

A LONG LEGACY OF PRECISION PRODUCTS

Precision Hose & Expansion Joints is one of a very few American companies that manufacture a complete line of metal hose, wire braid, round metal expansion joints, metallic flue duct expansion joints, non-metallic flue duct expansion joints and rubber pressure piping expansion joints. With over 65 years of being in the metal hose and expansion joint business—dating back to the early 1950's—the owners of Precision Hose & Expansion Joints have over 130 years combined experience in this industry.

Our 105,000 square foot manufacturing facility is located on 6 acres in Stone Mountain, Georgia. The plant was designed totally for the state of the art manufacturing of metal hose and expansion joints. We would certainly welcome you to visit our company on your next visit to the Atlanta area.

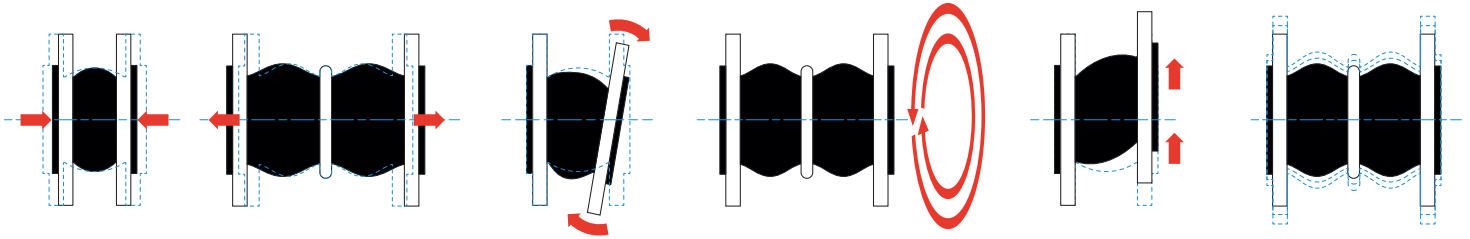
Quality, service and fair pricing is the basis on how we operate our business.

RUBBER EXPANSION JOINTS

PRECISION
HOSE & EXPANSION JOINTS

QUALITY ASSURANCE

Precision Hose & Expansion Joints manufactures to the highest quality standards in the industry. We can offer additional tests, if required, such as hydrostatic, cycle life, and burst testing. Precision Hose & Expansion Joints continually strives for better products and to improve the efficiency of our service without compromising standards. These product and quality improvements are from the standard catalog item to the more complicated aerospace product lines. Our rubber expansion joints are designed and built to the specifications outlined in the Fluid Sealing Association Technical Handbook 7th edition Non-Metallic Expansion Joints and Flexible Pipe Connections.



FUNCTION AND MOVEMENTS

Rubber expansion joints are designed to reduce vibration and dampen sound transmission. They are also designed to take the following movements: Compression, Extension, Angular, Torsional and Lateral.

SIZE RANGES AVAILABLE

We offer rubber expansion joints from 1/2" to 120" diameter and provide same day shipment for rubber expansion joint sizes from 1/2" through 24". Other sizes are available on special order.

MATERIALS AVAILABLE

Our rubber expansion joints are available in EPDM, Neoprene, Nitrile, Chlorobutyl, Butyl, Nitrile, Hypalon®, Viton® and Natural Rubber. Others materials are available on request.

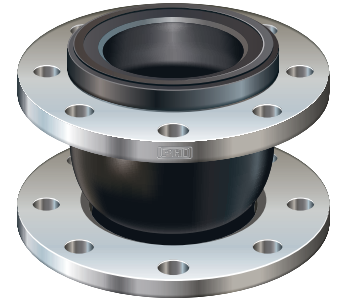
**Our expansion joints
are manufactured to the
highest quality standards
in the industry.**

Rubber Expansion Joints

Single Arch

Style: SA

Single Arch style molded rubber expansion joints are designed to absorb movements and stress on piping systems, compensate for pipe misalignment, reduce vibration and system noise. They also protect against start-up forces as well as system surges. All SA style joints come standard with ANSI 150# solid floating metallic flanges. The design of the SA style does not contain any metallic reinforcement in the carcass of the bellows. Instead the carcass has a minimum of four layers of high tensile synthetic fabric. Each layer is impregnated with a rubber or synthetic compound. This allows movement and flexibility between the layers of fabric. The SA style design has a long radius arch allowing for self cleaning and thus eliminating the need for a filled arch. The SA style is the most economic choice when it comes to rubber expansion joints. The SA style is available on request to meet the requirements of the U.S.C.G.



Size Nominal Diameter	Length OAL	PHI PART Number ⁶	Allowable Movement				Operating Condition		Weight (lbs)	
			Axial Compression	Axial Extension	Lateral Deflection	Angular Deflection	Max w.p. (psi) ^{3,4}	Max Vacuum (in. of Hg) ⁵	Exp. Joint + Flanges	Control Unit (2 Rod) ^{1,2}
1"	6"	SA-16-"XX"	1/2"	3/8"	± 1/2"	37°	225	26	3.75	5.50
1-1/4"	6"	SA-20-"XX"	1/2"	3/8"	± 1/2"	31°	225	26	4.75	5.50
1-1/2"	6"	SA-24-"XX"	1/2"	3/8"	± 1/2"	27°	225	26	5.75	5.50
2"	6"	SA-32-"XX"	1/2"	3/8"	± 1/2"	20°	225	26	8.25	6.75
2-1/2"	6"	SA-40-"XX"	1/2"	3/8"	± 1/2"	17°	225	26	10.25	7.50
3"	6"	SA-48-"XX"	1/2"	3/8"	± 1/2"	14°	225	26	13.50	7.75
3-1/2"	6"	SA-56-"XX"	1/2"	3/8"	± 1/2"	12°	225	26	17.50	7.75
4"	6"	SA-64-"XX"	3/4"	1/2"	± 1/2"	14°	225	26	17.75	7.00
5"	6"	SA-80-"XX"	3/4"	1/2"	± 1/2"	11°	225	26	21.25	7.50
6"	6"	SA-96-"XX"	3/4"	1/2"	± 1/2"	9°	225	26	24.75	8.50
8"	6"	SA-128-"XX"	3/4"	1/2"	± 1/2"	7°	225	26	38.00	11.25
10"	8"	SA-160-"XX"	1"	5/8"	± 3/4"	7°	225	26	57.00	24.50 ¹
12"	8"	SA-192-"XX"	1"	5/8"	± 3/4"	6°	225	26	80.00	26.00 ¹
14"	8"	SA-224-"XX"	1"	5/8"	± 3/4"	5°	150	26	104.00	31.00 ¹
16"	8"	SA-256-"XX"	1"	5/8"	± 3/4"	4°	150	26	129.00	38.50 ²
18"	8"	SA-288-"XX"	1"	5/8"	± 3/4"	4°	150	26	137.00	41.00 ²
20"	8"	SA-320-"XX"	1"	5/8"	± 3/4"	3°	150	26	167.00	41.75 ²
22"	10"	SA-352-"XX"	1"	5/8"	± 3/4"	3°	150	26	181.00	50.25 ²
24"	10"	SA-384-"XX"	1"	5/8"	± 3/4"	3°	150	26	194.00	58.75 ²

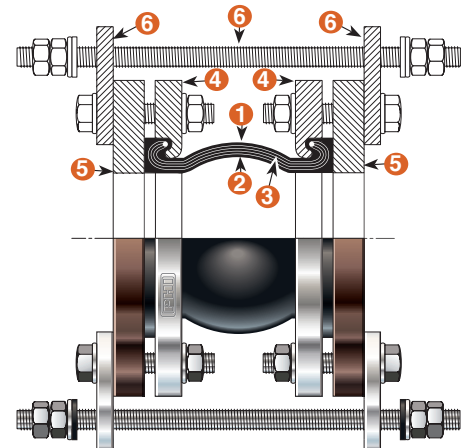
Remarks

- The joint body is available in 3 standard combinations of the (tube/cover): EPDM/EPDM, Neoprene/Neoprene, and Nitrile/Neoprene. The body components (tube/cover) are also available in a combination of the following additional materials on special order: Neoprene, EPDM, Chlorobutyl, Butyl, Nitrile, Hypalon®, Viton®, natural rubber etc. Please see the materials table to determine what material is best for your application.
- Standard flange drilling is ANSI 150#. Also available ANSI 25/125/250/300#, Navy, DN, BS, and JIS Drilling as well as others.
- Standard flange material is carbon steel with a plated rust inhibitor. Also available T-304, T-316 and other alloys.
- All Movements are non-concurrent. Contact Precision Hose & Expansion Joints to determine if your concurrent movements are acceptable.
- Please see "Control Unit" table to determine if your application requires control units. Control units must be used to protect the joint if the piping is not properly anchored. Control units are sold separately from the rubber joint.
- Gaskets are not required with the SA series rubber joint as long as a "flat-face" type mating flange is used. If this is not an option and a "raised face" type flange is used a ring gasket should be used to avoid cutting the sealing face of the rubber bead.



NOTES

- Control unit (3 Rod) Standard
- Control unit (4 Rod) Standard
- Maximum working pressure is based on 190° F. See Temperature vs. Pressure chart for operating temperatures above 190° F.
- Test pressure is 1.5 times working pressure. Burst pressure is approximately 4 times maximum working pressure.
- The vacuum rating is based on the joint installed in the neutral length. Joints should not be installed in the extended position on vacuum applications. Please advise if the joint will be subjected to full vacuum. The use of an internal vacuum ring may be necessary.
- "XX" in the part number is to be replaced by the appropriate body material code.

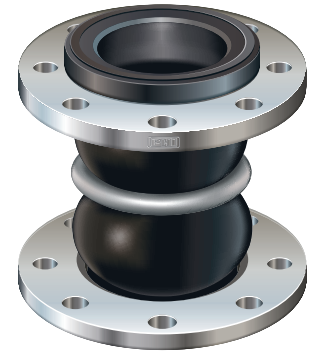


Item #	Part
1	Cover
2	Tube
3	Carcass
1+2+3	Body
4	EJ Flange
5	Mating Flange
6	Control Unit

Dual Arch

Style: DA

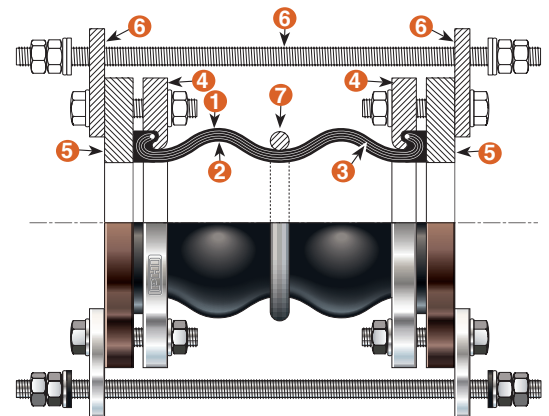
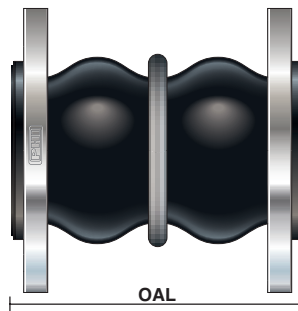
Dual Arch style molded rubber expansion joints are designed to absorb movements and stress on piping systems, compensate for pipe misalignment, reduce vibration and system noise. The style DA protects against start-up forces as well as system surges. All DA style joints come standard with ANSI 150# solid floating metallic flanges and metallic root rings. The design of the DA style does not contain any metallic reinforcement in the carcass of the bellows. Instead the carcass has a minimum of four layers of high tensile synthetic fabric. Each layer is impregnated with a rubber or synthetic compound. This allows movement and flexibility between the layers of fabric. The DA style design has a long radius arch allowing for self cleaning and thus eliminating the need for a filled arch. The DA style is the most economic choice when it comes to dual arch rubber expansion joints. The DA is available on request to meet the requirements of the U.S.C.G.



