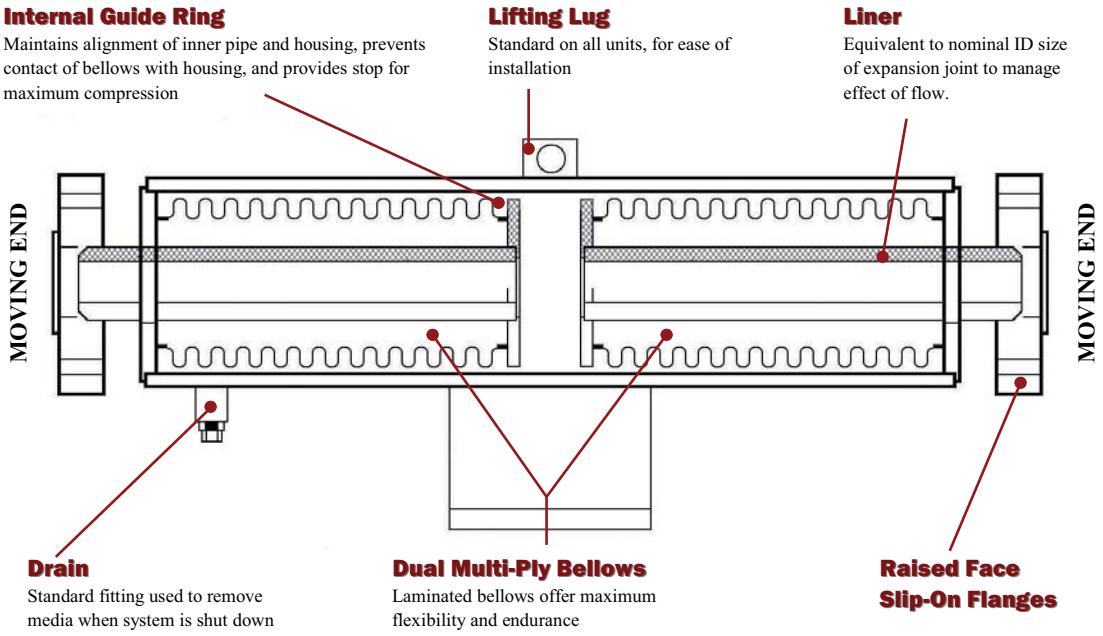
Dual Externally-Pressurized Expansion Joints

PLATINUM SERIES – DEP



Internal Guide Ring
Maintains alignment of inner pipe and housing, prevents contact of bellows with housing, and provides stop for maximum compression

Lifting Lug
Standard on all units, for ease of installation

Liner
Equivalent to nominal ID size of expansion joint to manage effect of flow.

Drain
Standard fitting used to remove media when system is shut down

Dual Multi-Ply Bellows
Laminated bellows offer maximum flexibility and endurance

Raised Face Slip-On Flanges

Externally-Pressurized Expansion Joints are Designed to Replace:

High Maintenance Packed Joints ♦ Space Confining Pipe Loops ♦ Costly Equalizing Expansion Joints

OPTIONAL CONFIGURATIONS

END TYPE:	LINER:	PRESSURE:
Weld Ends	Schedule 40	150 Lbs
Grooved Ends	Schedule 80	300 Lbs
Plate Flanges		Consult Factory for Higher Pressure Applications

ADDITIONAL LITERATURE PERTAINING TO THIS PRODUCT SERIES:

- ♦Installation Guide
- ♦Submittal Drawings
- ♦Engineering Specification
- ♦Multi-Ply Expansion Joint Selection Guide
- ♦Single Externally-Pressurized Expansion Joint (DEP Series)

FEATURES:

- ▶The First Choice In Steam Bearing Expansion Joints
- ▶Variety Of Available End Fittings
- ▶150 PSI Or 300 PSI
- ▶Traverse Up To 16”
- ▶Maintenance Free
- ▶Ready For Direct Burial*

