PROCO

The Expansion Joint and Check Valve People

Rubber Expansion Joint Series 230

Proco Series 230 Rubber Joints

Proco Series 230 Rubber Expansion Joints are designed for piping systems to absorb pipe movements, relieve stress, reduce system noise/vibration, compensate for misalignment/offset and to protect rotating mechanical equipment against start-up surge forces.

The Style 231 and FA231: Single wide-arch product and work horse for industrial applications available in open arch and filled arch configurations.
The Style 232 and FA232: Double wide-arch product where more movement is needed. Available in open arch and filled arch configurations.
The Style 233 and FA233: Triple wide-arch product where most movement is needed. Available in open arch and filled arch configurations.

Features and Benefits:

Absorbs Directional Movement

Thermal movements appear in any rigid pipe system due to temperature changes. The Series 230 wide arch expansion joints allow for axial compression or axial extension, lateral deflection as well as angular and torsional movements. (Note: Rated movements in this publication are based on one plane movements. Multiple movement conditions are based on a multiple movement calculation.)

Less Turbulence or Material Entrapment

The Series 230 expansion joints are manufactured with the integral rubber flange joining the body at a true 90° angle. This ensures the product will install snug against the mating pipe flange free of voids creating less turbulence in the pipe system. The Series 230 is also available with a filled arch for applications that have 20% or more solids in the process.

Absorbs Vibration, Noise and Shock

The Proco Series 230 rubber expansion joints effectively dampen and insulate downstream piping against the transmission of noise and vibration generated by mechanical equipment. Noise and vibrations caused by equipment can cause stress in pipe, pipe guides, anchors and other equipment downstream. The Series 230 expansion joints will help relieve noise and vibration occurrences in a pipe system. Water hammer and pumping impulses can also cause strain, stress or shock to a piping system. Install the Series 230 to help compensate for these system pressure spikes.

Compensates for Misalignment

Rubber expansion joints are commonly used by contractors and plant personnel to allow for slight pipe misalignment during installation of new piping and or replacement applications. (Although rubber expansion joints can be made with permanent offsets, it is suggested that piping misalignments be limited to no more than 1/8" per the Fluid Sealing Association Piping Expansion Technical Handbook www.fluidsealing.com.)

Wide Service Range and Less Weight

Engineered to operate up to 200 PSIG (nominal size dependent) Or up to 250°F (elastomer dependent), the Series 230 can be specified for a wide range of piping system requirements. The Series 230 rubber expansion joints are constructed in various elastomers with rubber impregnated polyester tire cord and reinforced with wire to create a product with greater operating performance.

Material Identification

All Series 230 expansion joints are strip branded with cure dates and elastomer designations.
All Neoprene Tube/Neoprene Cover (NN) and Nitrile Tube/Neoprene Cover (NP) elastomer designated joints meet the Coast Guard Requirements and conform to ASTM F 1123-87. EE-NSF/61 - ANSI/NSF Standard 61 standards were developed by the National Sanitation Foundation (NSF), and the American National Standards Institute (ANSI) and relates to water treatment which establishes stringent requirements for the control of equipment that comes in contact with either potable water or products that support the production of potable water

Large Inventory

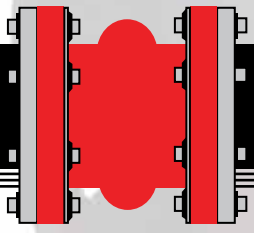
Proco Products, Inc. maintains one of the largest inventories of rubber expansion joints in the world.
Please contact us for price and availability.

Table 1: Available Materials • Temperatures

For Specific Chemical Compatibilities, See: **PROCO "Chemical To Elastomer Guide"**

Material Code	Cover [1,2] Elastomer	Tube [1,2] Elastomer	Maximum Operating Temp. °F (°C)	Branding Label Color	F.S.A. Material Class
BB	Chlorobutyl	Chlorobutyl	250° (121°)	Black	STD. III
EE	EPDM	EPDM	250° (121°)	Red	STD. III
EE-NSF61[6]	EPDM	EPDM	250° (121°)	Red	STD. III
EQ	EPDM	FDA-EPDM	250° (121°)	Red[3]	STD. II
NH	Neoprene	CSM	212° (100°)	Green	STD. II
NN	Neoprene	Neoprene	225° (107°)	Blue	STD. II
NF	Neoprene	FDA-Neoprene	225° (107°)	Blue[3]	STD. II
NP	Neoprene	Nitrile	212° (100°)	Yellow	STD. II
NR	Neoprene	Natural Rubber	180° (82°)	White	STD. I
NG	Neoprene	Natural Gum	180° (82°)	Tan	STD. I

Protecting Piping and Equipment Systems from Stress/Motion



Information subject to change without notice.

Notes: *All Products are reinforced with Polyester Tire Cord*

1. *Expansion Joint "Cover" can be coated with CSM UV Resistant Coating.*
2. *All NN & NP elastomer designated joints meet the Coast Guard Requirements and conform to ASTM F 1123-87 and are marked accordingly.*
3. *Branding Label will be marked as "Food Grade".*
4. *All elastomers above are not intended for steam service*
5. *BB or EE are good for 300°F blower service at 20 PSI or less.*
6. *EE-NSF/61 UL Classified Water Quality*

Style 231 Performance Data

Table 2: Sizes • Movements • Design Pressures • Weights

Expansion Joint Size Nom. I.D. Inch / (mm)		Neutral [10] Length Inch / (mm)		231 Movement Capability: [1, 2] From Neutral Position (Non-Concurrent)					Operating Conditions [3]			Weights lbs / (kgs) [4]		
				Axial Compression Inch / (mm)	Axial Extension Inch / (mm)	Lateral Deflection Inch / (mm)	Angular Deflection [5] (Degrees)	Torsional Rotation [6] (Degrees)	Thrust Factor [7] In2 / (cm2)	Positive PSIG (Bar)	Vacuum Inches of Hg / (mm of Hg)[8]	Expansion Joint	Retaining Ring Set	Control Rod Assembly [9]
1	(25)	6	(152)	0.6 (20)	0.4 (10)	0.5 (12)	50.4	2	5.31 (35)	200 (14)	26 (660)	2.0 (0.8)	2.0 (0.8)	2.3 (1.0)
1.25	(32)	6	(152)	0.8 (20)	0.4 (10)	0.5 (12)	43.1	2	6.38 (42)	200 (14)	26 (660)	2.5 (1.1)	2.5 (1.1)	2.3 (1.0)
1.5	(40)	6	(152)	0.8 (20)	0.4 (10)	0.5 (12)	38.1	2	7.55 (49)	200 (14)	26 (660)	3.0 (1.4)	2.5 (1.1)	2.3 (1.0)
2	(50)	6 7 8 9 10 12	(152) (178) (203) (229) (254) (305)	1.4 (35)	0.7 (17)	0.6 (16)	34.2	2	12.57 (81)	200 (14)	26 (660)	4.0 (1.8)	4.0 (1.8)	2.8 (1.3)
2.5	(65)	6 7 8 9 10 12	(152) (178) (203) (229) (254) (305)	1.4 (35)	0.7 (17)	0.6 (16)	27.6	2	15.90 (103)	200 (14)	26 (660)	4.5 (2.0)	4.5 (2.0)	2.8 (1.3)
3	(80)	6 7 8 9 10 12	(152) (178) (203) (229) (254) (305)	1.4 (35)	0.7 (17)	0.6 (16)	23.0	2	19.64 (127)	200 (14)	26 (660)	5.5 (2.5)	5.5 (2.5)	2.8 (1.3)
4	(100)	6 7 8 9 10 12	(152) (178) (203) (229) (254) (305)	1.4 (35)	0.7 (17)	0.6 (16)	18.8	2	28.27 (182)	200 (14)	26 (660)	8.0 (3.6)	8.0 (3.6)	2.8 (1.3)
5	(125)	6 7 8 9 10 12	(152) (178) (203) (229) (254) (305)	1.6 (40)	0.8 (20)	0.7 (18)	15.2	2	43.01 (277)	190 (13)	26 (660)	9.0 (4.1)	8.5 (3.9)	4.0 (1.8)

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Style 231 Performance Data continued...

Table 2: Sizes • Movements • Design Pressures • Weights

Expansion Joint Size Nom. I.D. Inch / (mm)		Neutral [10] Length Inch / (mm)		231 Movement Capability: [1, 2] From Neutral Position (Non-Concurrent)					Operating Conditions [3]			Weights lbs / (kgs) [4]		
				Axial Compression Inch / (mm)	Axial Extension Inch / (mm)	Lateral Deflection Inch / (mm)	Angular Deflection [5] (Degrees)	Torsional Rotation [6] (Degrees)	Thrust Factor [7] In2 / (cm2)	Positive PSIG (Bar)	Vacuum Inches of Hg / (mm of Hg)[8]	Expansion Joint	Retaining Ring Set	Control Rod Assembly [9]
6	(150)	6	(152)	1.6 (40)	0.8 (20)	0.7 (18)	12.8	2	55.42 (358)	190 (13)	26 (660)	11.0 (5.0)	9.5 (4.3)	4.0 (1.8)
		7	(178)											
		8	(203)											
		9	(229)											
		10	(254)											
		12	(305)											
8	(200)	6	(152)	1.6 (40)	0.8 (20)	0.7 (18)	9.7	2	89.95 (580)	190 (13)	26 (660)	15.0 (6.8)	14.5 (6.6)	8.0 (3.6)
		7	(178)											
		8	(203)											
		9	(229)											
		10	(254)											
		12	(305)											
		14	(356)											
10	(250)	8	(203)	1.6 (40)	0.8 (20)	0.7 (18)	9.1	2	120.76 (779)	190 (13)	26 (660)	23.0 (10.4)	17.0 (7.7)	10.0 (4.5)
		9	(229)											
		10	(254)											
		12	(305)											
		14	(356)											
12	(300)	8	(203)	1.6 (40)	0.8 (20)	0.8 (20)	7.6	2	172.03 (1110)	190 (13)	26 (660)	34.0 (15.4)	24.5 (11.0)	10.0 (4.5)
		9	(229)											
		10	(254)											
		12	(305)											
		14	(356)											
14	(350)	8	(203)	1.6 (40)	0.8 (20)	0.8 (20)	6.5	2	221.67 (1430)	130 (9.0)	26 (660)	40.0 (18.1)	27.0 (12.3)	12.0 (5.4)
		9	(229)											
		10	(254)											
		12	(305)											
		14	(356)											
16	(400)	8	(203)	1.6 (40)	0.8 (20)	0.8 (20)	5.7	2	277.59 (1791)	115 (8.0)	26 (660)	47.0 (21.3)	33.5 (15.2)	15.0 (6.8)
		9	(229)											
		10	(254)											
		12	(305)											
		14	(356)											
18	(450)	8	(203)	1.6 (40)	0.8 (20)	0.8 (20)	5.1	2	339.80 (2192)	115 (8.0)	26 (660)	56.0 (25.4)	34.0 (15.5)	16.0 (7.2)
		9	(229)											
		10	(254)											
		12	(305)											
		14	(356)											
20	(500)	8	(203)	1.6 (40)	0.8 (20)	0.8 (20)	5.7	2	408.28 (2634)	115 (8.0)	26 (660)	67.0 (30.4)	38.0 (17.3)	16.0 (7.2)
		9	(229)											
		10	(254)											
		12	(305)											
		14	(356)											

Table 2: Sizes • Movements • Design Pressures • Weights

Expansion Joint Size Nom. I.D. Inch / (mm)		Neutral [10] Length Inch / (mm)		231 Movement Capability: [1, 2] From Neutral Position (Non-Concurrent)					Operating Conditions [3]			Weights lbs / (kgs) [4]		
				Axial Compression Inch / (mm)	Axial Extension Inch / (mm)	Lateral Deflection Inch / (mm)	Angular Deflection [5] (Degrees)	Torsional Rotation [6] (Degrees)	Thrust Factor [7] In2 / (cm2)	Positive PSIG (Bar)	Vacuum Inches of Hg / (mm of Hg)[8]	Expansion Joint	Retaining Ring Set	Control Rod Assembly [9]
22	(550)	10 12 14	(254) (305) (356)	2.0 (50)	1.0 (25)	0.9 (23)	5.2	2	498.76 (3218)	100 (7.0)	26 (660)	70.0 (31.8)	44.0 (20.0)	19.0 (8.6)
24	(600)	10 12 14	(254) (305) (356)	2.0 (50)	1.0 (25)	0.9 (23)	4.8	2	581.76 (3749)	100 (7.0)	26 (660)	79.0 (35.8)	48.0 (21.8)	20.0 (9.0)
26	(650)	10 12 14	(254) (305) (356)	2.0 (50)	1.0 (25)	0.9 (23)	4.4	2	669.66 (4320)	90 (6.0)	26 (660)	100.0 (45.4)	51.0 (23.1)	20.0 (9.0)
28	(700)	10 12 14	(254) (305) (356)	2.0 (50)	1.0 (25)	0.9 (23)	4.1	2	764.54 (4933)	90 (6.0)	26 (660)	102.0 (46.3)	55.0 (25.0)	28.0 (12.6)
30	(750)	10 12 14	(254) (305) (356)	2.0 (50)	1.0 (25)	0.9 (23)	2.2	2	865.70 (5585)	90 (6.0)	26 (660)	117.0 (53.1)	63.0 (28.6)	29.5 (13.3)
32	(800)	10 12 14	(254) (305) (356)	2.0 (50)	1.0 (25)	0.9 (23)	3.6	2	973.14 (6278)	90 (6.0)	26 (660)	120.0 (54.4)	68.0 (30.8)	33.0 (14.9)
34	(850)	10 12 14	(254) (305) (356)	2.0 (50)	1.0 (25)	0.9 (23)	3.4	2	1086.87 (7012)	90 (6.0)	26 (660)	122.0 (55.3)	72.0 (32.7)	43.0 (19.5)
36	(900)	10 12 14	(254) (305) (356)	2.0 (50)	1.0 (25)	0.9 (23)	3.2	2	1206.87 (7786)	90 (6.0)	26 (660)	143.0 (64.9)	76.0 (34.5)	43.0 (19.5)
38	(950)	10 12 14	(254) (305) (356)	2.0 (50)	1.0 (25)	0.9 (23)	3.0	2	1333.16 (8601)	90 (6.0)	26 (660)	162.0 (73.5)	86.0 (39.0)	43.0 (19.5)
40	(1000)	10 12 14	(254) (305) (356)	2.0 (50)	1.0 (25)	0.9 (23)	2.9	2	1465.74 (9456)	90 (6.0)	26 (660)	173.0 (78.5)	100.0 (45.5)	43.0 (19.5)
42	(1050)	12 14	(305) (356)	2.4 (60)	1.2 (30)	1.1 (28)	3.3	2	1661.90 (10722)	80 (5.5)	26 (660)	193.0 (87.5)	100.0 (45.5)	44.0 (20.0)
44	(1100)	12 14	(305) (356)	2.4 (60)	1.2 (30)	1.1 (28)	3.1	2	1809.56 (11675)	80 (5.5)	26 (660)	198.0 (89.8)	104.0 (37.2)	44.0 (20.0)
46	(1150)	12 14	(305) (356)	2.4 (60)	1.2 (30)	1.1 (28)	3.0	2	1963.50 (12668)	80 (5.5)	26 (660)	205.0 (93.0)	127.0 (57.6)	44.0 (20.0)

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Style 231 Performance Data continued...

Table 2: Sizes • Movements • Design Pressures • Weights

Expansion Joint Size Nom. I.D. Inch / (mm)		Neutral [10] Length Inch / (mm)		231 Movement Capability: [1, 2] From Neutral Position (Non-Concurrent)					Operating Conditions [3]			Weights lbs / (kgs) [4]		
				Axial Compression Inch / (mm)	Axial Extension Inch / (mm)	Lateral Deflection Inch / (mm)	Angular Deflection [5] (Degrees)	Torsional Rotation [6] (Degrees)	Thrust Factor [7] In2 / (cm2)	Positive PSIG (Bar)	Vacuum Inches of Hg / (mm of Hg)[8]	Expansion Joint	Retaining Ring Set	Control Rod Assembly [9]
48	(1200)	12	(305)	2.4	1.2	1.1	2.9	2	2123.72	80	26	211.0	132.0	44.0
		14	(356)	(60)	(30)	(28)			(13700)	(5.5)	(660)	(95.7)	(59.9)	(20.0)
50	(1250)	12	(305)	2.4	1.2	1.1	2.8	2	2290.72	80	26	240.0	134.0	44.0
		14	(356)	(60)	(30)	(28)			(14776)	(5.5)	(660)	(108.8)	(60.0)	(20.0)
52	(1300)	12	(305)	2.4	1.2	1.1	2.6	2	2463.00	80	26	256.0	136.0	60.0
		14	(356)	(60)	(30)	(28)			(15890)	(5.5)	(660)	(116.1)	(61.7)	(27.0)
54	(1350)	12	(305)	2.4	1.2	1.1	2.6	2	2715.47	80	26	265.0	150.0	63.0
		14	(356)	(60)	(30)	(28)			(17519)	(5.5)	(660)	(120.1)	(68.0)	(28.6)
56	(1400)	12	(305)	2.4	1.2	1.1	2.5	2	2903.33	80	26	288.0	165.0	63.0
		14	(356)	(60)	(30)	(28)			(18731)	(5.5)	(660)	(130.6)	(70.8)	(28.6)
58	(1450)	12	(305)	2.4	1.2	1.1	2.4	2	3097.48	80	26	300.0	190.0	66.2
		14	(356)	(60)	(30)	(28)			(19984)	(5.5)	(660)	(136.1)	(86.2)	(30.0)
60	(1500)	12	(305)	2.4	1.2	1.1	2.3	2	3297.92	80	26	310.0	200.0	68.3
		14	(356)	(60)	(30)	(28)			(21277)	(5.5)	(660)	(140.6)	(90.7)	(31.2)
66	(1650)	12	(305)	2.4	1.2	1.1	2.1	2	3936.92	80	26	350.0	240.0	71.0
		14	(356)	(60)	(30)	(28)			(25399)	(5.5)	(660)	(158.7)	(108.8)	(32.2)
68	(1700)	12	(305)	2.4	1.2	1.1	2.0	2	4162.48	70	26	368.8	227.0	76.3
		14	(356)	(60)	(30)	(28)			(26855)	(5.0)	(660)	(166.9)	(103.0)	(34.6)
72	(1800)	12	(305)	2.4	1.2	1.1	1.9	2	4632.47	70	26	390.0	290.0	87.0
		14	(356)	(60)	(30)	(28)			(29887)	(5.0)	(660)	(176.9)	(131.5)	(39.4)
78	(1950)	12	(305)	2.3	1.2	1.1	1.8	2	5410.60	85	26	410.0	315.0	103.0
		14	(356)	(57)	(30)	(28)			(34907)	(6.0)	(660)	(186.0)	(142.9)	(46.7)
84	(2100)	12	(305)	2.3	1.2	1.1	1.6	2	6221.13	85	26	440.0	350.0	113.0
		14	(356)	(57)	(30)	(28)			(40136)	(6.0)	(660)	(200.0)	(158.0)	(51.3)
90	(2250)	12	(305)	2.3	1.2	1.1	1.6	2	7088.11	85	26	448.0	363.0	125.0
		14	(356)	(57)	(30)	(28)			(45730)	(6.0)	(660)	(203.1)	(164.6)	(56.7)
96	(2400)	12	(305)	2.3	1.2	1.1	1.4	2	8011.85	85	26	466.0	367.0	125.0
		14	(356)	(57)	(30)	(28)			(51689)	(6.0)	(660)	(211.3)	(170.5)	(56.7)
102	(2550)	12	(305)	2.3	1.2	1.1	1.3	2	8992.02	85	26	485.8	395.0	137.0
		14	(356)	(57)	(30)	(28)			(58013)	(6.0)	(660)	(220.0)	(179.1)	(62.1)
108	(2700)	12	(305)	2.3	1.2	1.1	1.2	2	10028.75	85	26	510.0	425.0	139.0
		14	(356)	(57)	(30)	(28)			(64702)	(6.0)	(660)	(231.3)	(192.7)	(63.0)
120	(3000)	12	(305)	2.3	1.2	1.1	1.1	2	12271.84	85	26	540.0	565.0	151.0
		14	(356)	(57)	(30)	(28)			(79173)	(6.0)	(660)	(244.9)	(256.2)	(65.8)

Neutral lengths in RED are the recommended minimum lengths.

Metric Conversion Formula: Nominal I.D. : in. x 25 = mm; Neutral length: in. x 25.4 = mm

NOTES:

1. *Concurrent Movements - Concurrent movements are developed when two or more movements in a pipe system occur at the same time. If multiple movements exceed single arch design there may be a need for additional arches. To perform calculation for concurrent movement when a pipe system design has more than one movement, please use the following formula:*

$$\frac{\text{Actual Axial Compression}}{\text{Rated Axial Compression}} + \frac{\text{Actual Axial Extension}}{\text{Rated Axial Extension}} + \frac{\text{Actual Lateral (X)}}{\text{Rated Lateral (X)}} + \frac{\text{Actual Lateral (Y)}}{\text{Rated Lateral (Y)}} = / < 1$$

   Calculation must be equal to or less than 1 for expansion joint to operate within concurrent movement capability.

2. *Filled Arch Rubber Expansion Joints - Known as Style FA 231. The Series FA230 rubber expansion joints should be selected when there are 20% or more solids being conveyed in the pipe system. The filled arch products are manufactured with seamless tube filled with a lower durometer rubber in the arch core. The filled arch product will have a 50% reduced movement capability from the information provided in Table 2.*

3. *Pressure rating is based on 170˚ F operating temperature with a 4:1 safety factor. At higher temperatures, the pressure rating is reduced slightly. Hydrostatic testing at 1.5 times rated maximum catalogue pressure or design working pressure of pipe system for 10 minutes is available upon request.*

4. *Weights are approximate and vary due to length.*

5. *The degree of angular movement is based on the maximum rated extension.*

6. *Torsional movement is expressed when the expansion joint is at neutral length.*

7. *Calculation of Thrust (Thrust Factor). When expansion joints are installed in the pipeline, the static portion of the thrust is calculated as a product of the area of the I.D. of the arch of the expansion joint times the maximum pressure (design, test or surge) that will occur in the line. The result is a force expressed in pounds.* ***Take Design, surge or test pressure X thrust factor to calculate end thrust.***

"Effective Area"

Thrust Factor=

$T = \frac{\pi}{4}(D)^2, (P)$

T= Thrust
P= PSI (Design, Test or Surge)
D= Arch I.D.

8. *Parts listed at 26" Hg / 660 mm Hg vacuum have a design rating of 30" Hg / 762 mm Hg (full vacuum). Vacuum rating is based on neutral installed length, without external load. Products should not be installed "extended" on vacuum applications.*

9. *Limit rod unit weight consists of one rod with washers, nuts and two limit rod plates. Multiply number of limit rods needed for the application (as specified in the Fluid Sealing Association's Technical Handbook, Seventh Edition or table 4 in this manual) to determine correct weights.*

10. *Shorter neutral lengths available in style 221 for sizes 10", 12", 24" & 30".*

Style 232 Performance Data

Table 3: Sizes • Movements • Design Pressures • Weights

Expansion Joint Size Nom. I.D. Inch / (mm)		Neutral Length Inch / (mm)		232 Movement Capability: [1, 2] From Neutral Position (Non-Concurrent)					Operating Conditions [3]			Weights lbs / (kgs) [4]		
				Axial Compression Inch / (mm)	Axial Extension Inch / (mm)	Lateral Deflection Inch / (mm)	Angular Deflection [5] (Degrees)	Torsional Rotation [6] (Degrees)	Thrust Factor [7] In2 / (cm2)	Positive PSIG (Bar)	Vacuum Inches of Hg / (mm of Hg)[8]	Expansion Joint	Retaining Ring Set	Control Rod Assembly [9]
1.5	(40)	10	(254)	1.6 (40)	0.8 (20)	0.9 (24)	58.0	2	7.44 (48)	200 (14.0)	26 (660)	3.0 (1.4)	2.5 (1.1)	2.3 (1.0)
2	(50)	10	(254)	2.8 (70)	1.4 (35)	1.2 (32)	58.0	2	12.40 (80)	200 (14.0)	26 (660)	4.0 (1.8)	4.0 (1.8)	2.8 (1.3)
2.5	(65)	10	(254)	2.8 (70)	1.4 (35)	1.2 (32)	47.4	2	15.66 (101)	200 (14.0)	26 (660)	4.5 (2.0)	4.5 (2.0)	2.8 (1.3)
3	(80)	10	(254)	2.8 (70)	1.4 (35)	1.2 (32)	42.2	2	19.36 (125)	200 (14.0)	26 (660)	6.0 (2.7)	5.5 (4.3)	2.8 (1.3)
4	(100)	10	(254)	2.8 (70)	1.4 (35)	1.2 (32)	34.2	2	27.90 (180)	200 (14.0)	26 (660)	8.5 (3.9)	8.0 (3.6)	2.8 (1.3)
5	(125)	10	(254)	3.2 (80)	1.6 (40)	1.4 (36)	28.6	2	38.13 (246)	190 (13.0)	26 (660)	9.5 (4.3)	8.5 (3.9)	4.0 (1.8)
6	(150)	10 12	(254) (305)	3.2 (80)	1.6 (40)	1.4 (36)	24.4	2	49.91 (322)	190 (13.0)	26 (660)	11.5 (5.2)	9.5 (4.3)	4.0 (1.8)
8	(200)	10 12	(254) (305)	3.2 (80)	1.6 (40)	1.4 (36)	18.8	2	77.97 (503)	190 (13.0)	26 (660)	16.0 (7.3)	14.5 (6.6)	8.0 (3.6)
10	(250)	14	(356)	3.2 (80)	1.6 (40)	1.4 (36)	17.8	2	119.97 (774)	190 (13.0)	26 (660)	29.0 (13.2)	17.0 (7.7)	10.0 (4.5)
12	(300)	14	(356)	3.2 (80)	1.6 (40)	1.6 (40)	14.9	2	161.98 (1045)	190 (13.0)	26 (660)	36.0 (16.3)	24.5 (11.0)	10.0 (4.5)
14	(350)	14 16	(356) (406)	3.2 (80)	1.6 (40)	1.6 (40)	12.9	2	210.18 (1356)	130 (9.0)	26 (660)	44.0 (20.0)	27.0 (12.3)	12.0 (5.4)
16	(400)	14 16	(356) (406)	3.2 (80)	1.6 (40)	1.6 (40)	11.3	2	264.74 (1708)	115 (8.0)	26 (660)	53.0 (24.0)	33.5 (15.2)	15.0 (6.8)
18	(450)	14 16	(356) (406)	3.2 (80)	1.6 (40)	1.6 (40)	10.1	2	325.50 (2100)	115 (8.0)	26 (660)	61.0 (27.7)	34.0 (15.5)	16.0 (7.2)
20	(500)	14 16	(356) (406)	3.2 (80)	1.6 (40)	1.6 (40)	9.1	2	392.62 (2533)	115 (8.0)	26 (660)	73.0 (33.1)	38.0 (17.2)	16.0 (7.2)
24	(600)	16	(406)	4.0 (100)	2.0 (50)	1.8 (46)	9.5	2	562.03 (3626)	100 (7.0)	26 (660)	88.0 (40.0)	48.0 (21.8)	20.0 (9.1)
30	(750)	16	(406)	4.0 (102)	2.0 (50)	1.8 (46)	7.6	2	842.27 (5434)	90 (6.0)	26 (660)	127.0 (57.6)	63.0 (28.6)	29.5 (13.3)
34	(850)	16	(406)	4.0 (102)	2.0 (50)	1.8 (46)	6.7	2	1060.51 (6842)	90 (6.0)	26 (660)	134.8 (60.8)	72.0 (32.7)	43.0 (19.5)
36	(900)	16	(406)	4.0 (102)	2.0 (50)	1.8 (46)	6.3	2	1179.09 (7607)	90 (6.0)	26 (660)	156.0 (70.8)	76.0 (34.5)	45.0 (20.4)
42	(1050)	16	(406)	4.8 (120)	2.4 (60)	2.2 (56)	6.5	2	1628.28 (10505)	80 (5.5)	26 (660)	211.0 (95.7)	100.0 (45.4)	47.0 (21.3)
48	(1200)	16	(406)	4.8 (120)	2.4 (60)	2.2 (56)	5.7	2	2085.53 (13455)	80 (5.5)	26 (660)	222.8 (101.0)	132.0 (59.9)	49.0 (22.2)

