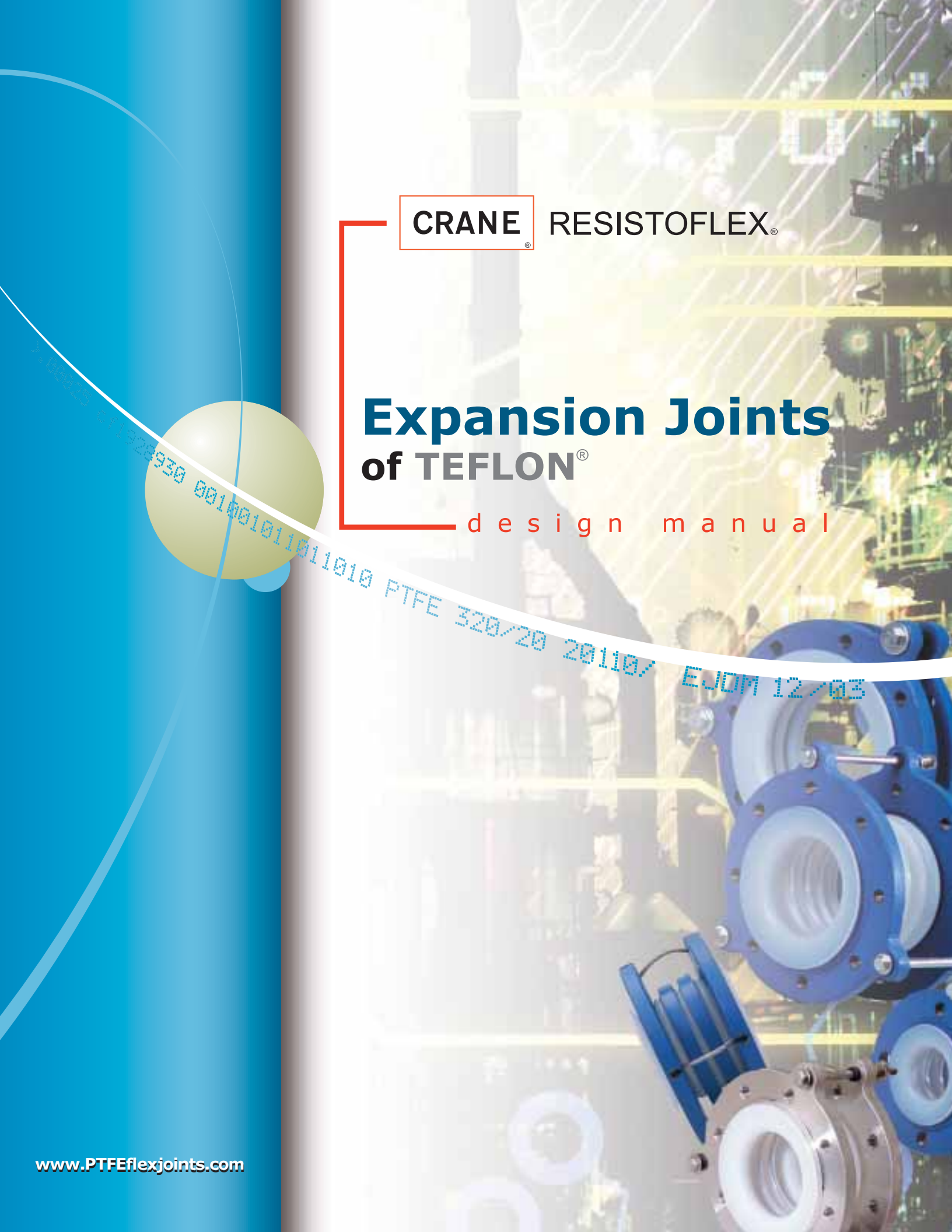
CRANE RESISTOFLEX®

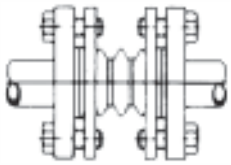
Expansion Joints of TEFLON®

design manual



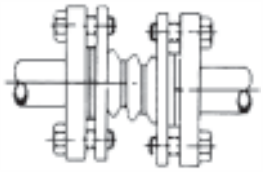
www.PTFEflexjoints.com

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 they can compensate. Expansion joints should never be used to compensate for rotation about the pipe axis.



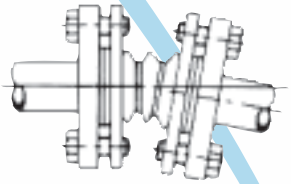
AXIAL TRAVEL

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



MIS ALIGN MENT

"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!

For clarity of the above illustrations, REQUIRED limit bolts or cables are not shown. 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.

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

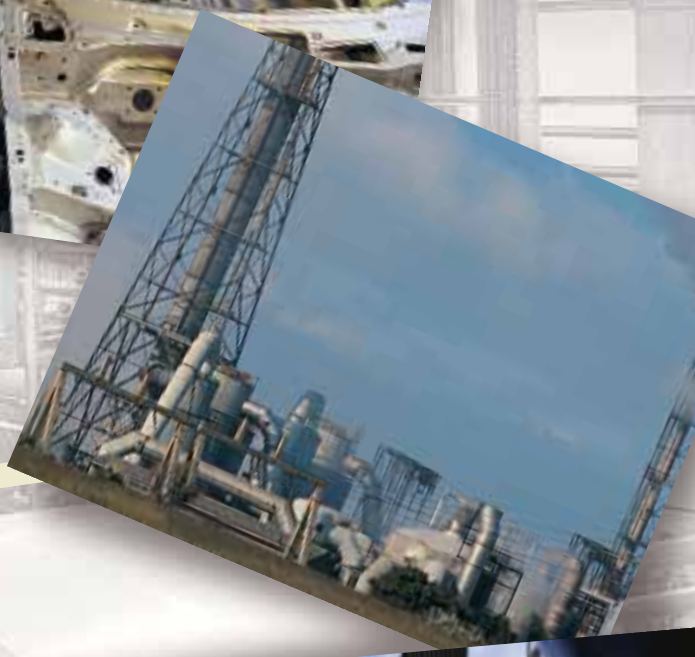
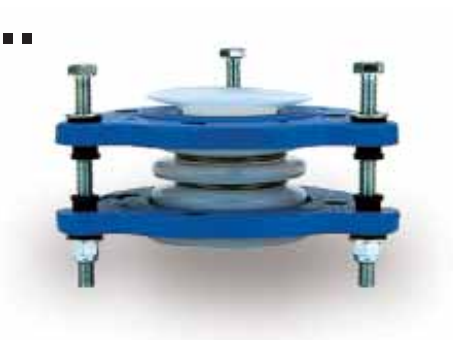


Table of Contents

The RESISTOFLEX® 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.

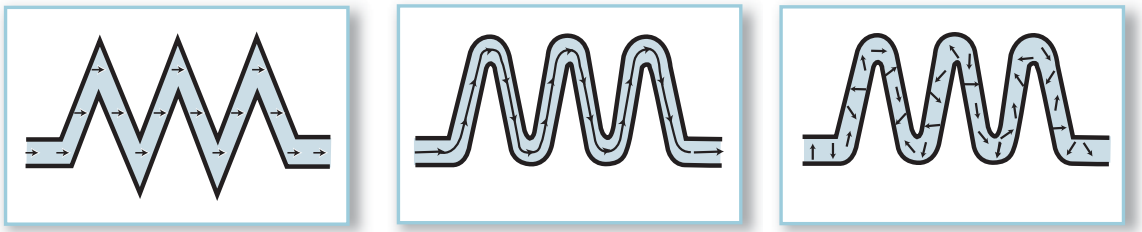
Properties of DuPont PTFE T-62

Properties	Unit	PTFE-62 Copolymer	Homopolymer	FEP	PFA
Continue 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 Resistoflex.

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, 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***

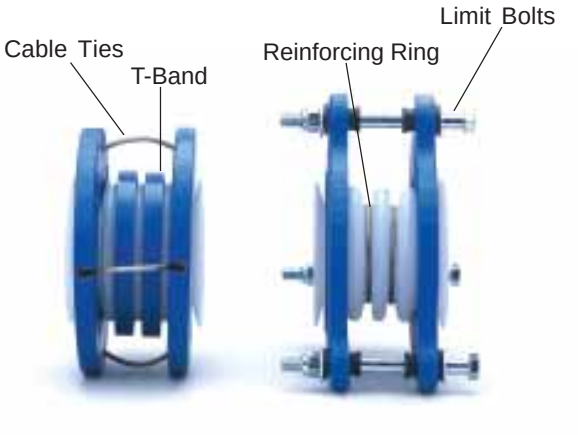
The lines of orientation above show the differences in molecular orientation which result from different processes, and underscore why contour molded bellows provide such exceptional performance.

WARNING
Always Use Safety Shields in Hazardous Service

Different by design...

Only Resistoflex offers such a broad array of materials, sizes, and design options, all backed by a cumulative knowledge base begun over 50 years ago. Our familiar R-Series expansion joints are available in 2, 3, and 5 convolute designs, with either standard Resistoflex neutral lengths or a newly available length common to other manufacturers. This newly offered length makes drop-in replacement of underperforming expansion joints simple and painless. Also, our new E-Series expansion joints offer a design alternative with either 2, 3, or 5 convolutions, with basic differences illustrated to the right:

The R7000 Stainless Steel Armored joint, shown on page 18, brings yet another level of performance with multiple length options available in each diameter. This manual provides detailed information on all these designs.