Size Nominal Diameter	Length OAL	PHI PART Number ⁶	Allowable Movement				Operating Condition		Weight (lbs)	
			Axial Compression	Axial Extension	Lateral Deflection	Angular Deflection	Max w.p. (psi) ^{3,4}	Max Vacuum (in. of Hg) ⁵	Exp. Joint + Flanges	Control Unit (2 Rod) ^{1,2}
1"	5"	DA-16-"XX"	2"	1.188"	± 1.75"	45°	225	26	4.00	5.50
1-1/4"	7"	DA-20-"XX"	2"	1.188"	± 1.75"	45°	225	26	5.25	5.50
1-1/2"	7"	DA-24-"XX"	2"	1.188"	± 1.75"	45°	225	26	6.00	5.50
2"	7"	DA-32-"XX"	2"	1.188"	± 1.75"	45°	225	26	8.50	6.75
2-1/2"	7"	DA-40-"XX"	2"	1.188"	± 1.75"	43°	225	26	11.25	8.00
3"	7"	DA-48-"XX"	2"	1.188"	± 1.75"	38°	225	26	13.75	8.00
3-1/2"	10"	DA-56-"XX"	2"	1.188"	± 1.75"	34°	225	26	16.50	8.00
4"	9"	DA-64-"XX"	2.25"	1.375"	± 1.562"	34°	225	26	19.25	7.50
5"	9"	DA-80-"XX"	2.25"	1.375"	± 1.562"	29°	225	26	22.50	8.00
6"	9"	DA-96-"XX"	2.25"	1.375"	± 1.562"	25°	225	26	28.00	9.00
8"	13"	DA-128-"XX"	2.50"	1.375"	± 1.375"	19°	225	26	46.00	13.00
10"	13"	DA-160-"XX"	2.50"	1.375"	± 1.375"	15°	225	26	63.00	25.25 ⁻¹
12"	13"	DA-192-"XX"	2.50"	1.375"	± 1.375"	13°	225	26	88.00	28.01 ⁻¹
14"	13.75"	DA-224-"XX"	1.75"	1.118"	± 1.118"	9°	150	26	119.00	33.55 ⁻¹
16"	13.75"	DA-256-"XX"	1.75"	1.118"	± 1.118"	8°	150	26	147.00	41.00 ⁻²
18"	13.75"	DA-288-"XX"	1.75"	1.118"	± 1.118"	7°	150	26	158.00	43.50 ⁻²
20"	13.75"	DA-320-"XX"	1.75"	1.118"	± 1.118"	7°	150	26	185.00	44.50 ⁻²
22"	12"	DA-352-"XX"	1.75"	1.118"	± 1.118"	6°	150	26	198.00	53.50 ⁻²
24"	13.75"	DA-384-"XX"	1.75"	1.118"	± 1.118"	5°	150	26	211.00	62.50 ⁻²

Remarks

- The joint body is available in 3 standard combinations of the (tube/cover): EPDM/EPDM, Neoprene/Neoprene, and Nitrile/Neoprene. The body components (tube/cover) are also available in a combination of the following additional materials on special order: Neoprene, EPDM, Chlorobutyl, Butyl, Nitrile, Hypalon®, Viton®, natural rubber etc. Please see the materials table to determine what material is best for your application.
- Standard flange drilling is ANSI 150#. Also available ANSI 25/125/250/300#, Navy, DN, BS, and JIS Drilling as well as others.
- Standard flange material is carbon steel with a plated rust inhibitor. Also available T-304, T-316 and other alloys.
- All Movements are non-concurrent. Contact Precision Hose & Expansion Joints to determine if your concurrent movements are acceptable.
- Please see "Control Unit" table to determine if your application requires control units. Control units must be used to protect the joint if the piping is not properly anchored. Control units are sold separately from the rubber joint.
- Gaskets are not required with the DA series rubber joint as long as a "flat-face" type mating flange is used. If this is not an option and a "raised face" type flange is used then a ring gasket should be used to avoid cutting the sealing face of the rubber bead.



NOTES

- Control unit (3 Rod) Standard
- Control unit (4 Rod) Standard
- Maximum working pressure is based on 190° F. See Temperature vs. Pressure chart for operating temperatures above 190° F.
- Test pressure is 1.5 times working pressure. Burst pressure is approximately 4 times maximum working pressure.
- The vacuum rating is based on the joint installed in the neutral length. Joints should not be installed in the extended position on vacuum applications. Please advise if the joint will be subjected to full vacuum. The use of an internal vacuum ring may be necessary.
- "XX" in the part number is to be replaced by the appropriate body material code.

Item #	Part
1	Cover
2	Tube
3	Carcass
1+2+3	Body
4	EJ Flange
5	Mating Flange
6	Control Unit

Rubber Expansion Joints

Spool Type

Style: ST Style: STF

Spool Type Style molded rubber expansion joints are designed with a metal reinforcing collar molded into the necks of the carcass. This allows the ST style to use light weight split retaining rings (sold separately) to back-up the molded integral rubber flange that is molded into the ST. The ST style is also available in a filled arch design know as style STF.

The ST can be made custom with multiple arches to improve movement, non standard flanges or enlarge flange type (different size flanges on each end), non standard lengths, as a reducer type, or with permanent offsets built into the joint. Larger sizes are available on request. The ST and STF are available on request to meet the requirements of the U.S.C.G.

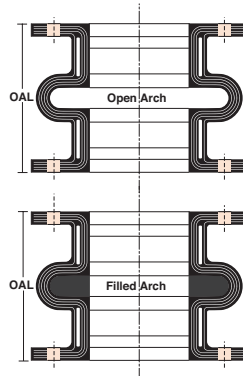
The STF style or filled arch will reduce allowable movements by 50%. It will also increase spring rates by 4 times that of the ST style. The filled arch design is a great option to reduce turbulence and eliminates the ability of solids to settle and remain in the arch. The "filler" in the filled arch is made from a low durometer soft rubber material that is bonded to the ID of the traditional arch. The ID of the STF has a one piece seamless inner tube eliminating the ability of the filler to come loose in service.



Size Nominal Diameter	Length OAL	PHI PART Number ⁶	Allowable Movement				Operating Condition		Weight (lbs)	
			Axial Compression	Axial Extension	Lateral Deflection	Angular Deflection	Max w.p. (psi) ³⁻⁴	Max Vacuum (in. of Hg) ⁵	Exp. Joint + Retaining Ring	Control Unit (2 Rod) ¹⁻²
2"	6"	ST-32-"XX"	7/16"	1/4"	1/2"	19°	150	26	11.50	6.75
2-1/2"	6"	ST-40-"XX"	7/16"	1/4"	1/2"	15°	150	26	17.00	7.50
3"	6"	ST-48-"XX"	7/16"	1/4"	1/2"	13°	150	26	18.75	7.75
4"	6"	ST-64-"XX"	7/16"	1/4"	1/2"	10°	150	26	23.00	7.00
5"	6"	ST-80-"XX"	7/16"	1/4"	1/2"	8°	150	26	26.75	7.50
6"	6"	ST-96-"XX"	7/16"	1/4"	1/2"	6°	150	26	30.00	8.50
8"	6"	ST-128-"XX"	11/16"	3/8"	1/2"	6°	150	26	44.75	11.25
10"	8"	ST-160-"XX"	11/16"	3/8"	1/2"	5°	150	26	61.25	24.50 ¹
12"	8"	ST-192-"XX"	11/16"	3/8"	1/2"	5°	150	26	84.75	26.00 ¹
14"	8"	ST-224-"XX"	11/16"	3/8"	1/2"	4°	150	15	102.00	31.00 ¹
16"	8"	ST-256-"XX"	11/16"	3/8"	1/2"	4°	150	15	123.00	38.50 ²
18"	8"	ST-288-"XX"	11/16"	3/8"	1/2"	3°	150	15	128.50	41.00 ²
20"	8"	ST-320-"XX"	13/16"	7/16"	1/2"	3°	150	15	151.00	41.75 ²
24"	10"	ST-384-"XX"	13/16"	7/16"	1/2"	3°	150	15	193.00	58.75 ²

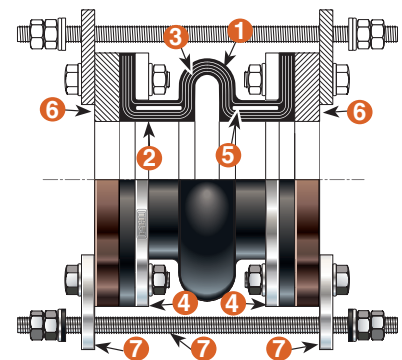
Remarks

- The joint body is available in 3 standard combinations of the (tube/cover): EPDM/EPDM, Neoprene/Neoprene, and Butyl/Butyl. The (tube/cover) are also available in a combination of the following additional materials on special order: Neoprene, EPDM, Chlorobutyl, Nitrile, Hypalon®, Viton®, Natural Rubber etc. Please see the materials table to determine what material is best for your application.
- Standard flange drilling is ANSI 150#. Also available ANSI 25/125/250/300#, Navy, DN, BS, and JIS Drilling as well as others.
- Standard flange material is carbon steel that has been treated with a rust inhibitor. Also available T-304, T-316 and other alloys.
- All Movements are non-concurrent. Contact Precision Hose & Expansion Joints to determine if your concurrent movements are acceptable.
- Please see "Control Unit" table to determine if your application requires control units. Control units must be used to protect the joint if the piping is not properly anchored. Control units are sold separately from the rubber joint.
- Liners are available for the ST and STF style.



NOTES

- Control unit (3 Rod) Standard
- Control unit (4 Rod) Standard
- Maximum working pressure is based on 190° F. See Temperature vs. Pressure chart for operating temperatures above 190° F.
- Test pressure is 1.5 times working pressure. Burst pressure is approximately 4 times maximum working pressure.
- The vacuum rating is based on the joint installed in the neutral length. Joints should not be installed in the extended position on vacuum applications. Please advise if the joint will be subjected to full vacuum. The use of an internal vacuum ring may be necessary.
- "XX" in the part number is to be replaced by the appropriate body material code.
- Designate STF in the part number when ordering a "FILLED ARCH" design. NOT ST.



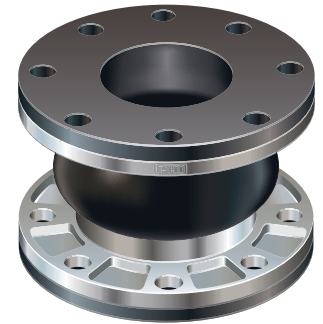
Item #	Part
1	Cover
2	Tube
3	Carcass
1+2+3	Body
4	EJ Retaining Ring
5	Metal Reinforcing Collar
6	Mating Flange
7	Control Unit

Wide Arch

Style: WA Style: WAF

Wide Arch style molded rubber expansion joints are designed with a molded integral flange and without a metal reinforcing collar molded into the necks of the body. Alternatively, the WA style uses a metal collar cast directly into the retaining ring. The WA style has a much larger arch than traditional spool type rubber expansion joints. This allows for greater movements and lower spring rates when compared to traditional spool type rubber joints. The WA style is also available in a filled arch design know as style WAF. The WA and WAF are a great option for an economical wide arch rubber expansion joint.

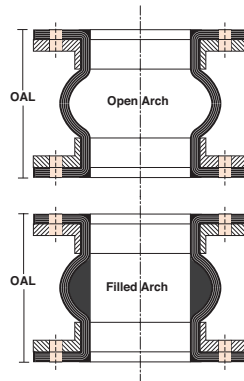
The WAF style or filled arch will reduce allowable movements by 50%. It will also increase spring rates by 4 times that of the WA style. The filled arch design is a great option to reduce turbulence and eliminates the ability of solids to settle and remain in the arch. The "filler" in the filled arch is made from a soft rubber material that is bonded to the ID of the traditional arch. The ID of the WAF has a one piece seamless inner tube eliminating the ability of the filler to come loose in service.



