RESISTOFLEX®

brands you trust

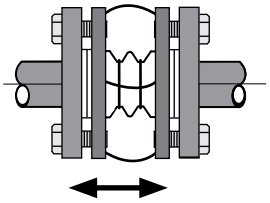
Expansion Joint Design Manual

CRANE®

ChemPharma Flow Solutions

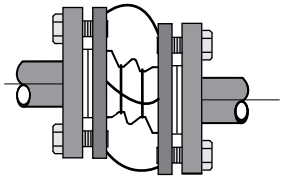
www.cranechempharma.com

PTFE Expansion Joints are used to compensate for movement, misalignment and/or vibration in piping systems. Generally, the more convolutions in the joint design, the greater the range of motions it can compensate. Expansion joints should never be used to compensate for rotation about the pipe axis.



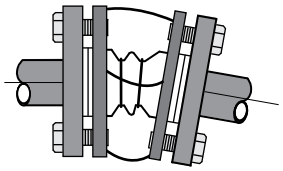
AXIAL TRAVEL

"Maximum Axial Travel" may be called longitudinal movement or axial compression and extension. It is based on installation with no misalignment or angular deflection.



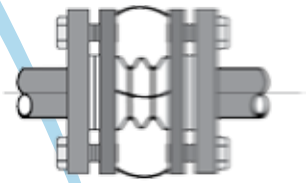
MISALIGNMENT

"Maximum Misalignment" may also be referred to as lateral offset or deflection. It is based on installation with no axial travel or angular deflection.



ANGULAR DEFLECTION

"Maximum Angular Deflection" may be called angular rotation. It is based on installation with no axial travel or lateral offset.



VIBRATION

In addition to noise, vibration transmitted through piping can cause leaks, premature equipment wear, and cracked welds. Expansion joints drastically reduce vibration transmission, thereby solving many of these issues.

Warning

See section in this manual entitled "Limit Bolts" regarding damage which can result if they are removed. Rotation (or "torsion") about the longitudinal axis of an expansion joint is prohibited and can lead to premature failure and/or rupture of the unit and may result in property damage, serious personal injury, or death.

Use of these units either when improperly installed or beyond the Pressure/Temperature Rating or Vacuum Rating may cause premature failure and/or rupture of the Unit and may result in property damage, serious personal injury, or death. Safety shields must be used in hazardous service.

If components show significant deterioration due to abrasion, damage, or corrosion, the assembly should be removed from service. Failure to periodically perform inspection for abrasion, damage, or corrosion may lead to failure and/or rupture of the assembly resulting in property damage, serious personal injury, or death.

Do not install nuts or connecting bolt heads behind expansion joint flanges or accidental wrench damage may occur to the PTFE element. Do not drill out threads.

An internal sleeve should be used where abrasive slurries or solids are or may be present.

Table of Contents

CRANE® RESISTOFLEX®

Flanged Plastic-Lined Pipe

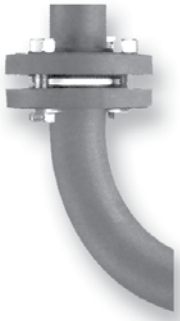
CRANE ChemPharma, Resistoflex plastic-lined pipe is made with a locked-in liner to minimize the adverse effects of differential thermal expansion between the liner and the steel. Available liners are: PP, Kynar® PVDF, and Teflon® PTFE or PFA.

Plastic-Lined Fittings

PP, Kynar® PVDF, and Teflon® PFA fittings are all injection or transfer molded. TEFZEL® lined fittings and special shapes are roto-lined in custom housings. Teflon® PTFE liners are made by isostatic molding.

Special Shapes

- Custom fittings, manifolds, and small vessels
- Lined with TEFZEL® ETFE
- Available through 24" diameter



Thermalok Pipe

- Stress relieved liner
- Unlimited housing material options
- Sizes ranging from 1" - 24" diameter

Swaged Pipe

- Used exclusively for CONQUEST® and MULTI-AXIS®
- Sizes ranging from 1" - 8"
- Threaded flanges and threaded rotatable flange assemblies only

CONQUEST® Connections

- Patented flangeless joint design
- Performance of a welded system
- Available in 1" - 4" for all liner types
- Virtually zero maintenance

HOSES OF TEFLON®

- Liners of Teflon® PTFE T-62 or Teflon® FEP
- Convoluted or Smoothbore
- Wide variety of fittings - pipe, flange, cam and groove, sanitary
- Braid available in SS, Monel®, PVDF, or polypropylene

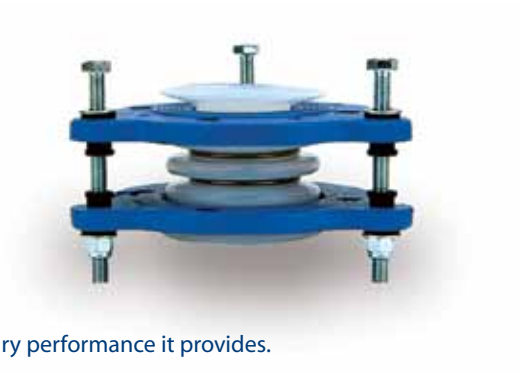
ResistoPure™

- High-Purity Silicone Hoses
- High-Purity Teflon® Hoses
- Clean-Room Assembly Packaging
- Virtually zero maintenance

The RESISTOFLEX® Difference is the PERFORMANCE Difference

It all starts with the resin...

Resistoflex expansion joints are contour molded of paste extruded TEFLON® PTFE by an exclusive patented process. They are corrosion resistant, non-aging, with extraordinary flex life and unmatched reliability. They offer a low spring rate to protect stress-sensitive glass, graphite or FRP equipment and are cost effective. The convoluted PTFE expansion joints are flared over the flanges to eliminate the need for separate gaskets.



Resistoflex uses only TEFLON® T-62 resins by DuPont because of the extraordinary performance it provides.

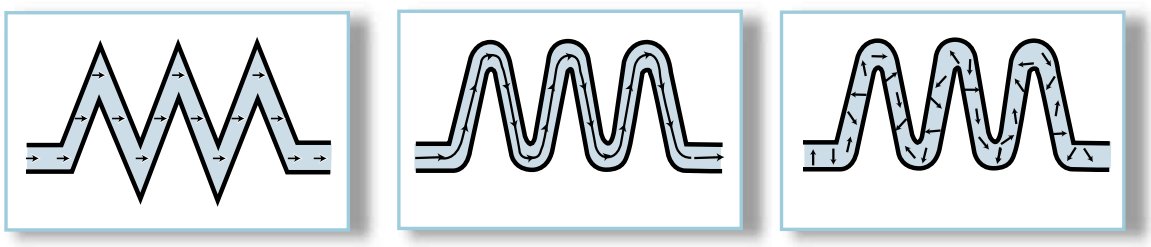
Properties of DuPont PTFE T-62

Properties	Unit	Teflon® PTFE-62 Copolymer	Homopolymer	FEP	PFA
Continuous Service Temp	°F	500 °F	500 °F	300 °F	500 °F
Tensile Strength	PSI	5,000	3,000	3,000	3,000
Flex Life	Cycles	>18,000,000	>1,000,000	5,000	15,000

TEFLON® is a registered Trademark of E.I. du Pont de Nemours and Company and is used under license by Crane.

The benefits of contour molding...

The extraordinary flex life performance of Teflon® T-62 is only part of the story. From the beginning, Resistoflex has recognized the importance of contour molding its bellows from extruded tubing as opposed to machining them from bar or tube stock, or blow molding them from isostatically molded tubes. That's because only the contour molding process provides the optimal combination of flexibility and tensile strength. It prevents the stress concentrations common in machined bellows which is vital because of PTFE's inherent notch sensitivity. Furthermore, and perhaps most importantly, the activation/deflection forces are an order of magnitude lower with Resistoflex contour molded expansion joints than those made via any other process. Its smooth contours provide a better fit with exterior reinforcing rings, reducing the possibility of joint damage as they flex.



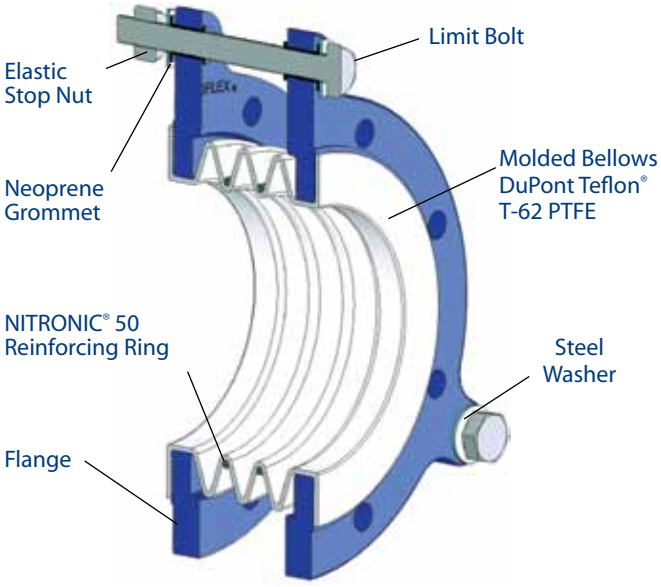
Machined **Contour Molded** **Isostatically Molded**

The lines of orientation above show the differences in molecular orientation which result from different processes and underscore why contour molded bellows provide such exceptional performance.

R-Series or E-Series?

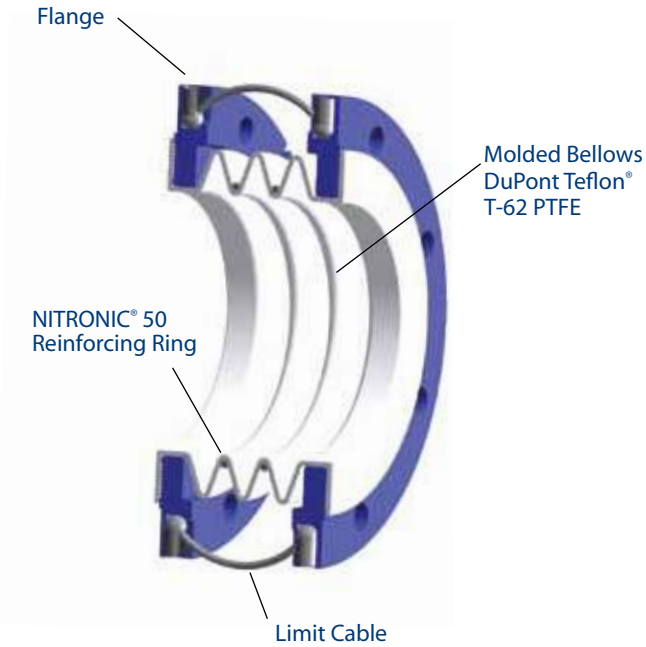
R-Series

- Steel bolts limit axial extension, offset, and angular misalignment. They also restrict harmful torsional movement.
- Limit-rods are pre-set at the factory with elastic stop nuts (this setting must not be modified).
- Reinforcing rings provide pressure-retaining capability.



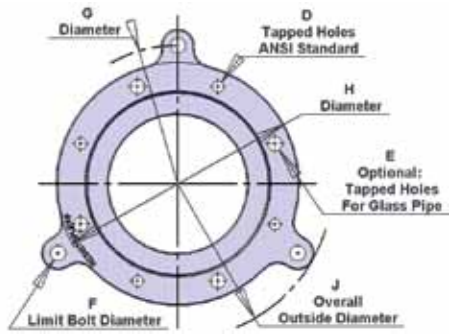
E-Series

- Stainless steel aircraft-grade cables limit extension.
- Cable-limited joints allow for greater offset and angular misalignment than bolt-limited joints.
- Neutral lengths are common to other manufacturers, allowing drop-in replacement of underperforming joints in many cases.
- Reinforcing rings provide pressure-retaining capability.



