

REINHOLD ENVIRONMENTAL Ltd.



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Preventing Failure of Elastomeric Expansion Joints in FGD Systems

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PMP for Elastomeric Expansion Joints

A robust Preventative Maintenance Program for elastomer expansion joints can improve both plant safety and the mechanical integrity of equipment. The key elements of such a program include:

1. A comprehensive, systematic survey of all expansion joints
2. Stocking the proper types and levels of inventory
3. Periodic follow-up inspections
4. Analysis of prematurely failed joints
5. Ongoing training for plant personnel.

The Biggest Asset to PM Programs

Visible signs of wear and fatigue can alert observant users to potential failure. This is the single biggest advantage to a Plant's Preventative Maintenance Program (PMP).

Plant personnel should be able to detect and interpret the signs of potential joint failure and take the necessary preventive action.

Expansion Joints

Expansion joints are flexible connectors used to:

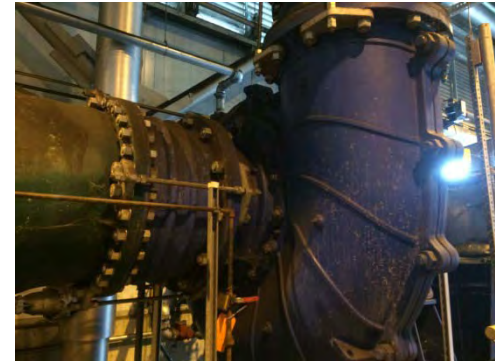
- Compensate for movements
- Compensate for piping misalignment
- Reduce vibration
- Dampen sound

in industrial piping systems for pressurized fluids



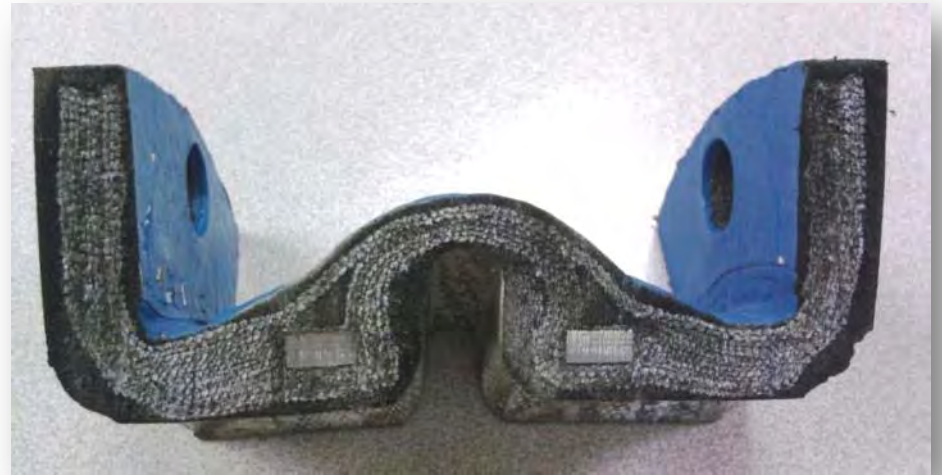
Expansion Joints

These systems are subject to movement from pressure or vacuum, temperature gradients, equipment vibration, their own weight and structural settlement. To compensate for this movement, expansion joints are typically installed at the suction or discharge side of pumps, and at directional changes and long runs of piping.



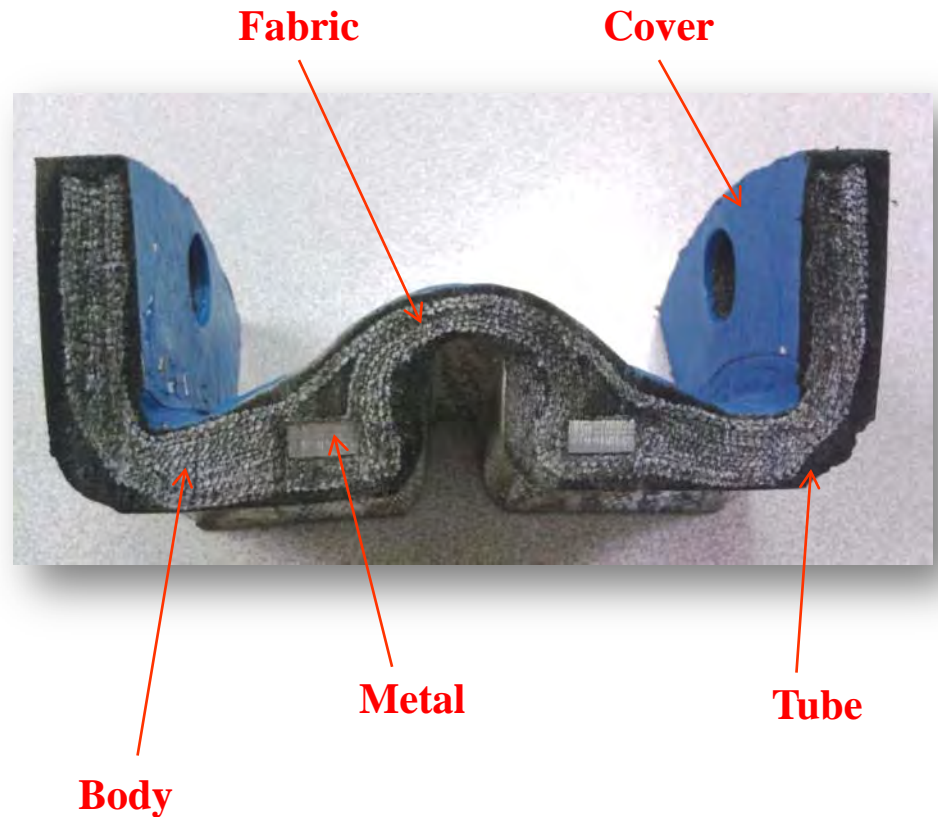
What is an Expansion Joint?

