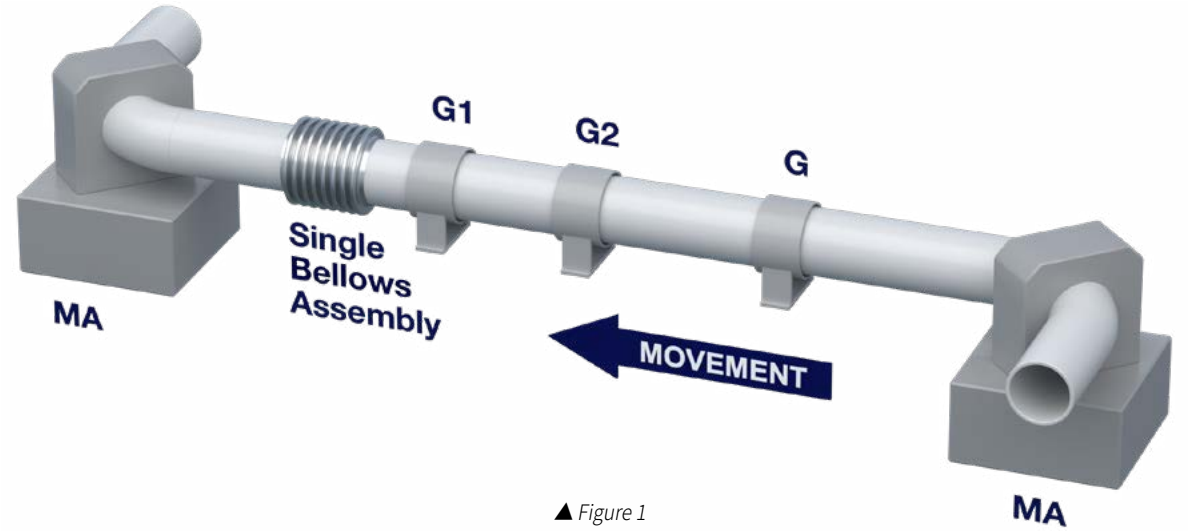
▲ *Typical Unstrained System*

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:

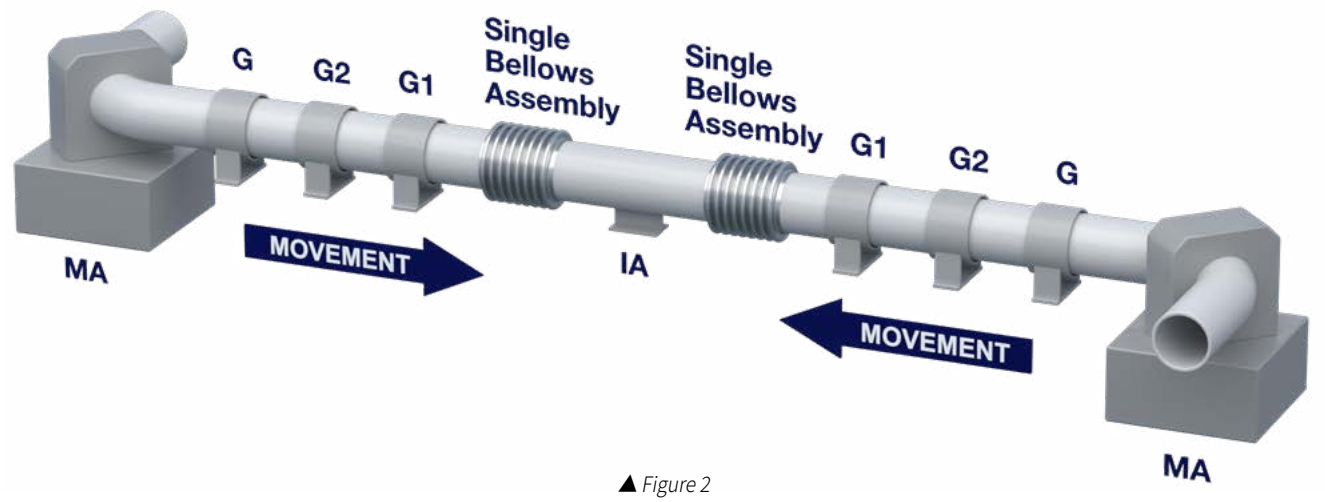
1. Install one expansion joint between main anchors (MA).
2. Locate main anchors at change in direction of piping.
3. Locate expansion joint immediately adjacent to a main anchor.
4. Space first pipe alignment guide (G1) within four times of pipe diameters of expansion joint.
5. The remaining guides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



▲ *Figure 1*

Figure 2

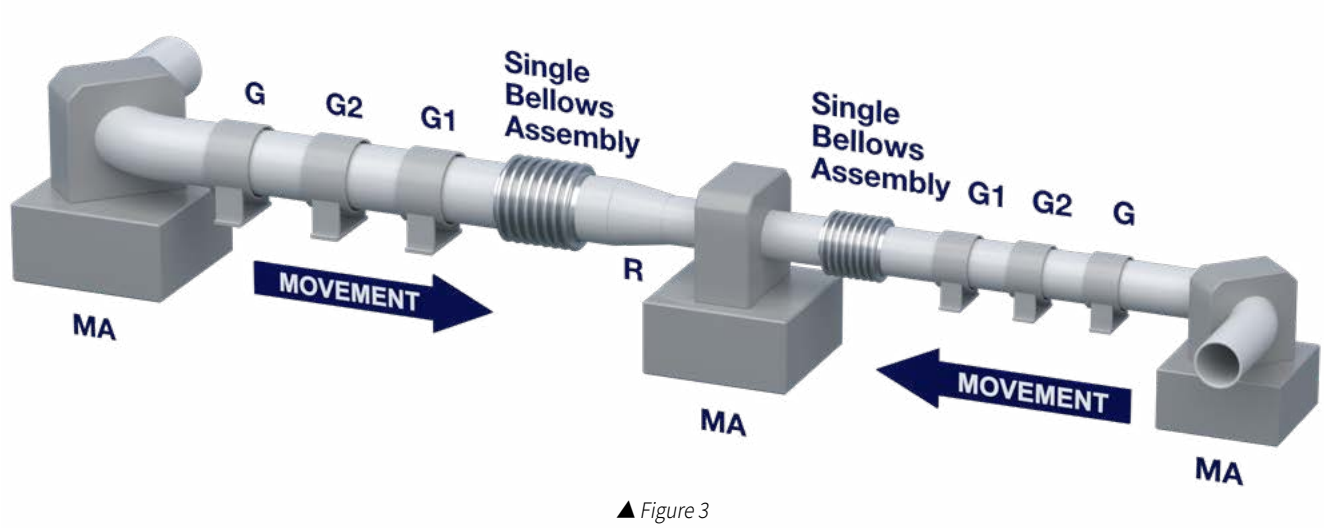
When thermal expansion between the main anchors (MA) exceeds the capacity of a Single Bellows Assembly, then the pipe system must be divided into smaller sections. The use of an intermediate anchor (IA) located between two Single Bellows Assemblies or as an integral part of a Universal Bellows Assembly 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 2*

Figure 3

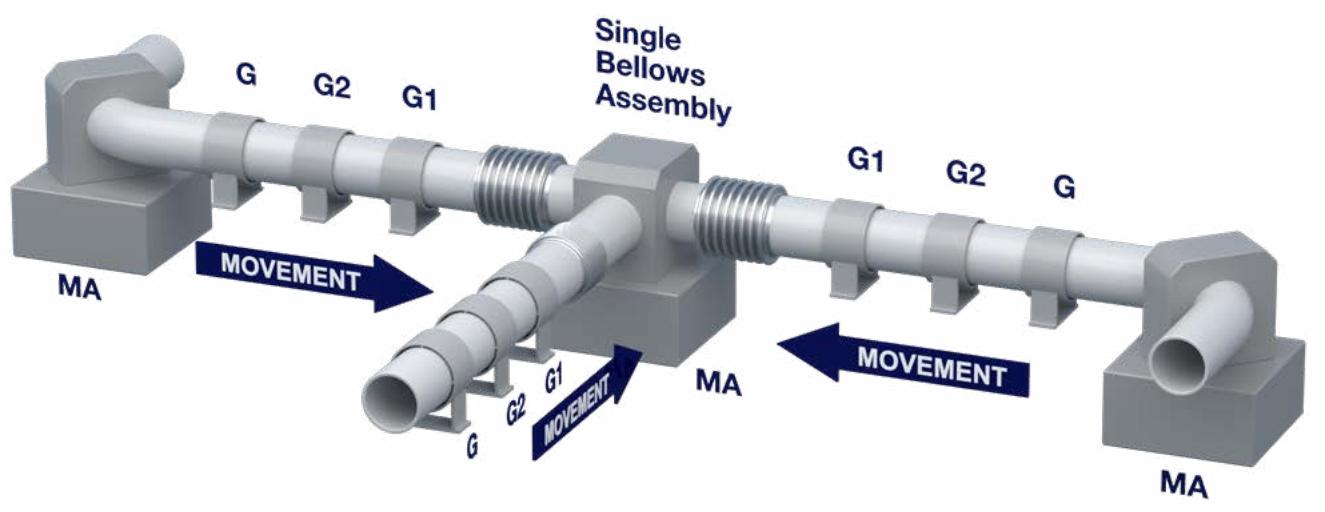
If two expansion joints of different pipe diameters are used in the same section of pipe, such as a line containing a reducer, the pressure thrusts are no longer equal. In this case, the anchor dividing the expansion joints must be a main anchor designed to withstand the difference in pressure thrust 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

A T 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.



▲ *Figure 4*

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.

Intermediate Anchors

Pipe Alignment Guide

Planer Pipe Guide

Tied Bellows Assembly

Hinged Bellows Assembly

Gimbal Bellows Assembly

Pressure Balanced Assembly

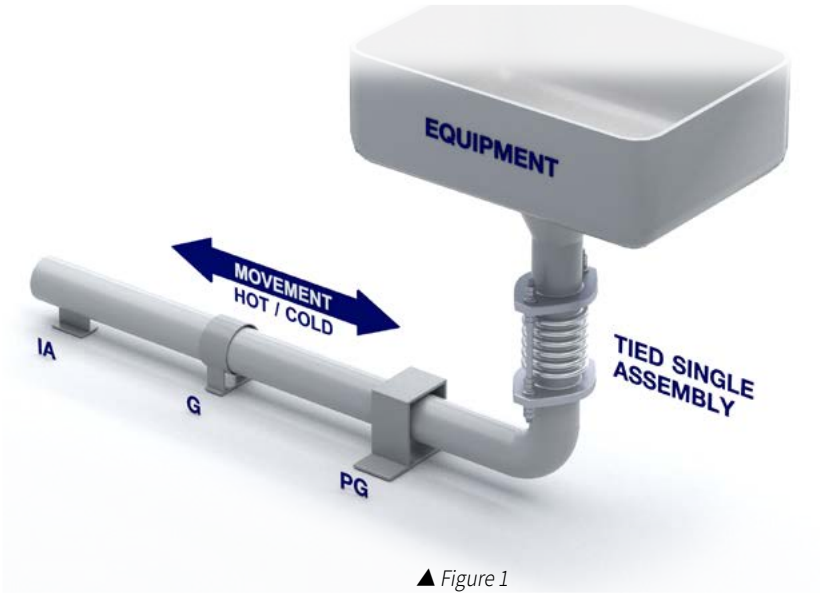
▲ *Typical Restrained Systems*

Application Engineering:

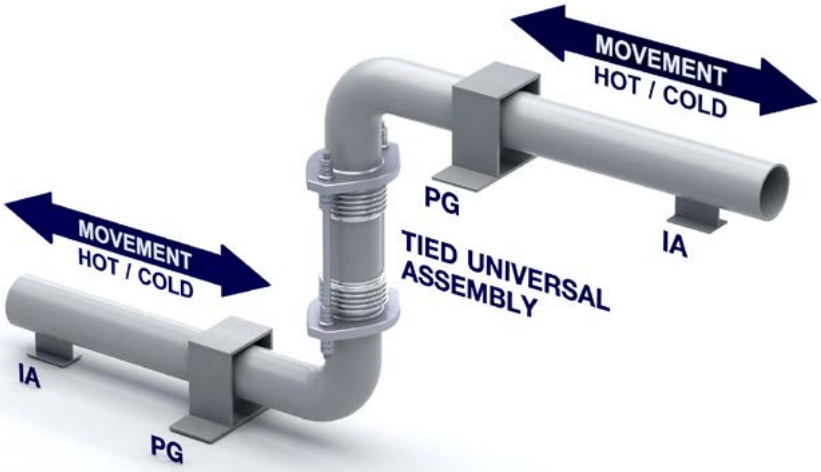
TIED SINGLE ASSEMBLY
TIED UNIVERSAL ASSEMBLY

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*

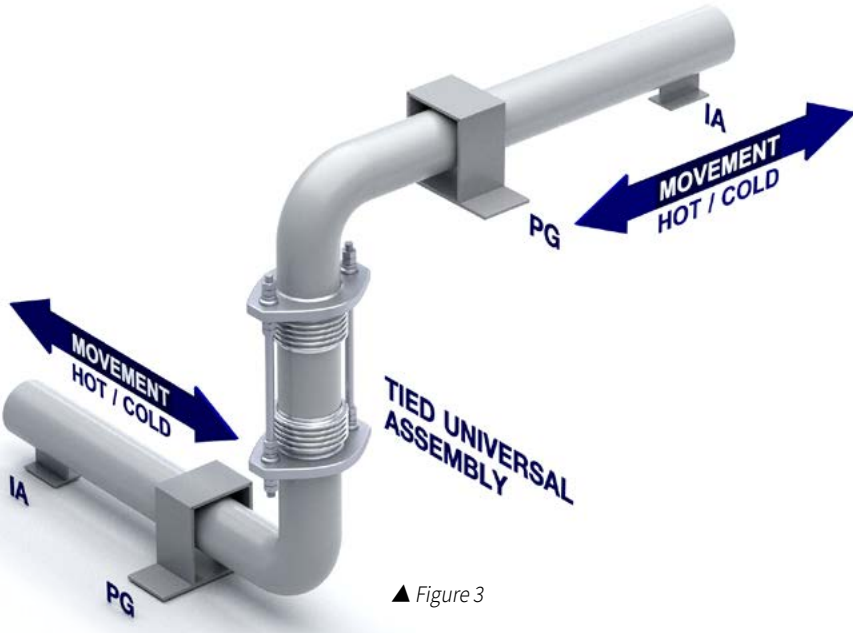
Figure 2

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

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:

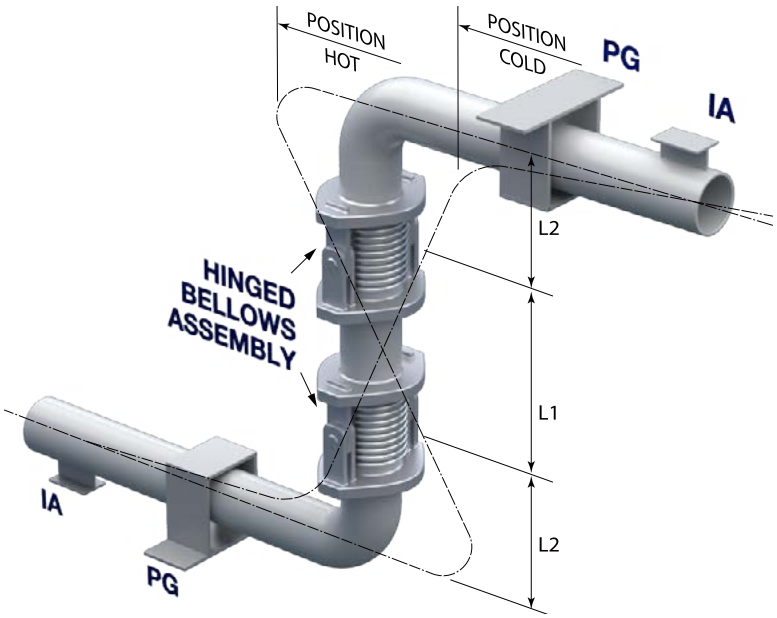
HINGED BELLOWS ASSEMBLY
GIMBAL BELLOWS ASSEMBLY

Figure 1

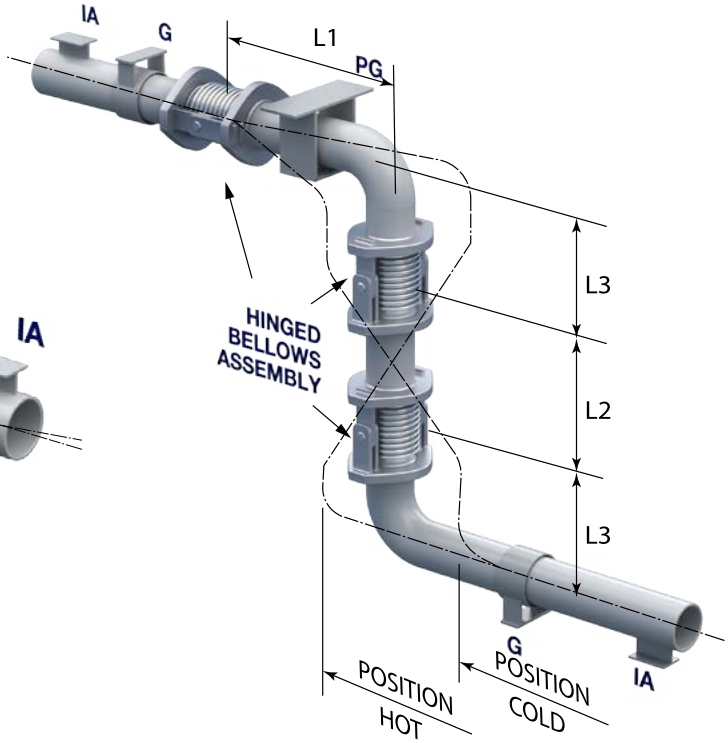
When two Hinged Bellows Assemblies are installed in a "Z" offset, as shown, they can absorb large amounts of thermal movement in a piping system. The expansion joints should be cold spring (pre-set in a deflected position) in order to maximize their movement capability. The thermal expansion in the offset 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 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 1*



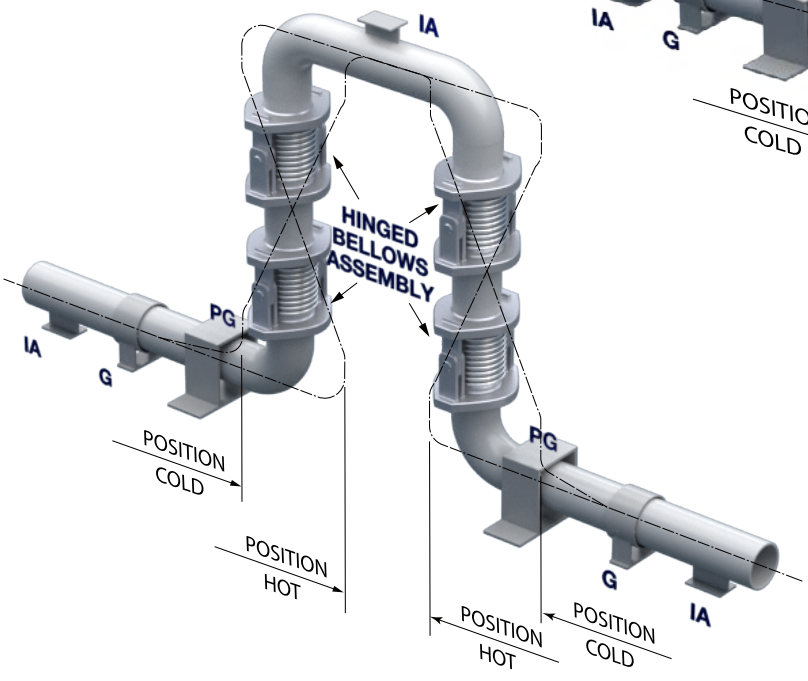
▲ *Figure 2*

Figure 3

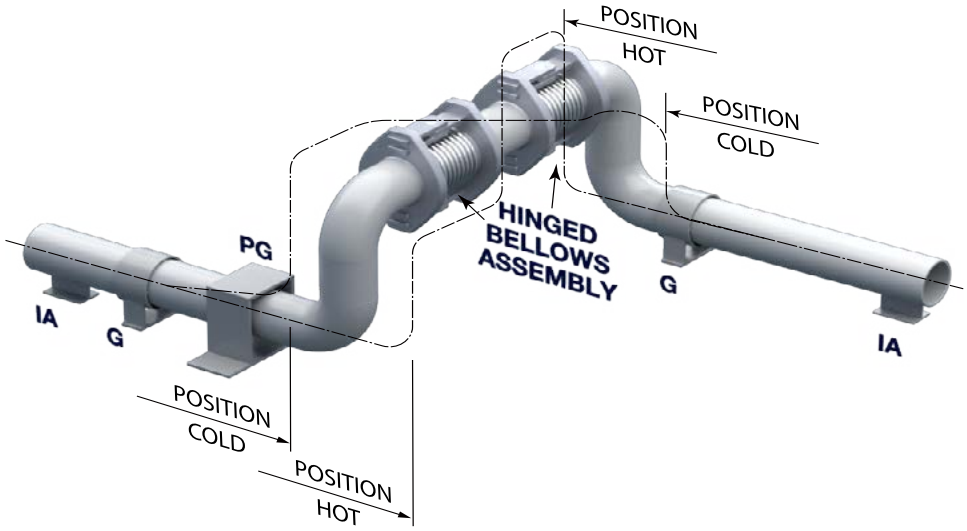
In a long piping system, the number of expansion joints can be reduced by incorporating four Hinged Assemblies in a "U" bend system as shown. Pressure drop in the system is kept to a minimum, and pipe supports reduced in number when compared to a system using pipe loops. An intermediate anchor at the "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 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 spring, 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.



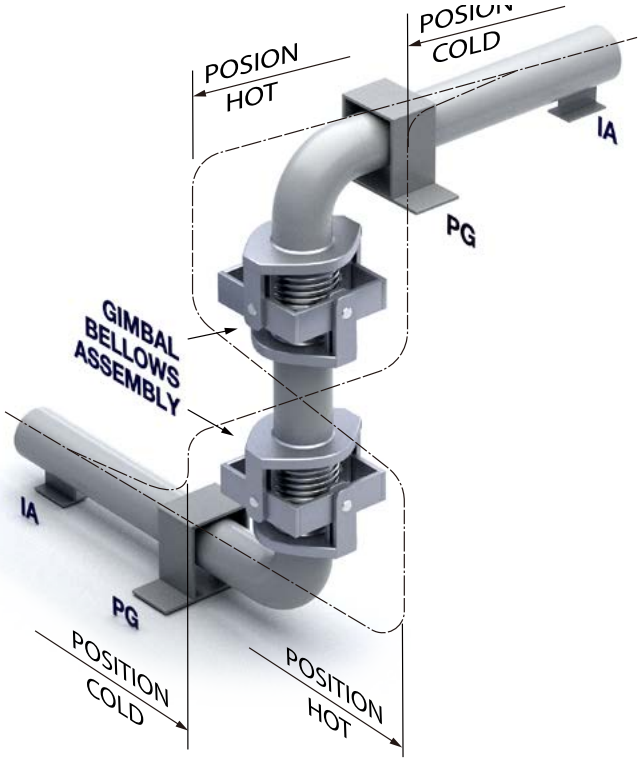
▲ *Figure 3*



▲ *Figure 4*

Figure 5

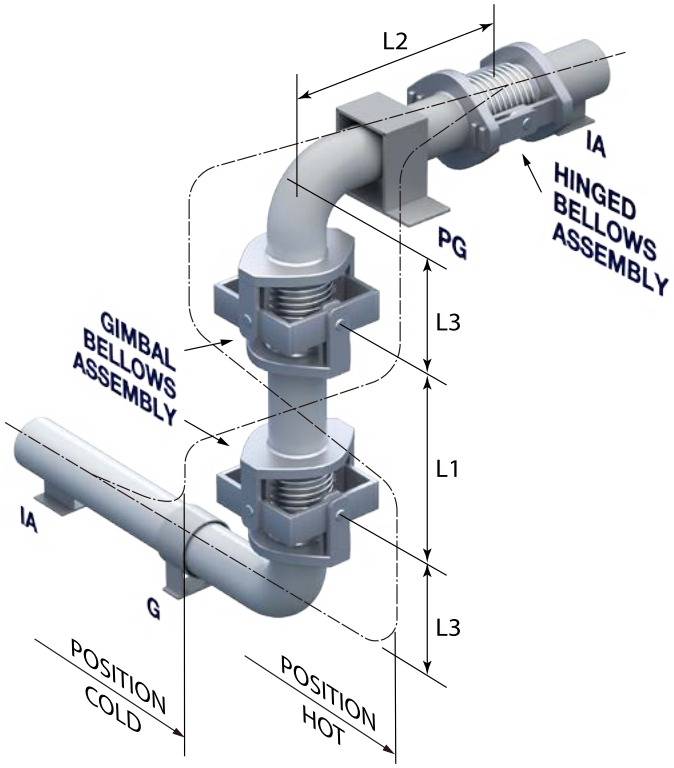
In a multi-planer piping system the use of two Gimbal Bellows Assemblies in a multi-plane "Z" bend is the best solution. The gimbal restraint allows thermal expansion in two planes as shown, while still absorbing the pressure thrust. The thermal expansion in the offset leg is taken by the flexibility 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 5*

Figure 6

There are many applications in a multi planer piping system where the horizontal pipe leg is not flexible enough 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.



▲ *Figure 6*

Application Engineering:

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. 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.