E-Series ***R-Series***

Using the best materials for the best performance...

We know that it's not all about the resin. That's why we offer both the E-Series and R-Series with ductile iron, zinc plated steel, or stainless steel flanges - so that the metallurgy suits each application. Only Resistoflex uses NITRONIC® 50 for the critical reinforcing rings on R-Series and E-Series joints. NITRONIC® 50 is an austenitic stainless super-alloy providing the corrosion resistance of MONEL® and twice the yield strength of 316 stainless steel. Resistoflex uses these materials so that the metallic components last as long as our superior bellows.

NOTE: Not all flange materials are available on all sizes and styles.

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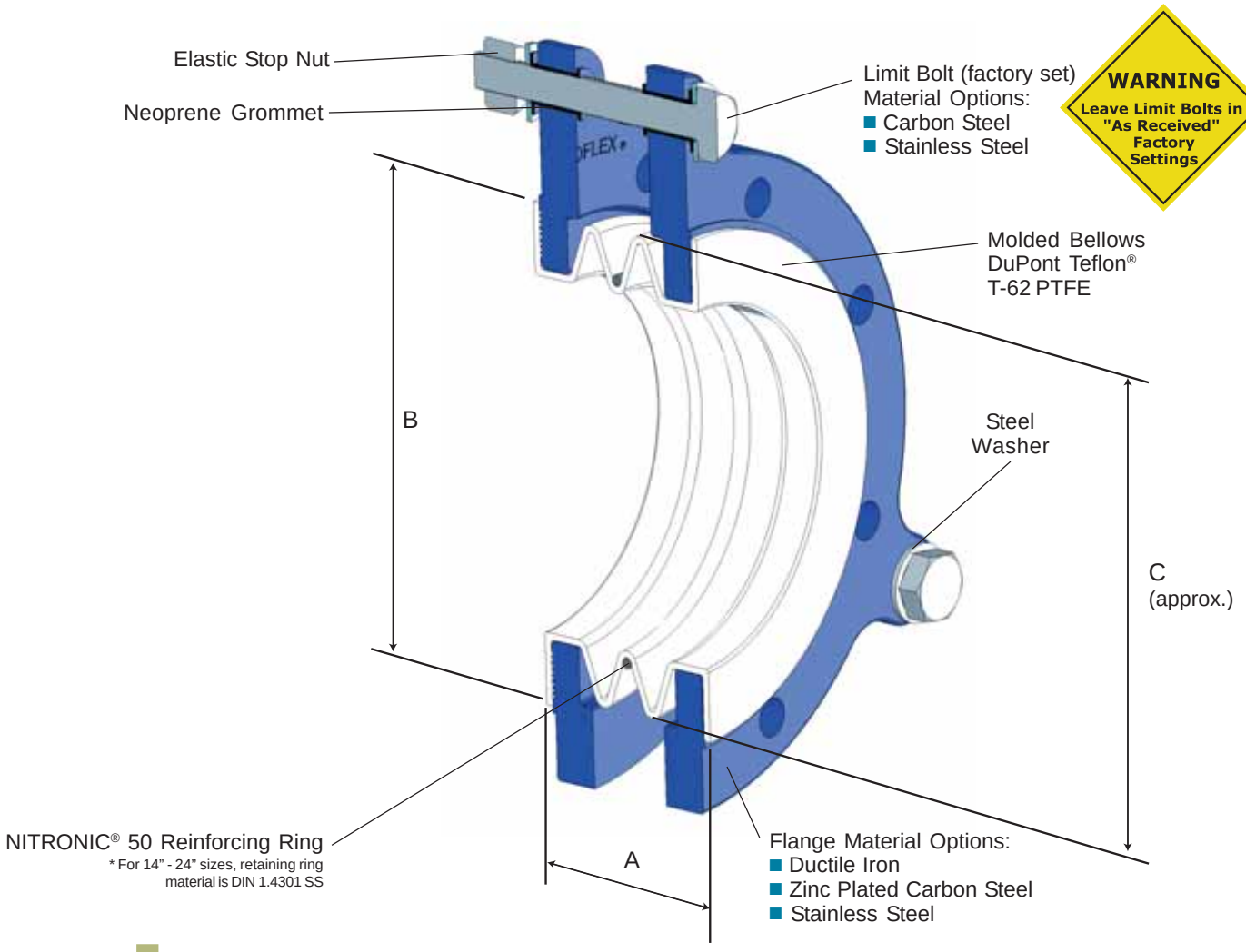
Unmatched Experience...

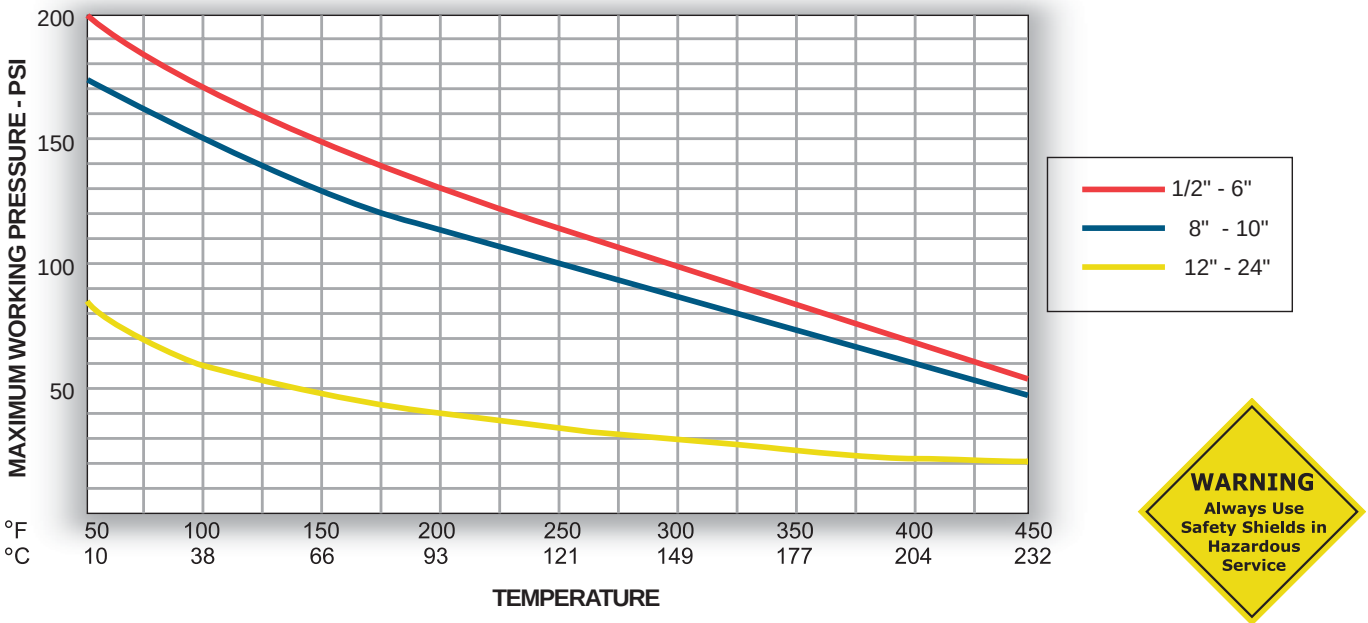
Expansion joints may be the most critical component in a fluid handling system. We've known that since the 1950's, when we developed them for the U.S. Air Force and the newly formed NASA. We refined our experience to match the needs of the chemical industry's most demanding applications in the 1960's, and scaled up our knowledge to build custom expansion joints, some over 30 feet in diameter, for the nuclear industry in the 1970's. For over 50 years, we've been improving our materials, processes, and testing because your process and our reputation depend on it.

...Don't be fooled by cheap imitations.

R6904 - 2 Convoluted PTFE Expansion Joint



NON-SHOCK WORKING PRESSURE vs. TEMPERATURE



WARNING
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Part # R6904-	Nom. Size (I.D.)	A †		B Flare Diameter	C Convolute O.D.	Maximum Misalignment	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 Travel + or -								
008**	1/2	1 1/4	1/4	1 3/8	1	1/16	CF	CF	CF	3	CF
012**	3/4			1 11/16	1 11/32						
016*	1	1 3/8		2	1 7/8	1/8	104	80	104	2	FV/425
E-016*		1 3/4	11/32				140	144	120		
024*	1 1/2	1 3/8	1/4	2 7/8	2 27/64	1/8	320	180	224	3	
E-024*		1 13/16	11/32				240	200	240		
032*	2	1 9/16	1/4	3 5/8	3		512	300		7	
E-032*		1 7/8	11/32				430	350	440		
040*	2 1/2	2 1/4	5/16	4 1/8	3 1/2		457	278	328	10	
048*	3		3/8	5	4 1/2	3/16	648	320	319		
E-048*		2 3/16	11/32				650		350		
064*	4	2 5/8	1/2	6 3/16	5 1/2	1/4	480	280	400	18	FV/400
E-064*		2 9/32	7/16				360		630		
080*	5	3 1/4	1/2	7 5/16	6 1/2		440	440	320	24	
096*	6	2 3/4		8 1/2	8			386	440	29	
E-096*		2 17/32	15/32				460	350	720		
128*	8	4	1/2	10 5/8	10 5/16		450	390	480	47	FV/250
E-128*		2 3/4	17/32		10 3/16		300	230	800		
160*	10	5 1/4	1/2	12 3/4	11 3/4		760	600	580	64	
E-160*		2 31/32	9/16				1280	870	1000		
192*	12	6	1/2	15	15		1300	420	700	115	FV/75
E-192*		3 3/32	19/32				380	240	1000		
224**	14	6 5/16	3/4	16 1/4	17 1/4	3/8	CF	CF	CF	126	CF
256**	16	7	1	18 1/2	18 3/16					159	
288**	18	7 15/16		21	20 1/4					174	
320**	20	9		23	21 27/32					183	
384**	24	6 5/16	5/8	27 1/4	26 3/16					238	

All Dimension in inches.