- Flexible connector
- Natural or synthetic elastomers
- Combinations of rubber, fabric, metal reinforcement



Standard Design

- **Tube**
 - Protects body
- **Body (Carcass)**
 - Fabric/Metal reinforcement
 - Provides strength and flexibility
- **Cover**
 - Provides protection from:
 - Mechanical damage
 - Ozone

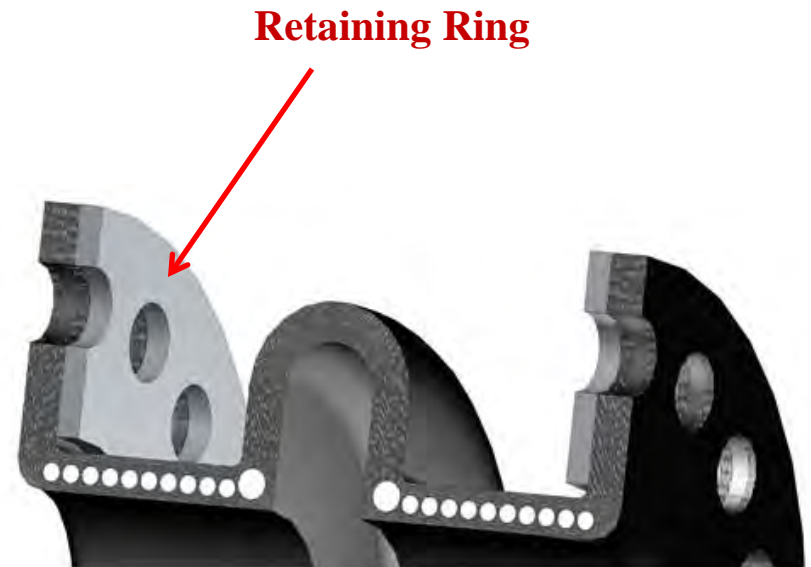


Common Accessories

Retaining Rings, Control Units & Flow Liners

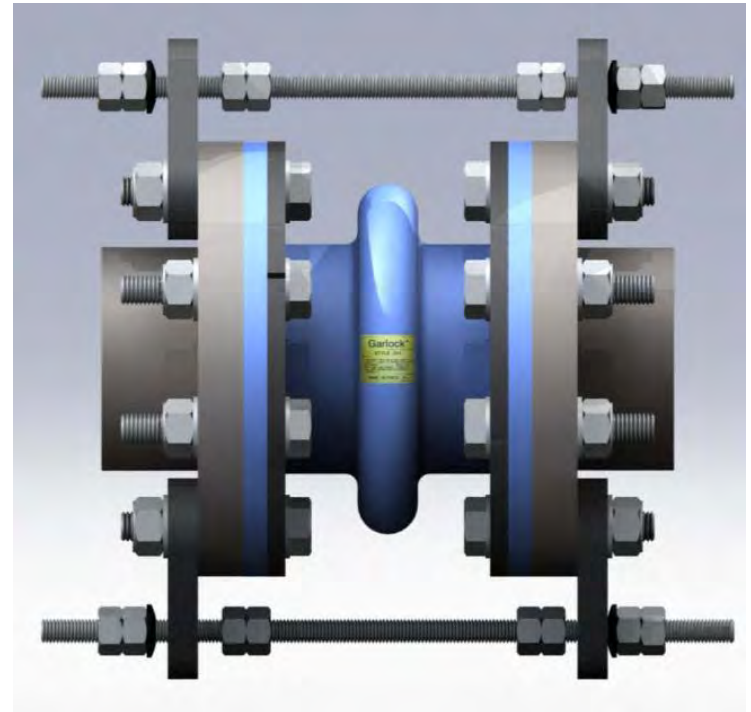
Retaining Rings

- Required
- Purpose - achieve seal & distribute bolt load evenly
- Carbon Steel, Galvanized, 304SS, 316SS, etc.
- Should be replaced with new expansion joints
 - Style & manufacturer specific



