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EXPANSION JOINT



# EXPANSION JOINT

*Metallic Expansion Joint*

*Non-metallic Expansion Joint*

*Rubber Expansion Joint*

HANKOOK RASEONKWAN CO., LTD



## 9. ADDITIONAL TIPS

- 1) Do not insulate over a non-metallic expansion joint. If required, allow enough space for the tightening of loosened bolts without any access difficulties for regular inspection.
- 2) Do not weld near a non-metallic expansion joint.
- 3) Checks whether the cover material of the outdoor installed joint is resistant to ozone or sunlight. Neoprene and Chlorobutyl are recommended. Use weather resistant paint on other materials to avoid the effects by ozone and sunlight.
- 4) Check for leakage 2~3 weeks after installation. If necessary, tighten it again.  
Note: Expansion joint may be used in pipelines or equipment that transfers temperature and pressure generating gas or harmful materials. Therefore, do not install a rubber joint where checking is impossible due to difficult access. Leakage unable to be recovered must be checked for proper exhaust.

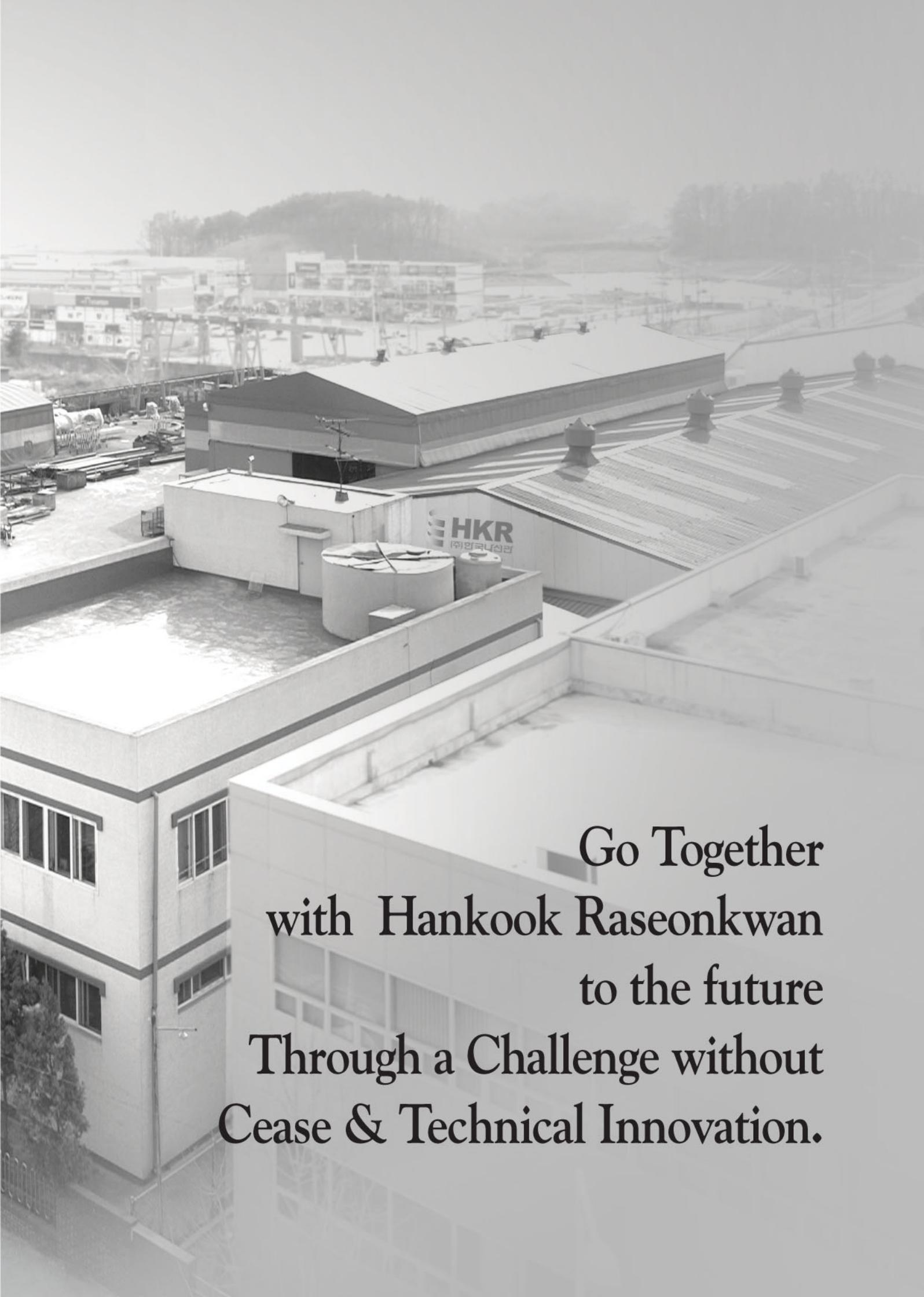
## 10. INSTALLATION OF CONTROL UNIT

- 1) Install the products provided with retaining ring in the piping section, allowing the same distance face to face, of the expansion joint.
- 2) Place the control rod plate behind of the pipe flange.  
Use bolts of sufficient length to apply the plate. The plates should be assembled at an equally spaced around the flange. Use two or more control rods in accordance with pressure and size.
- 3) Insert a control rod through the plate hole. Positioned a steel washer outside the plate. For additional rubber washers, assemble them between the plate and steel washers.
- 4) Fasten a nut, considering the proper distance between washers and nuts for the extension range of the product. Apply tack welding or bind it with wire to avoid unfastening of a nut. Tightening nuts are also available.
- 5) Install pipe sleeve by using normal pipe as long as product's compression.
- 6) The control rod for reducer type product should also be parallel to pipes.

## 11. INSTALLATION LOCATION

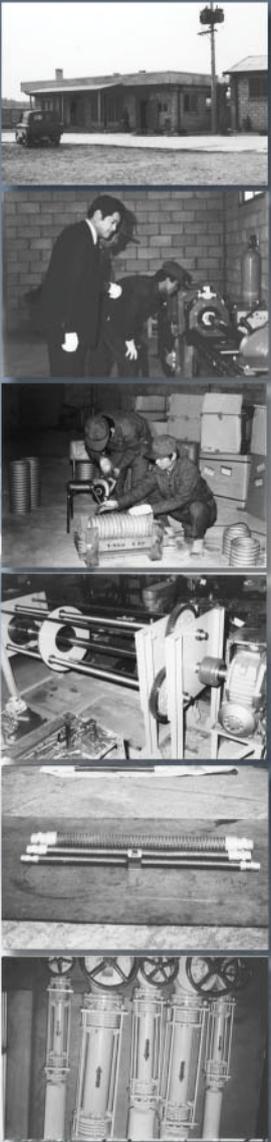
The expansion joint should always be installed in an accessible location to allow for future inspection or replacement.





**Go Together  
with Hankook Raseonkwan  
to the future  
Through a Challenge without  
Cease & Technical Innovation.**

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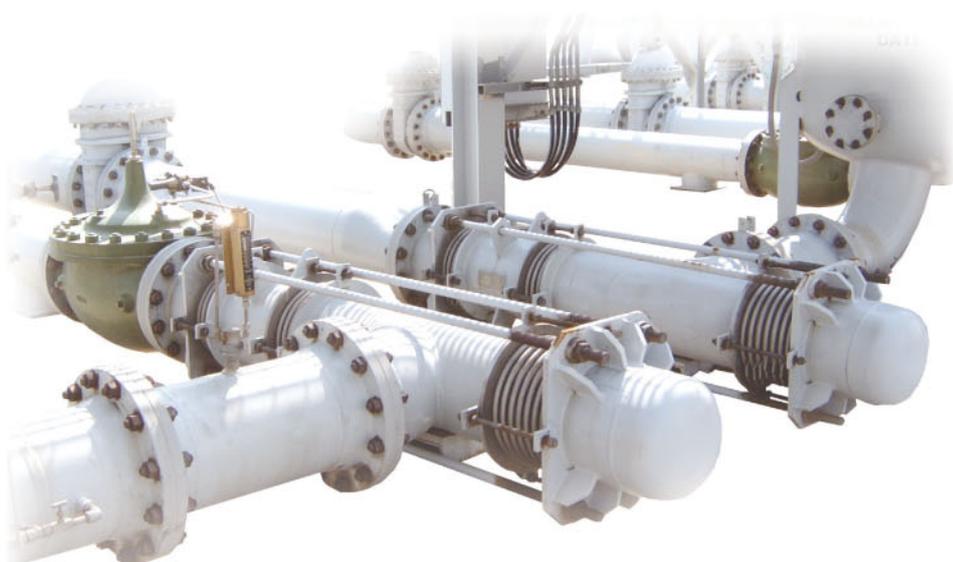




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# THE DEFINITION OF BELLOWS

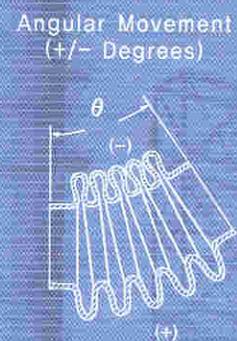
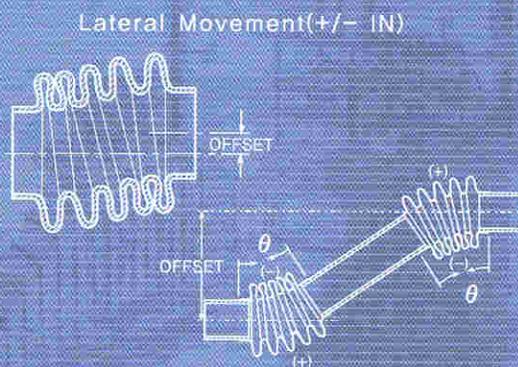
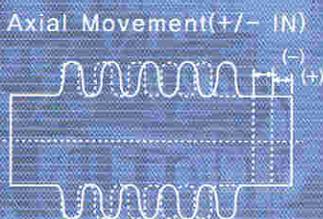
## ■ Operation mechanism of bellows

Bellows are a flexible piping element. The corrugation of the expansion joint is designed to be flexible in order to absorb pipe expansion and contraction due to changes in temperature. The number of corrugation of bellows is decided according to the displacement amount and the expansionary and contracting force that the bellows have to absorb. Bellows have to be strong to the design pressure and operating pressure of piping and installation and they also have to be flexible to absorb thermal movement. The thrust force of the flow in the piping has to be buttressed by things other than bellows. These are usually anchors, tie rods, hinges, or gimballed structures.