† 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: Angular Deflection, maximum of 7 degrees.
Consult factory for spring rates for angular deflection.

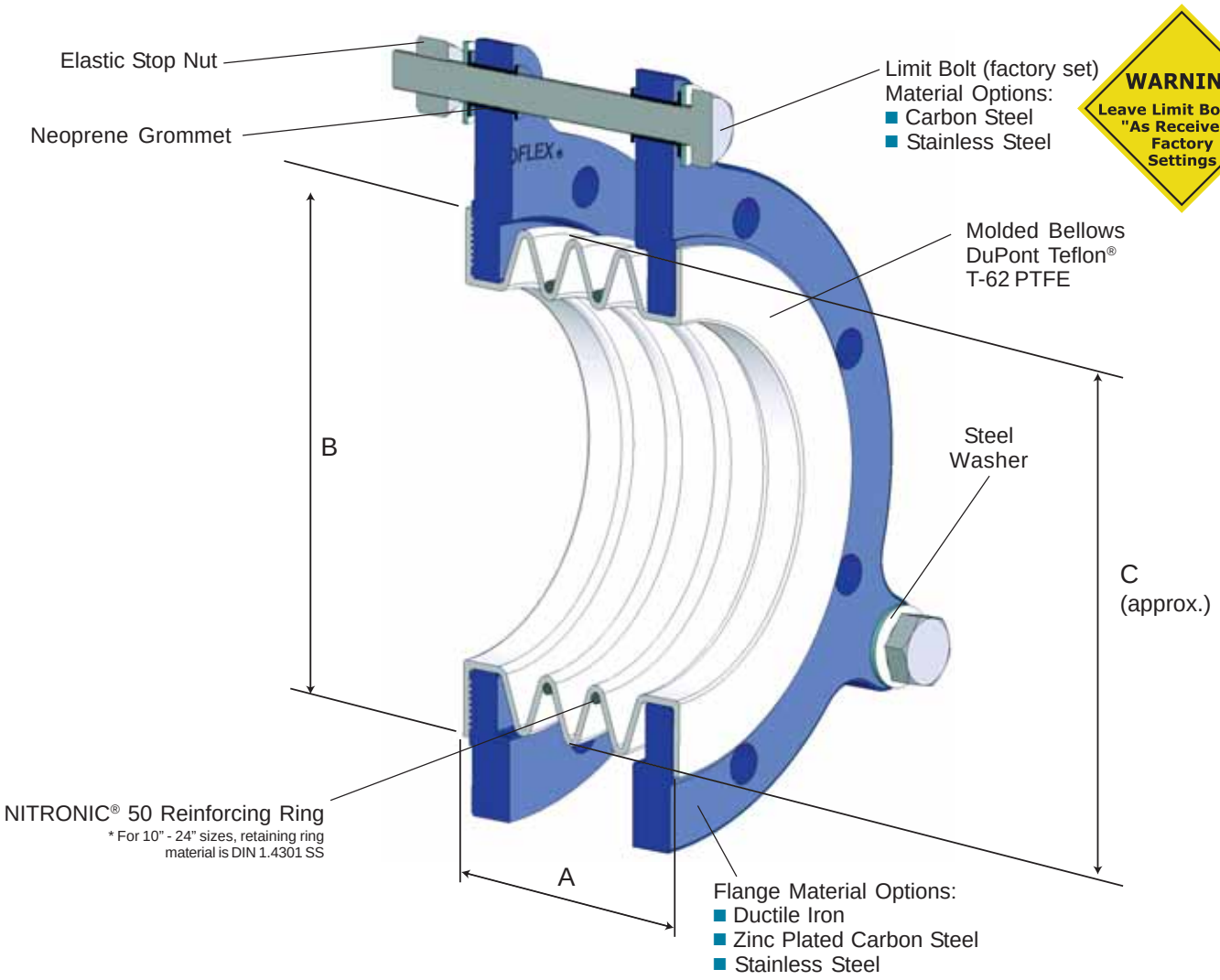
Part Number Notation	Flange Material	Limit Bolt Material	Reinforcing Ring Material
*	Painted Ductile Iron	Carbon Steel	NITRONIC® 50
**	Zinc Plated Carbon Steel	Carbon Steel	Stainless Steel

Stainless

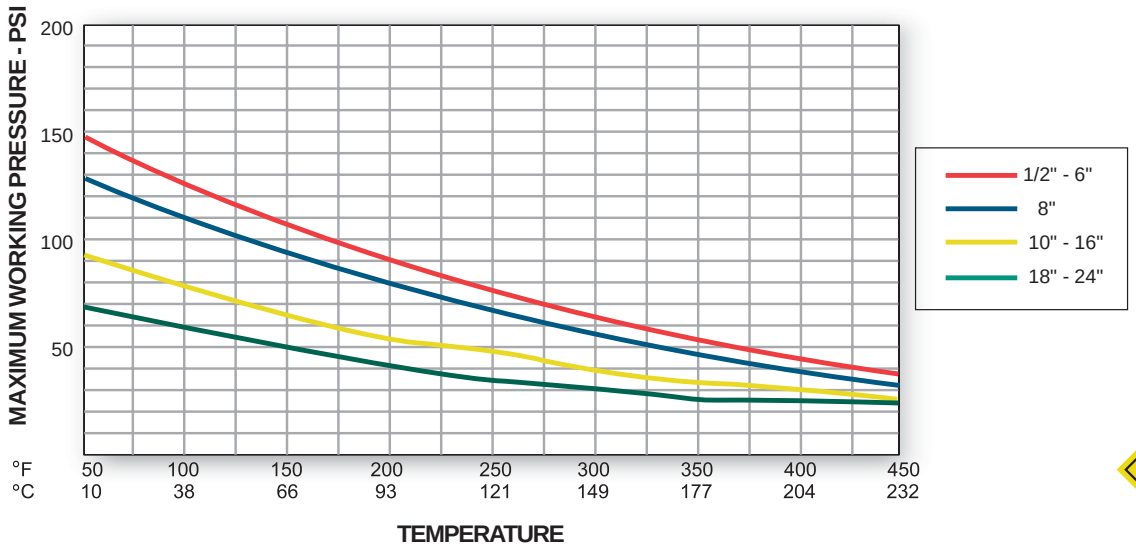
- 316 Stainless steel flanges and limit bolts are available as a standard stock option.

WARNING
Always Use Safety Shields in Hazardous Service

R6905 - 3 Convoluted PTFE Expansion Joint



NON-SHOCK WORKING PRESSURE vs. TEMPERATURE



WARNING
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Part # R6905-	Nom. Size (I.D.)	A †		B	C	Maximum Misalignment	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 Travel + or -								
008**	1/2	1 3/4		1 3/8	1	3 /16	CF	CF	CF	3	CF
012**	3/4		1/2	1 11/16	1 11/32					4	
016*	1			2	1 57/64	1/4	190	82	96	2	FV/400
E-016*		2 5/16					130	130	260		
024*	1 1/2	2		2 7/8	2 35/64		84	66	108	4	
E-024*		2 13/32	17/32				80	70	110		
032*	2	2 3/4	3/4	3 5/8	3 13/32	3/8	69	76	109	8	
E-032*		2 1/2	17/32				70	80	160		
040*	2 1/2	3 3/16	3/4	4 1/8	3 13/16		91	97	160	11	
048*	3	3 5/8	1	5	4 41/64	1/2	124	125	194	13	
E-048*		2 29/32	5/8				140	160	190		
064*	4	3 5/8	1	6 3/16	5 11/16		220	155	264	19	
E-064*		3 1/16	21/32					160	190		
080*	5	4	1	7 5/16	6 5/8		320	210	324	25	FV/300
096*	6		1 1/8	8 1/2	8	9/16	289	187	266	30	
E-096*		3 3/8	23/32				350	190	540		
128*	8	6	1 1/8	10 5/8	10 5/16		178	218	423	48	FV/125
E-128*		3 21/32	25/32		10 3/16		450	170	750		
160**	10	7 7/8	1 3/16	12 3/4	12 51/64	1/2	CF	CF	CF	60	CF
192**	12	7 3/4		15	13 37/64	5/8				77	
224**	14	8 1/2	1 1/4	16 1/4	17 1/4	11/16				132	
256**	16	9 3/16	1 3/8	18 1/2	18 3/16	3/4				165	
288**	18	11 1/16	1 3/16	21	20 1/4					201	
320**	20	12 7/8		23	21 27/32	1				243	
384**	24	11 7/8	1	27 1/4	26 3/16	3/4				309	

All Dimension in inches.

† 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: Angular Deflection, maximum of 14 degrees.
Consult factory for spring rates for angular deflection.