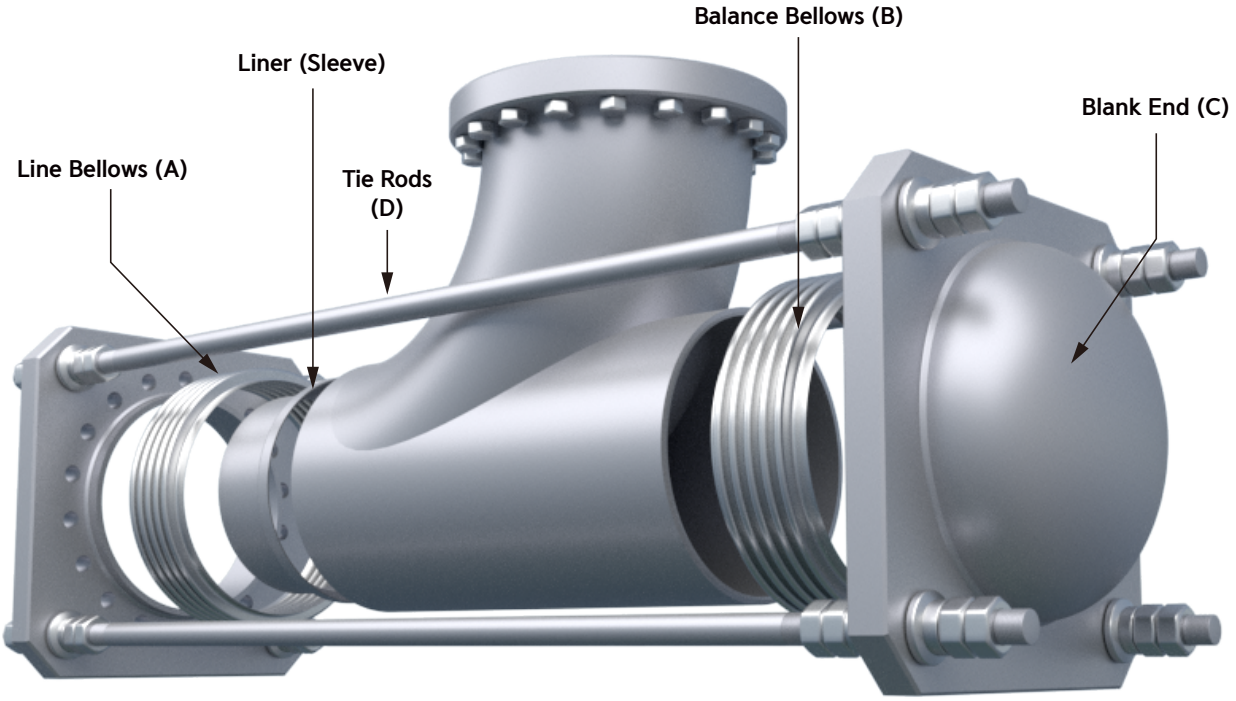
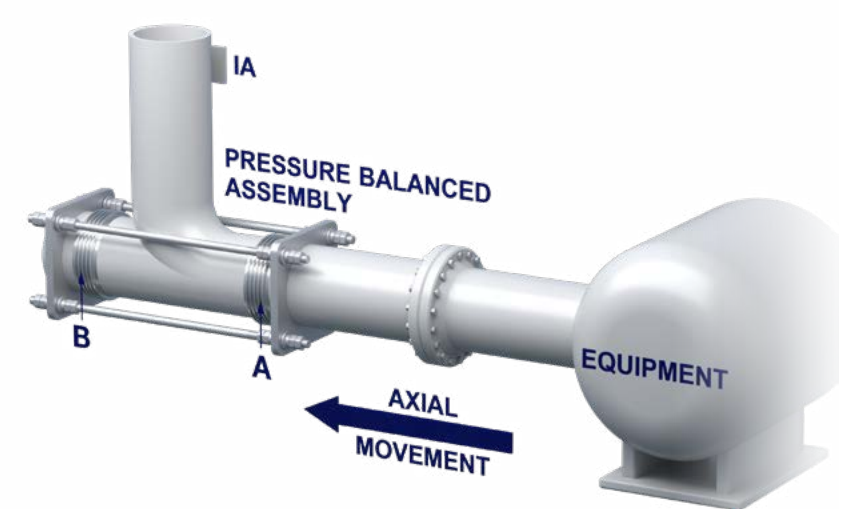


Figure 1

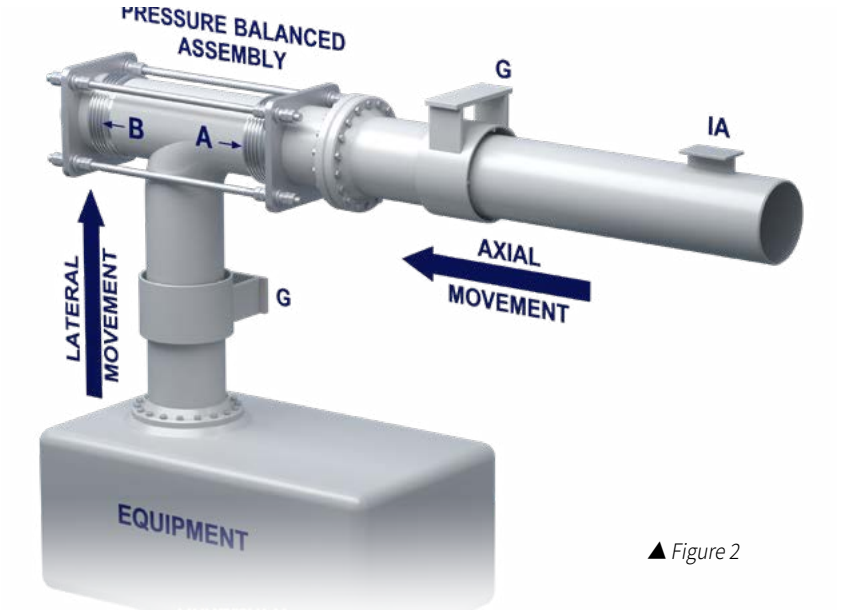
This example shows a single Pressure Balanced Assembly used to protect rotating equipment from the effects of thermal expansion between two intermediate anchors (IA). In operation, the thermal growth in the system compresses the line bellows (A). Internal pressure acting through the tie rods instantaneously elongates the balancing bellows (B) an equal amount, providing a completely balanced system.
If no lateral movement is present, the number of convolutions 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

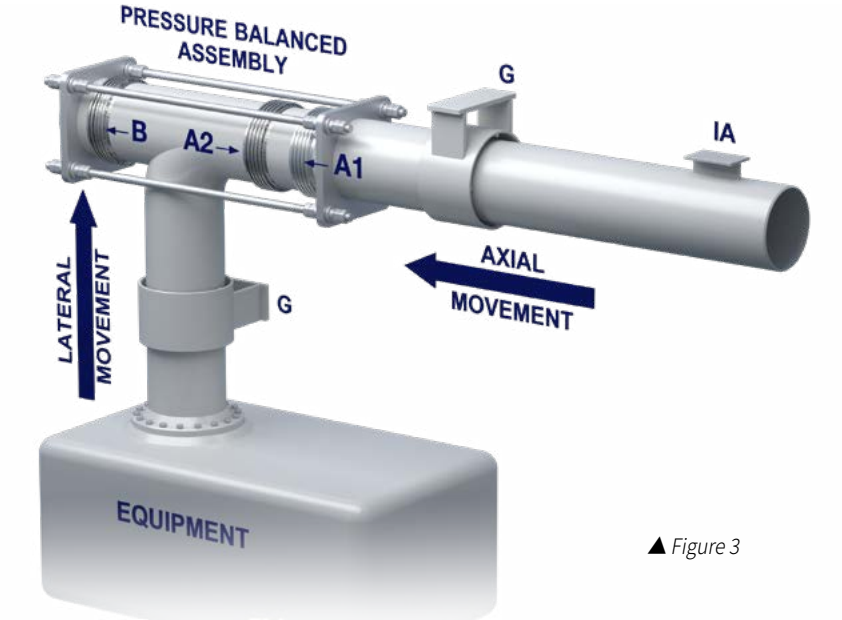
A single Pressure Balanced Assembly can be used to absorb lateral and axial movement. In the example shown, bellows (A) has sufficient convolutions to absorb both the axial and lateral movement present in the piping system. The balancing bellows (B) requires only sufficient convolutions to compensate 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 2*

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 (Al) 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

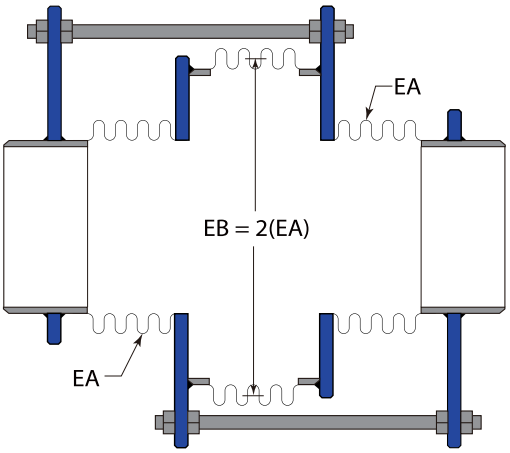
An In-Line Pressure Balanced Assembly is designed to absorb small amounts of axial and lateral movement while counteracting the pressure thrust in a system. This is achieved with a series of rods similar to the Pressure Balanced Elbow Assembly and a balancing bellows with twice the effective area as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

▲ *In-Line Pressure Balance Type Expansion Joint DN2400 x 3200mmL (96")*

Principle of Operation

Reference the diagram (to the right), 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.

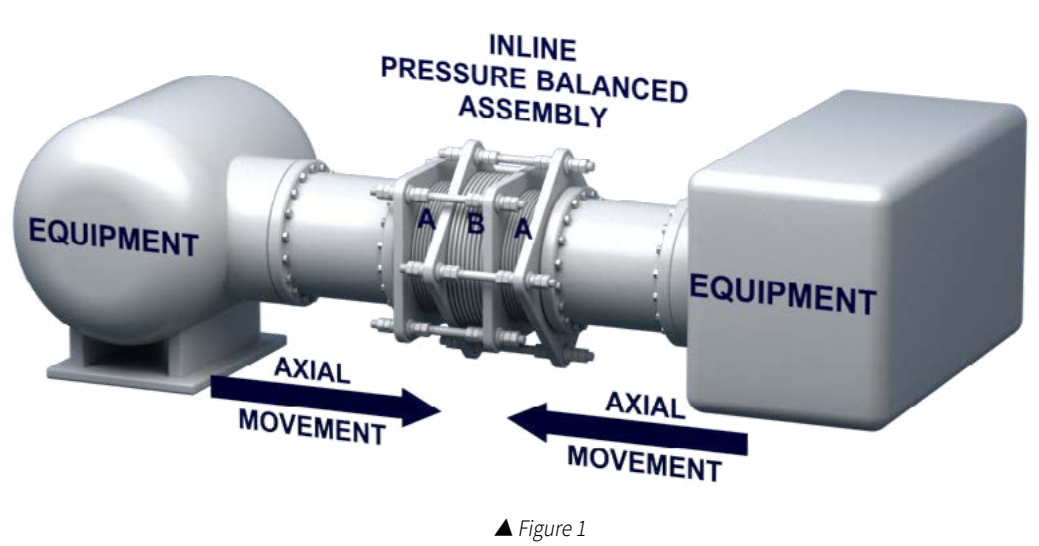


EA = LINE BELLOWS EFFECTIVE AREA
EB = BALANCE BELLOWS EFFECTIVE AREA

▲ *Untied In-Line Pressure Balance Type Expansion Joint DN1600 x 3200mmL (64")*

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.

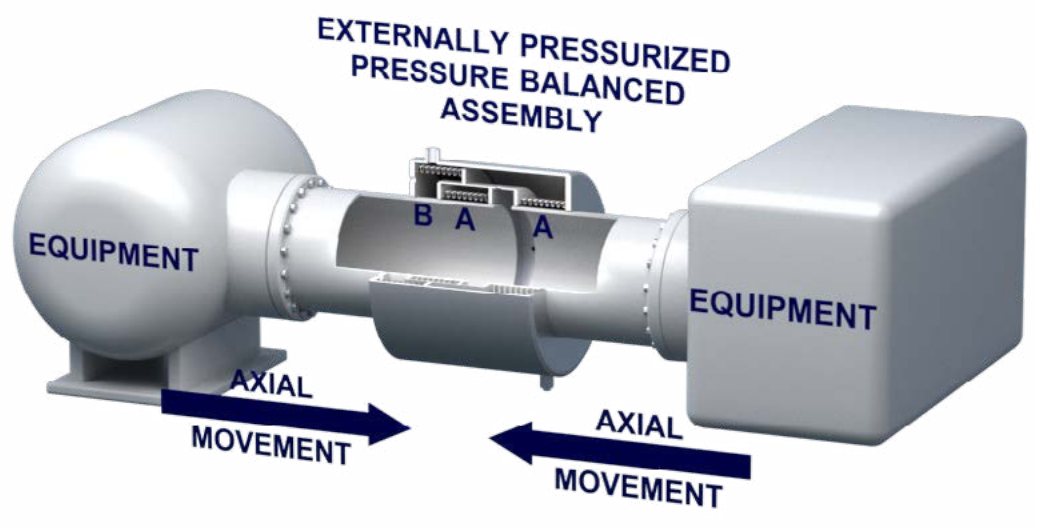


▲ *Figure 1*

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.



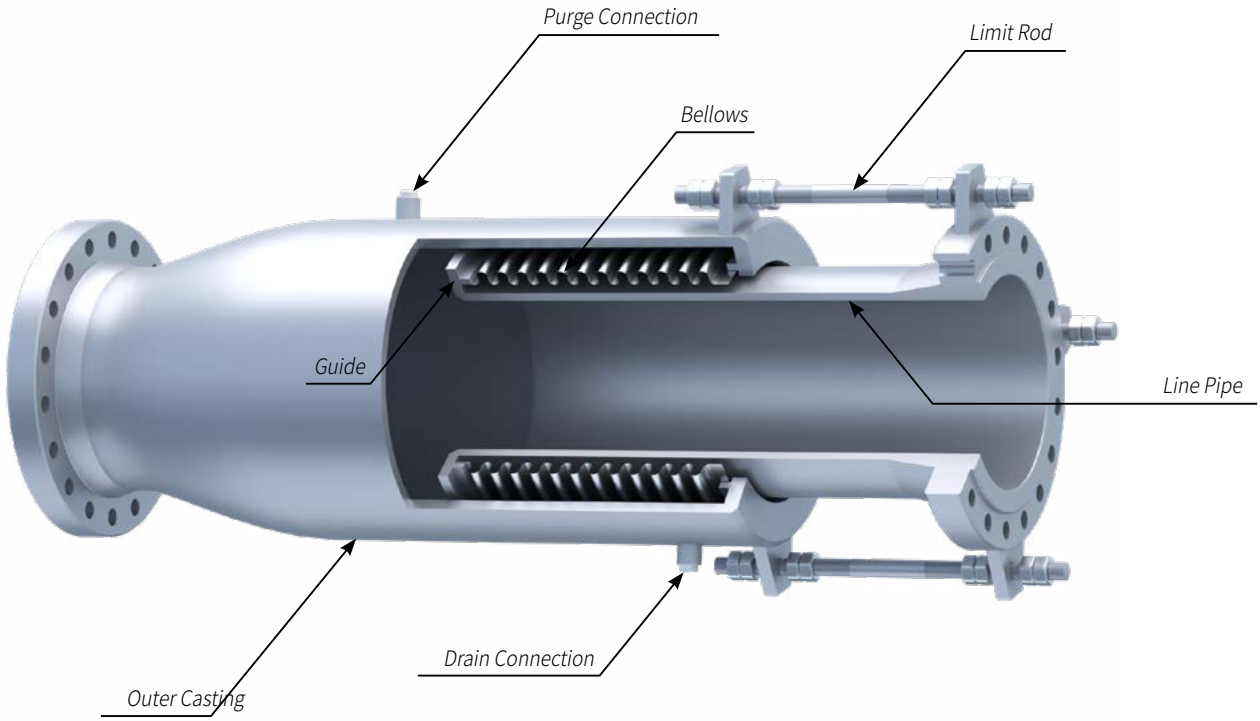
▲ *Figure 2*

Application Engineering:
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*



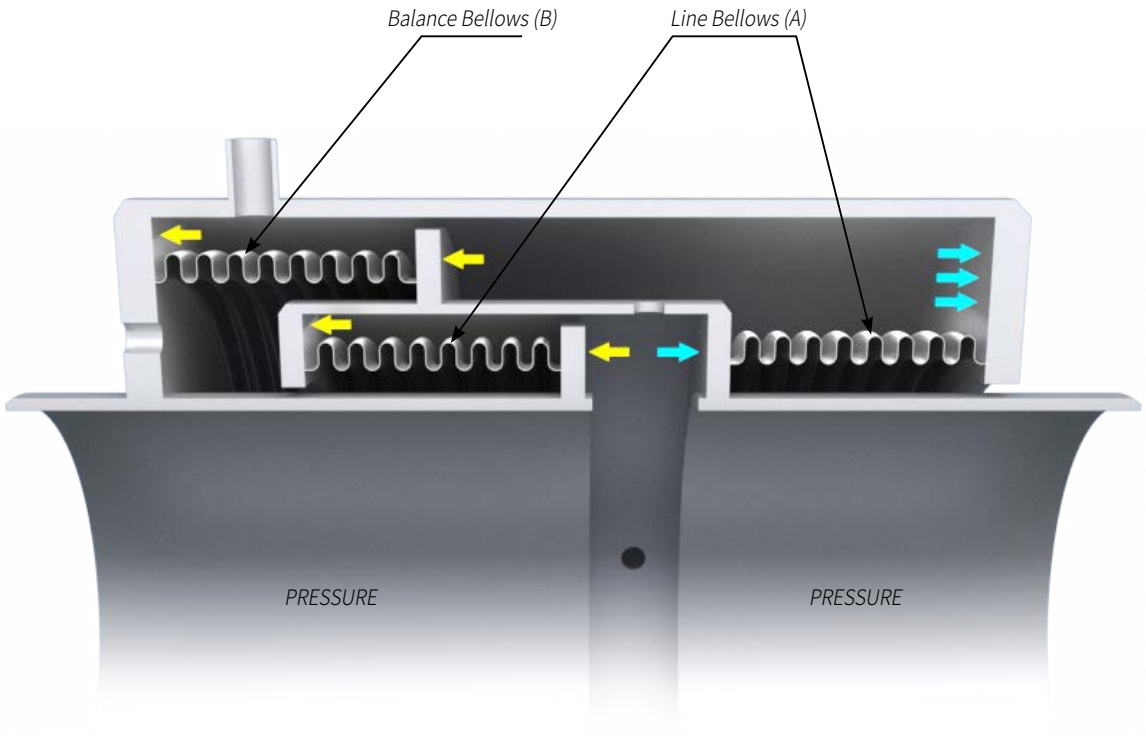
EXTERNALLY PRESSURIZED PRESSURE BALANCED ASSEMBLY

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 needed in this system.

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.

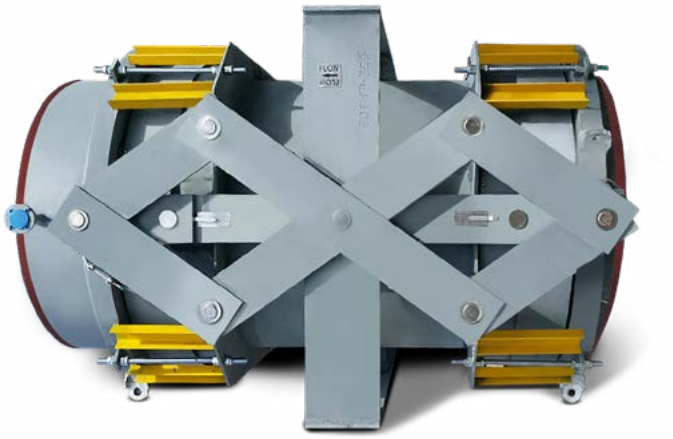
This type of expansion joint is also seen between two pieces of load sensitive equipment where minimum forces and movements are required. It is also used in steam line installations where pipe main anchors are far apart. The only loads seen by the equipment are the sum of the axial force required to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



▲ *How An Externally Pressurized Pressure Balanced Assembly Works*

FOR FLUID CATALYTIC CRACKING UNITS (FCCU) EXPANSION JOINTS

Along with our standard expansion joint product line, MEGAFLEXON manufactures various specialty metal and fabric 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. It's 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 Manufacturers' 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.



▲ *FCC Unit Spent Catalyst Stand Pipe Expansion Joint*

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, provides tighter controls over the carbon, silicon and nitrogen contents. This produces a microstructure that enhances low-cycle fatigue.

Features

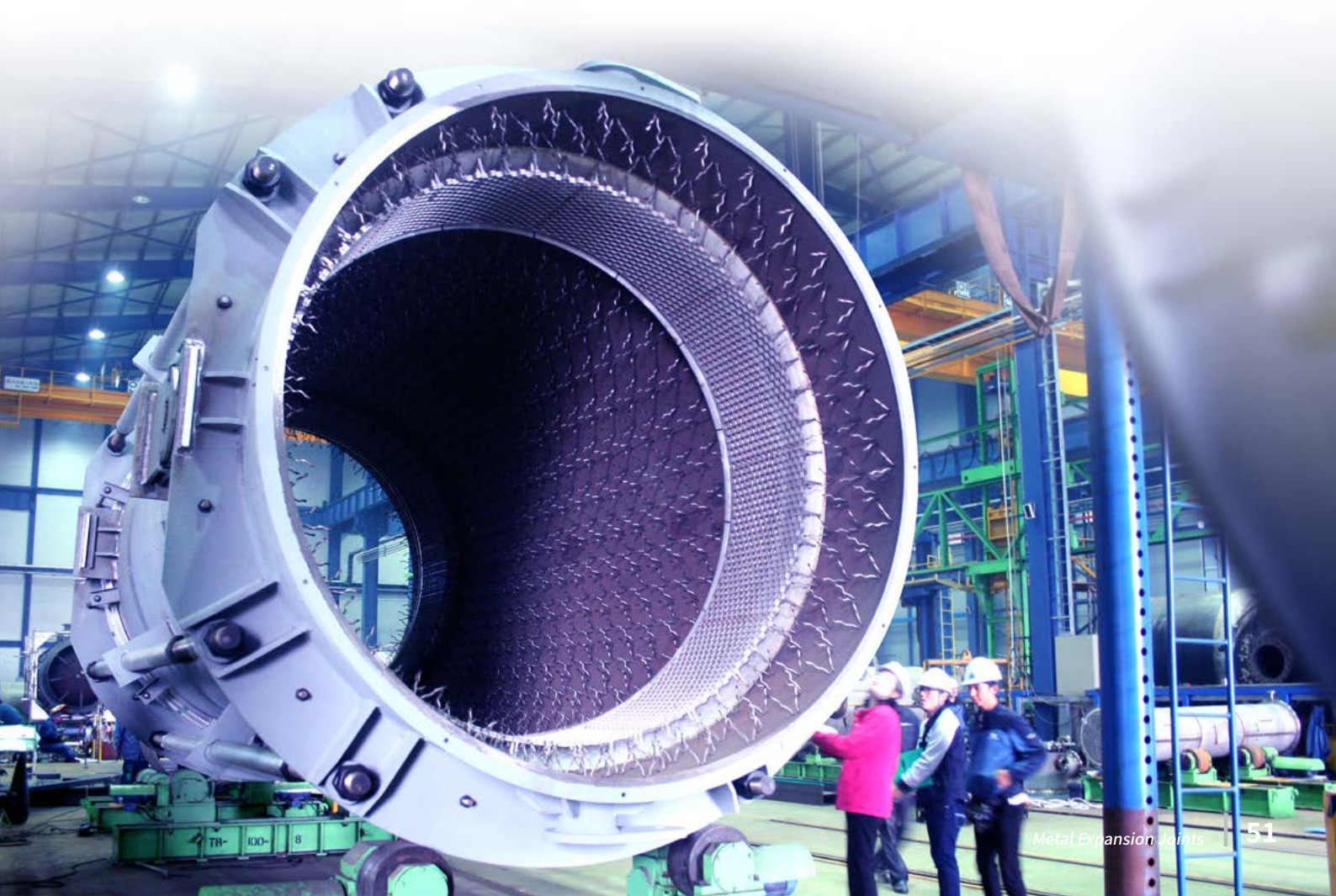
- Heavy duty expansion joints for high temperature, high pressure and high movement applications
- Withstand abrasive media like powder catalyst entrained in hydrocarbon flow
- Used in fluidized catalytic cracker units(FCCU's)
- Shell wall temperatures do not exceed 340 °C

Advantages

- Reliable exp ansion joints in critical applications
- Extensive experience in FCCU business

▲ *Pneumatic Testing View*

▲ *After Finish Refractory Lining Works*



FOR PROPANE DE HYDROGENATION (PDH) EXPANSION JOINTS

Features

- Heavy duty expansion joints for high temperature, high pressure and high movement applications
- Withstand abrasive media like powder catalyst entrained in hydrocarbon flow
- Used in fluidized catalytic cracker units(FCCU's)
- Shell wall temperatures do not exceed 600 °C

Advantages

- Reliable expansion joints in critical applications
- Extensive experience in FCCU, PDH and Styrene Monomer business

▲ *Universal Pantograph Type Expansion Joint for PDH*

▲ *Hot Wall Expansion Joints for PDH Installation View / SK GAS ULSAN PDH PLANT, KOREA*

▲ *Propane De-Hydrogenation(PDH) Plant View*

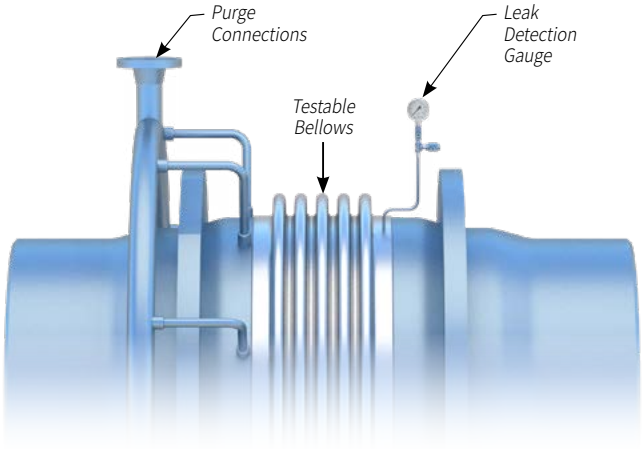
Purged Bellows

Purged bellows are not as commonly used today, but they are still installed successfully on some FCCU units when required.

The purge is applied to the bellows annulus in the form of air or steam. The continuous flow under the bellows introduces a high-pressure area and a flow going back into the gas stream. The purges stop the catalyst from entering the bellows annulus.

Caution should be taken so that the media used to purge the bellows is compatible with the process conditions and does not cause corrosion problems within the bellows element.

Typically numerous nozzles are used to introduce the purge equally around the annulus. The nozzles are connected to a circular pipe manifold that surrounds the bellows on the outside of the joint.



▲ *3D cross section model of a purged bellows*

▲ *Installation View*

▲ *Single Hinged Expansion Joints with Purge Manifold*

▲ *Single Gimbal Expansion Joints with Purge Manifold*

FOR HEAT EXCHANGER EXPANSION JOINTS

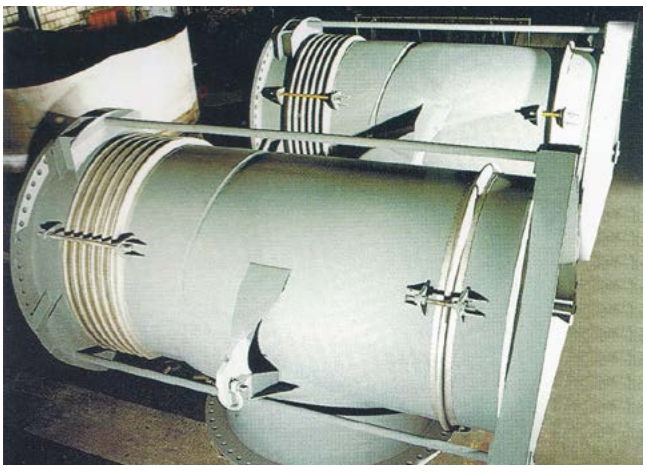
For more than 35 years, Megaflexon has been supplying compensators all over the world for extreme operating conditions. The know-how resulting from this makes us one of the leading manufactures and suppliers of compensators for all industrial applications, e.g.

- ***Machine and Plant Construction***
- ***Chemical Systems***
- ***Power Stations***
- ***District Heating Systems***
- ***Tank Farms***
- ***FCC Systems***
- ***General Pipeline Systems***

Megaflexon expansion joint for heat exchangers are in operation all over the world with excellent results and satisfied customers including following.

- ***DOOSAN HEAVY IND CO., LTD. (KOREA)***
- ***IHI (JAPAN)***
- ***MITSUI (JAPAN)***
- ***HITACHI (JAPAN)***
- ***BASF KOREA (KOREA)***
- ***SAMSUNG HEAVY IND CO., LTD. (KOREA)***
- ***SK CORP. (KOREA)***
- ***UOP (USA)***

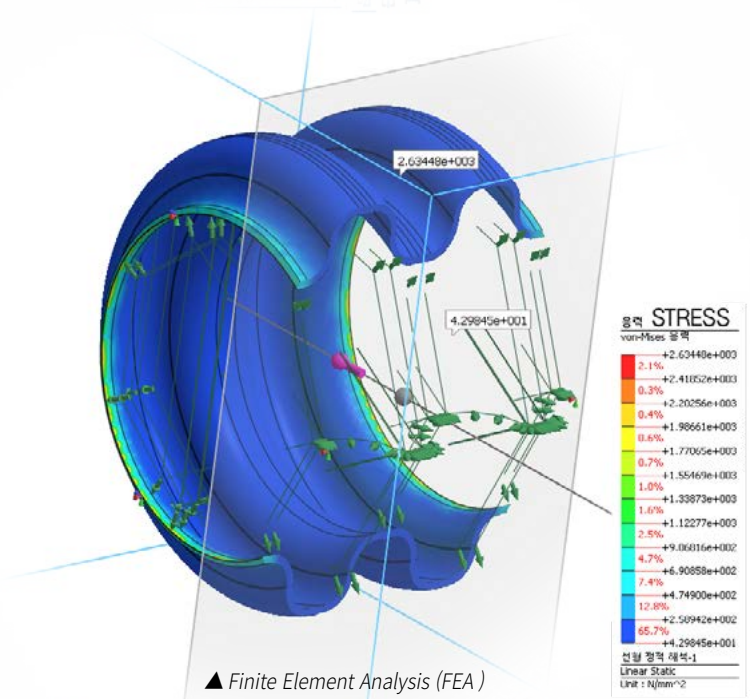
▲ *Flanged and Flued Type*



▲ *Bellows Type*

Extreme Operating Conditions

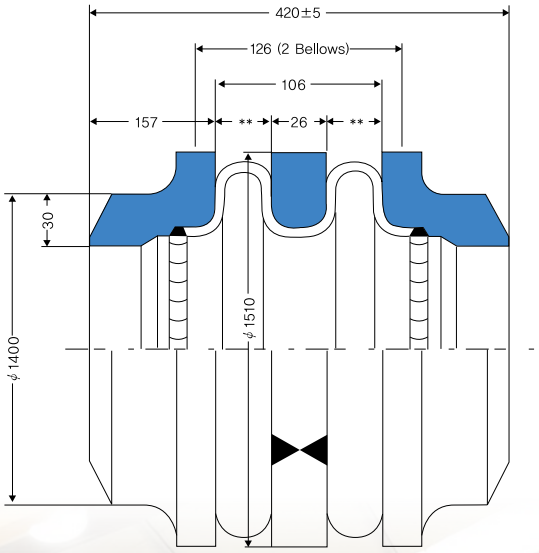
Megaflexon axial compensators for heat exchangers are manufactured according to the corresponding standards and code regulations, in rated sizes DN 15 to 15,000 and with operating pressures from 0 bar to 200 bar, temperatures excursions from -200°C to 800°C (load alternation 200 to 200,000).



▲ *Finite Element Analysis (FEA)*

Materials of Construction

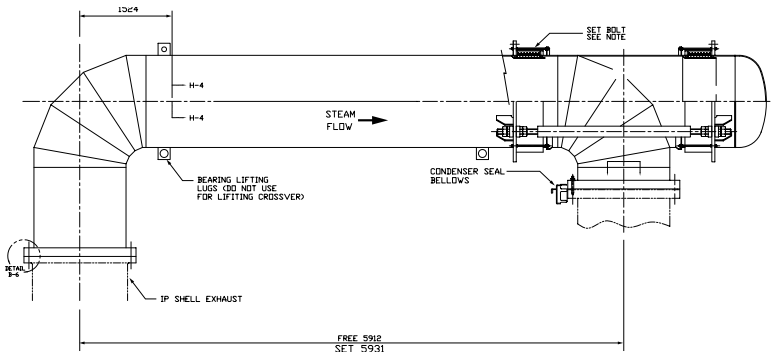
Bellows are manufactured from austenitic stainless steel or any specified materials such as Ni, Ti, Hasteloy, Inconel etc..
In addition ferritic materials e.g. carbon steel, CrMo are used for the end fitting materials.