Neutral lengths in RED are the recommended minimum lengths.
Metric Conversion Formula: Nominal I.D. : in. x 25 = mm; Neutral length: in. x 25.4 = mm

Table 3: Sizes • Movements • Design Pressures • Weights

Expansion Joint Size Nom. I.D. Inch / (mm)		Neutral Length Inch / (mm)		232 Movement Capability: [1, 2] From Neutral Position (Non-Concurrent)					Operating Conditions [3]			Weights lbs / (kgs) [4]		
				Axial Compression Inch / (mm)	Axial Extension Inch / (mm)	Lateral Deflection Inch / (mm)	Angular Deflection [5] (Degrees)	Torsional Rotation [6] (Degrees)	Thrust Factor [7] In2 / (cm2)	Positive PSIG (Bar)	Vacuum Inches of Hg / (mm of Hg) [8]	Expansion Joint	Retaining Ring Set	Control Rod Assembly [9]
54	(1350)	16	(406)	4.8 (120)	2.4 (60)	2.2 (56)	5.0	2	2599.53 (16770)	80 (5.5)	26 (660)	281.5 (127.7)	150.0 (162.7)	67.0 (30.4)
60	(1500)	18	(450)	4.8 (120)	2.4 (60)	2.2 (56)	4.5	2	3208.97 (20703)	80 (5.5)	26 (660)	358.7 (162.7)	200.0 (90.7)	72.0 (32.7)
66	(1650)	18	(450)	4.8 (120)	2.4 (60)	2.2 (56)	4.1	2	3839.51 (24771)	80 (5.5)	26 (660)	419.0 (190.1)	240.0 (108.8)	75.0 (34.0)
72	(1800)	18	(450)	4.8 (120)	2.4 (60)	2.2 (56)	3.8	2	4526.62 (29244)	70 (5.0)	26 (660)	478.8 (217.2)	290.0 (131.5)	94.0 (42.6)
78	(1950)	18	(450)	4.5 (112)	2.5 (64)	2.0 (51)	5.2	2	5410.60 (34907)	85 (6.0)	26 (660)	754.0 (342.0)	315.0 (142.9)	111.0 (50.3)
84	(2100)	18	(450)	4.5 (112)	2.5 (64)	2.0 (51)	4.6	2	6221.13 (40136)	85 (6.0)	26 (660)	819.0 (371.5)	350.0 (158.0)	121.0 (54.9)
96	(2400)	18	(450)	4.5 (112)	2.5 (64)	2.0 (51)	4.0	2	8011.85 (51689)	85 (6.0)	26 (660)	1300.0 (589.7)	367.0 (170.5)	134.0 (60.8)
108	(2700)	18	(450)	4.5 (112)	2.5 (64)	2.0 (51)	3.4	2	10029.75 (64702)	85 (6.0)	26 (660)	1462.0 (663.2)	425.0 (192.7)	153.0 (69.4)
120	(3000)	18	(450)	4.5 (112)	2.5 (64)	2.0 (51)	3.0	2	12271.84 (79173)	85 (6.0)	26 (660)	1820.0 (825.5)	565.0 (256.2)	167.0 (75.7)

NOTES:

1. *Concurrent Movements - Concurrent movements are developed when two or more movements in a pipe system occur at the same time. If multiple movements exceed single arch design there may be a need for additional arches. To perform calculation for concurrent movement when a pipe system design has more than one movement, please use the following formula:*

$$\frac{\text{Actual Axial Compression}}{\text{Rated Axial Compression}} + \frac{\text{Actual Axial Extension}}{\text{Rated Axial Extension}} + \frac{\text{Actual Lateral (X)}}{\text{Rated Lateral (X)}} + \frac{\text{Actual Lateral (Y)}}{\text{Rated Lateral (Y)}} = / < 1$$

Calculation must be equal to or less than 1 for expansion joint to operate within concurrent movement capability.

2. *Filled Arch Rubber Expansion Joints - Known as Style FA 232. The Series FA230 rubber expansion joints should be selected when there are 20% or more solids being conveyed in the pipe system. The filled arch products are manufactured with seamless tube filled with a lower durometer rubber in the arch core. The filled arch product will have a 50% reduced movement capability from the information provided in Table 3.*

3. *Pressure rating is based on 170° F operating temperature with a 4:1 safety factor. At higher temperatures, the pressure rating is reduced slightly. Hydrostatic testing at 1.5 times rated maximum catalogue pressure or design working pressure of pipe system for 10 minutes is available upon request.*

4. *Weights are approximate and vary due to length.*

5. *The degree of angular movement is based on the maximum rated extension.*

6. *Torsional movement is expressed when the expansion joint is at neutral length.*

7. *Calculation of Thrust (Thrust Factor). When expansion joints are installed in the pipeline, the static portion of the thrust is calculated as a product of the area of the I.D. of the arch of the expansion joint times the maximum pressure (design, test or surge) that will occur in the line. The result is a force expressed in pounds.*
Take Design, surge or test pressure X thrust factor to calculate end thrust.

"Effective Area"
Thrust Factor=

$$T = \frac{\pi}{4}(D)^2, (P)$$

T= Thrust
P= PSI (Design, Test or Surge)
D= Arch I.D.

8. *Parts listed at 26" Hg / 660 mm Hg vacuum have a design rating of 30" Hg / 762 mm Hg (full vacuum). Vacuum rating is based on neutral installed length, without external load. Products should not be installed "extended" on vacuum applications.*

9. *Limit rod unit weight consists of one rod with washers, nuts and two limit rod plates. Multiply number of limit rods needed for the application (as specified in the Fluid Sealing Association's Technical Handbook, Seventh Edition or table 4 in this manual) to determine correct weights.*

Style 233 Performance Data

Table 4: Sizes • Movements • Design Pressures • Weights

Expansion Joint Size Nom. I.D. Inch / (mm)		Neutral Length Inch / (mm)		233 Movement Capability: [1, 2] From Neutral Position (Non-Concurrent)					Operating Conditions [3]			Weights lbs / (kgs) [4]		
				Axial Compression Inch / (mm)	Axial Extension Inch / (mm)	Lateral Deflection Inch / (mm)	Angular Deflection [5] (Degrees)	Torsional Rotation [6] (Degrees)	Thrust Factor [7] In2 / (cm2)	Positive PSIG (Bar)	Vacuum Inches of Hg / (mm of Hg)[8]	Expansion Joint	Retaining Ring Set	Control Rod Assembly [9]
1.5	(40)	14	(356)	2.4 (60)	1.2 (30)	1.4 (36)	67.4	2	7.44 (48)	200 (14.0)	26 (660)	4.0 (1.8)	2.5 (1.1)	6.0 (2.7)
2	(50)	14	(356)	4.1 (105)	2.0 (52)	1.9 (48)	63.9	2	12.40 (80)	200 (14.0)	26 (660)	5.5 (2.5)	4.0 (1.8)	7.0 (3.2)
2.5	(65)	14	(356)	4.1 (105)	2.0 (52)	1.9 (48)	58.5	2	15.66 (101)	200 (14.0)	26 (660)	6.0 (2.7)	4.5 (2.0)	7.0 (3.2)
3	(80)	14	(356)	4.1 (105)	2.0 (52)	1.9 (48)	53.4	2	19.38 (125)	200 (14.0)	26 (660)	7.0 (3.2)	5.5 (4.3)	7.3 (3.4)
4	(100)	14	(356)	4.1 (105)	2.0 (52)	1.9 (48)	45.6	2	27.90 (180)	200 (14.0)	26 (660)	9.0 (4.1)	8.0 (3.6)	8.0 (3.6)
5	(125)	14	(356)	4.7 (120)	2.4 (60)	2.1 (54)	39.2	2	38.13 (246)	190 (13.0)	26 (660)	11.0 (5.0)	8.5 (3.9)	8.0 (3.6)
6	(150)	14 16	(356) (406)	4.7 (120)	2.4 (60)	2.1 (54)	34.2	2	49.91 (322)	190 (13.0)	26 (660)	13.5 (6.1)	9.5 (4.3)	12.0 (5.4)
8	(200)	14 16	(356) (406)	4.7 (120)	2.4 (60)	2.1 (54)	27.0	2	77.97 (503)	190 (13.0)	26 (660)	18.0 (8.2)	14.5 (6.6)	12.0 (5.4)
10	(250)	18	(457)	4.7 (120)	2.4 (60)	2.1 (54)	25.6	2	119.97 (774)	190 (13.0)	26 (660)	31.0 (14.1)	17.0 (7.7)	16.0 (7.2)
12	(300)	18	(457)	4.7 (120)	2.4 (60)	2.4 (60)	25.6	2	161.98 (1045)	190 (13.0)	26 (660)	40.0 (18.1)	24.5 (11.0)	16.0 (7.2)
14	(350)	18 20	(457) (508)	4.7 (120)	2.4 (60)	2.4 (60)	18.9	2	210.18 (1356)	130 (9.0)	26 (660)	48.5 (22.0)	27.0 (12.3)	16.0 (7.2)
16	(400)	18 20	(457) (508)	4.7 (120)	2.4 (60)	2.4 (60)	16.7	2	264.74 (1708)	115 (8.0)	26 (660)	55.0 (24.0)	33.5 (15.2)	20.0 (9.1)
18	(450)	18 20	(457) (508)	4.7 (120)	2.4 (60)	2.4 (60)	14.9	2	325.50 (2100)	115 (8.0)	26 (660)	66.0 (27.7)	34.0 (15.5)	21.0 (9.5)
20	(500)	18 20	(457) (508)	4.7 (120)	2.4 (60)	2.4 (60)	13.5	2	392.62 (2533)	115 (8.0)	26 (660)	78.0 (35.4)	38.0 (17.2)	21.0 (9.5)
24	(600)	20	(508)	6.0 (150)	3.0 (75)	2.7 (69)	14.0	2	562.03 (3626)	100 (7.0)	26 (660)	91.5 (41.5)	48.0 (21.8)	32.0 (14.5)
30	(750)	20	(508)	6.0 (150)	3.0 (75)	2.7 (69)	11.3	2	842.27 (5434)	90 (6.0)	26 (660)	131.0 (59.4)	63.0 (28.6)	32.0 (14.5)
36	(900)	20	(508)	6.0 (150)	3.0 (75)	2.7 (69)	9.5	2	1179.09 (7607)	90 (6.0)	26 (660)	157.0 (71.2)	76.0 (34.5)	43.0 (19.5)
42	(1050)	22	(559)	7.2 (180)	3.6 (90)	3.3 (84)	6.5	2	1628.28 (10505)	80 (5.5)	26 (660)	242.0 (109.8)	100.0 (45.4)	50.0 (22.7)
48	(1200)	22	(559)	7.2 (180)	3.6 (90)	3.3 (84)	5.7	2	2085.53 (13455)	80 (5.5)	26 (660)	257.0 (116.6)	132.0 (59.9)	52.0 (23.6)

Neutral lengths in RED are the recommended minimum lengths.

Metric Conversion Formula: Nominal I.D. : in. x 25 = mm; Neutral length: in. x 25.4 = mm

Table 4: Sizes • Movements • Design Pressures • Weights

Expansion Joint Size Nom. I.D. Inch / (mm)		Neutral Length Inch / (mm)		233 Movement Capability: [1, 2] From Neutral Position (Non-Concurrent)					Operating Conditions [3]			Weights lbs / (kgs) [4]		
				Axial Compression Inch / (mm)	Axial Extension Inch / (mm)	Lateral Deflection Inch / (mm)	Angular Deflection [5] (Degrees)	Torsional Rotation [6] (Degrees)	Thrust Factor [7] In2 / (cm2)	Positive PSIG (Bar)	Vacuum Inches of Hg / (mm of Hg)[8]	Expansion Joint	Retaining Ring Set	Control Rod Assembly [9]
54	(1350)	22	(559)	7.2 (180)	3.6 (90)	3.3 (84)	5.0	2	2599.53 (16770)	80 (5.5)	26 (660)	325.0 (147.4)	150.0 (162.7)	70.0 (31.8)
60	(1500)	24	(610)	7.2 (180)	3.6 (90)	3.3 (84)	4.5	2	3208.97 (20703)	80 (5.5)	26 (660)	413.0 (187.3)	200.0 (90.7)	76.0 (34.5)
66	(1650)	24	(610)	7.2 (180)	3.6 (90)	3.3 (84)	4.1	2	3839.51 (24771)	80 (5.5)	26 (660)	482.0 (218.6)	240.0 (108.8)	79.0 (35.8)
72	(1800)	24	(610)	7.2 (180)	3.6 (90)	3.3 (84)	3.8	2	4526.62 (29244)	70 (5.0)	26 (660)	551.0 (249.9)	290.0 (131.5)	100.0 (45.4)
78	(1950)	24	(610)	6.75 (169)	3.75 (94)	3.0 (75)	5.2	2	5410.60 (34907)	85 (6.0)	26 (660)	868.0 (393.7)	315.0 (142.9)	118.0 (53.5)
84	(2100)	24	(610)	6.75 (169)	3.75 (94)	3.0 (75)	4.6	2	6221.13 (40136)	85 (6.0)	26 (660)	942.0 (427.3)	350.0 (158.0)	130.0 (59.0)
96	(2400)	24	(610)	6.75 (169)	3.75 (94)	3.0 (75)	4.0	2	8011.85 (51689)	85 (6.0)	26 (660)	1495.0 (678.1)	367.0 (170.5)	144.0 (65.3)
108	(2700)	24	(610)	6.75 (169)	3.75 (94)	3.0 (75)	3.4	2	10029.75 (64702)	85 (6.0)	26 (660)	1682.0 (762.9)	425.0 (192.7)	169.0 (76.7)
120	(3000)	24	(610)	6.75 (169)	3.75 (94)	3.0 (75)	3.0	2	12271.84 (79173)	85 (6.0)	26 (660)	2093.0 (949.4)	565.0 (256.2)	183.0 (83.0)

NOTES:

1. *Concurrent Movements - Concurrent movements are developed when two or more movements in a pipe system occur at the same time. If multiple movements exceed single arch design there may be a need for additional arches. To perform calculation for concurrent movement when a pipe system design has more than one movement, please use the following formula:*

$$\frac{\text{Actual Axial Compression}}{\text{Rated Axial Compression}} + \frac{\text{Actual Axial Extension}}{\text{Rated Axial Extension}} + \frac{\text{Actual Lateral (X)}}{\text{Rated Lateral (X)}} + \frac{\text{Actual Lateral (Y)}}{\text{Rated Lateral (Y)}} = / < 1$$

Calculation must be equal to or less than 1 for expansion joint to operate within concurrent movement capability.

2. *Filled Arch Rubber Expansion Joints - Known as Style FA 233. The Series FA230 rubber expansion joints should be selected when there are 20% or more solids being conveyed in the pipe system. The filled arch products are manufactured with seamless tube filled with a lower durometer rubber in the arch core. The filled arch product will have a 50% reduced movement capability from the information provided in Table 4.*

3. *Pressure rating is based on 170˚ F operating temperature with a 4:1 safety factor. At higher temperatures, the pressure rating is reduced slightly. Hydrostatic testing at 1.5 times rated maximum catalogue pressure or design working pressure of pipe system for 10 minutes is available upon request.*

4. *Weights are approximate and vary due to length.*

5. *The degree of angular movement is based on the maximum rated extension.*

6. *Torsional movement is expressed when the expansion joint is at neutral length.*

7. *Calculation of Thrust (Thrust Factor). When expansion joints are installed in the pipeline, the static portion of the thrust is calculated as a product of the area of the I.D. of the arch of the expansion joint times the maximum pressure (design, test or surge) that will occur in the line. The result is a force expressed in pounds.* ***Take Design, surge or test pressure X thrust factor to calculate end thrust.***

"Effective Area"

Thrust Factor=

$$T = \frac{\pi}{4}(D)^2, (P)$$

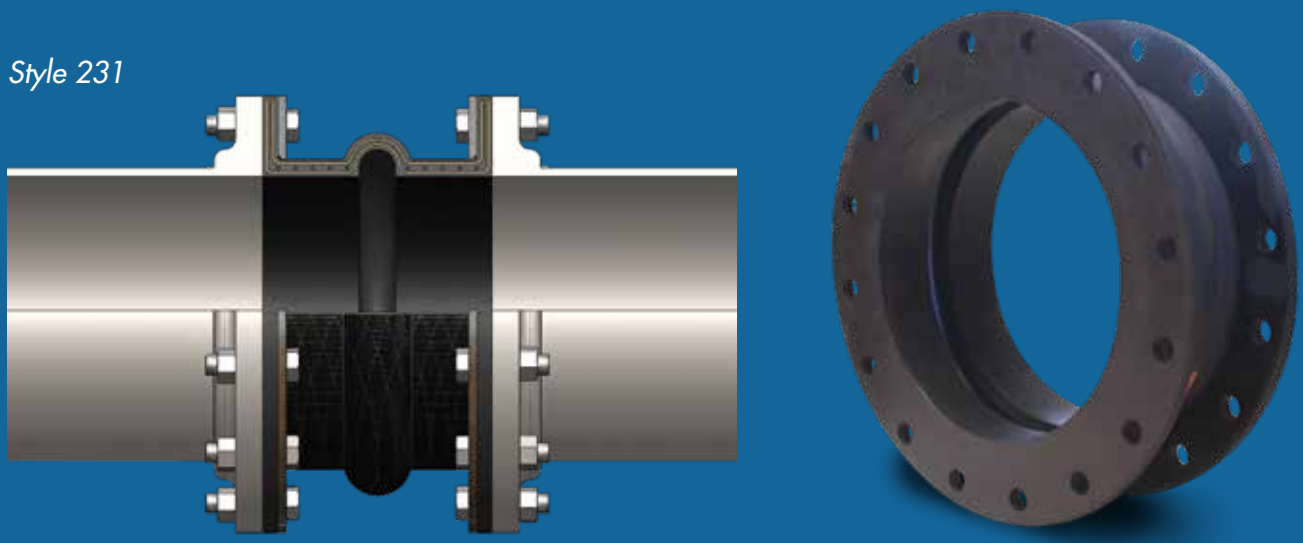
T= Thrust
P= PSI (Design, Test or Surge)
D= Arch I.D.

8. *Parts listed at 26" Hg / 660 mm Hg vacuum have a design rating of 30" Hg / 762 mm Hg (full vacuum). Vacuum rating is based on neutral installed length, without external load. Products should not be installed "extended" on vacuum applications.*

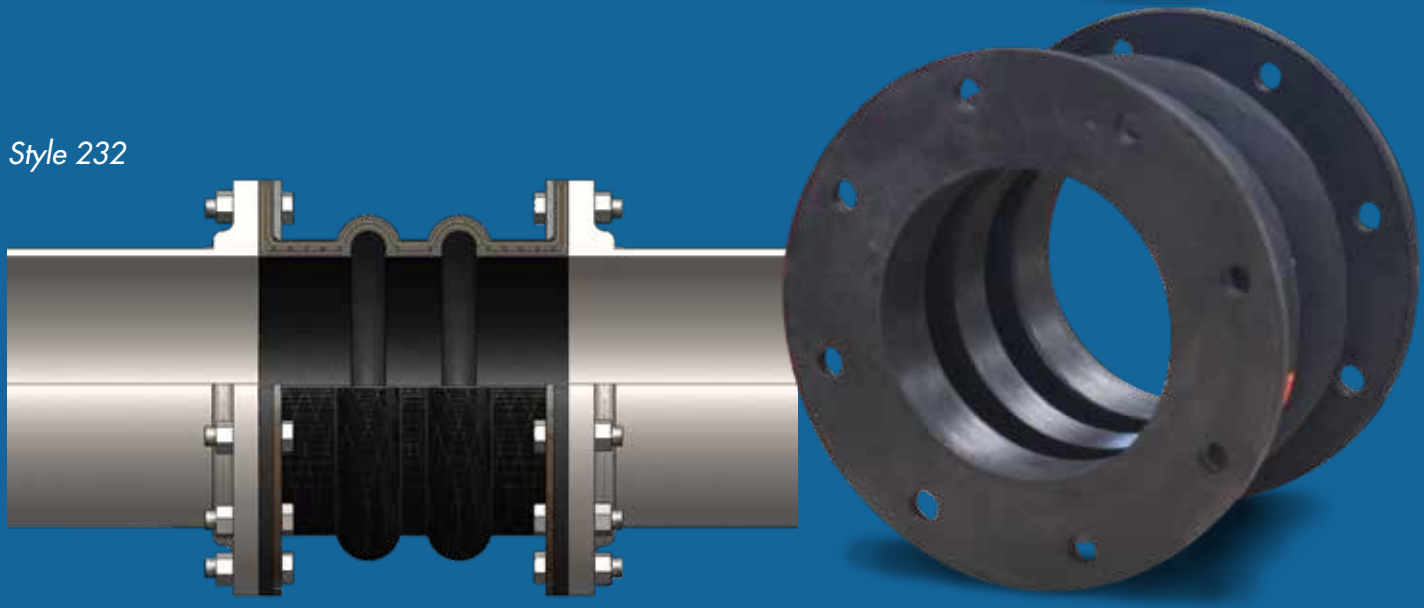
9. *Limit rod unit weight consists of one rod with washers, nuts and two limit rod plates. Multiply number of limit rods needed for the application (as specified in the Fluid Sealing Association's Technical Handbook, Seventh Edition or table 4 in this manual) to determine correct weights.*

Series 230

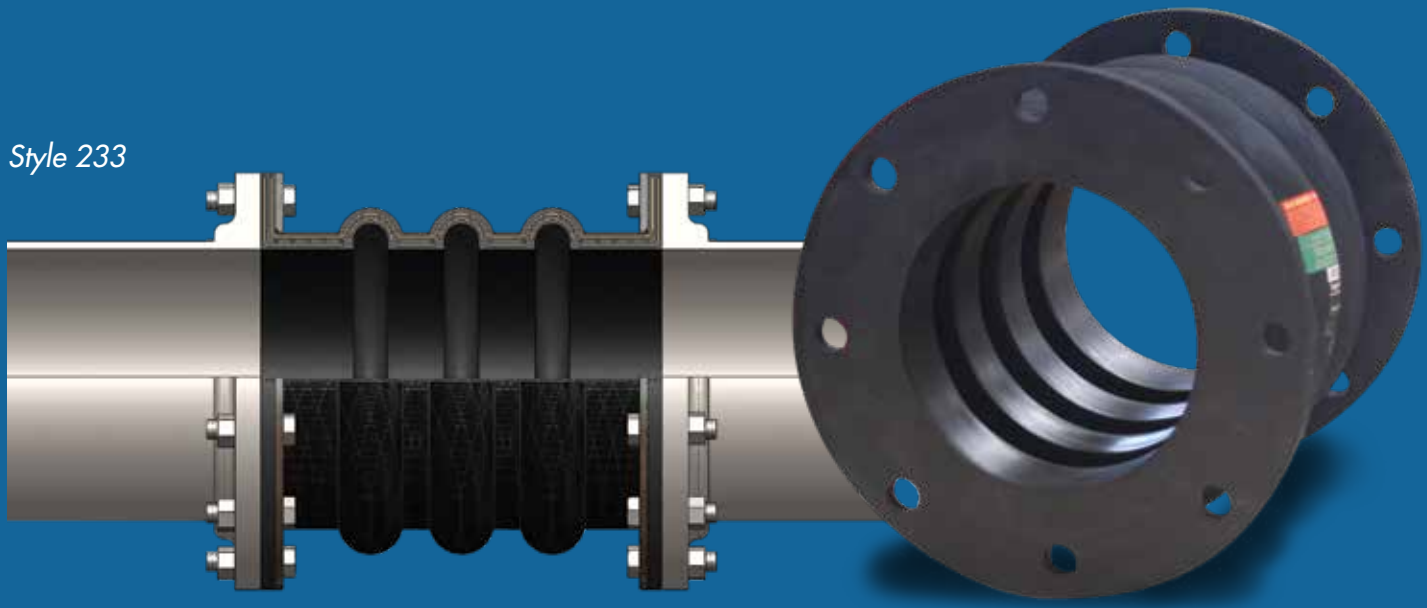
Style 231



Style 232

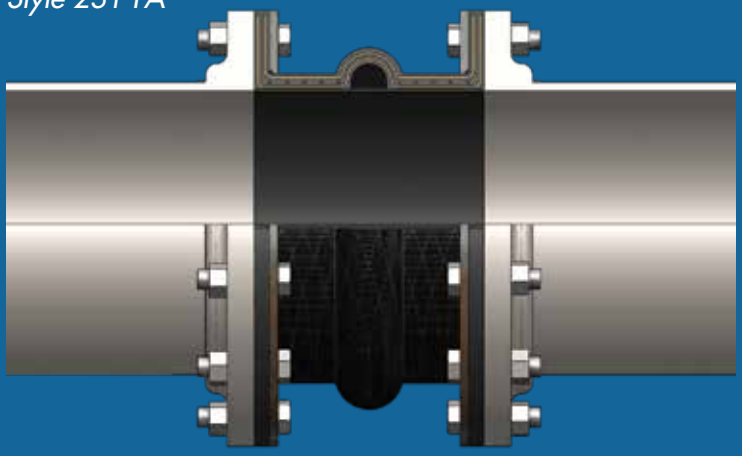


Style 233



Series 230 FA

Style 231 FA



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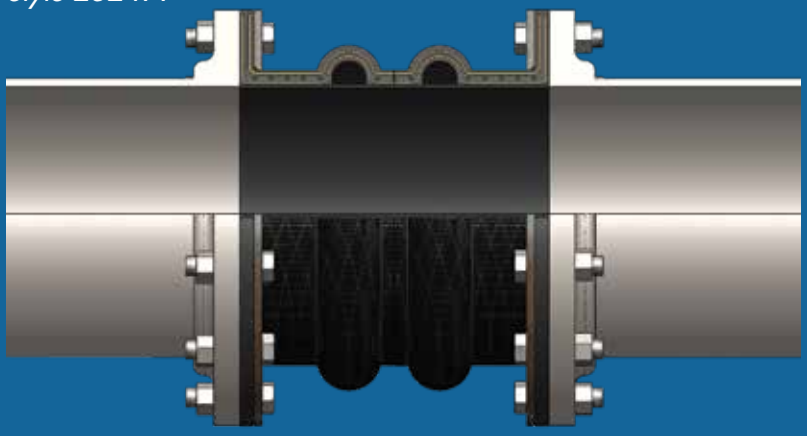
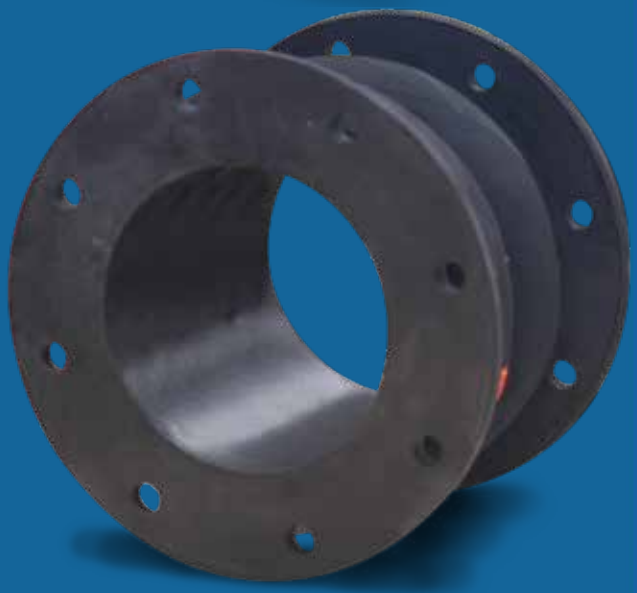
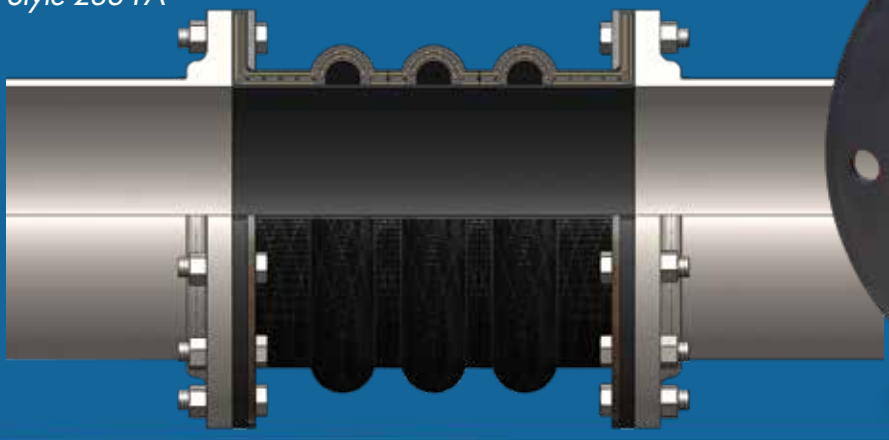