Part Number Notation	Flange Material	Limit Bolt Material	Reinforcing Ring Material
*	Painted Ductile Iron	Carbon Steel	NITRONIC® 50
**	Zinc Plated Carbon Steel	Carbon Steel	Stainless Steel

Stainless

- 316 Stainless steel flanges and limit bolts are available as a standard stock option.

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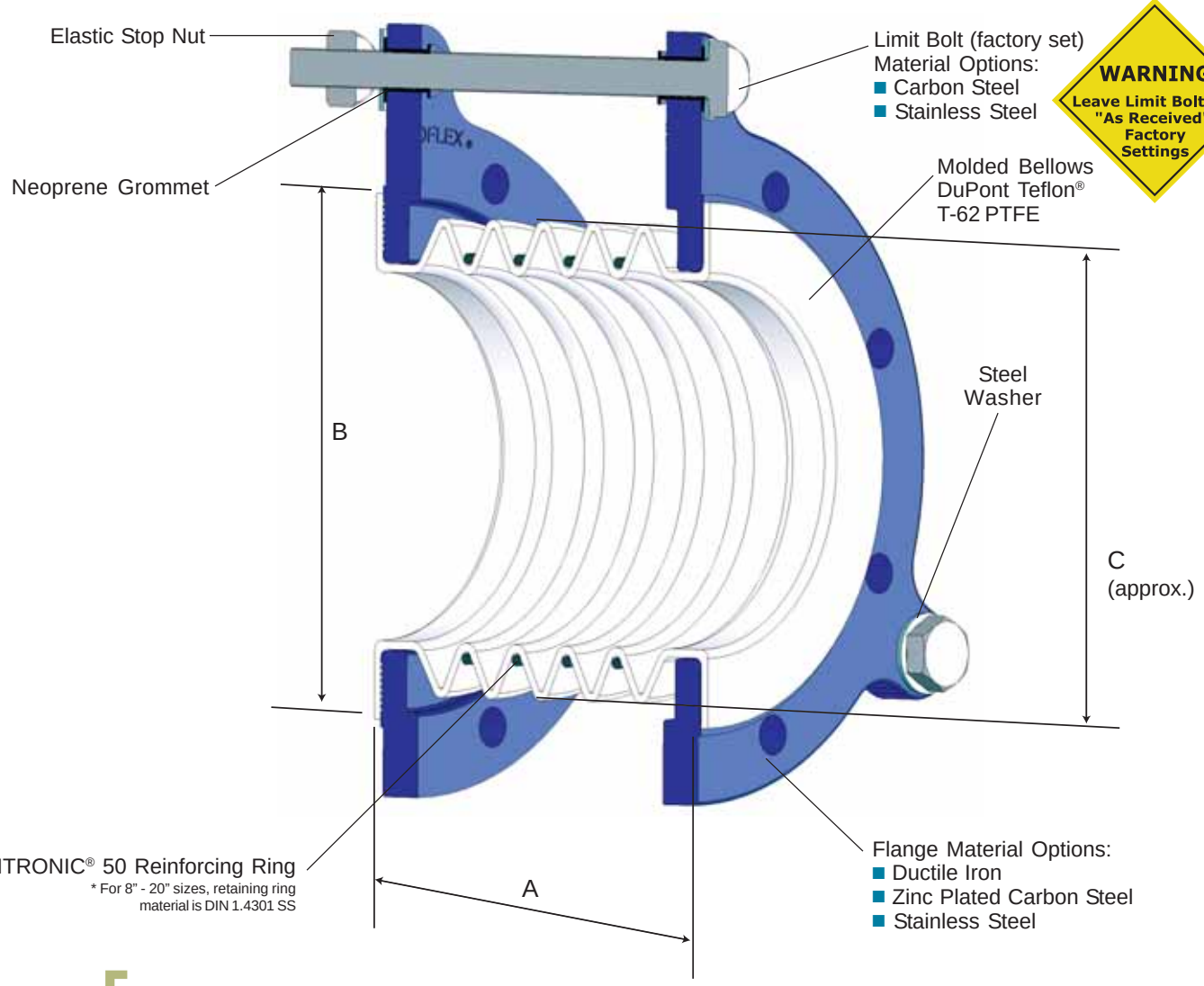
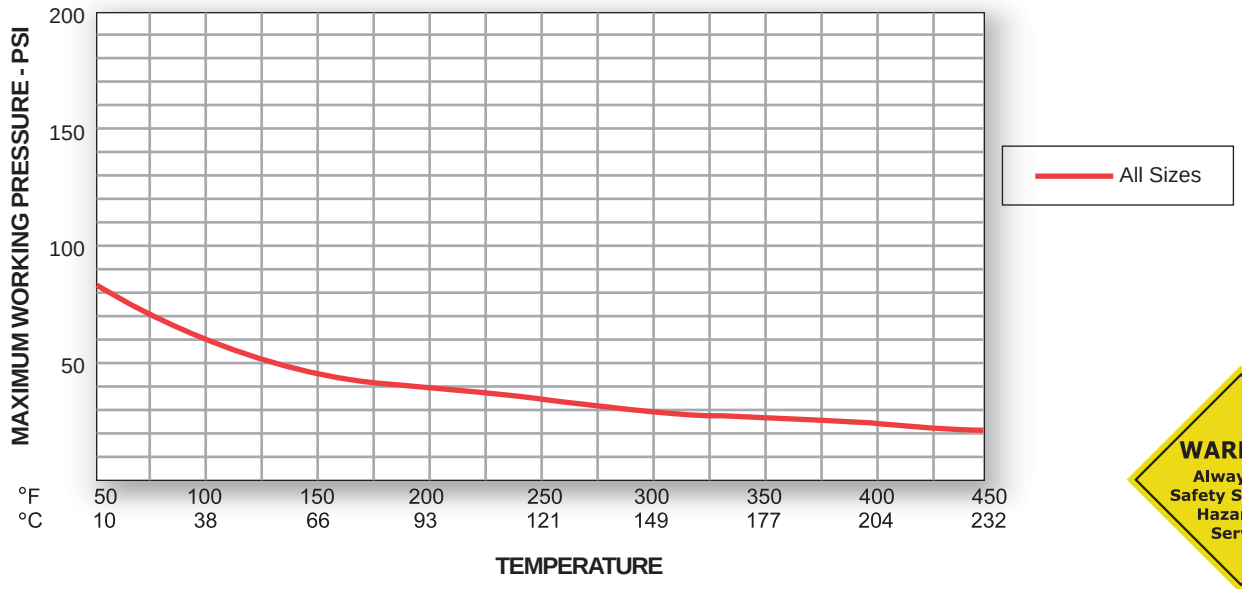
R6906 - 5 Convoluted PTFE Expansion Joint



NON-SHOCK WORKING PRESSURE vs. TEMPERATURE



WARNING
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Part # R6906-	Nom. Size (I.D.)	A †		B	C	Maximum Misalignment	Compression Force Spring Rate (lb_f / in.)	Extension Force Spring Rate (lb_f / in.)	Misalignment Force Spring Rate (lb_f / in.)	Wt. (lbs.)
		Neutral Length	Max Travel + or -							
008**	1/2	2 1/2	7/16	1 3/8	1	5/16	CF	CF	CF	3
012**	3/4		1/2	1 11/16	1 11/32	7/16				4
016*	1	3		2	1 57/64	1/2	30	44	22	2
E-016*		3 1/2	27/32				50	110	50	
024*	1 1/2		3/4	2 7/8	2 35/64		75	83	46	5
E-024*		3 5/8	7/8					80	50	
032*	2	4	1	3 5/8	3 13/32		60	47		9
E-032*		3 3/4	7/8					50		
048*	3	5	1	5	4 41/64		55	60	170	14
E-048*		4 3/8	1 1/32							
064*	4	5 1/4	1 1/4	6 3/16	5 11/16	5/8	72		80	20
E-064*		4 9/16	1 3/32				70			
096*	6	6	1 1/4	8 1/2	8		190	130	195	31
E-096*		5 1/32	1 3/16							
128*	8	6 1/16	1 1/4	10 5/8	9 27/32		CF	CF	CF	49
160**	10	8 3/16		12 3/4	12 51/64					64
192**	12	11 7/8	1 3/8	15	13 37/64	11/16				88
224**	14	11 3/8		16 1/4	17 1/4					143
256**	16	12 3/4	1 5/8	18 1/2	18 3/16	1				179
320**	20	20 1/5		23	21 27/32					243

All Dimension in inches.

† 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: Angular Deflection, maximum of 20 degrees.
Consult factory for spring rates for angular deflection.