The value of the thrust force of bellows is usually calculated by multiplying the value of the effective cross section area by the value of the flow pressure of pipe.



There are three kinds of bellows movements: Axial Movement, Lateral Movement, and Angular Movement. The diagrams for the movements are as follows.



## ■ Why the expansion joint required.

While designing energy pipelines, a main artery of the modern industry, planners always face many obstacles: the expansion and contraction of pipes caused by temperature changes both external and internal, vibrations generated from machine operation and other stress imposed on the pipelines by wind or in some cases by earthquake. Therefore, protection from these hazardous elements is always of major interest to the pipeline engineers.

To absorb pressure from expansion, contraction and the vibration of pipes, flexibility is key. One of the most effective flexible elements is the metallic bellows-type expansion joint, which is currently widely used due to continued developments and improvements in the performance and design technique.



## ■ Various forming methods of bellows.

Metal bellows are manufactured by piping made of thin metal plates. The following are several types of forming methods.

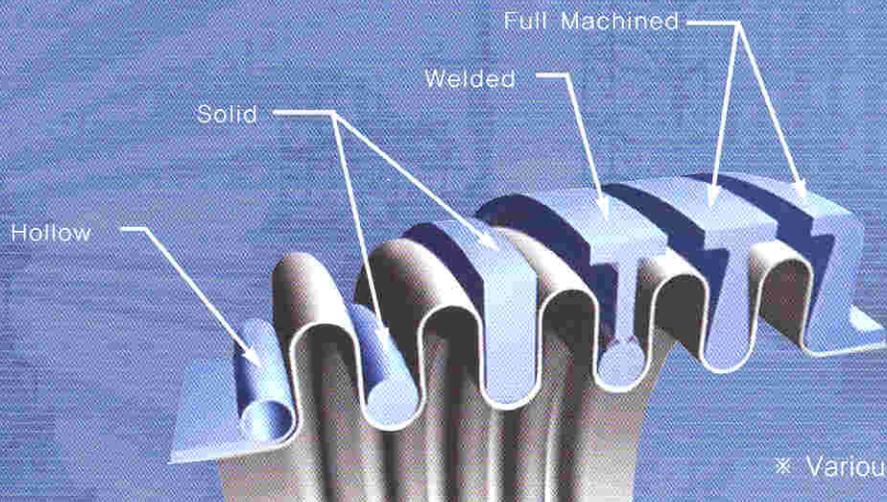
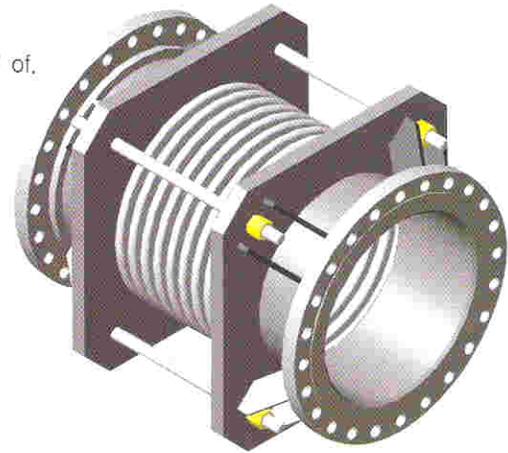
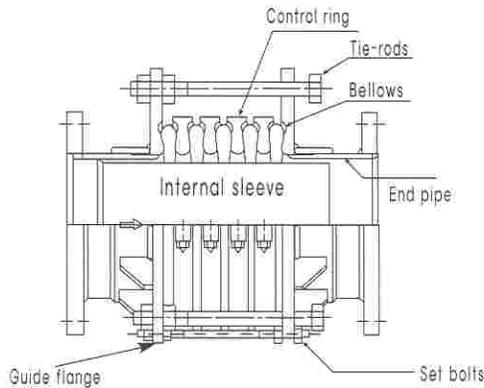
- 1) **Hydraulic forming** : uses pressure from water or oil to mold.
- 2) **Roll-forming** : presses rollers inside and outside of the pipe alternatively to create waves.
- 3) **Rubber forming** : forming by doughnut shaped rubber at the inner parts of piping for bellow in the axial direction.
- 4) **Press forming** : widely used method for forming square type expansion joint is to form it by pressing materials for bellows with mold.



# THE COMPOSITION OF A BELLOW TYPE EXPANSION JOINT

## ■ Parts and components

The picture below shows how a bellows type expansion joint is composed of.



✧ Various types of control ring

## ■ Parts and features of expansion joint.

1) **Bellows** : After piping with high-quality stainless steel plates or alloyed steel sheet, bellows are produced through hydraulic forming or roll forming. And sometimes the bellows are heat treated to eliminate the remaining welding stress on the welding part or to remove the remaining stress generated during forming.

2) **End pipe** : To facilitate connecting and fitting into the ends of bellows, the end pipe is normally made with the same material that is used for the pipeline, and also to the same size as the pipeline.

3) **Control-ring** : The control ring is applied to bellows that are used for pipelines under high pressure. Installed on the convoluted parts of bellows, it reinforces the strength of bellows against high-pressure. It can be manufactured in a variety of forms according to the level of pressure.

4) **Internal Sleeve** : A device which minimizes contact between the inner surface of the bellows of an expansion joint and the fluid flowing through it. It prevents vibration, and erosion of the bellows.

5) **Flange** : Customers can choose a flange standard from among KS, JIS, ANSI, and DIN.

6) **Tie rod** : Tie rods protect a device from excessive stretching and prevent the dislocation of pipelines. They also stabilize pipelines by absorbing thrusts.

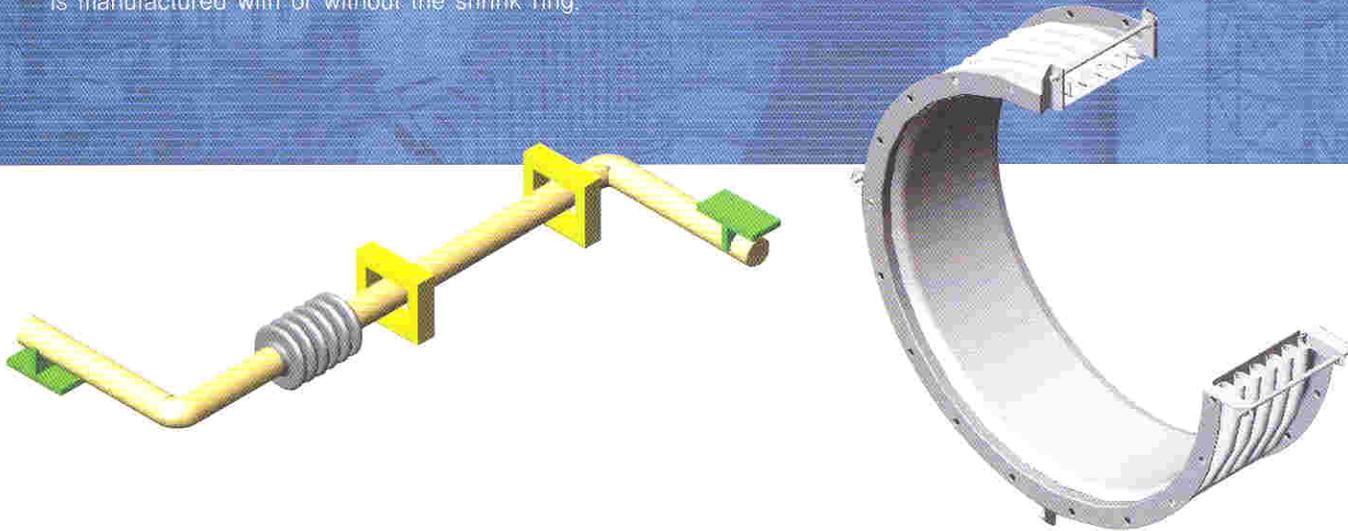
7) **Set bolt** : Set bolts are used to maintain "face to face" dimension, while shipping or installing, and are removed after installation is complete.