* Consult Factory For Installation Details

100% American Made

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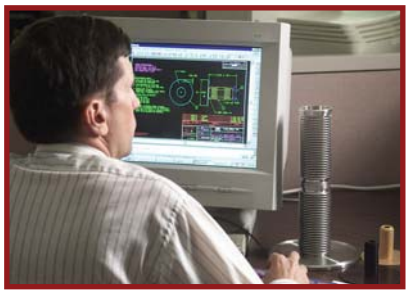
SPOTLIGHT ON MULTI-PLY EXPANSION JOINTS

KEFLEX™ MULTI-PLY ADVANTAGES

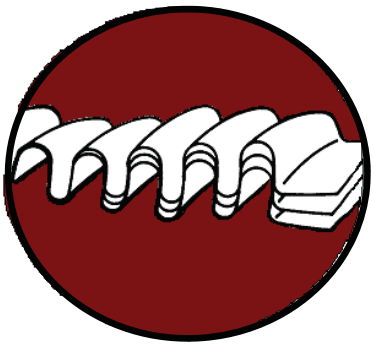
- Increased flexibility
- Higher pressures attainable
- Lower thrust forces
- Lower spring rates & higher elasticity
- Minimal installation length required
- Fail safe design--shoulder, liners, multi-ply standard construction
- Elevated corrosion resistance
- Low cost

ADVANTAGES:



MULTI-PLY SAFETY FACTORS - In a critical application, a multi-ply expansion joint can in most cases preclude a catastrophic failure. If a failure occurs in one ply due to corrosion or fatigue, the intact plies will work as a protective barrier to contain the pressure and the medium until a replacement can be made. Flex-Weld Multi-ply expansion joints are designed to provide utmost safety in the event of system failure. The burst pressures are a multiplier of the operating pressure making the Flex-Weld multi-ply bellows the most reliable component in the system.

CYCLE LIFE OPTIMIZATION - The technical advantage of using multiple plies of thin wall thickness material is that less residual stresses are introduced at the time of bellows forming. Overall, Flex-Weld multi-ply expansion joints have lower built-in and induced stresses which ultimately results in longer cycle life. Also, the thinner gauge multiple plies have less localized induced stresses during operation compared to a single thicker ply. The configuration of the convolutions (pitch, depth, contour, number of plies, ply thickness) of FLEX-WELD multi-ply expansion joints are optimized to offer the highest fatigue life.



COMPACT DESIGN - Multi-ply expansion joints have more flexibility than conventional single-ply expansion joints and thus require less live length to accommodate a given movement. The live length of the bellows can be minimized to absorb a given combination of axial, lateral and angular movements. This results in an economical compact assembly which can be installed in a minimal amount of space. An additional benefit is a small effective area resulting in lower thrust pressures on the anchors and mechanical equipment in the system.

LOWER THRUST FORCES - The multi-ply design results in lower spring rates. Also, the effective cross sectional area of multi-ply expansion joints is less, compared to single-ply bellows, to accommodate a given movement. These two reductions result in lower forces and moments on the anchors, equipment and guides. A side benefit is that less anchors and guides will be required in the overall bellows piping system.

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SPOTLIGHT ON MULTI-PLY EXPANSION JOINTS

KEFLEX

MANUFACTURING CAPABILITIES

- Proprietary forming techniques produce metallic expansion joint bellows of consistent quality and close tolerances.
- In-process testing & inspection result in the most reliable expansion joints.
- Mechanically forming one convolution at a time minimizes material thinning.
- High frequency pulse TIG welds minimize the heat –affected (HAZ) zone and results in superior bellows strength, ductility and dependability.
- Diameters ranging from 2” I.D. to 12" I.D.
- Pressures ranging from vacuum to 1,000 PSI depending on application.
- Temperatures ranging from cryogenic to 2600°F
- Axial movements up to 8" depending up on size.
- Material handling from abrasive solids to corrosive gases and liquids.