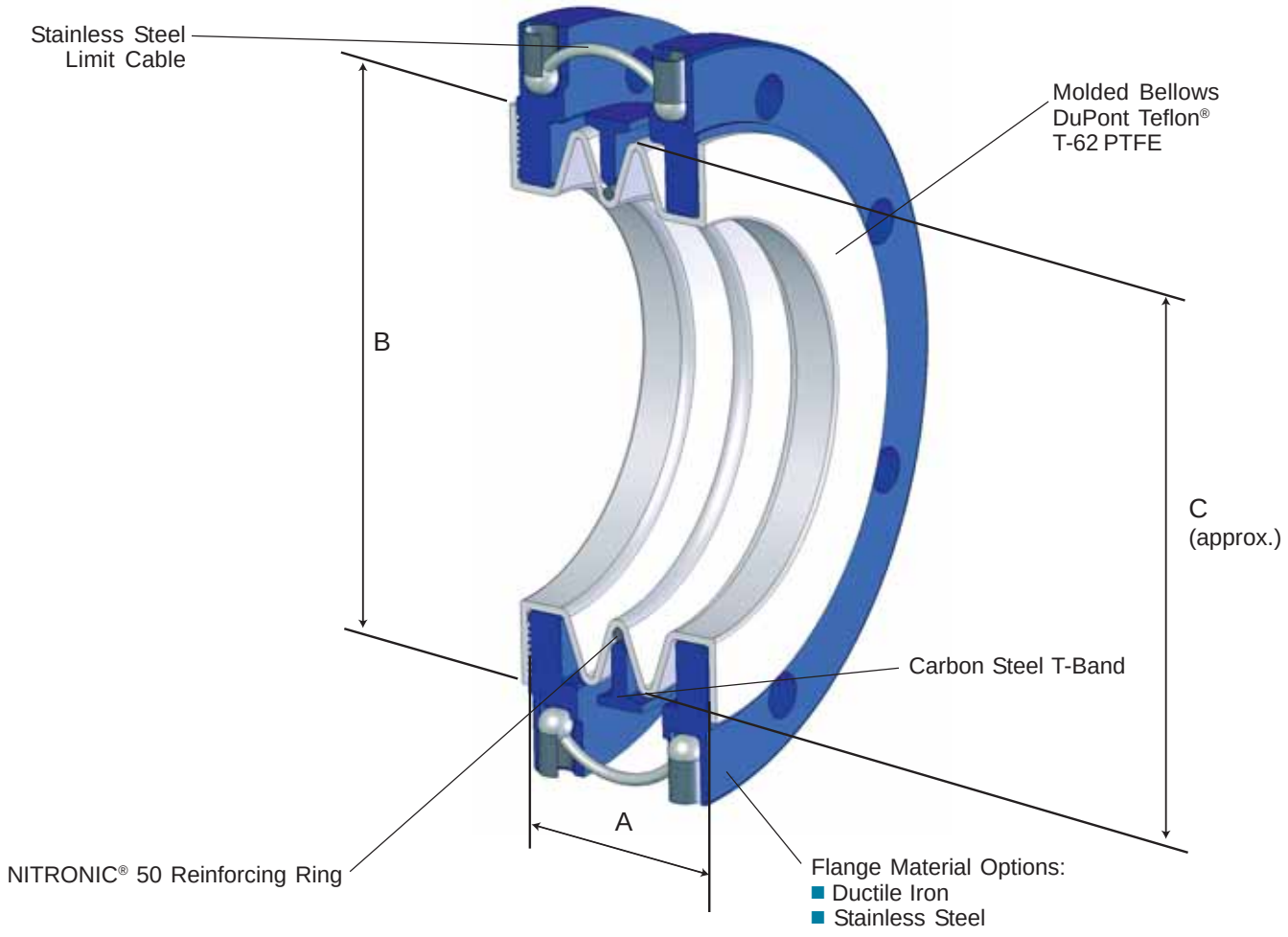
5-Convolute expansion joints are not recommended for vacuum service. Recommended only for low-pressure applications such as weigh tank connections.

Part Number Notation	Flange Material	Limit Bolt Material	Reinforcing Ring Material
*	Painted Ductile Iron	Carbon Steel	NITRONIC® 50
**	Zinc Plated Carbon Steel	Carbon Steel	Stainless Steel

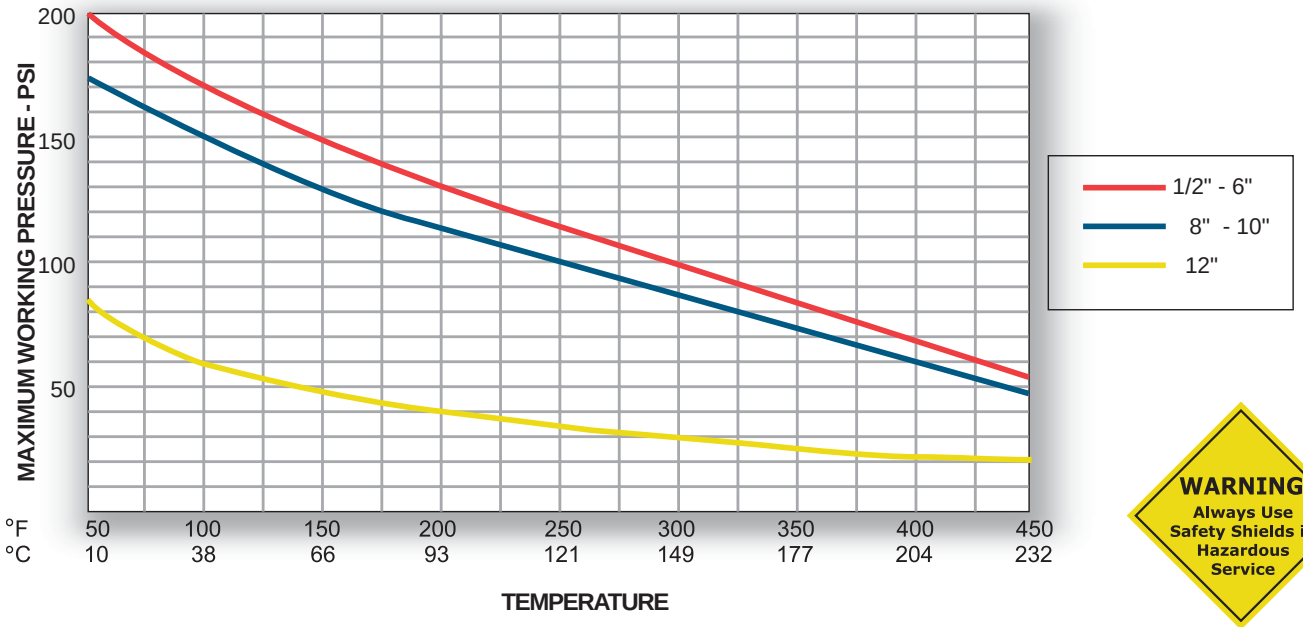
Stainless

- 316 Stainless steel flanges and limit bolts are available as a standard stock option.

E6904 - 2 Convoluted Expansion Joint



NON-SHOCK WORKING PRESSURE vs. TEMPERATURE



WARNING
Always Use Safety Shields in Hazardous Service

Part # E6904-	Nom. Size (I.D.)	A		B	C	Maximum Misalignment		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 Travel + or -			Angular	Parallel					
016	1	1 3/4	11/32	2	1 7/8	16°	1/4"	140	144	120	3	FV/425
024	1 1/2	1 13/16	11/32	2 7/8	2 27/64	13°	1/4"	240	200	240	4	
032	2	1 7/8	11/32	3 5/8	3	12°	9/32"	430	350	440	7	
048	3	2 3/16	13/32	5	4 1/2	10°	5/16"	650	320	350	10	
064	4	2 9/32	7/16	6 3/16	5 1/2	9°	5/16"	360	280	630	17	FV/400
096	6	2 17/32	15/32	8 1/2	8	7°	3/8"	460	350	720	27	FV/400
128	8	2 3/4	17/32	10 5/8	10 3/16	6°	13/32"	300	230	800	35	FV/250
160	10	2 31/32	9/16	12 3/4	11 3/4	5°	7/16"	1280	870	1000	52	FV/250
192	12	3 3/32	19/32	15	15	5°	15/32"	380	240	1000	107	FV/75

All Dimension 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 – which is better?