▲ *Example Design*

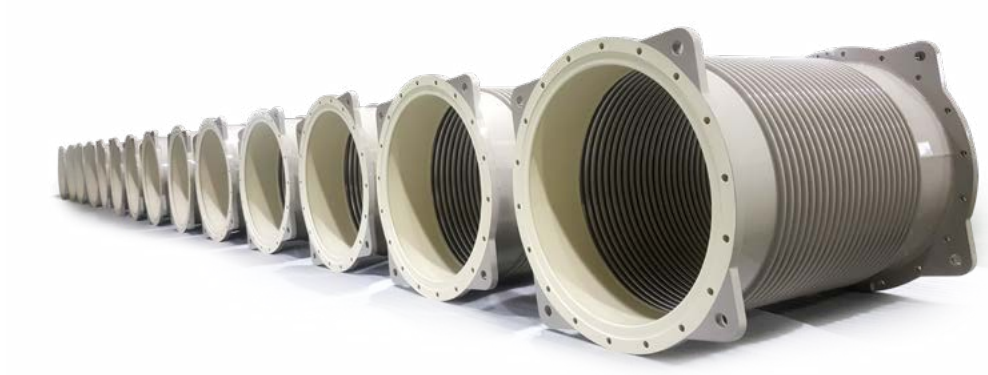
Cross-Over Expansion Joint

It is used to transfer the steam from LP hood of steam turbine system. It is designed to absorb different thermal movements between turbine and casing, and to keep the steam pressure stable during operation.



GIS Expansion Bellows

For GIS system does normally use SF6 gas as medium, GIS expansion bellows are required to be extremely high quality.
Megaflexon manufactures GIS expansion bellows under strict quality control and advanced engineering design and has supplied our GIS expansion bellows to world well-known GIS manufacturer, Hyundai Electric and Fuji Electric Japan for a long period.
We also offer specially-designed GIS expansion bellows. For it has an automatic pressure control device on tie-rods, it ensures the safety and reliability as well as easy maintenance.



▲ *GIS Expansion Bellows*

▲ *GIS Bellows Welding Work*

NOOTER/ERIKSEN HEAT RECOVERY STEAM GENERATORS (HRSG)

PENETRATION SEALS EXPANSION JOINTS

for HRSG Boilers

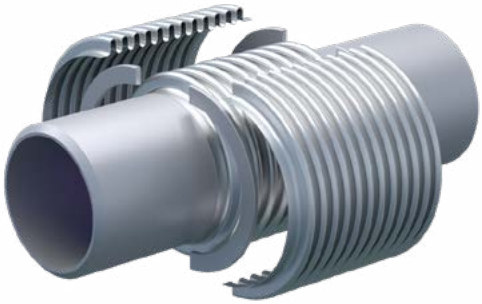
Pipe penetration seals are used to allow tubes or pipes to expand thermally by penetrating the shell or pressure casing.
Metal seals are designed to accept axial, lateral and angular movements therefore, lowering the stress on the tubes and pipes to which they are attached. Metal seals also provide good insulation between the boiler wall and the attachment ring.

Advantages of Using Penetration Seals Expansion Joints

- *Personnel are protected*
- *No leaks*
- *Reduces pipe stress*
- *Increased boiler efficiency*
- *Noise reduction*
- *No maintenance*
- *With insulation on request*

Clamshell Expansion Joints

Clamshell seals perform the same service as normal seals, but the life expectancy of a clamshell seal is dependent on the quality of the convolution weld made by an experienced welder during installation.



▲ *Over Size Clamshell*

▲ *Same Size Clamshell*

RECTANGULAR EXPANSION JOINTS

Megaflexon provides metal rectangular expansion joints subjected to axial, lateral, angular movements, or any combination of these as the same with the metallic circular expansion joint.
To complete this expansion joint in designing, the bellows are to be designed in accordance with the bellows performance equations defined in clause Section V in the current EJMA edition, Expansion joint Manufacturer Association.

Megaflexon can supply single mitered corner, double mitered corner, camera corner and rounded corner in case that especially specified.

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.

▲ *Rectangular Type Expansion Joint for MAILIAO POWER PLANT, TAIWAN*

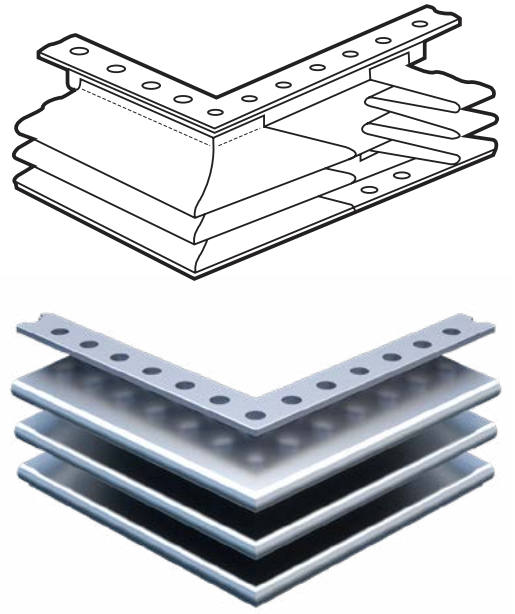
Corner Configuration

Rectangular type expansion joints are available in four different corner configurations. Typical corner construction details are shown below.

Single Miter

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.

- Fitted with high convolution profiles.
- Maximum amount of movement possible for or given convolution profile.
- Lowest cost.



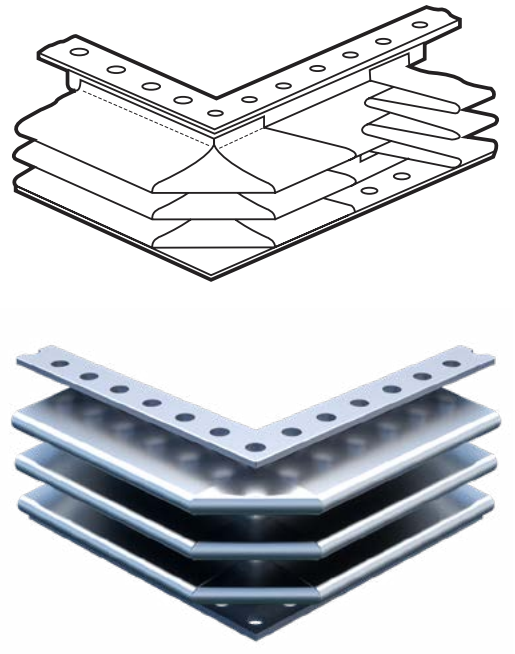
▲ *Construction of Single Miter*

Double Miter

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.

- Fitted which high convolution profile.
- Maximum amount of movement possible for a given convolution profile.
- Low cost.

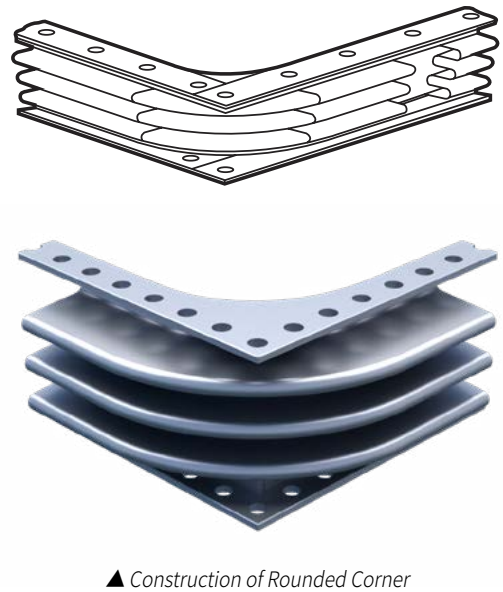
If a corner preference is not specified, MEGAFLEXON would design the double mitered corner configuration in corner construction.



▲ *Construction of Double Miter*

Rounded Corner

This type 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.
MEGAFLEXON can supply the round corner design as well because this design has a advantage in the technical view point.
That is, this design results in the lowest corner stress if sit up and welding of the corner seams are carefully controlled.
MEGAFLEXON is producing 60mm high convolution profile as standard unless specified.



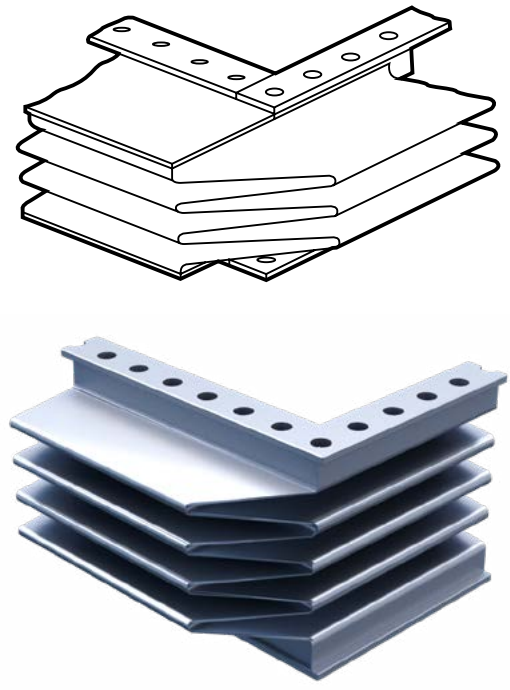
▲ *Construction of Rounded Corner*

Camera Corner

This type is used mainly on low-pressure applications. They have good cycle life characteristics and are less costly than the double miter corner design.

- Low cost
- All corner seam welding to be performed on the outside of the corner in a easily accessible area.
- Disadvantage : deep crevices at the corner, a reduction in movement available for a given profile and convolution count because the convolutions are overlapped at the corner.

MEGAFLEXON does not recommend this shape of expansion joint but will provide if specified.



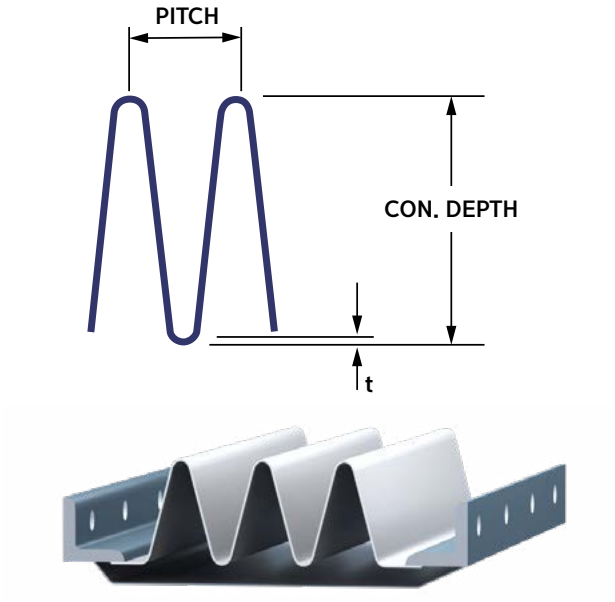
▲ *Construction of Camera Corner*

Convolution Profile

The application and operating conditions will dictate the correct choice of corner configuration. Typical convolution geometry details are shown below.
For higher-pressure applications up to 30 P.S.I.G., "U" span is preferred.

"V" Profile

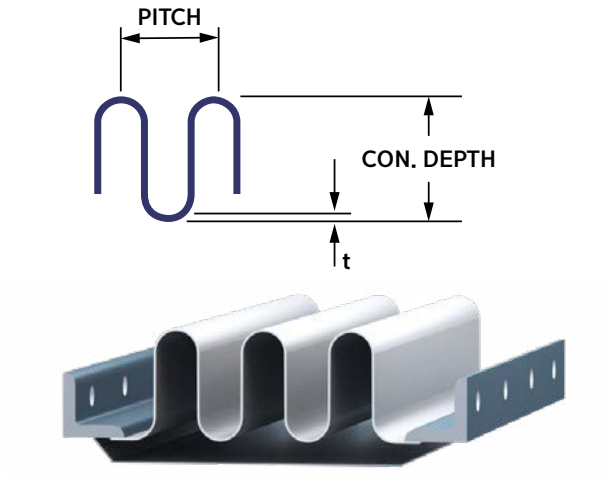
This type is used for low pressure applications. The "V" convolution profile will be supplied with single miter corner, unless otherwise specified.



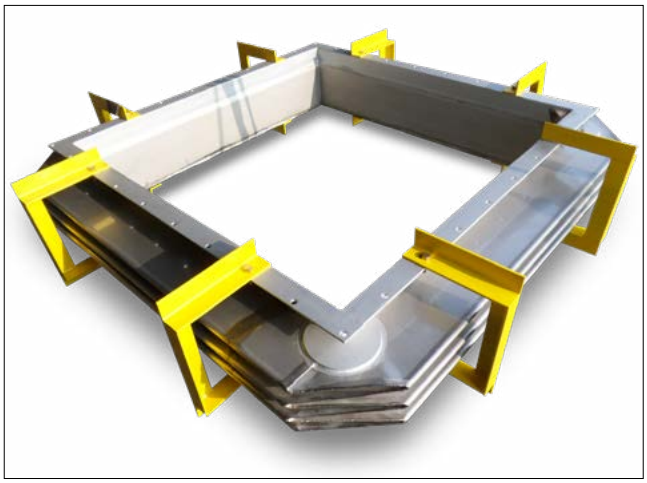
▲ *Shape of "V" Profile*

"U" Profile

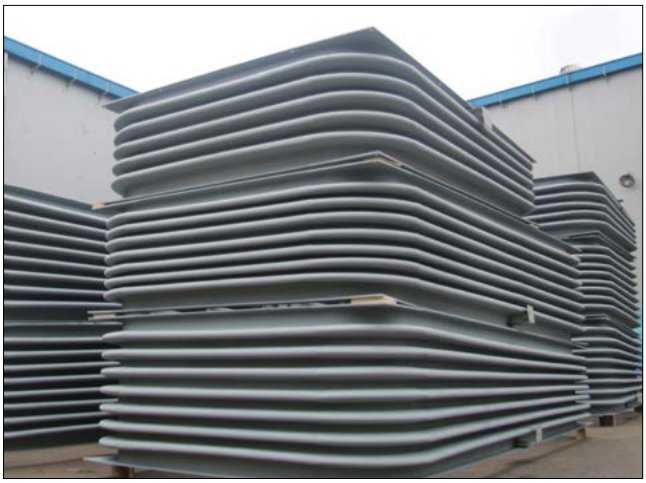
This type is preferred for higher pressure applications up to 30 P.S.I.G. Round corner bellows will always be constructed using the "U" convolution profile.



▲ *Shape of "U" Profile*



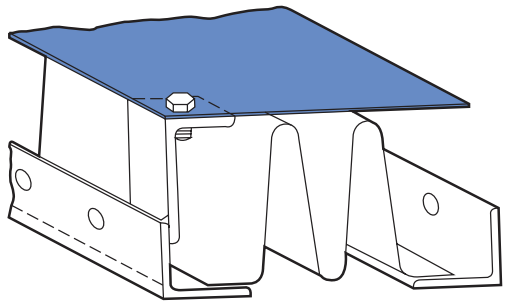
▲ *Camera Corner with "V" convolution profile*



▲ *Rounded Corner with "U" convolution profile*

Cover Application

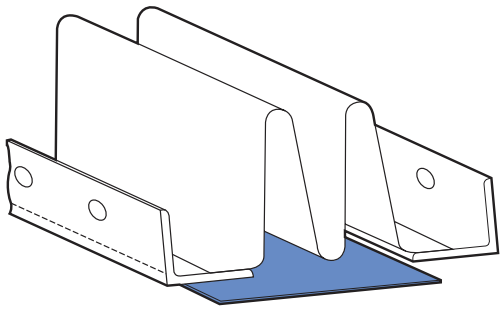
- To avoid accidental damage to the bellows while shipment, installation or operation.
- To protect the bellows from weld splatter, or other metal work



▲ *Cover*

Internal sleeve Application

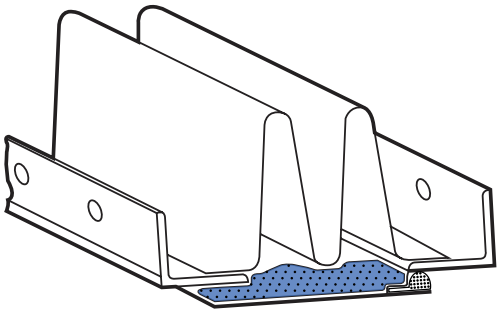
- Flow velocity is the above of 7~10m/sec and fluid is abrasive.
- **Advantage :** In high - temperature operation or rapid variation of temperature, the air barrier may be formed on space between bellows and liner and the rapid increasement of skin temp. On bellows can be avoided, which results in the reduction of circumferential stresses in the bellows. That cause buckling or rapid fatigue failure of the bellows.



▲ *Internal Sleeve*

Internal packing Application

- The protection against thermal shock and cracking occured in case that the rectangular expansion joint is subjected to the rapid temperature range. Normally, the packing reduce the skin temperature of bellows while operation.
- In the coal fired boiler flue gas line, the packing acts like filter to avoid fly ash from accumulating in the bellows convolution. The fly ash filled can affect severe chemical attack and immobilization of bellows motion.



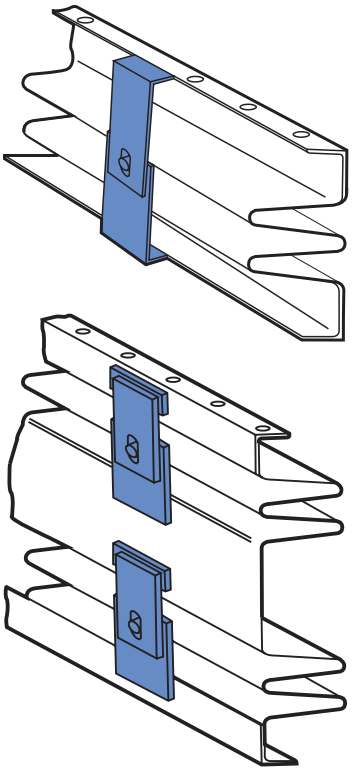
▲ *Internal Packing*

Insulation support

On outer insulation, it is often specified for the support of insulation material.

Hinges and slotted hinges Application

- As the support for the weight of the ducting between two single expansion joints
- As the controller suitable for axial and lateral offset in universal type expansion joint.



▲ *Hinges and Slotted Hinges*

Material

Megaflexon use following material on bellows fabrication (ASTM) A240 T304, A240 T304L, A240 T316, A240 T316L, A240 T321, B168 Alloy600, A606(corten)
A36, or A387 Gr 12 would be applied on flange, internal sleeve and inter-mediate duct pipe if required.

Quality Assurance

- All welding shall comply with ASME Section IX,latest edition.
- All dimensional tolerance shall be in compliance with EJMA Section VI.
- Quality assurance system is currently maintained according to ISO 9001:2015.
- If the leak-test specified on ASME B31.3 is not available due to dimension, the air jet leak examination shall be applied, which is specified on SectionVII in EJMA latest edition.

Design Standard

BELLOWS TYPE	MAX. WORKING PRESSURE	NO. OF CORRUGATION	TOTAL EXPANSION ABSORBED	LENGTH AS SUPPLIED				SPRING RATE
				SL50	SL65	SL75	SL100	
	kgf/cm^2	kgf/mm	mm					kg/mm
Miter, Round Corner Type	0.5	1	±20	160	190	210	260	0.032×ℓ
		2	±40	220	250	270	320	0.016×ℓ
		3	±60	280	310	330	380	0.011×ℓ
Camera Corner Type	0.5	2	±20	220	250	270	320	0.011×ℓ
		3	±30	280	310	330	380	0.008×ℓ
		5	±40	400	130	450	500	0.006×ℓ

Shipment

- The expansion joint shall be prepared for shipment in such a manner that the quality, cleanliness and finish shall be maintained during shipment.
- Shipping bar shall be equipped to maintain proper shipping length and alignment and shipping bars shall be painted yellow.
- Each expansion joint shall be tagged with recommended installation instruction.
- MEGAFLEXON provide lifting lugs in case that expansion joint weighing more than 200kgf. If more than one lug is furnished, each lug shall be designed to carry the entire weight of the assembly.

STANDARD METAL EXPANSION JOINTS

DATA SHEETS

A. Axial Expansion Joint

A-1	Axial Expansion Joints with Welding Ends	DN 100 to DN 1000	150Lbf/in^2
A-2	Axial Expansion Joints with Welding Ends	DN 100 to DN 600	300Lbf/in^2
A-3	Axial Expansion Joints with Fixed Flange Ends	DN 100 to DN 600	150Lbf/in^2
A-4	Axial Expansion Joints with Fixed Flange Ends	DN 100 to DN 600	300Lbf/in^2

B. Lateral Expansion Joint

B-1	Lateral Expansion Joints with Welding Ends	DN 100 to DN 1000	150Lbf/in^2
B-2	Lateral Expansion Joints with Welding Ends	DN 100 to DN 600	300Lbf/in^2
B-3	Lateral Expansion Joints with Fixed Flange Ends	DN 100 to DN 1000	150Lbf/in^2
B-4	Lateral Expansion Joints with Fixed Flange Ends	DN 100 to DN 600	300Lbf/in^2
B-5	Lateral Expansion Joints with Welding Ends	DN 100 to DN 1000	150Lbf/in^2
B-6	Lateral Expansion Joints with Welding Ends	DN 100 to DN 600	300Lbf/in^2
B-7	Lateral Expansion Joints with Fixed Flange Ends	DN 100 to DN 1000	150Lbf/in^2
B-8	Lateral Expansion Joints with Fixed Flange Ends	DN 100 to DN 600	300Lbf/in^2

C. Angular Expansion Joint

C-1	Angular Expansion Joints with Hinge and Welding Ends	DN 100 to DN 1000	150Lbf/in^2
C-2	Angular Expansion Joints with Hinge and Welding Ends	DN 100 to DN 600	300Lbf/in^2
C-3	Angular Expansion Joints with Hinge Fixed Flange Ends	DN 100 to DN 1000	150Lbf/in^2
C-4	Angular Expansion Joints with Hinge Fixed Flange Ends	DN 100 to DN 600	300Lbf/in^2

D. Gimbal Expansion Joint

D-1	Gimbal Expansion Joint with Welding Ends	DN 100 to DN 1000	150Lbf/in^2
D-2	Gimbal Expansion Joint with Welding Ends	DN 100 to DN 600	300Lbf/in^2
D-3	Gimbal Expansion Joint with Fixed Flange Ends	DN 100 to DN 1000	150Lbf/in^2
D-4	Gimbal Expansion Joint with Fixed Flange Ends	DN 100 to DN 600	300Lbf/in^2

Note: *Megaflexon can manufacture up to nominal size of 8000mm of metal expansion joint. Further detail of engineering with technical data can be provided upon request.*

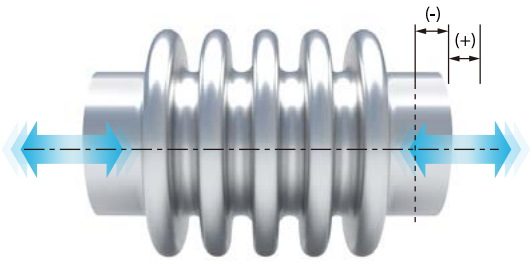
A

STANDARD METAL EXPANSION JOINTS

AXIAL EXPANSION JOINTS

MEGAFLEXON standard axial expansion joint are available in types MAXW, with weld ends, and MAXF with flanges. Axial Expansion joints are used in pipeline systems for absorption of movements along the longitudinal axis of the pipeline.
Megaflexon standard axial expansion joints are to be installed so that there is only 1 expansion joint between each fixing point. Pipeline systems where axial expansion joints are used must be protected against sideways bending. This is done by fitting guide types.

- **Advantage**
  - · Simple way to absorb thermal growth on pipe-work as per the temperature variation
  - · The flow direction unchanged
  - · The efficient way to save installation space
- **Disadvantage**
  - · The solid fix point required
  - · The good sliding bearing required for the movement axially
  - · A lot of fix points is required on a long pipe run



A-1, SINGLE JOINTS, FREE TYPE

Generally, the ends on both side can be fabricated as not only a fixed flange end or free type, but also butt weld end.

Application

This type of expansion joints is well fitted with low pressure gas pipe, exhaust pipe, duct, flue, etc, for the purpose of absorbing thermal growth and contraction, or preventing vibration in exhaust pipe of engine, blower, inlet and outlet of pump, and so on. Applicable pressure rating : max. 20 kgf/cm^2-full vacuum

▲ *Axial Expansion Joint with Welding Ends*

A-2, REINFORCED EXPANSION JOINT(CONTROL RING TYPE)

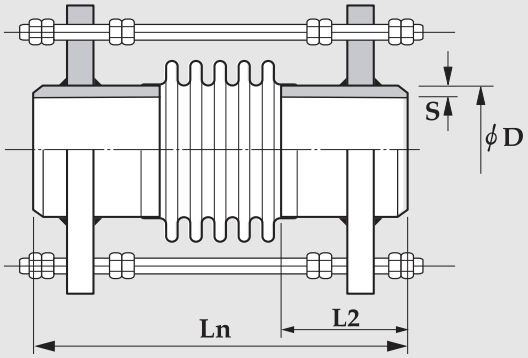
Normally, the reinforcing, or equalizing ring, is installed on the convolution root of bellows to reinforce the bellows against a high internal pressure.

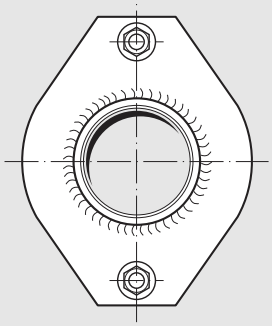
Megaflexon standard material for control ring : GC 20, SS400

- **Maximum service pressure : 40kgf/cm^2**
- **Maximum service temperature : 300 °C**
- **Test pressure : 1.5 x maximum service pressure**

▲ *Axial Expansion Joint with Fixed Flange Ends*

A-1 Axial Expansion Joints with Welding Ends





■ Design Pressure

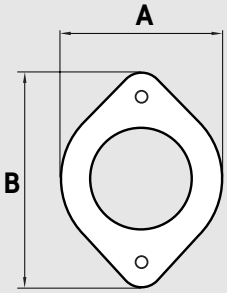
150Lbf/in²

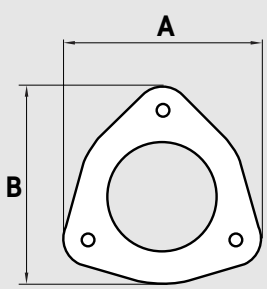
DN	TYPE	MOVEMENT		Ln	SPRING RATE		WELDING ENDS			BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
		+/- AX	+/- LA		AX	LA	øD	L2	S	Di	Do		
		mm	mm	mm	kgf/mm	kgf/mm	mm	mm	mm	mm	mm	cm²	kg
100	MAXW-0100-022-10	22	6	175	17.24	41.50	114.3	40	3.6	104.6	130.2	108.2	1.5
100	MAXW-0100-048-10	48	25	265	8.06	4.90	114.3	40	3.6	104.6	130.2	108.2	2.0
125	MAXW-0125-025-10	25	5	170	16.43	60.70	139.7	40	3.6	130.2	157.8	162.9	1.9
125	MAXW-0125-053-10	53	22	265	7.65	7.24	139.7	40	3.6	130.2	157.8	162.9	2.7
150	MAXW-0150-025-10	25	4	195	19.70	99.39	168.3	50	4.0	155.0	186.6	229.1	2.8
150	MAXW-0150-054-10	54	20	285	8.98	11.43	168.3	50	4.0	155.0	186.6	229.1	3.6
175	MAXW-0175-025-10	25	4	195	21.63	114.70	193.7	50	4.5	180.6	212.2	303.0	3.7
175	MAXW-0175-054-10	54	17	285	9.90	16.63	193.7	50	4.5	180.6	212.2	303.0	4.6
200	MAXW-0175-054-10	27	3	195	19.90	173.78	219.1	50	4.5	206.1	239.7	390.2	4.3
200	MAXW-0200-058-10	58	16	285	8.98	20.10	219.1	50	4.5	206.1	239.7	390.2	5.3
250	MAXW-0250-026-10	26	3	195	24.00	324.90	273.0	50	5.0	260.0	293.6	601.8	5.8
250	MAXW-0250-066-10	66	17	315	9.29	23.37	273.0	50	5.0	260.0	293.6	601.8	7.5
300	MAXW-0300-028-10	28	2	240	35.80	606.22	323.9	70	6.0	311.1	347.5	851.7	10.8
300	MAXW-0300-086-10	86	22	400	11.94	28.88	323.9	70	6.0	311.1	347.5	851.7	17.9
350	MAXW-0350-028-10	28	2	240	39.08	793.6	355.6	70	6.0	342.8	379.2	1023.5	13.1
350	MAXW-0350-086-10	86	20	400	12.96	37.76	355.6	70	6.0	342.8	379.2	1023.5	20.7
400	MAXW-0400-037-10	14	4	265	28.98	477.35	406.4	70	6.0	389.9	437.1	1342.9	17.2
400	MAXW-0400-096-10	30	22	430	11.12	34.18	406.4	70	6.0	389.9	437.1	1342.9	27.9
450	MAXW-0450-036-10	18	3	265	40.41	866.53	457.2	70	6.0	440.5	489.5	1698.2	19.1
450	MAXW-0450-084-10	38	15	390	18.37	96.02	457.2	70	6.0	440.5	489.5	1698.2	30.2
500	MAXW-0500-050-10	22	5	305	39.29	585.41	508	70	6.0	485.4	536.4	2050	22
500	MAXW-0500-110-10	47	23	465	17.86	67.04	508	70	6.0	485.4	536.4	2050	33.4
550	MAXW-0550-050-10	22	5	305	42.55	765.31	558.8	70	6.0	536.4	587.4	2479.8	25.7
550	MAXW-0500-088-10	48	14	410	23.57	153.47	558.8	70	6.0	536.4	587.4	2479.8	31.0
600	MAXW-0600-041-10	25	3	275	72.24	2217.04	609.6	70	6.0	585.6	645.6	2976.4	30.1
600	MAXW-0600-124-10	53	22	480	24.08	119.39	609.6	70	6.0	585.6	645.6	2976.4	49.6
700	MAXW-0700-040-10	25	2	280	70.10	2838.57	711.2	70	8.0	687.5	756.5	4094.2	39.9
700	MAXW-0700-121-10	54	19	485	23.37	153.37	711.2	70	8.0	687.5	756.5	4094.2	67.2
800	MAXW-0800-040-10	25	2	280	76.73	4040.82	812.8	70	8.0	789.5	858.5	5332.7	49.1
800	MAXW-0800-121-10	54	16	485	25.65	218.37	812.8	70	8.0	789.5	858.5	5332.7	80.2
900	MAXW-0900-040-10	27	2	280	84.18	5580.61	914.4	70	8.0	890.5	959.5	6720.1	55.1
900	MAXW-0900-121-10	58	15	485	28.06	301.53	914.4	70	8.0	890.5	959.5	6720.1	90.1
1000	MAXW-1000-040-10	26	2	280	91.94	7513.47	1016.0	70	8.0	992.5	1061.5	8283.8	61.3
1000	MAXW-1000-121-10	66	13	485	30.61	406.02	1016.0	70	8.0	992.5	1061.5	8283.8	100.1