Size Nominal Diameter	Length OAL	PHI PART Number ⁶	Allowable Movement				Operating Condition		Weight (lbs)	
			Axial Compression	Axial Extension	Lateral Deflection	Angular Deflection	Max w.p. (psi) ^{3,4}	Max Vacuum (in. of Hg) ⁵	Exp. Joint + Flanges	Control Unit (2 Rod)
2"	6"	WA-32-"XX"	1-3/4"	3/4"	3/4"	35°	150	15	7.75	6.75
2-1/2"	6"	WA-40-"XX"	1-3/4"	3/4"	3/4"	30°	150	15	9.75	7.50
3"	6"	WA-48-"XX"	1-3/4"	3/4"	3/4"	30°	150	15	10.50	7.75
4"	6"	WA-64-"XX"	1-3/4"	3/4"	3/4"	25°	150	15	14.25	7.00
5"	6"	WA-80-"XX"	1-3/4"	3/4"	3/4"	25°	150	15	16.50	7.50
6"	6"	WA-96-"XX"	1-3/4"	3/4"	1"	20°	150	15	18.50	8.50
8"	6"	WA-128-"XX"	1-3/4"	3/4"	1"	20°	150	15	26.00	11.25
10"	8"	WA-160-"XX"	1-3/4"	3/4"	1"	15°	150	15	43.00	24.50 ¹
12"	8"	WA-192-"XX"	1-3/4"	3/4"	1"	15°	150	15	57.00	26.00 ¹
14"	8"	WA-224-"XX"	1-3/4"	7/8"	1-1/8"	12°	150	10	71.00	31.00 ¹
16"	8"	WA-256-"XX"	2"	7/8"	1-1/8"	12°	150	10	75.00	38.50 ²
18"	8"	WA-288-"XX"	2"	7/8"	1-1/8"	9°	150	10	79.00	41.00 ²
20"	8"	WA-320-"XX"	2"	7/8"	1-1/8"	9°	150	10	89.00	41.75 ²
24"	10"	WA-384-"XX"	2-1/4"	1"	1-1/8"	9°	150	10	139.00	58.75 ²
30"	10"	WA-480-"XX"	2-1/4"	1"	1-1/8"	6°	150	10	140.00	124.00 ²
36"	10"	WA-576-"XX"	2-1/4"	1"	1-1/8"	5°	90	10	190.00	172.00 ²

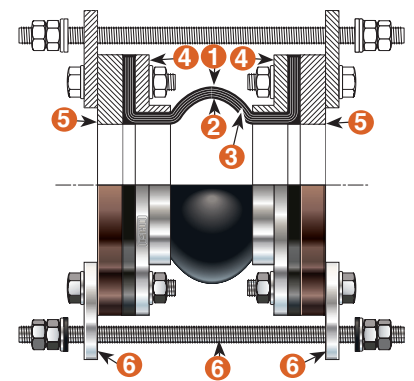
Remarks

- The joint body is available in 3 standard combinations of the (tube/cover): EPDM/EPDM, Neoprene/Neoprene, and Butyl/Butyl. The body components (tube/cover) are also available in a combination of the following additional materials on special order: Neoprene, EPDM, Chlorobutyl, Nitrile, Hypalon®, Viton®, Natural Rubber etc. Please see the materials table to determine what material is best for your application.
- Standard flange drilling is ANSI 125/150#. Other drillings available on request.
- Standard flange material is carbon steel that has been treated with a rust inhibitor. Also available T-304, T-316 and other alloys.
- All Movements are non-concurrent. Contact Precision Hose & Expansion Joints to determine if your concurrent movements are acceptable.
- Please see "Control Unit" table to determine if your application requires control units. Control units must be used to protect the joint if the piping is not properly anchored. Control units are sold separately from the rubber joint.



NOTES

- Control unit (3 Rod) Standard
- Control unit (4 Rod) Standard
- Maximum working pressure is based on 190° F. See Temperature vs. Pressure chart for operating temperatures above 190° F.
- Test pressure is 1.5 times working pressure. Burst pressure is approximately 4 times maximum working pressure.
- The vacuum rating is based on the joint installed in the neutral length. Joints should not be installed in the extended position on vacuum applications. Please advise if the joint will be subjected to full vacuum. The use of an internal vacuum ring may be necessary.
- "XX" in the part number is to be replaced by the appropriate body material code.
- Designate WAF in the part number when ordering a "FILLED ARCH" design. NOT WA.



Item #	Part
1	Cover
2	Tube
3	Carcass
1+2+3	Body
4	EJ Retaining Ring
5	Metal Reinforcing Collar
6	Mating Flange

Threaded Union

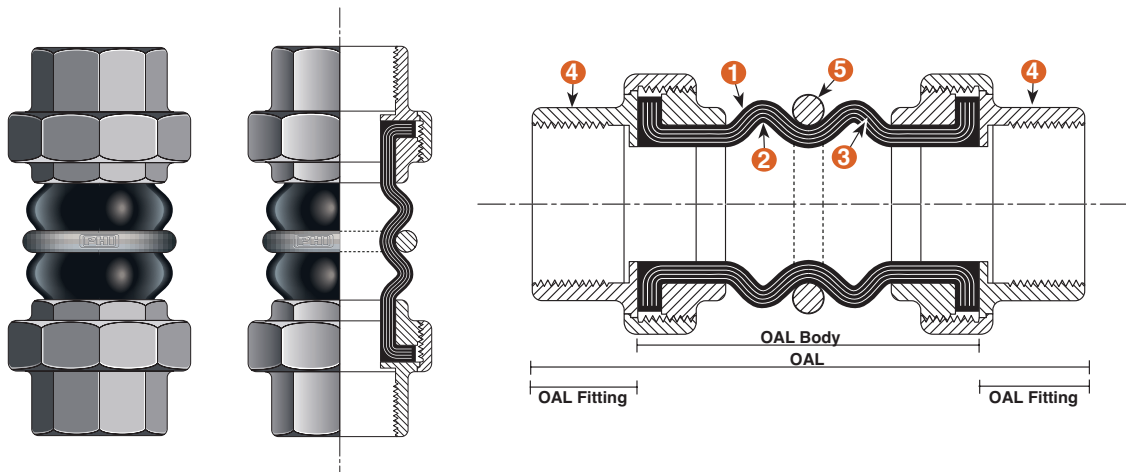
Style: TU

Threaded Union style molded rubber expansion joints are the choice when an economical threaded pipe connection is needed. The TU is engineered to absorb thermal movement, offset and misalignment in piping systems. The TU style is an excellent choice to absorb and isolate vibration. Use the TU to protect your system from start-up forces as well as system surges. There is no need to worry about Electrolysis when using a TU. Due to the design of the TU having a rubber body it eliminates metal to metal contact stopping the electrolytic process.

The TU comes standard with galvanized ductile iron female unions. Stainless T-304, T-316 and Bronze unions are also available. The TU rubber expansion joint comes standard and in stock in 100% EPDM and 100% Neoprene for same day shipment. The body components (tube/cover) are also available in a combination of the following additional materials on special order: Neoprene, EPDM, Chlorobutyl, Nitrile, Hypalon®, Viton®, Natural Rubber etc. Please see the materials table to determine what material is best for your application. The TU is also available on special request with the following female union threads: BSPP, BSPT and other standards.



Size	PHI	Operating Condition			OAL Length						Allowable Movement ¹				Dimensions		Weight (lbs)
		Max w.p. (psi) ^{2,3}	Max Vacuum (in. of Hg) ⁴	Max Temperature ²	Neutral OAL	Min Installed	Max Installed	Max Compressed	Max Extended	Recommended Pipe Opening	Axial Compression	Axial Extension	Lateral Deflection	Angular Deflection	OAL Fitting	OAL Body	
1/2"	TU-08-"XX"	150	26"	250° F	8.0"	7.35"	8.12"	7.13"	8.23"	7.20"	0.87"	0.23"	± 0.87"	± 32.2°	0.92"	6.16"	1.08
3/4"	TU-12-"XX"	150	26"	250° F	8.0"	7.35"	8.12"	7.13"	8.23"	7.10"	0.87"	0.23"	± 0.87"	± 32.2°	1.00"	6.00"	1.54
1"	TU-16-"XX"	150	26"	250° F	8.0"	7.35"	8.12"	7.13"	8.23"	7.10"	0.87"	0.23"	± 0.87"	± 25.3°	1.25"	5.50"	2.65
1-1/4"	TU-20-"XX"	150	26"	250° F	8.0"	7.35"	8.12"	7.13"	8.23"	7.00"	0.87"	0.23"	± 0.87"	± 20.7°	1.25"	5.50"	3.48
1-1/2"	TU-24-"XX"	150	26"	250° F	8.0"	7.35"	8.12"	7.13"	8.23"	6.70"	0.87"	0.23"	± 0.87"	± 17.5°	1.35"	5.30"	4.32
2"	TU-32-"XX"	150	26"	250° F	8.0"	7.35"	8.12"	7.13"	8.23"	6.70"	0.87"	0.23"	± 0.87"	± 13.3°	1.60"	4.80"	5.71
2-1/2"	TU-40-"XX"	150	26"	250° F	9.6"	8.95"	9.72"	7.13"	8.23"	8.10"	0.87"	0.23"	± 0.87"	± 10.7°	2.00"	5.60"	9.38
3"	TU-48-"XX"	150	26"	250° F	9.6"	8.95"	9.72"	7.13"	8.23"	7.60"	0.87"	0.23"	± 0.87"	± 8.9°	2.00"	5.60"	11.62

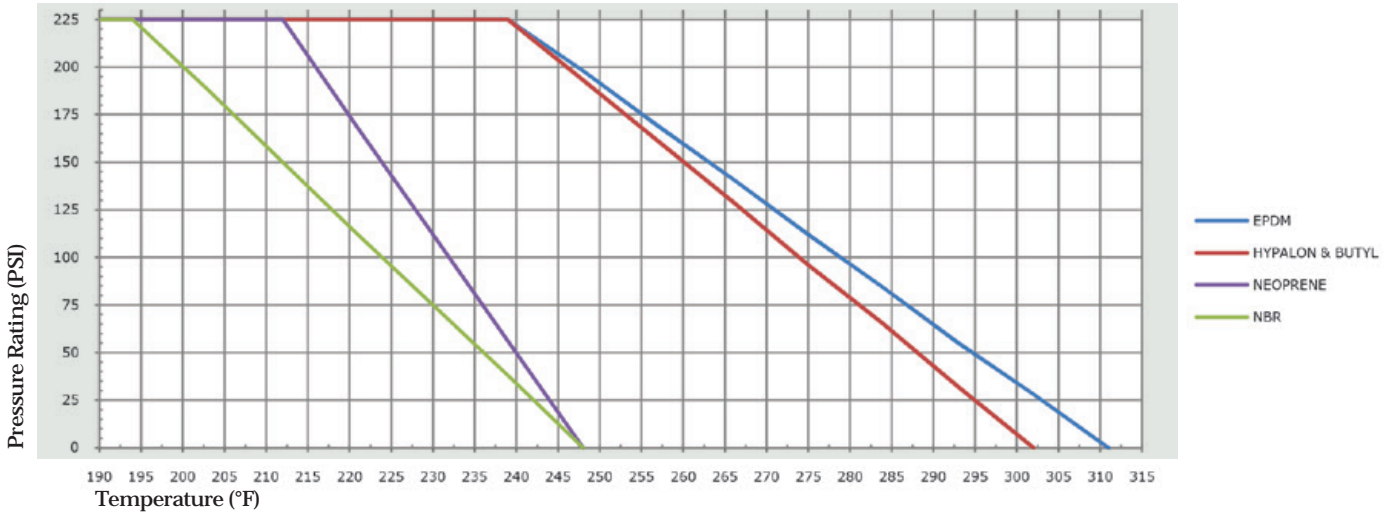


NOTES

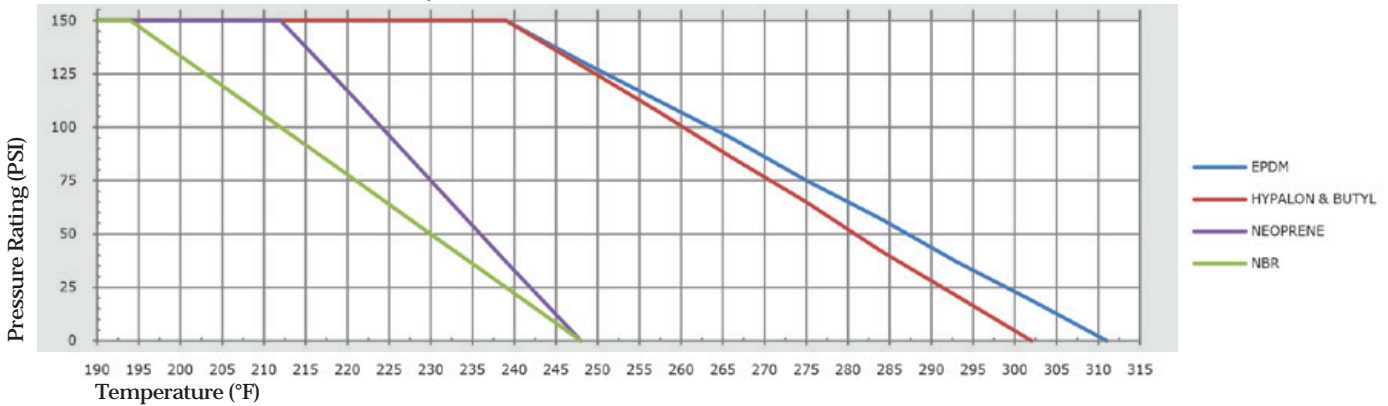
- All Movements are non-concurrent. Contact Precision Hose & Expansion Joints to determine if your concurrent movements are acceptable.
- Maximum working pressure is based on 190° F. See Temperature vs. Pressure chart for operating temperatures above 190° F.
- Test pressure is 1.5 times working pressure. Burst pressure is approximately 4 times maximum working pressure.
- The vacuum rating is based on the joint installed in the neutral length. Joints should not be installed in the extended position on vacuum applications.
- "XX" in the part number is to be replaced by the appropriate body material code.
- 1/2" and 3/4" TU do not have root rings as shown.