Style 233 FA



Style 230 Drilling Chart

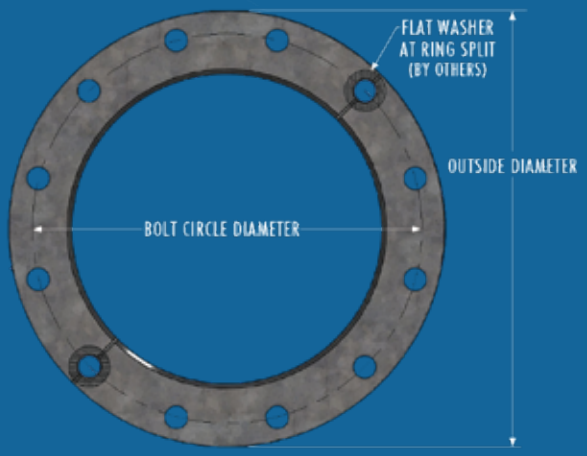
Table 5		Standard Drilling for PROCO Rubber Expansion Joints							Thickness of Materials for PROCO Rubber Expansion Joints						Control Unit Plate Detail			
Nominal Pipe Size Expansion Joint I.D. Inch /(mm)		Flange Dimensions [2]							Material Thickness [1] for Bolt Length Requirements									
		Flange O.D. Inch / (mm)		Bolt Circle Inch / (mm)		Number Of Holes	Size Of Holes Inch / (mm)		Retaining Rings Thickness Inch / (mm)		Rubber Flange Thickness Inch / (mm)		Adjacent [3] Mating Flange Thickness	Max. Control [4] Rod Plate Thickness Inch / (mm)		Control Rod [6] Plate O.D. Inch / (mm)		Maximum [7] Rod Diameter Inch / (mm)	
1	(25)	4.25	(107.95)	3.13	(79.50)	4	0.625	(15.9)	0.375	(9.53)	0.472	(11.99)	CUSTOMER TO SPECIFY MATING FLANGE THICKNESS	0.625	(15.9)	8.375	(212.7)	0.625	(15.9)
1.25	(32)	4.63	(117.60)	3.50	(88.90)	4	0.625	(15.9)	0.375	(9.53)	0.472	(11.99)		0.625	(15.9)	8.750	(222.3)	0.625	(15.9)
1.5	(40)	5.00	(127.00)	3.88	(98.55)	4	0.625	(15.9)	0.375	(9.53)	0.472	(11.99)		0.375	(9.5)	9.125	(231.8)	0.625	(15.9)
2	(50)	6.00	(152.40)	4.75	(120.65)	4	0.750	(19.1)	0.375	(9.53)	0.472	(11.99)		0.500	(12.7)	10.125	(257.2)	0.625	(15.9)
2.5	(65)	7.00	(177.80)	5.50	(139.70)	4	0.750	(19.1)	0.375	(9.53)	0.472	(11.99)		0.500	(12.7)	11.125	(282.6)	1.000	(25.4)
3	(80)	7.50	(190.50)	6.00	(152.40)	4	0.750	(19.1)	0.375	(9.53)	0.472	(11.99)		0.500	(12.7)	11.625	(295.3)	1.000	(25.4)
3.5	(90)	8.50	(215.90)	7.00	(177.80)	8	0.750	(19.1)	0.375	(9.53)	0.472	(11.99)		0.625	(15.9)	12.625	(320.7)	1.000	(25.4)
4	(100)	9.00	(228.60)	7.50	(190.50)	8	0.750	(19.1)	0.375	(9.53)	0.472	(11.99)		0.625	(15.9)	13.125	(333.4)	1.000	(25.4)
5	(125)	10.00	(254.00)	8.50	(215.90)	8	0.875	(22.2)	0.375	(9.53)	0.551	(14.00)		0.625	(15.9)	14.125	(358.8)	1.000	(25.4)
6	(150)	11.00	(279.40)	9.50	(241.30)	8	0.875	(22.2)	0.375	(9.53)	0.551	(14.00)		0.500	(12.7)	15.125	(384.2)	1.000	(25.4)
8	(200)	13.50	(342.90)	11.75	(298.45)	8	0.875	(22.2)	0.375	(9.53)	0.630	(16.00)		0.750	(19.1)	19.125	(485.8)	1.000	(25.4)
10	(250)	16.00	(406.40)	14.25	(361.95)	12	1.000	(25.4)	0.375	(9.53)	0.630	(16.00)		0.750	(19.1)	21.625	(549.3)	1.000	(25.4)
12	(300)	19.00	(482.60)	17.00	(431.80)	12	1.000	(25.4)	0.375	(9.53)	0.748	(19.00)		0.750	(19.1)	24.625	(625.5)	1.000	(25.4)
14	(350)	21.00	(533.40)	18.75	(476.25)	12	1.125	(28.6)	0.375	(9.53)	0.866	(22.00)		0.750	(19.1)	26.625	(676.3)	1.000	(25.4)
16	(400)	23.50	(596.90)	21.25	(539.75)	16	1.125	(28.6)	0.375	(9.53)	0.866	(22.00)		0.750	(19.1)	30.125	(765.2)	1.250	(31.8)
18	(450)	25.00	(635.00)	22.75	(577.85)	16	1.250	(31.8)	0.375	(9.53)	0.866	(22.00)		0.750	(19.1)	31.625	(803.3)	1.250	(31.8)
20	(500)	27.50	(698.50)	25.00	(635.00)	20	1.250	(31.8)	0.375	(9.53)	0.984	(24.99)		0.750	(19.1)	34.125	(866.8)	1.250	(31.8)
22	(550)	29.50	(749.30)	27.25	(692.15)	20	1.375	(34.9)	0.375	(9.53)	0.984	(24.99)		1.000	(25.4)	36.125	(917.6)	1.250	(31.8)
24	(600)	32.00	(812.80)	29.50	(749.30)	20	1.375	(34.9)	0.375	(9.53)	0.984	(24.99)		1.000	(25.4)	38.625	(981.1)	1.250	(31.8)
26	(650)	34.25	(869.95)	31.75	(806.32)	24	1.375	(34.9)	0.375	(9.53)	0.984	(24.99)		1.000	(25.4)	40.875	(1038.2)	1.250	(31.8)
28	(700)	36.50	(927.10)	34.00	(863.60)	28	1.375	(34.9)	0.375	(9.53)	0.984	(24.99)		1.250	(31.8)	44.125	(1120.8)	1.500	(38.1)
30	(750)	38.75	(984.25)	36.00	(914.40)	28	1.375	(34.9)	0.375	(9.53)	0.984	(24.99)		1.250	(31.8)	46.375	(1177.9)	1.500	(38.1)
32	(800)	41.75	(1060.45)	38.50	(977.90)	28	1.625	(41.3)	0.375	(9.53)	0.984	(24.99)		1.250	(31.8)	49.375	(1254.1)	1.500	(38.1)
34	(850)	43.75	(1111.25)	40.50	(1028.70)	32	1.625	(41.3)	0.375	(9.53)	0.984	(24.99)		1.500	(38.1)	52.375	(1330.3)	1.750	(44.5)
36	(900)	46.00	(1168.40)	42.75	(1085.85)	32	1.625	(41.3)	0.375	(9.53)	0.984	(24.99)		1.500	(38.1)	54.625	(1387.5)	1.750	(44.5)
38	(950)	48.75	(1238.25)	45.25	(1149.35)	32	1.625	(41.3)	0.375	(9.53)	0.984	(24.99)		1.500	(38.1)	57.375	(1457.3)	1.750	(44.5)
40	(1000)	50.75	(1289.05)	47.25	(1200.15)	36	1.625	(41.3)	0.375	(9.53)	0.984	(24.99)		1.500	(38.1)	58.375	(1482.7)	1.750	(44.5)
42	(1050)	53.00	(1346.20)	49.50	(1257.30)	36	1.625	(41.3)	0.375	(9.53)	1.181	(30.00)		1.500	(38.1)	61.625	(1565.3)	1.750	(44.5)
44	(1100)	55.25	(1403.35)	51.75	(1314.45)	40	1.625	(41.3)	0.375	(9.53)	1.181	(30.00)		1.500	(38.1)	63.875	(1622.4)	1.750	(44.5)
46	(1150)	57.25	(1454.15)	53.75	(1365.25)	40	1.625	(41.3)	0.375	(9.53)	1.181	(30.00)		1.500	(38.1)	65.875	(1673.2)	1.750	(44.5)
48	(1200)	59.50	(1511.30)	56.00	(1422.40)	44	1.625	(41.3)	0.375	(9.53)	1.181	(30.00)		1.500	(38.1)	68.125	(1730.4)	1.750	(44.5)
50	(1250)	61.75	(1568.45)	58.25	(1479.55)	44	1.875	(47.6)	0.375	(9.53)	1.181	(30.00)		1.500	(38.1)	70.375	(1787.5)	1.750	(44.5)
52	(1300)	64.00	(1625.60)	60.50	(1536.70)	44	1.875	(47.6)	0.375	(9.53)	1.181	(30.00)		1.750	(44.5)	73.625	(1870.7)	2.000	(50.8)
54	(1350)	66.25	(1682.75)	62.75	(1593.85)	44	2.000	(50.8)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	75.875	(1927.2)	2.000	(50.8)
56	(1400)	68.75	(1746.25)	65.00	(1651.00)	48	1.875	(47.6)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	78.375	(1990.7)	2.000	(50.8)
58	(1450)	71.00	(1803.40)	67.25	(1708.15)	48	1.875	(47.6)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	80.625	(2047.9)	2.000	(50.8)
60	(1500)	73.00	(1854.20)	69.25	(1758.95)	52	2.000	(50.8)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	82.625	(2098.7)	2.000	(50.8)
66	(1650)	80.00	(2032.00)	76.00	(1930.40)	52	2.000	(50.8)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	89.625	(2276.5)	2.000	(50.8)
68	(1700)	82.25	(2089.15)	78.25	(1987.55)	56	2.000	(50.8)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	91.875	(2333.6)	2.000	(50.8)
72	(1800)	86.50	(2197.10)	82.50	(2095.50)	60	2.000	(50.8)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	96.125	(2441.6)	2.000	(50.8)
78	(1950)	93.00	(2362.20)	89.00	(2260.60)	64	2.125	(53.0)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	103.125	(2619.4)	2.250	(57.2)
84	(2100)	99.75	(2533.65)	95.50	(2425.70)	64	2.250	(57.2)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	109.875	(2790.8)	2.250	(57.2)
90	(2250)	106.50	(2705.10)	102.00	(2590.80)	68	2.375	(60.3)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	117.125	(2975.0)	2.500	(63.5)
96	(2400)	113.25	(2876.55)	108.50	(2755.90)	68	2.500	(63.5)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	124.625	(3165.9)	2.750	(69.9)

Table 5	Standard Drilling for PROCO Rubber Expansion Joints							Thickness of Materials for PROCO Rubber Expansion Joints						Control Unit Plate Detail			
Nominal Pipe Size Expansion Joint I.D. Inch /(mm)		Flange Dimensions [2]						Material Thickness [1] for Bolt Length Requirements									
		Flange O.D. Inch / (mm)		Bolt Circle Inch / (mm)		Number Of Holes	Size Of Holes Inch / (mm)		Retaining Rings Thickness Inch / (mm)		Rubber Flange Thickness Inch / (mm)		Adjacent [3] Mating Flange Thickness	Max. Control [4] Rod Plate Thickness Inch / (mm)		Control Rod [6] Plate O.D. Inch / (mm)		Maximum [7] Rod Diameter Inch / (mm)	
102	(2550)	120.00	(3048.00)	114.50	(2908.30)	72	2.625	(66.7)	0.375	(9.53)	1.181	(30.00)	Customer to Specify Mating Flange Thickness	2.000	(50.8)	131.375	(3336.5)	2.750	(69.9)
108	(2700)	126.75	(3219.45)	120.75	(3067.05)	72	2.625	(66.7)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	138.125	(3508.4)	2.750	(69.9)
120	(3000)	140.25	(3562.35)	132.75	(3371.85)	76	2.875	(73.0)	0.375	(9.53)	1.181	(30.00)		2.000	(50.8)	152.125	(3864.0)	3.000	(76.2)

Metric Conversion Formula: Nominal I.D. : in. x 25 = mm; Neutral length: in. x 25.4 = mm

Notes:

1. *Limit/Control Rod length is determined by neutral length of rubber expansion joint, rated extension, control rod plate thickness, mating flange thickness and number of nuts. Consult PROCO for rod lengths.*
2. *Flange Dimensions shown are in accordance with ANSI B16.1 and ANSI B16.5 Class 125/150, AWWA C-207-07, Tbl 2 and 3 - Class D, Table 4 - Class E. Hole size shown is 1/8" larger than AWWA Standard.*
3. *Adjacent mating flange thickness is required to determine overall rod length and compression sleeve length (if required).*
4. *Plate thickness is based on a maximum width PROCO would use to design a Limit/Control Rod plate.*
5. *Flat Washers required at ring splits and are by others.*
6. *Control rod plate O.D. installed dimension is based on a maximum O.D. Proco would supply.*
7. *Control rod diameter is based on a maximum diameter Proco would use to design a control rod.*
8. *Additional flange drilling such as 300 LB., PN10, PN16 and other special drilling's are available upon request.*



A - Retaining Ring Thickness.
B - Rubber Flange Thickness.
C - Adjacent Mating Flange Thickness (By Others).
D - Control Unit Plate Thickness.
E - Double Nut Thickness is determined by Control Rod Diameter.
F - Control Rod Bolt Length is determined by A through E + OAL [1].
G - Control Rod Control Rod Plate O.D.
H - Maximum Rod Diameter

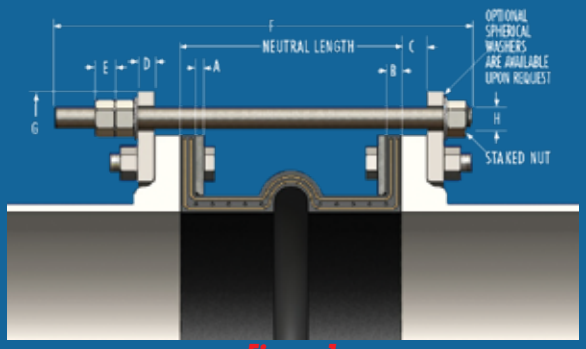


Figure 1

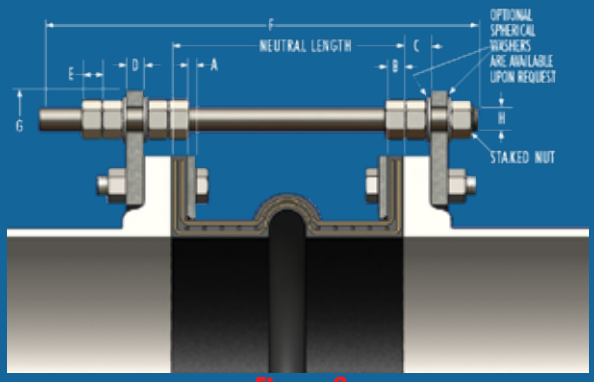


Figure 2

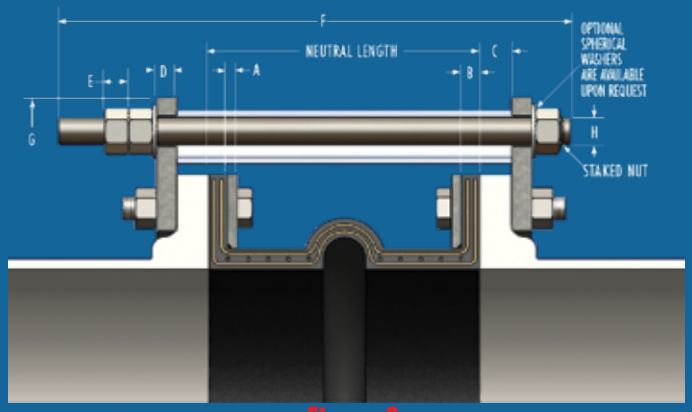


Figure 3

Limit Rods, Control Rods & Compression Sleeves

Use of Control Units with Rubber Expansion Joints

Definition

A control unit assembly is a system of two or more control rod units (limit rods, tie rods or compression sleeves) placed across an expansion joint from flange to flange to minimize possible damage caused by excessive motion of a pipeline. The control unit assemblies can be set at the maximum allowable expansion and/or contraction of the rubber expansion joint. When used in this manner, control units are an additional safety factor and can minimize possible damage to adjacent equipment.

Rubber expansion joints should be installed between two fixed anchor points in a piping system. The pipe system must be rigidly anchored on both sides of the expansion joint to control expansion or contraction of the line. Piping anchors must be capable of withstanding the line thrusts generated by internal pressure or wide temperature fluctuations.

When proper anchoring cannot be provided, **CONTROL UNITS ARE REQUIRED.** For un-anchored piping systems nuts shall be tightened snug against rod plate to prevent over extension due to pressure thrust created by expansion joint. Refer to "Thrust Factor in Table 2, note 5 in this manual.

Listed below are three (3) control unit configurations supplied by PROCO and are commonly used with rubber expansion joints in piping systems.

Figure 1

Known as a **LIMIT ROD**, this control unit configuration will allow an expansion joint to extend to a predetermined extension setting. Nuts shall be field set to no more than the maximum allowable extension movement of a rubber expansion joint (unless used in an un-anchored system). Refer to Table 2 in this manual for allowable movement capabilities. Spherical washers can also be furnished (upon request) to combat any "nut to plate" binding during offset. ***Consult the systems engineer for proper nut settings prior to system operation.***

Figure 2

Known as a **LIMIT/CONTROL ROD**, this control unit configuration is used to allow specified pipe expansion (expansion joint axial compression) and pipe contraction (expansion joint axial extension) movements. Nuts shall be field set to no more than the maximum allowable extension (unless used in an un-anchored pipe system) or compression of a rubber expansion joint. Refer to Table 2 in this manual for allowable movement capabilities. Internal and external nuts can also be field set to allow for no movement in the horizontal plane. This setting will allow the rubber to move laterally while keeping expansion joint thrust forces low on adjacent equipment. Spherical washers can also be furnished (upon request) to combat any potential "nut to plate" binding during offset. ***Limit/Control rods with internal nuts must be specified at the time of inquiry. Consult the systems engineer for proper nut settings prior to system operation.***

Figure 3

Known as a **COMPRESSION SLEEVE**, this configuration is used to allow for specified pipe expansion (expansion joint axial compression) and pipe contraction (expansion joint extension) movements. Nuts shall be field set to no more than the maximum allowable extension (unless used in an un-anchored pipe system) of a rubber expansion joint. Refer to Table 2 in this manual for allowable movement capabilities. PROCO will supply each compression sleeve to allow for no axial movement unless otherwise specified by the purchaser. Compression sleeves shall be field trimmed to meet required allowable axial movement as set forth by system requirements. Spherical washers can also be furnished (upon request) to combat any potential "nut to plate" binding during offset. ***Consult the systems engineer for proper sleeve lengths prior to system operation.***

Important Control Unit Considerations

The number of rods, control rod diameters and control rod plate thicknesses are important considerations when specifying control units for an application. As a minimum, specifying engineers or purchasers shall follow the guidelines as set forth in Appendix C of the Fluid Sealing Association's Technical Handbook, Seventh Edition. PROCO engineers its control unit assemblies to system requirements. Our designs incorporate an allowable stress of 65% of material yield for each rod and plate (rod and plate material to be specified by purchaser). Therefore, it is important to provide pressure and temperature ratings to PROCO when requesting control units for rubber expansion joints. It is also important to provide adjacent mating flange thickness or mating specifications to ensure correct rod lengths are provided.

Installation Instructions for Control Rods

1. Assemble expansion joint between pipe flanges in its manufactured face-to-face length. Install the retaining rings furnished with the expansion joint.

2. Assemble control rod plates behind pipe flanges as shown. Flange bolts or all thread studs through the control rod plate must be longer to accommodate the plate thickness. Control rod plates should be equally spaced around the flange. Depending upon the size and pressure rating of the system, 2, 3, 4, or more control/limit rods may be required. Refer to Table 4 in this manual or to the Fluid Sealing Association's Technical Handbook, Seventh Edition, page 23 for control rod pressure ratings.

3. Insert control/limit rods through top plate holes. Steel flat washers are to be positioned at outer plate surface.

4. If a single nut per unit is furnished, position this nut so that there is a gap between the nut and the steel flat washer. This gap is equal to the joints maximum extension (commencing with the nominal face-to-face length). To lock this nut in position, either "stake" the thread in two places or tack weld the nut to the rod. If two nuts are supplied, the nuts will create a "jamming" effect to prevent loosening. (Nuts should be snug against flat washer and control rod plate when piping system is un-anchored.)

Note: Consult the manufacturer if there are any questions as to the rated compression and elongation. These two dimensions are critical in setting the nuts and sizing the compression pipe sleeve (if supplied).

5. If there is a requirement for compression pipe sleeves, ordinary pipe may be used, sized in length to allow the joint to be compressed to its normal limit.

6. If there is a requirement for optional spherical washers, these washers are to be positioned at outer plate surface and backed up by movable double nuts.