EXPANSION JOINT BELLOWS MATERIALS

- T-321 Stainless Steel
- T-316 (L) Stainless Steel
- T-304 (L) Stainless Steel
- T-347 Stainless Steel
- Brass
- Beryllium Copper
- Phosphor Bronze
- Carpenter Alloy 20
- Inconel 625
- Inconel 625 LCF
- Monel 400
- Titanium
- Hastelloy C-276, C-22, C-2000
- Haynes 230
- Hastelloy B, B2
- Other alloys available upon request

SPECIAL CAPABILITIES

- Mass Spec Leak Testing
- Teflon Coating
- Heat Treating
- Liquid Penetrant Testing / Radiography
- Plating
- Custom Flange Fitting Design
- Machining / Stamping
- Welding
  Laser, MIG, TIG, RSEW
- Soldering
- Brazing
- Material Selection
- Failure Analysis
- Concurrent Engineering
- Cleaning
- Electro-Polishing
- Special Testing
- Prototyping/Modeling
- CAD / CAM
- System Engineering and Design (Complete take offs)

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1, 2, 3 QUICK & EASY SELECTION GUIDE

1 Determine the Operating Conditions

Use the Product Engineering Worksheet as a guide

2 Develop the Expansion Joint Requirements

3 Select the Proper Expansion Joint

1 DETERMINE THE OPERATING CONDITIONS & SYSTEM PARAMETERS

Determining the necessary information is the first step. Use the Keflex™ Product Engineering Worksheet (Form #EJWS4102) as a guide to proper selection of a standard expansion joint .

- ☑ Size
  - •ID
  - •OAL
- ☑ Pipe Detail
  - •Material Type
  - •Length of Run
- ☑ Media
  - •External
  - •Internal
- ☑ System Temp. (Min/Max)
- ☑ Ambient Temp. (°F)
- ☑ Design PSI
- ☑ Working PSI
- ☑ Axial Compression
- ☑ Axial Extension
- ☑ Lateral Deflection
- ☑ Angular Motion

Name of Person Submitting Data:	Part Description	Quantity Required
Size of Assembly: Nominal size or inside diameter of the connecting end fittings	Inches	
Installed Length (OAL): Space between connecting points	Inches	
Type of Media: Indicate if liquid, steam, gas, exhaust, slurry, solids, etc.		
Bellows Material Type:		
Temperature of Flowing Media: Indicate both operating and maximum temperatures of system	Operating °F	Maximum °F
Temperature of Surrounding Atmosphere: Indicate both min. & max. temperatures of atmosphere at the expansion joint	Min. Degrees °F	Max. Degrees °F
Velocity of Flowing Media: In feet/Sec or Gallons/Min	Feet/Sec	Gal/Min
Operating Pressure: Actual pressure which system works under normal conditions	Positive PSIG	Negative HG
Design Pressure of the System: Highest / Most severe pressure during operation	Positive PSIG	Negative HG
Test Method & Requirements: Test method used and testing levels required for system	Positive PSIG	Negative HG
Axial Movement (Compression/Extension): In inches as a result of system extension/expansion	Compression in Inches	Extension in Inches
Lateral Deflection / Offset: In inches	Inches	
Angular Movement: In degrees	Degrees	
Liner / Shroud Type:	Liner	Shroud
Lead Time / Target Pricing:	Required Lead Time	Target Price
End Fittings 1/E: Indicate end fitting requirements, thickness, material type & configuration		
End Fittings O/E: Indicate end fitting requirements, thickness, material type & configuration		
System Accessories: Indicate any accessories required including; Guides, Control Rods, Retaining Rings, Anchor Bases, Insulation, Etc.		
Special Notes / Shipping Instructions:		