Note: "RE" Series joints are bolt-limited joints with "E-Series" neutral length dimensions.

Flange Dimensional Data



Nom. Size (in.)	D			E			F†		H	Flange Thickness		J†	Bolt Sizes* for connecting Expansion Joints to CPI & HVAC Class 125 & 150 ANSI Flanges *
	No. of Holes	Thread	B.C.	No. of Holes	Thread	B.C.	Limit Bolt Dia.	G† B.C.		R Series	E Series		
1	4	1/2 - 13	3 1/8	4	5/16 - 18	3 1/8	1/4	5 1/8	4 1/4	5/16	7/16	6	1/2"-13 X 1"
1 1/4	4	1/2 - 13	3 1/2	—	—	—	1/4	5 3/16	4 5/8	25/64	—	6 55/64	1/2"-13 X 1 1/8"
1 1/2	4	1/2 - 13	3 7/8	4	5/16 - 18	3 7/8	1/4	5 7/8	5	11/32	15/32	6 3/4	1/2" - 13 x 1 1/4"
2	4	5/8 - 11	4 3/4	4	5/16 - 18	4 3/4	3/8	6 7/8	6	7/16	31/64	8 1/8	5/8" - 11 x 1 1/2"
2 1/2	4	5/8 - 11	5 1/2	—	—	—	3/8	8 1/8	7	1/2	—	9 3/8	5/8" - 11 x 1 3/4"
3	4	5/8 - 11	6	4	5/16 - 18	6	3/8	8 3/4	7 1/2	1/2	37/64	10	5/8" - 11 x 1 3/4"
4	8	5/8 - 11	7 1/2	8	5/16 - 18	7 1/2	3/8	9 7/8	9	5/8	37/64	11 1/8	5/8" - 11 x 2"
5	8	3/4 - 10	8 1/2	—	—	—	1/2	11 1/2	10	3/4	—	13	3/4" - 10 x 2"
6	8	3/4 - 10	9 1/2	8	3/8 - 16	9 1/2	1/2	12 1/2	11	3/4	41/64	14	3/4" - 10 x 2"
8	8	3/4 - 10	11 3/4	N/A	N/A	N/A	1/2	14 3/4	13 1/2	15/16	11/16	16 1/4	3/4" - 10 x 2 1/2"
10	12	7/8 - 9	14 1/4	N/A	N/A	N/A	1/2	17 1/2	16	1	47/64	19	7/8" 9-x 2 1/2"
12	12	7/8 - 9	17	N/A	N/A	N/A	5/8	20 1/2	19	1	13/16	22	7/8" 9-x 2 1/2"
14	12	1 - 8	18 3/4	N/A	N/A	N/A	1 7/16	24 11/64	21	1 3/16	N/A	27 5/16	CF
16	16	1 - 8	21 1/4	N/A	N/A	N/A	1 7/16	27 9/16	23 1/2	1 3/16	N/A	31 1/2	CF
18	16	1 1/8 - 7	22 3/4	N/A	N/A	N/A	1 7/16	29	25	1 3/16	N/A	32 29/32	CF
20	20	1 1/8 - 7	25	N/A	N/A	N/A	1 7/16	31 1/2	27 1/2	1 3/16	N/A	35 7/16	CF
24	20	1 1/4 - 7	29 1/2	N/A	N/A	N/A	1 7/16	35 29/32	32	1 11/32	N/A	39 27/32	CF

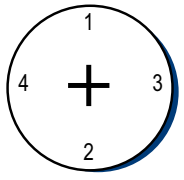
* Add bolt diameter to length for stud bolts.
** Lap-joint flanges may require 1/4" longer bolt in some instances.
CF = Consult Factory
† Applicable to R-Series and RE-Series, only

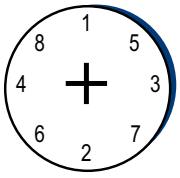
NOTE: Flanges are available in Class 300, DIN, and other drillings upon request. Expansion joint pressure/temperature ratings remain unchanged.

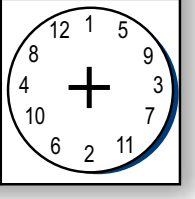
Bolt Torque Information

Bolts should be tightened using the following torques as a guide and with lightly oiled threads.

Nominal Expansion Joints Size (inches)	1	1 1/4 1 1/2	2	2 1/2	3	4	5	6	8	10	12
Class 150 Flange Bolt Torque (ft-lbs)	8 - 13	19 - 31	39 - 65	35 - 58	62 - 103	40 - 67	60 - 100	75 - 124	100 - 167	94 - 157	116 - 193
Flanges Drilled for Glass Pipe Bolt Torque (ft-lbs)	8 - 10	12 - 20	20 - 33	–	35 - 51	20 - 34	–	37 - 62	–	–	–

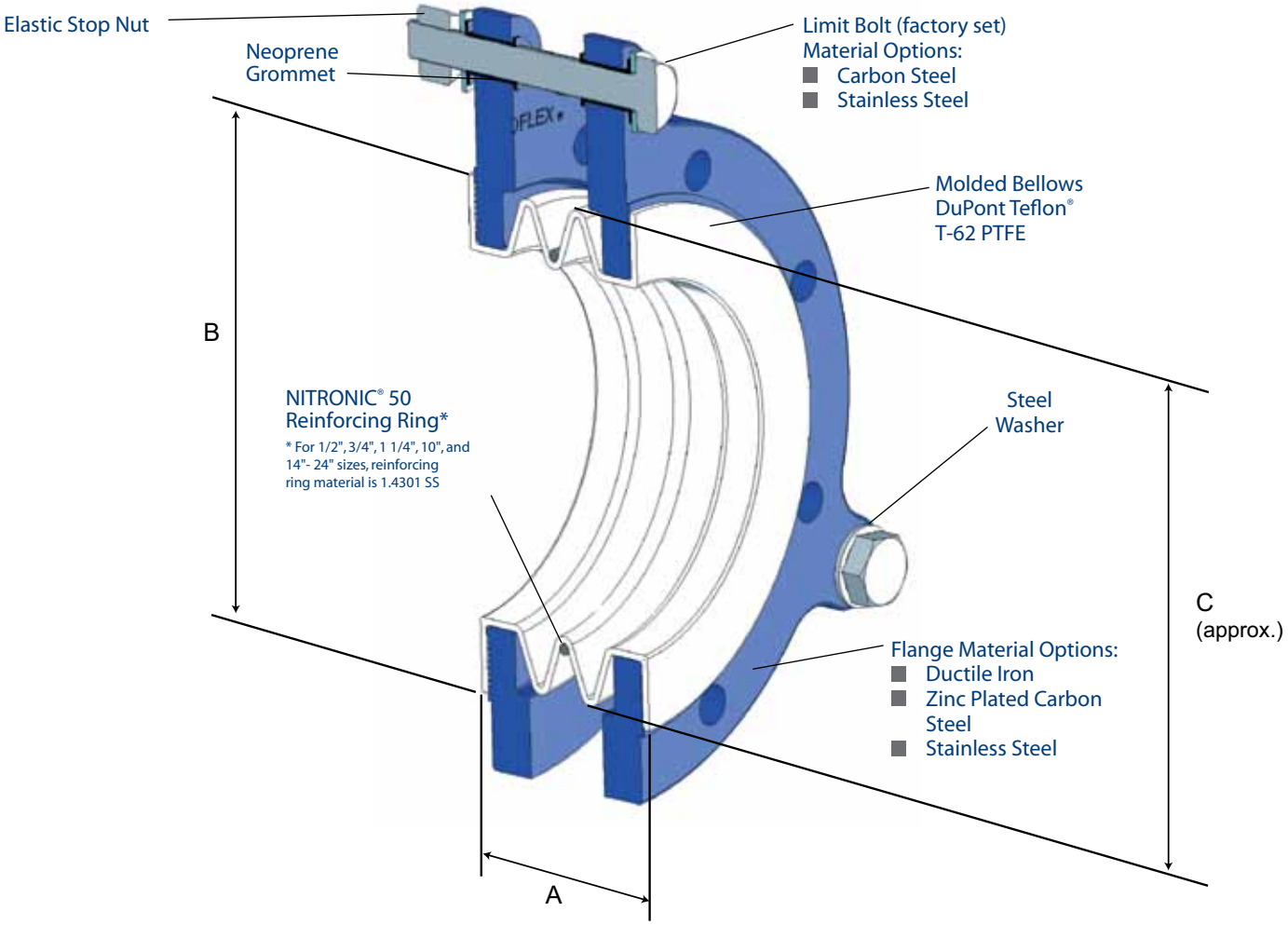




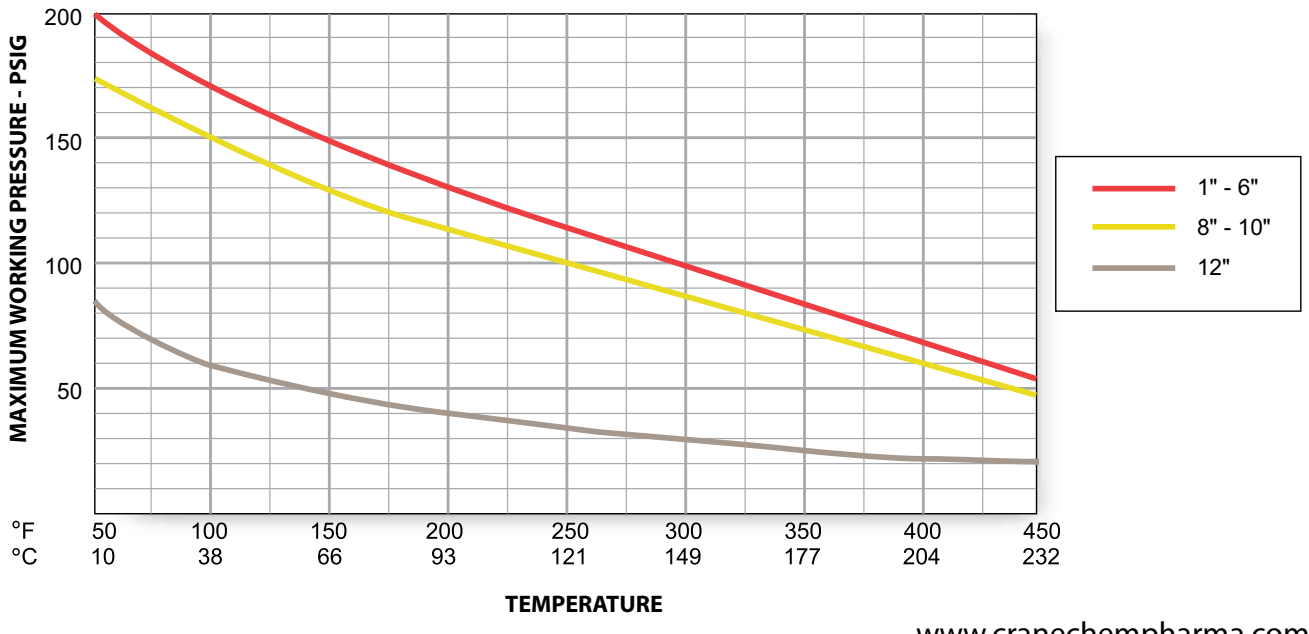


NOTE: The values in this table are a guide. In some instances, higher torque may be required. However, excessive torque should be avoided..