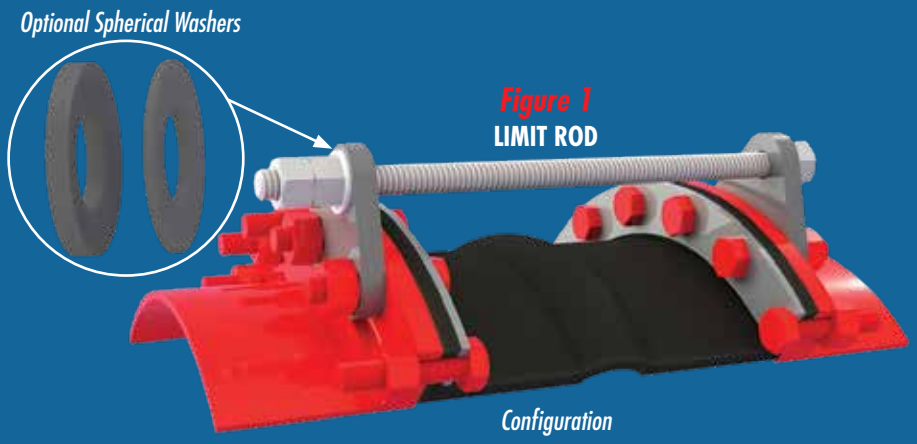


Figure 1
LIMIT ROD
Configuration

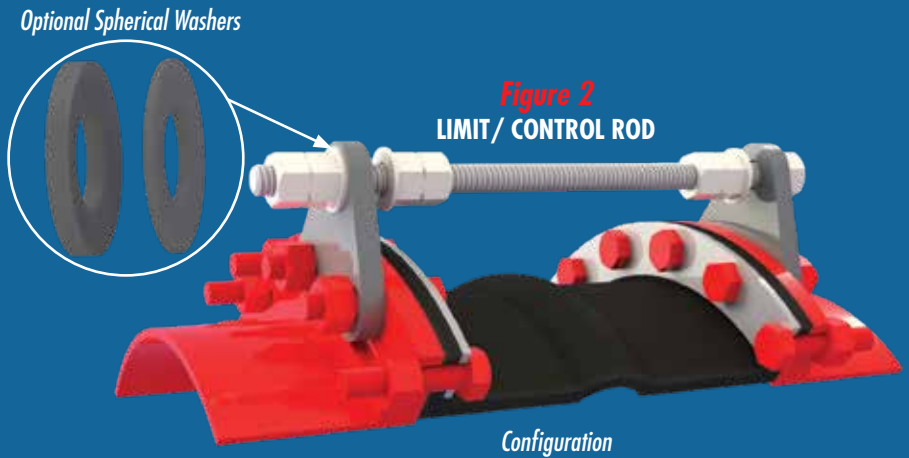


Figure 2
LIMIT/ CONTROL ROD
Configuration

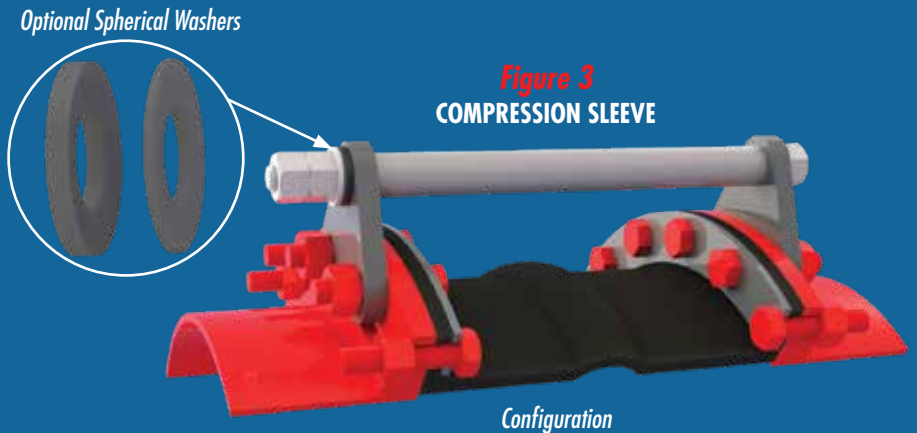


Figure 3
COMPRESSION SLEEVE
Configuration

Table 6		Maximum Surge or Test Pressure of the Systems			
Nominal Pipe Size Expansion Joint I.D. Inch /(mm)		Number of Control Rods Recommended			
		2	4	6	8
2	(51)	661	•	•	•
4	(102)	311	622	•	•
6	(152)	186	371	•	•
8	(203)	163	326	•	•
10	(254)	163	325	488	•
12	(305)	160	320	481	•
14	(356)	112	223	335	•
16	(406)	113	227	340	453
18	(457)	94	187	281	375
20	(508)	79	158	236	315
22	(559)	85	171	256	342
24	(610)	74	147	221	294
26	(660)	62	124	186	248
28	(711)	65	130	195	261
30	(762)	70	141	211	281
32	(813)	63	125	188	251
34	(864)	72	143	215	286
36	(914)	69	138	207	276
38	(965)	63	125	188	251
40	(1016)	42	85	127	169
42	(1067)	48	96	144	192
44	(1118)	44	88	133	177
46	(1168)	41	82	122	163
48	(1219)	40	81	141	161
50	(1270)	37	75	112	150
52	(1321)	35	70	105	140
54	(1372)	43	86	128	171
56	(1422)	40	80	120	160
58	(1473)	38	75	113	150
60	(1524)	35	71	106	141
62	(1575)	33	66	100	133
66	(1676)	30	59	89	119
72	(1829)	25	50	75	101
78	(1981)	28	56	84	112
84	(2134)	24	49	73	98
90	(2286)	26	53	79	106
98	(2489)	29	58	86	115
102	(2591)	25	51	76	102
108	(2743)	23	46	75	92
120	(3048)	18	37	56	75

Notes:
1. Pressures listed above do not relate to the actual design pressure of the expansion joint products, but are the maximum surge or pressure for a specific control rod nominal pipe size.

Installation Instructions for Non-Metallic Expansion Joints

1. Service Conditions:

Make sure the expansion joint rating for temperature, pressure, vacuum and movements match the system requirements. Contact the manufacturer for advice if the system requirements exceed those of the expansion joint selected. Check to make sure the elastomer selected is chemically compatible with the process fluid or gas.

2. Alignment:

Expansion joints are normally not designed to make up for piping misalignment errors. Piping should be lined up within 1/8". Misalignment reduces the rated movements of the expansion joint and can induce severe stress and reduce service life. Pipe guides should be installed to keep the pipe aligned and to prevent undue displacement.

3. Anchoring:

Solid anchoring is required wherever the pipeline changes direction and expansion joints should be located as close as possible to anchor points. If piping is not adequately anchored, control rods should be used. If anchors are not used, pressure thrust may cause excessive movement damaging the expansion joint.

4. Pipe Support:

Piping must be supported by hangers or anchors so expansion joints do not carry any pipe weight.

5. Mating Flanges:

Install the expansion joint against the mating pipe flanges and install bolts so that the bolt head and washer are against the retaining rings. If washers are not used, flange leakage can result – particularly at the split in the retaining rings. Flange-to-flange dimension of the expansion joint must match the breech opening. Make sure the mating flanges are clean and are flat faced type or no more than 1/16" raised face type. Never install expansion joints that utilize split retaining rings next to wafer type check or butterfly valves. Serious damage can result to a rubber joint of this type unless installed against full face flanges.

6. Bolting Torque:

Table 7 shows the recommended torque ranges for non-metallic expansion joints with full-faced rubber flanges: Torque specifications are approximate. Tighten bolts in stages using cross-bolt tightening pattern. If the joint has integral fabric and rubber flanges, the bolts should be tight enough to make the rubber flange OD bulge between the retaining rings and the mating flange. After installation, the system should be pressurized and examined to confirm a proper seal. Torque bolts sufficiently to assure leak free operation at hydrostatic test pressure. Note: Torque values are approximate due to mating flange surfaces, installation offsets, operating pressures and environmental conditions.

Table 7 Size	Approximate Torque Values
1" THRU 2"	20 - 40 ft/lbs
2.5" THRU 5"	25 - 60 ft/lbs
6" THRU 12"	35 - 140 ft/lbs
14" THRU 18"	50 - 180 ft/lbs
20" THRU 24"	60 - 200 ft/lbs
26" THRU 40"	70 - 300 ft/lbs
42" THRU 50"	80 - 300 ft/lbs
52" THRU 60"	100 - 400 ft/lbs
66" THRU 72"	200 - 500 ft/lbs
78" THRU 90"	300 - 600 ft/lbs
96" THRU 108"	400 - 700 ft/lbs
120"	500 - 800 ft/lbs

7. Storage:

Ideal storage is in a warehouse with a relatively dry, cool location. Store flanges face down on a pallet or wooden platform. Do not store other heavy items on top of expansion joints. Ten year shelf life can be expected with ideal conditions. If storage must be outdoors, place on wooden platform and joints should not be in contact with the ground. Cover with a tarpaulin.

8. Large Joint Handling:

Do not lift with ropes or bars through the bolt holes. If lifting through the bore, use padding or a saddle to distribute the weight. Make sure cables or forklift tines do not contact the rubber. Do not let expansion joints sit vertically on the edges of the flanges for any period of time.

9. Additional Tips:

A. Do not insulate over a non-metallic expansion joint; however, if insulation is required, it should be made removable to permit easy access to the flanges. This facilitates periodic inspection of the tightness of the joint bolting.
B. It is acceptable (but not necessary) to lubricate the expansion joint flanges with a thin film of graphite dispersed in glycerin or water to ease disassembly at a later time.
C. Do not weld in the near vicinity of a non-metallic joint.
D. If expansion joints are to be installed underground, or will be submerged in water, contact manufacturer for specific recommendations.
E. If the expansion joint will be installed outdoors, make sure the cover material will withstand ozone, sunlight, etc.
F. Check the tightness of lead-free flanges two or three weeks after installation and retighten if necessary.

Warning: Expansion joints may operate in pipelines or equipment carrying fluids and/or gasses at elevated temperature and pressures and may transport hazardous materials. Precautions should be taken to protect personnel in the event of leakage or splash. Rubber joints should not be installed in areas where inspection is impossible. Make sure proper drainage is available in the event of leakage when operating personnel are not available.

Piping System Layout Examples

Anchored System

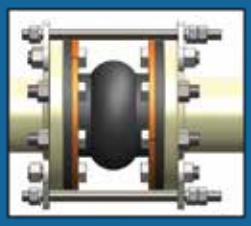


Figure 1

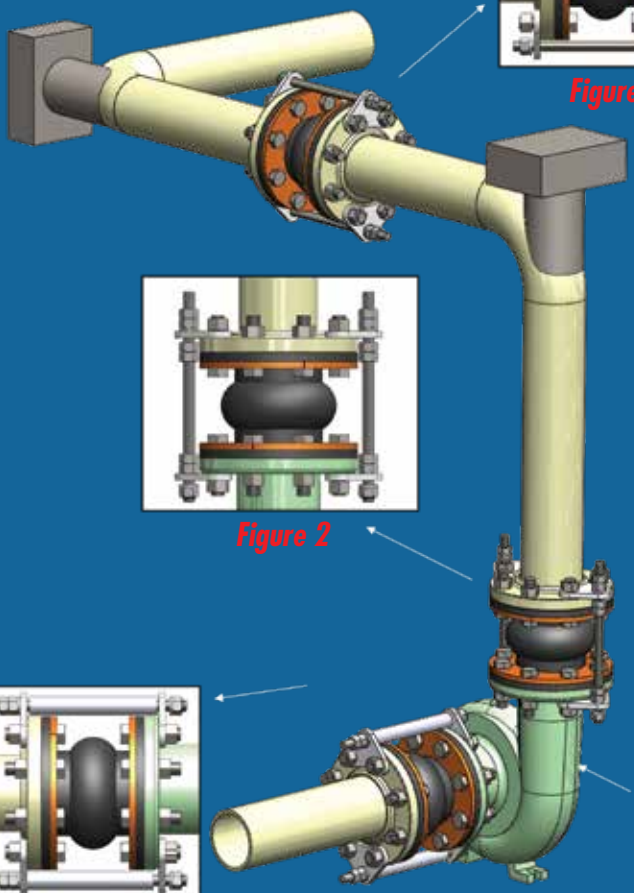


Figure 2

Figure 3

Pump

Anchored System Note:

Although limit rods, control rods or limit rods with compression sleeves are not required in an anchored pipe system, you may want to consider using them. If an anchor were to fail, any rod configuration would be capable of handling the pressure thrust of the system and lessen the likelihood of an expansion joint failure.

Un-Anchored System

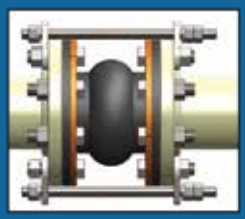


Figure 1

Figure 2

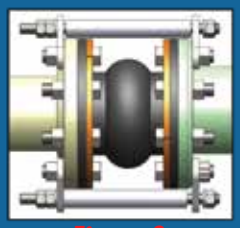


Figure 3

Pump

Un-Anchored System Note:

Rod sets should be installed so that external nuts are snug against the plate at installation. Pressure thrust of the pipe system can cause expansion joint to over-elongate and reduce movement capabilities.

ALSO AVAILABLE FROM
Proco Products, Inc.

Proco Products, Inc. can supply an Integral Tie Rod Design Joint when space prohibits use of typical rod designs. Integral Tie Rod Designs can also be used for installations on HDPE or Plastic Pipe Systems where thrust loads can be evenly distributed under pressure.

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PROCO

The Expansion Joint and Check Valve People

Molded Spherical Joints Style 240/242

Proco Style 240/242 Molded Spherical Joints

Proco Style 240/242 Spherical Molded Expansion Joints are designed for piping systems to absorb pipe movements, relieve stress, reduce system noise/vibration, compensate for misalignment/offset and to protect rotating mechanical equipment against start-up surge forces.

The molded style 240 single sphere and 242 twin sphere designed bellows are inherently stronger than the conventional hand-built style spool arch type. Internal pressure within a "sphere" is exerted in all directions, distributing forces evenly over a larger area. The spherical design "flowing arch" reduces turbulence and sediment buildup.

Features and Benefits:

Absorbs Directional Movement

Thermal movements appear in any rigid pipe system due to temperature changes. The Style 240 and Style 242 spherical arch expansion joints allow for axial compression or axial extension, lateral deflection as well as angular movement. (Note: Rated movements in this publication are based on single plane movements. Multiple movement conditions are based on a multiple movement calculation. Contact Proco for information when designing multiple pipe movements.)

Easy Installation with Rotating Metallic Flanges

The floating metallic flanges freely rotate on the bellows, compensating for mating flange misalignment, thus speeding up installation time. Gaskets are not required with the Style 240 or Style 242, provided the expansion joints are mated against a flat face flange as required in the installation instructions.

Flange Materials/Drilling

The Proco Style 240 and Style 242 molded expansion joints are furnished complete with plated carbon steel flanges for corrosion protection. 304 or 316 stainless steel flanges are available upon request as well as ANSI 250/300 lb., BS-10, DIN PN10 & PN16 and JIS-10K drilling.

Absorbs Vibration, Noise and Shock

The Proco Style 240 and Style 242 molded expansion joints effectively dampen and insulate downstream piping against the transmission of noise and vibration generated by mechanical equipment. Noise and vibration caused by equipment can cause stress in pipe, pipe guides, anchors and other equipment downstream. Water hammer and pumping impulses can also cause strain, stress or shock to a piping system. Install the Style 240 or Style 242 molded expansion joints to help compensate for these system pressure spikes.

Wide Service Range with Low Cost

Engineered to operate up to 300 PSIG or 265°F, the Proco Style 240 and Style 242 can be specified for a wide range of piping requirements. Compared to conventional hand-built spool type joints, you will invest less money when specifying the mass-produced, consistent high quality, molded single or twin sphere expansion joints.

Material Identification

All Style 240 or Style 242 molded expansion joints have branded elastomer designations. Neoprene Tube/Neoprene Cover (NN) and Nitrile Tube/Neoprene Cover (NP) elastomer designated joints meet the Coast Guard Requirements and conform to ASTM F1123-87. 240C/NP-9 joints have ABS certification.

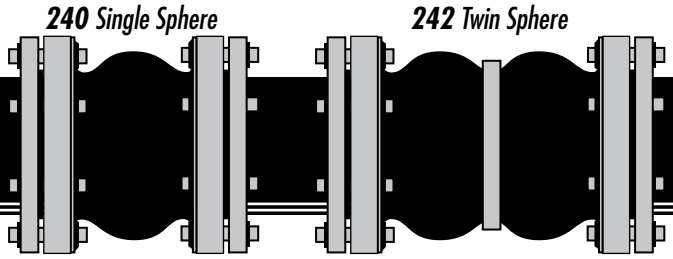
Large Inventory

Proco Products, Inc. maintains one of the largest inventories of rubber expansion joints in the world. Please contact us for price and availability.

Table 1: Available Styles • Materials

For Specific Elastomer Recommendations, See: **PROCO** "Chemical To Elastomer Guide"

240-A	240-C	240-AV,D,E,M [11]	242-A,B,C	PROCO Material Code	Cover Elastomer [1]	Tube Elastomer [2]	Max-imum Operating Temp. °F	Identifying Color Band/Label
		X	X	/BB[3]	Chlorobutyl	Chlorobutyl	250°	Black
		X	X	/EE[2,3,7]	EPDM	EPDM	250°	Red
X	X			/EE[2,3,4]	EPDM	FDA-EPDM	250°	Red
		X		/EQ[2,3]	EPDM	FDA-EPDM	250°	Red
X	X			/EE-9[3,5]	EPDM	EPDM	265°	DBL Red
	X			/HH	CSM	CSM	212°	Green
		X	X	/NH	Neoprene	CSM	212°	Green
	X			/NJ[2]	Neoprene	FDA-Nitrile	212°	White
	X	X	X	/NN[7]	Neoprene	Neoprene	225°	Blue
X	X	X	X	/NP	Neoprene	Nitrile	212°	Yellow
X	X			/NP-9[6]	Neoprene	Nitrile-ABS	212°	DBL Yellow



Protecting Piping and Equipment Systems from Stress/Motion

Notes: All Products are reinforced with Nylon Tire Cord, except 240-A and 240-C which are reinforced with Polyester.

1. *All NN & NP elastomer designated joints meet the Coast Guard Requirements and conform to ASTM F 1123-87 and are marked accordingly.*
2. *Branding Label will be marked as "Food Grade".*
3. *BB, EE or EE-9 are good for 300°F blower service at 20 PSI or less.*
4. *240-A & 240-C expansion joints have black EPDM tube, but are FDA compliant.*
5. *EE-9 joints are peroxide cured.*
6. *NP-9 joints have ABS certification.*
7. *Elastomers are in accordance with NSF/ANSI 372, File MH47689 Und. Lab. Classified.*
8. *All elastomers above are not intended for steam service.*
9. *For PTFE lined single sphere see www.procoproducts.com/ptfelined.html*
10. *For 240A & 240C Rubber Joints, Vacuum Support devices are available. Published movements will be reduced by approximately 50% for this option.*
11. *Series 240AV,D,E&M + 242A,B&C In Elastomers EPDM & Neoprene are all listed for low lead content in accordance with NSF/ANSI 372*

Information subject to change without notice.

Style 240 Single Sphere Performance Data

Table 2: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL Pipe Size I.D.	Neutral Length	PROCO Style Number [1]	240 Movement Capability: From Neutral Position (Non-Concurrent) [2]					Pressure [4]		Standard Flange Drilling Dimensions [8]					Weight in lbs	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust Factor [3]	Positive PSIG [5,9]	Vacuum [6] Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole [7] Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
1 (25)	5.00	240-C	1.063	1.250	1.188	45	4.43	225	26	4.25	3.13	4	0.625	1/2-13 UNC	3.8	3.3
	6.00	240-AV	0.500	0.375	0.500	37										
1.25 (32)	3.74	240-D	0.312	0.188	0.312	45	6.34	225	26	4.63	3.5	4	0.625	—	4.6	3.3
	5.00	240-C	1.063	1.250	1.188	17		235	21				0.625	—	5.0	
	5.00	240-E	0.500	0.375	0.500	31		225	26				0.625	—	5.0	
	6.00	**240-AV**	0.500	0.375	0.500	31		225	26				0.625	1/2-13 UNC	5.0	
1.5 (40)	3.74	240-D	0.375	0.188	0.312	14	6.49	225	26	5.0	3.88	4	0.625	—	5.4	4.6
	4.00	240-M	0.375	0.188	0.312	14		225	26				0.625	—	5.5	
	5.00	240-C	1.063	1.250	1.188	45		235	18				0.625	—	5.1	
	5.00	240-E	0.500	0.375	0.500	27		225	26				0.625	—	6.0	
	6.00	**240-AV**	0.500	0.375	0.500	27		225	26				0.625	1/2-13 UNC	6.1	
2 (50)	4.00	240-M	0.375	0.188	0.312	11	7.07	225	26	6.0	4.75	4	0.750	—	8.3	6.3
	4.13	240-D	0.375	0.188	0.312	11		225	26	6.0	4.75	4	0.750	—	8.5	6.3
	5.00	240-C	1.063	1.250	1.188	45		235	18	6.0	4.75	4	0.750	—	7.1	6.3
	5.00	240-E	0.375	0.375	0.500	20		225	26	6.0	4.75	4	0.750	—	8.5	6.3
	6.00	240-A	1.188	1.188	1.188	45		235	18	6.0	4.75	4	0.750	—	7.1	6.3
	6.00	**240-AV**	0.500	0.375	0.500	20		225	26	6.0	4.75	4	0.750	5/8-11 UNC	12.3	7.6
	6.00	Q-240-HW	0.500	0.375	0.500	20		300	26	6.5	5.0	8	0.750	—	11.0	7.6
2.5 (65)	4.00	240-M	0.375	0.188	0.375	8	11.05	225	26	7.0	5.5	4	0.750	—	12.0	7.6
	4.53	240-D	0.500	0.188	0.375	11		225	26				0.750	—	12.3	
	5.00	240-C	1.063	1.250	1.188	45		235	18				0.750	—	10.6	
	5.00	240-E	0.500	0.375	0.500	17		225	26				0.750	—	12.0	
	6.00	240-A	1.188	1.188	1.188	43		235	18				0.750	—	12.0	
	6.00	**240-AV**	0.500	0.375	0.500	17		225	26				0.750	5/8-11 UNC	12.3	
3 (80)	5.00	240-C	1.063	1.250	1.188	40	13.36	235	15	7.5	6.0	4	0.750	—	13.3	8.3
	5.00	240-E	0.500	0.375	0.500	14		225	26	7.5	6.0	4	0.750	—	14.0	8.3
	5.12	240-D	0.500	0.375	0.500	14		225	26	7.5	6.0	4	0.750	—	14.0	8.3
	6.00	240-A	1.188	1.188	1.188	38		235	15	7.5	6.0	4	0.750	—	13.8	8.3
	6.00	**240-AV**	0.500	0.375	0.500	14		225	26	7.5	6.0	4	0.750	5/8-11 UNC	14.0	8.3
	8.00	**240-AV**	0.500	0.375	0.500	14		225	26	7.5	6.0	4	0.750	5/8-11 UNC	15.0	8.7
	6.00	Q-240-HW	0.500	0.375	0.500	14		300	26	8.25	6.62	8	0.875	—	17.5	8.3
3.5 (90)	6.00	240-AV	0.500	0.375	0.500	12	18.67	225	26	8.5	7.0	8	0.750	5/8-11 UNC	17.6	7.4
4 (100)	5.00	240-C	1.063	1.250	1.188	32	22.69	235	15	9.0	7.5	8	0.750	—	16.5	7.4
	5.00	240-E	0.750	0.500	0.500	14		225	26	9.0	7.5	8	0.750	—	17.0	7.4
	5.32	240-D	0.750	0.500	0.500	14		225	26	9.0	7.5	8	0.750	—	17.1	7.4
	6.00	240-A	1.188	1.188	1.188	30		235	15	9.0	7.5	8	0.750	—	17.5	7.4
	6.00	**240-AV**	0.750	0.500	0.500	14		225	26	9.0	7.5	8	0.750	5/8-11 UNC	18.3	7.4
	8.00	**240-AV**	0.750	0.500	0.500	14		225	26	9.0	7.5	8	0.750	5/8-11 UNC	19.3	7.8
	6.00	Q-240-HW	0.750	0.500	0.500	14		300	26	10.0	7.88	8	0.750	—	26.0	7.4
5 (125)	5.00	240-C	1.063	1.250	1.188	27	30.02	235	10	10.0	8.5	8	0.875	—	20.3	8.3
	5.00	240-E	0.750	0.500	0.500	11		225	26	10.0	8.5	8	0.875	—	22.0	8.3
	6.00	240-A	1.188	1.188	1.188	25		235	10	10.0	8.5	8	0.875	—	21.8	8.3
	6.00	**240-AV**	0.750	0.500	0.500	11		225	26	10.0	8.5	8	0.875	3/4-10 UNC	22.8	8.3
	6.69	240-D	0.750	0.500	0.500	11		225	10	10.0	8.5	8	0.875	—	23.6	8.5
	8.00	**240-AV**	0.750	0.500	0.500	11		225	26	10.0	8.5	8	0.875	3/4-10 UNC	25.0	10.8
	6.00	Q-240-HW	0.750	0.500	0.500	11		300	26	11.0	9.25	8	0.875	—	28.0	14.0

See Notes Page 4

Style 240 Single Sphere Performance Data

Table 2: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL Pipe Size I.D.	Neutral Length	PROCO Style Number [1]	240 Movement Capability: From Neutral Position (Non-Concurrent) [2]					Pressure [4]		Standard Flange Drilling Dimensions [8]					Weight in lbs	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust Factor [3]	Positive PSIG [5,9]	Vacuum [6] Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole [7] Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
6 (150)	5.00	240-C	1.063	1.250	1.188	23		225	8	11.0	9.5	8	0.875	—	22.6	10.4
	5.00	240-E	0.750	0.500	0.500	9		225	26	11.0	9.5	8	0.875	—	26.0	10.4
	6.00	240-A	1.188	1.188	1.188	21		235	10	11.0	9.5	8	0.875	—	24.0	10.4
	6.00	**240-AV**	0.750	0.500	0.500	9	41.28	225	26	11.0	9.5	8	0.875	3/4-10 UNC	26.8	10.4
	7.09	240-D	0.750	0.500	0.500	9		225	26	11.0	9.5	8	0.875	—	29.0	10.6
	8.00	**240-AV**	0.750	0.500	0.500	9		225	26	11.0	9.5	8	0.875	3/4-10 UNC	29.1	10.8
	6.00	Q-240-HW	0.750	0.500	0.500	9		300	26	12.5	10.62	12	0.875	—	39.0	10.4
8 (200)	5.00	240-C	1.063	1.188	1.188	17		235	8	13.5	11.75	8	0.875	—	35.5	13.4
	5.00	240-E	0.750	0.500	0.500	7		225	26	13.5	11.75	8	0.875	—	40.0	13.4
	6.00	240-A	1.188	1.188	1.188	16		235	8	13.5	11.75	8	0.875	—	38.5	13.4
	6.00	**240-AV**	0.750	0.500	0.500	7	63.62	225	26	13.5	11.75	8	0.875	3/4-10 UNC	40.6	13.4
	8.07	240-D	1.000	0.563	0.875	8		225	26	13.5	11.75	8	0.875	—	41.3	14.0
	6.00	Q-240-HW	0.750	0.500	0.500	7		300	26	15.0	13.00	12	1.000	—	70.0	13.4
10 (250)	5.00	240-C	1.063	1.188	1.188	14		235	6	16.0	14.25	12	1.000	—	49.3	21.0
	5.00	240-E	1.000	0.625	0.750	7		225	26	16.0	14.25	12	1.000	—	56.0	21.0
	8.00	240-A	1.188	1.188	1.188	13		145	6	16.0	14.25	12	1.000	—	53.6	21.3
	8.00	**240-AV**	1.000	0.625	0.750	7	103.87	225	26	16.0	14.25	12	1.000	7/8-9 UNC	56.6	21.3
	9.00	**240-AV**	1.000	0.625	0.750	7		225	26	16.0	14.25	12	1.000	7/8-9 UNC	57.0	22.0
	9.45	240-D	1.000	0.625	0.750	7		225	26	16.0	14.25	12	1.000	—	58.5	22.0
	10.00	**240-AV**	1.000	0.625	0.875	7		225	26	16.0	14.25	12	1.000	7/8-9 UNC	60.5	26.5
	8.00	Q-240-HW	1.000	0.625	0.750	7		275	26	17.5	15.25	16	1.125	—	56.0	22.0
12 (300)	5.00	240-C	1.063	1.250	1.188	12		235	6	19.0	17.0	12	1.000	—	73.4	26.5
	5.00	240-E	1.000	0.625	0.750	6		225	26	19.0	17.0	12	1.000	—	74.0	26.5
	8.00	240-A	1.188	1.188	1.188	11		145	6	19.0	17.0	12	1.000	—	80.0	27.0
	8.00	**240-AV**	1.000	0.625	0.750	6	137.89	225	26	19.0	17.0	12	1.000	7/8-9 UNC	83.0	27.0
	9.00	**240-AV**	1.000	0.625	0.750	6		225	26	19.0	17.0	12	1.000	7/8-9 UNC	88.0	27.0
	10.24	240-D	1.000	0.625	0.875	6		225	26	19.0	17.0	12	1.000	—	89.0	28.0
	8.00	Q-240-HW	1.000	0.625	0.750	6		275	26	20.5	17.75	16	1.250	—	100.0	27.0
14 (350)	8.00	240-C	1.000	1.063	1.188	8	182.65	232	6	21.0	18.75	12	1.125	—	112.0	28.0
	8.00	**240-AV**	1.000	0.625	0.750	6		150	26				1.125	—	115.0	28.0
16 (400)	8.00	240-C	1.000	1.063	1.188	8		232	6				1.125	—	136.0	26.8
	8.00	240-HW	1.000	0.625	0.750	4		175	26				1.125	—	186.0	26.8
	8.00	**240-AV**	1.000	0.625	0.750	4	240.53	125	26	23.5	21.25	16	1.125	—	165.0	26.8
	9.00	240-M	1.000	0.625	0.750	4		125	26				1.125	—	168.0	27.0
	10.43	240-D	1.000	0.625	0.875	4		125	26				1.125	—	170.0	27.0
18 (450)	8.00	240-HW	1.000	0.625	0.750			175	26				1.250	—	209.0	31.4
	8.00	**240-AV**	1.000	0.625	0.750	4	298.65	125	26	25.0	22.75	16	1.250	—	168.0	31.4
	9.00	240-M	1.000	0.625	0.750			125	26				1.250	—	169.0	33.1
	10.43	240-D	1.000	0.625	0.875			125	26				1.250	—	170.0	33.1
20 (500)	8.00	240-C	1.000	1.063	1.188	6		145	6				1.250	—	154.0	32.4
	8.00	240-HW	1.000	0.625	0.750	3		175	26				1.250	—	234.0	32.4
	8.00	**240-AV**	1.000	0.625	0.750	3	363.05	125	26	27.5	25.00	20	1.250	—	170.0	32.4
	9.00	240-M	1.000	0.625	0.750	3		125	26				1.250	—	173.0	34.1
	10.43	240-D	1.000	0.625	0.875	3		125	26				1.250	—	175.0	34.1
24 (600)	8.00	240-C	1.000	1.063	1.188	5		145	6				1.375	—	214.0	44.0
	10.00	**240-AV**	1.000	0.625	0.750	3	510.70	110	26	32.5	29.5	20	1.375	—	255.0	45.5
	10.00	240-HW	1.000	0.625	0.750	3		160	26				1.375	—	297.0	45.5
	10.47	240-D	1.000	0.625	0.875	3		110	26				1.375	—	265.0	46.0
30 (750)	10.00	**240-AV**	1.000	0.625	0.750	2	779.31	110	26	38.75	36.0	28	1.375	—	295.0	57.0

See Notes Page 4

NOTES:

Standard Proco Style 240-AV Expansion Joints shown in Bold Type are considered Standards and are inventoried in large quantities.