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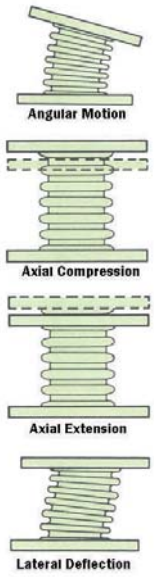
KEFLEX 1, 2, 3 QUICK & EASY SELECTION GUIDE

2 DEVELOP THE EXPANSION JOINT REQUIREMENTS

- **Size**—Measure pipe size (ID) of the system.
- **Type**—Determine piping material type.
- **Run of Pipe**—Length of pipe measured from anchor to anchor.
- **Media**—Identify what is going through the expansion joint (i.e. water, air, steam, etc.).
- **Design PSI**—Identify the pressure the system was designed to carry. Some systems carry a design pressure greater than the working pressure. If no design pressure is available, use the working pressure.
- **Working PSI**—Identify the maximum working or operating pressure of the system.
- **System Temp. (°F)** - Identify the max./min. temperature range of the system. This is necessary in order to determine maximum pipe growth and the expansion joint axial compression or extension required.
- **Ambient Temp. (°F)** - External temperature to the system should be considered if it falls outside of the max./min. media temperatures.
- **Axial Motion (in.)** also **Axial Extension (in.)** - Sometimes referred to as traverse, is defined as the amount of motion parallel to the longitudinal axis in a straight, guided pipe line which is absorbed by an expansion joint. **Compression:** As the pipe expands (lengthens) due to temperature increase, the expansion joint compresses (shortens). **Extension:** As the pipe contracts (shortens) due to temperature decrease (below installation temperature), the expansion joint will extend (lengthen).
- **Angular Motion (Degrees)** - Also referred to as radial-angular movement, is defined as movement in which the ends are displaced at an angle to each other rather than remaining parallel. **DOES NOT APPLY TO SEP SERIES.**
- **Lateral Deflection**—Lateral deflection, also referred to as shear or offset, is defined as single plane deflection from the center line of one end of an expansion joint, but with that end remaining parallel to the other end. **DOES NOT APPLY TO SEP SERIES.**



How to Use the Thermal Expansion Table:

Example: Find the expansion 0f 105ft. Of any diameter carbon steel pipe carrying steam at 138 PSIG and at a lowest surrounding ambient temperature of 40°F.

- Maximum temperature = 360°F (138 PSIG saturated steam)
- Calculated traverse (from table)
  Expansion per 100 ft. of carbon steel at 360°F = 2.88”
- Less expansion per 100 ft. of carbon steel pipe at 40°F = 0.30”
- Expected traverse per 100 ft. = 2.58”

Expansion of 105 ft. = (105 / 100) x 2.58” = 2.71”

Conclusion: Since an expansion joint is normally set at 80% in compression and 20% in extension, an expansion joint with 4” total axial movement should be selected.