R6904 - 2 Convoluted PTFE Expansion Joint



NON-SHOCK WORKING PRESSURE vs. TEMPERATURE



R6904 - 2 Convoluted PTFE Expansion Joint

Nom. Size (I.D.)	Part Number	A †		B	C	Maximum Misalignment + or -	Max. Angular Deflection + or -	Compression Force Spring Rate (lb_f / in.)	Extension Force Spring Rate (lb_f / in.)	Misalignment Force Spring Rate (lb_f / in.)	Wt. (lbs.)	Vacuum Rating (In. Hg/°F)
		Neutral Length	Max. Axial Travel + or -	Flare Diameter	Convolute O.D.							
1/2	R6904-008	1 1/4	7/32	1 3/8	1	1/16	7°	CF	CF	CF	3	FV/450
3/4	R6904-012	1 1/4	1/4	1 11/16	1 11/32	3/32						
1	R6904-016	1 3/8	1/4	2	1 7/8	1/8	7°	104	80	104	2	FV/425
	R6904E-016	1 3/4	11/32					140	144	120		
1 1/4	R6904-020	1 3/8	1/4	2 1/2	1 11/64	1/8	7°	61	137	400	5	FV/400
1 1/2	R6904-024	1 3/8	1/4	2 7/8	2 27/64	1/8	7°	320	180	224	3	FV/425
	R6904E-024	1 13/16	11/32					240	200	240		
2	R6904-032	1 9/16	1/4	3 5/8	3	1/8	7°	512	300	240	7	FV/425
	R6904E-032	1 7/8	11/32					430	350	440		
2 1/2	R6904-040	2 1/4	5/16	4 1/8	3 1/2	1/8	7°	457	278	328	10	FV/425
3	R6904-048	2 1/4	3/8	5	4 1/2	3/16	7°	648	320	319	10	FV/425
	R6904E-048	2 3/16	13/32					650		350		
4	R6904-064	2 5/8	1/2	6 3/16	5 1/2	1/4	7°	480	280	400	18	FV/400
	R6904E-064	2 9/32	7/16					360		630		
5	R6904-080	3 1/4	1/2	7 5/16	6 1/2	1/4	7°	440	440	320	24	FV/400
6	R6904-096	2 3/4	1/2	8 1/2	8	1/4	7°	440	386	440	29	FV/400
	R6904E-096	2 17/32	15/32					460	350	720		
8	R6904-128	4	1/2	10 5/8	10 5/16	1/4	7°	450	390	480	47	FV/250
	R6904E-128	2 3/4	17/32		10 3/16			300	230	800		
10	R6904-160	5 1/4	1/2	12 3/4	11 3/4	1/4	7°	760	600	580	64	FV/250
	R6904E-160	2 31/32	9/16				6°	1280	870	1000		
12	R6904-192	6	1/2	15	15	1/4	7°	1300	420	700	115	FV/75
	R6904E-192	3 3/32	19/32				5°	380	240	1000		
14	R6904-224	6 5/16	3/4	16 1/4	17 1/4	3/8	7°	320	1056	1256	126	10/212
16	R6904-256	7	1	18 1/2	18 3/16			297	1096	1256	159	
18	R6904-288	7 15/16		21	20 1/4			440	1941	1370	174	
20	R6904-320	9		23	21 27/32			CF	CF	CF	183	6/212
24	R6904-384	6 5/16	5/8	27 1/4	26 3/16						238	4/212

All Dimension in inches unless otherwise noted.
† At neutral length with limit bolts in place.
† Maximum (axial) travel is based on installation with no misalignment or angular deflection.
† This is an installation dimension not a limit bolt setting.
CF = Consult Factory
FV = Full Vacuum

NOTE: Consult factory for spring rates for angular deflection.

Standard Material Offering

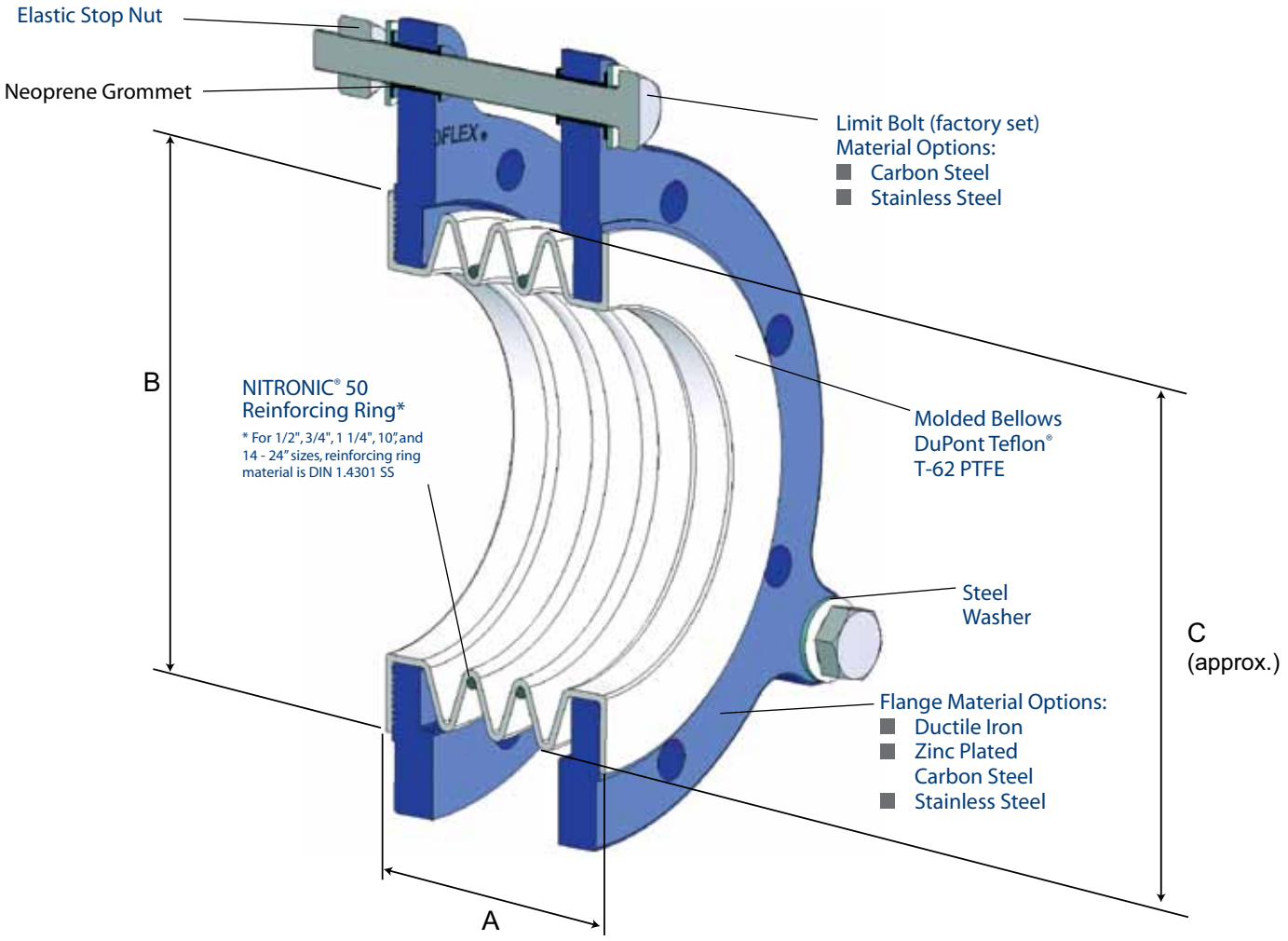
Size (in.)	Flange	Limit Bolt	Reinforcing Ring
1 - 12	Painted Ductile Iron	Carbon Steel	NITRONIC® 50*
1/2, 3/4, 1 1/4, 14-24	Zinc Plated Carbon Steel	Carbon Steel	DIN 1.4301 Stainless Steel

Warning
Always Use Safety Shields in Hazardous Service

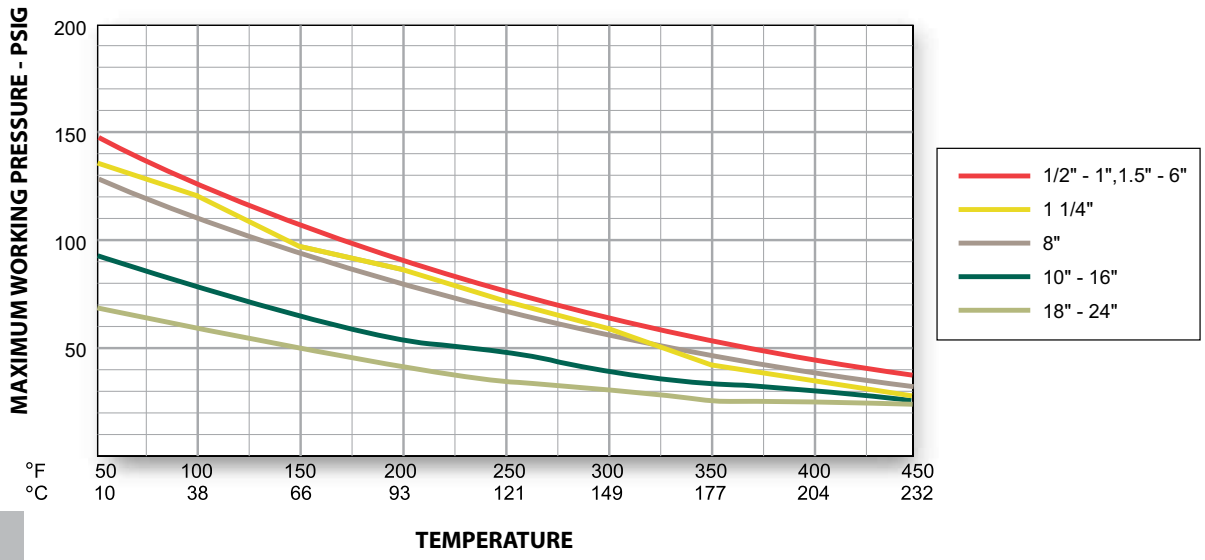
Stainless

■ 316 Stainless steel flanges and limit bolts are available as an option.

R6905 - 3 Convoluted PTFE Expansion Joint



NON-SHOCK WORKING PRESSURE vs. TEMPERATURE



R6905 - 3 Convoluted PTFE Expansion Joint

Nom. Size (I.D.)	Part Number	A †		B	C	Maximum Misalignment + or -	Max. Angular Deflection + or -	Compression Force Spring Rate (lb_f / in.)	Extension Force Spring Rate (lb_f / in.)	Misalignment Force Spring Rate (lb_f / in.)	Wt. (lbs.)	Vacuum Rating (In. Hg/°F)
		Neutral Length	Max. Axial Travel + or -	Flare Diameter	Convolute O.D.							
1/2	R6905-008	1 3/4	3/8	1 3/8	1	3 /16	14°	CF	CF	CF	3	FV/450
3/4	R6905-012	1 3/4	1/2	1 11/16	1 11/32						4	
1	R6905-016	1 3/4	1/2	2	1 57/64	1/4	14°	190	82	96	2	FV/400
	R6905E-016	2 5/16						130	130	260		
1 1/4	R6905-020	1 13/16	1/2	2 1/2	1 11/64	1/4	14°	40	120	314	5	FV/400
1 1/2	R6905-024	2	1/2	2 7/8	2 35/64	1/4	14°	84	66	108	4	FV/400
	R6905E-024	2 13/32	17/32				12°	80	70	110		
2	R6905-032	2 3/4	3/4	3 5/8	3 13/32	3/8	14°	69	76	109	8	FV/400
	R6905E-032	2 1/2	17/32				12°	70	80	160		
2 1/2	R69050-40	3 3/16	3/4	4 1/8	3 13/16	3/8	14°	91	97	160	11	FV/400
3	R6905-048	3 5/8	1	5	4 41/64	1/2	14°	124	125	194	13	FV/400
	R6905E-048	2 29/32	5/8				10°	140	160	190		
4	R6905-064	3 5/8	1	6 3/16	5 11/16	1/2	14°	220	155	264	19	FV/400
	R6905E-064	3 1/16	21/32				10°		160	190		
5	R6905-080	4	1	7 5/16	6 5/8	1/2	14°	320	210	324	25	FV/300
6	R6905-096	4	1 1/8	8 1/2	8	9/16	14°	289	187	266	30	FV/300
	R6905E-096	3 3/8	23/32				9°	350	190	540		
8	R6905-128	6	1 1/8	10 5/8	10 5/16	9/16	14°	178	218	423	48	FV/125
	R6905E-128	3 21/32	25/32		10 3/16		9°	450	170	750		
10*	R6905-160	7	1 3/16	12 3/4	11 3/4	1/2	14°	420	531	857	60	10/212
12	R6905-192	7 7/8	1 3/16	15	15	5/8	14°	743	542	857	77	10/212
14	R6905-224	8 1/2	1 1/4	16 1/4	17 1/4	11/16	14°	239	628	970	132	10/212
16	R6905-256	9 3/16	1 3/8	18 1/2	18 3/16	3/4		245	571	970	165	10/212
18	R6905-288	11 1/16	1 3/16	21	20 1/4	3/4		CF	CF	CF	201	9/212
20	R6905-320	12 7/8	1 3/16	23	21 27/32	1					243	9/212
24	R6905-384	11 7/8	1	27 1/4	26 3/16	3/4					309	4/212

All Dimensions in inches unless otherwise noted.