1. *"HW" denotes Heavy Weight Construction. For sizes 2" I.D. thru 12" I.D., Proco will only offer these items with 300 lb. drilling and are denoted by Q-240-HW. All Q-240-HW units will only be sold with control units.*

2. *Concurrent Movements - Concurrent movements are developed when two or more movements in a pipe system occur at the same time. If multiple movements exceed single arch design there may be a need for an additional arch. To perform calculation for concurrent movement when a pipe system design has more than one movement, please use the following formula:*

$$\frac{\text{Actual Axial Compression}}{\text{Rated Axial Compression}} + \frac{\text{Actual Axial Extension}}{\text{Rated Axial Extension}} + \frac{\text{Actual Lateral (X)}}{\text{Rated Lateral (X)}} + \frac{\text{Actual Lateral (Y)}}{\text{Rated Lateral (Y)}} = / < 1$$

Calculation must be equal to or less than 1 for expansion joint to operate within concurrent movement capability.

3. *Calculation of Thrust (Thrust Factor). When expansion joints are installed in the pipeline, the static portion of the thrust is calculated as a product of the area of the I.D. of the arch of the expansion joint times the maximum pressure (design, test or surge) that will occur in the line. The result is a force expressed in pounds.* ***Take design, surge or test pressure X thrust factor to calculate end thrust.***

"Effective Area"

Thrust Factor=

$T = \frac{\pi}{4}(D)^2 (P)$

T= Thrust
P= PSI (Design, Test or Surge)
D= Arch I.D.

4. *Pressure rating is based on 170°F operating temperature. The pressure rating is reduced at higher temperatures.*

5. *Pressures shown at maximum "operating pressure". Test pressure is 1.5 times "operating pressure". Burst pressure is 4 times "operating pressure". If factory hydro-test is required, an additional joint per size must be purchased and tested. Once hydro-tested this joint may not be sent to field for installation as the beaded end will have taken a (compressed) set and can not be reused.*

6. *Vacuum rating is based on neutral installed length, without external load. Products should not be installed in extension for vacuum applications. Flattening of the arch in extended mode will cause the arch to collapse.*

7. *Style 240AV/NN and 240-D/NN (neoprene elastomer only) expansion joints 1.0" I.D. thru 12" I.D. are available with tapped (threaded) holes and must be specified at time of order.*

8. *In addition to standard 150 lb. drilled flanges, Proco can provide expasion joints listed above in 300 lb. drilling, BS-10 (British) drilling, Metric PN10 and PN16 drilling and JIS 10kg/cm drilling.*

9. *For PTFE lined single sphere see www.procoproducts.com/ptfelined.html*

Style 242 Twin Sphere Performance Data

Table 3: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL Pipe Size I.D.	Neutral Length	PROCO Style Number [1]	242 Movement Capability: From Neutral Position (Non-Concurrent) [2]					Pressure [4]		Standard Flange Drilling Dimensions [8]					Weight in lbs	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust Factor [3]	Positive PSIG [5]	Vacuum [6] Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole [7] Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
1 (25)	10.00	242-C	2.000	1.188	1.750	45	4.43	225	26	4.25	3.13	4	0.625	—	5.2	3.6
1.25 (32)	7.0	**242-A**	2.000	1.188	1.750	45	6.34	225	26	4.63	3.5	4	0.625	1/2-13 UNC	5.3	3.5
	7.0	242-HA						300					0.625	—	6.5	3.5
	10.00	242-C						225					0.625	—	6.2	3.6
1.5 (40)	6.00	242-B	2.000	1.188	1.750	45	6.49	225	26	5.0	3.88	4	0.625	—	6.1	4.6
	6.00	242-HB						300					0.625	—	7.6	4.6
	7.00	**242-A**						225					0.625	1/2-13 UNC	6.8	4.8
	7.00	242-HA						300					0.625	—	8.3	4.8
	10.00	242-C						225					0.625	—	7.7	5.1
2 (50)	6.00	242-B	2.000	1.188	1.750	45	7.07	225	26	6.0	4.75	4	0.750	—	9.0	6.6
	7.00	**242-A**						225		6.0	4.75	4	0.750	—	9.0	7.0
	10.00	242-C						235		6.0	4.75	4	0.750	5/8-11 UNC	10.2	7.3
	6.00	Q-242-HB						300		6.0	4.75	4	0.750	—	10.5	6.6
	7.00	Q-242-HA						300		6.5	5.00	8	0.750	—	10.5	7.0
2.5 (65)	6.00	242-B	2.000	1.188	1.750	43	11.05	225	26	7.0	5.5	4	0.750	—	12.9	7.6
	7.00	**242-A**						225					0.750	—	13.3	8.0
	10.00	242-C						225					0.750	5/8-11 UNC	14.5	8.4
	6.00	Q-242-HB						300					0.750	—	15.3	7.6
	7.00	Q-242-HA						300					0.750	—	15.8	8.0
3 (80)	7.00	**242-A**	2.000	1.188	1.750	38	13.36	225	26	7.5	6.0	4	0.750	5/8-11 UNC	14.3	8.6
	9.00	242-B						225		7.5	6.0	4	0.750	—	15.2	9.0
	10.00	242-C						225		7.5	6.0	4	0.750	—	15.8	9.1
	12.00	242-C						225		7.5	6.0	4	0.750	—	16.0	9.9
	7.00	Q-242-HA						300		8.25	6.62	8	0.875	—	18.2	8.6
4 (100)	9.00	**242-A**	2.000	1.375	1.562	34	22.69	225	26	9.0	7.5	8	0.750	5/8-11 UNC	20.3	8.0
	10.00	242-C						225		9.0	7.5	8	0.750	—	21.3	8.2
	12.00	242-C						225		9.0	7.5	8	0.750	—	22.0	8.2
	9.00	Q-242-HA						300		10.0	7.88	8	0.750	3/4-10 UNC	26.4	8.0
5 (125)	9.00	**242-A**	2.000	1.375	1.562	29	30.02	225	26	10.0	8.5	8	0.875	—	24.5	8.3
	10.00	242-C						225		10.0	8.5	8	0.875	—	25.5	9.1
	12.00	242-C						225		10.0	8.5	8	0.875	—	26.0	9.1
	9.00	Q-242-HA						300		11.0	9.25	8	0.875	—	31.4	8.3
6 (150)	9.00	**242-A**	2.000	1.375	1.562	25	41.28	225	26	11.0	9.5	8	0.875	3/4-10 UNC	29.5	11.7
	10.00	242-C						225		11.0	9.5	8	0.875	—	30.5	11.9
	12.00	242-C						225		11.0	9.5	8	0.875	—	31.0	12.0
	14.00	242-C						225		11.0	9.5	8	0.875	—	32.0	12.0
	9.00	Q-242-HA						300		12.5	10.62	12	0.875	—	38.6	11.7
8 (200)	9.00	242-B	2.375	1.375	1.375	19	63.62	225	26	13.5	11.75	8	0.875	—	42.3	14.5
	10.00	242-C						225		13.5	11.75	8	0.875	—	43.4	15.0
	12.00	242-C						225		13.5	11.75	8	0.875	—	44.0	15.2
	13.00	**242-A**						225		13.5	11.75	8	0.875	—	43.8	15.4
	14.00	242-C						225		13.5	11.75	8	0.875	3/4-10 UNC	46.0	16.0
	9.00	Q-242-HB						300		15.0	13.0	12	1.000	—	55.4	14.5
	13.00	Q-242-HA						300		15.0	13.0	12	1.000	—	57.5	15.4
10 (250)	12.00	242-B	2.375	1.375	1.375	15	103.87	225	26	16.0	14.25	12	1.000	—	64.1	23.5
	13.00	**242-A**						225		16.0	14.25	12	1.000	—	65.5	24.5
	14.00	242-C						225		16.0	14.25	12	1.000	7/8-9 UNC	66.7	24.5
	12.00	Q-242-HB						275		17.5	15.25	16	1.125	—	86.5	23.5
	13.00	Q-242-HA						275		17.5	15.25	16	1.125	—	88.4	24.5

See Notes Page 6

Table 3: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL Pipe Size I.D.	Neutral Length	PROCO Style Number [1]	242 Movement Capability: From Neutral Position (Non-Concurrent) [2]					Pressure [4]		Standard Flange Drilling Dimensions [8]					Weight in lbs	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust Factor [3]	Positive PSIG [5]	Vacuum [6] Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole [7] Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
12 (300)	12.00	242-B	2.375	1.375	1.375	13	137.89	225	26	19.0	17.00	12	1.000	—	94.0	30.0
	13.00	**242-A**						225		19.0	17.00	12	1.000	—	95.0	31.0
	14.00	242-C						225		19.0	17.00	12	1.000	7/8-9 UNC	99.1	31.0
	12.00	Q-242-HB						275		20.5	17.75	16	1.250	—	110.0	30.0
	13.00	Q-242-HA						275		20.5	17.75	16	1.250	—	110.0	31.0
14 (350)	13.75	**242-A**	1.750	1.118	1.118	9	182.65	150	26	21.0	18.75	12	1.125	—	142.0	32.0
16 (400)	12.00	242-C	1.750	1.118	1.118	8	240.53	125	26	23.5	21.25	16	1.125	—	154.0	28.8
	12.00	242-HC						175					1.125	—	190.0	28.8
	13.75	**242-A**						125					1.125	—	162.0	30.8
	13.75	242-HA						175					1.125	—	200.2	30.8
18 (450)	12.00	242-C	1.750	1.118	1.118	7	298.65	125	26	25.0	22.75	16	1.250	—	168.0	35.1
	13.75	**242-A**						125					1.250	—	176.0	36.1
	13.75	242-HA						175					1.250	—	211.2	36.1
20 (500)	12.00	242-C	1.750	1.118	1.118	7	363.05	125	26	27.5	25.0	20	1.250	—	202.0	35.0
	13.75	**242-A**						125					1.250	—	212.0	35.5
	13.75	242-HA						175					1.250	—	212.0	35.5
24 (600)	12.00	242-C	1.750	1.118	1.118	5	510.70	110	26	32.5	29.5	20	1.375	—	220.0	47.0
	13.75	**242-A**						110					1.375	—	250.0	48.0
	13.75	242-HA						160					1.375	—	296.2	48.0
30 (750)	12.00	242-C	1.750	1.118	1.118	4	779.31	110	26	38.75	36.0	28	1.375	—	300.0	62.0

NOTES:

Standard Proco Style 242-A Expansion Joints shown in Bold Type are considered Standards and are inventoried in large quantities.

1. *"HW" denotes Heavy Weight Construction. For sizes 2" I.D. thru 12" I.D., Proco will only offer these items with 300 lb. drilling and are denoted by Q-242-HW. All Q-240-HW units will only be sold with control units.*

2. *Concurrent Movements - Concurrent movements are developed when two or more movements in a pipe system occur at the same time. If multiple movements exceed single arch design there may be a need for an additional arch. To perform calculation for concurrent movement when a pipe system design has more than one movement, please use the following formula:*

$$\frac{\text{Actual Axial Compression}}{\text{Rated Axial Compression}} + \frac{\text{Actual Axial Extension}}{\text{Rated Axial Extension}} + \frac{\text{Actual Lateral (X)}}{\text{Rated Lateral (X)}} + \frac{\text{Actual Lateral (Y)}}{\text{Rated Lateral (Y)}} = / < 1$$

Calculation must be equal to or less than 1 for expansion joint to operate within concurrent movement capability.

3. *Calculation of Thrust (Thrust Factor). When expansion joints are installed in the pipeline, the static portion of the thrust is calculated as a product of the area of the I.D. of the arch of the expansion joint times the maximum pressure (design, test or surge) that will occur in the line. The result is a force expressed in pounds.* ***Take design, surge or test pressure X thrust factor to calculate end thrust.***

"Effective Area"

Thrust Factor=

$T = \frac{\pi}{4} (D)^2 (P)$

T= Thrust
P= PSI (Design, Test or Surge)
D= Arch I.D.

4. *Pressure rating is based on 170°F operating temperature. The pressure rating is reduced at higher temperatures.*

5. *Pressures shown at maximum "operating pressure". Test pressure is 1.5 times "operating pressure". Burst pressure is 4 times "operating pressure". If factory hydro-test is required, an additional joint per size must be purchased and tested. Once hydro-tested this joint may not be sent to field for installation as the beaded end will have taken a (compressed) set and can not be reused.*

6. *Vacuum rating is based on neutral installed length, without external load. Products should not be installed in extension for vacuum applications. Flattening of the arch in extended mode will cause the arch to collapse.*

7. *Style 242A/NN (neoprene elastomer only) expansion joints 1.0" I.D. thru 12" I.D. are available with tapped (threaded) holes and must be specified at time of order.*

8. *In addition to standard 150 lb. drilled flanges, Proco can provide expansion joints listed above in 300 lb. drilling, BS-10 (British) drilling, Metric PN10 and PN16 drilling and JIS 10kg/cm drilling.*

Style 240/242 Drilling Chart

Table 4: Flange Drilling

NOMINAL Pipe Size Inch (mm)	American 125/150# Conforms to ANSI B16.1 and B16.5						American 250/300# Conforms to ANSI B16.1 and B16.5					British Standard 10:1962 Conforms to BS 10 Table E				
	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Drilled Hole Size	Threaded Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size
1 (25)	0.55 (14.0)	4.25 (108.0)	3.13 (79.4)	4	0.62 (15.9)	1/2 - 13 UNC	0.63 (16.0)	4.88 (124.0)	3.5 (88.9)	4	0.75 (19.1)	0.59 (15.0)	4.5 (114.0)	3.25 (82.6)	4	0.62 (15.9)
1.25 (32)	0.55 (14.0)	4.63 (118.0)	3.5 (88.9)	4	0.62 (15.9)	1/2 - 13 UNC	0.63 (16.0)	5.25 (133.0)	3.88 (98.4)	4	0.75 (19.1)	0.59 (15.0)	4.75 (121.0)	3.44 (87.3)	4	0.62 (15.9)
1.5 (40)	0.55 (14.0)	5.0 (127.0)	3.88 (98.4)	4	0.62 (15.9)	1/2 - 13 UNC	0.63 (16.0)	6.12 (156.0)	4.50 (114.3)	4	0.88 (22.2)	0.59 (15.0)	5.25 (133.0)	3.88 (98.4)	4	0.62 (15.9)
2 (50)	0.63 (16.0)	6.0 (152.0)	4.75 (120.7)	4	0.75 (19.1)	5/8 - 11 UNC	0.71 (18.0)	6.50 (165.0)	5.00 (127.0)	8	0.75 (19.1)	0.63 (16.0)	6.0 (152.0)	4.5 (114.3)	4	0.75 (19.1)
2.5 (65)	0.71 (18.0)	7.0 (178.0)	5.5 (139.7)	4	0.75 (19.1)	5/8 - 11 UNC	0.71 (18.0)	7.5 (191.0)	5.88 (149.2)	8	0.88 (22.2)	0.71 (18.0)	6.5 (165.0)	5.0 (127.0)	4	0.75 (19.1)
3 (80)	0.71 (18.0)	7.5 (191.0)	6.0 (152.4)	4	0.75 (19.1)	5/8 - 11 UNC	0.79 (20.0)	8.25 (210.0)	6.62 (168.2)	8	0.88 (22.2)	0.71 (18.0)	7.25 (184.0)	5.75 (146.1)	4	0.75 (19.1)
3.5 (90)	0.71 (18.0)	8.5 (216.0)	7.0 (177.8)	8	0.75 (19.1)	5/8 - 11 UNC	0.79 (20.0)	9.0 (229.0)	7.25 (184.2)	8	0.88 (22.2)	0.71 (18.0)	8.0 (203.0)	6.5 (165.1)	8	0.75 (19.1)
4 (100)	0.71 (18.0)	9.0 (229.0)	7.5 (190.5)	8	0.75 (19.1)	5/8 - 11 UNC	0.79 (20.0)	10.0 (254.0)	7.88 (200.0)	8	0.88 (22.2)	0.71 (18.0)	8.5 (216.0)	7.0 (177.8)	8	0.75 (19.1)
5 (125)	0.79 (20.0)	10.0 (254.0)	8.5 (215.9)	8	0.88 (22.2)	3/4 - 10 UNC	0.87 (22.0)	11.0 (279.0)	9.25 (235.0)	8	0.88 (22.2)	0.79 (20.0)	10.0 (254.0)	8.25 (209.6)	8	0.75 (19.1)
6 (150)	0.87 (22.0)	11.0 (279.0)	9.5 (241.3)	8	0.88 (22.2)	3/4 - 10 UNC	0.87 (22.2)	12.5 (318.0)	10.62 (269.9)	12	0.88 (22.2)	0.87 (22.2)	11.0 (279.0)	9.25 (235.0)	8	0.88 (22.2)
8 (200)	0.87 (22.0)	13.5 (343.0)	11.75 (298.5)	8	0.88 (22.2)	3/4 - 10 UNC	0.95 (24.0)	15.0 (381.0)	13.0 (330.2)	12	1.00 (25.4)	0.87 (22.2)	13.25 (337.0)	11.5 (292.1)	8	0.88 (22.2)
10 (250)	0.95 (24.0)	16.0 (406.0)	14.25 (362.0)	12	1.00 (25.4)	7/8 - 9 UNC	1.02 (26.0)	17.5 (445.0)	15.25 (387.4)	16	1.13 (28.6)	0.95 (24.0)	16.0 (406.0)	14.0 (355.6)	12	0.88 (22.2)
12 (300)	0.95 (24.0)	19.0 (483.0)	17.0 (431.8)	12	1.00 (25.4)	7/8 - 9 UNC	1.02 (26.0)	20.5 (521.0)	17.75 (450.9)	16	1.25 (31.8)	0.95 (24.0)	18.0 (457.0)	16.0 (406.4)	12	1.00 (25.4)
14 (350)	1.02 (26.0)	21.0 (533.0)	18.75 (476.3)	12	1.13 (28.6)	1 - 8 UNC	1.10 (28.0)	23.0 (584.0)	20.25 (514.4)	20	1.25 (31.8)	1.02 (26.0)	20.75 (527.0)	18.5 (469.9)	12	1.00 (25.4)
16 (400)	1.10 (28.0)	23.5 (597.0)	21.25 (539.8)	16	1.13 (28.6)	1 - 8 UNC	1.18 (30.0)	25.5 (648.0)	22.5 (571.5)	20	1.38 (34.9)	1.10 (28.0)	22.75 (578.0)	20.5 (520.7)	12	1.00 (25.4)
18 (450)	1.18 (30.0)	25.0 (635.0)	22.75 (577.9)	16	1.25 (31.8)	1 1/8 - 7 UNC	1.18 (30.0)	28.0 (711.0)	24.75 (628.7)	24	1.38 (34.9)	1.18 (30.0)	25.25 (641.0)	23.0 (584.2)	16	1.00 (25.4)
20 (500)	1.18 (30.0)	27.5 (699.0)	25.0 (635.0)	20	1.25 (31.8)	1 1/8 - 7 UNC	1.18 (30.0)	30.5 (775.0)	27.0 (685.8)	24	1.38 (34.9)	1.18 (30.0)	27.75 (705.0)	25.25 (641.4)	16	1.00 (25.4)
24 (600)	1.18 (30.0)	32.06 (813.0)	29.5 (749.3)	20	1.38 (34.9)	1 1/4 - 7 UNC	1.18 (30.0)	36.0 (914.0)	32.0 (812.8)	24	1.62 (41.3)	1.18 (30.0)	32.5 (826.0)	29.75 (755.7)	16	1.25 (31.8)
30 (750)	1.26 (32.0)	38.75 (984.0)	36.0 (914.4)	28	1.38 (34.9)	1 1/4 - 7 UNC	1.26 (32.0)	43.0 (1092.0)	39.25 (997.0)	28	2.00 (50.8)	1.26 (32.0)	39.25 (997.0)	36.5 (927.1)	20	1.38 (34.9)

Table 4: Flange Drilling

NOMINAL Pipe Size Inch (mm)	Metric Series Conforms to I.S.O. 2084-1974 Table PN10 Holes to I.S.O. /R-273					Metric Series Conforms to I.S.O. 2084-1974 Table PN16 Holes to I.S.O. /R-273					J.I.S. Standard B-2212 Conforms to J.I.S. 10Kg/cm				
	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size
1 (25)	0.63 (16.0)	4.53 (115.0)	3.35 (85.0)	4	0.55 (14.0)	0.63 (16.0)	4.53 (115.0)	3.35 (85.0)	4	0.55 (14.0)	0.59 (15.0)	4.92 (125.0)	3.54 (90.0)	4	0.75 (19.0)
1.25 (32)	0.63 (16.0)	5.51 (140.0)	3.94 (85.0)	4	0.71 (18.0)	0.63 (16.0)	5.51 (140.0)	3.94 (100.0)	4	0.71 (18.0)	0.59 (15.0)	5.31 (135.0)	3.94 (100.0)	4	0.75 (19.0)
1.5 (40)	0.63 (16.0)	5.91 (150.0)	4.33 (110.0)	4	0.71 (18.0)	0.63 (16.0)	5.91 (150.0)	4.33 (110.0)	4	0.71 (18.0)	0.59 (15.0)	5.51 (140.0)	4.13 (105.0)	4	0.75 (19.0)
2 (50)	0.71 (18.0)	6.50 (165.0)	4.92 (125.0)	4	0.71 (18.0)	0.71 (18.0)	6.50 (165.0)	4.92 (125.0)	4	0.71 (18.0)	0.63 (16.0)	6.10 (155.0)	4.72 (120.0)	4	0.75 (19.0)
2.5 (65)	0.71 (18.0)	7.28 (185.0)	5.71 (145.0)	4	0.71 (18.0)	0.71 (18.0)	7.28 (185.0)	5.71 (145.0)	4	0.71 (18.0)	0.71 (18.0)	6.89 (175.0)	5.51 (140.0)	4	0.75 (19.0)
3 (80)	0.79 (20.0)	7.87 (200.0)	6.3 (160.0)	8	0.71 (18.0)	0.79 (20.0)	7.87 (200.0)	6.30 (160.0)	8	0.71 (18.0)	0.71 (18.0)	7.28 (185.0)	5.91 (150.0)	8	0.75 (19.0)
3.5 (90)	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	0.71 (18.0)	7.68 (195.0)	6.30 (160.0)	8	0.75 (19.0)
4 (100)	0.79 (20.0)	8.66 (220.0)	7.09 (180.0)	8	0.71 (18.0)	0.79 (20.0)	8.66 (220.0)	7.09 (180.0)	8	0.71 (18.0)	0.71 (18.0)	8.27 (210.0)	6.89 (175.0)	8	0.75 (19.0)
5 (125)	0.87 (22.0)	9.84 (250.0)	8.27 (210.0)	8	0.71 (18.0)	0.87 (22.0)	9.84 (250.0)	8.27 (210.0)	8	0.71 (18.0)	0.79 (20.0)	9.84 (250.0)	8.27 (210.0)	8	0.91 (23.0)
6 (150)	0.87 (22.0)	11.22 (285.0)	9.45 (240.0)	8	0.87 (22.0)	0.87 (22.0)	11.22 (285.0)	9.45 (240.0)	8	0.87 (22.0)	0.87 (22.0)	11.02 (280.0)	9.45 (240.0)	8	0.91 (23.0)
8 (200)	0.87 (22.0)	13.39 (340.0)	11.61 (295.0)	8	0.87 (22.0)	0.87 (22.0)	13.39 (340.0)	11.61 (295.0)	12	0.87 (22.0)	0.87 (22.0)	12.99 (330.0)	11.42 (290.0)	12	0.91 (23.0)
10 (250)	1.02 (26.0)	15.55 (395.0)	13.78 (350.0)	12	0.87 (22.0)	1.02 (26.0)	15.94 (405.0)	13.98 (355.0)	12	1.02 (26.0)	0.95 (24.0)	15.75 (400.0)	13.98 (355.0)	12	0.98 (25.0)
12 (300)	1.02 (26.0)	17.52 (445.0)	15.75 (400.0)	12	0.87 (22.0)	1.02 (26.0)	18.11 (460.0)	16.14 (410.0)	12	1.02 (26.0)	0.95 (24.0)	17.52 (445.0)	15.75 (400.0)	16	0.98 (25.0)
14 (350)	1.10 (28.0)	19.88 (505.0)	18.11 (460.0)	16	0.87 (22.0)	1.10 (28.0)	20.47 (520.0)	18.50 (470.0)	16	1.02 (26.0)	1.02 (26.0)	19.29 (490.0)	17.52 (445.0)	16	0.98 (25.0)
16 (400)	1.18 (30.0)	22.24 (565.0)	20.28 (515.0)	16	1.02 (26.0)	1.18 (30.0)	22.83 (580.0)	20.67 (525.0)	16	1.18 (30.0)	1.10 (28.0)	22.05 (560.0)	20.08 (510.0)	16	1.06 (27.0)
18 (450)	1.18 (30.0)	24.21 (615.0)	22.24 (565.0)	20	1.02 (26.0)	1.18 (30.0)	25.20 (640.0)	23.03 (585.0)	20	1.18 (30.0)	1.18 (30.0)	24.41 (620.0)	22.24 (565.0)	20	1.06 (27.0)
20 (500)	1.18 (30.0)	26.38 (670.0)	24.41 (620.0)	20	1.02 (26.0)	1.18 (30.0)	28.15 (715.0)	25.59 (650.0)	20	1.30 (33.0)	1.18 (30.0)	26.57 (675.0)	24.41 (620.0)	20	1.06 (27.0)
24 (600)	1.18 (30.0)	30.71 (780.0)	28.54 (725.0)	20	1.18 (30.0)	1.18 (30.0)	33.07 (840.0)	30.31 (770.0)	20	1.42 (36.0)	1.18 (30.0)	31.30 (795.0)	28.74 (730.0)	24	1.30 (33.0)
30 (750)	1.26 (32.0)	37.99 (965.0)	35.43 (900.0)	24	1.30 (33.0)	1.26 (32.0)	38.19 (970.0)	35.43 (900.0)	24	1.42 (36.0)	1.26 (32.0)	38.19 (970.0)	35.07 (900.0)	24	1.30 (33.0)