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

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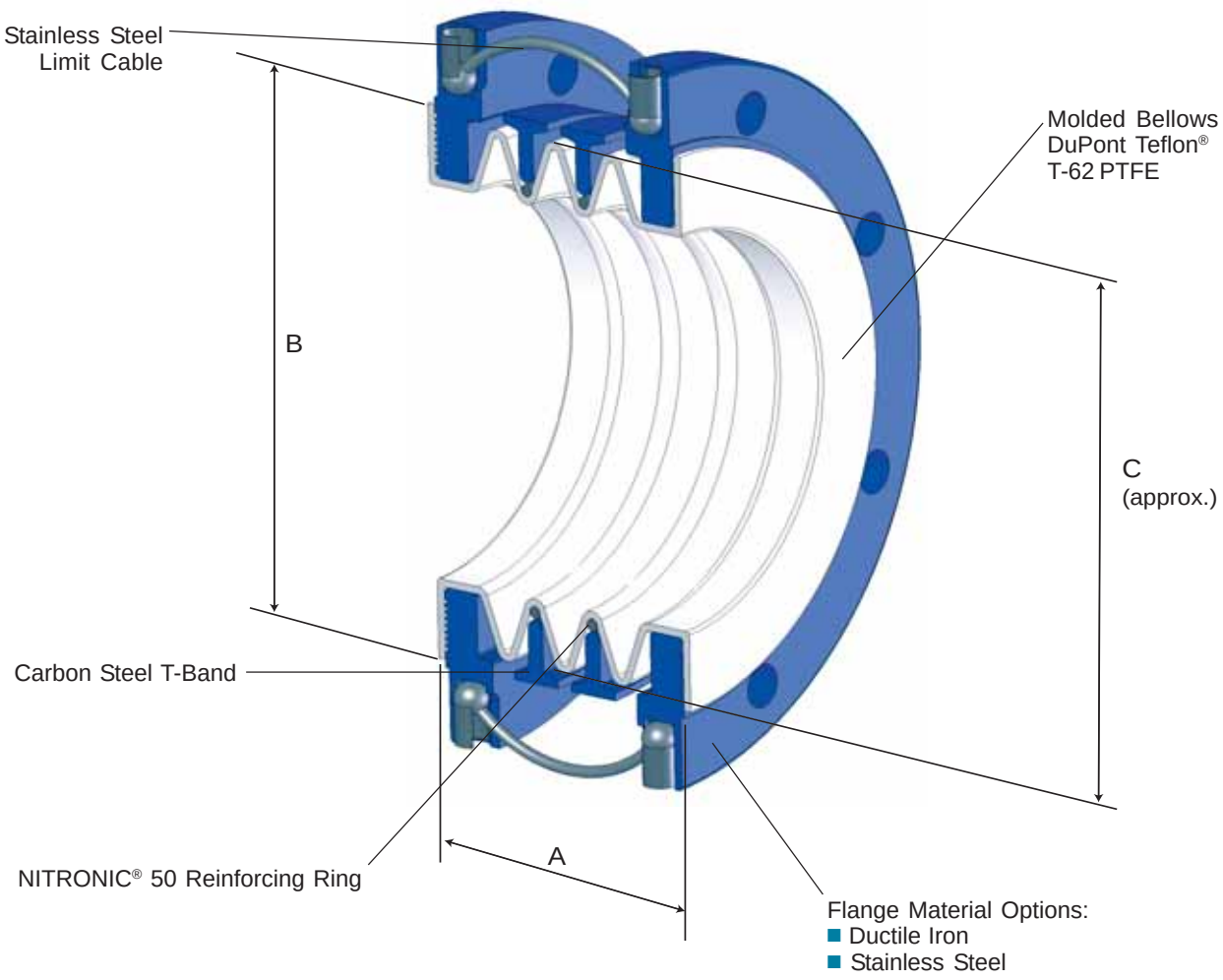
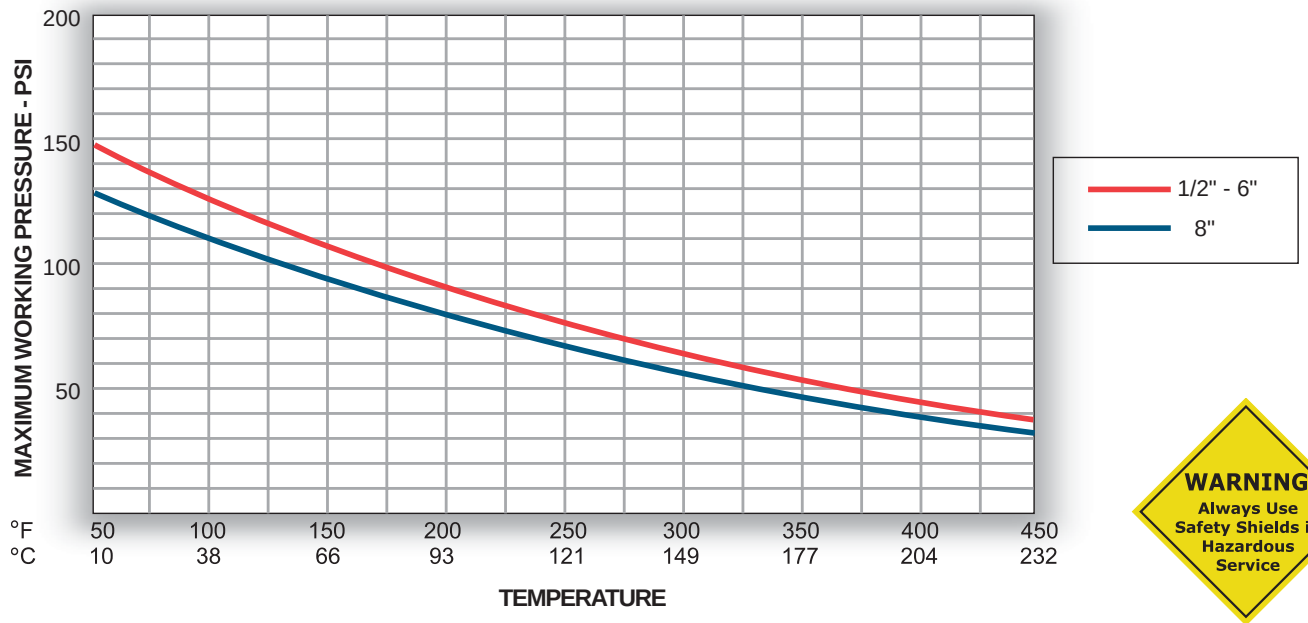
E6905 - 3 Convoluted Expansion Joint



NON-SHOCK WORKING PRESSURE vs. TEMPERATURE



WARNING
Always Use Safety Shields in Hazardous Service

Part # E6905-	Nom. Size (I.D.)	A		B	C	Maximum Misalignment		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 Travel + or -			Angular	Parallel					
016	1	2 5/16	1/2	2	1 57/64	24°	3/8"	130	130	260	3	FV/400
024	1 1/2	2 13/32	17/32	2 7/8	2 35/64	20°	3/8"	80	70	110	5	
032	2	2 1/2	17/32	3 5/8	3 13/32	17°	13/32"	70	80	160	8	
048	3	2 29/32	5/8	5	4 41/64	15°	15/32"	140	160	190	14	
064	4	3 1/16	21/32	6 3/16	5 11/16	13°	1/2"	220	160	190	19	
096	6	3 3/8	23/32	8 1/2	8	10°	17/32"	350	190	540	30	FV/300
128	8	3 21/32	25/32	10 5/8	10 3/16	9°	19/32"	450	170	750	39	FV/125

All Dimension 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
T-Band Material = Carbon Steel

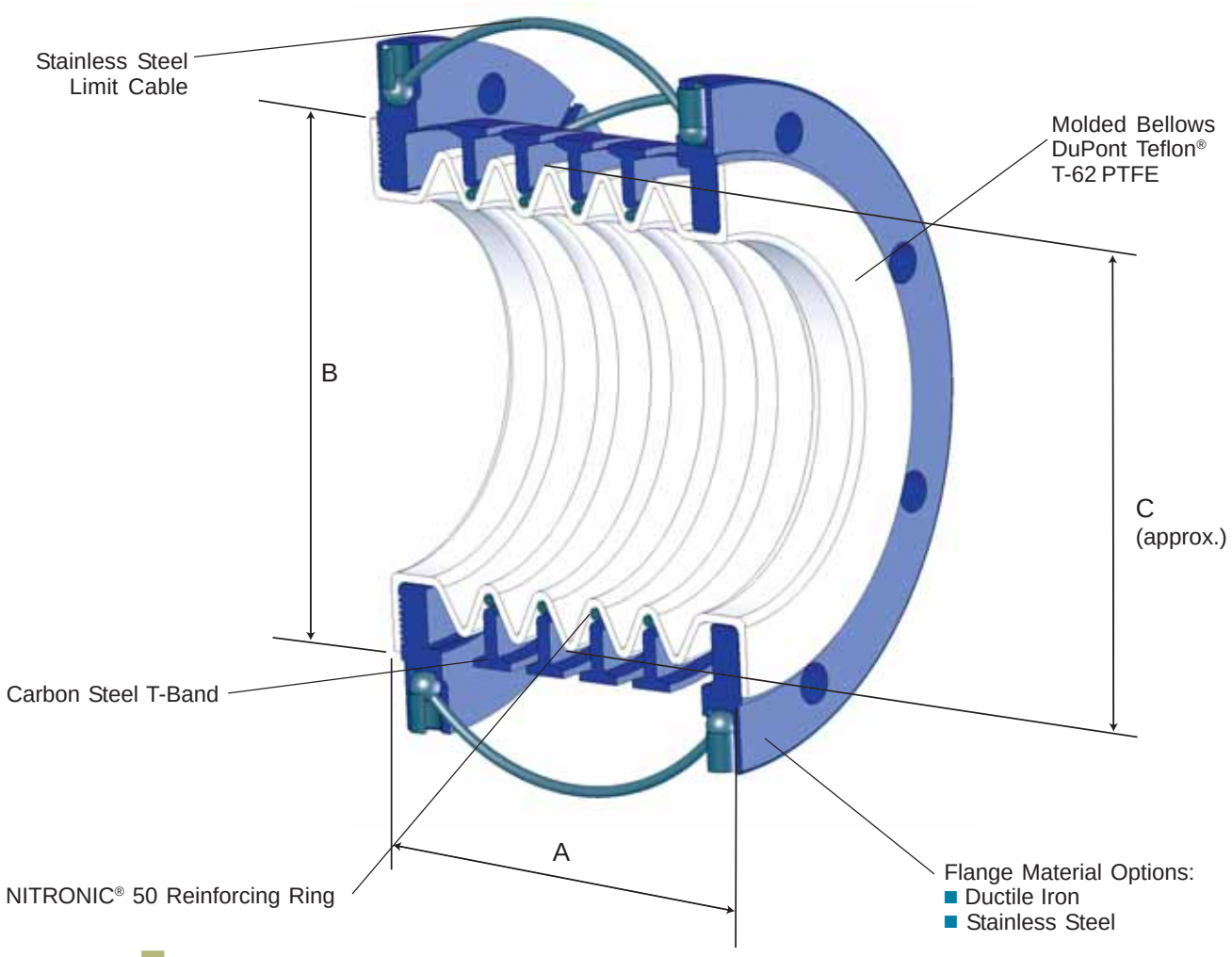
NOTE: Consult factory for spring rates for angular deflection.