† At neutral length with limit bolts in place.

† Maximum (axial) travel is based on installation with no misalignment or angular deflection.

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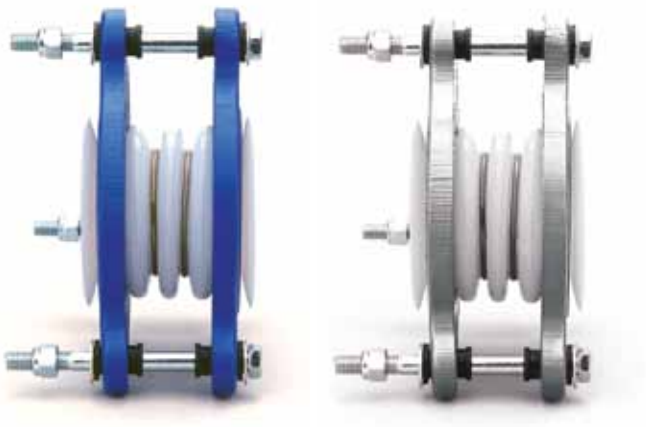
CF = Consult Factory

FV = Full Vacuum

NOTE: Consult factory for spring rates for angular deflection.



Standard Material Offering

Size (in.)	Flange	Limit Bolt	Reinforcing Ring
1 - 12	Painted Ductile Iron	Carbon Steel	NITRONIC® 50*
1/2, 3/4, 1 1/4, 14-24	Zinc Plated Carbon Steel	Carbon Steel	DIN 1.4301 Stainless Steel

* 10" size has ductile iron flanges and DIN 1.4301 reinforcing ring

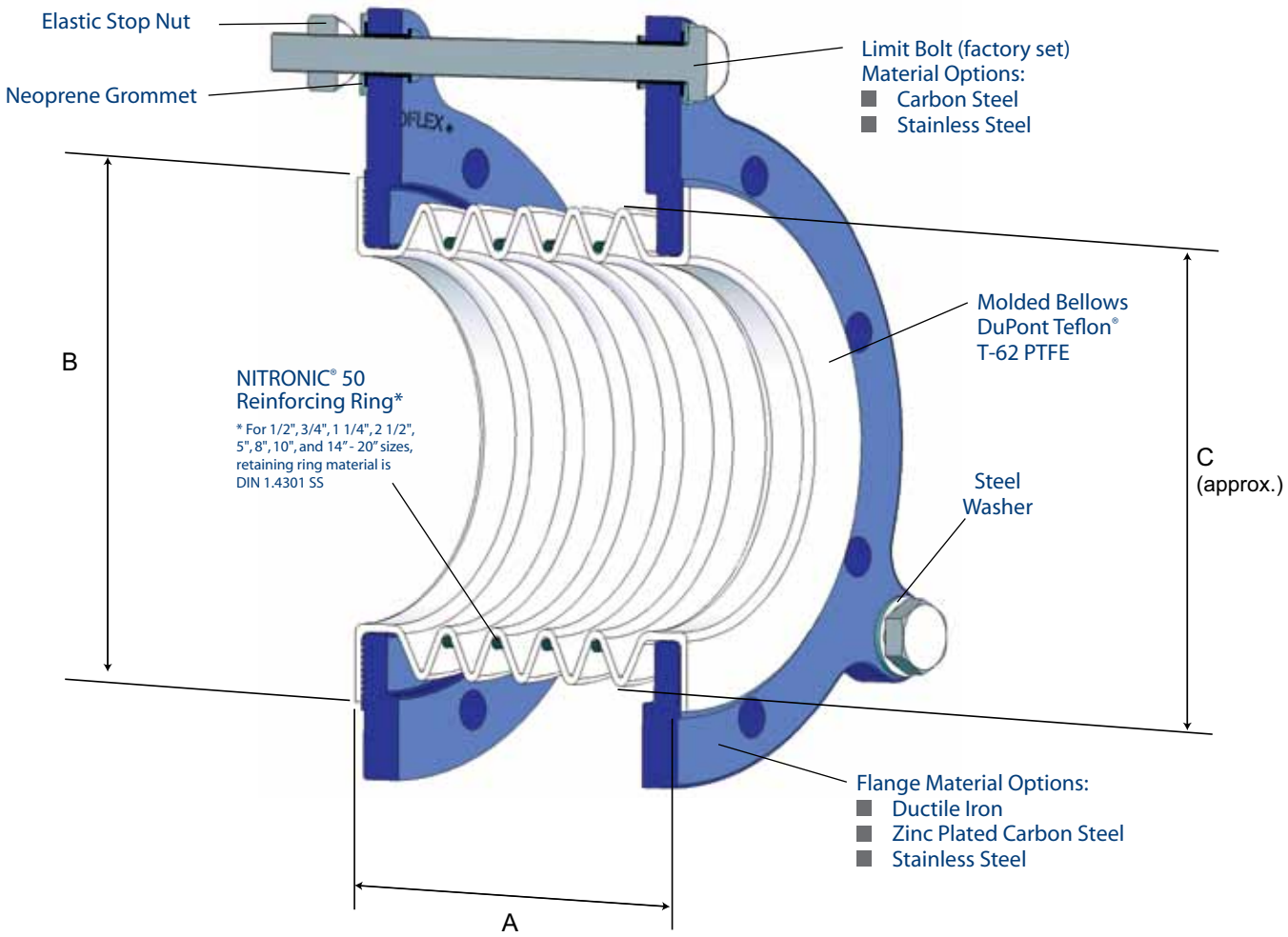
Stainless

■ 316 Stainless steel flanges and limit bolts are available as an option.

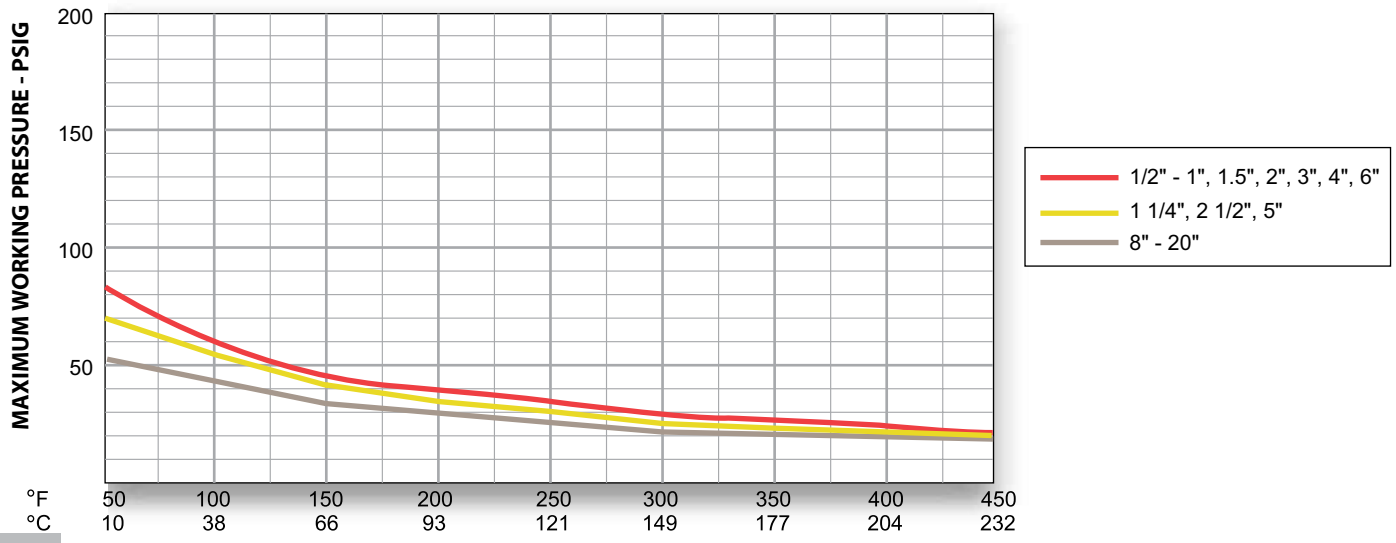
Warning

Always Use Safety Shields in Hazardous Service

R6906 - 5 Convoluted PTFE Expansion Joint



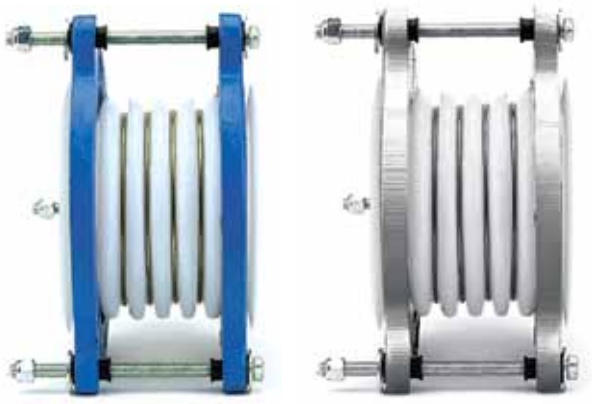
NON-SHOCK WORKING PRESSURE vs. TEMPERATURE



R6906 - 5 Convoluted PTFE Expansion Joint

Nom. Size (I.D.)	Part Number	A †		B	C	Maximum Misalignment + or -	Max. Angular Deflection + or -	Compression Force Spring Rate (lb_f / in.)	Extension Force Spring Rate (lb_f / in.)	Misalignment Force Spring Rate (lb_f / in.)	Wt. (lbs.)	Vacuum Rating (In. Hg/°F)
		Neutral Length	Max. Axial Travel + or -	Flare Diameter	Convolute O.D.							
1/2	R6906-008	2 1/2	7/16	1 3/8	1	5/16	20°	CF	CF	CF	3	5-Convolute Expansion Joints Are Not Rated for Vacuum Service
3/4	R6906-012		1/2	1 11/16	1 11/32	3/8					4	
1	R6906-016	3	1/2	2	1 57/64	1/2	20°	30	44	22	2	
	R6906E-016	3 1/2	27/32					50	110	50		
1 1/4	R6906-020	2 43/64	13/32	2 1/2	1 11/64	1/2	20°	36	114	171	5	
1 1/2*	R6906-024	3 1/2	3/4	2 7/8	2 35/64	1/2	20°	75	83	46	5	
	R6906E-024	3 5/8	7/8						80	50		
2	R6906-032	4	1	3 5/8	3 55/64	1/2	20°	60	47	50	9	
	R6906E-032	3 3/4	7/8				15°		50			
2 1/2	R6906-040	4 19/32	15/16	4 1/8	3 1/2	1/2	20°	116	319	285	11	
3	R6906-048	5	1	5	4 41/64	1/2	20°	55	60	170	14	
	R6906E-048	4 3/8	1 1/32				17°					
4	R6906-064	5 1/4	1 1/4	6 3/16	5 11/16	5/8	20°	72	60	80	20	
	R6906E-064	4 9/16	1 3/32				15°	70				
5*	R6906-080	6	1 1/4	7 5/16	6 5/8	5/8	20°	140	388	400	26	
6	R6906-096	6	1 1/4	8 1/2	8	5/8	20°	190	130	195	31	
	R6906E-096	5 1/32	1 3/16				15°					
8*	R6906-128	8	1 1/4	10 5/8	10 5/16	5/8	20°	304	388	457	49	
10*	R6906-160	8 3/4	1 1/4	12 3/4	11 3/4	5/8		458	388	457	64	
12	R6906-192	9	1 3/8	15	15	11/16		529	445	457	88	
14	R6906-224	12 51/64	1 3/8	16 1/4	17 1/4			203	371	514	143	
16	R6906-256	13 1/2	1 5/8	18 1/2	18 3/16	1		180	383	514	179	
20	R6906-320	20 15/32	1 5/8	23	21 27/32			185	371	571	243	

All Dimension in inches unless otherwise noted.
† At neutral length with limit bolts in place.
† Maximum (axial) travel is based on installation with no misalignment or angular deflection.
† This is an installation dimension not a limit bolt setting.
CF = Consult Factory



NOTE: Consult factory for spring rates for angular deflection.