Temperature vs. Working Pressure

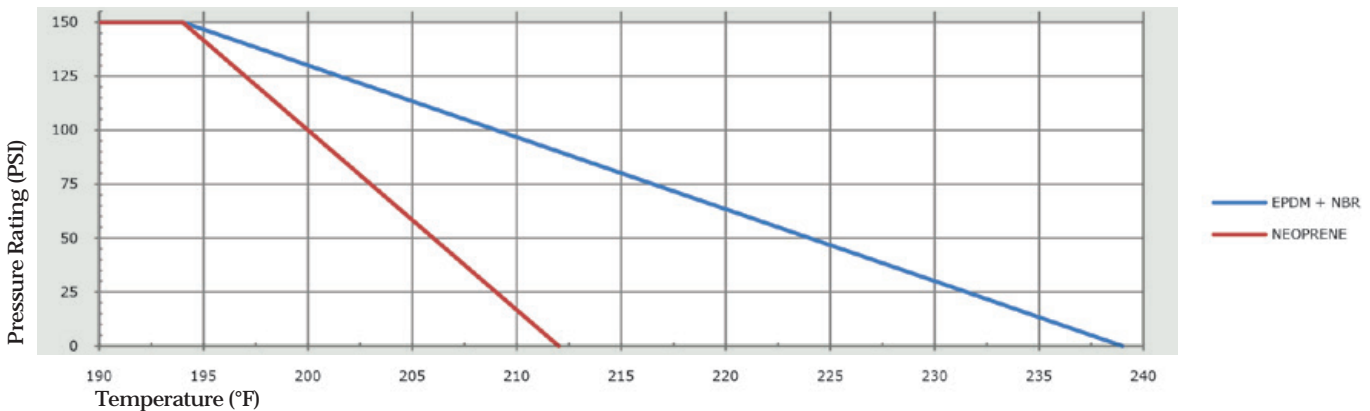
Style: SA + DA (Sizes 1" - 12")



Style: SA + DA (Sizes 14" - 24") | Style: ST + WA (Sizes 1" - 24")



Style: TU (Sizes 1/2" - 3")



Control Units

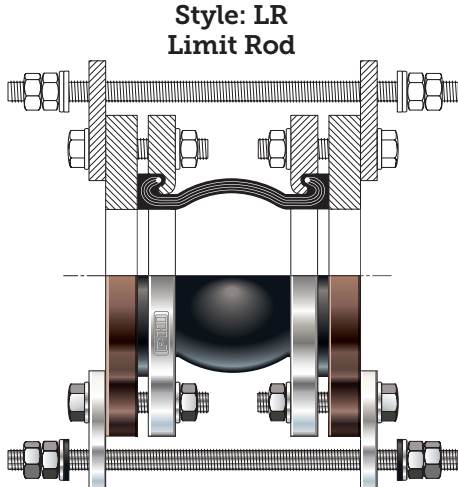
Style: LR Style: CR and CS

A control unit assembly is a system of two or more control rods (also known as tie rods) placed across an expansion joint from flange to flange to minimize possible damage to the expansion joint caused by excessive motion of the pipeline. The control rod assemblies are set at the maximum allowable expansion and/or contraction of the joint and will absorb the static pressure thrust developed at the expansion joint. When used in this manner, they are an additional safety factor, minimizing possible failure of the expansion joint and possible damage to the equipment. Control units will adequately protect the joints, but the user should be sure that the pipe flange strength is sufficient to withstand total force that will be encountered.

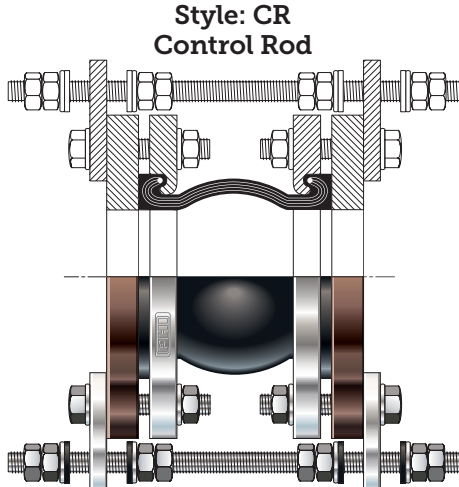
Extension

Control units must be used when it is not feasible in a given structure to provide adequate anchors in the proper location. In such cases, the static pressure thrust on the system will cause the expansion joint to extend to the limit set by the control rods which will then preclude the possibility of further motion that would over-elongate the joint. Despite the limiting action that control rods have on the joint, they must be used when proper anchoring cannot be provided. It cannot be emphasized too strongly that rubber expansion joints, by virtue of their function, are not designed to take end thrusts and, in all cases where such are likely to occur, proper anchoring is essential. If this fact is ignored, premature failure of the expansion joint is a forgone conclusion.

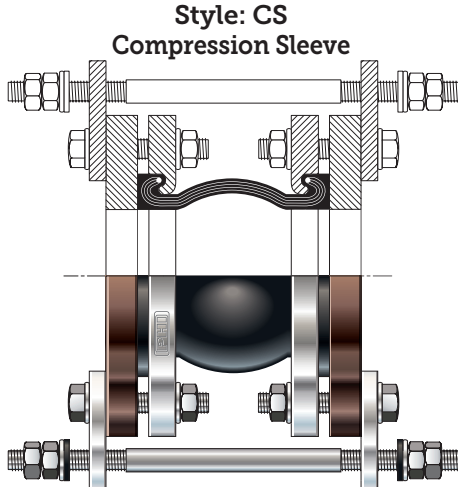
Control units are available on all our rubber expansion joints, NOT just the style SA illustrated below.



**Style: LR
Limit Rod**



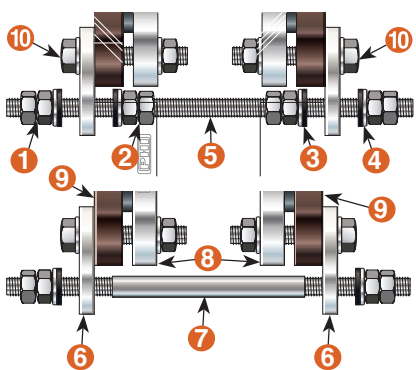
**Style: CR
Control Rod**




**Style: CS
Compression Sleeve**

Style: LR
Our standard control unit is the LR or Limit Rod style. The LR style will ONLY limit extension. Unless specifically specified the LR style will be supplied when "control units" are called out when ordered. If compression is a factor style CR or CS should be used.

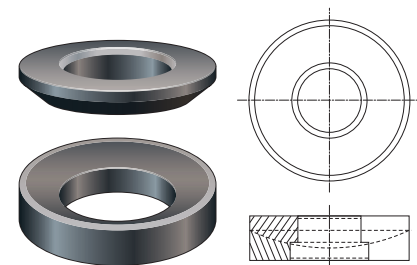
Style: CR and CS
Our CR and CS control unit should be used when compression outside the designed stated limits of the joint could or will be a factor in the service of the expansion joint. Both the CR and CS control units will accomplish the same end result. The style CR utilizes inside nuts where the style CS utilizes a pipe sleeve cut to a predetermined length. We recommend the style CR.





Typical end view of a 2 rod control unit, the rods should be equally spaced around the joint.

Item #	Part
1	Outside Nuts
2	Inside Nuts
3	Rubber Washer
4	Metal Washer
5	Control Rod
6	Control Plate
7	Compression Sleeve
8	EJ Flange
9	Mating Flange
10	Flange Bolt and Nut



As an option spherical washers can be utilized on the control unit when significant lateral offsets are encountered.

Control Units and Guide to Elastomers

Control Unit								
Nominal Pipe Size	Maximum Control Rod Plate O.D.	Maximum Rod Thickness	Maximum Control Plate Thickness	Maximum Test or Surge Pressure of the System Number of Control Rods Recommended				
				2	3	4	6	8
In Inches								
1.00"	8.375"	1/2"	7/16"	949	X	X	X	X
1.25"	9.750"	1/2"	7/16"	830	X	X	X	X
1.50"	9.875"	1/2"	7/16"	510	X	X	X	X
2.00"	11.250"	5/8"	7/16"	661	X	X	X	X
2.50"	12.250"	5/8"	7/16"	529	X	X	X	X
3.00"	13.250"	5/8"	7/16"	441	X	X	X	X
3.50"	12.625"	5/8"	7/16"	365	547	729	X	X
4.00"	13.500"	5/8"	7/16"	311	467	622	X	X
5.00"	14.500"	5/8"	7/16"	235	353	470	X	X
6.00"	15.500"	5/8"	7/16"	186	278	371	X	X
8.00"	19.125"	3/4"	7/16"	163	244	326	X	X
10.00"	21.625"	7/8"	3/4"	163	244	325	488	X
12.00"	24.625"	1.00"	3/4"	160	240	320	481	X
14.00"	26.625"	1.00"	3/4"	112	167	223	335	X
16.00"	30.125"	1-1/8"	3/4"	113	170	227	340	453
18.00"	31.625"	1-1/8"	3/4"	94	141	187	181	375
20.00"	34.125"	1-1/8"	3/4"	79	118	158	236	315
22.00"	36.125"	1-1/4"	1.00"	85	128	171	256	342
24.00"	38.625"	1-1/4"	1.00"	74	110	147	221	294
26.00"	40.825"	1-1/4"	1.00"	62	93	124	186	248
28.00"	44.125"	1-3/8"	1.25"	65	98	130	195	261
30.00"	46.375"	1-1/2"	1.25"	70	105	141	211	281
32.00"	49.375"	1-1/2"	1.25"	63	94	125	188	251
34.00"	51.375"	1-5/8"	1.50"	72	107	143	215	286
36.00"	53.625"	1-3/4"	1.50"	69	103	138	207	276

Maximum Pressures for Unanchored Control Units		
Test-Design-Surge-Operating		
Nominal Pipe Size	STYLE	
	SA, ST, STF WA, WAF	DA
1" - 4"	175	130
5" - 10"	130	130
12" - 14"	85	85
16" - 24"	40	40
26" - 30"	30	30

Elastomer Physical and Chemical Properties Comparison

COMMON NAME Chemical Group Name	Ozone	Weather	Sunlight	Oxidation	Heat	Cold	Flame	Tear	Abrasion	Impermeability	Dynamic	Rebound-Hot	Rebound-Cold	Compression Set	Tensile Strength	Dielectric Strength	Electric Insulation	Water Absorption	Radiation	Swelling in Oil	Acid Diluted	Acid Concentrated	Aliphatic Hydro	Armoatic Hydro	Oxygenated Hydro	Laquers	Oil & Gas	Alkali Diluted	Alkali Concentrated	Animal & Vegetable Oil	Chemical	Water	ASTM-D-2000/D1418-77	ANSI/ASTM D1418-77
NEOPRENE Chloroprene	5	6	5	5	4	4	4	4	5	4	2	5	4	2	4	5	3	4	5	4	6	4	3	2	1	0	4	4	0	4	3	4	BC BE	CR
GUM RUBBER Polyisoprene, Synthetic	0	2	0	4	2	5	0	5	7	2	6	6	6	4	6	6	5	5	6	0	3	3	0	0	4	0	0	X	X	X	3	5	AA	NR
NATURAL RUBBER Polyisoprene, Synthetic	0	2	0	4	2	5	0	5	6	2	2	6	6	4	6	6	5	5	6	0	3	3	0	0	4	0	0	X	X	X	3	5	AA	IR
BUTYL Isobutene-Isoprene	6	5	5	6	5	4	0	4	4	6	2	5	0	3	4	5	5	5	4	0	6	4	0	0	4	3	0	4	4	5	6	5	AA	IIR
CHLOROBUTYL Chloro-Isobutene-Isoprene	6	5	5	6	5	4	0	4	4	6	2	5	0	3	4	5	5	5	4	0	6	4	0	0	4	3	0	4	4	5	6	5	AA BA	CIIR
BUNA-N/NITRILE Nitril-Butadiene	2	2	0	4	4	3	0	3	4	4	5	4	4	5	5	0	1	4	5	5	4	4	6	4	0	2	5	4	0	5	3	4	BE BK CH	NBR
SBR/GRS/BUNA-S Styrene-Butadiene	0	2	0	2	3	5	0	3	5	2	4	4	4	4	5	4	5	5	6	0	3	3	0	0	4	0	0	4	2	X	3	5	AA	SBR
HYPALON® Chloro-Sulfonyl-Polyethylene	7	6	7	6	4	4	4	3	4	4	2	4	2	2	2	5	3	4	5	4	6	4	3	2	1	3	4	4	4	4	6	5	CE	CSM
VITON® Fluorocarbon Elastomer	7	7	7	7	7	2	6	2	5	5	5	4	2	6	5	5	3	5	5	6	5	5	6	6	0	1	6	4	0	6	6	5	HK	FKM
EPDM Ethylene-Propylene-Diene-Terpolymer	7	6	7	6	6	5	0	4	5	4	5	6	6	4	5	7	6	6	7	0	6	4	0	0	6	3	0	6	6	5	6	5	BA CA DA	EPR
PTFE/TFE/FEF Fluoro-Ethylene-Polymers	7	7	7	7	7	X	X	X	4	X	X	X	X	X	X	X	X	7	3	7	7	7	7	7	7	7	7	7	7	7	7	7		AFMU
SILICONE	6	6	6	6	7	6	2	2	0	2	0	6	6	3	0	4	6	6	5	2	6	2	0	0	2	0	X	2	0	5	5	5	GE	SI