## PRODUCT MODELS AND FEATURES

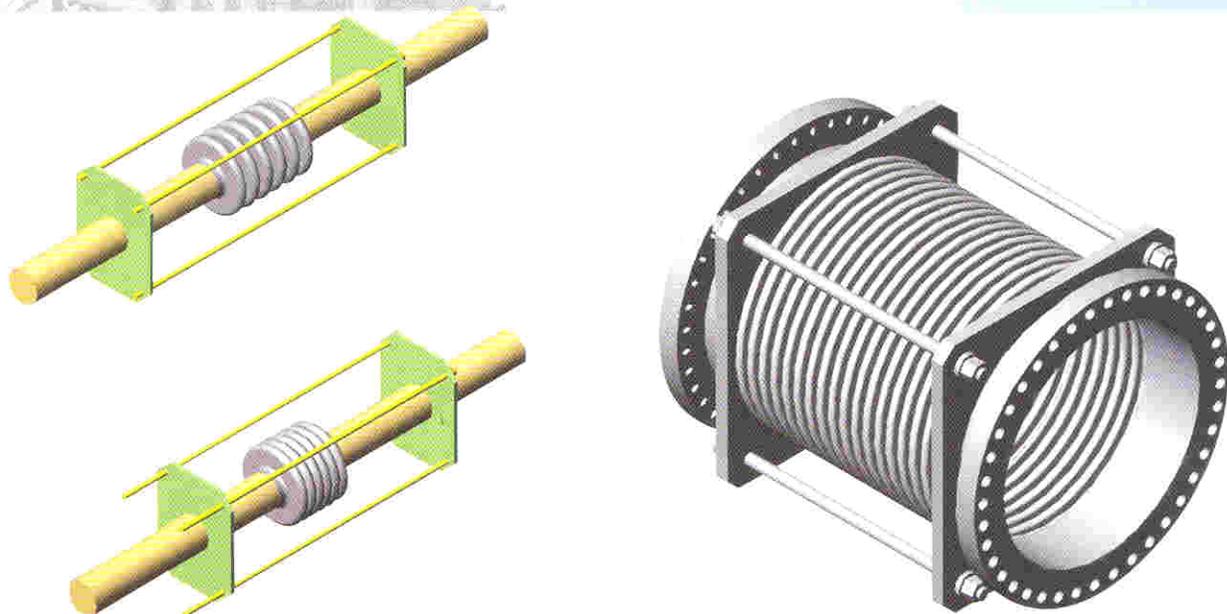
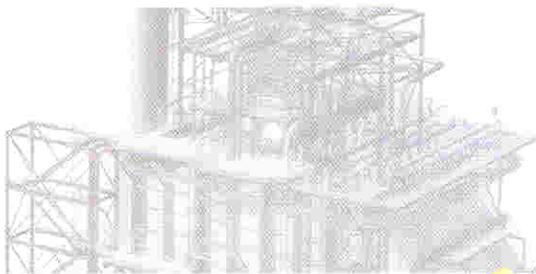
### ■ SINGLE TYPE EXPANSION JOINT-UN TIED (MSN)

The simplest form of expansion joint, of single bellows construction, designed to absorb all of the movements of the pipe section in which it is installed. According to operated pressure of a device, this model is manufactured with or without the shrink ring.



### ■ SINGLE TYPE EXPANSION JOINT- TIED (MST)

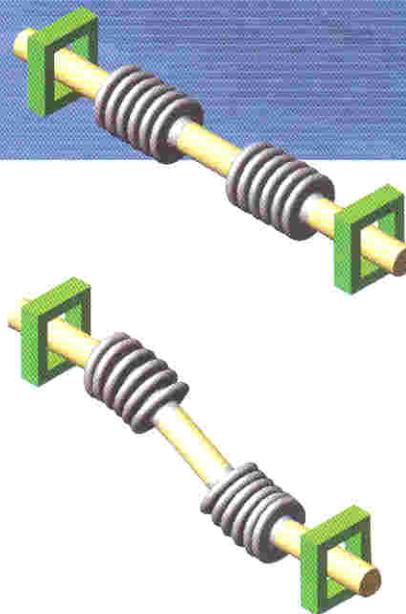
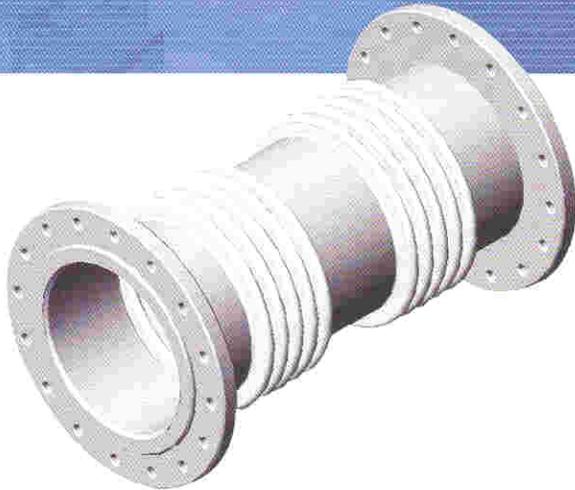
This model, with the tie-rod assembly, is an improvement on the Single Type Expansion Joint. This model is designed for pipelines with lateral movements. Tie-rods are designed to sustain the thrust generated during operation.



## ■ UNIVERSAL TYPE EXPANSION JOINT-UN TIED (MUN)

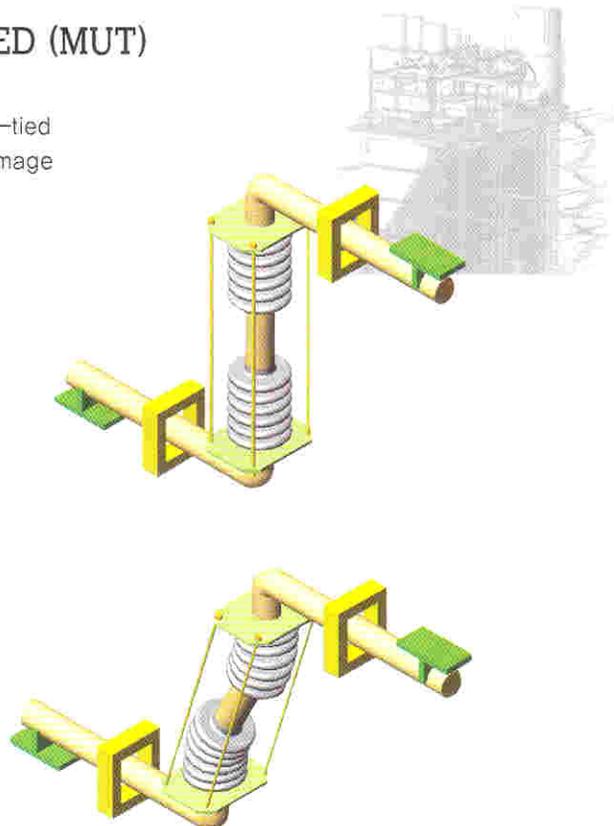
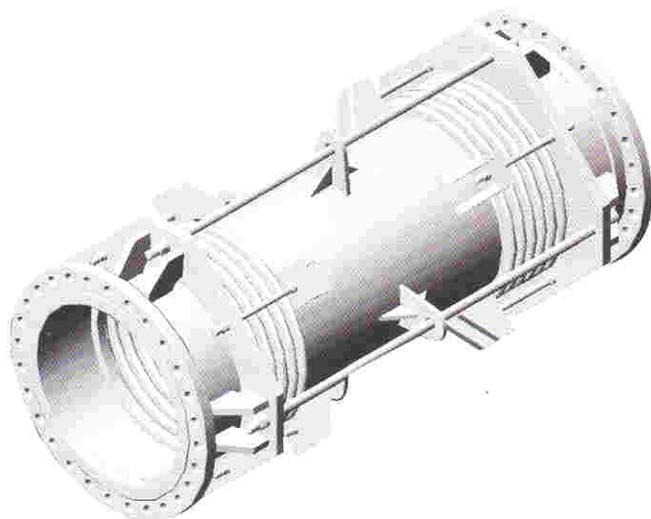
A universal expansion joint contains two bellows joined by a intermediate pipe for the purpose of absorbing any combination of the three basic movements, i.e. axial movements, lateral deflection, and angular rotation.

This model is used for pipelines with bigger lateral movements than the single type.



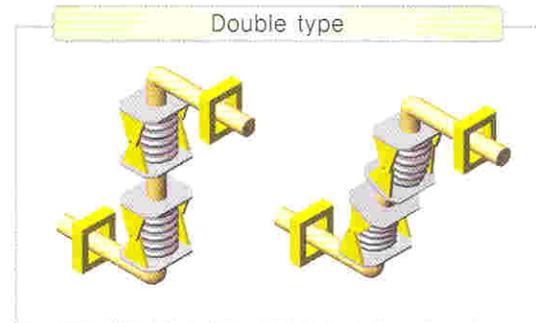
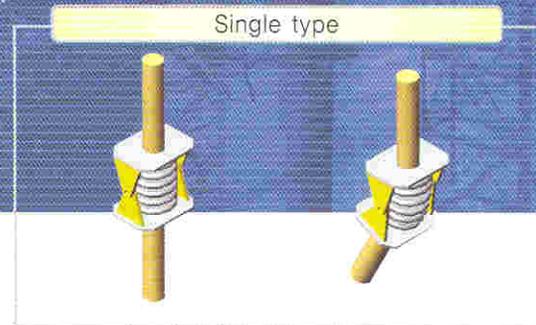
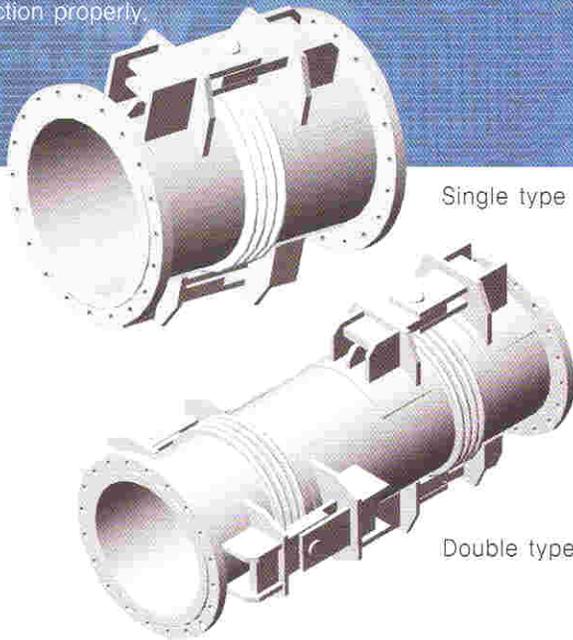
## ■ UNIVERSAL TYPE EXPANSION JOINT-TIED (MUT)

This model, with a tie rod assembly, is an improvement on the un-tied universal type. The tie rod absorbs the thrust, which may damage the device.