5-Convolute expansion joints are not recommended for vacuum service. Recommended only for low-pressure applications such as weigh tank connections.

Standard Material Offering

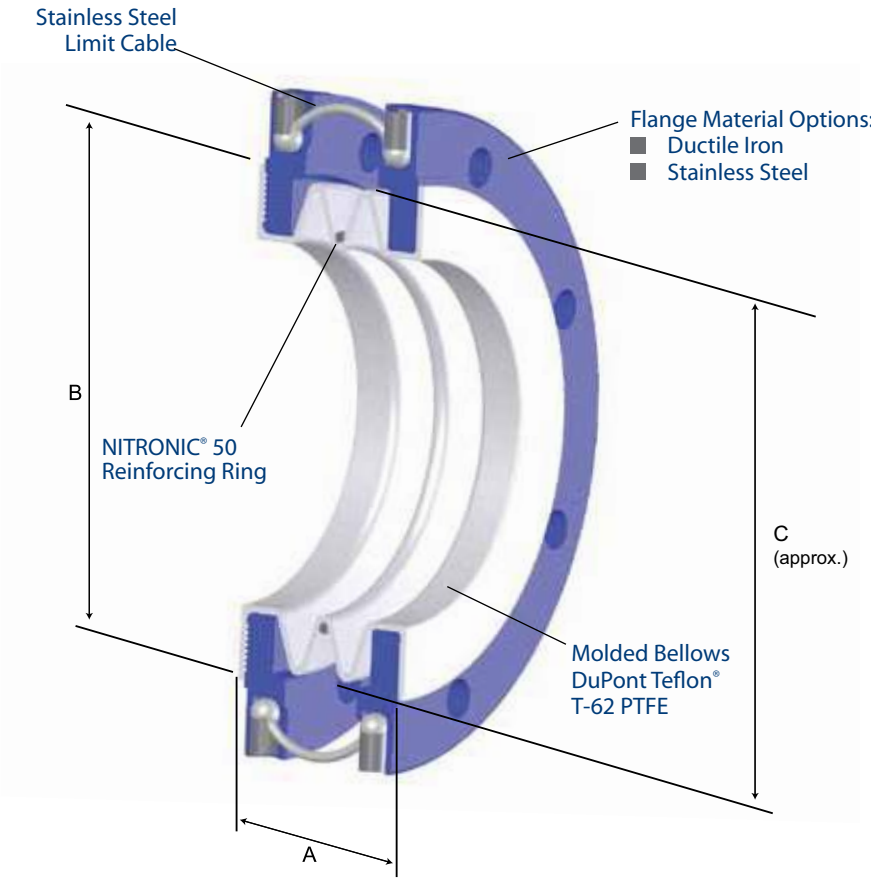
Size (in.)	Flange	Limit Bolt	Reinforcing Ring
1 - 12	Painted Ductile Iron	Carbon Steel	NITRONIC® 50*
1/2", 3/4", 1 1/4",14" - 20"	Zinc Plated Carbon Steel	Carbon Steel	DIN 1.4301 Stainless Steel

* 2 1/2", 5", 8" and 10" sizes have ductile iron flanges and DIN 1.4301 SS reinforcing rings

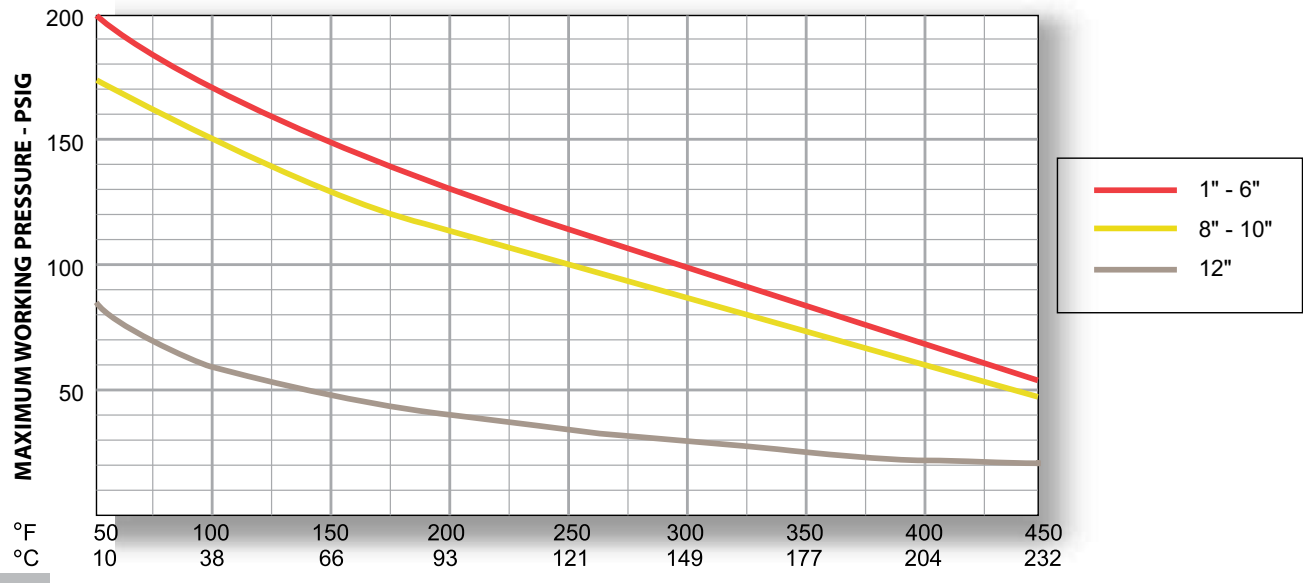
Stainless

- 316 Stainless steel flanges and limit bolts are available as an option.

E6904 - 2 Convoluted Expansion Joint



NON-SHOCK WORKING PRESSURE vs. TEMPERATURE



E6904 - 2 Convoluted Expansion Joint

Nom. Size (I.D.)	Part Number	A		B Flare Dia.	C Convolute O.D.	Maximum Misalignment + or -	Max. Angular Deflection + or -	Compression Force Spring Rate (lb_f/in.)	Extension Force Spring Rate (lb_f/in.)	Misalignment Force Spring Rate (lb_f/in.)	Wt. (lbs.)	Vacuum Rating (in. Hg/°F)
		Neutral Length	Max Axial Travel + or -									
1	E6904-016	1 3/4	11/32	2	1 7/8	1/4	16°	140	144	120	3	FV/425
1 1/2	E6904-024	1 13/16	11/32	2 7/8	2 27/64	1/4	13°	240	200	240	4	
2	E6904-032	1 7/8	11/32	3 5/8	3	9/32	12°	430	350	440	7	
3	E6904-048	2 3/16	13/32	5	4 1/2	5/16	10°	650	320	350	10	
4	E6904-064	2 9/32	7/16	6 3/16	5 1/2	5/16	9°	360	280	630	17	FV/400
6	E6904-096	2 17/32	15/32	8 1/2	8	3/8	7°	460	350	720	27	FV/400
8	E6904-128	2 3/4	17/32	10 5/8	10 3/16	13/32	6°	300	230	800	35	FV/250
10	E6904-160	2 31/32	9/16	12 3/4	11 3/4	7/16	5°	1280	870	1000	52	FV/250
12	E6904-192	3 3/32	19/32	15	15	15/32	5°	380	240	1000	107	FV/75

All Dimensions in inches.
Maximum (axial) travel is based on installation with no misalignment or angular deflection.

Flange Material = Painted Ductile Iron
Limit Cable Material = Stainless Steel
Retaining Ring Material = NITRONIC® 50 Stainless Steel
T-Band Material = Carbon Steel

NOTE: Consult factory for spring rates for angular deflection.

Limit Cables vs. Limit Bolts

Limit cables provide a compact installation with no protruding bolt ends. They allow greater lateral and angular misalignment. Expansion joints with limit cables make a very compact package. Cables are permanently installed and cannot be misadjusted. The flexibility of the cable design does have three potential concerns:

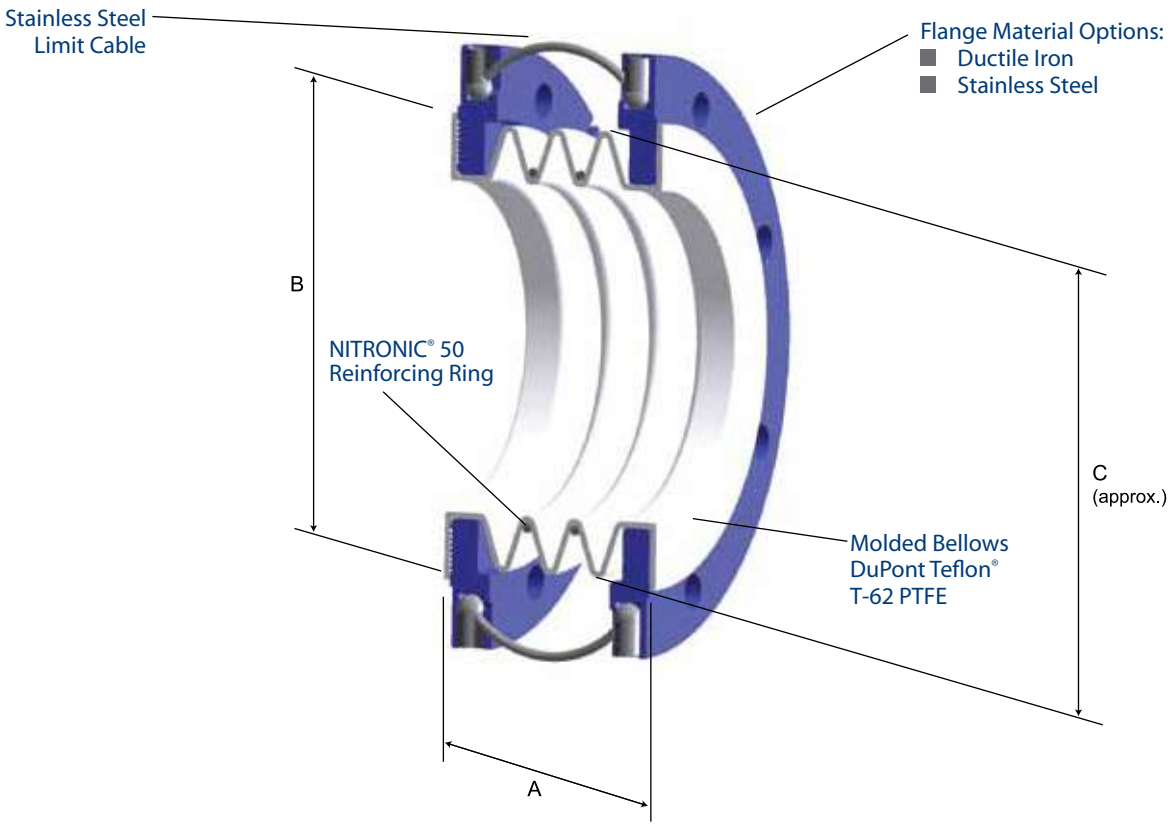
- pipefitters can install this design at lateral misalignments beyond the allowable limits
- the individual strands of stainless steel aircraft cable can rapidly degrade and fray in coastal or chlorine service environments
- the cables do not provide any resistance or indicate that rotational forces (which will lead to premature failure and/or rupture) are present