Why Use T-Bands?

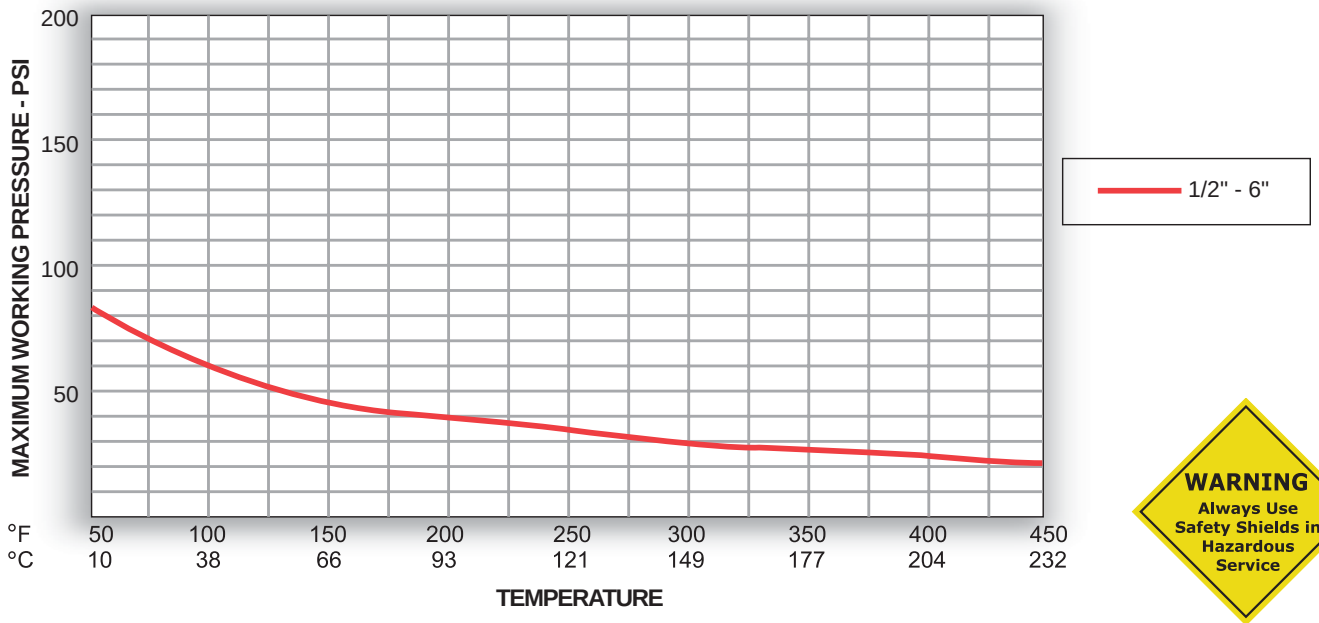
The addition of a T-band provides a travel limiter and visual indicator that a joint is at it's maximum compression. While there are many individuals who see T-bands as a way of providing some protection against dropped tools, T-bands are not designed to replace safeguarding. Wrap around safety shields are specifically designed to provide sprayout protection, and are required for hazardous service.

WARNING
Always Use Safety Shields in Hazardous Service

E6906 - 5 Convoluted Expansion Joint



NON-SHOCK WORKING PRESSURE vs. TEMPERATURE



WARNING
Always Use Safety Shields in Hazardous Service

Part # E6906-	Nom. Size (I.D.)	A		B	C	Maximum Misalignment		Compression Force Spring Rate (lb_f/in.)	Extension Force Spring Rate (lb_f/in.)	Misalignment Force Spring Rate (lb_f/in.)	Wt. (lbs.)
		Neutral Length	Max Travel + or -			Angular	Parallel				
016	1	3 1/2	27/32	2	1 57/64	39°	5/8"	50	110	50	3
024	1 1/2	3 5/8	7/8	2 7/8	2 35/64	32°	21/32"	75	80	50	7
032	2	3 3/4	7/8	3 5/8	3 13/32	29°	21/32"	60	50	50	10
048	3	4 3/8	1 1/32	5	4 41/64	25°	25/32"	55	60	170	16
064	4	4 9/16	1 3/32	6 3/16	5 11/16	21°	13/16"	70	60	80	23
096	6	5 1/32	1 3/16	8 1/2	8	17°	29/32"	190	130	195	34

All Dimension 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
T-Band Material = Carbon 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

Not enough can be said about 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

R7000 Series - Stainless Steel Armored PTFE Expansion Joint

Part	Nom. Size (I.D.)	A †		Spring Rate (lb_f / in.)	Weight (lbs.)
		Neutral Length	Max Travel + or -		
R7001-020	1 1/4	6.30	3/16	1702	11
R7002-020		9.41	5/16	1662	11
R7003-020		10.67	3/8	1410	13
R7001-024	1 1/2	6.38	3/16	2609	13
R7002-024		10.08	3/8	1850	13
R7003-024		12.72	1/2	1559	15
R7001-032	2	5.79	1/4	1833	15
R7002-032		8.62	3/8	1559	15
R7003-032		11.89	5/8	1987	18
R7001-040	2 1/2	5.91	1/4	2547	15
R7002-040		8.86	7/16	1273	18
R7003-040		11.38	11/16	1399	20
R7001-048	3	8.35	1/2	1901	22
R7002-048		11.42	11/16	1210	24
R7003-048		15.28	1	2512	27
R7001-064	4	6.81	1/2	1582	27
R7002-064		10.12	3/4	1056	31
R7003-064		13.78	1	1496	35
R7001-080	5	8.19	1/2	3152	37
R7002-080		10.98	3/4	1576	40
R7003-080		15.35	1 1/4	1650	44
R7001-096	6	7.56	7/16	3357	48
R7002-096		10.75	3/4	1918	55
R7003-096		15.16	1 1/4	1839	62
R7001-128	8	7.09	7/16	2883	64
R7002-128		10.51	15/16	2410	70
R7003-128		13.90	1 5/16	1604	81
R7001-160	10	7.56	9/16	6401	103
R7002-160		9.96	15/16	2558	114
R7003-160		13.82	1 9/16	2193	125
R7001-192	12	6.38	5/8	5139	110
R7002-192		12.95	1 3/4	2695	150

All dimensions are in inches.
Consult factory for requirements over 12".
Neutral length tolerance +5% / -1.5%

Standard

- Liner - PTFE
- Housing - 321 SS
- Flange - Zinc Plated Carbon Steel
- Limit Rod - Carbon Steel

Stainless

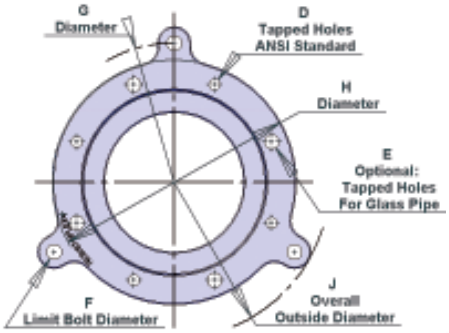
- Liner - PTFE
- Housing - 321 SS
- Flange - 321 SS
- Limit Rod - Stainless Steel

*Custom materials available for housing and flanges.

NOTE: Custom lengths are available.

WARNING
Always Use Safety Shields in Hazardous Service

Flange Dimensional Data



Nom. Size (in.)	D			E			F†	G†	H	Flange Thickness		J†	Bolt Sizes* for connecting Expansion Joints to CPI & HVAC Class 125 & 150 ANSI Flanges *
	Holes	Thread	B.C.*	Holes	Thread	B.C.*		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 1/2			3 7/8			3 7/8		5 7/8	5	11/32	15/32	6 3/4	1/2" - 13 x 1 1/4"
2		5/8 - 11	4 3/4			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			5 1/2	—	—	—		8 1/8	7	1/2	—	9 3/8	5/8" - 11 x 1 3/4"
3			6	4	5/16 - 18	6		8 3/4	7 1/2		37/64	10	5/8" - 11 x 1 3/4"
4	8		7 1/2	8		7 1/2		9 7/8	9	5/8	37/64	11 1/8	5/8" - 11 x 2"
5		3/4 - 10	8 1/2	—	—	—	1/2	11 1/2	10	3/4	—	13	3/4" - 10 x 2"
6			9 1/2	8	3/8 - 16	9 1/2		12 1/2	11		41/64	14	3/4" - 10 x 2"
8			11 3/4	—	—	—		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					17 1/2	16	1	47/64	19	7/8" - 9 x 2 1/2"
12			17				5/8	20 1/2	19		13/16	22	7/8" - 9 x 2 1/2"
14		1 - 8	18 3/4				CF	24 11/64	21	1 3/16	—	27 5/16	CF
16	16		21 1/4					27 9/16	23 1/2			31 1/2	
18		1 1/8 - 7	22 3/4					29	25			32 29/32	
20	20		25					31 1/2	27 1/2			35 7/16	
24		1 1/4 - 7	29 1/2					35 29/32	32	1 11/32		39 27/32	

* 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 only

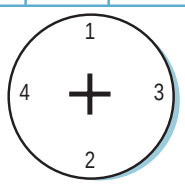
NOTE: Flanges are available in Class 300, DIN, and other drillings upon request.

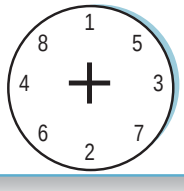
Bolt Torque Information

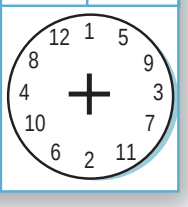
Bolts should be tightened using the following torques as a guide and with lightly oiled threads.