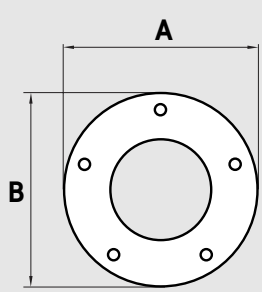
■ Number of Tie Rods

DN 40 - DN 100 : 2 PCS
DN 125 - DN 800 : 3 PCS
DN 900 : 4 PCS
DN 1000 : 5 PCS

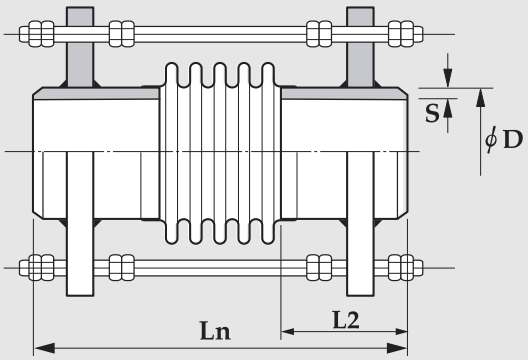
** The number of tie rods can be changed according to design conditions.*

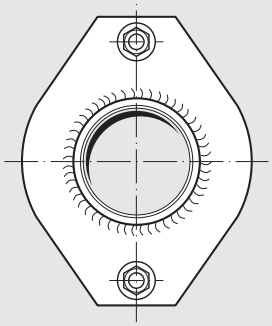






A-2 Axial Expansion Joints with Welding Ends





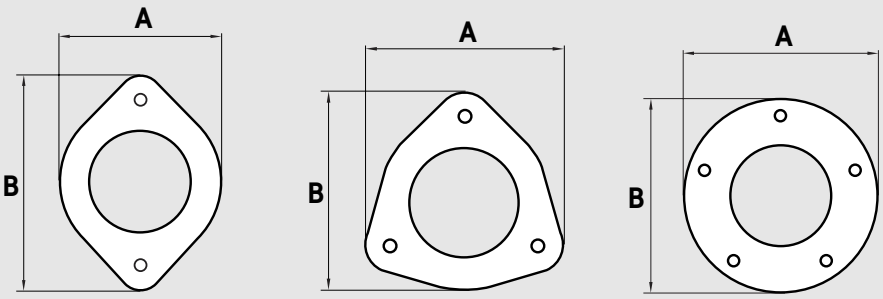
■ Design Pressure

300Lbf/in²

DN	TYPE	MOVEMENT		Ln	SPRING RATE		WELDING ENDS			BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
		+/- AX	+/- LA		AX	LA	øD	L2	S	Di	Do		
		mm	mm	mm	kgf/mm	kgf/mm	mm	mm	mm	mm	mm	cm^2	kg
100	MAXW-0100-016-20	16	3.0	205	37.35	139.18	114.3	40	3.6	104.6	131.0	109.0	1.6
100	MAXW-0100-035-20	35	14.0	280	17.04	16.02	114.3	40	3.6	104.6	131.0	109.0	2.2
125	MAXW-0125-016-20	16	3.0	210	43.37	238.27	139.7	40	4.0	130.2	156.6	161.5	2.1
125	MAXW-0125-040-20	40	16.0	310	16.63	17.04	139.7	40	4.0	130.2	156.6	161.5	3.1
150	MAXW-0150-023-20	23	5.0	255	50.92	20.33	168.3	50	4.5	155.0	186.2	228.6	3.7
150	MAXW-0150-050-20	50	20.0	360	23.16	23.27	168.3	50	4.5	155.0	186.2	228.6	5.2
175	MAXW-0175-023-20	23	4.0	255	55.10	289.90	193.7	50	5.6	180.6	211.8	302.3	4.7
175	MAXW-0175-050-20	50	18.0	360	25.00	33.16	193.7	50	5.6	180.6	211.8	302.3	6.4
200	MAXW-0200-028-20	28	4.0	270	52.80	347.55	219.1	50	6.3	206.2	242.2	394.8	6.7
200	MAXW-0200-063-20	63	20.0	380	23.98	38.98	219.1	50	6.3	206.2	242.2	394.8	9.4
250	MAXW-0200-028-20	28	3.0	285	61.12	603.12	273.0	50	7.1	260.3	296.3	608.3	8.8
250	MAXW-0250-060-20	60	16.0	395	27.26	69.18	273.0	50	7.1	260.3	296.3	608.3	12.3
300	MAXW-0300-024-20	24	2.0	295	88.98	1249.69	323.9	70	8.0	311.2	349.2	856.3	13.9
300	MAXW-0300-042-20	42	8.0	365	49.39	251.94	323.9	70	8.0	311.2	349.2	856.3	16.7
350	MAXW-0350-023-20	23	2.0	310	96.84	163.53	355.6	70	8.0	343.0	381.0	1029.2	15.3
350	MAXW-0350-042-20	42	7.0	380	53.77	331.02	355.6	70	8.0	343.0	381.0	1029.2	18.4
400	MAXW-0400-023-20	23	1.8	235	136.02	3807.04	406.4	70	10.0	390.4	440.4	1355.3	22.2
400	MAXW-0400-040-20	40	2.0	365	81.73	1022.35	406.4	70	10.0	390.4	440.4	1355.3	24.0
450	MAXW-0450-023-20	23	1.6	240	156.32	5132.24	457.2	70	10.0	441.5	494.5	1720.2	27.0
450	MAXW-0450-039-20	39	4.0	290	93.78	1378.37	457.2	70	10.0	441.5	494.5	1720.2	29.7
500	MAXW-0500-032-20	32	2.6	365	162.55	4154.18	508.0	70	10.0	486.5	541.5	2075.0	30.7
500	MAXW-0500-054-20	54	6.0	300	97.55	1112.96	508.0	70	10.0	486.5	541.5	2075.0	36.6
550	MAXW-0550-032-20	32	2.4	265	172.04	5309.59	558.8	70	10.0	537.8	592.8	2509.9	33.8
550	MAXW-0550-053-20	53	6.0	330	103.27	1422.55	558.8	70	10.0	537.8	592.8	2509.9	40.3
600	MAXW-0600-042-20	42	3.5	295	180.10	4241.63	609.6	70	12.0	586.6	651.6	3010.3	252.1
600	MAXW-0600-070-20	70	8.0	485	107.96	1135.41	609.6	70	12.0	586.6	651.6	3010.3	61.3

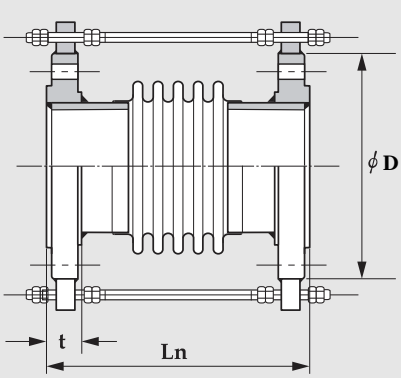
■ Number of Tie Rods

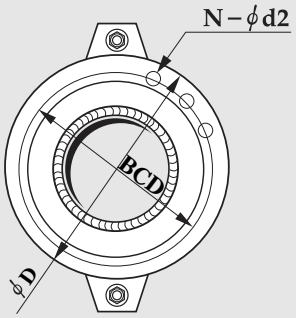
DN 40 - DN 100 : 2 PCS
DN 125 - DN 450 : 3 PCS
DN 500 - DN 600 : 4 PCS



** The number of tie rods can be changed according to design conditions.*

A-3 Axial-Expansion Joints with Fixed Flange Ends





■ Design Pressure

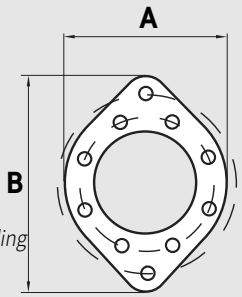
150Lbf/in²

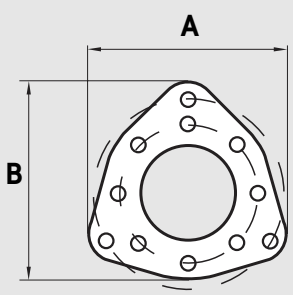
DN	TYPE	MOVEMENT		Ln	SPRING RATE		FLANGES ACC. TO ASME B 16.5					BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
		+/- AX	+/- LA		AX	LA	øD	t	PCD	N	ød2	Di	Do		
		mm	mm	mm	kgf/mm	kgf/mm	mm	mm	mm	EA	mm	mm	mm	cm²	kg
100	MAXF-0100-022-10	22	6	135	17.24	10.92	229	24.0	190.5	8	20	104.6	130.2	108.2	8.8
100	MAXF-0100-048-10	48	25	225	8.06	4.90	229	24.0	190.5	8	20	104.6	130.2	108.2	9.3
125	MAXF-0125-025-10	25	5	135	16.43	60.71	254	24.0	215.9	8	23	130.2	157.8	162.9	11.7
125	MAXF-0125-053-10	53	22	230	7.65	7.24	254	24.0	215.9	8	23	130.2	157.8	162.9	12.5
150	MAXF-0150-025-10	25	4	140	19.69	99.39	279	25.5	241.3	8	23	155.0	186.6	229.1	14.0
150	MAXF-0150-054-10	54	20	230	8.78	11.43	279	25.5	241.3	8	23	155.0	186.6	229.1	14.8
200	MAXF-0200-027-10	27	3	145	19.90	173.78	343	29.0	298.4	8	23	206.1	239.7	390.2	19.9
200	MAXF-0200-058-10	58	16	235	8.98	20.10	343	29.0	298.4	8	23	206.1	239.7	390.2	20.9
250	MAXF-0250-026-10	26	3	145	24.08	324.90	406	30.5	361.9	12	26	260.0	293.6	601.8	25.4
250	MAXF-0250-066-10	66	17	265	9.29	23.37	406	30.5	361.9	12	26	260.0	293.6	601.8	27.1
300	MAXF-0300-028-10	28	2	150	35.82	606.22	483	32.0	431.8	12	26	311.1	347.5	851.7	30.5
300	MAXF-0300-086-10	86	22	310	11.94	28.88	483	32.0	431.8	12	26	311.1	347.5	851.7	37.6
350	MAXF-0350-028-10	28	2	155	39.08	793.16	535	35.0	476.2	12	29	342.8	379.2	1023.5	44.5
350	MAXF-0350-086-10	86	20	315	12.96	37.76	535	35.0	476.2	12	29	342.8	379.2	1023.5	52.1
400	MAXF-0400-037-10	37	4	190	28.98	477.35	595	37.0	539.7	16	29	389.9	437.1	1342.9	61.8
400	MAXF-0400-096-10	96	22	355	11.12	34.18	595	37.0	539.7	16	29	389.9	437.1	1342.9	72.5
450	MAXF-0450-036-10	36	3	200	40.41	866.53	635	40.0	577.8	16	32	440.5	489.5	1698.2	77.7
450	MAXF-0450-084-10	84	15	325	18.37	96.02	635	40.0	577.8	16	32	440.5	489.5	1698.2	88.8
500	MAXF-0500-050-10	50	5	240	39.29	585.41	700	43.0	635.0	20	32	485.4	536.4	2050.0	90.1
500	MAXF-0500-110-10	110	23	400	17.86	67.04	700	43.0	635.0	20	32	485.4	536.4	2050.0	101.5
600	MAXF-0500-041-10	41	3	295	103.23	3160.24	815	48.0	749.3	20	35	585.6	645.6	2976.4	99.7
600	MAXF-0500-124-10	124	22	500	34.39	170.61	815	48.0	749.3	20	35	585.6	645.6	2976.4	120.2

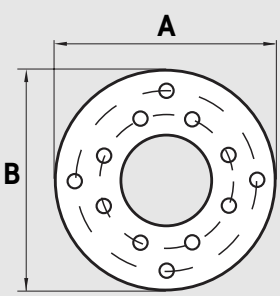
■ Number of Tie Rods

DN 40 - DN 100 : 2 PCS
DN 125 - DN 800 : 3 PCS
DN 900 : 6 PCS
DN 1000 : 7 PCS

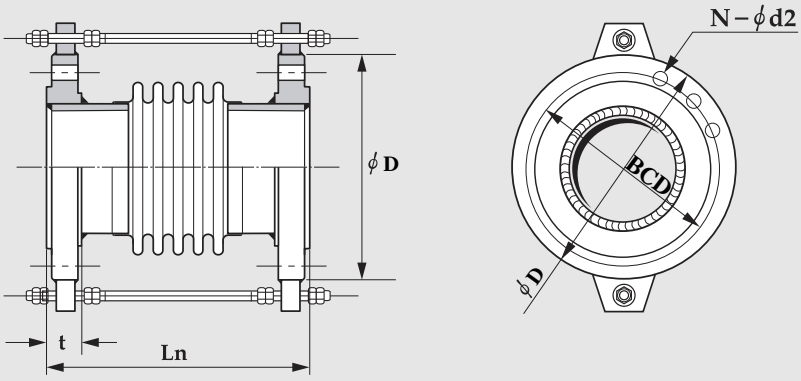
** The number of tie rods can be changed according to design conditions.*







A-4 Axial-Expansion Joints with Fixed Flange Ends



■ Design Pressure

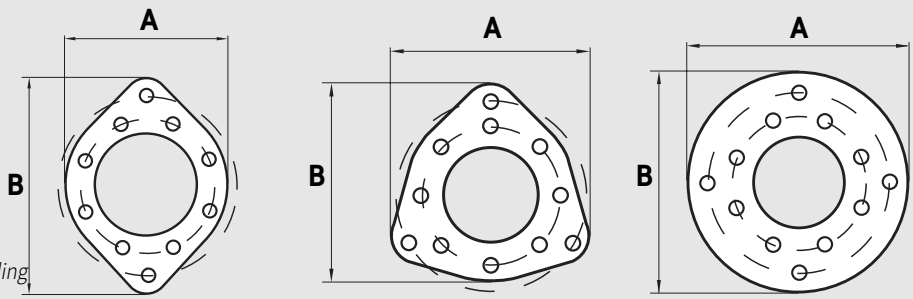
300Lbf/in²

DN	TYPE	MOVEMENT		Ln	SPRING RATE		FLANGES ACC. TO ASME B 16.5					BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
		+/- AX	+/- LA		AX	LA	øD	t	PCD	N	ød2	Di	Do		
		mm	mm	mm	kgf/mm	kgf/mm	mm	mm	mm	EA	mm	mm	mm	cm²	kg
100	MAXF-0100-016-20	16	3	205	7.35	139.18	254	32.0	200.0	8	23	104.6	131.0	109.0	13.8
100	MAXF-0100-035-20	35	14	280	17.04	16.02	254	32.0	200.0	8	23	104.6	131.0	109.0	14.4
125	MAXF-0125-016-20	16	3	210	43.37	238.30	279	35.0	234.9	8	23	130.2	156.6	161.5	19.1
125	MAXF-0125-040-20	40	16	310	16.63	17.04	279	35.0	234.9	8	23	130.2	156.6	161.5	20.1
150	MAXF-0150-023-20	23	5	255	50.92	203.27	318	37.0	269.9	12	23	155.0	186.2	228.6	25.4
150	MAXF-0150-050-20	50	20	360	23.16	23.27	318	37.0	269.9	12	23	155.0	186.2	228.6	26.9
200	MAXF-0200-028-20	28	4	270	52.86	347.55	381	41.5	330.2	12	26	206.2	242.2	394.8	37.3
200	MAXF-0200-063-20	63	20	380	23.98	38.98	381	41.5	330.2	12	26	206.2	242.2	394.8	40.0
250	MAXF-0250-028-20	28	3	285	61.12	603.16	445	48.0	387.3	16	29	260.3	296.3	608.3	52.9
250	MAXF-0250-060-20	60	16	395	27.76	69.18	445	48.0	387.3	16	29	260.3	296.3	608.3	56.4
300	MAXF-0300-024-20	24	2	295	88.98	1249.69	520	51.0	450.8	16	32	311.2	349.2	856.3	67.4
300	MAXF-0300-042-20	42	8	365	49.39	251.74	520	51.0	450.8	16	32	311.2	349.2	856.3	70.2
350	MAXF-0350-023-20	23	2	310	96.84	163.53	585	54.0	514.3	20	32	343.0	381.0	1029.2	99.9
350	MAXF-0350-042-20	42	7	380	53.78	328.98	585	54.0	514.3	20	32	343.0	381.0	1029.2	103.0
400	MAXF-0400-023-20	23	1.8	235	136.22	3807.04	650	57.5	571.5	20	35	390.4	440.4	1355.3	133.3
400	MAXF-0400-040-20	40	2	265	81.73	1022.35	650	57.5	571.5	20	35	390.4	440.4	1355.3	135.1
500	MAXF-0500-032-20	32	2.6	265	172.04	4154.18	775	63.5	685.8	24	35	486.5	541.5	2075.0	192.4
500	MAXF-0500-054-20	54	6	440	97.55	1112.96	775	63.5	685.8	24	35	486.5	541.5	2075.0	198.3
600	MAXF-0600-042-20	42	3.5	295	180.10	4241.63	915	70.0	812.8	24	42	586.6	651.6	3010.3	236.9
600	MAXF-0600-070-20	70	8	485	107.96	1135.41	915	70.0	812.8	24	42	586.6	651.6	3010.3	246.1

■ Number of Tie Rods

DN 40 - DN 100 : 2 PCS
DN 125 - DN 600 : 3 PCS
DN 700 : 4 PCS
DN 900 : 6 PCS
DN 1000 : 7 PCS

** The number of tie rods can be changed according to design conditions.*



B

STANDARD METAL EXPANSION JOINTS

LATERAL EXPANSION JOINTS

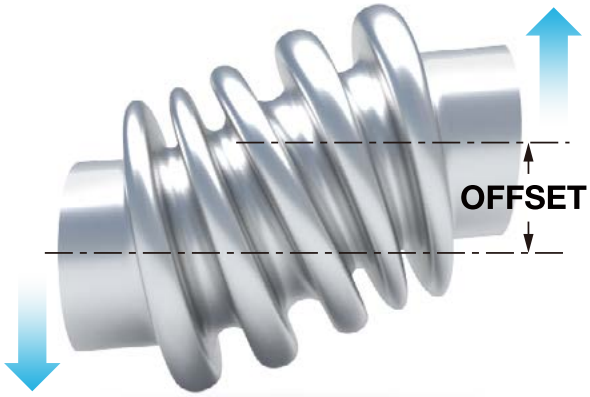
Megaflexon standard lateral expansion joints are available in two designs. The light design, type MLW, MLF, has tie rods which are secured to the flanges by means of nuts and a specially designed spherical disk, allowing angular movement between bolt and flange.
The number of tie rods is dependent on diameter and pressure. MEGAFLEXON standard lateral expansion joint with tie rods is available in a design with single or double tie rods.
The design with tie rods can only be used within a limited pressure range and a temperature range(max. 400°C).
Common to both models is the fact that tie rods and hinges alike have the task of absorbing the thrust forces arising from the operating pressure. The tie rods and hinges make axial expansion impossible.
This means that a lateral expansion joint can only move sideways(laterally) on one or more planes, making it possible for those movements which are perpendicular to the longitudinal direction to be absorbed. Lateral expansion joints are therefore ideal for installation in pipe systems with bends.

● ADVANTAGE

· Absorb thermal growth in all direction in one plane
· A largely reduced load on fix point

● DISADVANTAGE

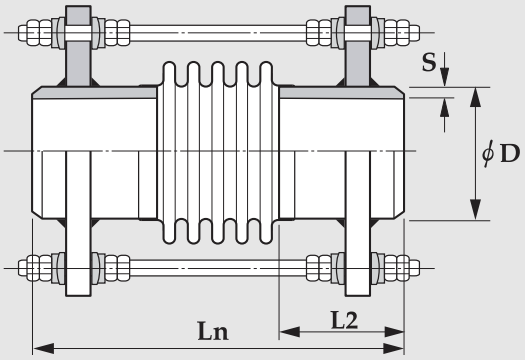
· The changed flow direction

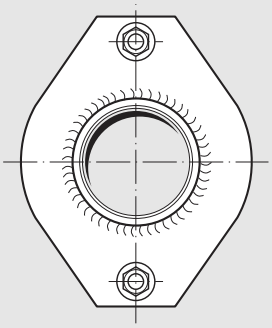


▲ *Lateral Expansion Joint with Welding Ends*

▲ *Lateral Expansion Joint with Fixed Flange Ends*

B-1 Lateral Expansion Joints with Welding Ends





■ Design Pressure

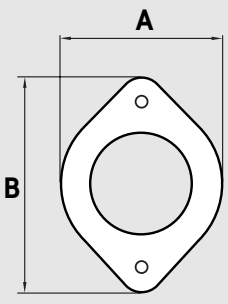
150Lbf/in²

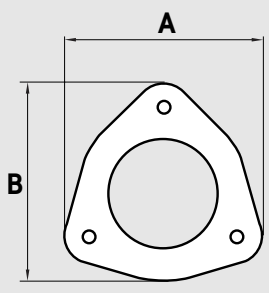
DN	TYPE	MOVEMENT	Ln	SPRING RATE		WELDING ENDS			DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
		+/- LA		AX	LA	øD	L2	S	A	B	Di	Do		
		mm	mm	kgf/mm	kgf/mm	mm	mm	mm	mm	mm	mm	mm	cm²	kg
100	MLWS-0100-025-10	25	475	8.06	4.89	114.3	145	3.6	175	245	104.6	130.2	108.2	9.9
125	MLWS-0125-022-10	22	475	7.65	7.24	139.7	145	4.0	239	235	130.2	157.8	162.9	13.2
150	MLWS-0150-020-10	20	475	8.97	11.42	168.3	145	4.5	260	262	155.0	186.6	229.1	15.4
175	MLWS-0175-017-10	17	475	9.89	16.63	193.7	145	5.6	282	295	180.6	212.2	303.0	22.1
200	MLWS-0200-016-10	16	525	8.97	20.10	219.1	170	5.6	303	312	206.1	239.7	390.2	22.2
250	MLWS-0250-017-10	17	555	9.28	23.36	273.0	170	6.3	347	368	260.0	293.6	601.8	29.2
300	MLWS-0300-022-10	22	600	11.93	28.87	323.9	170	8.0	400	423	311.1	347.5	851.7	46.9
350	MLWS-0350-020-10	20	600	12.95	37.75	355.6	170	8.0	435	460	342.8	379.2	1023.5	56.6
400	MLWS-0400-022-10	22	630	11.12	34.18	404.6	170	8.0	506	528	389.9	437.1	1342.9	78.8
450	MLWS-0450-015-10	15	590	18.36	96.02	457.2	170	8.0	600	600	440.5	489.5	1698.2	99.3
500	MLWS-0500-023-10	23	775	17.85	67.04	508.0	225	8.0	675	675	485.4	536.4	2050.0	148.9
550	MLWS-0550-014-10	14	720	23.57	153.46	558.8	225	10.0	725	725	536.4	587.4	2479.8	157.8
600	MLWS-0600-022-10	22	790	24.08	119.38	609.6	225	10.0	790	790	585.6	645.6	2976.4	210.9
700	MLWS-0700-019-10	19	905	23.36	153.36	711.2	280	10.0	905	905	687.5	756.5	4094.2	306.8
800	MLWS-0800-016-10	16	905	25.61	218.36	812.8	280	10.0	1010	1010	789.5	858.5	5332.7	383.2
900	MLWS-0900-015-10	15	905	28.06	301.53	914.4	280	10.0	1105	1105	890.5	959.5	6720.1	448.8
1000	MLWS-1000-013-10	13	905	30.61	406.02	1016.0	280	10.0	1210	1210	992.5	1061.5	8283.8	504.7

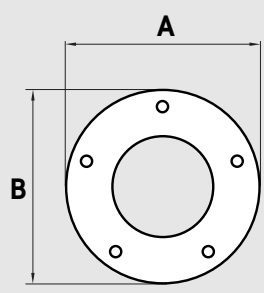
■ Number of Tie Rods

DN 40 - DN 100 : 2 PCS
DN 125 - DN 800 : 3 PCS
DN 900 : 4 PCS
DN 1000 : 5 PCS

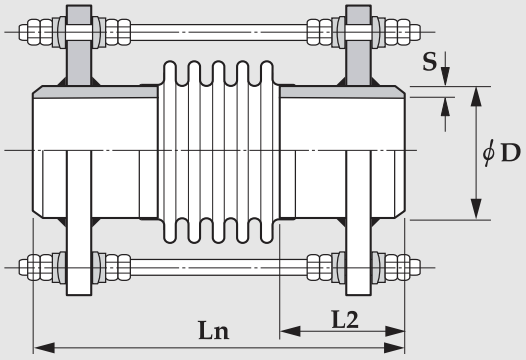
** The number of tie rods can be changed according to design conditions.*

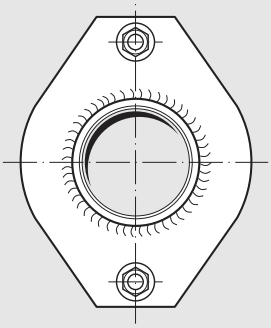






B-2 Lateral Expansion Joints with Welding Ends





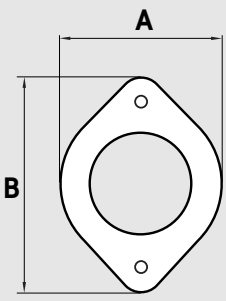
■ Design Pressure

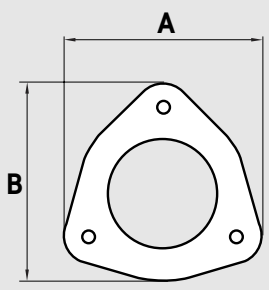
300Lbf/in²

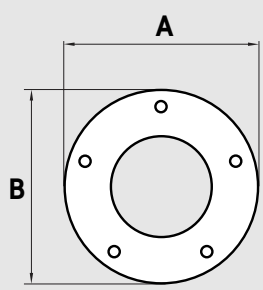
DN	TYPE	MOVEMENT	Ln	SPRING RATE		WELDING ENDS			DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
		+/- LA		AX	LA	øD	L2	S	A	B	Di	Do		
		mm	mm	kgf/mm	kgf/mm	mm	mm	mm	mm	mm	mm	mm	cm²	kg
100	MLWS-0100-014-20	25	440	17.04	16.02	114.3	145	3.6	175	230	104.6	131.0	109.0	9.7
125	MLWS-0125-016-20	22	465	16.63	17.04	139.7	145	4.0	226	228	130.2	156.6	161.5	13.1
150	MLWS-0150-020-20	20	500	23.16	23.26	168.3	145	4.5	256	269	155.0	186.2	228.6	20.4
175	MLWS-0175-018-20	17	500	25.00	33.16	193.7	145	5.6	278	294	180.6	211.8	302.3	24.2
200	MLWS-0200-020-20	16	560	23.97	38.97	219.1	170	6.3	313	328	206.2	242.2	394.8	31.3
250	MLWS-0250-016-20	17	560	27.75	69.18	273.0	170	7.1	405	405	260.3	296.3	608.3	54.0
300	MLWS-0300-008-20	22	630	49.38	251.93	323.9	225	8.0	480	480	311.2	349.2	856.3	88.9
350	MLWS-0350-007-20	20	630	53.77	328.97	355.6	225	8.0	510	510	343.0	381.0	1029.2	98.6
400	MLWS-0400-013-20	22	690	45.40	205.61	404.6	225	10.0	580	580	390.4	440.4	1355.3	138.8
450	MLWS-0450-012-20	15	810	52.04	277.24	457.2	280	10.0	650	650	441.5	494.5	1720.2	199.5
500	MLWS-0500-012-20	23	810	69.69	448.26	508.0	280	10.0	695	695	486.5	541.5	2075.0	223.8
550	MLWS-0550-011-20	14	810	73.67	572.85	558.8	280	10.0	750	750	537.8	592.8	2509.9	273.2
600	MLWS-0600-016-20	22	875	77.14	457.04	609.6	280	12.0	805	805	586.6	651.6	3010.3	319.0