By comparison, expansion joints with limit bolts are designed specifically to:

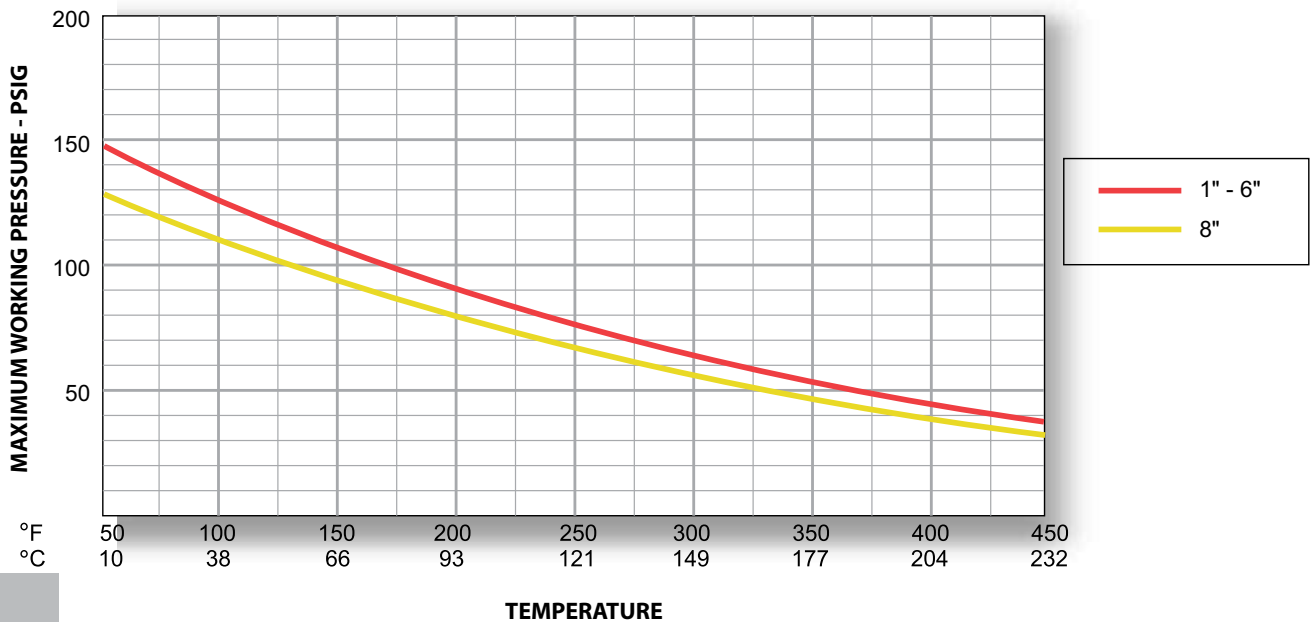
- limit lateral misalignment at installation
- provide a solid visual indicator (2X stronger than cables)
- stand up to service in coastal, marine, and chlorine environments
- provide resistance to rotational forces
- indicate the presence of rotational forces beyond the limit bolt yield strength

Warning
Always Use Safety Shields in Hazardous Service

E6905 - 3 Convoluted Expansion Joint



NON-SHOCK WORKING PRESSURE vs. TEMPERATURE



E6905 - 3 Convoluted Expansion Joint

Nom. Size (I.D.)	Part Number	A		B Flare Dia.	C Convolute O.D.	Maximum Misalignment + or -	Max. Angular Deflection + or -	Compression Force Spring Rate (lb_f/in.)	Extension Force Spring Rate (lb_f/in.)	Misalignment Force Spring Rate (lb_f/in.)	Wt. (lbs.)	Vacuum Rating (in. Hg/°F)
		Neutral Length	Max Axial Travel + or -									
1	E6905-016	2 5/16	1/2	2	1 57/64	3/8	24°	130	130	260	3	
1 1/2	E6905-024	2 13/32	17/32	2 7/8	2 35/64	3/8	20°	80	70	110	5	
2	E6905-032	2 1/2	17/32	3 5/8	3 13/32	13/32	17°	70	80	160	8	FV/400
3	E6905-048	2 29/32	5/8	5	4 41/64	15/32	15°	140	160	190	14	
4	E6905-064	3 1/16	21/32	6 3/16	5 11/16	1/2	13°	220	160	190	19	
6	E6905-096	3 3/8	23/32	8 1/2	8	17/32	10°	350	190	540	30	FV/300
8	E6905-128	3 21/32	25/32	10 5/8	10 3/16	19/32	9°	450	170	750	39	FV/125

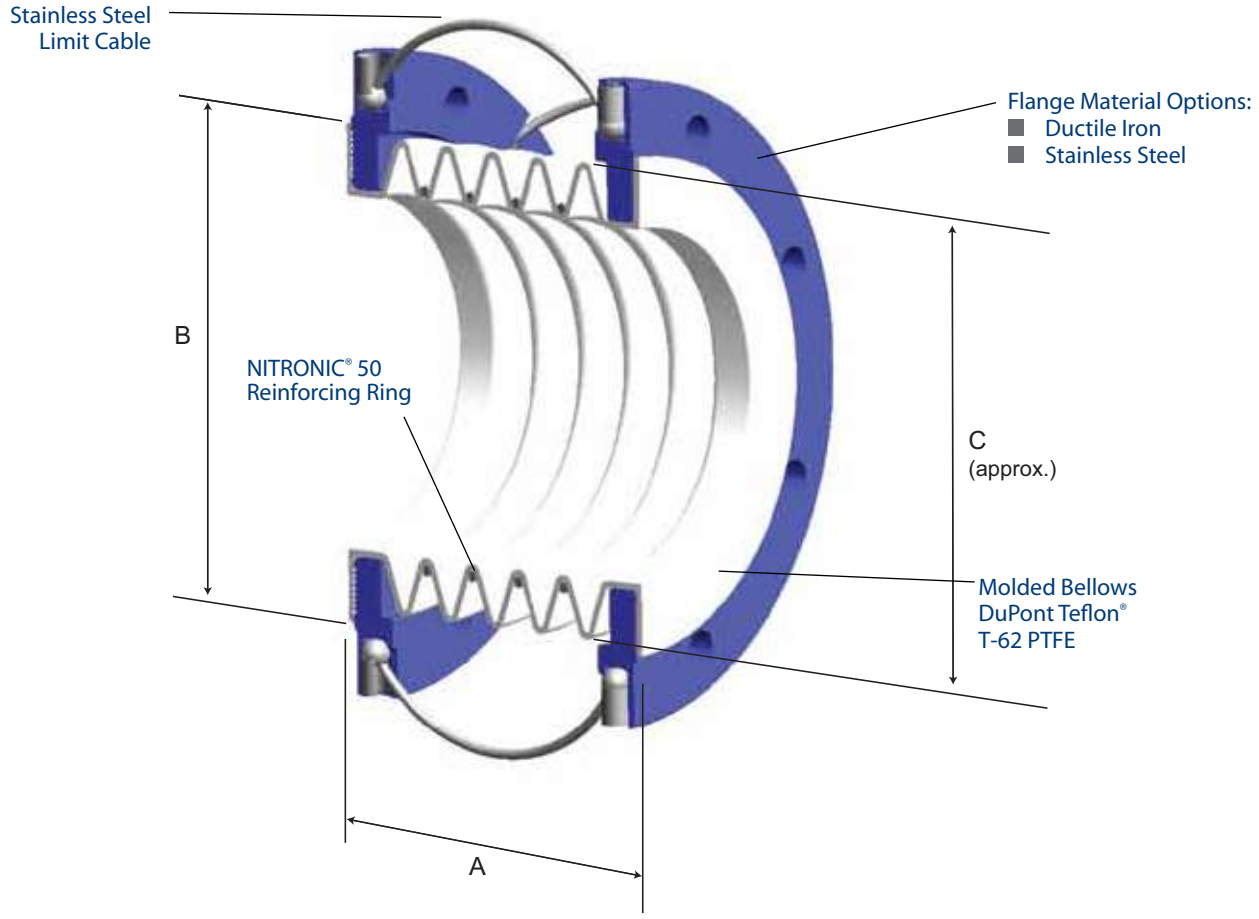
All Dimensions in inches.
Maximum (axial) travel is based on installation with no misalignment or angular deflection.

Flange Material = Ductile Iron
Limit Cable Material = Stainless Steel
Retaining Ring Material = NITRONIC® 50 Stainless Steel

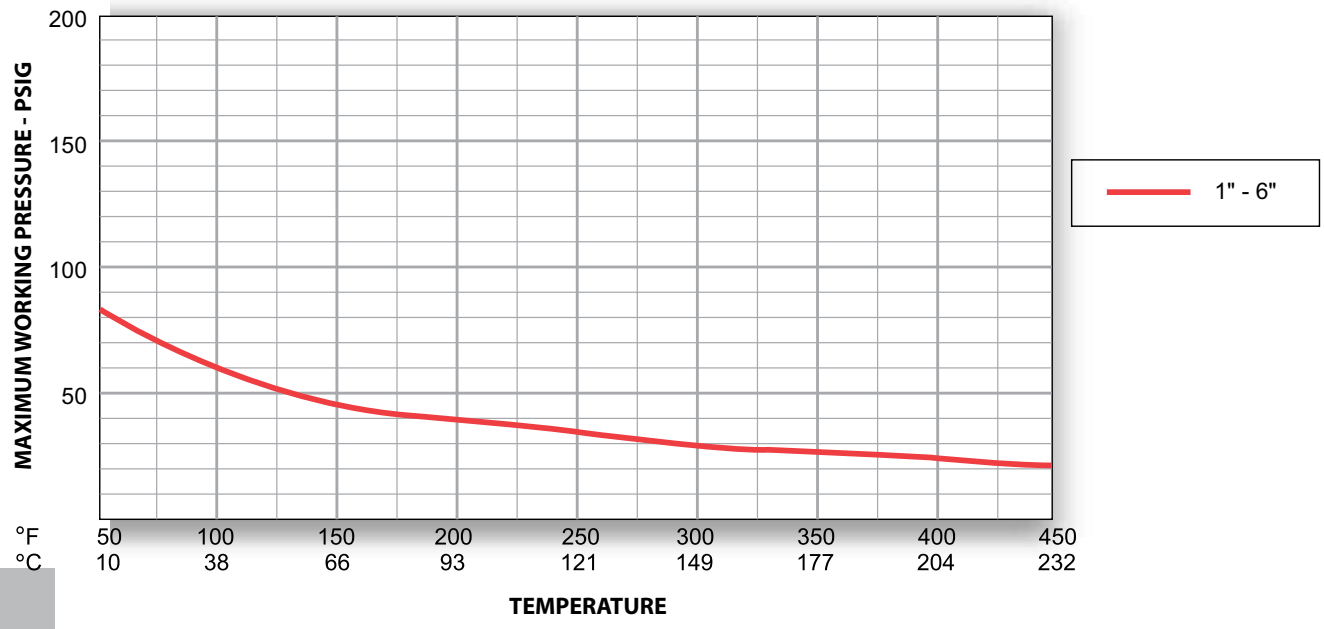
NOTE: Consult factory for spring rates for angular deflection.