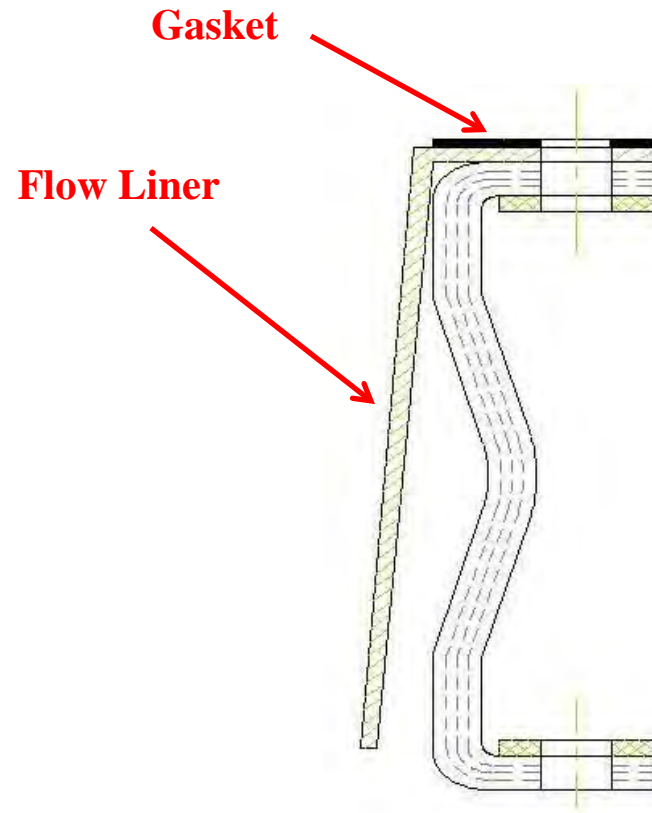
Universal Control Units (Tie Rods)

- 2+ control rod assemblies
 - Minimize damage caused by excessive axial movements (comp. or elong.)
- Compression nuts
 - Replace sleeve
 - Adjustability



Metal Flow Liner

- Abrasive media
- Protect tube
- Tapered & cut short
 - Allow lateral movement
 - Allow compression
- Carbon or stainless
- Used when:
 - Flow horizontal
 - Flow downward



Bolting Elastomeric Expansion Joints

- Gaskets not required
 - If full face
 - If raised face less than or equal to $1/16''$
- If raised face greater than $1/16''$
 - Use gasket to fill out flange and create a full face flange
- Bolt torques are rough guidelines
- “Bulge” of OD most important
 - Rubber on OD of flange should bulge outside of pipe flange by about $1/8''$ – $1/4''$

Surveys

Depending on the size of the facility, a survey could take up to three days to gather the relevant data for each of its expansion joints, including location, orientation, inside diameter and face-to-face dimensions, as well as any misalignment and offsets, either lateral or angular.



Movement vs. Misalignment

Allowable Pipe Misalignment for Rubber Expansion Joints

Nominal Pipe Size Expansion Joint I.D.		Pipe Misalignment					
		Angular (A)		Lateral (L)		Torsional (T)	
in.	mm	in.	mm	in.	mm	in.	mm
0 - 10	0 - 250	1/8	3	1/8	3	1/8	3
12 - 22	300 - 550	1/8	3	1/8	3	1/8	3
24 - 46	600 - 1150	3/16	5	1/4	6	1/4	6
48 - 70	1200 - 1750	1/4	6	3/8	10	3/8	10
72 & Up	1800 & up	1/4	6	3/8	10	3/8	10