Nominal Expansion Joints Size (inches)	1	1 1/2	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. .







WARNING
Always Use Safety Shields in Hazardous Service

Expansion Joint Part Numbering System

Example: E6904-032WDN

E6904 – 0 3 2 W D N

E6904

R 6904
R 6905
R 6906

R 6904E
R 6905E
R 6906E

E 6904
E 6905
E 6906

R 7001
R 7002
R 7003

032

008 - .5"
012 - .75"
016 - 1"
024 - 1.5"
032 - 2"
040 - 2.5"
048 - 3"
064 - 4"
080 - 5"
096 - 6"
128 - 8"
160 - 10"
192 - 12"
224 - 14"
256 - 16"
288 - 18"
320 - 20"
384 - 24"

W

W - White
B - Black

D

D - Painted Ductile Iron
C - Carbon Steel Zinc Plated
S - Stainless Steel

N

D - DIN PN10 Drilling
G - Glass Bolt Drilling
J - JIS 10K Drilling
K - Kynar Coated Flanges
N - Nozzle Liner
P - Polypropylene Flanges
S - Stainless Steel Hardware
3 - ANSI Class 300 Drilling

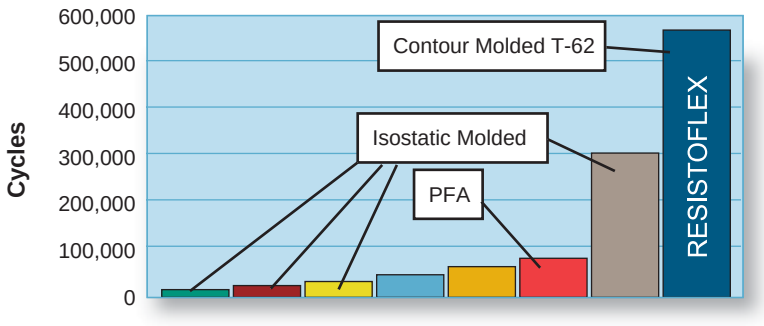
NOTE: See dimensional pages for size availabiltiy of each style.

Product Performance Testing

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 eight manufacturer's joints failed at 300,000 cycles or less, Resistoflex® joints continued to perform beyond 575,000 cycles without failure and the test was discontinued.

WARNING
Always Use Safety Shields in Hazardous Service

2. Static Test

The static test is the most rigorous test Resistoflex performs on the expansion joint product line. This test consists of 3 pressure stages for each expansion joint. The procedures for this test are outlined in the chart below.

Test Cycle	Test Sequence	Time from Previous Change, hrs.	Elapsed Time, hrs.	Temp.°F	Stage 1	Stage 2	Stage 3
					Pressure, psig	Pressure, psig	Pressure, psig
1	1	Start	0	150	1.0 x rated pressure	1.5 x rated pressure	2.0 x rated pressure
	2	24	24	250	1.0 x rated pressure	1.5 x rated pressure	2.0 x rated pressure
	3	24	48	350	1.0 x rated pressure	1.5 x rated pressure	2.0 x rated pressure
	4	24	72	450	1.0 x rated pressure	1.5 x rated pressure	2.0 x rated pressure
	5	24	96	Purge to Amb. Temp	0	0	0

Repeat above for total of 4 test cycles. Time to cool to ambient temperature is added to elapsed time for each cycle.
At the end of each stage, units must not show any signs of visible deterioration, stress marks, crazing, cracks, delaminations, splits, or holes.
Rated pressure is defined as the published maximum operating pressure at the test temperature for that unit.
Product Performance Testing is for design qualification and not performed on each individual joint manufactured.

3. Vacuum Data

Maximum Temperature for Full Vacuum (29.9" Hg)

Size	R6904 E6904	R6905 E6905	R6906 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: Using internal vacuum support rings or SHD liner allows for a full vacuum rating at elevated temperatures. Consult factory for additional information.

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.

CF = Consult Factory
For R7000 and larger size vacuum data, please consult factory.
Vacuum data above representative of standard products without internal support ridges.

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 hydrophobic acrylic polymer 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 hydrophobic acrylic polymer 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)

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.

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 can. 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 their 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.

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. Please contact RAMCO Manufacturing Company, Roselle Park, NJ at (908) 245-4500 for Expando-Gard safety shield information.

RAMCO® EXPANDO-GARD® Safety Shield

Limit Bolts

Limit bolts with elastic stop nuts are factory set at the maximum travel position to prevent overextension. 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

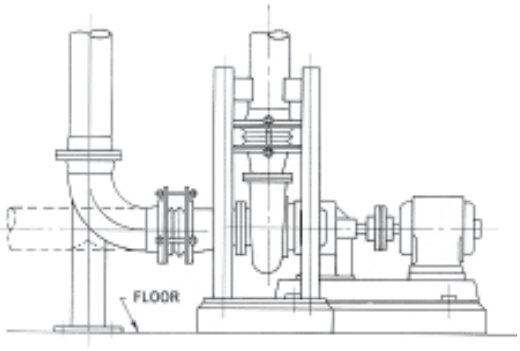
Limit cables are not designed to withstand all possible forces generated in a piping system. Maintenance personnel should periodically check the limit cables. If a limit cable appears to be in tension, or shows signs of having been stretched, the limit of expansion joint travel has been reached. This 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.

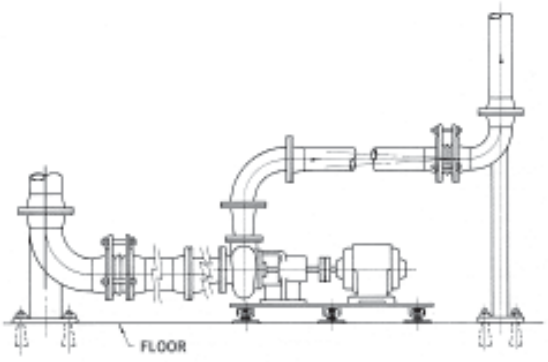
WARNING
Always Use Safety Shields in Hazardous Service

Suggested Installation as Pump Connectors



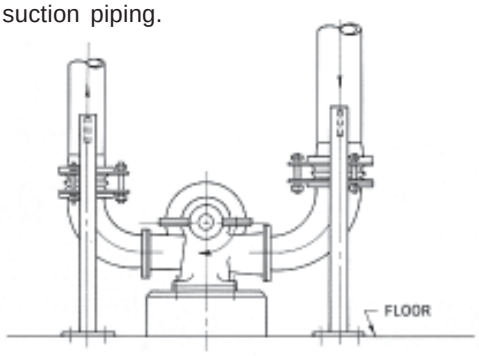
End Suction Vertical Discharge Pump
Pump is solid mounted

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.



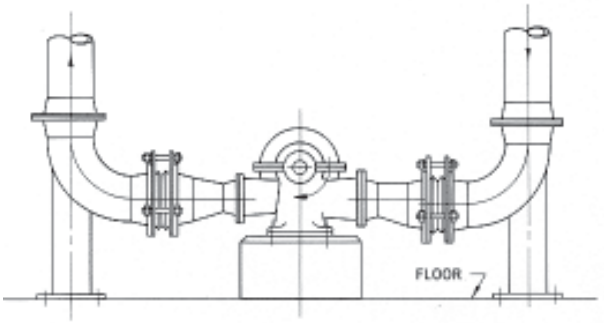
End Suction Vertical Discharge Pump
Pump is mounted on spring-supported inertia block

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 an internal 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”.

WARNING
Always Use Safety Shields in Hazardous Service

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.)

_____

_____

Diameter (if known) _____ Neutral Length _____

If size is unknown, specify fluid and flow rate _____

Movement Requirements

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) _____

Installation Description (Please make a sketch on separate sheet.)

If flexing is involved, please specify the following:

Frequency _____ Amplitude of Motion _____

Additional special requirements: _____

_____

_____

Sleeve or guard required _____

Other factors involved _____

Number of units required _____

FAX: 828-724-4783 **www.PTFEflexjoints.com**

RESISTOFLEX® **Product Families**

FLANGED PLASTIC-LINED PIPE

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

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 rotatable flange assemblies only

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.

CONQUEST® CONNECTIONS

- Patented flangeless joint design
- Performance of a welded system
- Available in 1” - 4” for all liner types
- Zero maintenance

SPECIAL SHAPES

- Custom fittings and small vessels
- Lined with TEFZEL® ETFE
- Available through 24” diameter

RESISTOFLEX® ConneXion™

Longer gaps, higher pressures, too much misalignment…Let Resistoflex’s PTFE *Teflon®* Hose **ConneXion** fill in. With a variety of hose styles such as seamless convoluted, True ID smooth bore, and even dual containment, we have many ways to protect your piping system from shock, stresses, corrosion, and other key factors in pump protection. Combine that with our PTFE *Teflon®* expansion joints to compensate for axial movement or misalignment. Resistoflex can fit your needs with a variety of fittings including flare through flanged ends, male pipe, sanitary, and other fittings necessary to connect your pump and piping system.

Let Resistoflex help solve all of your pump connection problems.

CRANE RESISTOFLEX®

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www.resistoflex.com
www.ptfeflexjoints.com
www.ptfe-hose.com
www.resistopure.com

DuPont™ Teflon® fluoropolymer

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