Warning
Always Use Safety Shields in Hazardous Service

E6906 - 5 Convoluted Expansion Joint



NON-SHOCK WORKING PRESSURE vs. TEMPERATURE



E6906 - 5 Convoluted Expansion Joint

Nom. Size (I.D.)	Part Number	A		B Flare Dia.	C Convolute O.D.	Maximum Misalignment + or -	Max. Angular Deflection + or -	Compression Force Spring Rate (lb_f/in.)	Extension Force Spring Rate (lb_f/in.)	Misalignment Force Spring Rate (lb_f/in.)	Wt. (lbs.)	Vacuum Rating
		Neutral Length	Max Axial Travel + or -									
1	E6906-016	3 1/2	27/32	2	1 57/64	5/8"	39°	50	110	50	3	*These Units Are Not Rated for Vacuum Service*
1 1/2	E6906-024	3 5/8	7/8	2 7/8	2 35/64	21/32"	32°	75	80	50	7	
2	E6906-032	3 3/4	7/8	3 5/8	3 13/32	21/32"	29°	60	50	50	10	
3	E6906-048	4 3/8	1 1/32	5	4 41/64	25/32"	25°	55	60	170	16	
4	E6906-064	4 9/16	1 3/32	6 3/16	5 11/16	13/16"	21°	70	60	80	23	
6	E6906-096	5 1/32	1 3/16	8 1/2	8	29/32"	17°	190	130	195	34	

All Dimensions in inches.
Maximum (axial) travel is based on installation with no misalignment or angular deflection.

Flange Material = Ductile Iron
Limit Cable Material = Stainless Steel
Retaining Ring Material = NITRONIC® 50 Stainless Steel

NOTE: Consult factory for spring rates for angular deflection.

5-Convolute expansion joints are not recommended for vacuum service.
Recommended only for low-pressure applications such as weigh tank connections.

Safeguarding

Unless they are armored, expansion joints only provide a single process containment layer and are vulnerable to the abuse common in some process plants. Placing an expansion joint into hazardous service without safeguarding increases the risk of serious personal injury or death. Resistoflex requires that safeguarding, such as wrap around safety shields, be used on all expansion joints in hazardous service.

Warning
Always Use Safety Shields in Hazardous Service

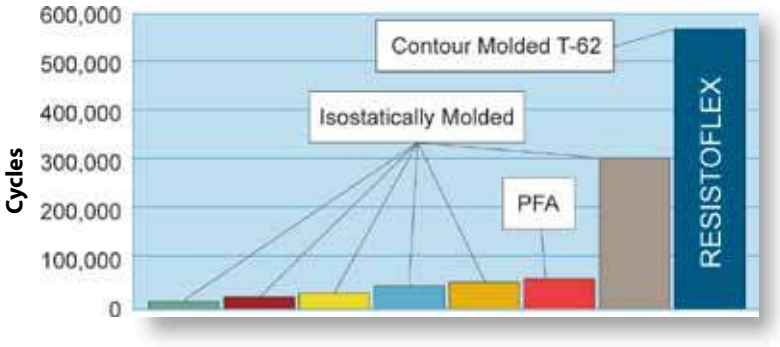
Product Performance Testing

Expansion Joints are normally subject to a combination of motions and pressure pulsations, requiring the use of a highly engineered, high performance product for long term performance and safety. Resistoflex has developed and utilizes a series of tests described herein to verify the design and long term performance of expansion joints, and to benchmark performance of alternate designs.

1. Flex Life

In this test, one expansion joint of each size is installed at neutral length on the flex tester and is flexed at 100% of the maximum allowable compression and extension. One cycle is defined as neutral-compression-neutral-extension-neutral at a specified pressure and temperature. Units are certified to 100,000 cycles while still retaining full pressure handling capability.

This flex test comparison was performed with 2" 3-convolute expansion joints from various manufacturers. The test was performed at 250°F with 75 psig hot oil. Neutral-Extended-Neutral-Compressed-Neutral position equals one cycle. Each joint was extended and compressed to the published maximum allowable position.



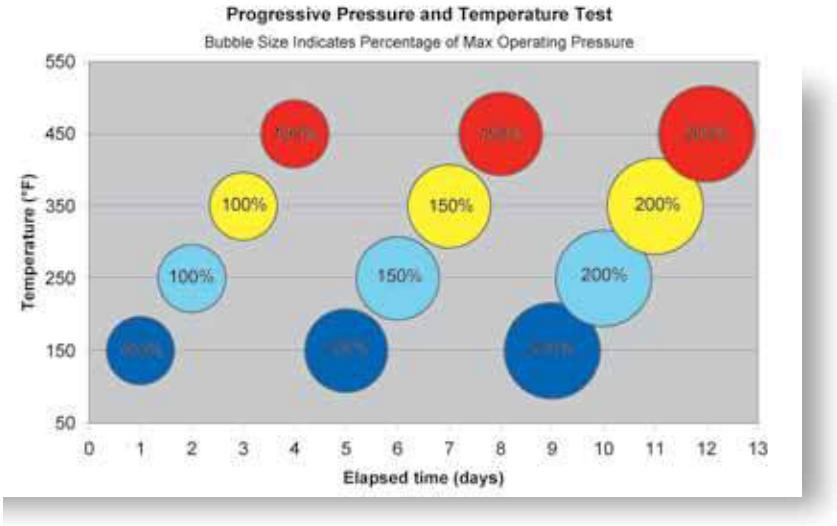
Flex Test Comparison

NOTE: While all other manufacturer's joints failed at 300,000 cycles or less (and most didn't make it to 100,000 cycles), Resistoflex® joints continued to perform beyond 575,000 cycles without failure and the test was discontinued.

Performance

2. Progressive Pressure/Temperature Test

The most rigorous and difficult test is known as the Progressive Pressure/Temperature Test (PPTT). This design qualification test consists of 4 cycles, each lasting 24 hours. Each cycle begins at maximum operating pressure, then ramps up to 1.5 times, then 2 times maximum pressure recommendations. The first cycle is at 150°F, followed by cycles of 250°F, 350°F and finally 450°F.



3. Vacuum Data

Maximum Temperature for Full Vacuum (29.9" Hg)

Size*	R6904 R6904E E6904	R6905 R6905E E6905	R6906 R6906E E6906
1 - 3	425°F	400°F	Not Rated for Vacuum Service
4	400°F	400°F	
5 - 6	400°F	300°F	
8	250°F	125°F	
10	250°F	CF	
12	75°F	CF	

NOTE: These ratings are for expansion joints in the fully extended condition. When they are at the neutral length or compressed, it is sometimes possible to exceed the listed temperature at full vacuum. Consult Factory.

Warning
Always Use Safety Shields in Hazardous Service

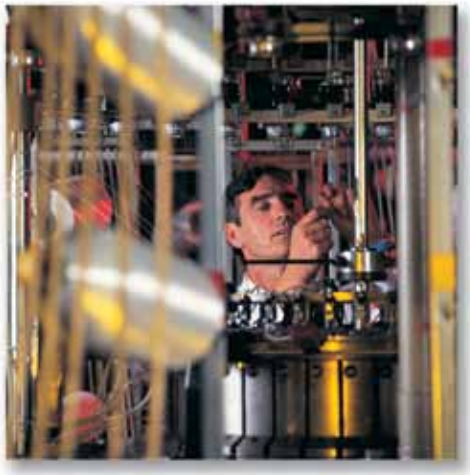
* For 1/2", 3/4", and 14" - 24" size vacuum data, please consult individual dimensional tables in this design manual.

CF = Consult Factory

Quality Assurance

Testing... For Your Safety

Resistoflex has a more vigorous quality assurance program than any other expansion joint manufacturer. The following tests are performed on 100% of our expansion joints, ensuring that every unit meets performance specifications.



1. Roll Test

100% of Resistoflex expansion joints are roll tested before they are molded into convoluted form. In this test, the liner is compressed to 50% of its diameter in two different planes to detect liner defects. Any non-conformance found is cause for rejection. Roll tests CANNOT be performed with isostatically molded expansion joints.

2. Hydro Test

100% of Resistoflex expansion joints are hydrostatically tested prior to shipping. This ensures that the final product is free from defects. All expansion joints are hydrostatically tests at 1.5 times their ambient temperature pressure rating - any leakage is cause for rejection.

Recommended Procurement Specifications

1. Scope

1.1 This specification provides information for the procurement of PTFE expansion joints with 2, 3, or 5 convolutions.

1.2 The subjects covered include Materials, Design and Construction, Qualification and Performance, Inspection, and Handling and Shipping.

2. Materials

2.1 The fluoropolymer components shall be made from a PTFE copolymer fine powder resin conforming to ASTM D4895, Type I, Grade 4, Class B such as Teflon® T-62.

2.2 Standard flanges shall be ductile iron conforming to ASTM A395 and coated with a aliphatic acrylic-polyester polyurethane for maximum corrosion resistance, or 316SS. Carbon Steel flanges shall be zinc-plated.

2.3 Reinforcing rings shall be NITRONIC® 50 or conform to ASTM A276, Grade XM-19.

2.4 Standard limit bolts will be carbon steel or stainless steel with elastic stop nuts. Limit cables shall be stainless steel.

3. Design & Construction Details

3.1 The flanges shall be one-piece construction. No welding is allowed.

3.2 Standard flanges shall have bolting patterns conforming to ASME B16.5, Class 150. The bolt holes shall be threaded to accommodate the bolts specified in ASME B16.5.

3.3 All ductile iron flanges shall be coated with chemical resistant aliphatic acrylic-polyester polyurethane unless otherwise specified.

3.4 The convolutions shall be contour molded to uniform radii and free from sharp corners and other areas of stress concentration.

3.5 The gasket face of the expansion joint shall be concentric with the bore and conform to the standard ASME B16.5, Class 150 flange raised face diameter for the equivalent pipe size.

3. Design & Construction Details (cont'd.)

3.6 All flanged assemblies will be equipped with limit bolts or limit cables to restrict maximum extension, misalignment, and angular deflection.

3.7 A neoprene grommet shall be inserted in the limit bolt hole to reduce friction and vibration while protecting the limit bolts.

4. Testing

4.1 Prior to forming the expansion joint convolutions, each tube must be roll tested to 1/2 the nominal ID in at least two planes to identify liner defects.

4.2 Each tube must be visually inspected for imperfections.

4.3 Each assembly must be hydrostatically tested at 1.5 times the 70°F working pressure.

5. Handling & Shipping

5.1 All assemblies shall have their gasket faces protected by wooden covers and secured by metal clips or bolts. End covers are not to be removed except for inspection, testing, or installation.

5.2 Each unit will be packed in a separate container and clearly marked to identify product.

5.3 Each packed assembly must be further protected by corrugated boxes or other containers that will protect them from damage during handling, shipping, and storage.

5.4 Each unit will include a detailed installation instruction sheet showing at minimum recommended procedures, bolt tightening sequence and torque, unit pressure/temperature ratings, unit minimum and maximum travel, and all warnings associated with the proper use of the product.

Warning

Always Use Safety Shields in Hazardous Service

Common Applications

Misalignment

Perhaps the most common use of expansion joints is as a means to compensate for differences between what appears on the designers work station and what takes place in the field during construction. Good designers recognize installation variability and use expansion joints so that the flexibility required by the piping is not improperly constrained by the location of fixed equipment.

FRP Piping

Stress sensitive FRP piping has a thermal expansion coefficient 10 times greater than carbon steel and cannot absorb the stresses at flanged connections like carbon steel piping. For these reasons, expansion joints are critical in FRP piping, and according to FRP manufacturers, joints requiring low activation energy are essential. Only Resistoflex joints provide the ideal combination of low activation energy along with the strength and flex life to provide years and even decades of trouble-free performance.