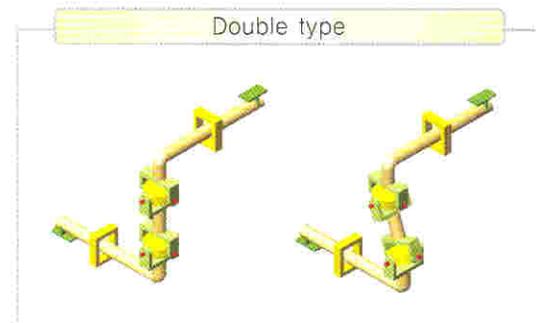
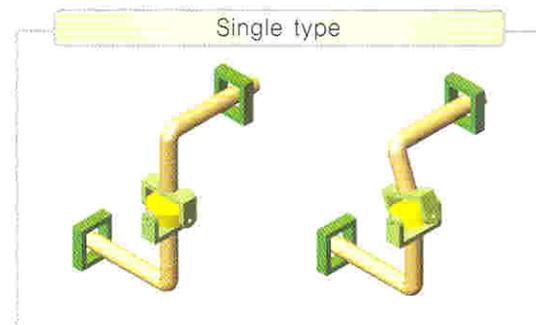
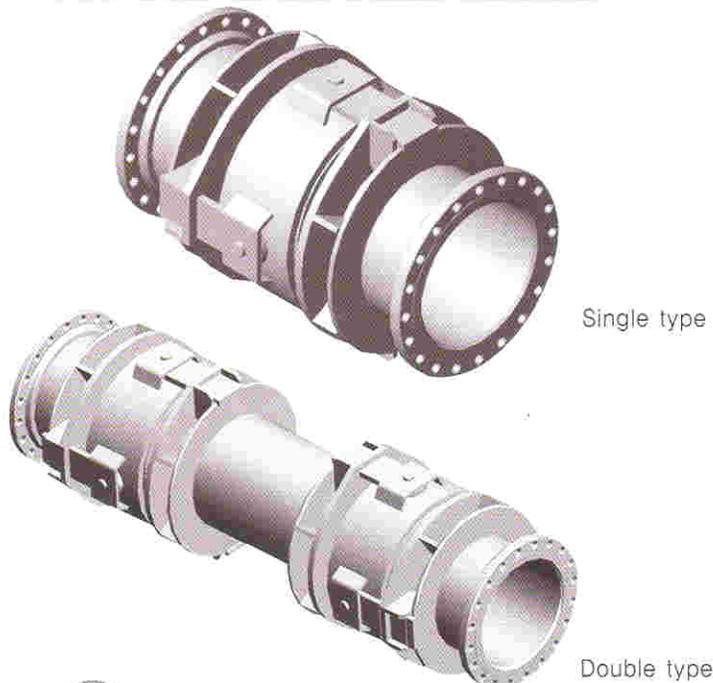
## ■ HINGE TYPE EXPANSION JOINT (MSH)

A hinged expansion joint contains one bellows and is designed to permit angular rotation, by the use of a pair of pins through hinge plates attached to the expansion joint ends. The hinge arms and hinge pins must be designed to restrain the thrust of the expansion joint due to internal pressure. Hinged expansion joints should be used in sets of two or three to function properly.



## ■ GIMBAL TYPE EXPANSION JOINT (MSG)

A gimbal expansion joint is designed to absorb combined movements by the use of two pairs of gimbal arm and gimbal pin, which restrains the thrust of the expansion joint due to internal pressure while the bellows is designed to absorb angular rotation only. Gimbal expansion joints should be used in sets of two or three to function properly just like hinged expansion joints.

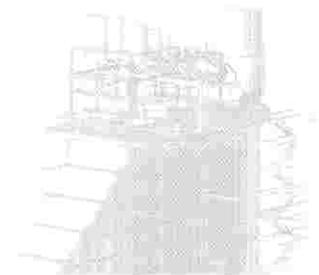
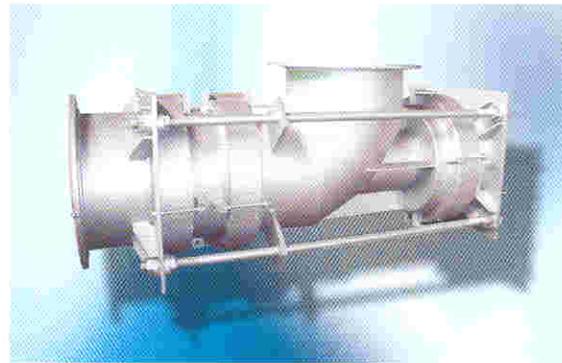
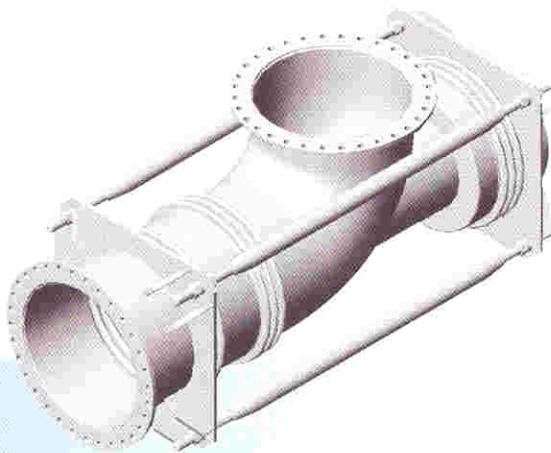


## ■ PRESSURE BALANCED TYPE EXPANSION JOINT (MSB)

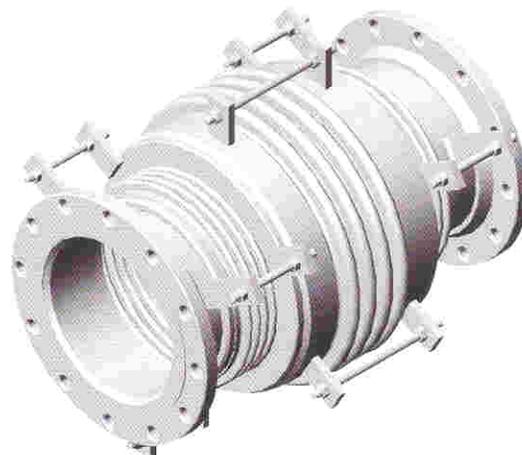
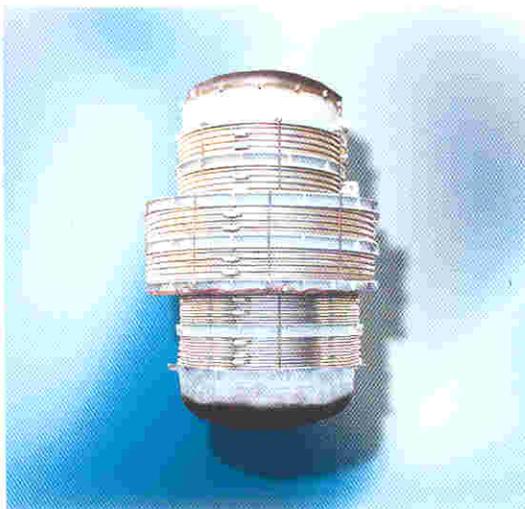
If the diameter of the pipe is excessively large or high pressure is running in the pipes, anchors must be installed to restrain the thrust of the expansion joint. However when conditions would not allow the installation of anchors, this pressure balance type expansion joint has to be used. According to the location of installation, L type (MSB-Bent Pipe Balanced) or S type (MSS-Straight Pipe Balanced type) is used.