Thermal Expansion Table

Thermal Expansion of Pipe in Inches per 100 Feet							
Saturated Steam Vacuum in HG below 212°F, Pressure, PSIG above 212°F	Temp. ° F	Cast Iron	Carbon Steel or Steel	Wrought Iron	4-6% Cr. Alloy Steel	18 Cr.-8Ni Stainless Steel	Copper
	-200	-1.058	-1.282	-1.289	-1.250	-2.030	-1.955
	-180	-0.982	-1.176	-1.183	-1.150	-1.850	-1.782
	-160	-0.891	-1.066	-1.073	-1.030	-1.670	-1.612
	-140	-0.797	-0.948	-0.955	-0.970	-1.480	-1.428
	-120	-0.697	-0.826	-0.833	-0.800	-1.300	-1.235
	-100	-0.593	-0.698	-0.705	-0.700	-0.900	-1.040
	-80	-0.481	-0.563	-0.570	-0.500	-0.880	-0.835
	-60	-0.368	-0.428	-0.435	-0.430	-0.670	-0.630
	-40	-0.248	-0.288	-0.295	-0.920	-0.450	-0.421
	-20	-0.127	-0.145	-0.152	-0.145	-0.225	-0.210
	0	0	0	0	0	0	0
	20	0.128	1.148	0.180	0.140	0.223	0.238
	32	0.209	0.230	0.280	0.234	0.356	0.366
29.39	40	0.270	0.300	0.350	0.280	0.446	0.451
	60	0.410	0.448	0.540	0.430	0.669	0.684
28.89	80	0.550	0.580	0.710	0.500	0.892	0.896
27.99	100	0.680	0.753	0.887	0.650	1.115	1.134
26.48	120	0.830	0.910	1.058	0.800	1.338	1.366
24.04	140	0.970	1.064	1.240	0.950	1.545	1.590
20.27	160	1.110	1.200	1.420	1.100	1.784	1.804
14.63	180	1.240	1.360	1.580	1.250	2.000	2.051
6.45	200	1.390	1.520	1.750	1.400	2.230	2.296
0	212	1.480	1.610	1.870	1.500	2.361	2.428
2.50	220	1.530	1.680	1.940	1.550	2.460	2.516
10.30	240	1.670	1.840	2.120	1.720	2.680	2.756
20.70	260	1.820	2.020	2.300	1.880	2.920	2.985
34.50	280	1.970	2.180	2.470	2.050	3.150	3.218
52.30	300	2.130	2.350	2.670	2.200	3.390	3.461
74.90	320	2.268	2.530	2.850	2.370	3.615	3.696
103.30	340	2.430	2.700	3.040	2.530	3.840	3.941
138.30	360	2.590	2.880	3.230	2.700	4.100	4.176
180.90	380	2.750	3.060	3.425	2.860	4.346	4.424
232.40	400	2.910	3.230	3.620	3.010	4.580	4.666
293.70	420	3.090	3.421	3.820	3.180	4.800	4.914
366.10	440	3.250	3.595	4.020	3.350	5.050	5.154
451.30	460	3.410	3.784	4.200	3.530	5.300	5.408
550.30	480	3.570	3.955	4.400	3.700	5.540	5.651
664.30	500	3.730	4.151	4.600	3.860	5.800	5.906
795.30	520	3.900	4.342	4.810	4.040	6.050	6.148
945.30	540	4.080	4.525	5.020	4.200	6.280	6.410
1115.00	560	4.250	4.730	5.220	4.400	6.520	6.646
1308.00	580	4.430	4.930	5.430	4.560	6.780	6.919
1525.00	600	4.600	5.130	5.620	4.750	7.020	7.184
1768.00	620	4.790	5.330	5.840	4.920	7.270	7.432
2041.00	640	4.970	5.530	6.050	5.100	7.520	7.689
2346.00	660	5.150	5.750	6.250	5.300	7.770	7.949
2705.00	680	5.330	5.950	6.470	5.480	8.020	8.196
3080.00	700	5.520	6.160	6.670	5.650	8.280	8.472
	720	5.710	6.360	6.880	5.850	8.520	8.708
	740	5.900	6.570	7.100	6.030	8.780	8.999
	760	6.090	6.790	7.320	6.220	9.050	9.256
	780	6.280	7.000	7.530	6.410	9.300	9.532
	800	6.470	7.230	7.730	6.610	9.580	9.788
	820	6.660	7.450	7.960	6.800	9.820	10.068
	840	6.850	7.660	7.180	7.000	10.100	10.308

Note: The shaded area indicates the maximum and minimum recommended temperature for each material. For applications requiring lower or higher temperatures, consult the factory. From the Piping Handbook by Sabin Crocker, McGraw-Hill Publishing Co. & Acme Paper No. 53-A-52, 1954.

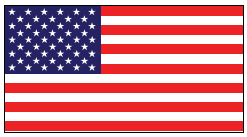
NOTE: Expansion joints are not designed to absorb torsional movement or stress. Subjecting an expansion joint to torsion of any amount may drastically affect operating life and will void the warranty. Consult factory if torsion is present.