Glass-Lined Equipment

The flange faces of glass-lined equipment such as pumps or vessels are extremely sensitive to shock, vibration, and compressive forces which may result from uncompensated pipe expansion. Because such equipment is usually used in severe service applications, PTFE expansion joints provide the ideal solution. Contour molded joints of Teflon® T-62 from Resistoflex provide the low spring rates and high flex life required to protect such sensitive and expensive equipment.

Weigh Tanks

Process control systems often rely upon load cells to meter accurate quantities of reactants to a process, or finished products to packaging systems. The low spring rate of the Resistoflex expansion joints result in improved scale accuracy and less frequent calibration requirements.

Centrifugal Pumps

The energy and vibration generated by centrifugal pumps must be dissipated. Most of that energy is transferred to the conveyed fluid. What is not, is transferred to the adjacent piping and to the bearings and packings of the pump, causing leaks, increased maintenance, and downtime. With unparalleled flex life, Resistoflex expansion joints are designed to absorb this energy, and provide the ideal solution to this common problem.

Hydraulic Shock

Many fluid systems are subject to hydraulic shock, or "water hammer". These rapid fluctuations in line pressure cause stress and noise in a piping systems, resulting in leaks and stress cracking. Expansion joints compensate for the movement and vibration often caused by hydraulic shock, reducing stress and noise.

Vibration

Vibrations inherent in engines must be absorbed to prolong life and reduce noise. With large engines, such as diesel generators, vibration must also be isolated from the fuel, lubrication, and coolant systems connected to them by rigid piping systems. Expansion joints provide the ideal solution to isolating vibration, thereby reducing noise and maintenance.

Noise in HVAC systems

Architects and building designers learned centuries ago that noise should be minimized for the comfort of its occupants. Heating and air conditioning systems are one of the most common sources of noise, and transmission through piping and ducts provide the path to the occupants. The high acoustical resistance of PTFE expansion joints makes them ideally suited to reducing if not eliminating the transmission of noise in such systems. They are used in commercial buildings of all types and sizes, from schools to hospitals to airports.

Warning

Always Use Safety Shields in Hazardous Service

Expansion Joint Installation and Operating

Expansion Joint Installation & Operating Instructions

- Do not bore out threads in bolt holes.
- Do not exceed pressure/temperature or vacuum ratings.
- Safeguard expansion joint units in hazardous service, per ASME B31.3.
- Follow sound piping installation procedures. A typical reference is the "Piping Handbook" by Nayyar published by McGraw-Hill, Inc.
- Leave limit bolts in "as received" factory settings. Severe damage can result if the limit bolts and stop nuts are removed, replaced or altered to exceed the factory setting. (See Limit Bolt notes below)
  Remove flange covers only when ready to install expansion joints.
- Insure that sealing faces are clean, smooth & parallel.
- For hot service install nearly extended; for cold service install nearly compressed.
- Thread installation bolt from mating flange side to prevent possible damage to the PTFE element. Do not extend bolts behind expansion joint flange more than 1-2 threads. Do not use nuts on inside of flanges.

Additional information & specific bolt torque data will be found on the detailed installation instruction sheet included in the box of each & every unit shipped.

Warning

Failure to follow the above installation instructions may cause premature failure and/or rupture of the unit resulting in property damage, serious personal injury, or death.

Safeguarding

The Process Piping Code, ANSI/ASME B31.3, in Appendix G outlines recommendations for safeguarding piping systems. Resistoflex subscribes to this emphasis on safety and requires the code suggestion for shielding bellows units where hazardous fluids are conveyed. Safety shields are designed to prevent sprayout of hazardous fluids.

Limit Bolts

Limit bolts with elastic stop nuts are factory set at the maximum travel position to prevent over-extension. Severe damage, personal injury, or death can result if the limit bolts and stop nuts are removed or altered to exceed the factory setting, or if non-locking nuts are installed.

Limit Cables

Limit cables are not designed to withstand all possible forces generated in a piping system. Maintenance personnel should periodically check the limit cables. If a limit cable appears to be in tension, or shows signs of having been stretched, the limit of expansion joint travel has been reached. This is an indication that excess motion or stress generated in the piping system is threatening failure. If a cable shows frayed strands, or is corroded, the joint should be replaced immediately.

Maintenance

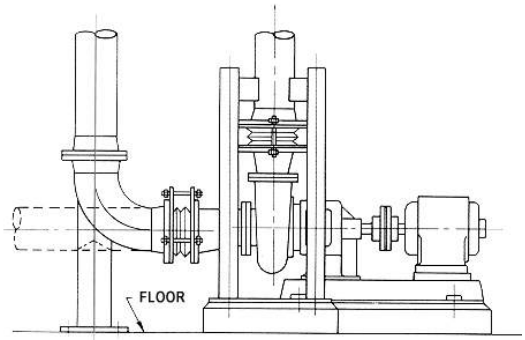
Maintenance personnel should periodically check expansion joints in the piping system. If a limit cable or limit bolt appears to be in tension, or shows signs of having been stressed, the limit of expansion joint travel has been reached. This is an indication that excess motion or stress generated in the piping system is threatening to cause failure. If components show significant deterioration due to abrasion, damage, or corrosion, the assembly should be removed from service. Failure to periodically perform inspection for abrasion, damage, or corrosion may lead to failure and/or rupture of the assembly resulting in property damage, serious personal injury, or death.

Warning

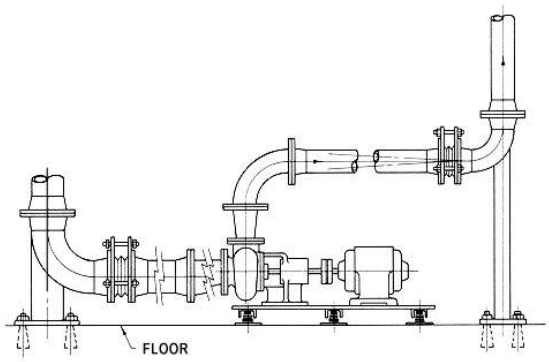
Always Use Safety Shields in Hazardous Service

Instructions

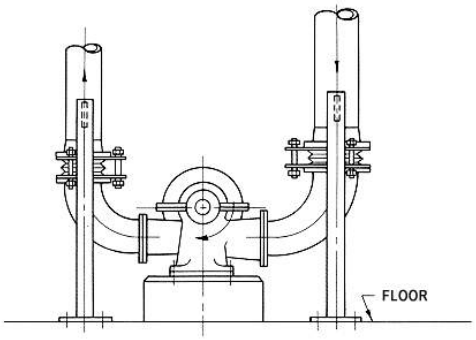
Suggested Installation as Pump Connectors



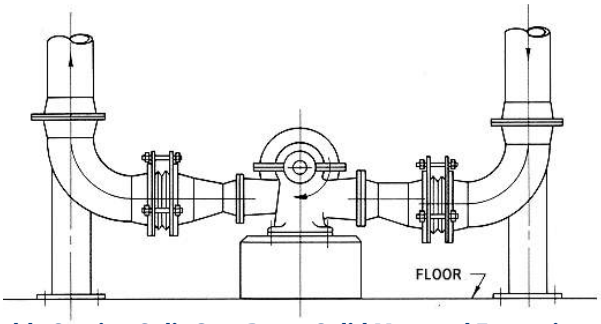
End Suction Vertical Discharge Pump
Pump is solid mounted
Pipe is anchored to support it and to stabilize expansion joint flanges farthest from pump. Use "H-frame" anchor for vertical discharge and pipe-leg anchor for horizontal suction piping.



End Suction Vertical Discharge Pump
Pump is mounted on spring-supported inertia block
Discharge and suction piping have been arranged to be parallel with drive shaft of pump. Locating expansion joints further away from pump minimizes strain from misalignment or angular deflection.



Double Suction Split Case Pump Solid Mounted
Flexible connectors in vertical lines
"H-frame" supports contain end thrust and prevent lateral motion that might cause excessive misalignment. Anchors are welded to pipe before installation of flexible connector. Weight of pipe should not compress the expansion joint.



Double Suction Split Case Pump Solid Mounted Expansion Joint in horizontal lines
Anchors are located at 90° elbows where piping changes from horizontal to vertical. Flanges farthest from pump are stabilized. Design prevents excessive misalignment or angular defection. Pipe-leg anchor and floor flange must be designed to withstand the forces and movements imposed on it by the piping system.

Use of Internal Sleeves in Expansion Joints

Certain abrasive applications, such as slurries, or high velocity flow rates may damage the PTFE convolution or radius surface at the end of the flares and cause catastrophic failure. In such circumstances a factory install PTFE or metallic nozzle liner should be installed at the inlet side of the expansion joint to help protect the unit or smooth out the flow. While such liners may greatly extend useful service life, they will restrict parallel or angular movement unless the factory is consulted to supply an internal liner with smaller O.D. Unless otherwise specified, overall length is 6".

Expansion Joints of TEFLON® Application Guide

Copy or scan this sheet to request price and delivery from Resistoflex or a Resistoflex Authorized Stocking/Fabricating Distributor, or download pdf at www.PTFEflexjoints.com

Company Name:_____

Address:_____

_____

Contact:_____

Description of application (include type of equipment plus description of fluid system.)

_____

_____

Movement Requirements

Diameter (if known) _____ Neutral Length _____

If size is unknown, specify fluid and flow rate_____

Axial Compression _____ Axial Extension _____

Misalignment _____ Angular Deflection _____

Fluid being conveyed_____

Fluid temperature_____°F Max. _____°F Min. _____ °F Normal

Temperature of surrounding atmosphere _____ °F Max. _____ °F Min.

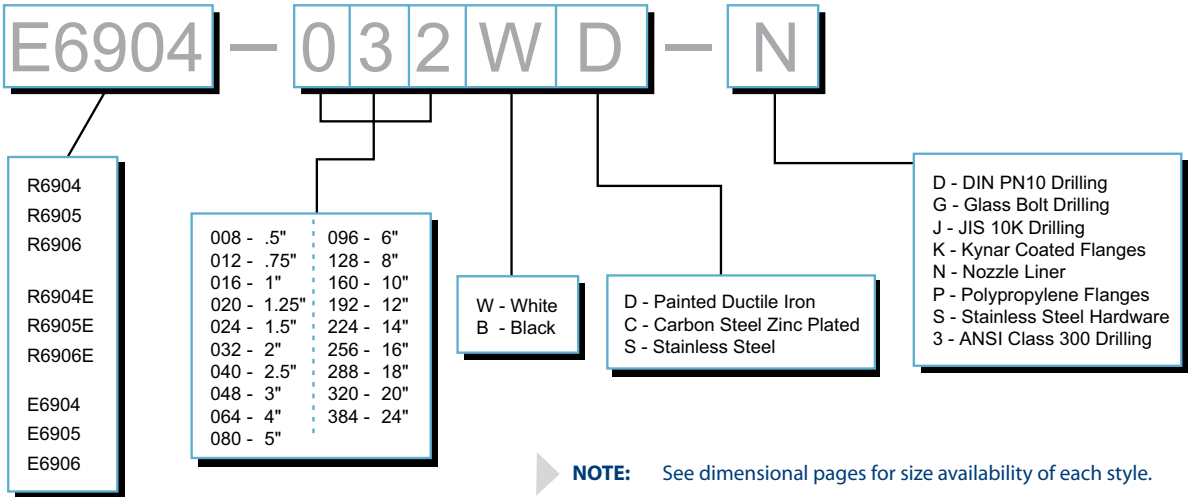
Fluid Pressure _____PSI Max._____ Vacuum _____ (inches, Hg)

Pressure Cycle _____PSI Max._____PSI Min. _____ Frequency

Surges (please explain) _____

Expansion Joint Part Numbering System

Example: E6904-032WD-N



NOTE: See dimensional pages for size availability of each style.

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