"L" type PRESSURE BALANCED EXPANSION JOINT

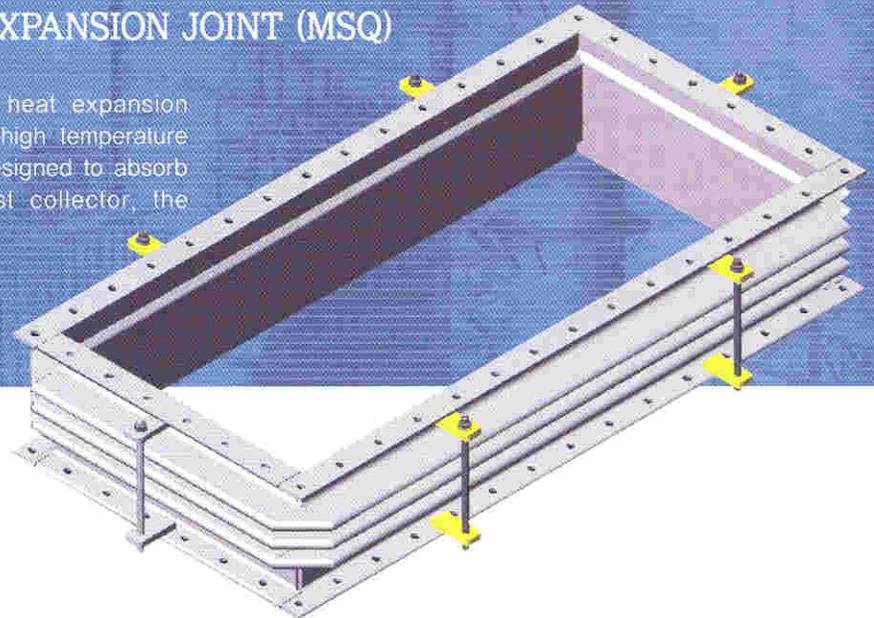


"S" type PRESSURE BALANCED EXPANSION JOINT



## ■ RECTANGULAR TYPE EXPANSION JOINT (MSQ)

This product is designed to absorb heat expansion around large-scale rectangular line of high temperature and low pressure. This model is also designed to absorb movements and vibration of the dust collector, the exhaust duct, and the ventilator.



1) **CORNER type** : There are five corner types; Single miter, Round, Double miter, Camera, and Box Single Miter



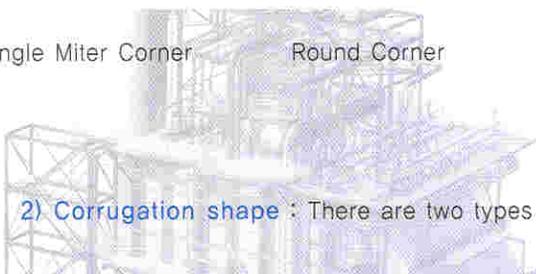
Single Miter Corner

Round Corner

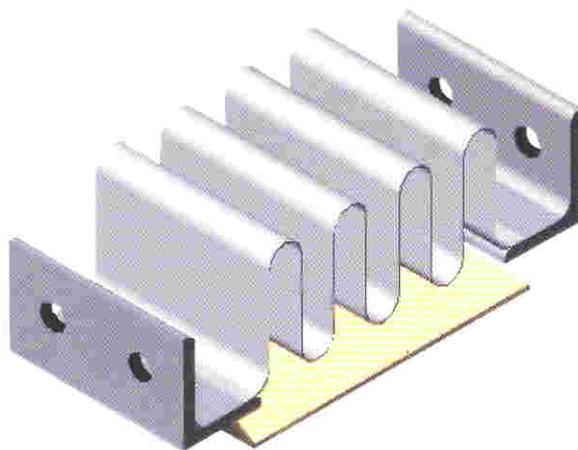
Double Miter Corner

Camera Corner

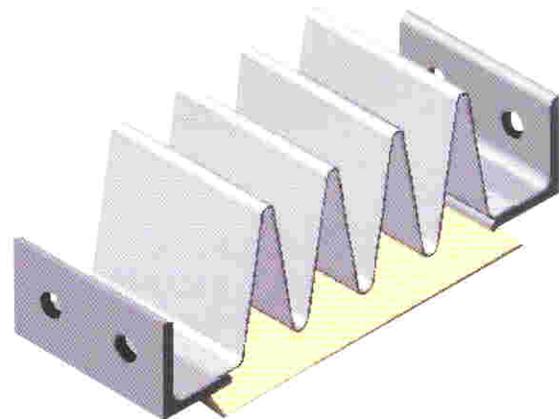
Box Single Miter Corner



2) **Corrugation shape** : There are two types of bellows: U-shaped and V-shaped



"U" Profile

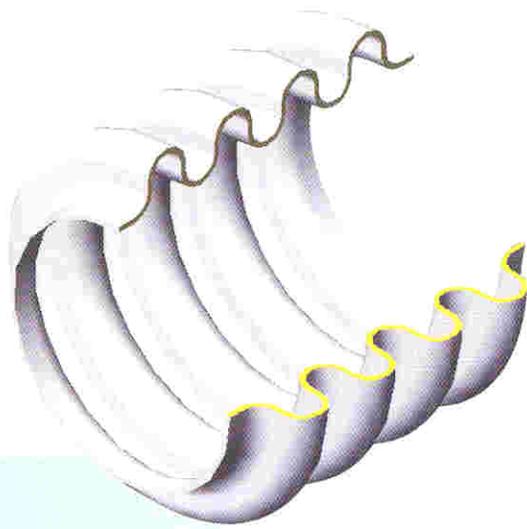


"V" Profile

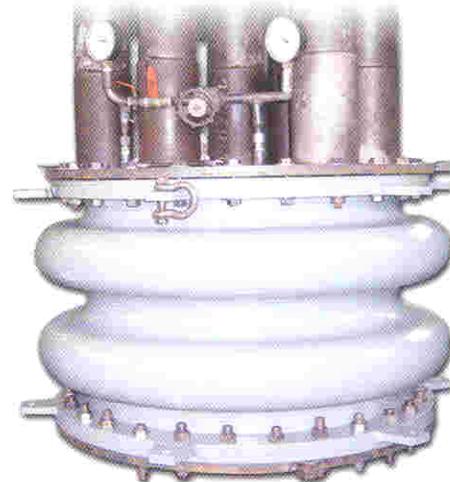
## ■ EXPANSION BELLOWS FOR HEAT EXCHANGER

The expansion bellows for heat exchanger is used to restrain the heat stress, which is generated by temperature difference between the heat exchanger shell and the tube.

Installed on the shell of the heat exchanger, the bellows prevent the heat stress from reaching the body or the tube.



Cross-section of the product



## 크로스오버 파이프의 일반 사양

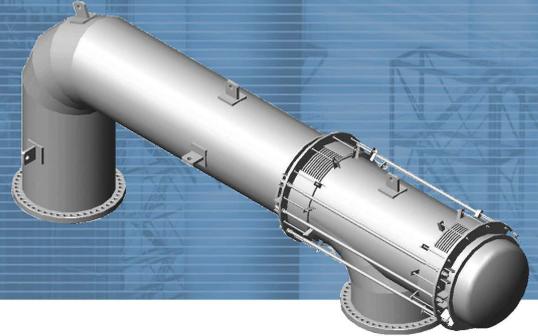
크로스오버 파이프는, 스팀터빈장치가 있는 IP(또는 HP) CASING에서 LP HOOD로 스팀을 이동시키는 용도로 사용된다. 터빈과 CASING사이의 THERMAL MOVEMENT가 다르기 때문에 적당한 유연성을 지녀야 한다. 또한, 운전시 스팀압력에 대한 안정성을 갖춰야 한다.

### 설계 조건

- 온도 : up to 380 °C
- 압력 : 10 kg/cm<sup>2</sup>

### 규격

- From 48" to 84" Diameter.
- Expansion Joint Type : Pressure Balanced type-Elbow



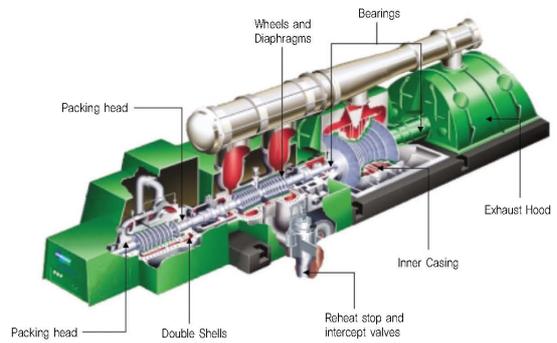
### 재질

- Bellows : ASTM A240-316 (or SUS 316)
- Body : Carbon Steel (JIS or ASTM)
- Flange : ASTM A105 (or SF440A)
- Tie Rod : ASTM A 193-B7 (or SCM435)

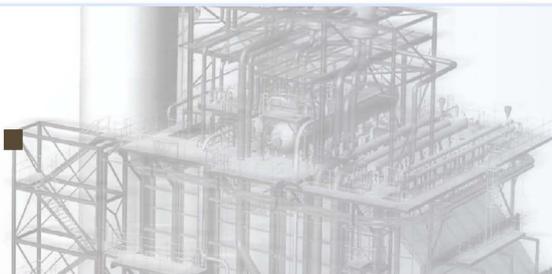
※ 벨로우즈 성형방법 : 액압성형

### Design Code

- ASME B31.1 Power piping
- ASME Section VIII, Pressure vessel
- PED 97/23/EC, European Pressure Equipment Directive
- EJMA, Expansion Joint Manufacturers Association



<Fig.1 General Lay-out of Turbine Ass'y>



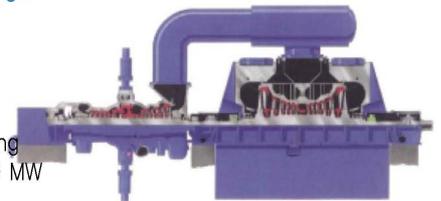
### A Series

Full/Partial Arc  
Admission Tandem  
compound Reheat  
Steam Turbine  
50/60Hz Two-Casing  
Single Flow to 300 MW