Drilling Chart for Bolting Requirements

Table 5:	Standard Drilling for PROCO Rubber Expansion Joints					Thickness of Materials for PROCO Rubber Expansion Joints			Control Unit Plate Detail	
	Flange Dimensions [2]					Material Thickness [1] for Bolt Length Requirements				
Nominal Pipe Size Expansion Joint I.D. Inch /(mm)	Flange O.D. Inch / (mm)	Bolt Circle Inch / (mm)	Number Of Holes	Size Of Holes Inch / (mm)	Bolt Hole Thread	Nominal Flange/ Beaded End Thickness Inch / (mm) (Approx. Value)	Adjacent Mating [3] Flange Thickness	Max. Control [4] Rod Plate Thickness Inch / (mm)	Control Rod [6] Plate O.D. Inch / (mm)	Maxi-mum [7] Rod Diameter Inch / (mm)
1 (25)	**4.25 (108.0)**	**3.13** (79.50)	4	**0.625** (15.87)	1/2-13 UNC	**1.25** (31.75)	CUSTOMER TO SPECIFY MATING FLANGE THICKNESS	**0.375** (9.53)	**8.375** (215.9)	**0.625** (15.9)
1.25 (32)	**4.63** (118.0)	**3.5** (88.90)	4	**0.625** (15.87)	1/2-13 UNC	**1.25** (31.75)		**0.375** (9.53)	**8.750** (222.3)	**0.625** (15.9)
1.5 (40)	**5.0** (127.0)	**3.88** (98.55)	4	**0.625** (15.87)	1/2-13 UNC	**1.25** (31.75)		**0.375** (9.53)	**9.125** (231.8)	**0.625** (15.9)
2 (50)	**6.00** (152.00)	**4.75** (120.65)	4	**0.750** (19.05)	5/8-11 UNC	**1.25** (31.75)		**0.375** (9.53)	**10.125** (257.2)	**0.625** (15.9)
2.5 (65)	**7.00** (178.00)	**5.50** (139.70)	4	**0.750** (19.05)	5/8-11 UNC	**1.25** (31.75)		**0.375** (9.53)	**11.125** (282.6)	**0.625** (15.9)
3 (80)	**7.50** (191.00)	**6.00** (152.40)	4	**0.750** (19.05)	5/8-11 UNC	**1.25** (31.75)		**0.375** (9.53)	**11.625** (295.3)	**0.625** (15.9)
3.5 (90)	**8.5** (216.0)	**7.0** (177.80)	8	**0.750** (19.05)	5/8-11 UNC	**1.25** (31.75)		**0.375** (9.53)	**12.625** (320.7)	**0.625** (15.9)
4 (100)	**9.00** (229.00)	**7.50** (190.50)	8	**0.750** (19.05)	5/8-11 UNC	**1.25** (31.75)		**0.375** (9.53)	**13.125** (333.4)	**0.625** (15.9)
5 (125)	**10.00** (254.00)	**8.50** (215.90)	8	**0.875** (22.23)	3/4-10 UNC	**1.50** (38.10)		**0.500** (12.70)	**14.125** (358.8)	**0.625** (15.9)
6 (150)	**11.00** (279.00)	**9.50** (241.30)	8	**0.875** (22.23)	3/4-10 UNC	**1.50** (38.10)		**0.500** (12.70)	**15.125** (384.2)	**0.625** (15.9)
8 (200)	**13.50** (343.00)	**11.75** (298.45)	8	**0.875** (22.23)	3/4-10 UNC	**1.50** (38.10)		**0.750** (19.05)	**19.125** (485.8)	**1.000** (25.4)
10 (250)	**16.00 (406.00)**	**14.25** (361.95)	12	**1.000** (25.40)	7/8-9 UNC	**1.50** (38.10)		**0.750** (19.05)	**21.625** (549.3)	**1.000** (25.4)
12 (300)	**19.00** (483.00)	**17.00** (431.80)	12	**1.000** (25.40)	7/8-9 UNC	**1.50** (38.10)		**0.750** (19.05)	**24.625** (625.5)	**1.000** (25.4)
14 (350)	**21.00** (533.00)	**18.75** (476.25)	12	**1.125** (28.58)	—	**1.75** (44.45)		**0.750** (19.05)	**26.625** (676.3)	**1.000** (25.4)
16 (400)	**23.50** (597.00)	**21.25** (539.75)	16	**1.125** (28.58)	—	**1.75** (44.45)		**0.750** (19.05)	**30.125** (765.2)	**1.250** (31.8)
18 (450)	**25.00** (635.00)	**22.75** (577.85)	16	**1.250** (31.75)	—	**2.00** (50.80)		**0.750** (19.05)	**31.625** (803.3)	**1.250** (31.8)
20 (500)	**27.50** (699.00)	**25.00** (635.00)	20	**1.250** (31.75)	—	**2.00** (50.80)		**0.750** (19.05)	**34.125** (866.8)	**1.250** (31.8)
24 (600)	**32.00** (813.00)	**29.50** (749.30)	20	**1.375** (34.93)	—	**2.00** (50.80)		**1.000** (25.40)	**38.625** (981.1)	**1.250** (31.8)
30 (750)	**38.75** (984.00)	**36.00** (914.40)	28	**1.375** (34.93)	—	**2.00** (50.80)		**1.250** (31.75)	**46.375** (1177.9)	**1.500** (38.1)

Metric Conversion Formula: Nominal I.D.: in. x 25 = mm; Dimensions/ Thickness': in. x 25.4 = mm.

Notes:

1. *Limit/Control Rod length is determined by neutral length of rubber expansion joint, rated extension, control rod plate thickness, mating flange thickness and number of nuts. Consult PROCO for rod lengths.*
2. *Flange Dimensions shown are in accordance with ANSI B16.1 and ANSI B16.5 Class 125/150, AWWA C-207-07, Tbl 2 and 3 - Class D, Table 4 - Class E. Hole size shown is 1/8" larger than AWWA Standard.*
3. *Adjacent mating flange thickness is required to determine overall rod length and compression sleeve length (if required).*
4. *Plate thickness is based on a maximum width PROCO would use to design a Limit/Control Rod plate.*
5. *Flat Washers required at ring splits and are supplied by others.*
6. *Control rod plate O.D. installed dimension is based on a maximum O.D. Proco would supply.*
7. *Control rod diameter is based on a maximum diameter Proco would use to design a control rod.*

A - Flange/Beaded End Thickness (Approximated Figure)
B - Adjacent Mating Flange Thickness (By Others)
C - Control Unit Plate Thickness
D - Double Nut Thickness is determined by Control Rod Diameter
E - Control Rod Bolt Length is determined by A through E + OAL [1]
F - Control Rod Control Rod Plate O.D.
G - Maximum Rod Diameter

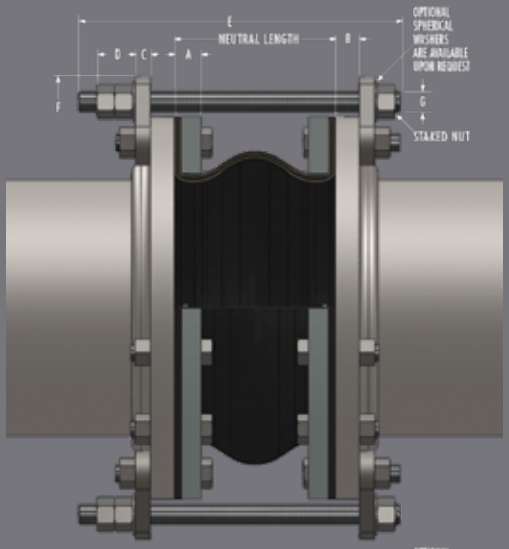


Figure 1
Style 240

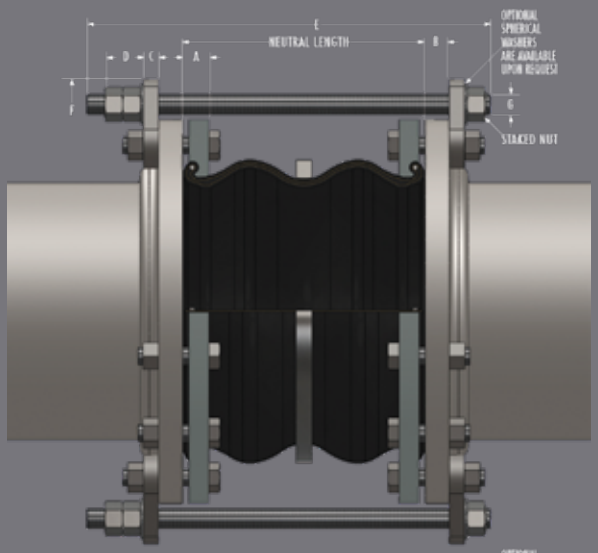


Figure 1
Style 242

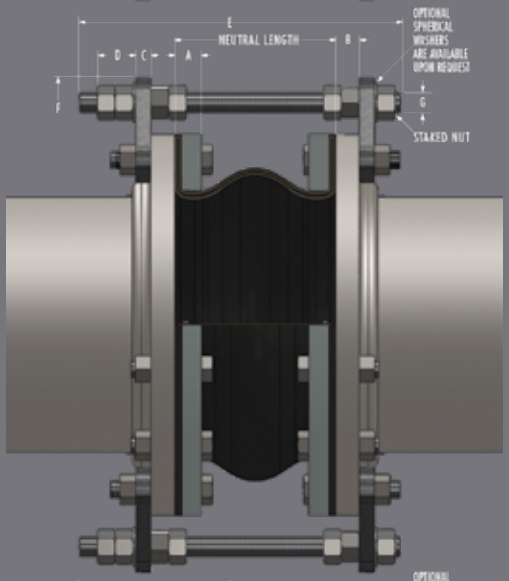


Figure 2
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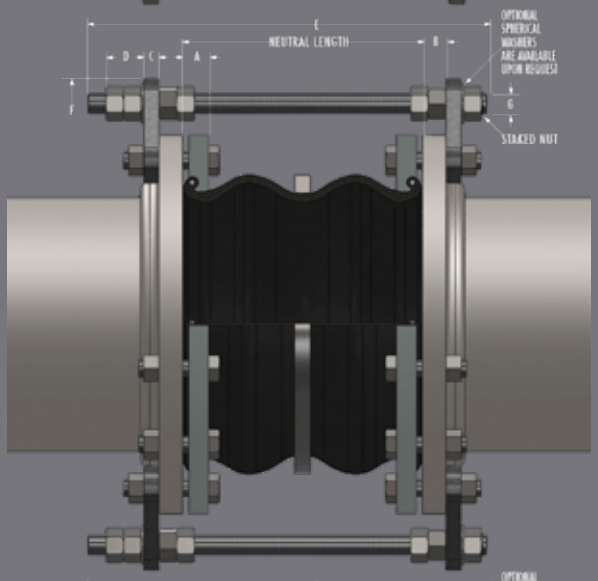

Figure 2
Style 242

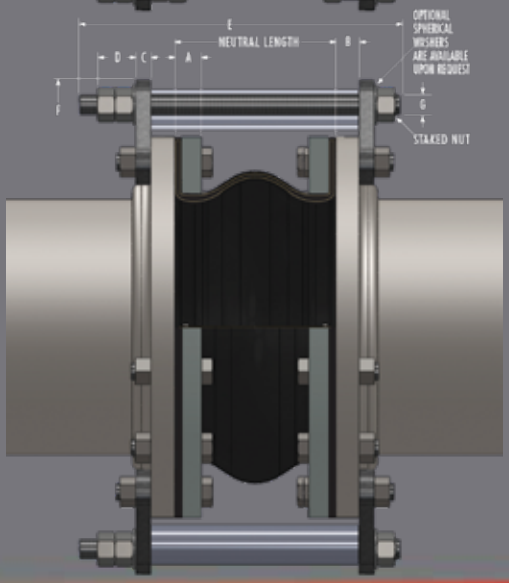

Figure 3
Style 240

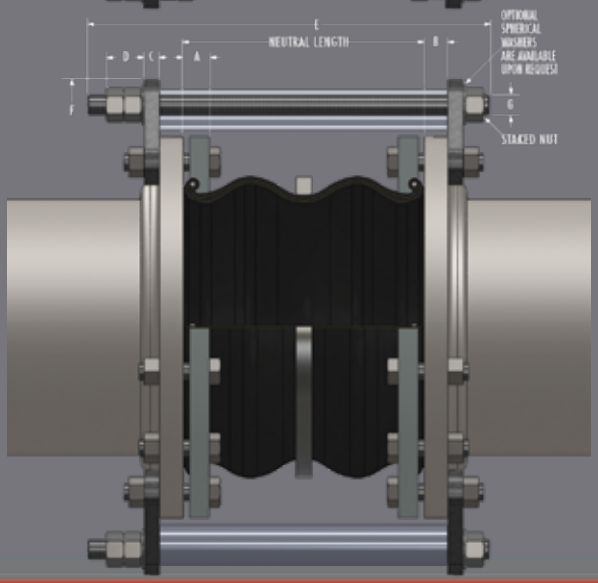

Figure 3
Style 242

Use of Control Units with Rubber Expansion Joints

Definition

A control unit assembly is a system of two or more control rod units (limit rods, tie rods or compression sleeves) placed across an expansion joint from flange to flange to minimize possible damage caused by excessive motion of a pipeline. The control unit assemblies can be set at the maximum allowable expansion and/or contraction of the rubber expansion joint. When used in this manner, control units are an additional safety factor and can minimize possible damage to adjacent equipment.

Rubber expansion joints should be installed between two fixed anchor points in a piping system. The pipe system must be rigidly anchored on both sides of the expansion joint to control expansion or contraction of the line. Piping anchors must be capable of withstanding the line thrusts generated by internal pressure or wide temperature fluctuations.

When proper anchoring cannot be provided, **CONTROL UNITS ARE REQUIRED.** For un-anchored piping systems nuts shall be tightened snug against rod plate to prevent over-extension due to pressure thrust created by expansion joint. Refer to "Thrust Factor" in Table 2, note 5 in this manual. Please also see Table 7 for number of control rods recommended based on maximum serge for test pressure of the system

Listed below are three (3) control unit configurations supplied by PROCO and are commonly used with rubber expansion joints in piping systems.

Figure 1

Known as a **LIMIT ROD**, this control unit configuration will allow an expansion joint to extend to a predetermined extension setting. Nuts shall be field-set to no more than the maximum allowable extension movement of a rubber expansion joint (unless used in an un-anchored system). Refer to Table 2 in this manual for allowable movement capabilities. Spherical washers can also be furnished (upon request) to combat any "nut-to-plate" binding during offset. ***Consult the systems engineer for proper nut settings prior to system operation.***

Figure 2

Known as a **LIMIT/CONTROL ROD**, this control unit configuration is used to allow specified pipe expansion (expansion joint axial compression) and pipe contraction (expansion joint axial extension) movements. Nuts shall be field set to no more than the maximum allowable extension (unless used in an un-anchored pipe system) or compression of a rubber expansion joint. Refer to Table 2 in this manual for allowable movement capabilities. Internal and external nuts can also be field-set to allow for no movement in the horizontal plane. This setting will allow the rubber to move laterally while keeping expansion joint thrust forces low on adjacent equipment. Spherical washers can also be furnished (upon request) to combat any potential "nut-to-plate" binding during offset. ***Limit/Control rods with internal nuts must be specified at the time of inquiry. Consult the systems engineer for proper nut settings prior to system operation.***

Figure 3

Known as a **COMPRESSION SLEEVE**, this configuration is used to allow for specified pipe expansion (expansion joint axial compression) and pipe contraction (expansion joint extension) movements. Nuts shall be field-set to no more than the maximum allowable extension (unless used in an un-anchored pipe system) of a rubber expansion joint. Refer to Table 2 in this manual for allowable movement capabilities. PROCO will manufacture each compression sleeve to allow for no axial movement unless otherwise specified by the purchaser. Compression sleeves shall be field-trimmed to meet required allowable axial movement as set forth by system requirements. Spherical washers can also be furnished (upon request) to combat any potential "nut-to-plate" binding during offset. ***Consult the systems engineer for proper sleeve lengths prior to system operation.***

Important Control Unit Considerations

The number of rods, control rod diameters and control rod plate thicknesses are important considerations when specifying control units for an application. As a minimum, specifying engineers or purchasers shall follow the guidelines as set forth in Appendix C of the Fluid Sealing Association's Technical Handbook, Seventh Edition. PROCO engineers its control unit assemblies to system requirements. Our designs incorporate an allowable stress of 65% of material yield for each rod and plate (rod and plate material to be specified by purchaser). Therefore, it is important to provide pressure and temperature ratings to PROCO when requesting control units for rubber expansion joints. It is also important to provide adjacent mating flange thickness or mating specifications to ensure correct rod lengths are provided.

Installation Instructions for Limit Rods

1. Assemble expansion joint between pipe flanges in its manufactured face-to-face length.

2. Assemble control rod plates behind pipe flanges as shown. Flange bolts or all-thread studs through the control rod plate must be longer to accommodate the plate thickness. Control rod plates should be equally spaced around the flange. Depending upon the size and pressure rating of the system, 2, 3, 4, or more control/limit rods may be required. Refer to Table 4 in this manual or to the Fluid Sealing Association's Technical Handbook, Seventh Edition, for control rod pressure ratings.

3. Insert control/limit rods through top plate holes. Steel flat washers are to be positioned at outer plate surface.

4. If a single nut per unit is furnished, position this nut so that there is a gap between the nut and the steel flat washer. This gap is equal to the joint's maximum extension (commencing with the nominal face-to-face length). To lock this nut in position, either "stake" the thread in two places or tack weld the nut to the rod. If two nuts are supplied, the nuts will create a "jamming" effect to prevent loosening. (Nuts should be snug against the flat washer and control rod plate when piping system is un-anchored.)

Note: Consult the manufacturer if there are any questions as to the rated compression and elongation. These two dimensions are critical in setting the nuts and sizing the compression pipe sleeve (if supplied).

5. If there is a requirement for compression pipe sleeves, an ordinary pipe may be used, sized in length to allow the joint to be compressed to its normal limit.

6. If there is a requirement for optional spherical washers, these washers are to be positioned at the inner and/or outer plate surface and backed up by movable double nuts.

Figure 1
Style 240

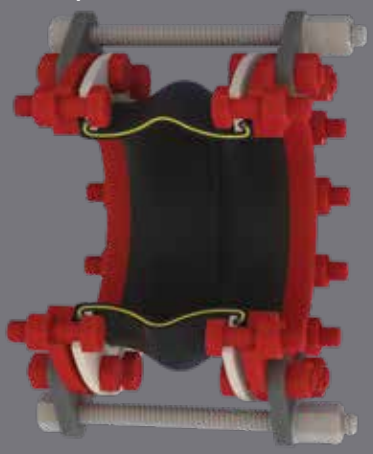

Figure 1
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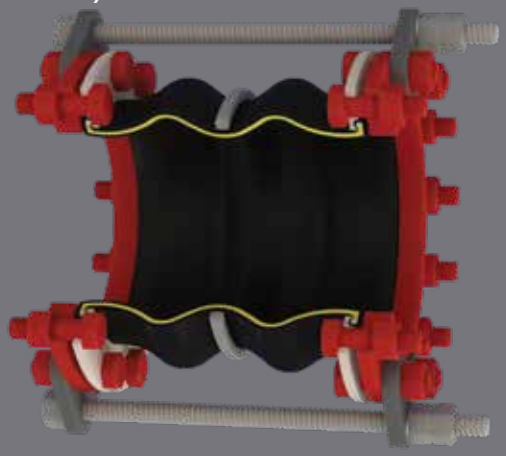

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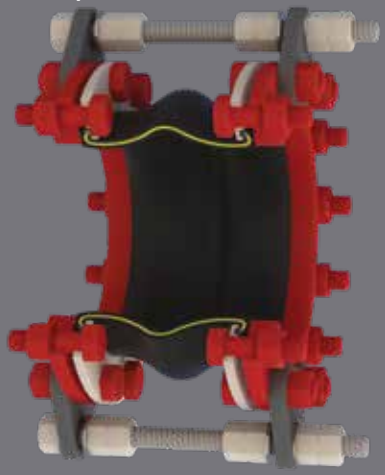

Figure 2
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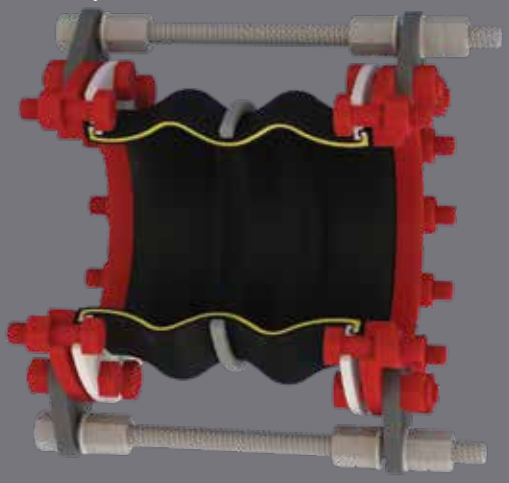

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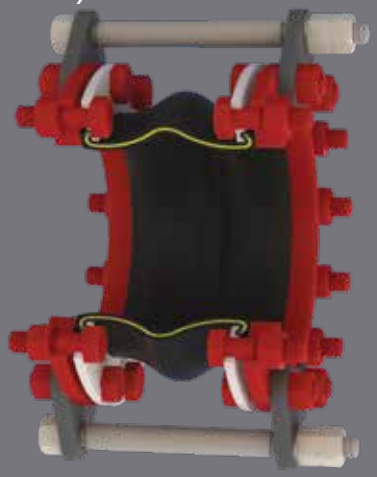

Figure 3
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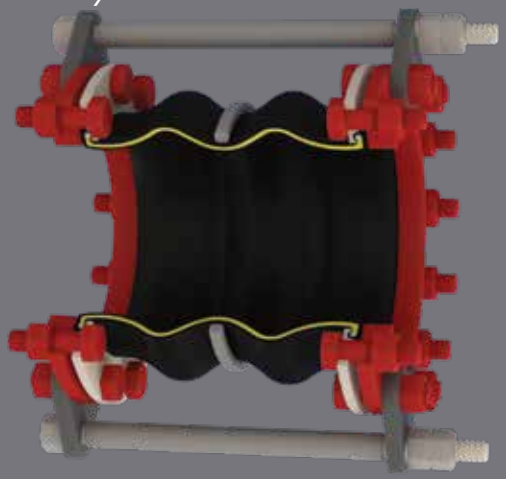


Table 6: Control Units/Anchored

Control Units must be installed when pressures (test • design • surge • operating) exceed rating below:

Pipe Size	Series 240 P.S.I.G.	Series 242 P.S.I.G.
1″ thru 4″	180	135
5″ thru 10″	135	135
12″ thru 14″	90	90
16″ thru 24″	45	45
30″	35	35

Table 7:

Nominal Pipe Size Expansion Joint I.D. Inch /(mm)		Maximum Surge or Test Pressure of the System — Number of Control Rods Recommended			
		2	4	6	8
1	(25)	949	•	•	•
1.25	(32)	830	•	•	•
1.5	(40)	510	•	•	•
2	(50)	661	•	•	•
2.5	(65)	529	•	•	•
3	(75)	441	•	•	•
4	(100)	311	622	•	•
5	(125)	235	470	•	•
6	(150)	186	371	•	•
8	(200)	163	326	•	•
10	(250)	163	325	488	•
12	(300)	160	320	481	•
14	(350)	112	223	335	•
16	(400)	113	227	340	453
18	(450)	94	187	281	375
20	(500)	79	158	236	315
24	(600)	74	147	221	294
30	(750)	70	141	211	281

Note:
Pressures listed above do not relate to the actual design pressure of the expansion joint products, but are the maximum surge or pressure for a specific control rod nominal pipe size.

Installation Instructions for Non-Metallic Expansion

1. Service Conditions:

Make sure the expansion joint rating for temperature, pressure, vacuum*, movements and selection of elastomeric materials match the system requirements. Contact the manufacturer if the system requirements exceed those of the expansion joint selected. (*Vacuum service for spherical rubber connectors: Vacuum rating is based on neutral installed length. These products should not be installed "extended" on vacuum applications.)

2. Alignment:

Expansion joints are not designed to make up for piping misalignment errors. Piping misalignment should be no more than 1/8" in any direction. Misalignment of an expansion joint will reduce the rated movements and can induce severe stress of the material properties, thus causing reduced service life or premature failure.

3. Anchoring:

Expansion joints should be located as close as possible to anchor points with proper pipe guides. Install expansion joints only on straight runs between anchors. It is recommended that control rods be installed on the expansion joint to prevent excessive movements from occurring due to pressure thrust of the line.

4. Pipe Support:

Piping must be supported so expansion joints do not carry any pipe weight.

5. Mating Flanges:

Install the expansion joint against the mating pipe flanges and install bolts so that the bolt head is against the expansion joint flange. Flange-to-flange dimension of the expansion joint must match the breech opening*. (*A spherical rubber connector must be pre-compressed 1/8" to 3/16" during installation in order to obtain a correct installed face-to-face dimension.)