■ Number of Tie Rods

DN 40 - DN 100 : 2 PCS
DN 125 - DN 450 : 3 PCS
DN 500 - DN 600 : 4 PCS

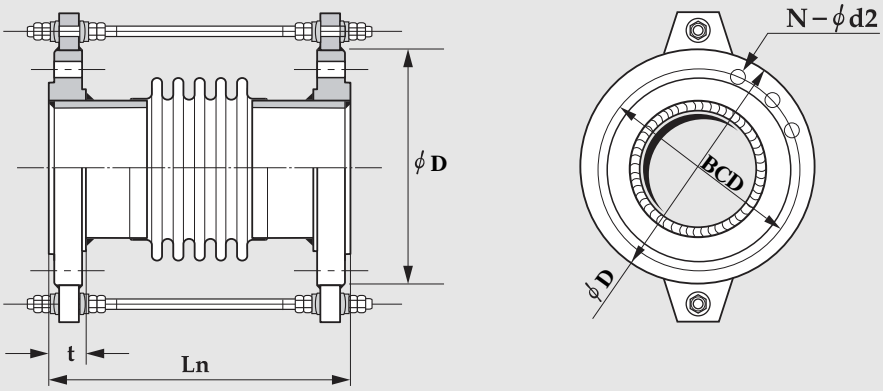






** The number of tie rods can be changed according to design conditions.*

B-3 Lateral Expansion Joints with Fixed Flange Ends



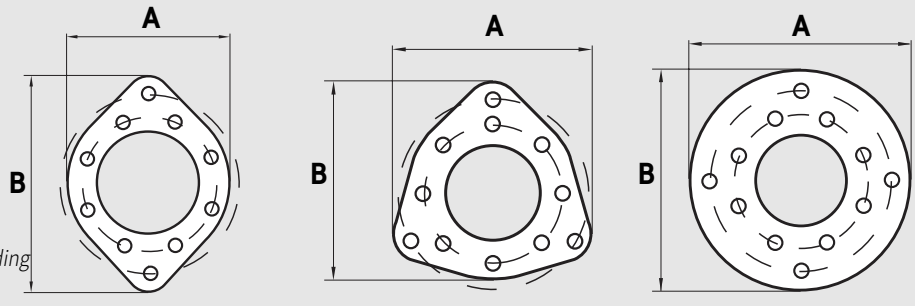
■ Design Pressure

150Lbf/in²

DN	TYPE	MOVEMENT	Ln	SPRING RATE		FLANGES ACC. TO ASME STD.					DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
		+/- LA		AX	LA	øD	PCD	t	N	ød2	A	B	Di	Do		
		mm	mm	kgf/mm	kgf/mm	mm	mm	mm	EA	mm	mm	mm	cm²	kg	cm²	kg
100	MLFS-0100-025-10	25	225	8.06	4.89	229	190.5	24.0	8	20.0	220	295	104.6	130.2	108.2	8.3
125	MLFS-0125-022-10	22	225	7.65	7.24	254	215.9	24.0	8	23.0	287	288	130.2	157.8	162.9	10.9
150	MLFS-0150-020-10	20	230	8.97	11.42	279	241.3	25.5	8	23.0	317	323	155.0	186.6	229.1	12.3
200	MLFS-0200-016-10	16	230	8.97	20.10	343	298.4	29.0	8	23.0	360	378	206.1	239.7	390.2	15.4
250	MLFS-0250-017-10	17	265	9.28	23.36	406	361.9	30.5	12	26.0	412	433	260.0	293.6	601.8	23.8
300	MLFS-0300-022-10	22	310	11.93	28.87	483	431.8	32.0	12	26.0	455	483	311.1	347.5	851.7	33.3
350	MLFS-0350-020-10	20	315	12.95	37.75	535	476.2	35.0	12	29.0	521	550	342.8	379.2	1023.5	43.6
400	MLFS-0400-022-10	22	355	11.12	34.18	595	539.7	37.0	16	29.0	573	610	389.9	437.1	1342.9	64.4
450	MLFS-0450-015-10	15	325	18.36	96.02	635	577.8	40.0	16	32.0	616	660	440.5	489.5	1698.2	68.8
500	MLFS-0500-023-10	23	400	17.85	67.04	700	635.0	43.0	20	32.0	693	730	485.4	536.4	2050.0	96.5
600	MLFS-0600-022-10	22	500	34.38	170.61	815	749.3	43.0	20	35.0	780	840	585.6	645.6	2976.4	138.6
700	MLFS-0700-019-10	19	505	33.36	219.08	927.1	863.6	71.0	24	35.0	896	965	687.5	756.5	4094.2	182.4
800	MLFS-0800-016-10	16	525	36.53	311.93	1060	978.0	81.0	28	41.0	1015	1080	789.5	858.5	5332.7	238.5
900	MLFS-0900-015-10	15	535	40.10	430.71	1168.4	1085.0	90.0	32	41	1115	1255	890.5	959.5	6720.1	274.9
1000	MLFS-1000-013-10	13	535	43.77	580.00	1289	1200.0	90.0	36	41	1306	1300	992.5	1061.5	8283.8	325.7

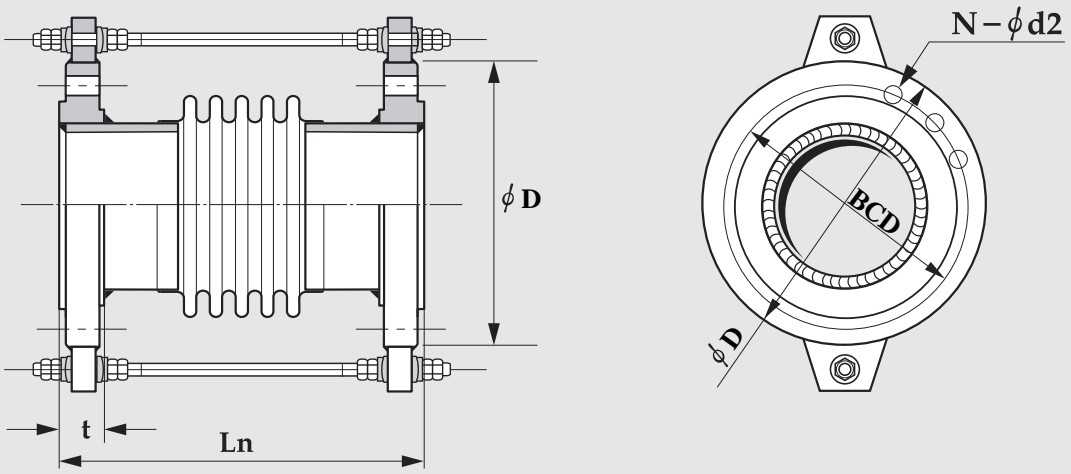
■ Number of Tie Rods

DN 40 - DN 100 : 2 PCS
DN 125 - DN 800 : 3 PCS
DN 900 : 6 PCS
DN 1000 : 7 PCS



** The number of tie rods can be changed according to design conditions.*

B-4 Lateral Expansion Joints with Fixed Flange Ends



■ Design Pressure

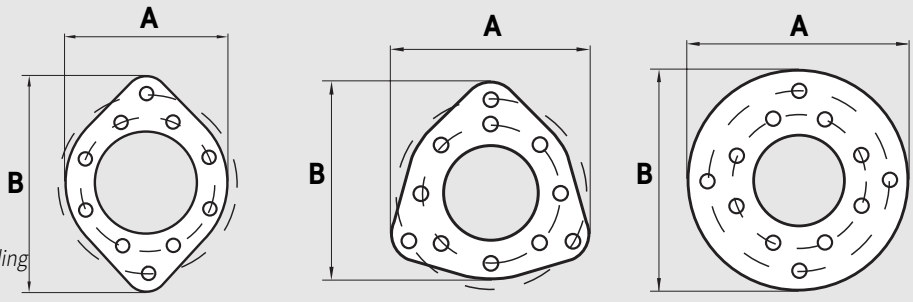
300Lbf/in²

DN	TYPE	MOVEMENT	Ln	SPRING RATE		FLANGES ACC. TO ASME B 16.5					DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
		+/- LA		AX	LA	øD	PCD	t	N	ød2	A	B	Di	Do		
		mm	mm	kgf/mm	kgf/mm	mm	mm	mm	EA	mm	mm	mm	mm	mm	cm²	kg
100	MLFS-0100-014-20	14	200	17.04	16.02	254	200.0	32.0	8	23.0	235	310	104.6	131.0	109.0	14.4
125	MLFS-0125-016-20	16	225	16.63	17.04	279	234.9	35.0	8	23.0	304	308	130.2	156.6	161.5	20.1
150	MLFS-0150-020-20	20	265	23.16	23.26	318	269.9	37.0	12	23.0	330	337	155.0	186.2	228.6	26.9
200	MLFS-0200-020-20	20	380	23.97	38.97	381	330.2	41.5	12	26.0	395	405	206.2	242.2	394.8	40.0
250	MLFS-0250-016-20	16	395	27.75	69.18	445	387.3	48.0	16	29.0	452	470	260.3	296.3	608.3	56.4
300	MLFS-0300-008-20	8	365	49.38	251.93	520	450.8	51.0	16	32.0	532	545	311.2	349.2	856.3	70.2
350	MLFS-0350-007-20	7	380	53.77	328.97	585	514.3	54.0	20	32.0	593	615	343.0	381.0	1029.2	103.0
400	MLFS-0400-013-20	13	460	45.40	205.61	650	571.5	57.5	20	35.0	649	680	390.4	440.4	1355.3	142.3
500	MLFS-0500-012-20	12	500	69.69	448.26	775	685.8	63.5	24	35.0	763	800	486.5	541.5	2075.0	204.9
600	MLFS-0600-016-20	16	565	77.14	457.04	915	812.8	70.0	24	42.0	845	985	586.6	651.6	3010.3	233.0

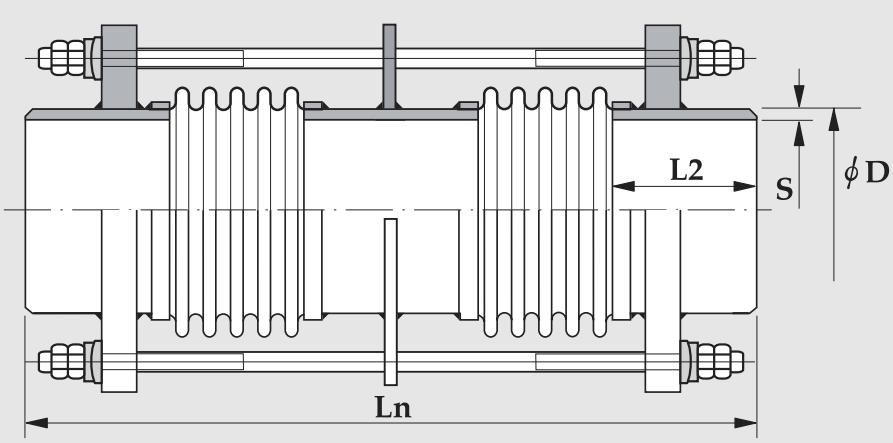
■ Number of Tie Rods

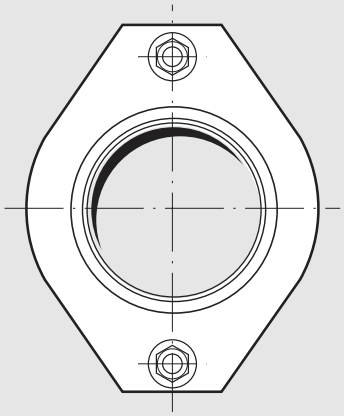
DN 40 - DN 100 : 2 PCS
DN 125 - DN 600 : 3 PCS
DN 700 : 4 PCS
DN 900 : 6 PCS
DN 1000 : 7 PCS

** The number of tie rods can be changed according to design conditions.*



B-5 Lateral Expansion Joints with Welding Ends





■ Design Pressure

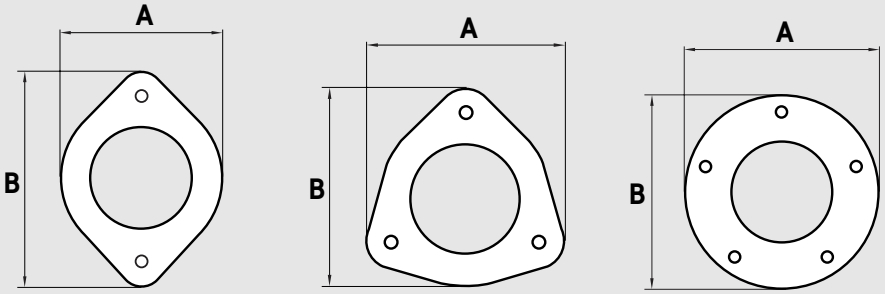
150Lbf/in²

DN	TYPE	MOVEMENT +/- LA	Ln	SPRING RATE		WELDING ENDS			DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
				AX	LA	øD	L2	S	A	B	Di	Do		
		mm	mm	kgf/mm	kgf/mm	mm	mm	mm	EA	mm	mm	mm	cm²	kg
100	MLWD-0100-075-10	75	645	8.67	0.81	114.3	145	3.6	175	245	104.6	130.2	108.2	13.5
125	MLWD-0125-075-10	75	660	8.26	1.12	139.7	145	4.0	239	235	130.2	157.8	162.9	18.5
150	MLWD-0150-075-10	75	700	9.79	1.42	168.3	145	4.5	260	262	155.0	186.6	229.1	22.8
175	MLWD-0175-075-10	75	745	10.81	1.63	193.7	145	5.6	282	295	180.6	212.2	303.0	32.7
200	MLWD-0200-075-10	75	805	9.89	1.83	219.1	170	5.6	303	312	206.1	239.7	390.2	34.6
250	MLWD-0250-055-10	55	765	12.04	4.18	273.0	170	6.3	347	368	260.0	293.6	601.8	43.0
300	MLWD-0300-055-10	55	780	17.95	8.36	323.9	170	8.0	400	423	311.1	347.5	851.7	63.0
350	MLWD-0350-055-10	55	815	19.48	8.97	355.6	170	8.0	435	460	342.8	379.2	1023.5	79.9
400	MLWD-0400-055-10	55	748	14.48	16.22	404.6	170	8.0	506	528	389.9	437.1	1342.9	98.9
450	MLWD-0450-055-10	55	805	20.20	19.08	457.2	170	8.0	600	600	440.5	489.5	1698.2	128.5
500	MLWD-0500-055-10	55	910	19.69	29.18	508.0	225	8.0	675	675	485.4	536.4	2050.0	176.8
550	MLWD-0550-055-10	55	945	21.22	30.51	558.8	225	10.0	725	725	536.4	587.4	2479.8	202.7
600	MLWD-0600-055-10	55	1005	36.12	39.38	609.6	225	10.0	790	790	585.6	645.6	2976.4	266.3
700	MLWD-0700-055-10	55	1175	35.10	40.71	711.2	280	10.0	905	905	687.5	756.5	4094.2	392.1
800	MLWD-0800-055-10	55	1245	38.36	43.97	812.8	280	10.0	1010	1010	789.5	858.5	5332.7	503.3
900	MLWD-0900-055-10	55	1315	42.04	47.75	914.4	280	10.0	1105	1105	890.5	959.5	6720.1	603.6
1000	MLWD-1000-055-10	55	1385	46.02	51.83	1016.0	280	10.0	1210	1210	992.5	1061.5	8283.8	699.1

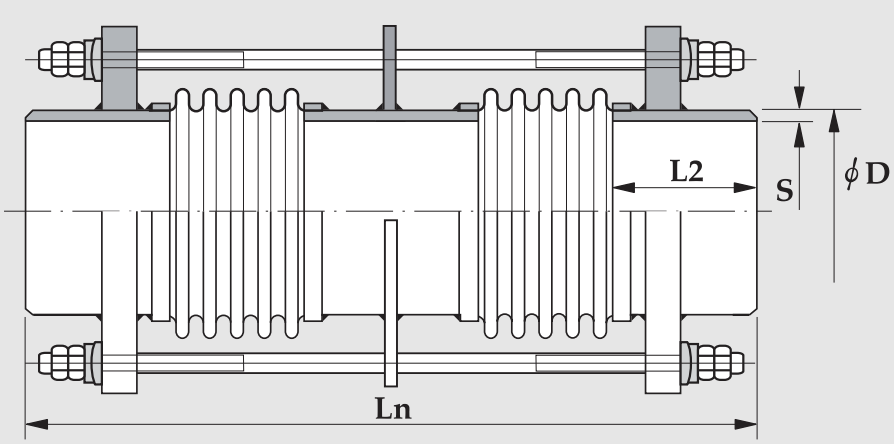
■ Number of Tie Rods

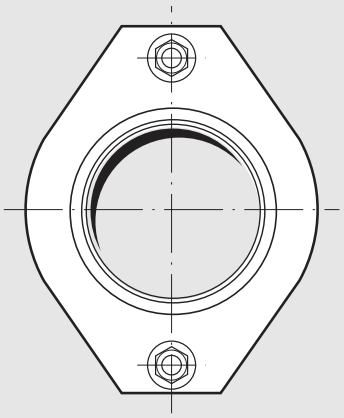
DN 40 - DN 100 : 2 PCS
DN 125 - DN 800 : 3 PCS
DN 900 : 4 PCS
DN 1000 : 5 PCS

** The number of tie rods can be changed according to design conditions.*



B-6 Lateral Expansion Joints with Welding Ends





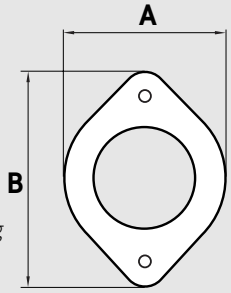
■ Design Pressure

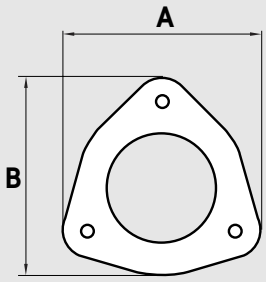
300Lbf/in²

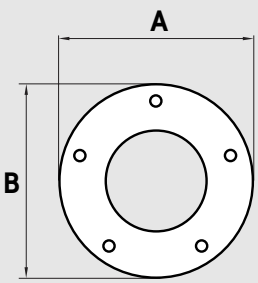
DN	TYPE	MOVEMENT	Ln	SPRING RATE		WELDING ENDS			DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
		+/- LA		AX	LA	øD	L2	S	A	B	Di	Do		
		mm	mm	kgf/mm	kgf/mm	mm	mm	mm	EA	mm	mm	mm	cm²	kg
100	MLWD-0100-055-20	55	625	18.67	2.04	114.3	145	3.6	175	230	104.6	131.0	109.0	13.3
125	MLWD-0125-055-20	55	670	21.63	2.44	139.7	145	4.0	226	228	130.2	156.6	161.5	18.7
150	MLWD-0150-055-20	55	635	25.40	6.53	168.3	145	4.5	256	269	155.0	186.2	228.6	24.0
175	MLWD-0175-055-20	55	670	27.55	7.14	193.7	145	5.6	278	294	180.6	211.8	302.3	29.9
200	MLWD-0200-055-20	55	695	26.42	11.12	219.1	170	6.3	313	328	206.2	242.2	394.8	35.6
250	MLWD-0250-055-20	55	755	30.61	12.85	273.0	170	8.0	405	405	260.3	296.3	608.3	62.5
300	MLWD-0300-055-20	55	980	44.48	13.87	323.9	225	8.0	480	480	311.2	349.2	856.3	115.9
350	MLWD-0350-055-20	55	970	48.36	18.97	355.6	225	8.0	510	510	343.0	381.0	1029.2	129.7
400	MLWD-0400-055-20	55	895	40.81	39.69	406.4	225	10.0	580	580	390.4	440.4	1355.3	159.5
450	MLWD-0450-055-20	55	1025	46.93	52.75	457.2	280	10.0	650	650	441.5	494.5	1720.2	219.8
500	MLWD-0500-055-20	55	1070	48.77	62.85	505.0	280	10.0	695	695	486.5	541.5	2075.0	250.3
550	MLWD-0550-055-20	55	1070	51.53	80.30	558.8	280	10.0	750	750	537.8	592.8	2509.9	305.4
600	MLWD-0600-055-20	55	1165	53.97	77.04	609.6	280	12.0	805	805	586.6	651.6	3010.3	343.6

■ Number of Tie Rods

DN 40 - DN 100 : 2 PCS
DN 125 - DN 450 : 3 PCS
DN 500 - DN 600 : 4 PCS

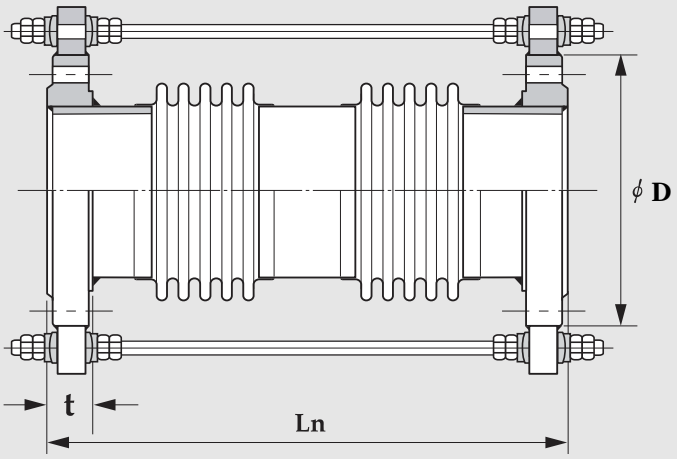


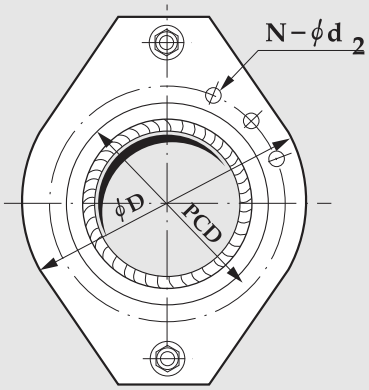




** The number of tie rods can be changed according to design conditions.*

B-7 Lateral Expansion Joints with Fixed Flange Ends





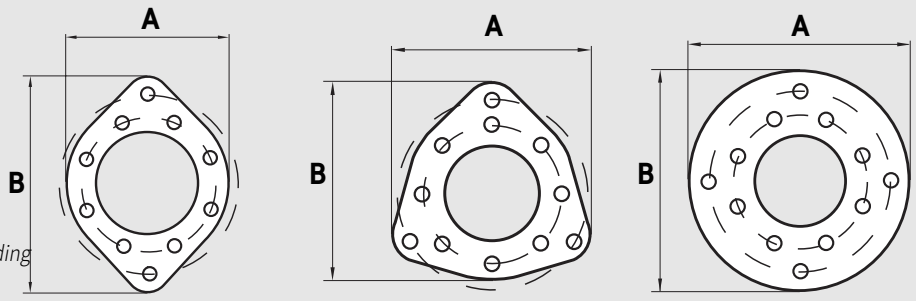
■ Design Pressure

150Lbf/in²

DN	TYPE	MOVEMENT	Ln	SPRING RATE		FLANGES ACC. TO ASME STD.					DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
		+/- LA		AX	LA	øD	PCD	t	N	ød2	A	B	Di	Do		
		mm	mm	kgf/mm	kgf/mm	mm	mm	mm	EA	mm	mm	mm	mm	mm	cm²	kg
100	MLFD-0100-075-10	75	395	12.34	1.22	229	190.5	24.0	8	20	220	295	104.6	130.2	108.2	12.1
125	MLFD-0125-075-10	75	415	11.73	1.63	254	215.9	24.0	8	23	287	288	130.2	157.8	162.9	16.5
150	MLFD-0175-075-10	75	455	13.97	2.04	279	241.3	25.5	8	23	317	323	155.0	186.6	229.1	19.9
200	MLFD-0250-075-10	75	515	14.18	2.55	343	298.4	29.0	8	23	360	378	206.1	239.7	390.2	28.0
250	MLFD-0250-055-10	55	475	17.24	6.02	406	361.9	30.5	12	26	412	433	260.0	293.6	601.8	37.8
300	MLFD-0300-055-10	55	490	25.61	11.93	483	431.8	32.0	12	26	455	483	311.1	347.5	851.7	49.5
350	MLFD-0350-055-10	55	530	27.85	12.85	535	476.2	35.0	12	29	521	550	342.8	379.2	1023.5	66.8
400	MLFD-0400-055-10	55	470	20.71	23.16	596	539.7	37.0	16	29	573	610	389.9	437.1	1342.9	84.8
450	MLFD-0450-055-10	55	540	28.87	27.24	635	577.8	40.0	16	32	616	660	440.5	489.5	1698.2	98.3
500	MLFD-0500-055-10	55	535	28.06	41.63	700	635.0	43.0	20	32	693	730	485.4	536.4	2050.0	124.7
600	MLFD-0600-055-10	55	715	51.63	56.22	815	749.3	43.0	20	35	780	840	585.6	645.6	2976.4	157.5
700	MLFD-0700-055-10	55	775	50.10	58.16	927.1	863.6	71.0	24	35	896	965	687.5	756.5	4094.2	216.8
800	MLFD-0800-055-10	55	865	54.79	62.85	1060	978.0	81.0	28	41	1015	1080	789.5	858.5	5332.7	278.4
900	MLFD-0900-055-10	55	945	60.10	68.26	1168	1085.0	90.0	32	41	1115	1255	890.5	959.5	6720.1	323.2
1000	MLFD-1000-055-10	55	1015	65.71	74.08	1289	1200.0	90.0	36	41	1306	1300	992.5	1061.5	8283.8	383.8

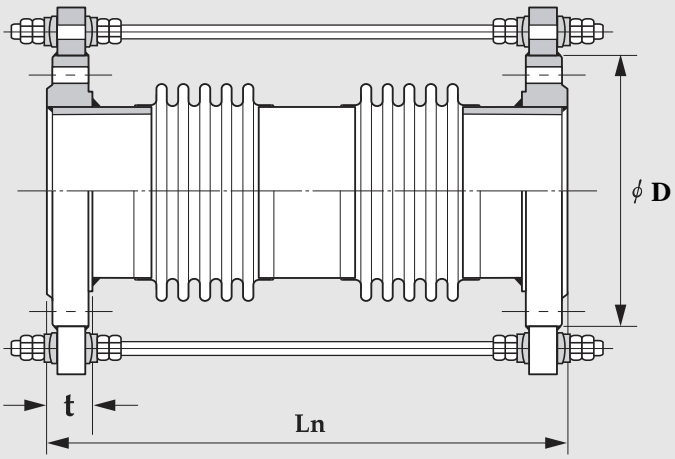
■ Number of Tie Rods

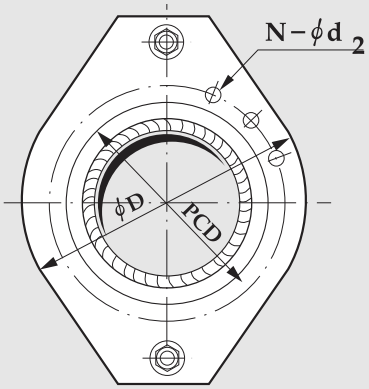
DN 40 - DN 100 : 2 PCS
DN 125 - DN 800 : 3 PCS
DN 900 : 6 PCS
DN 1000 : 7PCS



** The number of tie rods can be changed according to design conditions.*

B-8 Lateral Expansion Joints with Fixed Flange Ends





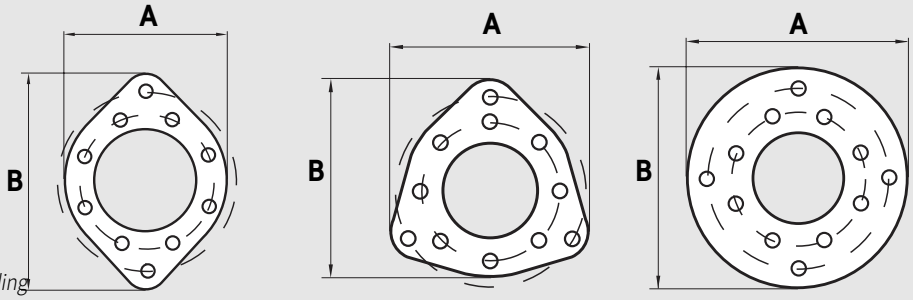
■ Design Pressure

300Lbf/in²

DN	TYPE	MOVEMENT	Ln	SPRING RATE		FLANGES ACC. TO ASME B 16.5					DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
		+/- LA		AX	LA	øD	PCD	t	N	ød2	A	B	Di	Do		
		mm	mm	kgf/mm	kgf/mm	mm	mm	mm	EA	mm	mm	mm	mm	mm	cm²	kg
100	MLFD-0100-055-20	55	385	26.73	2.85	254	200.0	32.0	8	23	235	310	104.6	131.0	109.0	15.8
125	MLFD-0125-055-20	55	430	30.91	3.46	279	234.9	35.0	8	23	304	308	130.2	156.6	161.5	21.6
150	MLFD-0150-055-20	55	400	36.32	9.38	318	269.9	37.0	12	23	330	337	155.0	186.2	228.6	23.3
200	MLFD-0200-055-20	55	515	37.75	15.81	381	330.2	41.5	12	26	395	405	206.2	242.2	394.8	38.3
250	MLFD-0250-055-20	55	590	43.67	18.36	445	387.3	48.0	16	29	452	470	260.3	296.3	608.3	57.2
300	MLFD-0300-055-20	55	715	63.57	19.79	520	450.8	51.0	16	32	532	545	311.2	349.2	856.3	88.4
350	MLFD-0350-055-20	55	720	69.08	27.04	585	514.3	54.0	20	32	593	615	343.0	381.0	1029.2	122.8
400	MLFD-0400-055-20	55	665	58.36	56.73	650	571.5	57.5	20	35	649	680	390.4	440.4	1355.3	151.9
500	MLFD-0500-055-20	55	760	69.69	89.79	775	685.8	63.5	24	35	763	800	486.5	541.5	2075.0	213.4
600	MLFD-0600-055-20	55	855	77.14	110.00	915	812.8	70.0	24	42	845	985	586.6	651.6	3010.3	280.4

■ Number of Tie Rods

DN 40 - DN 100	: 2 PCS
DN 125 - DN 600	: 3 PCS
DN 700	: 4 PCS
DN 900	: 6 PCS
DN 1000	: 7 PCS



** The number of tie rods can be changed according to design conditions.*

C

STANDARD METAL EXPANSION JOINTS

ANGULAR EXPANSION JOINTS

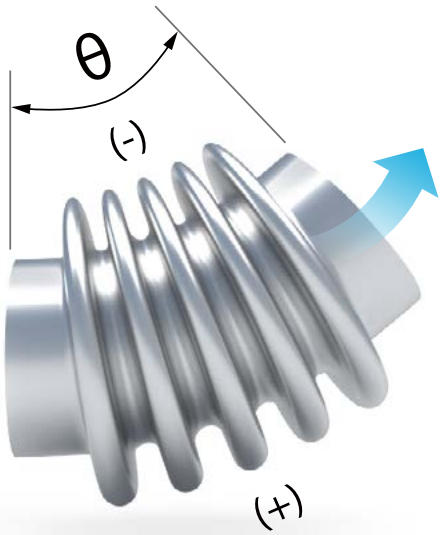
Angular expansion joint is designed with flat steel fittings which are fitted through the flanges and welded onto them on the outside. A cylindrical bolt, which allows angular movement in several planes, above center line of the bellows. The expansion joint is made with 1 bellows. The Megaflexon expansion joint is fitted with flat iron fittings which are fitted through the flanges and welded onto them on the outside. The fittings are secured to a middle ring with cylindrical bolts, which allow angular movement in several planes, above the center line of the bellows.
The expansion joint is made with a single bellows. Common to both types is the fact that the fittings have the task of absorbing the tensile forces arising from the operating pressure. The fitting make axial expansions impossible, which means that the expansion joint can only absorb bending forces. Angular expansion joints are suitable for installations where it is not possible to create sturdy fixing points, and in pipe systems where bending occurs.
Since the angular expansion joints can only absorb bending, at least, 2 or 3 angular expansion joints are required everytime to ensure correct absorption of the movements.
Two angular expansion joints correspond functionally to one lateral expansion joint, for which reason angular expansion joints are often used in pairs.