### D Series - 2 Casings

Full/Partial Arc  
Admission Tandem  
compound Reheat  
Steam Turbine  
50/60Hz Two-Casing  
Double Flow to 450 MW



### G Series - 3 Casings

Full/Partial Arc  
Admission Tandem  
compound Reheat  
Steam Turbine  
50/60Hz Four Flow,  
Up to 650 MW



### G Series - 4 Casings

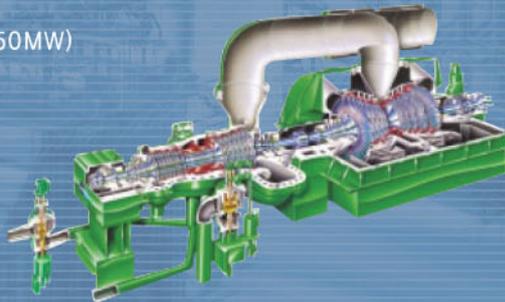
Full/Partial Arc  
Admission Tandem  
compound Reheat  
Steam Turbine  
50/60Hz Four Flow,  
Up to 1,100 MW



## ■ TYPICAL SERIES OF STEAM TURBINE WITH CROSSOVER PIPE

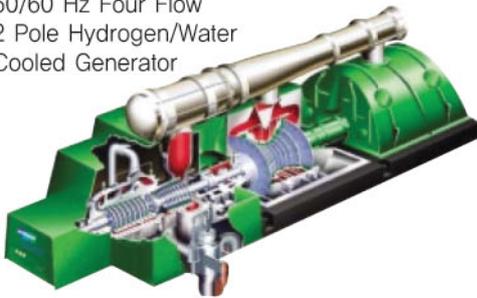
### D-Series-2 Casings Turbine(up to 450MW)

2400 psig, 1000oF/1000oF  
Tandem Compound-33.5" or 40"LSB  
Reheat Steam Turbine  
50/60 Hz Two Flow  
2 Pole Hydrogen/Water  
Cooled Generator



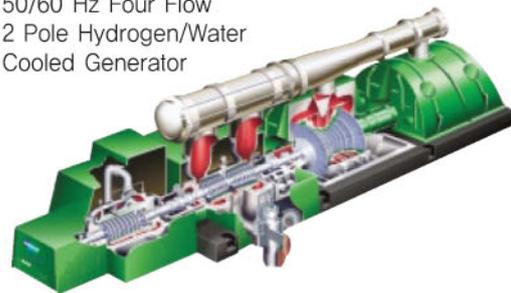
### G-Series 3-Casings Turbine(up to 650MW)

Full/Partial Arc Admission  
Tandem Compound  
Reheat Steam Turbine  
50/60 Hz Four Flow  
2 Pole Hydrogen/Water  
Cooled Generator

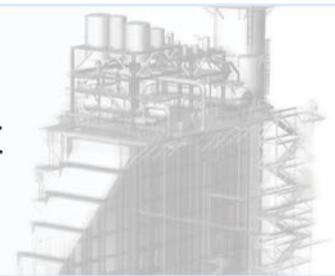


### G-Series 4-Casings Turbine(up to 1,100MW)

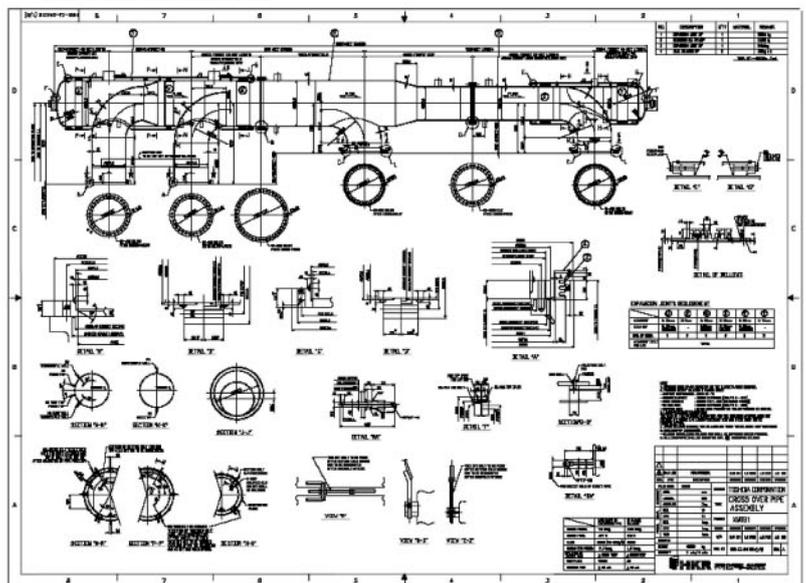
Full/Partial Arc Admission  
Tandem Compound  
Reheat Steam Turbine  
50/60 Hz Four Flow  
2 Pole Hydrogen/Water  
Cooled Generator



## ■ SITE INSTALLATION WORK



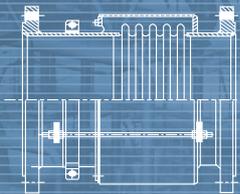
### - TYPICAL DRAWING



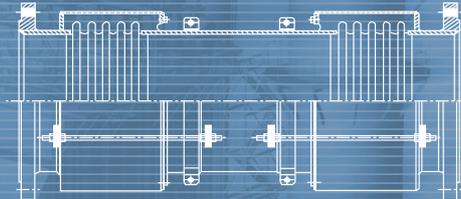
# DIRECT BURIED TYPE EXPANSION JOINT

It is built to absorb the land pressures and seismic against the duct breakage because of the ground settlements and the earthquake shocks.

Single type (HDBJ-S)



Double Type (HDBJ-D)



I) Single Type (Vaccum ~ 20kg/cm<sup>2</sup>)

N.D (A)	Corr. No.	Length (mm)	Angular Mov't (deg)
150	3	400	10
200	3	400	10
250	3	450	10
300	3	450	9
350	3	450	9
400	3	600	8
450	3	600	8
500	5	800	12
600	5	800	12
700	5	800	10
800	5	1000	10
900	5	1000	10
1000	5	1000	10
1100	5	1200	6
1200	5	1200	6
1350	5	1200	5
1500	5	1200	5
1600	5	1200	5
1800	5	1400	5
2000	5	1400	5
2200	5	1400	4
2400	5	1400	4
2800	5	1400	4

II) Double Type (Vaccum ~ 20kg/cm<sup>2</sup>)

N.D (A)	Corr. No.	Lateral Movement Capability (mm)				
		1500L	2000L	2500L	3000L	3500L
150	3+3	230	355			
200	3+3	190	290	380		
250	3+3	155	240	320		
300	3+3	180	275	375		
350	3+3	165	250	340		
400	5+5	165	275	395		
450	5+5	150	225	345		
500	5+5	135	240	315		
600	5+5	120	190	270	350	
700	5+5	105	155	225	290	
800	5+5	90	150	345	450	
900	5+5	80	135	300	395	
1000	5+5	75	120	270	355	
1100	5+5			255	335	
1200	5+5			225	295	370
1350	5+5			215	280	345
1500	5+5			185	240	300
1600	5+5				200	255
1800	5+5				185	230
2000	5+5				165	210
2200	5+5				150	180
2400	5+5				135	165
2800	5+5				110	145



# LNG Carriers EXPANSION JOINTS



HKR designs & manufactures a wide variety of bellows type expansion joints rating from 3/8" to unlimited size of nominal diameter in accordance with the EJMA, ASME, IGC, GTT and special code required from customers. Our products for LNG Carriers are inspected and certified by Lloyd's Register, ABS, DNV of Shipping.



HKR a wide range of standards expansion joints for all kinds of applications



Type : HS-Single Free Style



Type : HU-Universal Free Style



Type : HU-Tie Rod Style



Type : HU-Tie Rod Style



Type : HU-Hinge Style



Type : HU-Hinge Style



Type : HU-Hinge Style

## Our metal bellows program for LNG

- from DN 6 to 2100
- single or multi-ply construction
- made of ductile and malleable materials
- assemblies produced by welding, brazing, soldering and gluing with standard fittings or according to customer's specification.

- HKR metal bellows offer a solution to your technical problems
- for flexible connections
- for glandless sealing
- to absorb vibrations
- to accommodate build tolerances
- as a pressure accumulator
- as a control element



LIFE CYCLE TEST



FATIGUE TEST



BURSTING TEST

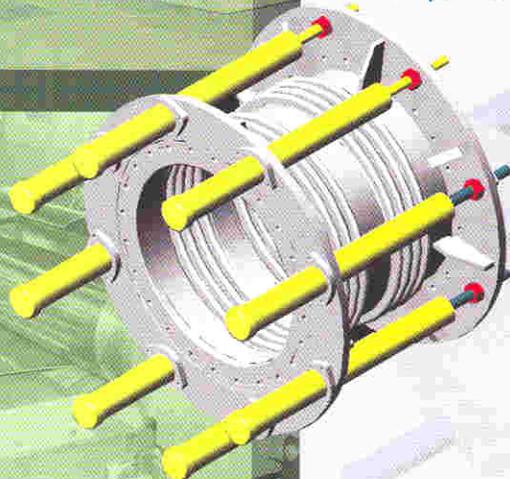


HYDRO TEST



# GIS & PRECISION BELLOWS

## Bellows for GIS (SF6 GAS Insulated Switchgear)



Expansion bellows used for the GIS device absorbs the shock generated during switching on and off. This bellows also permits changes in shape and length due to fluctuations in temperature while absorbing movements due to repair, reassembly or earthquake.