Make sure the mating flanges are clean and are a flat-faced type. When attaching beaded end flange expansion joints to raised face flanges, the use of composite gaskets are required to prevent metal flange faces from cutting rubber bead during installation.

Never install expansion joints next to wafer type check or butterfly valves.

6. Bolting Torque:

Table 8 shows the recommended torque values for non-metallic expansion joints with beaded end type-flanges: Tighten bolts in stages by alternating around the flange. Use the recommended torque values in Table 8 to achieve a good seal. Never tighten an expansion joint to the point that there is metal-to-metal contact between the expansion joint flanges and the mating flanges. A slight bulge in the rubber beaded end should create a flush tight seal.
Note: Torque values are approximate due to mating flange surfaces, installation offsets, operating pressures and environmental conditions.

7. Storage:

Ideal storage is in a warehouse with a relatively dry, cool location. Store flanges face down on a pallet or wooden platform. Do not store other heavy items on top of the expansion joints. Ten year shelf life can be expected with ideal conditions. If storage must be outdoors, place on a wooden platform and joints should not be in contact with the ground. Cover with a tarpaulin.

8. Large Joint Handling:

Do not lift with ropes or bars through the bolt holes. If lifting through the bore, use padding or a saddle to distribute the weight. Make sure cables or forklift tines do not contact the rubber. Do not let expansion joints sit vertically on the edges of the flanges for any period of time.

9. Additional Tips:

A. Do not insulate/cover over a rubber expansion joint. This prevents inspection of the tightness of the joint bolting.
B. It is acceptable (but not necessary) to lubricate the expansion joint beaded end with a thin film of graphite dispersed in glycerin or water at time of installation to prevent damage.
C. Do not weld in the near vicinity of a non-metallic joint.
D. If expansion joints are to be installed underground, or will be submerged in water, contact manufacturer for specific recommendations.
E. If the expansion joint will be installed outdoors, make sure the cover material will withstand ozone, sunlight, etc.
F. Check the tightness of flanges two or three weeks after installation and retighten if necessary. Refer to Notes in Para 6. Bolting Torque.
G. Expansion joint installation should be conducted by an authorized and qualified pipe fitter.
H. While all Proco expansion joints are guaranteed for a period of one year and designed for many years of service, it is suggested that expansion joints be routinely inspected based on service conditions.

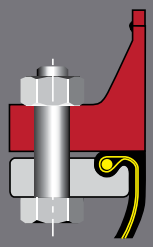
Warning: Expansion joints may operate in pipelines or equipment carrying fluids and/or gasses at elevated temperature and pressures and may transport hazardous materials. Precautions should be taken to protect personnel in the event of leakage or splash. Rubber joints should not be installed in areas where inspection is impossible. Make sure proper drainage is available in the event of leakage when operating personnel are not available.

Joints with Beaded End Flanges

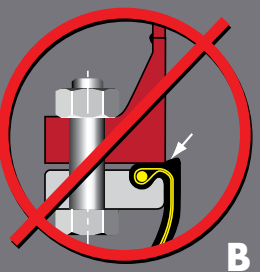
Table 8:	Bolt-Torque				
Nominal Pipe Size Expansion Joint I.D. Inch /(mm)	Step 1 FT-LBS (Nm)	Rest	Step 2 FT-LBS (Nm)	Rest	Step 3 FT-LBS (Nm)
1 (25)	18 (25)	30 Min	30 (40)	60 Min	45-60 (60-80)
1.25 (32)	18 (25)	30 Min	30 (40)	60 Min	45-60 (60-80)
1.5 (40)	18 (25)	30 Min	30 (40)	60 Min	45-60 (60-80)
2 (50)	18 (25)	30 Min	30 (40)	60 Min	45-60 (60-80)
2.5 (65)	18 (25)	30 Min	35 (50)	60 Min	50-60 (70-80)
3 (80)	25 (35)	30 Min	45 (60)	60 Min	60-75 (80-100)
3.5 (90)	25 (35)	30 Min	45 (60)	60 Min	60-75 (80-100)
4 (100)	25 (35)	30 Min	45 (60)	60 Min	60-75 (80-100)
5 (125)	25 (35)	30 Min	45 (60)	60 Min	60-75 (80-100)
6 (150)	30 (40)	30 Min	50 (70)	60 Min	60-75 (80-100)
8 (200)	30 (40)	30 Min	50 (70)	60 Min	60-75 (80-100)
10 (250)	30 (40)	30 Min	50 (70)	60 Min	75-85 (100-115)
12 (300)	30 (40)	30 Min	50 (70)	60 Min	75-85 (100-115)
14 (350)	30 (40)	30 Min	60 (80)	60 Min	75-95 (110-130)
16 (400)	30 (40)	30 Min	60 (80)	60 Min	75-95 (110-130)
18 (450)	30 (40)	30 Min	60 (80)	60 Min	90-95 (120-130)
20 (500)	30 (40)	30 Min	65 (90)	60 Min	95-185 (130-250)
24 (600)	30 (40)	30 Min	65 (90)	60 Min	95-185 (130-250)
30 (750)	30 (40)	30 Min	65 (90)	60 Min	95-220 (130-300)

Note: Bolt torque based on new bolts and nuts

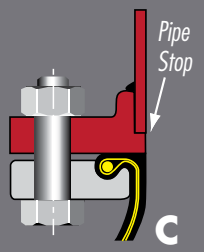
Right: Weld neck flanges with correct ID prevent damage to rubber.



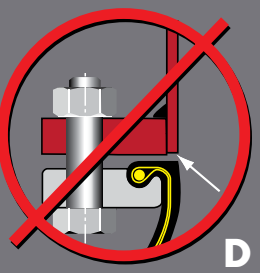
Wrong: Insure mating flange I.D. is flush with rubber.



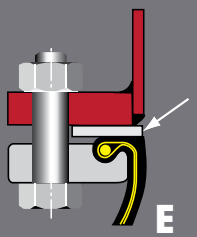
Right: Flanges with correct ID help prevent damage to rubber.



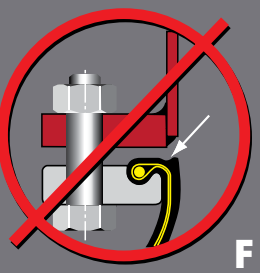
Wrong: Uneven end of pipe can cause damage to rubber.



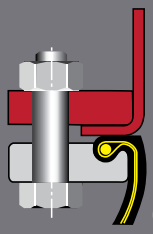
Right: In case of B, D, F an additional metal gasket can be used to prevent damage to rubber.



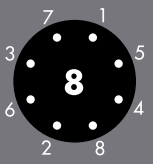
Wrong: Inner edge of flanges damages rubber.

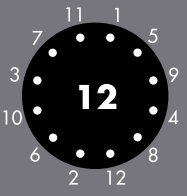


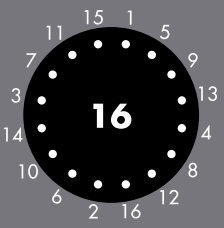
Right: Well rounded smooth edge prevents damage to rubber.

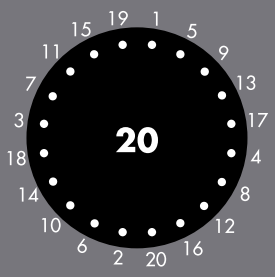


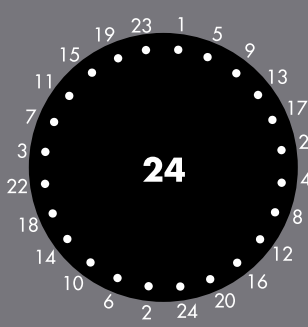
Tighten opposing nuts/bolts gradually according to the following sequence

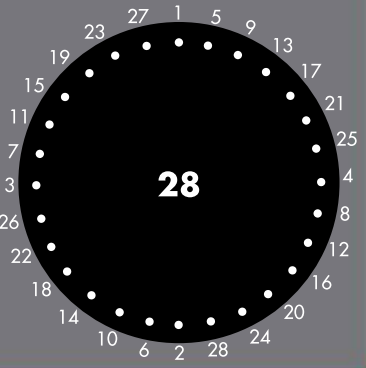


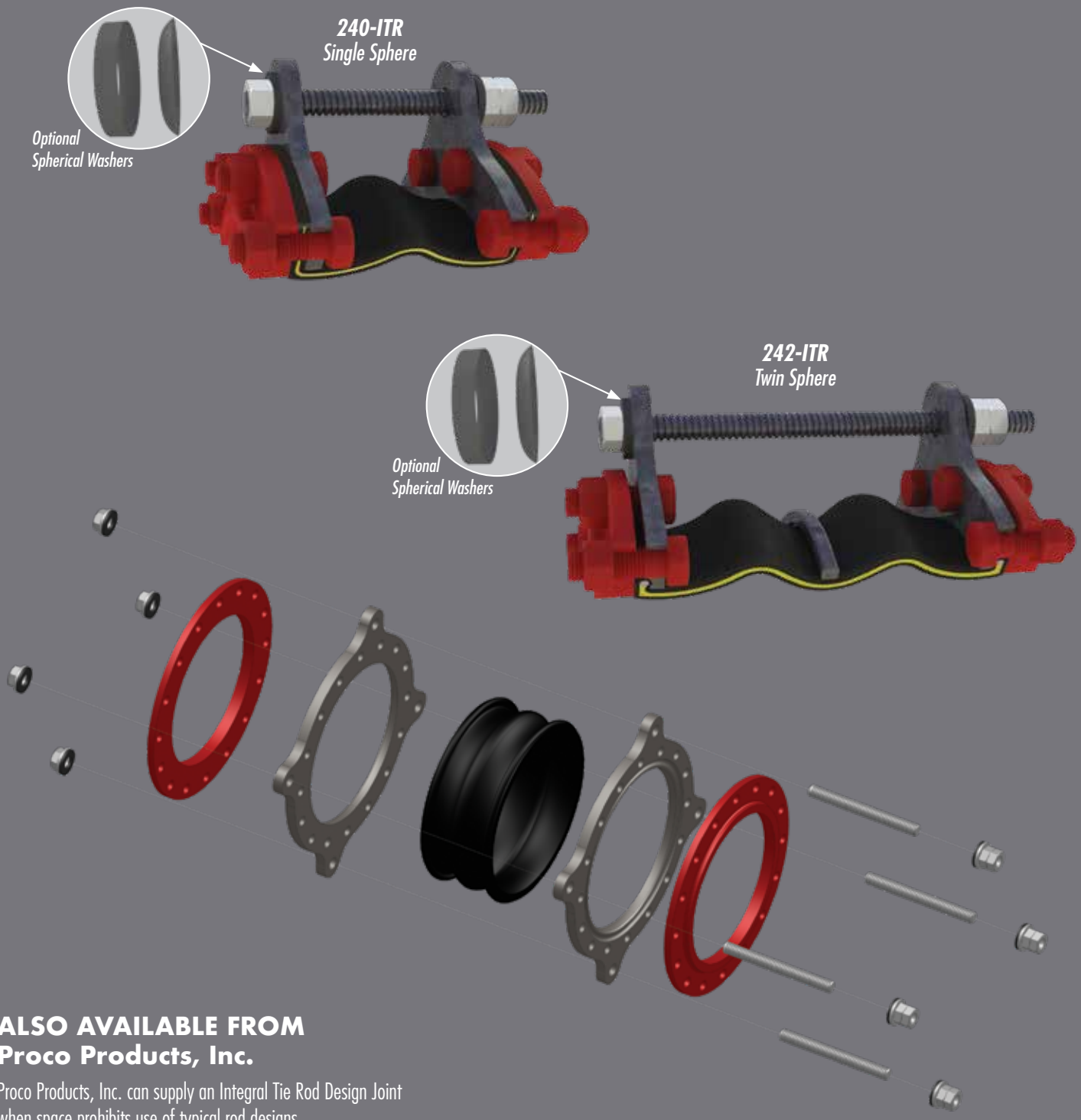












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Proco Products, Inc. can supply an Integral Tie Rod Design Joint when space prohibits use of typical rod designs.

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PROCO

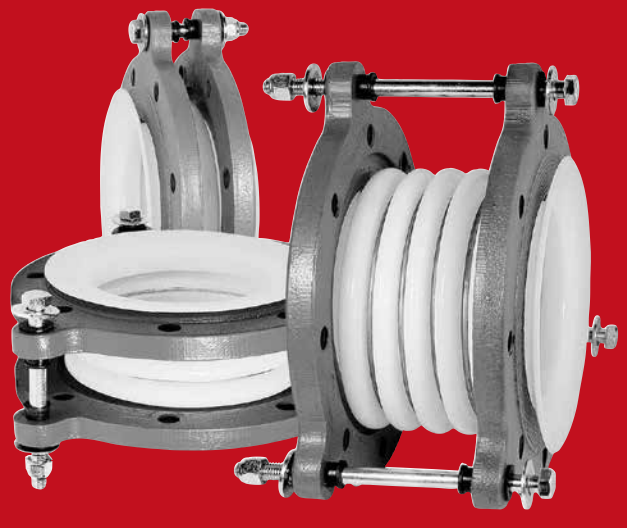
PROCO PRODUCTS, INC.

Series 440

Molded PTFE Expansion Joints

PROCO™

SERIES 440



molded PTFE expansion joints

The PROCO Series 440 PTFE Molded Expansion Joints are used for corrosive applications found in: Chemical-Petrochemical, Industrial Process Piping Systems, Power Generation Plants, Pulp/Paper Plants, Water-Wastewater Sewage and Pollution Control Systems where metallic joints/lap joints or PTFE & FEP-lined rubber expansion joints may have been previously used or specified. Specify PROCO Series 440 expansion joints for installation between anchor points or next to mechanical equipment such as: Absorption Machines, Blowers, Chillers, Fans, Graphite Heat Exchangers, Glass Lined Vessels, Pumps, and Exotic Alloy/Plastic/Glass Lined Piping Systems. The Series 440 expansion joints are designed to: (1) Absorb Pipe Movements/Stress, (2) Reduce System Noise, (3) Reduce Mechanical Vibration, (4) Compensate Alignment/Offset, (5) Eliminate Electrolysis, (6) Protect against Start-up/Surge Forces. Our history in the manufacture of expansion joint products dates back to 1930. When an engineered solution is needed to solve a piping problem, call PROCO.

Engineered For Your Application. The PROCO Series 440 PTFE expansion joints are available in 2, 3, and 5 convolutions. Each convolution profile offers different overall lengths (face-to-face dimensions), movements and pressure/temperature rating to fit the required specification. Available styles include:

- **Style 442-BD:** Features two convolutions for minimal movements, higher pressure/temperature ratings and short face-to-face opening requirements. Style 442-BD sizes range from 1" to 24" diameter. (See Table 1)
- **Style 443-BD:** Features three convolutions and is designed for moderate movement and ease of system installation. Style 443-BD sizes range from 1" to 24" diameter. (See Table 2)
- **Style 445-BD:** Features five convolutions, and is designed for maximum movements, low pressure/temperature ranges, vibration reduction and greater face-to-face lengths. Style 445-BD sizes range from 1" to 20" diameter. (See Table 3)
- **Style 440-BE:** Features varying Neutral Lengths with Styles' 440-BD Limit Bolts. (See Table 4)

Absorbs Pipe-Wall and Fluid-Borne Noise. The quiet operating PROCO Series 440 PTFE expansion joints are a replacement for "sound transmitting" metallic/lap joints. Pipe Wall sound loses energy and is absorbed as the noise carried by the piping enters and exits the PTFE section. Fluid-borne noise is absorbed by the volumetric expansion (breathing of the connector). This action cushions water hammer and smoothes out pumping impulses.

Isolates Vibration and Motion. PROCO Series 440 PTFE expansion joints should be installed immediately after and ahead of equipment generating vibration in order to isolate the rotating/vibrating equipment from the rest of the piping system. For optimum performance, the PROCO Series 440 PTFE expansion joints should be installed horizontally to the shaft. Vertical and perpendicular installations are also acceptable as these expansion joints will accept axial, lateral and angular movements as well as vibration. Note: For maximum vibration transmission reduction, the pipe section beyond the PTFE expansion joints must be anchored or sufficiently rigid.

Reduces System Stress and Strain. Rigid attachment of piping to critical or mechanical equipment can produce excessive loading. Thermal or mechanically created strain-stress-shock are cushioned and absorbed with the installation of a flexible, low spring rate, PROCO Series 440 PTFE expansion joint. The PROCO Series 440 PTFE expansion joint adds a flexible component to the system that automatically self-corrects for misalignment created by structural movements caused by settling, pipe expansion or ground shifts.

Tested Force Pound and Spring Rate Tables. At PROCO we have machine tested nearly every size of the Series 440 PTFE expansion joints for Axial and Lateral Spring Rates and have provided Thrust/Force factors so designers can properly design system restraints. It should be noted that the PROCO Series 440 PTFE expansion joints are in accordance with the performance characteristics of the Fluid Sealing Association's Non-Metallic Expansion Joint Division.

Superior "Flex Life" and Strength. The PROCO Series 440 PTFE expansion joints are contour molded from extruded tubing providing superior "Flex Life" and Strength. Utilizing TEFLON® T-62 resins from DuPont, the PROCO Series 440 PTFE expansion joints provide dramatically more cycle life than that of PFA or FEP.

Flange and Limit Bolts. All PROCO Series 440 PTFE expansion joint flange configurations are coated with a rust inhibitive primer to prevent corrosion and are dimensionally tapped to ANSI 125/150# Standards. Hole drilling on center line, other drilling standards, or other flange materials, such as 316 stainless, 304 stainless, or Epoxy Coated flanges are available on special order. In addition, all PROCO Series 440 PTFE expansion joints are supplied with factory set limit bolts to prevent over-extension during operation.

Chemical Service Capability at Minimal Cost. Expensive, exotic metal, PTFE or FEP lined rubber expansion joints for severe chemical service can be replaced with the low cost PROCO Series 440 PTFE expansion joints. The PTFE bellows are van stoned to the flanges which allows all wetted surfaces to come in contact with only the PTFE material. Specify the PROCO Series 440 PTFE expansion joints where high temperatures coupled with lower pressures or lower temperatures coupled with higher pressures are proposed. The PROCO Series 440 PTFE offers the lowest cost expansion joint that is impervious to chemical attack. Use the PROCO "Chemical to Elastomer Guide" for reference on chemical compatibility.

Services and Locations. PROCO Series 440 PTFE Expansion Joints have been supplied and successfully used by a range of customers worldwide in the process industries for use in both organic and inorganic chemical processing and production, including such demanding applications as agrochemical and pharmaceutical chemical production, acid processing and food manufacture.

Information • Ordering • Pricing • Delivery. Day or night, weekends and holidays…the PROCO phones are monitored 24 hours around the clock. When you have a question, you can call us.

Toll-Free Phone ..... 800 / 344-3246 USA/CANADA
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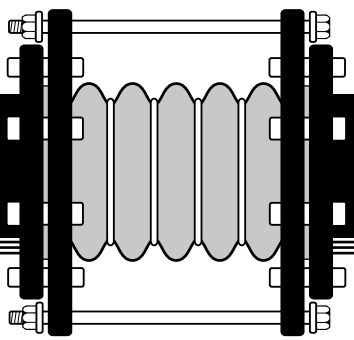
Fax ..... 209 / 943-0242
Email ..... sales@procoproducts.com
Website ..... www.procoproducts.com

Weekday office hours are 5:30 a.m. to 5:15 p.m. Pacific Time.



Protecting Piping And Equipment Systems From Stress/Motion

Rev. 4 9/10

PROCO™

STYLE 440-BE

molded PTFE expansion joints

Table 4: Sizes • Movements • Spring Rates • Flange Standards • Temperatures • Vacuum • Weights

NOMINAL SIZE I.D.	NEUTRAL LENGTH INCHES	MOVEMENT CAPABILITIES [1]			SPRING RATE CAPABILITY [2]				EXPANSION JOINT FLANGE DRILLING									PRESSURE AT TEMPERATURE (PSIG) @ °F								VACUUM RATING [3]	WEIGHT / LBS
		± AXIAL (Δx) MOVEMENT	LATERAL (Δy) DEFLECTION	ANGULAR DEFLECTION	COMPRESSION SPRING RATE	EXTENSION SPRING RATE	LATERAL SPRING RATE	THRUST FACTOR	# HOLES	THREADED HOLE SIZE	BOLT CIRCLE FLANGE "A"	PTFE FLARE O.D. "B"	FLANGE THICKNESS	NOMINAL FLANGE O.D.	LIMIT BOLT DIAMETER	BOLT CIRCLE LIMIT BOLT "C"	LIMIT BOLT "EAR" O.D.	70°	100°	150°	200°	250°	300°	350°	400°	Hg at Temp.	
		IN	IN	DEG.	LB_f/IN	LB_f/IN	LB_f/IN																				
Style 442-BE																											
1.00	1.750	0.344	.125	7	140	144	120	2.76	4	1/2- 13	3.125	2.000	.438	4.250	.250	5.125	6.000	185	170	148	130	115	100	84	68	29.9" @ 425°F	2
1.50	1.813	0.344	.125	7	240	200	240	4.60	4	1/2- 13	3.875	2.875	.469	5.000	.250	5.875	6.750	185	170	148	130	115	100	84	68	29.9" @ 425°F	2
2.00	1.875	0.344	.125	7	430	350	440	7.07	4	5/8- 11	4.750	3.625	.484	6.000	.375	6.875	8.125	185	170	148	130	115	100	84	68	29.9" @ 425°F	7
3.00	2.188	0.406	.188	7	650	320	350	15.90	4	5/8- 11	6.000	5.000	.578	7.500	.375	8.750	10.000	185	170	148	130	115	100	84	68	29.9" @ 425°F	10
4.00	2.281	0.438	.250	7	360	280	630	23.75	8	5/8- 11	7.500	6.188	.578	9.000	.375	9.875	11.125	185	170	148	130	115	100	84	68	29.9" @ 400°F	18
6.00	2.531	0.469	.250	7	460	350	720	50.24	8	3/4- 10	9.500	8.500	.641	11.000	.500	12.500	14.000	185	170	148	130	115	100	84	68	29.9" @ 400°F	29
8.00	2.750	0.531	.250	7	300	230	800	81.48	8	3/4- 10	11.750	10.625	.688	13.500	.500	14.750	16.250	164	150	129	112	100	87	73	60	29.9" @ 250°F	47
10.00	2.969	0.563	.250	6	1280	870	1000	108.38	12	7/8- 9	14.250	12.750	0.734	16.000	.500	17.500	19.000	164	150	129	112	100	87	73	60	29.9" @ 250°F	64
12.00	3.094	0.594	.250	5	380	240	1000	176.63	12	7/8- 9	17.000	15.000	0.813	19.000	.625	20.500	22.000	70	59	48	40	35	30	26	22	29.9" @ 75°F	115
Style 443-BE																											
1.00	2.313	0.500	.250	14	130	130	260	2.81	4	1/2- 13	3.125	2.000	.438	4.250	.250	5.125	6.000	138	126	107	90	76	64	53	45	29.9" @ 400°F	2
1.50	2.406	0.531	.250	12	80	70	110	5.09	4	1/2- 13	3.875	2.875	.469	5.000	.250	5.875	6.750	138	126	107	90	76	64	53	45	29.9" @ 400°F	4
2.00	2.500	0.531	.375	12	70	80	160	9.11	4	5/8- 11	4.750	3.625	.484	6.000	.375	6.875	8.125	138	126	107	90	76	64	53	45	29.9" @ 400°F	8
3.00	2.906	0.625	.500	10	140	160	190	16.91	4	5/8- 11	6.000	5.000	.578	7.500	.375	8.750	10.000	138	126	107	90	76	64	53	45	29.9" @ 400°F	13
4.00	3.063	0.656	.500	10	220	160	190	25.40	8	5/8- 11	7.500	6.188	.578	9.000	.375	9.875	11.125	138	126	107	90	76	64	53	45	29.9" @ 400°F	19
6.00	3.375	0.719	.563	9	350	190	540	50.24	8	3/4- 10	9.500	8.500	.641	11.000	.500	12.500	14.000	138	126	107	90	76	64	53	45	29.9" @ 300°F	30
8.00	3.656	0.781	.563	9	450	170	750	81.48	8	3/4- 10	11.750	10.625	.688	13.500	.500	14.750	16.250	120	110	94	80	67	57	47	38	29.9" @ 125°F	48
Style 445-BE																											
1.00	3.500	0.844	.500	20	50	110	50	2.81	4	1/2- 13	3.125	2.000	.438	4.250	.250	5.125	6.000	72	61	46	40	34	29	27	24	NOT DESIGNED FOR VACUUM SERVICE	2
1.50	3.625	0.785	.500	20	75	80	50	5.09	4	1/2- 13	3.875	2.875	.469	5.000	.250	5.875	6.750	72	61	46	40	34	29	27	24		5
2.00	3.750	0.875	.500	15	60	50	50	9.11	4	5/8- 11	4.750	3.625	.484	6.000	.375	6.875	8.125	72	61	46	40	34	29	27	24		9
3.00	4.375	1.031	.500	17	55	60	170	16.91	4	5/8- 11	6.000	5.000	.578	7.500	.375	8.750	10.000	72	61	46	40	34	29	27	24		14
4.00	4.563	1.094	.625	15	70	60	80	25.40	8	5/8- 11	7.500	6.188	.578	9.000	.375	9.875	11.125	72	61	46	40	34	29	27	24		20
6.00	5.031	1.188	.625	15	190	130	195	50.24	8	3/4- 10	9.500	8.500	.641	11.000	.500	12.500	14.000	72	61	46	40	34	29	27	24		31

NOTES: 1. Movements are non-concurrent and based from Neutral Length with Limit Bolts installed.
2. Spring Rate Capability is based on 1" of movement at zero pressure conditions.
3. Vacuum Rating is based from fully extended position. Style 445-BE is not designed for Vacuum Service.