Rating Scale: 7 Outstanding 6 Excellent 5 Very Good 4 Good 3 Fair to Good 2 Fair 1 Poor To Fair 0 Poor X Contact Manufacture

How to Order

Rubber Expansion Joints

SA-48-EE-304

Style (Joint)		Size (Pipe)		Body Material (Tube/Cover)		Fitting Hardware (Alloy)	
Single Arch	SA	1/2"	08	BB	BUTYL / BUTYL	304	T-304 STAINLESS
Dual Arch	DA	3/4"	12	EE	EPDM / EPDM	316	T-316 STAINLESS
Wide Arch	WA	1"	16	HH	HYPALON / HYPALON	BZ	BRONZE
Wide Arch Filled	WAF	1-1/4"	20	NH	HYPALON / NEOPRENE	ZP	ZINC PLATED CARBON STEEL
Spool Type	ST	1-1/2"	24	NR	NATURAL RUBBER / NATURAL RUBBER	GV	GALVANIZED (TU STYLE STANDARD)
Spool Type Filled	STF	2"	32	NN	NEOPRENE / NEOPRENE	Leave Blank = If ZP or GV.	
Threaded Union	TU	2-1/2"	40	NP	NITRILE / NEOPRENE		
		3"	48	BN	NITRILE / NITRILE		
		3-1/2"	56	EN	EPDM / NEOPRENE		
		4"	64	FKM	VITON / VITON		
		5"	80				
		6"	96				
		8"	128				
		10"	160				
		12"	192				
		14"	224				
		16"	256				
		18"	288				
		20"	320				
		22"	352				
		24"	384				

WARNING: Instructions Control Units must be used to protect this part from excessive movement if piping is not properly anchored. Expansion Joints may operate in pipelines or equipment carrying fluids and/or gases at elevated temperatures and pressures. Normal precautions should be taken to make sure these parts are installed correctly and inspected regularly. Precautions should be taken to protect personnel in the event of leakage or splash.

Control Units

Sold Separately

LR-48-S-304

1 Set: Consists of the following
 1" - 8" = 2 RODS/SET
 10" - 14" = 3 RODS/SET
 16" - 24" = 4 RODS/SET
 26" and UP = Consult MFG

Style (Control Unit)		Size	Length (Short / Long)		Alloy	
Limit Rod	LR	See above	S	SA, WA, WAF, ST, STF	304	T-304 STAINLESS
Control Rod	CR		L	DA	316	T-316 STAINLESS
Compression Sleeve	CS				BZ	BRONZE

Leave Blank = If ZP.

Elastomer Labels

BUTYL TUBE BUTYL COVER TYPE: BB For General Services	NATURAL RUBBER TUBE NATURAL RUBBER COVER TYPE: NR For General Services	EPDM TUBE EPDM COVER TYPE: EE For General Services	EPDM TUBE NEOPRENE COVER TYPE: EN For General Services	NEOPRENE TUBE NEOPRENE COVER TYPE: NN For General Services
HYPALON TUBE HYPALON COVER TYPE: HH	HYPALON TUBE HYPALON COVER TYPE: NH For General Services	NITRILE TUBE NEOPRENE COVER TYPE: NP For General Services	NITRILE TUBE NITRILE COVER TYPE: BN For General Services	VITON TUBE VITO COVER TYPE: FKM

Standard Flange Dimensions

Nominal Pipe Size	25/125/150 LB. DRILLING							250/300 LB. DRILLING				NAVY DRILLING			
	COMMON SIZE			BOLT HOLE DIAMETER Drilling Column				O.D.	B.C. DIA.	No. B.H.	B.H. DIA.	O.D.	B.C. DIA.	No. B.H.	B.H. DIA.
	O.D.	B.C. DIA.	No. B.H.	1	2	3	4								
1/4	2-1/2	1-11/16	4	7/16								3-1/4	2-1/8	3	9/16
3/8	2-1/2	1-11/16	4	7/16								3-3/8	2-1/4	3	9/16
1/2	3-1/2	2-3/8	4	5/8		5/8		3-3/4	2-5/8	4	5/8	3-9/16	2-7/16	3	9/16
3/4	3-7/8	2-3/4	4	5/8		5/8		4-5/8	3-1/4	4	3/4	3-13/16	2-11/16	4	9/16
1	4-1/4	3-1/8	4	5/8		5/8		4-7/8	3-1/2	4	3/4	4-1/4	3-1/8	4	9/16
1-1/4	4-5/8	3-1/2	4	5/8		5/8		5-1/4	3-7/8	4	3/4	4-1/2	3-3/8	4	9/16
1-1/2	5	3-7/8	4	5/8		5/8		6-1/8	4-1/2	4	7/8	5-1/16	3-15/16	6	9/16
2	6	4-3/4	4	3/4		3/4		6-1/2	5	8	3/4	5-9/16	4-7/16	6	9/16
2-1/2	7	5-1/2	4	3/4		3/4		7-1/2	5-7/8	8	7/8	6-1/8	5	6	9/16
3	7-1/2	6	4	3/4		3/4		8-1/4	6-5/8	8	7/8	6-5/8	5-1/2	8	9/16
3-1/2	8-1/2	7	8	3/4		3/4		9	7-1/4	8	7/8	7-3/16	6-1/16	8	9/16
4	9	7-1/2	8	3/4	3/4	3/4	3/4	10	7-7/8	8	7/8	7-11/16	6-9/16	8	9/16
4-1/2												8-3/16	7-1/16	10	9/16
5	10	8-1/2	8	7/8	3/4	7/8	3/4	11	9-1/4	8	7/8	9-1/16	7-13/16	10	11/16
5-1/2												9-9/16	8-5/16	10	11/16
6	11	9-1/2	8	7/8	3/4	7/8	3/4	12-1/2	10-5/8	12	7/8 1	10-1/8	8-7/8	12	11/16
6-1/2												10-5/8	9-3/8	12	11/16
7												11-5/16	10	12	11/16
7-1/2												11-7/8	10-9/16	12	11/16
8	13-1/2	11-3/4	8	7/8	3/4	7/8	3/4	15	13	12	1	12-3/8	11-1/16	14	11/16
8-1/2												12-15/16	11-5/8	14	11/16
9												13-15/16	12-3/8	14	13/16
9-1/2												14-1/2	12-15/16	14	13/16
10	16	14-1/4	12	1	3/4	1	3/4	17-1/2	15-1/4	16	1-1/8	15	13-7/16	15	13/16
11												16-9/16	15	16	13/16
12	19	17	12	1	3/4	1	3/4	20-1/2	17-3/4	16	1-1/4	17-5/8	16-1/16	18	13/16
14	21	18-3/4	12	1-1/8	7/8	1-1/8	7/8	23	20-1/4	20	1-1/4	19-1/8	17-3/8	19	15/16
16	23-1/2	21-1/4	16	1-1/8	7/8	1-1/8	7/8	25-1/2	22-1/2	20	1-3/8	21-3/16	19-7/16	20	15/16
18	25	22-3/4	16	1-1/4	7/8	1-1/4	7/8	28	24-3/4	24	1-3/8	23-1/4	21-1/2	22	15/16
20	27-1/2	25	20	1-1/4	7/8	1-1/4	7/8	30-1/2	27	24	1-3/8	25-13/16	23-13/16	24	1-1/16
22	29-1/2	27-1/4	20	1-3/8	7/8	1-3/8	7/8	33	29-1/4	24	1-5/8	27-7/8	25-7/8	26	1-1/16
24	32	29-1/2	20	1-3/8	7/8	1-3/8	7/8	36	32	24	1-5/8	30	28	28	1-1/16
25												31-1/2	29-1/4	29	1-3/16
26	34-1/4	31-3/4	24			1-3/8	7/8	38-1/4	34-1/2	28	1-3/4	32-9/16	30-6/16	30	1-3/16
28	36-1/2	34	28			1-3/8	7/8	40-3/4	37	28	1-3/4	34-11/16	32-7/16	32	1-3/16
30	38-3/4	36	28	1-3/8	1	1-3/8	1	43	39-1/4	28	2*	36-13/16	34-9/16	35	1-3/16
32	41-3/4	38-1/2	28			1-5/8	1	45-1/4	41-1/2	28	2	39	36-3/4	36	1-3/16
33												40	37-3/4	36	1-3/16
34	43-3/4	40-1/2	32			1-5/8	1	47-1/2	43-1/2	28	2	41	38-3/4	36	1-3/16
35												42-7/8	40-3/8	36	1-5/16
36	46	42-3/4	32	1-5/8	1	1-5/8	1	50	46	32	2-1/4*	43-7/8	41-3/8	36	1-5/16
38	48-3/4	45-1/4	32	1-5/8	1	1-5/8	1	56	43	32	1-5/8	46-1/8	43-5/8	36	1-5/16
40	50-3/4	47-1/4	36	1-5/8	1-1/8	1-5/8	1	48-3/4	45-1/2	32	1-3/4	48-1/8	45-5/8	36	1-5/16
42	53	49-1/2	36			1-5/8	1-1/8	57*	52-3/4*	36*	2-1/4*	50-1/4	47-3/4	38	1-5/16
44	55-1/4	51-3/4	40			1-5/8	1-1/8	53-1/4	49-3/4	32	1-5/8				
46	57-1/4	53-3/4	40			1-5/8	1-1/8	55-3/4	52	28	2	54-1/2	52	40	1-5/16
48	59-1/2	56	44	1-5/8	1-1/8	1-5/8	1-1/8	65*	60-3/4*	40*	2-1/4*				

Specifications: 25/125/150 LB. DRILLING
ANSI B16.1-1975 Class 25 - 2
ANSI B15.1-1975 Class 125 - 1
ANSI B16.24-1971 - 1
ANSI B16.5 Class 125/150 - 3

AWWA C207-78
Tbl 1 & 2, Class D, Tbl 3, Class E - 3
AWWA C207-78 Tbl 1 & 2, Class B - 4
MSS SP-44 1975 Class 150 - 1
SS SP-51 1965 MSS 150# - 1

Specifications: 250/300 LB. DRILLING
ANSI B16.1-1975 Class 250
ANSI B16.24-1971 300 lb.
ANSI B16.5-1973 Class 300
MSS SP-44-1975 Class 300

Specifications: NAVY DRILLING
MIL-F-20042C - 50 lb.
MIL-F-20042C - 150 lb.
BU Ships Drawing B.176

* Does not meet SMM SP-44.