**Applications :** products with the voltage range listed below

25.8kv, 72kv, 84kv, 145kv,  
170kv, 362kv, and 600kv

## PRECISION BELLOWS



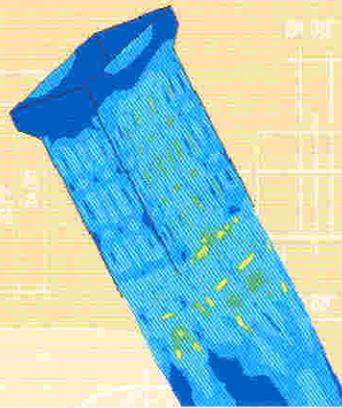
Hankook Raseonkwan's precision bellows are used for devices and valves requiring high precision and leakage protection.

**Applications:** Bellows sealed valve, vacuum interrupter, industrial auto controller, and others.

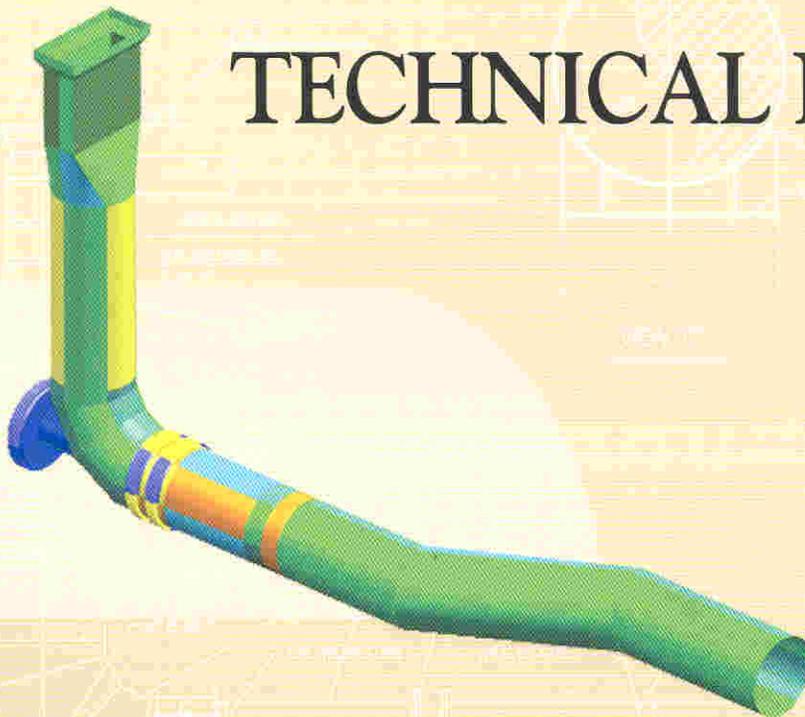


(OMEGA Type Bellows)

# Technical data



# TECHNICAL DATA



SECTION "B-B"

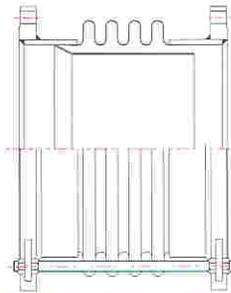
TOP E. 63'-4"

EXISTING BEAM  
W/ (4)X12 (REF.)

1/4" RISA STD.  
CONNECTION BELLOW

19

WP 22.05.21



## ■ MSN (Single Free Type)

**Applications** : low-pressure gas pipes, exhaust pipes, ducts, inlets and outlets of ventilators, and others.

**Pressure limits** : 1kg/cm<sup>2</sup>~3kg/cm<sup>2</sup>

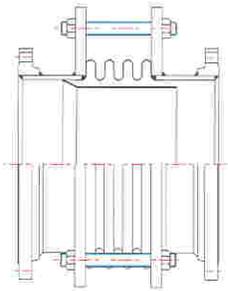
SINGLE - FREE TYPE (1~3kg/cm<sup>2</sup>)

Nominal diameter (N.D.)	External diameter (mm)	Dimensions: HxPxL(mm)	No. of corr. (N)	Length (mm)	Movement (mm)		Spring force (kg/mm)		Effective dia. (mm)	Effective area (cm <sup>2</sup> )	Weight (kg)
					X	Y	X	Y			
50	85	16x16x0.6	10	270	±10	±8	6.3	1.8	68.1	36.4	8
65	105	18x18x0.6	10	300	±13	±9	5.7	1.9	85.0	56.7	11
80	115	18x18x0.6	5	230	±7	±2	12.5	20.2			12
			10	320	±13	±8	6.3	2.5	93.2	68.2	13
100	155	24x22x0.6	7	314	±16	±6	5.4	5.5			18
			10	380	±23	±13	3.8	1.9	127.2	127.0	20
125	180	24x22x0.6	7	314	±16	±5	6.4	9.4			22
			10	380	±23	±11	4.5	3.2	151.9	181.1	24
150	220	32x28x0.8	6	328	±18	±5	9.3	16.8			28
			12	496	±35	±21	4.7	2.1	184.2	266.3	30
200	270	32x28x0.8	6	328	±18	±4	11.8	34.4			40
			12	496	±35	±16	5.9	4.3	233.7	428.7	44
250	320	32x28x0.8	6	328	±18	±3	14.3	60.5			57
			12	496	±35	±13	7.1	7.6	288.2	652.0	61
300	370	32x28x0.8	6	328	±18	±3	16.9	99.2			83
			12	496	±35	±11	8.4	12.4	332.7	868.9	89
			15	580	±44	±18	6.7	6.3			94
350	420	40x28x1.0	4	312	±13	±1	32.0	540.0			108
			8	424	±26	±5	16.0	67.5	376.0	1109.8	113
			10	480	±33	±8	12.8	34.6			116
400	470	40x28x1.0	4	312	±13	±1	36.1	777.5			133
			8	424	±26	±4	18.0	97.2	424.5	1414.6	140
			10	480	±33	±7	14.4	49.8			148
450	520	40x28x1.0	4	312	±13	±1	40.4	1088.6			170
			8	424	±26	±4	20.2	136.1	475.0	1771.2	182
			10	480	±33	±6	16.1	69.7			188
500	580	40x28x1.0	4	312	±13	±1	45.1	1519.5			216
			8	424	±26	±3	22.6	189.9	530.8	2211.7	228
			10	480	±33	±5	18.0	97.2			235
600	680	40x28x1.0	4	312	±13	-	53.7	-			280
			8	424	±26	±3	26.1	321.1	632.3	3138.5	295
			10	480	±33	±5	21.5	164.4			308
700	820	60x60x1.5	3	420	±18	±1	71.0	1847.4			115
			5	540	±30	±4	42.6	399.0	749.5	4409.7	132
			7	660	±41	±7	30.4	145.4			146
800	920	60x60x1.5	3	420	±18	±1	81.0	2737.0			142
			5	540	±30	±3	48.6	591.2	854.5	5731.8	173
			7	660	±41	±6	34.7	215.5			191
900	1020	60x60x1.5	3	420	±18	±1	90.2	3779.3			158
			5	540	±30	±3	54.1	816.3	951.5	7107.0	191
			7	660	±41	±6	38.6	297.5			210
1000	1120	60x60x1.5	3	420	±18	±1	99.7	5114.8			177
			5	540	±30	±3	59.8	1104.8	1052.5	8695.9	210
			7	660	±41	±5	42.7	402.6			220
1200	1320	60x60x1.5	3	480	±18	-	118.5	-			204
			5	600	±30	±2	71.1	1853.0	1250.5	12275.4	250
			7	720	±41	±4	50.8	675.3			286
1500	1620	60x60x1.5	3	480	±18	-	147.3	-			330
			5	600	±30	±2	88.4	3560.3	1554.5	18969.3	380
			7	720	±41	±3	63.1	1297.5			420
2000	2150	75x60x2.0	2	480	±13	-	399.9	-			440
			4	600	±25	-	199.9	-	2073.0	33734.0	510
			5	720	±31	±1	159.9	-			570
2500	2680	90x80x2.0	2	480	±19	-	274.1	-			600
			4	620	±38	-	137.0	-	2588.0	52577.3	700
			5	700	±47	±2	109.6	-			770
3000	3220	110x96x2.5	2	348	±22	-	355.3	-			900
			3	600	±33	-	236.9	-	3107.5	75804.0	1050
			4	696	±44	±1	177.7	-			1165
3500	3720	110x96x2.5	2	348	±22	-	412.5	-			1060
			3	600	±33	-	275.0	-	3607.5	102160.3	1240
			4	696	±44	±1	206.2	-			1370
4000	4220	110x96x2.5	2	348	±22	-	469.6	-			1220
			3	600	±33	-	313.1	-	4107.5	132441.7	1430
			4	696	±44	±1	234.8	-			1570

Design Cycles : The above movement value is based on 3000 cycles.

Weight : For models of lower than 600A, ANSI#150 flange is included, while for models of higher than 650A, flange is not included.

\* We can manufacture products different from the above specifications if customer's request.