Survey Report

Garlock Tag No.	Customer Tag # / Location	I.D.	F.F.	Lat.Off.	Drill	Visual	Evaluation	Recommendation
19329	3 CSW PUMP 3-B EAST EJ	54	12.13/12.5	NO LATERAL	ANSI STD. 150#	CONTROL UNIT NUTS & BOLTS RUSTED & CORRODED	NO VISIBLE DAMAGE	GARLOCK STYLE 204 / CHLOROBUTYL / POLY ESTER / NEOPRENE COVER / SINGLE - OPEN ARCH / STD DRILL
19337	2 CWS PUPMP 2A NORTH EJ	54	10/1038	NO LATERAL	ANSI STD. 150#	CRACKING @ BASE OF ARCH / DELAMINATION OF COVER / SOFTNESS / OIL LEAKING ON COVER	REPLACE	GARLOCK STYLE 204 / CHLOROBUTYL / POLY ESTER / NEOPRENE COVER / SINGLE - OPEN ARCH / STD DRILL
19338	3 CWS PUMP 2A SOUTH EJ	60	8.5/9	.38	ANSI STD. 150#		NO VISIBLE DAMAGE	GARLOCK STYLE 204 / CHLOROBUTYL / POLY ESTER / NEOPRENE COVER / SINGLE - OPEN ARCH / STD DRILL
19335	2 CWS PUMP 2B NORTH EJ	60	8.63/8.88	.25	ANSI STD. 150#	MINOR DELAMINATION OF FLANGE OD	REINSPECT	GARLOCK STYLE 204 / CHLOROBUTYL / POLY ESTER / NEOPRENE COVER / SINGLE - OPEN ARCH / STD DRILL
19336	2 CWS PUMP 2B NORTH EJ	54	9	.38	ANSI STD. 150#		NO VISIBLE DAMAGE	GARLOCK STYLE 204 / CHLOROBUTYL / POLY ESTER / NEOPRENE COVER / SINGLE - OPEN ARCH / STD DRILL
19333	3 CWS PUMP 23-C NORTH EJ	54	9.25/9.75	NO LATERAL	ANSI STD. 150#	CONTROL UNIT NUTS & BOLTS RUSTED & CORRODED	REINSPECT	GARLOCK STYLE 204 / CHLOROBUTYL / POLY ESTER / NEOPRENE COVER / SINGLE - OPEN ARCH / STD DRILL
19334	3 CWS PUMP 3-C SOUTH EJ	60	8.63/9	.5	ANSI STD. 150#		NO VISIBLE DAMAGE	GARLOCK STYLE 204 / CHLOROBUTYL / POLY ESTER / NEOPRENE COVER / SINGLE - OPEN ARCH / STD DRILL
19331	3 CWS PUMP 3A	60	11.75/12.63	NO LATERAL	ANSI STD. 150#		NO VISIBLE DAMAGE	GARLOCK STYLE 204 / CHLOROBUTYL / POLY ESTER / NEOPRENE COVER / SINGLE - OPEN ARCH / STD DRILL
19332	3 CWS PUMP 3A WEST EJ	54	12/12.5	NO LATERAL	ANSI STD. 150#	CONTROL UNIT NUTS & BOLTS RUSTED & CORRODED	REINSPECT	GARLOCK STYLE 204 / CHLOROBUTYL / POLY ESTER / NEOPRENE COVER / SINGLE - OPEN ARCH / STD DRILL

Orientation Markings



Failure Analysis & Signs of Fatigue

Common Issues with Rubber Expansion Joints

- Installation
 - Misalignment
 - Bolting
- Failures
 - Movement
 - Installation Errors
 - Pressure
 - Vacuum
 - Chemical Attack
 - Abrasion



Other Troubleshooting Tips

- Brittle and Hard
 - Old, Chemical Attack
- Soft and Spongy
 - Media Wicking Through Tube
- Splitting on O.D. of flange
 - Over-tightening, Movement
- Delamination of cover
 - Chemical Attack, Movement



Other Troubleshooting Tips

- Tacky to the touch
 - Chemical Attack
- Inconsistent Arch
 - Pressure/Vacuum too High
- Take field dimensions and compare to manufactured dimensions



Cracking of the Joint

Minor Surface Cracking

- Paint cracked
- Rubber cover cracked
- Still fully functional



Severe Cracking

- Fabric visible and torn
- Loss of strength



Cracking at base of the arch or Flange



This can be due to a number of reasons such as:

- Over-extension
- Misalignment
- Over pressurization

Leaking at the flange

This can be due to a number of reasons such as:

- Under torqued flanges
- Poor condition of flanges
- Overextension of joint
- Poor retaining ring condition



Failure Analysis



Vacuum Issues

- Arch Inversion
 - Vacuum sucks arch inward
 - Tube tearing from reinforcement
 - Media wicks into reinforcement



Educational Training Seminars

- Installation and removal of Expansion Joints
- Visual inspections
- Proper bolting sequence
- Lifting and lugging
- Troubleshooting
- Dimensional verification

Troubleshooting Expansion Joints

Insufficient Vacuum Support



Bolt Interference



Missing Retaining Rings



Extended Face to Face Length/Rubber to Rubber Sealing



Insufficient Anchoring



Thank You.