PROCO STYLE NUMBER:	STYLE 440-BE MATERIALS OF CONSTRUCTION						
	BELLOWS	FLANGES	REINFORCING RINGS	LIMIT BOLTS	NUTS	GROMMETS	WASHERS
442-BE — 1" THROUGH 12" 443-BE — 1" THROUGH 8" 445-BE — 1" THROUGH 6"	PTFE T-62	DUCTILE IRON	STAINLESS STEEL	CARBON STEEL	CARBON STEEL	NEOPRENE	CARBON STEEL

PROCO™

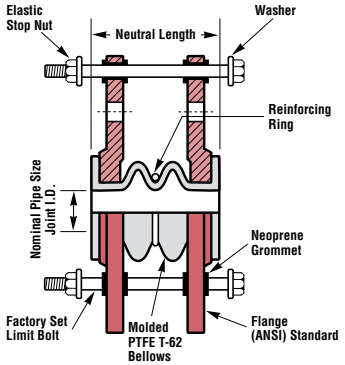
STYLE 442-BD

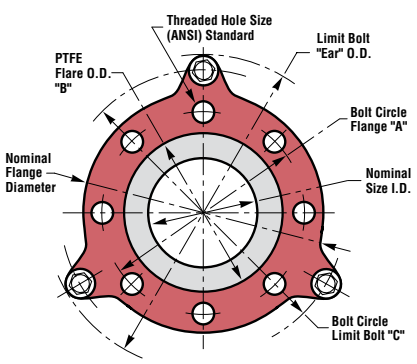
molded PTFE expansion joints

Table 1: Sizes • Movements • Spring Rates • Flange Standards • Temperatures • Vacuum • Weights

NOMINAL SIZE I.D.	NEUTRAL LENGTH INCHES	MOVEMENT CAPABILITIES BASED ON TWO CONVOLUTION DESIGN [1]			SPRING RATE CAPABILITY [2]				EXPANSION JOINT FLANGE DRILLING								PRESSURE AT TEMPERATURE (PSIG) @ °F								VACUUM RATING [3]	WEIGHT / LBS
		± AXIAL (Δx) MOVEMENT	LATERAL (Δy) DEFLECTION	ANGULAR DEFLECTION	COMPRESSION SPRING RATE	EXTENSION SPRING RATE	LATERAL SPRING RATE	THRUST FACTOR	# HOLES	THREADED HOLE SIZE	BOLT CIRCLE FLANGE "A"	PTFE FLARE O.D. "B"	FLANGE THICKNESS	NOMINAL FLANGE O.D.	LIMIT BOLT DIAMETER	BOLT CIRCLE LIMIT BOLT "C"	LIMIT BOLT "EAR" O.D.	70°	100°	150°	200°	250°	300°	350°	400°	Hg at Temp.	
		IN	IN	DEG.	LB_f/IN	LB_f/IN	LB_f/IN																				
1.00	1.375	0.250	.125	7	104	80	104	2.76	4	1/2- 13	3.125	2.000	.313	4.250	.250	5.125	6.000	185	170	148	130	115	100	84	68	29.9" @ 425°F	2
1.25	1.375	0.250	.125	7	61	137	400	2.25	4	1/2- 13	3.500	2.520	.394	4.630	.250	5.196	6.850	185	170	148	130	115	100	84	68	CF	5
1.50	1.375	0.250	.125	7	320	180	224	4.60	4	1/2- 13	3.875	2.875	.344	5.000	.250	5.875	6.750	185	170	148	130	115	100	84	68	29.9" @ 425°F	3
2.00	1.563	0.250	.125	7	512	300	240	7.07	4	5/8- 11	4.750	3.625	.438	6.000	.375	6.875	8.125	185	170	148	130	115	100	84	68	29.9" @ 425°F	7
2.50	2.250	0.313	.125	7	457	278	328	9.62	4	5/8- 11	5.500	4.125	.500	7.000	.375	8.125	9.375	185	170	148	130	115	100	84	68	29.9" @ 425°F	10
3.00	2.250	0.375	.188	7	648	320	319	15.90	4	5/8- 11	6.000	5.000	.500	7.500	.375	8.750	10.000	185	170	148	130	115	100	84	68	29.9" @ 425°F	10
4.00	2.625	0.500	.250	7	480	280	400	23.75	8	5/8- 11	7.500	6.188	.625	9.000	.375	9.875	11.125	185	170	148	130	115	100	84	68	29.9" @ 400°F	18
5.00	3.250	0.500	.250	7	440	440	320	33.17	8	3/4- 10	8.500	7.313	.750	10.000	.500	11.500	13.000	185	170	148	130	115	100	84	68	29.9" @ 400°F	24
6.00	2.750	0.500	.250	7	440	386	440	50.24	8	3/4- 10	9.500	8.500	.750	11.000	.500	12.500	14.000	185	170	148	130	115	100	84	68	29.9" @ 400°F	29
8.00	4.000	0.500	.250	7	450	390	480	83.49	8	3/4- 10	11.750	10.625	.938	13.500	.500	14.750	16.250	164	150	129	112	100	87	73	60	29.9" @ 250°F	47
10.00	5.250	0.500	.250	7	760	600	580	108.38	12	7/8- 9	14.250	12.750	1.000	16.000	.500	17.500	19.000	164	150	129	112	100	87	73	60	29.9" @ 250°F	64
12.00	6.000	0.500	.250	7	1300	420	700	176.63	12	7/8- 9	17.000	15.000	1.000	19.000	.625	20.500	22.000	70	59	48	40	35	30	26	22	29.9" @ 75°F	115
14.00	6.313	0.750	.375	7	320	1056	1256	233.59	12	1- 8	18.750	16.250	1.188	21.000	1.420	24.172	27.313	70	59	48	40	35	30	26	22	10.0" @ 212°F	126
16.00	7.000	1.000	.375	7	297	1096	1256	259.68	16	1- 8	21.250	18.500	1.188	23.500	1.420	27.563	31.500	70	59	48	40	35	30	26	22	10.0" @ 212°F	159
18.00	7.938	1.000	.375	7	440	1941	1370	321.90	16	1 1/8- 8	22.750	21.000	1.188	25.000	1.420	29.000	32.906	70	59	48	40	35	30	26	22	9.0" @ 212°F	174
20.00	9.000	1.000	.375	7	—	—	—	374.57	20	1 1/8- 8	25.000	23.000	1.188	27.500	1.420	31.500	35.438	70	59	48	40	35	30	26	22	6.0" @ 212°F	183
24.00	6.313	0.625	.375	7	—	—	—	538.36	20	1 1/4- 7	29.500	27.250	1.344	32.000	1.420	35.906	39.844	70	59	48	40	35	30	26	22	4.0" @ 212°F	238

NOTES: 1. Movements are non-concurrent and based from Neutral Length with Limit Bolts installed.
2. Spring Rate Capability is based on 1" of movement at zero pressure conditions.
3. Vacuum Rating is based from fully extended position. CF = Contact Factory.





SERIES 442-BD MATERIALS OF CONSTRUCTION

DESCRIPTION	1" THROUGH 12"	14" THROUGH 24"
BELLOWS	PTFE T-62	PTFE T-62
FLANGES	DUCTILE IRON	ZINC PLATED CARBON STEEL
REINFORCING RINGS	STAINLESS STEEL	STAINLESS STEEL
LIMIT BOLTS	CARBON STEEL	CARBON STEEL
NUTS	CARBON STEEL	CARBON STEEL
GROMMETS	NEOPRENE	NEOPRENE
WASHERS	CARBON STEEL	CARBON STEEL

PROCO™

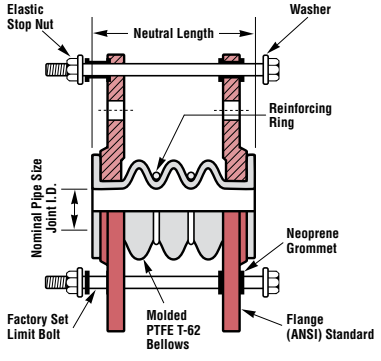
STYLE 443-BD

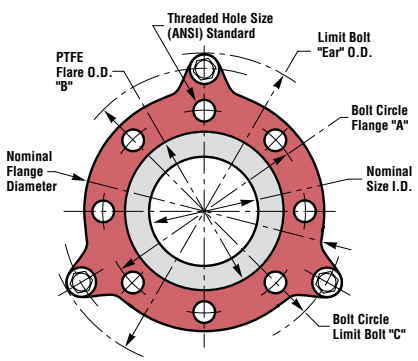
molded PTFE expansion joints

Table 2: Sizes • Movements • Spring Rates • Flange Standards • Temperatures • Vacuum • Weights

NOMINAL SIZE I.D.	NEUTRAL LENGTH INCHES	MOVEMENT CAPABILITIES BASED ON THREE CONVOLUTION DESIGN [1]			SPRING RATE CAPABILITY [2]				EXPANSION JOINT FLANGE DRILLING									PRESSURE AT TEMPERATURE (PSIG) @ °F								VACUUM RATING [3]	WEIGHT / LBS
		± AXIAL (Δx) MOVEMENT	LATERAL (Δy) DEFLECTION	ANGULAR DEFLECTION	COMPRESSION SPRING RATE	EXTENSION SPRING RATE	LATERAL SPRING RATE	THRUST FACTOR	# HOLES	THREADED HOLE SIZE	BOLT CIRCLE FLANGE "A"	PTFE FLARE O.D. "B"	FLANGE THICKNESS	NOMINAL FLANGE O.D.	LIMIT BOLT DIAMETER	BOLT CIRCLE LIMIT BOLT "C"	LIMIT BOLT "EAR" O.D.	70°	100°	150°	200°	250°	300°	350°	400°	Hg at Temp.	
		IN	IN	DEG.	LB_f/IN	LB_f/IN	LB_f/IN																				
1.00	1.750	0.500	.250	14	190	82	96	2.81	4	1/2- 13	3.125	2.000	.313	4.250	.250	5.125	6.000	138	126	107	90	76	64	53	45	29.9" @ 400°F	2
1.25	1.810	0.500	.250	14	40	120	314	2.25	4	1/2- 13	3.500	2.520	.394	4.630	.250	5.196	6.850	128	120	96	85	72	56	42	36	CF	5
1.50	2.000	0.500	.250	14	84	66	108	5.09	4	1/2- 13	3.875	2.875	.344	5.000	.250	5.875	6.750	138	126	107	90	76	64	53	45	29.9" @ 400°F	4
2.00	2.750	0.750	.375	14	69	76	109	9.11	4	5/8- 11	4.750	3.625	.438	6.000	.375	6.875	8.125	138	126	107	90	76	64	53	45	29.9" @ 400°F	8
2.50	3.188	0.750	.375	14	91	97	160	11.41	4	5/8- 11	5.500	4.125	.500	7.000	.375	8.125	9.375	138	126	107	90	76	64	53	45	29.9" @ 400°F	11
3.00	3.625	1.000	.500	14	124	125	194	16.91	4	5/8- 11	6.000	5.000	.500	7.500	.375	8.750	10.000	138	126	107	90	76	64	53	45	29.9" @ 400°F	13
4.00	3.625	1.000	.500	14	220	155	264	25.40	8	5/8- 11	7.500	6.188	.625	9.000	.375	9.875	11.125	138	126	107	90	76	64	53	45	29.9" @ 400°F	19
5.00	4.000	1.000	.500	14	320	210	324	34.45	8	3/4- 10	8.500	7.313	.750	10.000	.500	11.500	13.000	138	126	107	90	76	64	53	45	29.9" @ 300°F	25
6.00	4.000	1.125	.563	14	289	187	266	50.24	8	3/4- 10	9.500	8.500	.750	11.000	.500	12.500	14.000	138	126	107	90	76	64	53	45	29.9" @ 300°F	30
8.00	6.000	1.125	.563	14	178	218	423	83.49	8	3/4- 10	11.750	10.625	.938	13.500	.500	14.750	16.250	120	110	94	80	67	57	47	38	29.9" @ 125°F	48
10.00	7.000	1.188	.500	14	420	531	857	128.55	12	7/8- 9	14.250	12.750	1.000	16.000	.500	17.500	19.000	82	70	64	52	46	39	34	30	19.0" @ 212°F	60
12.00	7.875	1.188	.625	14	743	542	857	144.72	12	7/8- 9	17.000	15.000	1.000	19.000	.625	20.500	22.000	82	70	64	52	46	40	34	30	10.0" @ 212°F	77
14.00	8.500	1.250	.688	14	239	628	970	233.59	12	1- 8	18.750	16.250	1.188	21.000	1.420	24.172	27.313	82	70	64	52	46	40	34	30	10.0" @ 212°F	132
16.00	9.188	1.375	.750	14	245	571	970	259.68	16	1- 8	21.250	18.500	1.188	23.500	1.420	27.563	31.500	82	70	64	52	46	40	34	30	10.0" @ 212°F	165
18.00	11.063	1.188	.750	14	—	—	1085	321.90	16	1 1/8- 8	22.750	21.000	1.188	25.000	1.420	29.000	32.906	60	58	48	42	36	30	28	26	9.0" @ 212°F	201
20.00	12.875	1.188	1.000	14	—	—	1142	374.57	20	1 1/8- 8	25.000	23.000	1.188	27.500	1.420	31.500	35.438	60	58	48	42	36	30	28	26	6.0" @ 212°F	243
24.00	11.875	1.000	.750	14	—	—	—	538.36	20	1 1/4- 7	29.500	27.250	1.344	32.000	1.420	35.906	39.844	60	58	48	42	36	30	28	26	4.0" @ 212°F	309

NOTES: 1. Movements are non-concurrent and based from Neutral Length with Limit Bolts installed.
2. Spring Rate Capability is based on 1" of movement at zero pressure conditions.
3. Vacuum Rating is based from fully extended position. CF = Contact Factory.



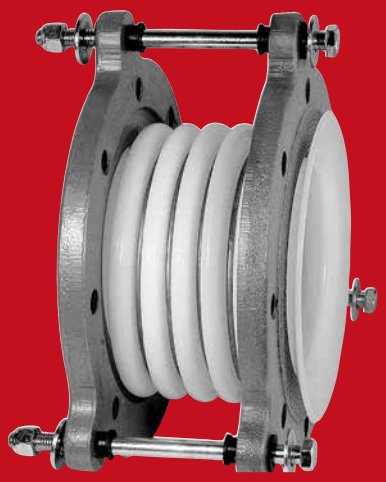


SERIES 443-BD MATERIALS OF CONSTRUCTION

DESCRIPTION	1" THROUGH 12"	14" THROUGH 24"
BELLOWS	PTFE T-62	PTFE T-62
FLANGES	DUCTILE IRON	ZINC PLATED CARBON STEEL
REINFORCING RINGS	STAINLESS STEEL	STAINLESS STEEL
LIMIT BOLTS	CARBON STEEL	CARBON STEEL
NUTS	CARBON STEEL	CARBON STEEL
GROMMETS	NEOPRENE	NEOPRENE
WASHERS	CARBON STEEL	CARBON STEEL

PROCO™

STYLE 445-BD

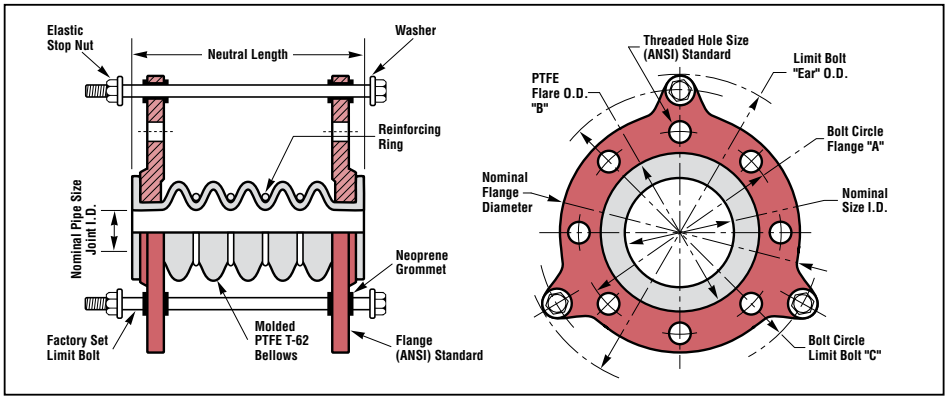


molded PTFE expansion joints

Table 3: Sizes • Movements • Spring Rates • Flange Standards • Temperatures • Vacuum • Weights

NOMINAL SIZE I.D.	NEUTRAL LENGTH INCHES	MOVEMENT CAPABILITIES BASED ON FIVE CONVOLUTION DESIGN [1]			SPRING RATE CAPABILITY [2]				EXPANSION JOINT FLANGE DRILLING								PRESSURE AT TEMPERATURE (PSIG) @ °F								VACUUM RATING [3]	WEIGHT / LBS
		± AXIAL (Δx) MOVEMENT	LATERAL (Δy) DEFLECTION	ANGULAR DEFLECTION	COMPRESSION SPRING RATE	EXTENSION SPRING RATE	LATERAL SPRING RATE	THRUST FACTOR	# HOLES	THREADED HOLE SIZE	BOLT CIRCLE FLANGE "A"	PTFE FLARE O.D. "B"	FLANGE THICKNESS	NOMINAL FLANGE O.D.	LIMIT BOLT DIAMETER	BOLT CIRCLE LIMIT BOLT "C"	LIMIT BOLT "EAR" O.D.	70°	100°	150°	200°	250°	300°	350°	400°	Hg at Temp.	
		IN	IN	DEG.	LB_f/IN	LB_f/IN	LB_f/IN																				
1.00	3.000	0.500	.500	20	30	44	22	2.81	4	1/2- 13	3.125	2.000	.313	4.250	.250	5.125	6.000	72	61	46	40	34	29	27	24		2
1.25	2.670	0.394	.470	20	36	114	171	2.25	4	1/2- 13	3.500	2.520	.394	4.630	.250	5.196	6.850	62	56	42	36	30	26	22	22		5
1.50	3.500	0.750	.500	20	75	83	46	5.09	4	1/2- 13	3.875	2.875	.344	5.000	.250	5.875	6.750	72	61	46	40	34	29	27	24	NOT	5
2.00	4.000	1.000	.500	20	60	47	50	9.11	4	5/8- 11	4.750	3.625	.438	6.000	.375	6.875	8.125	72	61	46	40	34	29	27	24		9
2.50	4.600	0.980	.510	20	116	319	285	10.08	4	5/8- 11	5.500	4.125	.500	7.000	.375	8.125	9.375	62	56	42	36	30	26	22	22		11
3.00	5.000	1.000	.500	20	55	60	170	16.91	4	5/8- 11	6.000	5.000	.500	7.500	.375	8.750	10.000	72	61	46	40	34	29	27	24	DESIGNED	14
4.00	5.250	1.250	.625	20	72	60	80	25.40	8	5/8- 11	7.500	6.188	.625	9.000	.375	9.875	11.125	72	61	46	40	34	29	27	24		20
5.00	6.000	1.250	.625	20	140	388	400	32.33	8	3/4- 10	8.500	7.313	.750	10.000	.500	11.500	13.000	62	56	42	36	30	26	22	22	FOR	26
6.00	6.000	1.250	.625	20	190	130	195	50.24	8	3/4- 10	9.500	8.500	.750	11.000	.500	12.500	14.000	72	61	46	40	34	29	27	24		31
8.00	8.000	1.250	.625	20	304	388	457	76.07	8	3/4- 10	11.750	10.625	.938	13.500	.500	14.750	16.250	48	42	34	30	26	22	22	22		49
10.00	8.750	1.250	.625	20	458	388	457	128.55	12	7/8- 9	14.250	12.750	1.000	16.000	.500	17.500	19.000	48	42	34	30	26	22	22	22	VACUUM	64
12.00	9.000	1.375	.688	20	529	445	457	144.72	12	7/8- 9	17.000	15.000	1.000	19.000	.625	20.500	22.000	48	42	34	30	26	22	22	22		88
14.00	12.790	1.375	.688	20	203	371	514	233.59	12	1- 8	18.750	16.250	1.188	21.000	1.420	24.172	27.313	48	42	34	30	26	22	22	22		143
16.00	13.500	1.625	1.000	20	180	383	514	259.68	16	1- 8	21.250	18.500	1.188	23.500	1.420	27.563	31.500	48	42	34	30	26	22	22	22	SERVICE	179
20.00	20.470	1.625	1.000	20	185	371	571	374.57	20	1 1/8- 8	25.000	23.000	1.188	27.500	1.420	31.500	35.438	48	42	34	30	26	22	22	22		243

NOTES: 1. Movements are non-concurrent and based from Neutral Length with Limit Bolts installed.
2. Spring Rate Capability is based on 1" of movement at zero pressure conditions.
3. Style 445-BD is not designed for Vacuum Service.



SERIES 445-BD MATERIALS OF CONSTRUCTION		
DESCRIPTION	1" THROUGH 12"	14" THROUGH 20"
BELLOWS	PTFE T-62	PTFE T-62
FLANGES	DUCTILE IRON	ZINC PLATED CARBON STEEL
REINFORCING RINGS	STAINLESS STEEL	STAINLESS STEEL
LIMIT BOLTS	CARBON STEEL	CARBON STEEL
NUTS	CARBON STEEL	CARBON STEEL
GROMMETS	NEOPRENE	NEOPRENE
WASHERS	CARBON STEEL	CARBON STEEL

Installation Instructions for Series 440 PTFE Expansion Joints

TORQUE TABLE LISTING

SIZE I.D. (IN)	1.0	1.25	1.5	2.0	2.5	3.0	4.0	5.0	6.0	8.0	10.0	12.0
TORQUE (FT/LBS)	10	16	25	52	47	82	54	80	100	135	125	155
TOLERANCE (+/-)(FT/LBS)	2	3	6	13	11	20	13	20	24	32	31	38

Notes: 1. Bolt Torque requirements may vary depending on mating flange material and installation.
2. "Over-Torque" may cause the PTFE material to creep.

1. Service Conditions: Make sure the expansion joint ratings for temperature, vacuum, spring rates and movements match the system requirements. Contact PROCO if the system requirements exceed those of the expansion joint selected.

2. Alignment: PROCO Series 440 PTFE expansion joints are not designed to make up for piping misalignment error. Pipe misalignment should be no more than 1/8" in any direction. Misalignment of an expansion joint will reduce the rated movements and can cause stress of material properties, thus causing reduced service life.

3. Limit Bolts: Limit bolts are factory set at the maximum allowable travel position to prevent over extension. Do not remove or alter nuts at any time. Damage or personal injury can result due to changes in limit bolt settings.

4. Anchoring: Solid anchoring is required whenever the pipeline changes direction. PROCO Series 440 PTFE expansion joints should be located as close as possible to these anchor points. If an anchoring system is not used, any associated pressure thrust can cause excessive movement, ultimately damaging the expansion joint. **(It should be noted that the attached limit bolts/cables are designed to limit movement and are not designed to handle pressure thrust.)**

5. Pipe Support: Piping must be supported by hangers or anchors so expansion joints do not carry any pipe weight.

6. Personnel Protection: It is strongly recommended that spray shields be used for all hazardous service to protect against serious personal injury in the event of expansion joint failure. (Contact PROCO for spray shield information.)

7. Installation:

a. Store expansion joints with wood covers in-place to protect PTFE flange surfaces from damage until ready to install.

b. Check to make sure PTFE surfaces are clean and free of foreign sediment. Remove nicks, burrs and deep scratches with a fine emery cloth. If surface irregularities cannot be completely removed, install a PTFE envelope-type gasket to obtain an adequate seal.

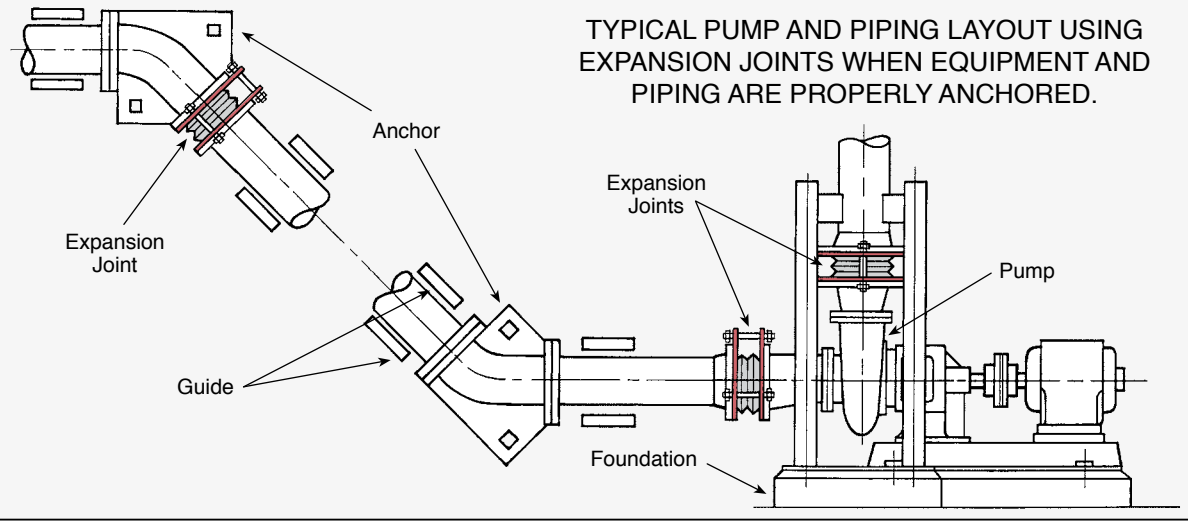
c. Install the PROCO Series 440 PTFE expansion joints to the prescribed neutral lengths. If expansion joints are used in high temperature processes, it is recommended that units be installed at/near the extended values. For cold process installations, expansion joints should be installed in a nearly compressed length. These settings will enable the expansion joint to realize full travel capabilities. (See appropriate Tables for Neutral Lengths.)

d. Thread installation bolts from mating flange side to prevent possible damage to PTFE elements. Extend bolts beyond the expansion joint flange by no more than 1–2 threads. Nuts are not necessary due to threaded flange holes.

e. Tighten flange bolts with a torque wrench. Tighten in an alternate crossing pattern in 20% increments until 80% of final bolt torques have been achieved. Tighten to final torque values (listed in Torque Table Listing) in a clockwise fashion around the flange to ensure bolts carry equal stress burdens.

f. Re-tighten bolts after first cycle of operation. Re-tighten as necessary after every planned maintenance shutdown. All bolts should be re-torqued to the above listed values.

8. Operations: After expansion joints are installed, it may be necessary to air blast the exterior to remove foreign debris, such as metal chips, from between the convolutions. The expansion joint should then be covered with a shield to protect from damage and foreign debris during operation. **(Note: Do not weld in immediate vicinity of expansion joint unless it is properly protected.)**



TYPICAL PUMP AND PIPING LAYOUT USING EXPANSION JOINTS WHEN EQUIPMENT AND PIPING ARE PROPERLY ANCHORED.

ENGINEERING DESIGN NOTES:

1. It is essential that piping system thrusts be calculated to ensure correct sizing of anchors and pipe supports, plus ensure that allowable thrust forces on adjacent mechanical and rotating equipment are not exceeded. Please use the following formulas:

$$T_p = P \cdot T_f$$

T_p is the pressure thrust (lb_f), **P** is the system operating pressure (Psig) and T_1 is the thrust factor (or bellows effective area [in^2]). The pressure thrust, T_p, will act in the axial direction and must be added to the axial spring force **(Fx•Δx)** to give the total axial reaction force, **Rx**.

$$Rx = T_p + (Fx \cdot \Delta x)$$

Rx is the pipe support reaction force (lb_f), T_p is the pressure thrust (lb_f), **Fx** is the axial spring force of the unit and **Δx** is the expected or designed axial movement of the unit (See Tables 1–3).

2. It should be noted that axial spring rate values found in Tables 1 through 3 are based on an ambient temperature (70°F) and will decrease as the system temperature rises. In addition, spring rates decrease over time due to thermoplastic creep if units are operated under pressure.

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