Nominal	PN Flange Specifications																			
	PN6				PN10				PN16				PN25				PN40			
	O.D.	B.C. DIA.	No. B.H.	B.H. DIA.	O.D.	B.C. DIA.	No. B.H.	B.H. DIA.	O.D.	B.C. DIA.	No. B.H.	B.H. DIA.	O.D.	B.C. DIA.	No. B.H.	B.H. DIA.	O.D.	B.C. DIA.	No. B.H.	B.H. DIA.
DN 25	3.94	2.95	4	0.55	4.53	3.35	4	0.55	4.53	3.35	4	0.55	4.53	3.35	4	0.55	4.53	3.35	4	0.55
DN 32	4.72	3.54	4	0.55	5.51	3.94	4	0.71	5.51	3.94	4	0.71	5.51	3.94	4	0.71	5.51	3.94	4	0.71
DN 40	5.12	3.94	4	0.55	5.91	4.33	4	0.71	5.91	4.33	4	0.71	5.91	4.33	4	0.71	5.91	4.33	4	0.71
DN 50	5.51	4.33	4	0.55	6.50	4.92	4	0.71	6.50	4.92	4	0.71	6.50	4.92	4	0.71	6.50	4.92	4	0.71
DN 65	6.30	5.12	4	0.55	7.28	5.71	4	0.71	7.28	5.71	4	0.71	7.28	5.71	8	0.71	7.28	5.71	8	0.71
DN 80	7.48	5.91	4	0.71	7.87	6.30	8	0.71	7.87	6.30	8	0.71	7.87	6.30	8	0.71	7.87	6.30	8	0.71
DN 100	8.27	6.69	4	0.71	8.66	7.09	8	0.71	8.66	7.09	8	0.71	9.25	7.48	8	0.87	9.25	7.48	8	0.87
DN 125	9.45	9.45	8	0.71	9.84	9.84	8	0.71	9.84	9.84	8	0.71	10.63	10.63	8	1.02	10.63	10.63	8	1.02
DN 150	10.43	8.86	8	0.71	11.22	9.45	8	0.87	11.22	9.45	8	0.87	11.81	9.84	8	1.02	11.81	9.84	8	1.02
DN 175	----	----	----	----	12.40	10.63	8	0.87	12.40	10.63	8	0.87	12.99	11.02	12	1.02	13.78	11.61	12	1.18
DN 200	12.60	11.20	8	0.71	13.39	11.61	8	0.87	13.39	11.61	12	0.87	14.17	12.20	12	1.02	14.76	12.60	12	1.18
DN 250	14.76	13.19	12	0.71	15.55	13.78	12	0.87	15.94	13.98	12	1.02	16.73	14.57	12	1.18	17.72	15.16	12	1.30
DN 300	17.32	15.55	12	0.87	17.52	15.75	12	0.87	18.11	16.14	12	1.02	19.09	16.93	16	1.18	20.28	17.72	16	1.30
DN 350	19.29	17.52	12	0.87	19.88	18.11	16	0.87	20.47	18.50	16	1.02	21.85	19.29	16	1.30	22.83	20.08	16	1.42
DN 400	21.26	19.49	16	0.87	22.24	20.28	16	1.02	22.83	20.67	16	1.18	24.41	21.65	16	1.42	25.98	23.03	16	1.54
DN 500	25.39	23.62	20	0.87	26.38	24.41	20	1.02	28.15	25.59	20	1.30	28.74	25.98	20	1.42	29.72	26.38	20	1.65
DN 600	29.72	27.76	20	0.94	30.71	28.54	20	1.06	33.07	30.31	20	1.30	33.27	30.31	20	1.42	----	----	----	----

Precision Hose and Expansion Joints can also furnish standards: API Standard 605, British Standard 10:1962, DIN 2633 and ISO 2084 + 2536, and others standards on request.

Definitions

Abrasion Resistance: The ability to withstand the wearing effect of a rubbing surface. In elastomers, abrasion is a complicated process, often affected more by compounding and curing than by the elastomer. Soft, resilient compounds, such as pure gum rubber are frequently specified.¹

Ambient Temperature: The environment temperature surrounding the object under construction.¹

Anchor: Terminal point or fixed point in a piping system from which directional movement occurs.¹

Angular Movement: The movement which occurs when one flange of the expansion joint is moved to an out of parallel position with the other flange. Such movement being measured in degrees.¹

Arch: The portion of an expansion joint which accommodates the movement of the joint.¹

Atmospheric Cracking: Cracks produced on the surface of rubber articles by exposure to atmospheric conditions, especially sunlight, ozone and pollution. Chlorobutyl, EPDM, Neoprene and Fluoroelastomers are all highly resistant compounds.¹

Axial Compression: The dimensional reduction or shortening in the Face to Face parallel length of the joint measured along the longitudinal axis.¹

Axial Elongation: The dimensional increase or lengthening in the Face to Face parallel length of the joint measured along the longitudinal axis.¹

Axial Extension: The dimensional lengthening of an expansion joint parallel to its longitudinal axis. Such movement being measured in inches or millimeters.¹ See *Axial Elongation*

Back-up Rings: See *Retaining Rings*

Bellows: See *Arch or Expansion Joint*

Blisters: A raised spot on the surface or a separation between layers, usually forming a void or air-filled space in the rubber article.¹

Bloom: A natural discoloration or change in appearance of a surface of the rubber product caused by the migration of a liquid or solid to the surface. Examples: sulfur bloom, wax bloom. Not to be confused with dust on the surface from external sources.¹

Body: The body consists of the Cover, Carcass and Tube.

Body Rings: See *Metal Reinforcement*

Bolt Hole Pattern or Drill Pattern: The systematic location of bolt holes in the expansion joint flanges where joint is to be bolted to mating flanges.¹

Bore: A fluid passageway, normally the inside diameter of the expansion joint.¹

Burst Test: A test to measure the pressure at which an expansion joint bursts.¹

Carcass: The carcass or body of the expansion joint consist of fabric and, when necessary, metal reinforcement.¹ See *Body*

Chalking: Formation of a powdery surface condition due to disintegration of surface binder or elastomer, due in turn to weathering or other destructive environments.¹

Compression Set: The deformation which remains in rubber after it has been subjected to and released from a specific compressive stress for a definite period of time, at a prescribed temperature.¹

Concurrent Movements: Combination of two or more types of movement.¹

Conductive: A rubber having qualities of conducting or transmitting heat or electricity. Most, generally applied to rubber products capable of conducting static electricity.¹

Control Rods or Units: Devices usually in the form of tie rods, attached to the expansion joint assembly whose primary function is to restrict the bellows axial movement range during normal operation. In the event of a main anchor failure, they are designed to prevent bellows over-extension or over-compression while absorbing the static pressure thrust at the expansion joint, generated by the anchor failure.¹ *The definition of "Control Rods" when used in reference to rubber expansion joints differs than when used in reference to metal expansion joints. The definition above is the definition when used in reference to rubber expansion joints.*

Convolution: See *Arch*

Cover: The exterior surface of the joint is formed from natural or synthetic rubber, depending on service requirements. The prime function of the cover is to protect the carcass from outside damage or abuse. Special polymers can be supplied to resist chemicals, oils, sunlight, acid fumes, and ozone. Also, a protective coating may be applied to the exterior of the joint for additional protection.¹ *The definition of a metal expansion joint "cover" is totally different and should not be confused with the definition of a rubber expansion joint "cover" defined above.*

Cracking: See *Atmospheric Cracking, Flex Cracking*

Crazing: See *Atmospheric Cracking*

Cycle Life: One full movement cycle is defined as the sum of the total movements incurred when an expansion joint fully compresses from the neutral position then moves to the position of maximum allowed elongation and finally returns to neutral. Cycle life depends not only on the amount of

movement, but also on the frequency of cycles or cycle rate. Cycle life can also be affected by installation practices, temperature and type of media being handled.¹

Design Pressure: The maximum high temperature that the expansion joint is designed to handle during normal operating conditions. Not to be confused with excursion temperature.¹

Diameter Inside: The length of a straight line through the geometric center and terminating at the inner periphery of an expansion joint.¹

Directional Anchor: A directional or sliding anchor is one which is designed to absorb loading in one direction while permitting motion in another. It may be either a main or intermediate anchor, depending upon the application involved. When designed for the purpose, a directional anchor may also function as a pipe alignment guide.¹

Direct Shear: See *Lateral Deflection*

Drill Pattern: The systematic location of bolt holes on the mating flange to which the expansion joint will be attached. Usually meets a specific specification.¹

Durometer: A measurement of the hardness of rubber.¹ See *Hardness*

Eccentricity: A condition in which the inside and outside of two diameters deviate from a common center.¹

Electrical Resistivity: The resistance between opposite parallel faces of material having a unit length and unit cross section. Typically measured in ohms/cm.¹

Elongation: Increase in length expressed numerically as a fraction or a percentage of initial length.¹

Enlarged End: An end with inside diameter greater than that of the main body of an expansion joint.¹

Expansion Joint: Any device containing one or more bellows used to absorb dimensional changes, such as those caused by thermal expansion or contraction of a pipeline, duct or vessel.²

Fabric Reinforcement: The carcass fabric reinforcement is the flexible and supporting member between the tube and cover. Standard constructions normally utilize high quality synthetic fabric. Natural fabrics can also be used at some pressures and temperatures. All fabrics are impregnated with rubber or synthetic compounds to permit flexibility between the fabric plies.¹

Face to Face: Dimension between the pipe flange faces to which the expansion joint will be bolted. This is also the length of the expansion joint when the system is in the cold position.¹ See *Pre-compression and Pre-set*.

Filled Arch: Arch-type expansion joints may be supplied with a bonded-in-place soft rubber filler to provide a smooth interior bore. Filled arch joints also have a seamless tube so the arch filler cannot be dislodged during service. Filled arches, built as an integral part of the carcass, decrease the flexibility of the joint and should be used only when necessary. Movements of expansion joints with filled arches are limited to 50% of the normal movements of comparable size expansion joints with unfilled (open) arches.¹

Flex Cracking: A surface cracking induced by repeated bending or flexing.¹

Floating Flange: A metal flange which is grooved to contain the bead on each end of the expansion joint. The flange floats until lined up with mating bolt holes and bolted in place, and is used on spherical expansion joints.¹

Hardness: Property or extent of being hard. Measured by extent of failure of the indenter point of any one of a number of standard hardness testing instruments to penetrate the product.¹ See *Durometer*

Heat Resistance: The ability of rubber articles to resist the deteriorating effects of elevated temperatures.¹

Hydrostatic Test: Hydrostatic pressure testing involves filling the expansion joint with a liquid, usually potable water. After the expansion joint is filled it can then be pressurized to the required test pressure.² If required, joints can be hydrostatic tested up to 1.5 times the maximum allowable working pressure of the product, for a minimum of 10 minutes without leaks.¹

Installed Length: See *Face to Face*

Lateral Deflection: The relative displacement of the two ends of an expansion joint perpendicular to its longitudinal axis. This has been referred to as lateral offset, lateral movement, parallel misalignment, direct shear, or transverse movement.²

Lateral Movement: See *Lateral Deflection*

Lateral Offset: See *Lateral Deflection*

Limit Rods: The definition of "Limit Rods" when used in reference to rubber expansion joints differs than when used in reference to metal expansion joints. See *Control Units*

Main Anchor: A main anchor is one which must withstand all of the thrust due to pressure, flow, and spring forces of the system.¹

Maximum Burst: Is the theoretical (predetermined) burst pressure of an expansion joint.¹

Metal Reinforcement: Wire or solid steel rings imbedded in the carcass are frequently used as strengthening members of the joint. The use

of metal sometimes raises the rated working pressure and can supply rigidity to the joint for vacuum service.¹

Misalignment: The out of line condition that exists between the adjacent faces of the flanges¹

Movements: The dimensional changes which the expansion joint is designed to absorb, such as those resulting from thermal expansion or contraction. See *Angular Movement, Concurrent Movement, Resultant Movement, Lateral Movement, Torsional Movement, Thermal Movement, Transverse Movement.*¹

OAL: Alternative term for the Face to Face dimension of the overall length of an expansion joint.¹

Oil Resistant: The ability to withstand the deteriorating effects of oil (generally refers to petroleum) on the physical properties.¹

Oil Swell: The change in the volume of rubber due to absorption of oil.¹

Open Arch: The Arch or the Convolution is not filled it is open with no filler. The opposite of Open Arch is Filled Arch. See *Filled Arch*

Operating Temperature: The temperature at which the system will generally operate during normal conditions.¹

Parallel Misalignment: See *Lateral Deflection*

Permeability: The ability of a fluid or gas to pass through an elastomer.¹

Permanent Set: Permanent set is the deformation remaining after a specimen has been stressed in tension or compression a prescribed amount for a definite period and released for a definite period.¹

Ply: One concentric layer or ring of material, such as fabric plies in an expansion joint.¹

Pre-Compression: Compressing the expansion joint (shortening the Face to Face) so that in the cold position the joint has a given amount of compression set in the joint. The purpose of pre-compression is to allow for unexpected or additional axial extension. This is preformed at the job site.¹

Pre-Set: Dimension that joints are deflected to insure that desired movements will take place.¹ See *Lateral*

Proof Pressure Test: See *Hydrostatic Test*

Reinforcing Rings: Metal reinforcing rings in steel, stainless steel, Monel or other metals may be used to add strength between the Convolutions or Arches.¹

Reinforcement: See *Carcass*

Resultant Movement: The net effect of concurrent movement.¹

Retaining Rings: Split metal retaining rings are installed directly against the back of the flanges of the joint and bolted through to the mating flange of the pipe.¹

Root Ring: See *Reinforcing Rings*

Spool "Arch" Type: A full face integral flange is available in both single arch and multiple arch types. Construction is of fabric and rubber, reinforced with metal rings or wire. The full face flanges are integral with the body of the joint and drilled to conform to the bolt pattern of the companion metal flanges of the pipeline. This type of rubber face flange is of sufficient thickness to form a tight seal against the metal flanges without the use of gaskets.¹

Sun Checking: See *Atmospheric Cracking*

Thermal Movements: Movements created within the piping system by thermal expansion. Can be Axial, Lateral, or Torsional.¹

Torsional Movement: The twisting of one end of an expansion joint with respect to the other end about its longitudinal axis. Such movement is measured in degrees.¹

Transverse Movement: See *Lateral Deflection*

Tube: A protective, leak proof lining made of synthetic or natural rubber as the service dictates. This is a seamless tube that extends through the bore to the outside edges of the flanges. Its purpose is to eliminate the possibility of the materials being handled penetrating the carcass and weakening the fabric. These tubes can be designed to cover service conditions for chemical, petroleum, sewage, gaseous and abrasive materials.¹

Wide Arch: This type, similar to the Narrow "Arch" Type, is available in a metallic reinforced and non-metallic reinforced design. Generally the Wide Arch Type features greater movements than standard spool "Arch" Type.