Dual Externally-Pressurized Expansion Joints

3 SELECT THE PROPER EXPANSION JOINT

Working Pressure @ 650°F

Size (in)	Axial Compression (in)	150 PSI					300 PSI					Effective Area
		Flanged Ends		Weld Ends		Spring Rate	Flanged Ends		Weld Ends		Spring Rate	
		OAL (in)	LBS	OAL (in)	LBS		OAL (in)	LBS	OAL (in)	LBS		
1”	8	36-1/4	38	35-3/4	34	40	38-1/4	42	37-3/4	36	60	7.8”
	12	49-3/4	53	49-1/4	49	25	51-3/4	57	51-1/4	51	40	
	16	63-1/2	62	63	58	20	65-1/2	67	65	61	30	
1-1/4”	8	36-3/4	42	36-1/4	35	40	38-3/4	49	38-1/4	37	60	
	12	50-1/4	56	49-3/4	50	25	52-1/4	64	51-3/4	52	40	
	16	63-3/4	66	63-1/4	60	20	65-3/4	75	65-1/4	63	30	
1-1/2”	8	36-3/4	42	36-1/4	36	40	38-3/4	49	38-1/4	37	60	
	12	50-1/4	58	49-3/4	52	25	52-1/4	66	51-3/4	54	40	
	16	63-3/4	68	63-1/4	62	20	65-3/4	77	65-1/4	65	30	
2”	8	37-1/4	70	36-3/4	60	40	39-1/4	76	38-3/4	62	60	
	12	51-1/4	95	50-3/4	85	25	53-1/4	103	52-3/4	89	40	
	16	65	112	64-1/2	102	20	67	123	66-1/2	109	30	
2-1/2”	8	43	79	42-1/2	65	160	45	87	44-1/2	67	230	
	12	57	106	56-1/2	92	100	59	117	58-1/2	97	150	
	16	77	126	76-1/2	112	80	79	138	78-1/2	118	120	
3”	8	43	98	42-1/2	82	160	45	110	44-1/2	82	230	19.8”
	12	57	120	56-1/2	104	100	59	134	58-1/2	106	150	
	16	77	154	76-1/2	138	80	79	172	78-1/2	146	120	
3-1/2”	8	43	142	42-1/2	120	160	45	143	44-1/2	126	230	
	12	57	177	46-1/2	155	100	59	181	58-1/2	164	150	
	16	77	232	76-1/2	210	80	79	237	78-1/2	220	120	
4”	8	40-1/4	153	39-3/4	127	165	42-1/4	177	41-3/4	133	230	29.5”
	12	57-1/2	188	57	162	105	59-1/2	215	59	171	150	
	16	69-1/2	242	69	216	85	71-1/2	275	71	231	120	
5”	8	44	200	43-1/2	170	320	46	230	45-1/2	174	500	66.8”
	12	60	242	59-1/2	212	225	62	276	61-1/2	220	350	
	16	79	286	78-1/2	296	160	81	322	80-1/2	266	250	
6”	8	44	222	43-1/2	184	320	46	270	45-1/2	192	500	
	12	60	268	59-1/2	230	225	62	318	61-1/25	240	350	
	16	79	316	78-1/2	278	160	81	368	80-1/2	290	250	
8”	8	41	320	40-1/2	260	440	43	416	42-1/2	294	600	81”
	12	53-3/4	414	53-1/4	354	320	55-3/4	492	55-1/4	376	450	
	16	72	490	71-1/2	430	220	74	574	73-1/2	458	300	
10”	8	41	440	40-1/2	364	490	43	540	42-1/2	378	900	121”
	12	53-3/4	554	53-1/4	468	350	55-3/4	651	55-1/4	489	670	
	16	72	706	71-1/2	620	240	74	816	73-1/2	654	450	



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