● ADVANTAGE

· Absorb a relatively large movement by means of combination of this type of expansion joint
· A largely reduced load on fix point

● DISADVANTAGE

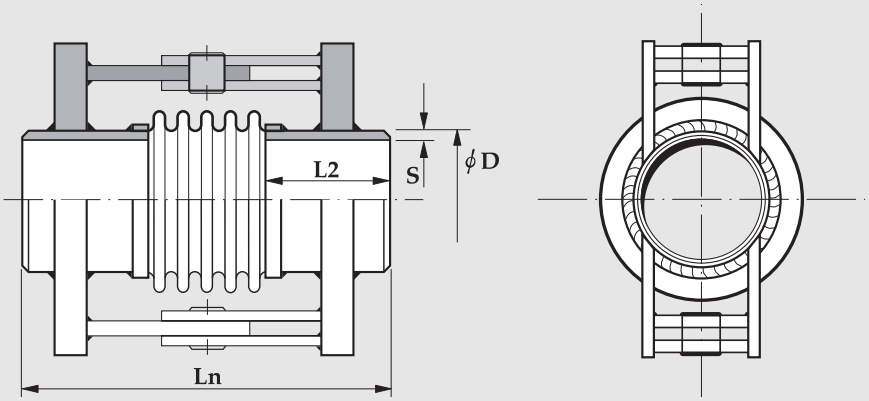
· The changed flow direction
· Relatively large space required on designing and installation



▲ *Angular Expansion Joint with Hinge and Welding Ends*

▲ *Angular Expansion Joint with Hinge Fixed Flange Ends*

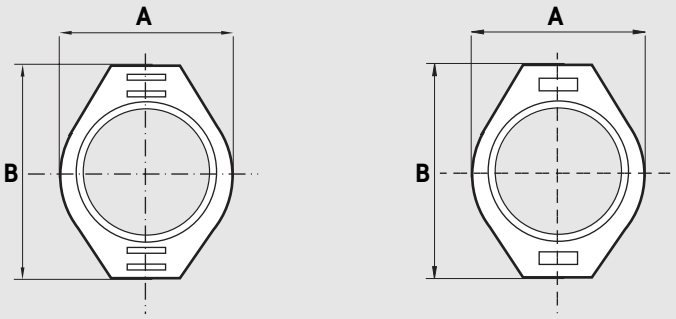
C-1 Angular Expansion Joints with Hinge and Welding Ends



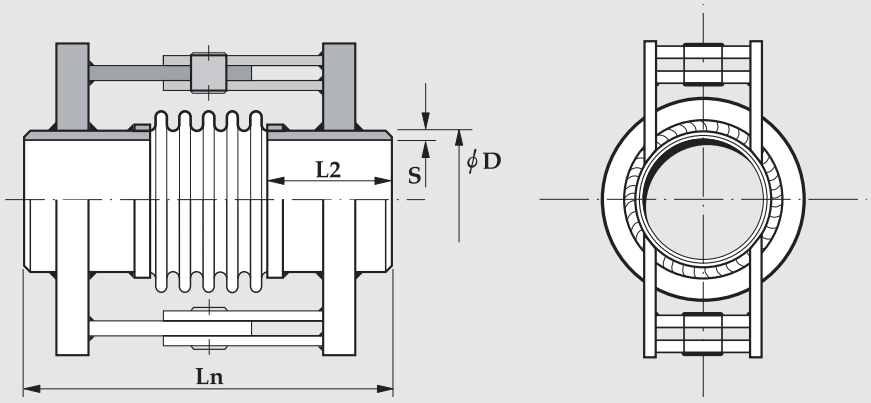
■ Design Pressure

150Lbf/in²

DN	TYPE	MOVEMENT +/- ANG	Ln	SPRING RATE ANG	WELDING ENDS			DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
					øD	L2	S	A	B	Di	Do		
		deg	mm	kgf·mm/deg	mm	mm	mm	mm	mm	mm	mm	cm²	kg
100	MANW-0100-015-10	15	315	753.57	114.3	110	3.6	155	210	104.6	130.2	108.2	6.2
100	MANW-0100-020-10	20	405	351.63	114.3	110	3.6	155	210	104.6	130.2	108.2	7.1
125	MANW-0125-015-10	15	315	156.83	139.7	110	4.0	180	280	130.2	157.8	162.9	13.6
125	MANW-0125-020-10	20	405	501.73	139.7	110	4.0	180	280	130.2	157.8	162.9	15.8
150	MANW-0150-015-10	15	315	1803.67	168.3	110	4.5	230	315	155.0	186.6	229.1	17.1
150	MANW-0150-020-10	20	405	819.79	168.3	110	4.5	230	315	155.0	186.6	229.1	19.3
175	MANW-0175-014-10	14	315	2624.79	193.7	110	5.6	255	350	180.6	212.2	303.0	20.0
175	MANW-0175-020-10	20	405	1193.06	193.7	110	5.6	255	350	180.6	212.2	303.0	22.3
200	MANW-0200-014-10	14	315	3094.89	219.1	110	5.6	280	390	206.1	239.7	390.2	25.4
200	MANW-0200-020-10	20	405	1406.83	219.1	110	5.6	280	390	206.1	239.7	390.2	27.8
250	MANW-0250-010-10	10	335	5787.24	273.0	120	6.3	355	455	260.0	293.6	601.8	35.1
250	MANW-0250-020-10	20	455	2225.91	273.0	120	6.3	355	455	260.0	293.6	601.8	38.7
300	MANW-0300-009-10	9	340	12199.28	323.9	120	8.0	425	560	311.1	347.5	851.7	68.8
300	MANW-0300-020-10	20	500	4066.42	323.9	120	8.0	425	560	311.1	347.5	851.7	83.5
350	MANW-0350-008-10	8	340	15961.42	355.6	120	8.0	455	590	342.8	379.2	1023.5	74.1
350	MANW-0350-020-10	20	500	5320.51	355.6	120	8.0	455	590	342.8	379.2	1023.5	89.2
400	MANW-0400-010-10	10	365	15584.28	406.4	120	8.0	505	645	389.9	437.1	1342.9	92.6
400	MANW-0400-020-10	20	530	5993.87	406.4	120	8.0	505	645	389.9	437.1	1342.9	111.1
450	MANW-0450-008-10	8	395	27408.46	457.2	135	8.0	575	710	440.5	489.5	1698.2	112.7
450	MANW-0450-015-10	15	520	12458.36	457.2	135	8.0	575	710	440.5	489.5	1698.2	129.6
500	MANW-0500-011-10	11	435	32153.77	508.0	135	8.0	630	755	485.4	536.4	2050.0	123.9
500	MANW-0500-020-10	20	595	14615.40	508.0	135	8.0	630	755	485.4	536.4	2050.0	142.8
550	MANW-0550-010-10	10	435	42034.18	558.8	135	10.0	680	805	536.4	587.4	2479.8	147.0
550	MANW-0550-014-10	14	540	23299.48	558.8	135	10.0	680	805	536.4	587.4	2479.8	157.3
600	MANW-0600-007-10	7	405	85920.00	609.6	135	10.0	750	885	585.6	645.6	2976.4	188.3
600	MANW-0600-020-10	20	610	28641.02	609.6	135	10.0	750	885	585.6	645.6	2976.4	217.5
700	MANW-0700-006-10	6	410	114728.06	711.2	135	10.0	870	1035	587.5	756.5	3546.7	278.4
700	MANW-0700-019-10	19	615	38242.65	711.2	135	10.0	870	1035	587.5	756.5	3546.7	322.4
800	MANW-0800-005-10	5	440	163319.38	812.8	150	10.0	995	1150	789.5	858.5	5332.7	371.1
800	MANW-0800-016-10	16	645	54439.79	812.8	150	10.0	995	1150	789.5	858.5	5332.7	418.9
900	MANW-0900-004-10	4	440	225555.81	914.4	150	10.0	1095	1250	890.5	959.5	6720.1	411.7
900	MANW-0900-015-10	15	645	75185.30	914.4	150	10.0	1095	1250	890.5	959.5	6720.1	466.0
1000	MANW-1000-004-10	4	440	303678.06	1016.0	150	10.0	1215	1365	992.5	1061.5	8283.8	516.3
1000	MANW-1000-013-10	13	645	10226.02	1016.0	150	10.0	1215	1365	992.5	1061.5	8283.8	577.7

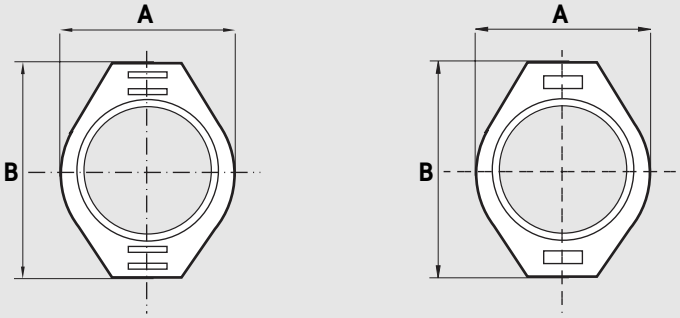


C-2 Angular Expansion Joints with Hinge and Welding Ends

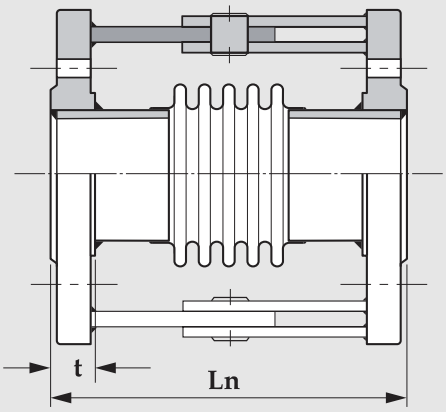


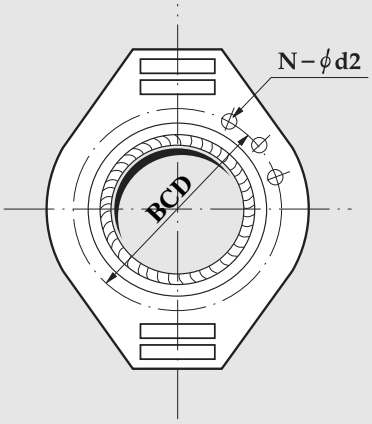
■ **Design Pressure** **300Lbf/in²**

DN	TYPE	MOVEMENT +/- ANG	Ln	SPRING RATE ANG	WELDING ENDS			DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
					øD	L2	S	A	B	Di	Do		
		deg	mm	kgf·mm/deg	mm	mm	mm	mm	mm	mm	mm	cm²	kg
100	MANW-0100-015-20	15	295	1650.71	114.3	110	3.6	175	260	104.6	131.0	109.0	13.3
100	MANW-0100-020-20	20	370	750.30	114.3	110	3.6	175	260	104.6	131.0	109.0	15.1
125	MANW-0125-012-20	12	295	2825.30	139.7	110	4	200	285	130.2	156.6	161.5	17.1
125	MANW-0125-020-20	20	395	1086.63	139.7	110	4	200	285	130.2	156.6	161.5	19.7
150	MANW-0150-015-20	15	345	4707.65	168.3	120	4.5	250	325	155.0	186.2	228.6	23.7
150	MANW-0150-020-20	20	450	2139.79	168.3	120	4.5	250	325	155.0	186.2	228.6	26.9
175	MANW-0175-014-20	14	345	6714.69	193.7	120	5.6	275	360	180.6	211.8	302.3	27.5
175	MANW-0175-020-20	20	450	3052.14	193.7	120	5.6	275	360	180.6	211.8	302.3	30.9
200	MANW-0200-015-20	15	350	8426.73	219.1	120	6.3	320	450	206.2	242.2	394.8	55.3
200	MANW-0200-020-20	20	460	3830.30	219.1	120	6.3	320	450	206.2	242.2	394.8	63.1
250	MANW-0250-012-20	12	380	14962.75	273.0	135	7.1	395	515	260.3	296.3	608.3	78.3
250	MANW-0250-020-20	20	490	6801.22	273.0	135	7.1	395	515	260.3	296.3	608.3	87.0
300	MANW-0300-008-20	8	380	30607.85	323.9	135	8	445	570	311.2	349.2	856.3	96.7
300	MANW-0300-015-20	15	450	17004.38	323.9	135	8	445	570	311.2	349.2	856.3	102.8
350	MANW-0350-007-20	7	380	399595.79	355.6	135	8	495	610	343.0	381.0	1029.2	112.2
350	MANW-0350-013-20	13	450	22199.89	355.6	135	8	495	610	343.0	381.0	1029.2	118.6
400	MANW-0400-010-20	10	415	45668.67	406.4	135	10	565	720	393.9	443.9	1378.2	177.5
400	MANW-0400-019-20	19	510	24775.71	406.4	135	10	565	720	393.9	443.9	1378.2	192.5
450	MANW-0450-009-20	9	450	64981.22	457.2	150	10	635	785	441.5	494.5	1720.2	227.8
450	MANW-0450-017-20	17	550	36100.71	457.2	150	10	635	785	441.5	494.5	1720.2	245.9
500	MANW-0500-012-20	12	490	81412.75	508.0	150	10	690	830	486.5	541.5	2075.0	266.5
500	MANW-0500-017-20	17	550	58151.93	508.0	150	10	690	830	486.5	541.5	2075.0	277.3
550	MANW-0550-011-20	11	490	104057.14	558.8	150	10	740	885	537.8	592.8	2509.9	296.3
550	MANW-0550-015-20	15	550	74326.14	558.8	150	10	740	885	537.8	592.8	2509.9	308.4
600	MANW-0600-012-20	12	535	130904.89	609.6	150	12	810	950	586.6	651.6	3010.3	387.6
600	MANW-0600-018-20	18	615	93524.89	609.6	150	12	810	950	586.6	651.6	3010.3	407.0



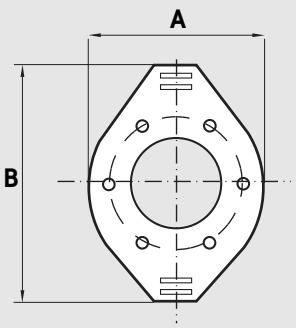
C-3 Angular Expansion Joints with Hinge Fixed Flange Ends

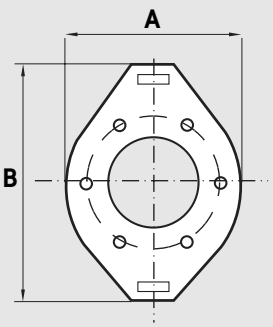




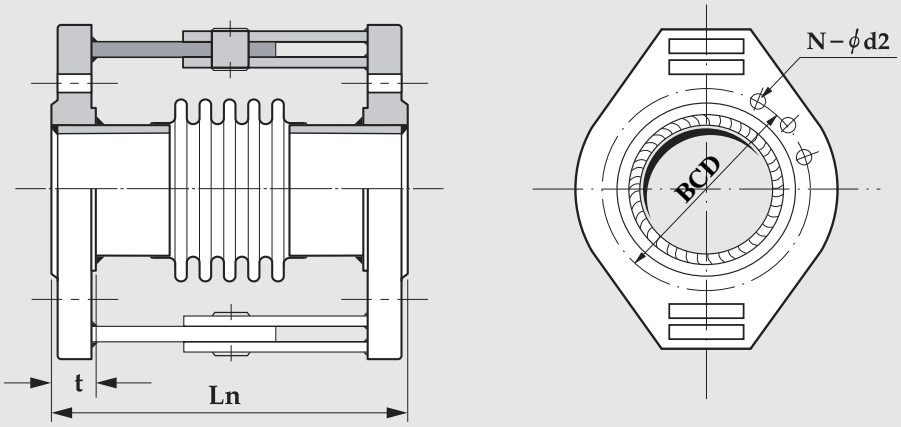
■ **Design Pressure** **150Lbf/in²**

DN	TYPE	MOVEMENT +/- ANG	Ln	SPRING RATE ANG	FLANGES ACC. TO ASME B 16.5				DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
					t	PCD	N	ød2	A	B	Di	Do		
		deg	mm	kgf·mm/deg	mm	mm	EA	mm	mm	mm	mm	mm	cm²	kg
100	MANF-0100-015-10	15	110	753.57	24.0	190.5	8	20	220	285	104.6	130.2	108.2	4.5
100	MANF-0100-020-10	20	200	351.63	24.0	190.5	8	20	220	285	104.6	130.2	108.2	5.4
125	MANF-0125-015-10	15	115	1075.20	24.0	215.9	8	23	250	365	130.2	157.8	162.9	8.0
125	MANF-0125-020-10	20	210	501.73	24.0	215.9	8	23	250	365	130.2	157.8	162.9	10.3
150	MANF-0150-015-10	15	120	1803.67	25.5	241.3	8	23	285	400	155.0	186.6	229.1	13.2
150	MANF-0150-020-10	20	210	819.79	25.5	241.3	8	23	285	400	155.0	186.6	229.1	15.4
200	MANF-0200-014-10	14	130	3094.89	29.0	298.4	8	23	340	475	206.1	239.7	390.2	21.1
200	MANF-0200-020-10	20	220	1406.83	29.0	298.4	8	23	340	475	206.1	239.7	390.2	23.6
250	MANF-0250-010-10	15	130	5787.24	30.5	361.9	12	26	395	530	260.0	293.6	601.8	23.8
250	MANF-0250-020-10	20	250	2225.91	30.5	361.9	12	26	395	530	260.0	293.6	601.8	27.3
300	MANF-0300-009-10	9	145	12199.28	32.0	431.8	12	26	445	630	311.1	347.5	851.7	49.2
300	MANF-0300-020-10	20	305	4066.42	32.0	431.8	12	26	445	630	311.1	347.5	851.7	63.8
350	MANF-0350-008-10	8	145	15961.42	35.0	476.2	12	29	505	690	342.8	379.2	1023.5	57.1
350	MANF-0350-020-10	20	305	5320.51	35.0	476.2	12	29	505	690	342.8	379.2	1023.5	72.2
400	MANF-0400-010-10	10	180	15584.28	37.0	539.7	16	29	565	760	389.9	437.1	1342.9	77.7
400	MANF-0400-020-10	20	345	5993.97	37.0	539.7	16	29	565	760	389.9	437.1	1342.9	96.1
450	MANF-0450-008-10	8	180	27408.46	40.0	577.8	16	32	615	810	440.5	489.5	1698.2	82.0
450	MANF-0450-015-10	15	305	12458.36	43.0	577.8	16	32	615	810	440.5	489.5	1698.2	98.9
500	MANF-0500-011-10	11	220	32153.77	43.0	635.0	20	32	670	865	485.4	536.4	2050.0	88.5
500	MANF-0500-020-10	20	380	14615.40	43.0	635.0	20	32	670	865	485.4	536.4	2050.0	107.4
600	MANF-0600-007-10	7	200	85920.00	43.0	749.3	20	35	780	985	585.6	645.6	2976.4	114.4
600	MANF-0600-020-10	20	405	28640.00	43.0	749.3	20	35	780	985	585.6	645.6	2976.4	143.6
700	MANF-0700-006-10	6	215	114728.06	71.0	863.6	24	35	895	1140	687.5	756.5	4094.2	179.4
700	MANF-0700-019-10	19	420	38242.65	71.0	863.6	24	35	895	1140	687.5	756.5	4094.2	223.5
800	MANF-0800-005-10	5	225	163319.38	81.0	978.0	28	41	1015	1280	789.5	858.5	5332.7	229.6
800	MANF-0800-016-10	16	430	54439.79	81.0	978.0	28	41	1015	1280	789.5	858.5	5332.7	277.4
900	MANF-0900-004-10	4	235	225555.81	90.0	1085.0	32	41	1115	1390	890.5	959.5	6720.1	268.3
900	MANF-0900-015-10	15	440	75185.30	90.0	1085.0	32	41	1115	1390	890.5	959.5	6720.1	322.6
1000	MANF-1000-004-10	4	245	303678.06	90.0	1200.0	36	41	1230	1515	992.5	1061.5	8283.8	337.3
1000	MANF-1000-013-10	13	450	101226.02	90.0	1200.0	36	41	1230	1515	992.5	1061.5	8283.8	398.6



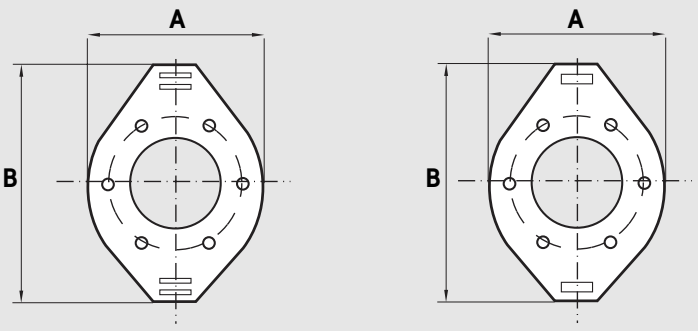


C-4 Angular Expansion Joints with Hinge Fixed Flange Ends



■ **Design Pressure** **300Lbf/in²**

DN	TYPE	MOVEMENT +/- ANG	Ln	SPRING RATE ANG	FLANGES ACC. TO ASME B 16.5				DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
					t	PCD	N	ød2	A	B	Di	Do		
		deg	mm	kgf·mm/deg	mm	mm	EA	mm	mm	mm	mm	mm	cm²	kg
100	MANF-0100-015-20	15	110	1650.71	32.0	200.0	8	23	235	360	104.6	131.0	109.0	15.6
100	MANF-0100-020-20	20	185	750.30	32.0	200.0	8	23	235	360	104.6	131.0	109.0	17.4
125	MANF-0125-012-20	15	110	2528.30	35.0	234.9	8	23	270	395	130.2	156.6	161.5	17.7
125	MANF-0125-020-20	20	210	1086.63	35.0	234.9	8	23	270	395	130.2	156.6	161.5	20.3
150	MANF-0150-015-20	15	140	4707.65	37.0	269.9	12	23	300	425	155.0	186.2	228.6	21.3
150	MANF-0150-020-20	20	245	2139.79	37.0	269.9	12	23	300	425	155.0	186.2	228.6	24.4
200	MANF-0200-015-20	15	165	8426.73	41.5	330.2	12	26	360	555	206.2	242.2	394.8	57.3
200	MANF-0200-020-20	20	275	3830.30	41.5	330.2	12	26	360	555	206.2	242.2	394.8	65.2
250	MANF-0250-012-20	12	165	14962.75	48.0	387.3	16	29	425	620	260.3	296.3	608.3	66.7
250	MANF-0250-020-20	20	275	6801.22	48.0	387.3	16	29	425	620	260.3	296.3	608.3	75.4
300	MANF-0300-008-20	8	175	30607.85	51.0	450.8	16	32	485	690	311.2	349.2	856.3	85.8
300	MANF-0300-015-20	15	245	17004.38	51.0	450.8	16	32	485	690	311.2	349.2	856.3	91.9
350	MANF-0350-007-20	7	185	39959.79	54.0	514.3	20	32	555	770	343.0	381.0	1029.2	122.1
350	MANF-0350-013-20	13	255	22199.89	54.0	514.3	20	32	555	770	343.0	381.0	1029.2	128.5
400	MANF-0400-010-20	10	230	45668.67	57.5	571.5	20	35	620	885	393.9	443.9	1378.2	193.1
400	MANF-0400-019-20	19	325	24775.71	57.5	571.5	20	35	620	885	393.9	443.9	1378.2	208.0
500	MANF-0500-012-20	12	285	81412.75	63.5	685.8	24	35	730	1005	486.5	541.5	2075.0	252.8
500	MANF-0500-017-20	17	345	58151.93	63.5	685.8	24	35	730	1005	486.5	541.5	2075.0	263.6
600	MANF-0600-012-20	12	340	28894.08	70.0	812.8	24	42	845	1120	586.6	651.6	3010.3	360.5
600	MANF-0600-018-20	18	420	93524.89	70.0	812.8	24	42	845	1120	586.6	651.6	3010.3	379.9



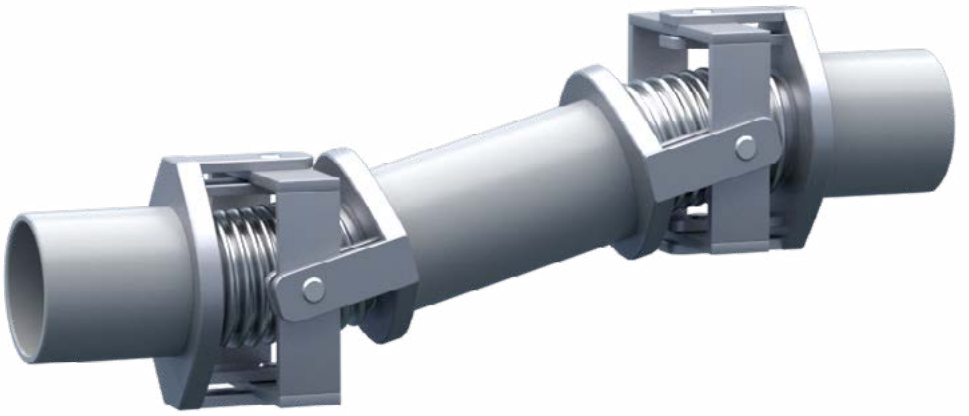
D

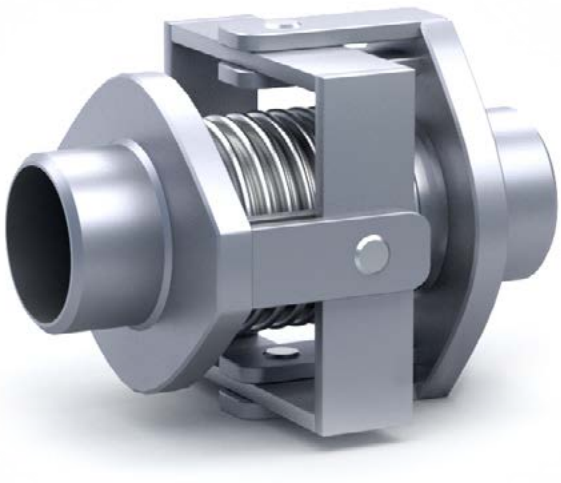
STANDARD METAL EXPANSION JOINTS

GIMBAL EXPANSION JOINTS

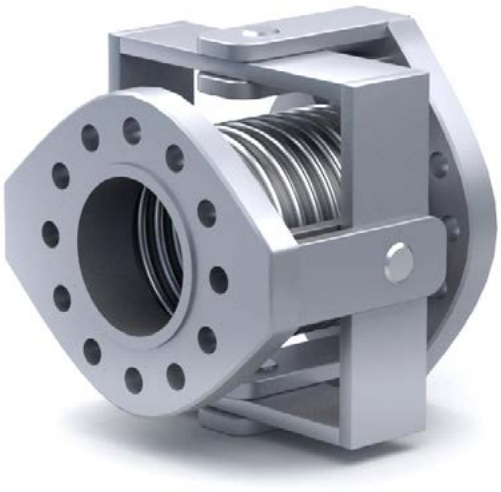
This type of expansion joint has similar structure with a hinged expansion joints and is designed to permit angular rotation in any plane by the use of two pairs of hinges affixed to a common floating gimbal ring. Normally, the thermal growth from two different directions on two planes are absorbed by two pair of this type expansion joints, that is, the double gimbal type expansion joint.
In designing, the thrust of the expansion joint, which is developed from internal pressure and extraneous force, should be carefully considered to be retained by the hardware, including gimbal ring, hinges and pins.
MEGAFLEXON Double Gimbal Expansion Joint are similar to the hinged universal except that the two joints are gimbal type. The advantage of this arrangement is the ability to absorb a large lateral movement in any plane at each end. Because the gimbals are attached to each end of the bellows, the thermal expansion of the intermediate pipe will not be absorbed by the universal but must be accepted by the adjacent piping.