Wire Reinforced: A product containing metal wire to give added strength, increased dimensional stability or crush resistance.¹ See *Reinforcement*

Wrap Marks: Impressions left on the cover surface by the material used to wrap the expansion joint during vulcanization. Usually shows characteristics of a woven pattern and wrapper width edge marks.¹

Van Stone Flange: A loose, rotating type flange, sometimes called a lap-joint flange.

1. As defined by the Fluid Sealing Association Technical Handbook 7th Edition Non-Metallic Expansion Joints and Flexible Pipe Connectors.
2. As defined by Standards of the Expansion Joint Manufacturers Association, Inc. Eighth Edition 2003.

Installation and Inspection Instructions

RUBBER EXPANSION JOINT INSTALLATION INSTRUCTIONS

- 1. Service Conditions.** Make sure the expansion joint rating for temperature, pressure, vacuum and movements match the system requirements. Contact the manufacturer for advice if the system requirements exceed those of the expansion joint selected. Check to make sure the elastomer selected is chemically compatible with the process fluid or gas.
- 2. Alignment.** Expansion joints are normally not designed to compensate for piping misalignment errors. Piping should be lined up within 1/8". Misalignment reduces the rated movements of the expansion joint and can induce severe stress and reduce service life. Pipe guides should be installed to keep the pipe aligned and to prevent undue displacement.
- 3. Anchoring.** Solid anchoring is required wherever the pipeline changes direction, and expansion joints should be located as close as possible to anchor points. If anchors are not used, the pressure thrust may cause excessive movements and damage the expansion joints.
- 4. Pipe Support.** Piping must be supported so expansion joints do not carry any pipe weight.
- 5. Mating Flanges.** Install the expansion joint against the mating pipe flanges and install bolts so that the bolt head and washer are against the retaining rings. If washers are not used, flange leakage can result, particularly at the split in the retaining rings. Flange-to-flange dimensions of the expansion joint must match the breech type opening. Make sure the mating flanges are clean and are flat-face-type or more than 1/16" raised-face type. Never install expansion joints that utilize split retaining rings next to wafer type check or butterfly valves. Serious damage can result to a rubber joint of this type unless installed against full-face flanges.
- 6. Tightening Bolts.** Tighten bolts in stages by alternating around the flange. If the joint has integral fabric and rubber flanges, the bolts should be tight enough to make the rubber flange O.D. bulge between the retaining rings and the mating flange. Torque bolts sufficiently to assure leak-free operation at hydrostatic test pressure. Bolt torquing values are available from most manufacturers. If the joint has metal flanges, tighten bolts only enough to achieve a seal and never tighten to the point that there is metal-to-metal contact between the joint flange and the mating flange.
- 7. Storage.** Ideal storage is a warehouse with a relatively dry, cool location. Store flange face down on a pallet or wooden platform. Do not store other heavy items on top of an expansion joint. Ten-year shelf life can be expected with ideal conditions. If storage must be outdoors joints should be placed on wooden platforms and should not be in contact with the ground. Cover with a tarpaulin.
- 8. Large Joint Handling.** Do not lift with ropes or bars through the bolt holes. If lifting through the bore, use padding or a saddle to distribute the weight. Make sure cables or forklift tines do not contact the rubber. Do not let expansion joints sit vertically on the edges of the flanges for any period of time.
- 9. Additional Tips.**
 - a.** For elevated temperatures, do not insulate over a non-metallic expansion joint.
 - b.** It is acceptable (but not necessary) to lubricate the expansion joint flanges with a thin film of graphite dispersed in glycerin or water to ease disassembly at a later time.
 - c.** Do not weld in the near vicinity of a non-metallic joint.
 - d.** If expansion joints are to be installed underground, or will be submerged in water, contact manufacturer for specific recommendations.
 - e.** If the expansion joint will be installed outdoors, make sure the cover material will withstand ozone, sunlight, etc. Materials such as EPDM and Hypalon® are recommended. Materials painted with weather paint will give additional ozone and sunlight protection.
 - f.** Check the tightness of leak-free flanges two or three weeks after installation and re-tightness if necessary.

CONTROL ROD INSTALLATION INSTRUCTIONS

1. Assemble expansion joint between pipe flanges to the manufactured face-to-face length of the expansion joint. Include the retaining rings furnished with the expansion joint.
2. Assemble control rod plates behind pipe flanges. Flange bolts through the control rod plate must be longer to accommodate the plate. Control rod plates should be equally spaced around the flange. Depending upon the size and pressure rating of the system, 2, 3 or more control rods may be required. Contact manufacturer for optional installations.
3. Insert control rods through top plate holes. Steel washers are to be positioned at the outer plate surface. An optional rubber washer is positioned between the steel washer and the outer plate surface.
4. If a single nut per unit is furnished, position this nut so that there is a gap between the nut and the steel washer. This gap is equal to the joint's maximum extension (commencing with the nominal face-to-face length). Do not consider the thickness of the rubber washer. To lock this nut in position, either "stake" the thread in two places or tack weld the nut to the rod. If two jam nuts are furnished for each unit, tighten the two nuts together, so as to achieve a "jamming" effect to prevent loosening. Note: Consult the manufacturer if there is any question as to the rated compression and elongation. These two dimensions are critical in setting the nuts and the sizing the compression pipe sleeves.
5. If there is a requirement for compression pipe sleeves, ordinary pipe may be used and sized in length to allow the joint to be compressed to its normal limit.
6. For reducer installations, it is recommended that all control rod installations be parallel to the piping.

INSPECTION PROCEDURE FOR RUBBER EXPANSION JOINTS IN SERVICE

The following guide is intended to assist in determining if an expansion joint should be replaced or repaired after extended service.

- 1. Replacement Criteria.** If an expansion joint is in a critical service condition and is five or more years old, consideration should be given to maintaining a spare or replacing the unit at a scheduled outage. If the service is not of a critical nature, observe the expansion joint on a regular basis and plan to replace after 10 years service. Applications vary and life can be as long as 30 years in some cases.
- 2. Procedures.**
 - a. Cracking.** (Sun Checking) Cracking, or crazing may not be serious if only the outer cover is involved and the fabric is not exposed. If necessary, repair on site with rubber cement where cracks are minor. Cracking where the fabric is exposed and torn, indicates the expansion joint should be replaced. Such cracking is usually the result of excess extension, angular or lateral movements. Such cracking is identified by: (1) a flattening of the arch, (2) cracks at the base of the arch, and/or (3) cracks at the base of the flange. To avoid future problems, replacement expansion joints should be ordered with control rod units.
 - b. Blisters-Deformation-Ply Separation.** Some blisters or deformations, when on the external portions of an expansion joint, may not affect the proper performance of the expansion joint. These blisters or deformations are cosmetic in nature and do not require repair. If major blisters, deformations and/or ply separations exist in the tube, the expansion joint should be replaced as soon as possible. Ply separation at the flange O.D. can sometimes be observed and is not a cause for replacement of the expansion joint.
 - c. Metal Reinforcement.** If the metal reinforcement of an expansion joint is visible through the cover, the expansion joint should be replaced as soon as possible.
 - d. Dimensions.** Any inspections should verify that the installation is correct; that there is no excessive misalignment between the flanges; and, that the installed face-to-face dimension is correct. Check for over-elongation, over-compression, lateral or angular misalignment. If incorrect installation has caused the expansion joint to fall, adjust the piping and order a new expansion joint to fit the existing installation.
 - e. Rubber Deterioration.** If the joint feels soft or gummy, plan to replace the expansion joint as soon as possible.
 - f. Leakage.** If leaking or weeping is occurring from any surface of the expansion joint, except where flanges meet, replace the joint immediately. If leakage occurs between the mating flange and expansion joint, tighten all bolts. If this is not successful, turn off the system pressure, loosen all flange bolts and then retighten bolts in stages by alternating around the flange. Make sure there are washers under the bolt heads, particularly at the split in the retaining rings. Remove the expansion joint and inspect both rubber flanges and pipe mating faces for damage and surface condition. Repair or replace as required. Also, make sure the expansion joint is not over elongated, as this can tend to pull the joint flange away from the mating flange resulting in leakage. If leakage persists, consult the manufacturer for additional recommendations.

The Installation/Inspection Instructions are considered to be the best industry practices and are defined by the Fluid Sealing Association Technical handbook 7th Edition Non-Metallic Expansion Joints and Flexible Pipe Connectors.

General Conversion Factors

Multiply	By	To Obtain	Multiply	By	To Obtain
Atmospheres	33.9	Feet of water	Inches of water	0.1867	Cms.of mercury
Atmospheres	29.92	Inches of mercury	Inches of water (at 4°C)	2.54×10^{-3}	Kgs./sq. cm.
Atmospheres	10332	Kilograms/sq. m.	Inches-pounds/deg.	0.66	Kilogram-meters/rad
Atmospheres	14.7	Pounds/sq. in.	Joules	9.486×10^{-4}	B.T.U.
Atmospheres	760	mm of mercury	Joules	0.7376	Foot-pounds
Bars	9.869×10^{-1}	Atmospheres	Joules	2.390×10^{-4}	Kg.-calories
Bars	1.0×10^6	Dynes/sq. cm.	Kilograms	980665	Dynes
Bars	1.020×10^4	Kas./sa. meter	Kilograms	1.0×10^3	Grams
Bars	14.5	Pounds/sq. in.	Kilograms	2.205	Pounds
British Thermal Units	777.5	Foot-pounds	Kilogram-calories	3.968	B.T.U.
British Thermal Units	1054.6	Joules	Kilogram-calories	3086	Foot-pounds
British Thermal Units	0.2520	Ka.-calories	Kiloaram-calories	4186	Joules
British Thermal Units	2.928×10^{-4}	K.W.-hours	Kilogram-meters	7.233	Foot-pounds
B.T.U./hr.	0.2520	Kg. cal/Hr.	Kilograms/cu. meters	3.613×10^{-5}	Pounds/cu. in.
B.T.U./hr./sq. ft.	2.712	Kg.-cal/hr./sq. m.	Kilograms/sq. cm.	9.80665×10^5	Dynes/sq. cm.
B.T.U./hr./sq. ft./deg F.	4.882	Kg. cal/hr./sq. m./deg C.	Kilograms/sq. cm.	14.226	Pounds/sq. in.
B.T.U./sq. ft.	2.712	Kg. cal./sq. m.	Kilograms/sq. meter	9.678×10^{-5}	Atmospheres
B.T.U./sq. ft./in.	6.892	Kg. cal/sq.m./cm.	Kilograms/sq. meters	9.804×10^{-5}	Bars
Celsius	$(^{\circ}\text{C} \times 1.8) + 32$	Fahrenheit	Kilometers	1.0×10^3	Centimeters
Centimeters	0.0328	Feet	Kilometers	3281	Feet
Centimeters	0.3937	Inches	Kilometers	3.937×10^4	Inches
Centimeters	0.01	Meters	Kilonewtons/sq. meter	0.145	Pounds/sq. in.
Centimeters	$1. \times 10^4$	Microns	Kilopascals	0.145	Pounds/sq. in.
Centimeters/sec	0.03281	Feet/sec	Liters	1.0×10^3	Cubic centimeters
Centipoises	0.000672	Lbs./ft.-sec.	Liters	0.0351	Cubic foot
Cubic centimeters	3.531×10^{-5}	Cubic feet	Liters	0.2642	Gallons (U.S.)
Cubic centimeters	6.102×10^{-2}	Cubic inches	Liters	1.0×10^{-3}	Cubic meters
Cubic centimeters	1.0×10^{-3}	Liters	Mega nascals (mPa)	145	Pounds/sq. in.
Cubic feet	1728	Cubic inches	Meters	3.281	Feet
Cubic feet	0.03704	Cubic Yards	Meters	39.37	Inches
Cubic feet	7.481	Gallons	Meters	100	Centimeters
Cubic feet	28.32	Liters	Meters	0.001	Kilometers
Cubic feet/second	26930	Gallons/hour	Meters	1000	Millimeters
Cubic inches	1.639×10^{-5}	Cubic meters	Meters/sec.	3.281	Feet/sec.
Cubic inches	4.329×10^{-3}	Gallons	Microns	3.94×10^{-5}	Inches
Cubic meters	1.0×10^6	Cubic cm.	Millimeters	0.1	Centimeters
Cubic meters	35.31	Cubic feet	Millimeters	0.003281	Feet
Cubic meters	1.308	Cubic yards	Millimeters	0.03937	Inches
Degrees(angle)	1.745×10^{-2}	Radians	Millimeters	1.0×10^{-6}	Kilometers
Dynes	1.020×10^{-6}	Kilograms	Millimeters	0.001	Meters
Dynes	2.248×10^{-6}	Pounds	Newtons	1.0×10^5	Dynes
Dynes/sq. cm.	9.870×10^{-7}	Atmosphere	Newtons	0.2248	Pounds
Dynes/sq. cm.	1×10^{-6}	Bars	Newtons/mm	5.71	Pounds/inch
Dynes/sa. cm.	0.0102	Kas./sa. meter	Newton-Meters	8.8504	Inch-pounds
Dynes/sq. cm.	2.089×10^{-3}	Pounds/sq. ft.	Newtons/sq. meter	1	Pascals
Dynes/sq. cm.	1.450×10^{-5}	Pounds/sq. in.	Ounces	28.35	Grams
Fahrenheit	$5/9(^{\circ}\text{F}-32)$	Celsius	Ounces (fluid)	0.02957	Liters
Feet	30.48	Centimeters	Pounds	444823	Dynes
Feet	3.048×10^{-4}	Kilometer	Pounds	453.6	Grams
Feet	0.3048	Meters	Pounds	0.4536	Kilograms
Feet	304.8	Millimeters	Pounds of water	0.01602	Cubic feet
Feet/minute	0.01667	Feet/second	Pounds of water	27.68	Cubic inches
Foot-pounds	1.356	Joules	Pounds of water	0.1198	Gallons
Foot-pounds	3.241×10^{-4}	Kg.-calories	Pounds/cu. foot	0.01602	Grams/cu. cm.
Foot-pounds	0.1383	Kg.-meters	Pounds/cubic foot	16.02	Kgs./cu. meter
Gallons (U.S.)	0.1337	Cubic feet	Pounds/cubic foot	5.787×10^{-4}	Pounds/cu. in.
Gallons (U.S.)	231	Cubic inches	Pounds/cu. in.	2.768×10^4	Kgs./cu. meter
Gallons (U.S.)	3.785×10^{-3}	Cubic meters	Pounds/cu. in.	1.728×10^3	Pounds/cu. ft.
Gallons (U.S.)	3.785	Liters	Pounds/inch	17.86	Kilograms/meter
Gallons of water	8.337	Pounds of water	Pounds/inch	178.6	Grams/cm.
Gallons/hour	3.71×10^{-5}	Cu. ft./sec.	Pounds/square inch	2.036	Inches of mercury
Grams	980.7	Dynes	Pounds/square inch	51.7	Mm of mercury
Grams	2.205×10^{-3}	Pounds	Pounds/square inch	703.1	Kgs./sq. meter
Grams/cubic cm.	0.03613	Lbs./cu. in.	Radians	57.3	Degrees
Grams/sq. cm.	1.422×10^{-2}	Lbs./sq. in.	Slugs	3.217×10^1	Pounds
Inches	2.54	Centimeters	Square centimeters	0.1550	Square inches
Inches	0.0254	Meters	Square feet	929	Square cms.
Inches	25.4	Millimeters	Square feet	0.0929	Square meters
Inches of mercury	0.03342	Atmospheres	Square inches	645.2	Square mms.
Inches of mercury	3.453×10^{-2}	Kgs./sq. cm.	Square inches	6.452	Square cms.
Inches of mercury	0.4912	Lbs./sq. in.	Square meters	1.55×10^3	Square inches
Inches of water	2.458×10^{-3}	Atmosphere	Square millimeters	1.0×10^{-2}	Square cms.
Inches of water	0.07349	Inches of mercury	Square millimeters	1.55×10^{-3}	Square inches
Inches of water	0.03609	Lbs./ sq. in.	Tons	0.02	Pounds/sq. in.

Specification Sheet

Customer	Company Name	Project Name				Date	
	Address	Job Number					
	City, State, Zip	Prepared by					
	Contact	Item No.	Item No.	Item No.	Item No.	Item No.	Item No.
	Phone Number	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity
Size	Pipe/Flange Size	Inches		Inches		Inches	
	Over All Length	Inches		Inches		Inches	
	Arches <i>(if known)</i>						
	Style <i>(if known)</i>						
Pressure	Operating Pressure	PSI	HG	PSI	HG	PSI	HG
	Design Pressure	PSI	HG	PSI	HG	PSI	HG
	Surge Pressure	PSI	HG	PSI	HG	PSI	HG
	Test Pressure	PSI	HG	PSI	HG	PSI	HG
		PSI	HG	PSI	HG	PSI	HG
Movements	Axial Compression	Inches		Inches		Inches	
	Axial Extension	Inches		Inches		Inches	
	Lateral Deflection	Inches		Inches		Inches	
	Angular Movement	Degrees		Degrees		Degrees	
	Torsional Movement	Degrees		Degrees		Degrees	
		Degrees		Degrees		Degrees	
Media	Flowing Media						
	Temperature of Media	Min °F	Max °F	Min °F	Max °F	Min °F	Max °F
	Velocity of Media	Ft/Min		Ft/Min		Ft/Min	
	Surrounding Atmosphere	Min °F	Max °F	Min °F	Max °F	Min °F	Max °F
Miscellaneous	Flange Drilling	Specification		Specification		Specification	
	Mating Flange Thickness	Inches		Inches		Inches	
	Flange Alloy						
	Elastomer <i>(tube/cover)</i>						
	Retaining Rings	YES	NO	YES	NO	YES	NO
	Control Unit	YES	NO	YES	NO	YES	NO
	Joint Location	Inside	Outside	Inside	Outside	Inside	Outside
	Hydrostatic Test of Joint Required	YES	NO	YES	NO	YES	NO

Warranty

- 1. DEFINITION:** "Document" shall refer to these General Terms and Conditions and the Purchase Order, Invoice, or Delivery Ticket, as the case may be, printed on the face hereof.
- 2. DELIVERY:** Time is of the essence in this transaction, and if delivery of conforming Product(s) or performance of conforming services is not completed by the time(s) promised, Buyer reserves the right, in addition to its other rights and remedies, to cancel this order, to reject such Product(s) or services in whole or part on reasonable notice to Seller, and/or to purchase substitute Products or services elsewhere and charge Seller with any loss incurred. Shipments sent C.O.D. without Buyer's written consent will not be accepted and will be at Seller's risk.
- 3. PRICE:** Buyer shall not be billed at prices higher than stated herein unless authorized in writing by Buyer. Seller agrees to notify Buyer of any price reduction made in Products or services covered by this Document subsequent to the date hereof and prior to delivery or performance and agrees that any such reduction will be applicable to this Document.
- 4. TERMS:** This sale is limited of these terms and conditions. Any additional or different terms or conditions proposed by you are rejected unless we expressly agree there to in writing. A contract embodying all and only these terms and conditions shall be formed by (i) delivery of materials or goods ("Product(s)") or performance of services and (ii) acceptance of such Product(s) or services by buyer. References to this document shall, unless the context otherwise requires, include any contract resulting from this Document. No modification of this document shall be effective without our written consent. No course of prior dealings, no usage of trade, and no course of performance shall be used to modify, supplement, or explain any terms used in this Document.
- 5. PAYMENT:** All payments are due pursuant to the payment term on the face of this Document.
- 6. TERMINATION:** Buyer expressly reserves the right, in the event that this Document is issued pursuant to a prime contract with the Government or to a subcontract thereunder, to terminate the work under this Document at any time by written or telegraphic notice to Seller stating the extent and effective date of such termination, in which event the rights and obligations of the parties hereto shall be determined in accordance with the termination provisions applicable to such Government contract.
- 7. CONTINGENCIES:** Failure of either party to perform hereunder, except for the payment of money, in whole or in part, occasioned by act of God, act of the public enemy, fire, explosion, perils of sea, flood, drought, war, riot, sabotage, terrorism, accident, embargo, government priority, requisition or allocation, or any circumstance of like or different character beyond the reasonable control of the party so failing to perform, shall not subject said party to any liability to the other party for such period of time and to the extent that such contingency precludes performance.
- 8. WARRANTIES:**
 - (a) Seller makes NO WARRANTY WHATSOEVER, except as to title, with respect to any Product(s) manufactured and/or designed to Buyer's own specifications (other than mere dimensions), and Buyer shall, at its own expense, indemnify, defend and hold Seller harmless from and against any claim, suit, or expense which shall be asserted or brought against Seller by reason of its manufacture or sale of such Product(s).
 - (b) Seller makes NO WARRANTY WHATSOEVER concerning any Product(s) manufactured by others, but will extend to Buyer any warranties respecting such Product(s) as made by the manufacturer of such Product(s). Seller will repair or replace any Product(s) manufactured by Seller which prove defective within one (1) year from the date of shipment if such defects are due to defective workmanship of Seller's employees, provided that the Product(s) has or has been (i) properly assembled and utilized in accordance with Seller's design thereof and instructions relating thereto AND (ii) returned to the Seller at Buyer's expense. This warranty shall be voided by any changes made in the Product(s) prior to or in connection with their assembly or use.
 - (c) EXCEPT FOR THE EXPRESS WARRANTY DESCRIBED ABOVE THERE ARE NO WARRANTIES INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, WHICH EXTEND BEYOND THE DESCRIPTION OF THE PRODUCT(S) ON THE FACE HEREOF NO WARRANTIES OF REPRESENTATIONS AT ANY TIME MADE BY ANY REPRESENTATIVE OF SELLER SHALL BE EFFECTIVE TO VARY OR EXTEND THE ABOVE REFERENCED EXPRESS WARRANTIES OR ANY OTHER TERMS HEREOF.
 - (d) In no event shall Seller be liable for consequential, incidental, or special damages resulting from or in any matter related to the Product(s), the design, use, or any inability to use the Product(s), including without limitation, damages arising out of or in any manner relating to the delivery of the Product(s), or any delay with respect to delivery of the Product(s). The sole and exclusive remedy with respect to any defective Product(s) manufactured by Seller shall be repair, correction, or replacement thereof pursuant to the "WARRANTY" provisions above. Should the Product(s) prove so defective, however, as to preclude the remedying of warranted defects by repair or replacement. Buyer's sole and exclusive remedy shall be the refund of the purchase price of the defective Product(s) involved, upon return of the Product(s) to Seller.
 - (e) Seller warrants that the use or sale of any Product(s) delivered hereunder, or any part thereof, except any Product(s) produced to Buyer's drawings or specifications, does not infringe any adverse valid existing patent. Seller shall indemnify, defend, and hold harmless Buyer, Buyer's customers, users of the Product(s), and any of their successors and assigns, from and against any and all liability, damage, loss, cost, or expense incurred in connection with any claim, suit, or action for actual or alleged infringement of any such patent, arising out of or in connection with the use or sale of such Product(s).
- 9. LOSS IN TRANSIT:** Title and risk of loss in transit shall pass to Buyer upon delivery to (i) Buyer or (ii) a carrier, where shipment is made F.O.B. Seller's shipping point.
- 10. ASSIGNMENT:** Either party's assignment of this Document, of any interest herein, or of any money due or to become due hereunder without the prior written consent of the other party shall be void, unless such assignment is made to an affiliate of the assigning party.
- 11. INDEPENDENT CONTRACTOR:** In performing any services hereunder, each party is and undertakes performance hereof as an independent contractor, with sole responsibility for all persons employed in connection therewith, including without limitation, exclusive liability for the payment of all Federal, State, and local Unemployment and Disability Insurance and all Social Security and/or other taxes and contributions payable in respect of such persons from and against which liability each party agrees to indemnify, defend, and hold harmless the other part.
- 12. MANNER OF PERFORMANCE:**
 - (a) Each party shall comply with all laws, regulations, and/or other requirements of local, state, and federal governments in connection with its manufacture or delivery of any Product(s) or performance of any services hereunder, including without limitation, those pertaining to financial capability responsibility and security for pollution damage and the price production sale, or delivery of the Product(s) or services. Specifically, but not by way of limitation, each party agrees to comply with Executive Order 11246 regarding equal employment opportunity, the Rehabilitation Act of 1973, the Vietnam Era Veterans Readjustment Act of 1972, the Occupational Safety and Health Act, the Fair Labor Standards Act, the Americans with Disabilities Act, and all regulations promulgated pursuant to any of the above.
 - (b) If this order involves the presence of either party on the other party's premises, such party comply with all safety, health, and security laws, regulations, and the other party's policies and shall take all necessary precautions to prevent injury or damage to persons or property while so engaged.