■ **Service Pressure : 1-20kgf/cm²**



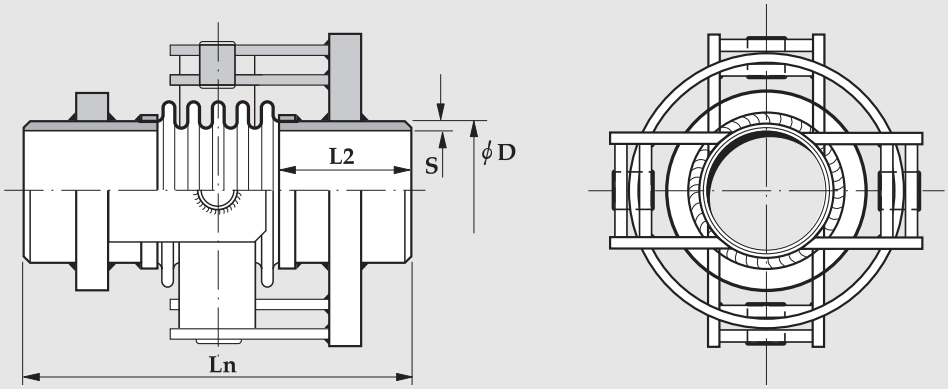


▲ *Gimbal Expansion Joint with Welding Ends*



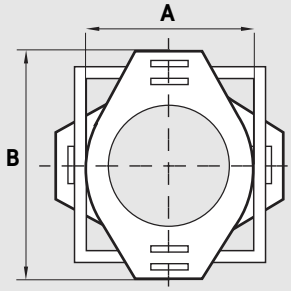
▲ *Gimbal Expansion Joint with Fixed Flange Ends*

D-1 Gimbal Expansion Joints with Welding Ends

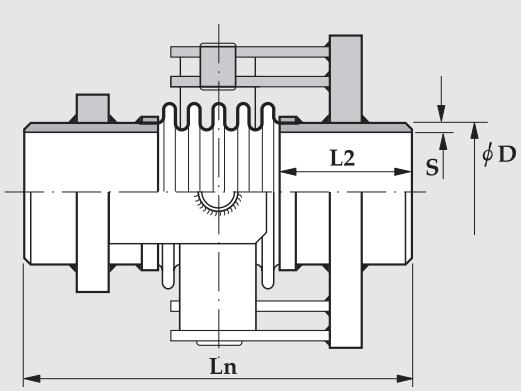


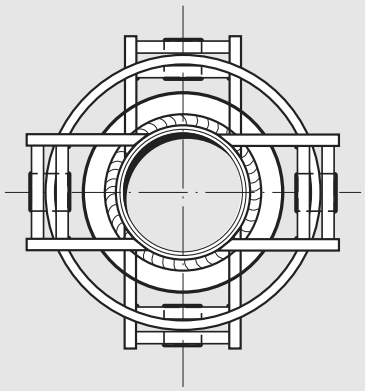
■ **Design Pressure** **150Lbf/in²**

DN	TYPE	MOVEMENT +/- ANG	Ln	SPRING RATE ANG	WELDING ENDS øD	WELDING ENDS L2	WELDING ENDS S	DIMENSIONS A	DIMENSIONS B	BELLOWS Di	BELLOWS Do	EFFECTIVE AREA	WEIGHT APPROX
		deg	mm	kgf·mm/deg	mm	mm	mm	mm	mm	mm	mm	cm²	kg
100	MGWS-0100-015-10	15	315	753.57	114.3	110	3.6	180	210	104.6	130.2	108.2	6.2
100	MGWS-0100-020-10	20	405	351.63	114.3	110	3.6	180	210	104.6	130.2	108.2	7.1
125	MGWS-0125-015-10	15	315	1075.20	139.7	110	4.0	240	280	130.2	157.8	162.9	11.9
125	MGWS-0125-020-10	20	405	501.73	139.7	110	4.0	240	280	130.2	157.8	162.9	14.2
150	MGWS-0150-015-10	15	315	1803.67	168.3	110	4.5	265	315	155.0	186.6	229.1	17.1
150	MGWS-0150-020-10	20	405	819.79	168.3	110	4.5	265	315	155.0	186.6	229.1	19.3
175	MGWS-0175-014-10	14	315	2624.79	193.7	110	5.6	300	350	180.6	212.2	303.0	20.0
175	MGWS-0175-020-10	20	405	1193.06	193.7	110	5.6	300	350	180.6	212.2	303.0	22.3
200	MGWS-0200-014-10	14	315	3094.89	219.1	110	5.6	340	390	206.1	239.7	390.2	22.3
200	MGWS-0200-020-10	20	405	1406.83	219.1	110	5.6	340	390	206.1	239.7	390.2	24.7
250	MGWS-0250-010-10	10	335	5787.24	273.0	120	6.3	395	455	260.0	293.6	601.8	35.1
250	MGWS-0250-020-10	20	455	2225.91	273.0	120	6.3	395	455	260.0	293.6	601.8	38.7
300	MGWS-0300-009-10	9	340	12199.28	323.9	120	8.0	480	560	311.1	347.5	851.7	68.8
300	MGWS-0300-020-10	20	500	4038.87	323.9	120	8.0	480	560	311.1	347.5	851.7	83.4
350	MGWS-0350-008-10	8	340	15961.42	355.6	120	8.0	510	590	342.8	379.2	1023.5	74.1
350	MGWS-0350-020-10	20	500	5320.51	355.6	120	8.0	510	590	342.8	379.2	1023.5	89.2
400	MGWS-0400-010-10	10	365	15584.28	406.4	120	8.0	565	645	389.9	437.1	1342.9	84.2
400	MGWS-0400-020-10	20	530	5993.87	406.4	120	8.0	565	645	389.9	437.1	1342.9	102.7
450	MGWS-0450-008-10	8	395	27408.46	457.2	135	8.0	620	710	440.5	489.5	1698.2	112.7
450	MGWS-0450-015-10	15	520	12458.36	457.2	135	8.0	620	710	440.5	489.5	1698.2	129.6
500	MGWS-0500-011-10	11	435	32153.77	508.0	135	8.0	665	755	485.4	536.4	2050.0	123.9
500	MGWS-0500-020-10	20	595	14615.40	508.0	135	8.0	665	755	485.4	536.4	2050.0	142.8
550	MGWS-0550-010-10	10	435	42034.18	558.8	135	10.0	715	805	536.4	587.4	2479.8	134.9
550	MGWS-0550-014-10	14	540	23299.48	558.8	135	10.0	715	805	536.4	587.4	2479.8	145.2
600	MGWS-0600-007-10	7	405	85920.00	609.6	135	10.0	785	885	585.6	645.6	2976.4	173.1
600	MGWS-0600-020-10	20	610	28640.00	609.6	135	10.0	785	885	585.6	645.6	2976.4	202.3
700	MGWS-0700-006-10	6	410	114728.06	711.2	135	10.0	915	1035	687.5	756.5	4094.2	257.9
700	MGWS-0700-019-10	19	615	38242.65	711.2	135	10.0	915	1035	687.5	756.5	4094.2	302.0
800	MGWS-0800-005-10	5	440	163319.38	812.8	150	10.0	1020	1150	789.5	858.5	5332.7	345.7
800	MGWS-0800-016-10	16	645	54439.79	812.8	150	10.0	1020	1150	789.5	858.5	5332.7	393.6
900	MGWS-0900-004-10	4	440	225555.81	914.4	150	10.0	1120	1250	890.5	959.5	6720.1	383.9
900	MGWS-0900-015-10	15	645	75185.30	914.4	150	10.0	1120	1250	890.5	959.5	6720.1	438.2
1000	MGWS-1000-004-10	4	440	303678.06	1016.0	150	10.0	1225	1365	992.5	1061.5	8283.8	483.2
1000	MGWS-1000-013-10	13	645	10226.02	1016.0	150	10.0	1225	1365	992.5	1061.5	8283.8	544.5



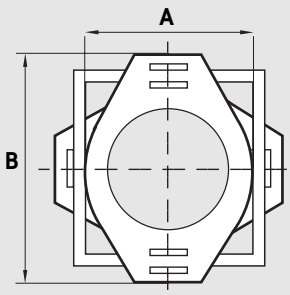
D-2 Gimbal Expansion Joints with Welding Ends



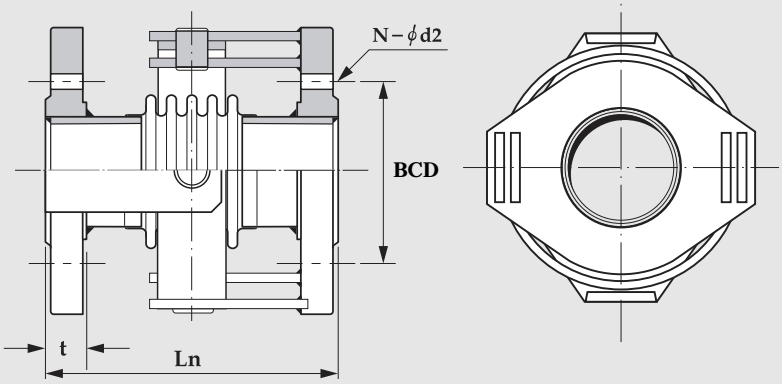


■ **Design Pressure** **300Lbf/in²**

DN	TYPE	MOVEMENT +/- ANG	Ln	SPRING RATE ANG	WELDING ENDS			DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
					øD	L2	S	A	B	Di	Do		
		deg	mm	kgf·mm/deg	mm	mm	mm	mm	mm	mm	mm	cm²	kg
100	MGWS-0100-015-20	15	295	1650.71	114.3	130	3.6	210	260	104.6	131.0	109.0	18.0
100	MGWS-0100-030-20	30	370	750.30	114.3	130	3.6	210	260	104.6	131.0	109.0	20.9
125	MGWS-0125-012-20	12	295	2825.30	139.7	135	4.0	235	285	130.2	156.6	161.5	19.8
125	MGWS-0125-030-20	30	395	1086.63	139.7	135	4.0	235	285	130.2	156.6	161.5	23.9
150	MGWS-0150-015-20	15	345	4707.65	168.3	135	4.5	265	325	155.0	186.2	228.6	29.3
150	MGWS-0150-030-20	30	450	2139.79	168.3	135	4.5	265	325	155.0	186.2	228.6	34.1
175	MGWS-0175-014-20	14	345	6714.69	193.7	135	5.6	300	360	180.6	211.8	302.3	33.0
175	MGWS-0175-030-20	30	450	3052.14	193.7	135	5.6	300	360	180.6	211.8	302.3	38.0
200	MGWS-0200-015-20	15	350	8426.73	219.1	140	6.3	370	450	206.2	242.2	394.8	72.1
200	MGWS-0200-030-20	30	460	3830.30	219.1	140	6.3	370	450	206.2	242.2	394.8	85.1
250	MGWS-0250-012-20	12	380	14962.75	273.0	160	7.1	425	515	260.3	296.3	608.3	96.7
250	MGWS-0250-025-20	25	490	6801.22	273.0	160	7.1	425	515	260.3	296.3	608.3	110.5
300	MGWS-0300-008-20	8	380	30607.85	323.9	180	8.0	480	570	311.2	349.2	856.3	106.8
300	MGWS-0300-015-20	15	450	17004.38	323.9	180	8.0	480	570	311.2	349.2	856.3	116.2
350	MGWS-0350-007-20	7	380	399595.79	355.6	185	8.0	510	610	343.0	381.0	1029.2	130.9
350	MGWS-0350-013-20	13	450	22199.89	355.6	185	8.0	510	610	343.0	381.0	1029.2	140.6
400	MGWS-0400-010-20	10	415	45668.67	406.4	220	10.0	600	720	393.9	443.9	1378.2	212.7
400	MGWS-0400-019-20	19	510	24775.71	406.4	220	10.0	600	720	393.9	443.9	1378.2	235.4
450	MGWS-0450-009-20	9	450	64981.22	457.2	220	10.0	655	785	441.5	494.5	1720.2	265.9
450	MGWS-0450-017-20	17	550	36100.71	457.2	220	10.0	655	785	441.5	494.5	1720.2	292.1
500	MGWS-0500-012-20	12	490	81412.75	508.0	220	10.0	700	830	486.5	541.5	2075.0	290.5
500	MGWS-0500-017-20	17	550	58151.93	508.0	220	10.0	700	830	486.5	541.5	2075.0	306.2
550	MGWS-0550-011-20	11	490	104057.14	558.8	225	10.0	755	885	537.8	592.8	2509.9	325.4
550	MGWS-0550-015-20	15	550	74326.53	558.8	225	10.0	755	885	537.8	592.8	2509.9	343.2
600	MGWS-0600-012-20	12	535	130904.89	609.6	225	11.0	810	950	586.6	651.6	3010.3	426.4
600	MGWS-0600-018-20	18	615	93524.89	609.6	225	11.0	810	950	586.6	651.6	3010.3	454.6

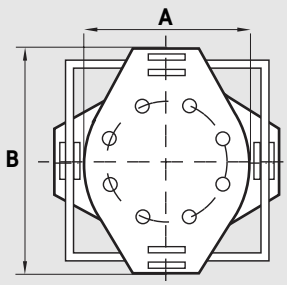


D-3 Gimbal Expansion Joints with Fixed Flange Ends

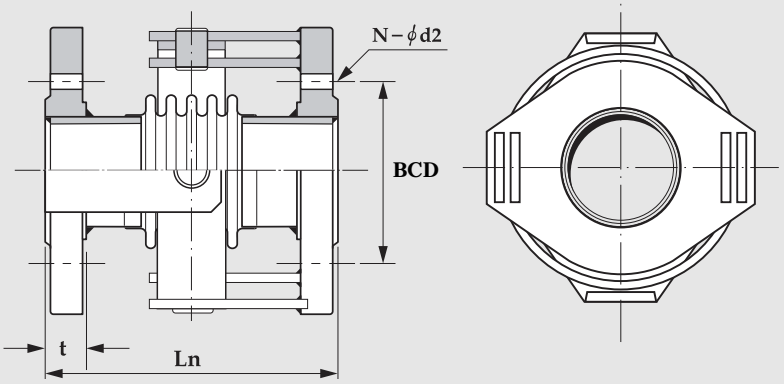


■ **Design Pressure** **150Lbf/in²**

DN	TYPE	MOVEMENT +/- ANG	Ln	SPRING RATE ANG	FLANGES ACC. TO ASME B 16.5 t	PCD	N	ød2	DIMENSIONS A	B	BELLOWS Di	Do	EFFECTIVE AREA	WEIGHT APPROX
		deg	mm	kgf·mm/deg	mm	mm	EA	mm	mm	mm	mm	mm	cm²	kg
100	MGFS-0100-015-10	15	110	753.57	24.0	190.5	8.0	20	220	285.0	104.6	130.2	108.2	7.3
100	MGFS-0100-020-10	20	200	351.63	24.0	190.5	8.0	20	220	285.0	104.6	130.2	108.2	8.1
125	MGFS-0125-015-10	15	115	1075.20	24.0	215.9	8.0	23	250	365.0	130.2	157.8	162.9	20.8
125	MGFS-0125-020-10	20	210	501.73	24.0	215.9	8.0	23	250	365.0	130.2	157.8	162.9	19.8
150	MGFS-0150-015-10	15	120	1803.67	25.5	241.3	8.0	23	285	400.0	155.0	186.6	229.1	23.7
150	MGFS-0150-020-10	20	210	819.79	25.5	241.3	8.0	23	285	400.0	155.0	186.6	229.1	25.9
200	MGFS-0200-014-10	14	130	3094.89	29.0	298.4	8.0	23	340	475.0	206.1	239.7	390.2	36.2
200	MGFS-0200-020-10	20	220	1406.83	29.0	298.4	8.0	23	340	475.0	206.1	239.7	390.2	38.6
250	MGFS-0250-010-10	10	130	5787.24	30.5	361.9	12.0	26	395	530.0	260.0	293.6	601.8	45.2
250	MGFS-0250-020-10	20	250	2225.91	30.5	361.9	12.0	26	395	530.0	260.0	293.6	601.8	48.8
300	MGFS-0300-009-10	9	145	12199.28	32.0	431.8	12.0	26	445	630.0	311.1	347.5	851.7	88.7
300	MGFS-0300-020-10	20	305	4066.42	32.0	431.8	12.0	26	445	630.0	311.1	347.5	851.7	103.4
350	MGFS-0350-008-10	8	145	15961.42	35.0	476.2	12.0	29	505	690.0	342.8	379.2	1023.5	106.7
350	MGFS-0350-020-10	20	305	5320.51	35.0	476.2	12.0	29	505	690.0	342.8	379.2	1023.5	121.8
400	MGFS-0400-010-10	10	180	15584.28	37.0	539.7	16.0	29	565	760.0	389.9	437.1	1342.9	144.5
400	MGFS-0400-020-10	20	345	5993.97	37.0	539.7	16.0	29	565	760.0	389.9	437.1	1342.9	163.0
450	MGFS-0450-008-10	8	180	27408.46	40.0	577.8	16.0	32	615	810.0	440.5	489.5	1698.2	167.1
450	MGFS-0450-015-10	15	305	12458.36	43.0	577.8	16.0	32	615	810.0	440.5	489.5	1698.2	184.1
500	MGFS-0500-011-10	11	220	32153.77	43.0	635	20.0	32	670	865.0	485.4	536.4	2050.0	190.9
500	MGFS-0500-020-10	20	380	14615.40	43.0	635	20.0	32	670	865.0	485.4	536.4	2050.0	209.9
600	MGFS-0600-007-10	7	200	85920.00	43.0	749.3	20.0	35	780	985.0	585.6	645.6	2976.4	268.4
600	MGFS-0600-020-10	20	405	28640.00	43.0	749.3	20.0	35	780	985.0	585.6	645.6	2976.4	297.5
700	MGFS-0700-006-10	6	215	114728.06	71.0	863.6	24.0	35	895	1140.0	687.5	756.5	4094.2	439.2
700	MGFS-0700-019-10	19	420	38242.65	71.0	863.6	24.0	35	895	1140.0	687.5	756.5	4094.2	483.3
800	MGFS-0800-005-10	5	225	1632.59	81.0	978	28.0	41	1015	1280.0	789.5	858.5	5332.7	579.7
800	MGFS-0800-016-10	16	430	54439.79	81.0	978	28.0	41	1015	1280.0	789.5	858.5	5332.7	627.5
900	MGFS-0900-004-10	4	235	225555.81	90.0	1085	32.0	41	1115	1390.0	890.5	959.5	6720.1	726.1
900	MGFS-0900-015-10	15	440	75185.30	90.0	1085	32.0	41	1115	1390.0	890.5	959.5	6720.1	780.4
1000	MGFS-1000-004-10	4	245	303678.06	90.0	1200	36.0	41	1230	1515.0	992.5	1061.5	8283.8	913.6
1000	MGFS-1000-013-10	13	450	101226.02	90.0	1200	36.0	41	1230	1515.0	992.5	1061.5	8283.8	974.9

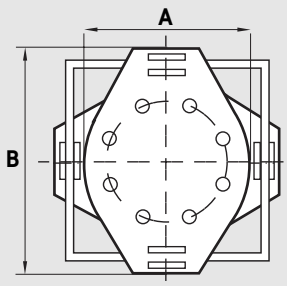


D-4 Gimbal Expansion Joints with Fixed Flange Ends



■ **Design Pressure** **300Lbf/in²**

DN	TYPE	MOVEMENT	Ln	SPRING RATE	FLANGES ACC. TO ASME B 16.5				DIMENSIONS		BELLOWS		EFFECTIVE AREA	WEIGHT APPROX
		+/- ANG		ANG	t	PCD	N	ød2	A	B	Di	Do		
		deg	mm	kgf·mm/deg	mm	mm	EA	mm	mm	mm	mm	mm	cm²	kg
100	MGFS-0100-015-20	15	125	1650.71	32.0	200.0	8	23	235	360	104.6	131.0	109.0	22.1
100	MGFS-0100-020-20	20	185	750.30	32.0	200.0	8	23	235	360	104.6	131.0	109.0	23.7
125	MGFS-0125-012-20	12	125	2528.30	35.0	234.9	8	23	270	395	130.2	156.6	161.5	27.0
125	MGFS-0125-020-20	20	210	1086.63	35.0	234.9	8	23	270	395	130.2	156.6	161.5	29.3
150	MGFS-0150-015-20	15	160	4707.65	37.0	269.9	12	23	300	425	155.0	186.2	228.6	32.6
150	MGFS-0150-020-20	20	245	2139.79	37.0	269.9	12	23	300	425	155.0	186.2	228.6	35.4
200	MGFS-0200-015-20	15	270	8426.73	41.5	330.2	12	26	360	555	206.2	242.2	394.8	93.3
200	MGFS-0200-020-20	20	275	3830.30	41.5	330.2	12	26	360	555	206.2	242.2	394.8	96.2
250	MGFS-0250-012-20	12	285	14962.75	48.0	387.3	16	29	425	620	260.3	296.3	608.3	115.2
250	MGFS-0250-020-20	20	275	6801.22	48.0	387.3	16	29	425	620	260.3	296.3	608.3	118.2
300	MGFS-0300-008-20	8	295	30607.85	51.0	450.8	16	32	485	690	311.2	349.2	856.3	144.7
300	MGFS-0300-015-20	15	245	17004.38	51.0	450.8	16	32	485	690	311.2	349.2	856.3	145.2
350	MGFS-0350-007-20	7	310	39959.79	54.0	514.3	20	32	555	770	343.0	381.0	1029.2	193.8
350	MGFS-0350-013-20	13	255	22199.89	54.0	514.3	20	32	555	770	343.0	381.0	1029.2	194.3
400	MGFS-0400-010-20	10	365	45668.67	57.5	571.5	20	35	620	885	393.9	443.9	1378.2	312.6
400	MGFS-0400-019-20	19	325	24775.71	57.5	571.5	20	35	620	885	393.9	443.9	1378.2	316.6
500	MGFS-0500-012-20	12	440	81412.75	63.5	685.8	24	35	730	1005	486.5	541.5	2075.0	416.6
500	MGFS-0500-017-20	17	345	58151.93	63.5	685.8	24	35	730	1005	486.5	541.5	2075.0	414.7
600	MGFS-0600-012-20	12	485	130934.89	70.0	812.8	24	42	845	1120	586.6	651.6	3010.3	582.0
600	MGFS-0600-018-20	18	420	93524.89	70.0	812.8	24	42	845	1120	586.6	651.6	3010.3	585.4



E

STANDARD METAL EXPANSION JOINTS

REFERENCE DATA

■ The Thermal Expansion of Pipe

The below table shows the thermal expansion of pipe per 1M and pipe material (Aluminum, copper, steel and iron) and thermal expansion coefficient (β)

When estimating the thermal growth, the flowing procedure shall be applied.

△ **L= β(T-t)L**

△ **L= pipe expending amount**
L = pipe length
β = thermal expansion coefficient
T = max. temperature
t = min. temperature

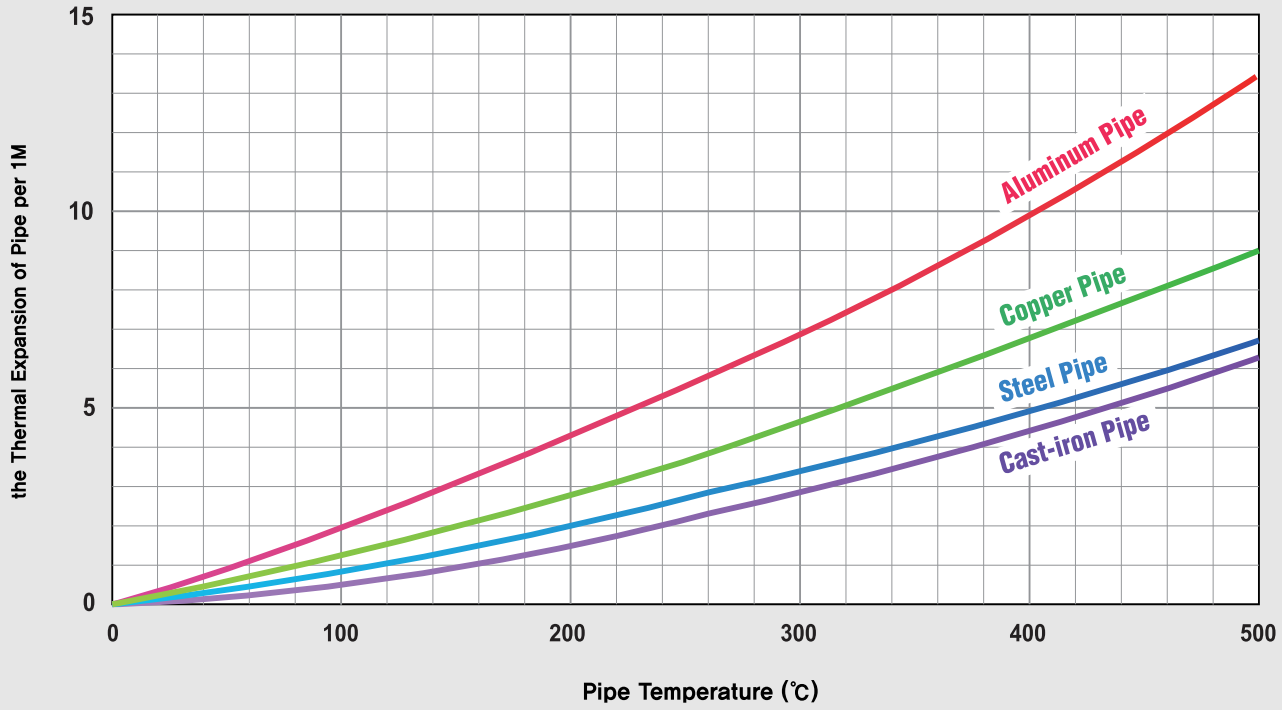
■ The Example of Calculation

Nominal diameter	**: 250A**
Pipe material	**: SPP**
Fluid : steam	
Service temperature	**: Tmax = 160 °C, Tmin = -10 °C**
Installation temperature	**: Ts = 20°C**
The pipe length	**: L = 30m** (the length between main fix points on straght line)
Pressure	**: 5kgf/cm^2**
The thermal coefficient of pipe	**: =12.0 × 10^{-3} mm/m/°C**

△ **L = (Tmax - Tmin) × β × L = [160 - (-10)] × 12.0 × 10^{-3} × 30 = 61.2mm**

E Reference Data

■ The Thermal Expansion of Pipe



β=10-3mm/m/°C

Max. Temp. \ Min. Temp.	40	30	20	10	0	-10	-20	-30	-40
-40	11.1	11.1	11.0	10.0	10.9	10.9	10.8	10.8	
-30	11.2	11.1	11.0	11.0	10.9	10.9	10.9		10.8
-20	11.2	11.0	11.0	11.0	11.00	11.0		10.9	10.8
-10	11.3	11.2	11.1	11.0	11.00		11.0	10.9	10.9
0	11.4	11.3	11.2	11.1		11.0	11.0	10.9	10.9
10	11.4	11.4	11.2		11.1	11.0	11.0	11.0	10.9
20	11.6	11.5		11.2	11.2	11.1	11.0	11.0	11
30	11.6		11.5	11.4	11.3	11.2	11.1	11.1	11.1
40		11.6	11.6	11.4	11.4	11.3	11.2	11.2	11.1
50	11.9	11.8	11.7	11.6	11.5	11.4	11.3	11.3	11.2
60	11.9	11.8	11.7	11.6	11.5	11.4	11.4	11.3	11.3
70	11.9	11.8	11.7	11.7	11.6	11.5	11.4	11.4	11.3
80	12.1	12.0	11.9	11.8	11.7	11.6	11.6	11.5	11.5
90	12.1	12.1	12.0	11.9	11.8	11.7	11.6	11.6	11.5
100	12.1	12.1	12.0	11.9	11.8	11.7	11.6	11.6	11.5
120	12.1	12.1	12.0	11.9	11.9	11.8	11.7	11.7	11.6
140	12.2	12.1	12.1	12.00	11.9	11.9	11.8	11.8	11.7
160	12.3	12.2	12.2	12.1	12.0	12.0	11.9	11.9	11.8
180	12.4	12.3	12.3	12.2	12.2	12.1	12.0	11.9	11.9
200	12.4	12.4	12.3	12.3	12.2	12.2	12.1	12.1	12
220	12.6	12.5	12.5	12.4	12.3	12.3	12.2	12.2	12.1

E Reference Data

Designtion		STS 304		STS 304L		STS 316		STS 316L		STS 316J1		STS 316J1L		STS 317		STS 317L		STS 321		STS 405	STS 410	STS 430
Composition Min. Required		18Cr, 8Ni		18Cr, 8Ni, min.C		16Cr, 12Ni, 2Mo		16Cr, 12Ni, 2Mo, min.C		18Cr, 12Ni, 2Mo, 2Cu		18Cr, 12Ni, 2Mo, 2Cu, min.C		18Cr, 12Ni, 3Mo		18Cr, 13Ni, 3Mo, min.C		18Cr, 10Ni, Ti		13Cr-Al	12Cr	16Cr
Min. Required Stress		53		49		53		49		53		49		53		49		53		42	45	46
The Allowable Stress for a Temperature (℃ / kgf / ㎟)	-30	13.1	13.1	11.3	11.3	13.1	13.1	11.3	11.3	13.1	13.1	11.3	11.3	13.1	13.1	11.3	11.3	13.1	13.1	-	-	-
	-10	13.1	13.1	11.3	11.3	13.1	13.1	11.3	11.3	13.1	13.1	11.3	11.3	13.1	13.1	11.3	11.3	13.1	13.1	10.5	11.0	11.5
	0	13.1	13.1	11.3	11.3	13.1	13.1	11.3	11.3	13.1	13.1	11.3	11.3	13.1	13.1	11.3	11.3	13.1	13.1	10.5	11.3	11.5
	40	13.1	13.1	11.3	11.3	13.1	13.1	11.3	11.3	13.1	13.1	11.3	11.3	13.1	13.1	11.3	11.3	13.1	13.1	10.5	11.3	11.5
	75	11.9	12.1	11.3	11.3	11.9	12.6	11.3	11.3	11.9	12.6	11.3	11.3	11.9	12.6	11.3	11.3	12.1	12.3	10.2	11.0	11.0
	100	11.1	11.6	10.6	11.3	11.2	12.3	11.3	11.3	11.2	12.3	11.3	11.3	11.2	12.3	11.3	11.3	11.5	11.7	10	10.8	11.0
	125	10.4	11.3	9.3	11.3	10.70	12.1	10.7	11.3	10.2	12.1	10.7	11.3	10.70	12.1	10.7	11.3	11.1	11.4	10.9	10.7	13.7
	150	9.6	10.9	9.2	11.2	10.20	11.9	10.0	11.1	10.7	11.9	10	11.1	10.20	11.9	10.7	11.1	10.7	11.1	9.7	10.5	10.5
	175	9.2	10.7	8.5	10.9	9.9	11.7	9.3	10.8	9.9	11.7	9.3	10.8	9.9	11.7	9.7	10.8	10.5	11	9.6	10.4	10.4
	200	8.7	10.5	7.8	10.6	9.6	11.5	8.6	10.4	9.6	11.5	8.6	10.4	9.6	11.5	8.6	10.4	10.2	1.9	9.4	10.2	10.2
	225	8.4	10.4	7.4	10.3	9.3	11.4	8.2	10.2	9.3	11.4	8.2	10.2	9.3	11.4	8.2	10.2	9.9	10.8	9.2	10.0	10
	250	8.1	10.3	7	10	9.0	11.3	7.9	9.9	9.0	11.3	7.9	9.9	9.0	11.3	7.9	9.9	9.6	10.7	9.1	9.8	9.8
	275	7.9	10.2	6.7	9.7	8.7	11.2	7.5	9.8	8.7	11.2	7.5	9.8	8.7	11.2	7.5	9.8	9.4	10.6	8.9	9.7	9.7
	300	7.7	10.1	6.4	9.3	8.5	11.2	7.3	9.6	8.5	11.2	7.3	9.6	8.5	11.2	7.3	9.6	9.1	10.6	8.8	9.5	9.5
	325	7.6	10.1	6.3	9	8.3	11.2	7.0	9.5	8.3	11.2	7	9.5	8.3	11.2	7.0	9.5	8.9	10.6	8.7	9.4	9.4
	350	7.5	10.0	6.1	8.7	8.1	11.2	6.8	9.4	8.1	11.2	6.8	9.4	8.1	11.2	6.8	9.4	8.7	10.6	8.5	9.3	9.3
	375	7.4	10.0	6	8.4	7.9	11.2	6.6	9.3	7.9	11.2	6.6	9.3	7.9	11.2	6.6	9.3	8.6	10.6	8.4	9.1	9.1
	400	7.3	9.9	5.8	8.1	7.7	11.1	6.4	9.1	7.7	11.1	6.4	9.1	7.7	11.1	6.4	9.1	8.5	10.6	8.1	8.8	8.8
	425	7.2	9.8	5.7	7.8	7.6	10.9	6.2	8.9	7.6	10.9	6.2	8.9	7.6	10.9	6.2	8.9	8.4	10.6	7.8	8.5	8.5
	450	7.1	9.7	-	-	7.5	10.8	6.0	8.7	7.5	10.8	6.0	8.7	7.5	10.8	6.0	8.7	8.2	10.6	7.4	8.0	8.0
	475	7.0	9.6	-	-	7.3	10.5	-	-	7.3	10.5	-	-	7.3	10.5	-	-	8.0	10.5	6.9	7.5	7.5
	500	6.9	9.5	-	-	7.2	10.3	-	-	7.2	10.3	-	-	7.2	10.3	-	-	7.8	10.4	9.2	6.6	6.6
	525	6.7	9.1	-	-	7.0	10.0	-	-	7.0	10	-	-	7.0	10	-	-	7.7	10.1	4.2	5.3	5.4
	550	6.5	8.4	-	-	6.8	9.6	-	-	6.8	9.6	-	-	6.8	9.6	-	-	7.6	9.3	2.8	3.8	4.0
	575	6.1	7.2	-	-	6.7	9.0	-	-	6.7	9	-	-	8.6	9	-	-	7.1	7.8	-	2.7	2.9
	600	5.6	5.8	-	-	6.5	8.0	-	-	6.5	8	-	-	6.5	8	-	-	5.9	5.9	-	1.8	2.1
	625	4.7	4.7	-	-	6.9	6.4	-	-	5.9	6.4	-	-	5.9	6.4	-	-	4.1	4.1	-	1.1	1.6
	650	3.8	3.8	-	-	4.8	4.8	-	-	4.8	4.8	-	-	4.8	4.8	-	-	3.1	3.1	-	0.7	1.2
	675	3.1	3.1	-	-	3.8	3.8	-	-	3.8	3.8	-	-	3.8	3.8	-	-	2.4	2.4	-	-	-
	700	2.5	2.5	-	-	3.0	3.0	-	-	3.0	3	-	-	3.0	3	-	-	1.7	1.7	-	-	-
	725	2.0	2.0	-	-	2.1	2.1	-	-	2.1	2.1	-	-	2.1	2.1	-	-	1.2	1.2	-	-	-
	750	1.6	1.6	-	-	1.6	1.6	-	-	1.6	1.6	-	-	1.6	1.6	-	-	0.9	0.9	-	-	-
	775	1.3	1.3	-	-	1.2	1.2	-	-	1.2	1.2	-	-	1.2	1.2	-	-	0.7	0.7	-	-	-
	800	1.0	1.0	-	-	0.9	0.9	-	-	0.9	0.9	-	-	0.9	0.9	-	-	0.6	0.6	-	-	-

E Reference Data

■ Corrosion Table

Corrosive Medium	Concentration	Temperature	STS 304	STS 316	STS 410	STS 430
Nitric Acid	5%	20°C	A	A	A	A
	20%	20°C	A	A	A	A
	50%	boiling	A	A	-	A
		"	D	D	E	D
Sulphuric Acid	5%	20°C	C	B	-	C
	5%	boiling	E	C	-	E
	50%	20°C	D	C	-	-
	50%	boiling	E	D	-	E
		20°C	A	A	-	A
		boiling	D	D	-	D
Hydrochloric Acid		20°C	E	E	E	E
Phosphoric Acid	1%	20°C	++A	++A	++A	++A
	5%	20°C	A	A	A	A
	10%	20°C	C	A	D	D
oxalic Acid	5%	20°C~boiling	A	A	B	A
	10%	boiling	D	C	-	-
Acetic Acid	5~10%	20°C	A	A	A	A
	20~100%	20°C	A	A	C	B
	50%	boiling	C	B	-	-
Latic Acid	5%	20°C	A	A	C	B
	5%	65°C	B	A	C	B
	10%	boiling	B	A	-	-
Citric Acid	5%	20~65°C	A	A	A	A
	15%	boiling	A	A	-	B
Chrom Acid	5%	20°C	A	A	-	B
	10%	20°C	C	B	-	D
Fluorine		20°C	E	E	E	E
Chorine Gas	dry	20°C	C	B	-	C
	humidy	20°C	D	C	-	D
Carbon Tetrachloride	pure	20°C	E	D	-	E
	5~10%	20°C	*C	*B	D	*C
Carbonic Acid		20°C	A	A	-	A
Tartaric Acid		20°C	A	A	C	C
Oleic Acid		20°C	*A	A	-	*B

E Reference Data

■ Corrosion Table

Corrosive Medium	Concentration	Temperature	STS 304	STS 316	STS 410	STS 430
Ammonia(ℓ)		20°C	A	A	-	A
Ammonia gas		50°C	-	D	-	D
Calcium Hydroxide	10~20%	boiling	A	A	-	-
	50%	"	C	B	-	-
			A	A	-	A
	5%	20~65°C	A	A	A	A
	all concentration	20°C	A	A	A	A
	5~10%	20~65°C	A	A	-	C
	1~5%	20°C	A	A	B	A
	5~20%	20~65°C	*A	A	*B	*B
	saturated	boiling	B	A	-	-
	5%	20°C	*A	*A	-	*A
	5~saturated	20°C	A	A	-	A
	1%	20°C	++*B	*A	C	*B
	5%	20°C	++*D	*C	D	*D
Ethyl Alcohol		20°C~boiling	A	A	-	A
Methyl Alcohol		20°C	A	A	-	A
		65°C	*C	B	-	C
Carbonated Water			A	A	A	A
		20°C	*A	A	A	A
Sea Water			*A	*A	-	*C
Milk		65°C	A	A	B	A
Molasses			A	A	-	A
Gasoline			A	A	A	A
Juice			A	A	A	A
Mayonnaise		20°C	*A	A	-	-
Glycerime			A	A	A	A
Catchup		20°C	*A	A	*A	A
Coffee		boiling	A	A	A	*A
Beer			A	A	-	-

A : fully corrosion resistance, less than 0.0089mm/month
B : sufficient corrosion resistance, 0.0089~0.089mm/month
C : practically corrosion resistance, 0.089~0.25mm/month
D : limited in corrosion resistance,0.25~0.89mm/month
E : absolutely not corrosion resistance, more than 0.89mm/month
+ : could be easily attacked by sulfric acid, if existed
++: could be easily attacked by hydrochloric acid, if existed

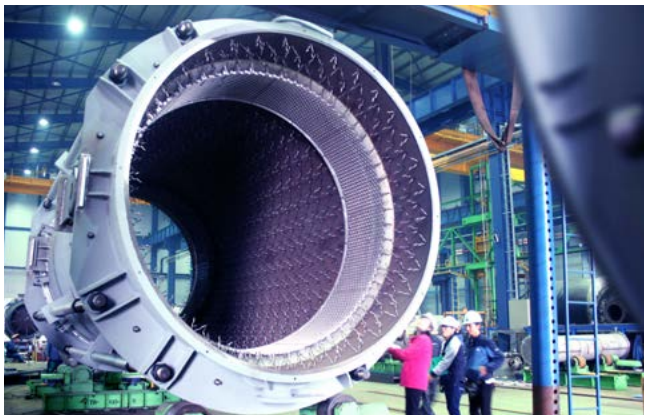
EXPERIENCE RECORDS

Latest Projects

▲ RAPID P1 PROJECT EXPANSION JOINTS SUPPLY VIEW

Expansion Joint for FCCU

for PETRONAS RAPID Package 1 PROJECT, MALAYSIA



▲ *Inspection View Before Refractory of Cold Wall Expansion Joint for FCCU*

PETRONAS Refinery and Petrochemical Integrated Development (RAPID)

Megaflexon achieved the feat of winning the first $10 million expansion joints supply through competing with US and European manufacturers for the RAPID Package 1 project from Malaysia's state-owned oil refinery PETRONAS.

As we have successfully manufactured and supplied a total of 36 sets to the PETRONAS RAPID project Package1 RFCC Unit, PETRONAS has satisfied with the quality and service so assigned Megaflexon as the best supplier. All of supplied expansion joints that we have manufactured are currently in perfect operating condition till now.

- ***Year*** ***: 2017***
- ***Owner*** ***: PETRONAS, MALAYSIA***
- ***Total Q'ty*** ***: 36sets***
- ***Type & Size*** ***: Tied Universal Expansion joint 12 sets***
  DN 3200, DN 2900, DN 2400
  Double Gimbal Expansion joint 8 sets
  DN 2900, DN 2400, DN 1960
  Single Gimbal Expansion joint 4 sets
  DN 1200
  Single Hinge Expansion joint 12 sets
  DN 2900, DN 2400, DN 1960, DN 1860

▲ *Tied Universal Type Expansion Joints*

▲ *Dual Gimbal Type Expansion Joint*

▲ *Dual Hinge Type Expansion Joints*

▲ *Inspection View*

▲ *Shipping View*

Tied Universal Type Metal Expansion Joints

for MAMMOTH PACIFIC, U.S.A

Megaflexon has successfully manufactured and delivered a total of 6 Tied Universal Type Metal Expansion Joints to the Mammoth Pacific geothermal power plant in U.S.A.
Tied Universal Type Metal Expansion Joint manufactured this time is 78 inches in diameter and 3800 mmL in length, and is mounted on the turbine unit of a power plant.

- ***Year*** *: 2021*
- ***Owner*** *: Mammoth Pacific, U.S.A.*
- ***Total Q'ty*** *: 6sets*

Tied Universal Type Metal Expansion Joint

- *Size : 78"(DN 1950) x 3800mmL*
- *Design Press. : 8.3 barG (F.V.)*
- *Design Temp. : 120°C (Int.)*

Materials

- *Bellows : UNS No. N08810*
- *Pipe : ASTM A358 TP 304H*
- *Hardware : ASTM A240 304H*

Design Code & Standard

- *EJMA 10th Edition*
- *ASME B31.3 2018 Edition Process Piping*
- *ASME Sec. V 2019 Edition*
- *ASME Sec.Ⅷ Div.1 2019 Edition*
- *ASME Sec. IX 2019 Edition*

High Temp. & Press. Gimbal Expansion Joints

for HYUNDAI CHEMICAL HPC PROJECT, KOREA

Megaflexon has successfully manufactured and delivered high-temperature & high-pressure 6 Single Gimbal Type Metal Expansion Joints, 3 Dual Gimbal Type Metal Expansion Joints, 4 Tied Universal Type Metal Expansion Joints, and a total of 13 units for the Hyundai Chemical HPC Project, KOREA.

- ***Year*** *: 2021*
- ***Owner*** *: Hyundai Chemical HPC Project, KOREA*
- ***Total Q'ty*** *: 13sets*

Single Gimbal Type Metal Expansion Joint

- *Size : 30"(DN 750) x 1000mmL*
- *Design Press. : 36.7 kg/㎠G*
- *Test Press. : 55.05 kg/㎠G*
- *Design Temp. : 125°C / -18°C*

Single Gimbal Type Metal Expansion Joint

- *Size : 42"(DN 1050) x 1000mmL*
- *Design Press. : 45.9 kg/㎠G*
- *Test Press. : 68.85 kg/㎠G*
- *Design Temp. : 130°C / -18°C*

Dual Gimbal Type Metal Expansion Joint

- *Size : 30"(DN 750) x 3500mmL*
- *Design Press. : 36.7 kg/㎠G*
- *Test Press. : 55.05 kg/㎠G*
- *Design Temp. : 125°C / -18°C*

Dual Gimbal Type Metal Expansion Joint

- *Size : 42"(DN 1050) x 3500mmL*
- *Design Press. : 45.9 kg/㎠G*
- *Test Press. : 68.85 kg/㎠G*
- *Design Temp. : 130°C / -18°C*

& Others

▲ *Reinforcing Rings for High-Pressure*

Design Code & Standard

- *ASME B31.3 2018 Edition Process Piping*
- *EJMA 10th Edition*
- *ASME BPVC Sec. V 2019 Edition*
- *ASME BPVC Sec.Ⅷ Div.1 2019 Edition*
- *ASME BPVC Sec.IX 2019 Edition*

Materials

- *Bellows : ASME SB-168 ALLOY 600*
- *Pipe : ASTM A516 Gr 70N*
- *Hardware : ASTM A105N for Gimbal Ring*
- *ASTM A516 Gr 70 for Gimbal Arm*
- *ASTM A240-304 for Cover etc.*

High-Temperature Metal Expansion Joints

for PDH POLSKA OLEFLEX CCR, POLAND

Megaflexon has successfully manufactured and supplied 12 high-temperature metal expansion joints to Polska Oleflex CCR PDH plant in Poland.

- ***Year*** *: 2020*
- ***Owner*** *: Polska Oleflex CCR, POLAND*
- ***Total Q'ty*** *: 12sets*

Dual Hinge with Tie Rod Type Metal Expansion Joint

- *Size : 32"(DN800) x 9346mmL*
- *Design Press. : 535 kPaG*
- *Design Temp. : 600°C*

Design Codes

- *EJMA 10th Edition*
- *ASME B31.3 2018 Edition Process Piping*
- *UOP Standard Specification for Metal Expansion Joint*

Materials

- *Bellows : UNS No. N08810*
- *Pipe : ASTM A358 TP 304H*
- *Hardware : ASTM A240 304H*

High-Temperature Metal Expansion Joints

for MOH (MOTOR OIL HELLAS MODULAR CCR) PROJECT, GREECE

- ***Year*** *: 2020*
- ***Owner*** *: MOH (Motor Oil Hellas Modular CCR), GREECE*
- ***Total Q'ty*** *: 6sets*

Megaflexon has manufactured and supplied 6 sets of high-temperature Metal Expansion Joints used in the MOH (Motor Oil Hellas Modular CCR) Project CCR Unit, the largest oil refinery in Greece.

Dual Hinge Type Metal Expansion Joint

- *Size : 16"(DN400) x 3440mmL*
- *Design Press. : 4.5 kg/cm2G*
- *Design Temp. : 580°C*

Dual Gimbal Type Metal Expansion Joint

- *Size : 16"(DN400) x 4505mmL*
- *Design Press. : 4.5 kg/cm2G*
- *Design Temp. : 580°C*

Design Codes

- *EJMA 10th Edition*
- *ASME B31.3 2018 Edition Process Piping*
- *UOP Standard Specification for Metal Expansion Joint*

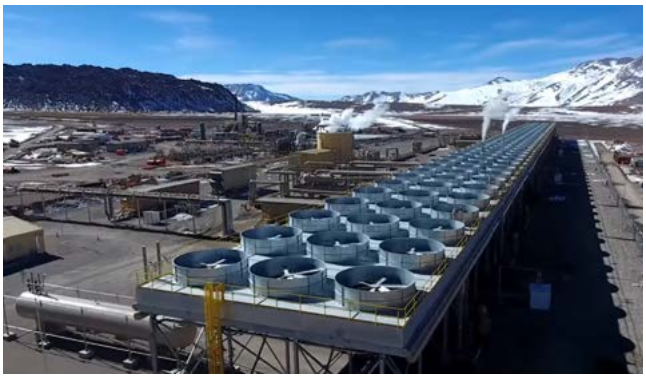
Materials

- *Bellows : UNS No. N08800*
- *Pipe : ASTM A358 TP 316H*
- *Hardware : ASTM A240 304H*

L-Type Pressure Balanced Expansion Joint

for CERRO PABELLON GEOTHERMAL POWER PLANT, CHILE

▲ *L-Type Pressure Balanced Expansion Joint*



Cerro Pabellón, South America's first geothermal power plant and the world's first large-scale plant

MEGAFLEXON has designed, manufactured and tested a large number of high-quality custom made L-Type Pressure Balanced Expansion Joints for Cerro Pabellon, South America's First Geothermal Power Plant.

- ***Year*** : *2019*
- ***Owner*** : *ENEL AND ENAP, CHILE*
- ***Total Q'ty*** : *6sets*
- ***Size*** : *66"(DN1650) x 6700mmL 2sets*
  56" (DN1400) x 5382mmL 4sets

Design Codes

- *EJMA 10th Edition*
- *ASME B31.3 2018 Edition Process Piping*

Materials

- *Bellows* : *ASTM A240-321UNS No. N08800*
- *Pipe* : *ASTM A516 Gr 70*
- *Hardware* : *ASTM A516 Gr 70*

Flanged and Flued Type Expansion Joint

for CALCASIEU PASS LNG EXPORT TERMINAL, USA

▲ *Bellows Thickness Measuring (35T)*

Calcasieu Pass LNG is a ten million tonnes per annum (Mtpa) LNG export terminal to be developed by Venture Global Calcasieu Pass, a subsidiary of Venture Global LNG, in Louisiana, US.

- ***Year*** : *2019*
- ***Owner*** : *VENTURE GLOBAL LNG, USA*
- ***Total Q'ty*** : *6sets*
- ***Size*** : *I.D. 1448mm x O.D. 2000mm x 1340mmL, t35*
- ***Material*** : *ASTM A516 Gr 70*

※ *Manufactured according to ASME "U" Stamp Program*

Dual Hinged Expansion Joint

For NGHI SON REFINERY PLANT, VIETNAM

- ***Year*** : *2019*
- ***Owner*** : *NSRP (NGHI SON Refinery Plant), VIETNAM*
- ***Total Q'ty*** : *7ets*
- ***Size*** : *34" (DN 850) x 4891mmL* — *1set*
  24" (DN 600) x 1995mmL — *1set*
  34" (DN 850) x 11515mmL — *1set*
  12" (DN 300) x 5916mmL — *1set*
  34" (DN 850) x 12391mmL — *1set*
  16" (DN 400) x 4255mmL — *1set*

NGHI SON refinery has a designed capacity of 10 million tons of crude oil per year.

All the expansion joints are designed based on the following:

- *ASME B31.3, BPVC Section II , Part D(Metric)*
- *EJMA 10th Edition,*
- *ASME B31.3 2016 Edition Process Piping,*
- *ASME BPVC Section V 2017 Edition,*
- *Asme bpvc Section VI 2017 Edition*

All bellows meet the requirement of min. 10,000 Cycles.
All the designs are satisfied with the concurrent movements according to the data sheet.
Our expansion joint are produced by hydraulic mandrel punch forming.

Floating Type Dual Gimbal Expansion Joint

(HOT WALL CONDITION) FOR CPC RFCC, TAIWAN

CPC now operates two refineries in Taiwan - at Taoyuan in the north and Dalin in the south - with a combined daily refining capacity of 600,000 barrels.

Megaflexon has successfully designed, manufactured and tested a FCCU expansion joint universal double gimbal cold wall design for CPC RFCC in TAIWAN.

The expansion joint, designed for 3.4 kg/cm² and a temperature of 538 °C(PIPE), and 777°C (bellows).

- ***Year*** : *2015*
- ***Owner*** : *CPC Corporation, TAIWAN*
- ***Total Q'ty*** : *6sets*
- ***Size*** : *98"(DN2450) x 13800mmL*
- ***Design Pressure*** : *3.4 kg/cm²*
- ***Design Temp.*** : *Bellows (777°C) / Pipe (538 °C)*
  Hot Wall Floating Type

Floating Pantograph Type (Hot Wall Condition) Installation View

Expansion Joint for PDH Project

for SK GAS ULSAN PDH PLANT, KOREA


▲ Dual Gimbal Type Expansion Joint installation View

Megaflexon has successfully manufactured and supplied a total of 138 high-temperature Expansion Joints such as Pantograph type, Gimbal type, Hinge type, etc. to SK GAS Ulsan PDH plant, the one of the largest world's PDH plant.

- ***Year*** : *2014*
- ***Owner*** : *SK GAS, KOREA*
- ***Total Q'ty*** : *138sets*
- ***Single Slotted Hinge Type*** *78"(DN1950) x 1850mmL*
- ***Single Gimbal Type*** *96"(DN2400) x 1950mmL*
- ***Universal Pantograph Type*** *96"(DN2400) x 4400mmL*

& others

Design Codes

- *EJMA 10th Edition*
- *ASME B31.3 2018 Edition Process Piping*

In-line Pressure Balanced Expansion Joint

for SHUWEIHAT S2 IWPP, UAE

The site of the SHUWEIHAT "S2" Independent Water and Power Project in Abu Dhabi, the United Arab Emirates.
Megaflexon has successfully designed, manufactured and delivered in-line pressure balanced expansion joints for the SHUWEIHAT "S2" independent water and power project in Abu dhabi, the United Arab Emirates.

- ***Year*** : *2010*
- ***Owner*** : *SHUWEIHAT S2, UAE*
- ***Total Q'ty*** : *48sets*
- ***Size*** : *96"(DN2400) X 3200mmL, etc.*
- ***Design Con.*** : *260 °C / 5 kg/cm2 FULL VACCUM*
- ***Bellows Materials*** : *ASTM A240-316, 2Plies*

L-Type Pressure Balanced Expansion Joint

for STEAM TURBINE PIPE LINE OF QATAR PETROCHEMICAL COMPANY (QAPCO) , QATAR

After many successful contracts, megaflexon has established itself as the leading supplier in the expansion joint market
Megaflexon reinforced its position with the contract to provide expansion joints for the The Qatar Petrochemical Company (QAPCO).

- ***Year*** : *2009*
- ***Owner*** : *QAPCO, QATAR*
- ***Total Q'ty*** : *12sets*
- ***Size*** : *60"(DN1500) X 6100mmL*
- ***DESIGN CON.*** : *649 ℃ / 2.81 kg / cm2g*

Qatar Petrochemical Company is one of the world's largest and most successful producers of low-density polyethylene.

Metal Expansion Joint with Reinforcing Rings

for POSCO (POHANG IRON AND STEEL COMPANY), KOREA

Megaflexon has designed, manufactured, tested and delivered a number of 2 special high tech metal expansion joints with reinforcing rings for Posco, Korea

- ***Year*** : *2019*
- ***Owner*** : *POSCO, KOREA*
- ***Total Q'ty*** : *2ets*
- ***Size*** : *30" (DN750) X 800mmL*
- ***Press. Test*** : *Hydrostatic Test Press 22.5kg/㎠*
  Pneumatic Test Press 16.5kg/㎠
- ***Design Press.*** : *15kg/㎠*

▲ *Detail of Reinforcing Rings*

POSCO is a South Korean steel-making company. It had an output of 42 million tonnes of crude steel in 2015, making it the world's fourth-largest steelmaker by this measure. In 2010, it was the world's largest steel manufacturing company by market value.

L-Type Pressure Balanced Expansion Joint

for LUNGMEN NUCLEAR POWER PLANT, TAIWAN

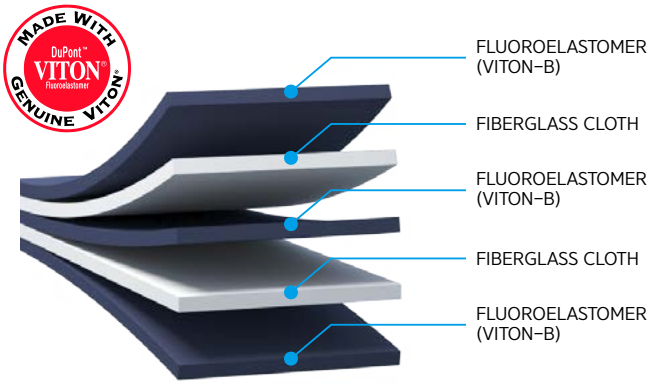
The Lungmen Nuclear Power Plant is an nuclear power plant in New Taipei City, Taiwan. It consists of two ABWRs each of 1,300 MWe net. It is owned by Taiwan Power Company (Taipower).

- ***Year*** : *2008*
- ***Owner*** : *Taiwan Power Company , TAIWAN*
- ***Total Q'ty*** : *6ets*
- ***Size*** : *84"(DN2100) X 6600mmL*
- ***Design*** : *152 °C / 241 kPaG / FULL VACUUM*
- ***Application*** : *Steam Turbine Pipe Line*

Rectangular Type Fabric Expansion Joint

for CENTRAL JAVA POWER PLANT, INDONESIA

▲ *Rectangular Type Fabric Expansion Joints*



▲ *Flue Gas Expansion Material Composition*

- ***Year*** : *2017*
- ***Owner*** : *Central Java Power Plant, INDONESIA*
- ***Total Q'ty*** : *48ets*
- ***Size*** : *1600 x 6000 x 160mmL*

Central Java Power Plant (CJPP) is an ultra critical Coal-fired power plant with 2 x 1,000 MW capacity in Batang Regency, Central Java.

Rounded Corner Type Rectangular Expansion Joint

for KOREA MIDLAND POWER, KOREA

▲ *Rounded Corner Type Rectangular Expansion Joint*

Korea Midland Power (KOMIPO): operates the Boryeong Thermalelectric Power Plant Site Division and the Yeongheung Thermal Power Plant, and possesses 9,399 MW in total installed capacity (as of Dec. 2010).

- ***Year*** : *2015*
- ***Owner*** : *Korea Midland Power, KOREA*
- ***Total Q'ty*** : *115ets*
- ***Size*** : *2000mm x 2830 x 400mmL 106 sets*
  4300mm x 5700 x 400mmL 9 sets

ISO 9001
ISO 14001
ISO 45001

MEGA FLEXON

EXPANSION JOINT & FLEXIBLE PRODUCTS

Megaflexon Co., Ltd

#78-12, Seungga-ro 76beon-gil, Gimpo-si, Gyeonggi-do, Korea

Tel:82-31-981-2381~3 / Fax:82-31-981-2384

E-mail: sales@megaflexon.com (for Domestic) / info@megaflexon.com (for International)

www.megaflexon.com

EXPANSION JOINT & FLEXIBLE PRODUCTS
BEST Quality
Since 1986