## ■ MSG (Single Guide Rod Type)

**Applications** : gas pipes, ventilators, low-pressure steam pipes, and others

**Pressure limits** : 1kg/cm<sup>2</sup>~2kg/cm<sup>2</sup>, less than 5kg/cm<sup>2</sup>, less than 10kg/cm<sup>2</sup>

SINGLE - GUIDE ROD TYPE (1~3kg/cm<sup>2</sup>)

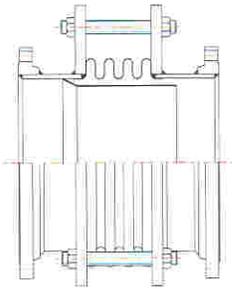
Nominal diameter (N.D.)	External diameter (mm)	Dimensions HxPxL(mm)	No. of corr. (N)	Length (mm)	Movement (mm)		Spring force (kg/mm)		Effective dia. (mm)	Effective area (cm <sup>2</sup> )	Weight (kg)
					X	Y	X	Y			
50	185	16x16x0.6	5	280	±5	±2	13.1	14.2	68.1	36.4	18
				360	±10	±8	6.3	1.8			
65	205	18x18x0.6	5	290	±6	±2	11.5	15.3	85.0	56.7	21
				380	±13	±9	5.7	1.9			
80	220	18x18x0.6	5	290	±6	±2	12.6	20.2	93.2	68.2	24
				380	±13	±8	6.3	2.5			
100	255	24x22x0.8	7	394	±11	±4	12.8	13.3	127.0	126.6	34
				460	±16	±9	8.9	4.5			
125	280	24x22x0.8	10	460	±16	±8	10.7	7.6	151.9	181.1	41
				570	±25	±18	7.1	2.3			
150	340	30x28x1.0	6	488	±12	±4	21.2	37.3	182.0	260.0	60
				656	±25	±15	10.6	4.7			
200	395	30x28x1.0	12	656	±25	±12	13.5	9.6	231.5	420.7	85
				740	±32	±19	10.8	4.9			
250	375	30x28x1.0	6	518	±12	±2	32.6	135.6	280.0	615.4	119
				686	±25	±10	16.3	17.0			
300	450	30x28x1.0	12	736	±25	±8	19.2	27.9	350.5	857.5	188
				820	±32	±13	15.4	14.3			
350	485	36x28x1.2	4	562	±9	±1	71.0	1174.1	371.8	1085.1	233
				674	±18	±3	35.5	146.8			
400	535	36x28x1.2	8	724	±18	±3	40.2	212.0	420.3	1386.7	280
				780	±23	±5	32.1	108.6			
450	590	36x28x1.2	4	612	±9	±1	90.0	2384.1	470.8	1740.0	297
				724	±18	±3	45.0	298.0			
500	650	36x28x1.2	8	774	±18	±2	50.3	417.0	526.6	2176.9	364
				830	±23	±4	40.2	213.5			
600	750	36x28x1.2	4	662	±9	-	100.6	3335.9	628.1	3096.9	492
				774	±18	±2	60.0	707.6			
700	1050	60x60x2.0	8	830	±23	±3	48.0	362.3	749.0	4403.9	513
				900	±22	±2	101.0	944.0			
800	1150	60x60x2.0	3	780	±13	±1	168.0	4370.3	854.0	5725.1	426
				900	±22	±2	101.0	944.0			
900	1280	60x60x2.0	5	900	±22	±2	128.2	1932.1	951.0	7099.5	456
				1020	±31	±4	91.6	704.1			
1000	1380	60x60x2.0	3	780	±13	-	236.3	-	1052.0	8687.6	467
				900	±22	±2	141.8	2615.5			
1200	1600	60x60x2.0	5	960	±22	±1	168.5	4387.5	1250.0	12265.6	512
				1080	±31	±3	120.3	1598.9			
1500	1950	60x60x2.0	3	840	±13	-	349.1	-	1554.0	18957.1	544
				960	±22	±1	209.5	8430.5			
2000	2450	75x60x2.0	7	1080	±31	±2	149.6	3072.3	2073.0	33734.0	551
				820	±12	-	399.9	-			
				940	±25	-	199.9	-			610
				1000	±31	±1	159.9	-			655
											670
											674
											719
											738
											916
											966
											986
											1249
											1318
											1347
											1670
											1775
											1820

Design Cycles : The above movement value is based on 3000 cycles.

Weight : For models of lower than 600A, ANSI#150 flange is included, while for models of higher than 650A, flange is not included.

\* We can manufacture products different from the above specifications if customer's request.

## ■ MSG (Single Guide Rod Type)



**Applications :** gas pipes, ventilators, low-pressure steam pipes, and others

**Pressure limits :** less than 5kg/cm<sup>2</sup>

**Design standards :** The below design specifications are based on two-layer bellows

SINGLE - GUIDE ROD TYPE (5kg/cm<sup>2</sup>)

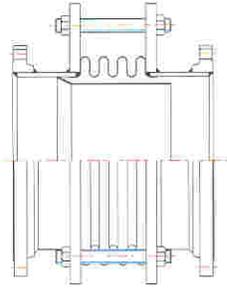
Nominal diameter (N.D.)	External diameter (mm)	Dimensions HxPxI(mm)	No. of corr. (N)	Length (mm)	Movement (mm)		Spring force (kg/mm)		Effective dia. (mm)	Effective area (cm <sup>2</sup> )	Weight (kg)
					X	Y	X	Y			
50	185	16x16x0.6-2P	5	280	±5	±2	25.9	27.7	67.5	35.8	18
			10	360	±10	±8	13	3.5			19
65	205	18x18x0.6-2P	5	290	±6	±2	22.8	30	84.4	55.9	21
			10	380	±13	±9	11.4	3.8			23
80	220	18x18x0.6-2P	5	290	±6	±2	25	39.6	92.6	67.3	24
			10	380	±13	±8	12.5	5			27
100	255	24x22x0.6-2P	7	394	±11	±4	25.4	25.6	126.2	125	34
			10	460	±16	±9	17.8	8.8			36
			15	570	±25	±21	11.9	2.6			39
125	280	24x22x0.8-2P	7	394	±11	±4	30.3	43.7	150.9	178.8	42
			10	460	±16	±8	21.2	15			47
			15	570	±25	±18	14.2	4.4			50
150	340	30x28x1.0-2P	6	488	±12	±4	42.1	73.3	181.0	257.2	61
			12	656	±25	±15	21	9.2			68
			15	740	±32	±24	16.8	4.7			71
200	395	30x28x1.0-2P	6	488	±12	±3	53.7	151.4	230.5	417.1	86
			12	656	±25	±12	26.8	18.9			94
			15	740	±32	±19	21.4	9.7			99
250	375	30x28x1.0-2P	6	518	±12	±2	64.9	268.4	279.0	611.1	121
			12	686	±25	±10	32.4	33.6			131
			15	770	±32	±15	26	17.2			138
300	450	30x28x1.0-2P	6	568	±12	±2	76.6	442.1	329.5	852.3	181
			12	736	±25	±8	38.3	55.3			193
			15	820	±32	±13	30.7	28.3			198
350	485	36x28x1.2-2P	4	562	±9	±1	141.6	2325.6	370.6	1078.2	237
			8	674	±18	±2	70.8	290.7			251
			10	730	±23	±5	56.6	184.8			259
400	535	36x28x1.2-2P	4	612	±9	±1	160.1	3363.2	419.1	1378.8	279
			8	724	±18	±3	80.1	420.4			294
			10	780	±23	±5	64.1	215.2			302
450	590	36x28x1.2-2P	4	612	±9	±1	179.4	4731.5	469.6	1731.1	302
			8	724	±18	±3	89.7	591.4			320
			10	780	±23	±4	71.8	302.8			328
500	650	36x28x1.2-2P	4	660	±9	-	200.4	-	525.4	2167.0	369
			8	774	±18	±2	100.4	828.3			390
			10	830	±23	±4	80.3	424			400
600	750	36x28x1.2-2P	4	662	±9	-	239.5	-	626.9	3085.1	498
			8	774	±18	±2	119.8	1407.1			527
			10	830	±23	±3	95.8	720.4			540
700	1050	60x60x2.0-2P	3	780	±13	±1	355.6	8670.7	747.0	4380.4	439
			5	900	±22	±2	201.4	1872.9			482
			7	1020	±31	±5	143.8	682.5			498
800	1150	60x60x2.0-2P	3	780	±13	-	382.8	-	852.0	5698.3	526
			5	900	±22	±2	229.7	2778.8			573
			7	1020	±31	±5	164.1	1012.7			589
900	1280	60x60x2.0-2P	3	780	±13	-	426.4	-	949.0	7069.7	621
			5	900	±22	±2	255.8	3839.9			677
			7	1020	±31	±4	182.7	1399.4			696
1000	1380	60x60x2.0-2P	3	780	±13	-	471	-	1050.0	8654.6	686
			5	900	±22	±2	283.1	5201.2			743
			7	1020	±31	±4	202.2	1895.5			763

Design Cycles : The above movement value is based on 3000 cycles.

Weight : For models of lower than 600A, ANSI#150 flange is included, while for models of higher than 650A, flange is not included.

\* We can manufacture products different from the above specifications if customer's request.

## ■ MSG (Single Guide Rod Type)



**Applications :** gas pipes, cold and hot water, oil pipes, ventilators, and others

**Pressure limits :** less than 10kg/cm<sup>2</sup>

**Design standards :** The below design specifications are based on three-layer bellows

SINGLE - GUIDE ROD TYPE (10kg/cm<sup>2</sup>)

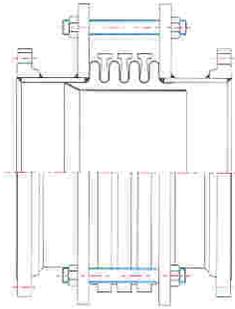
Nominal diameter (N.D.)	External diameter (mm)	Dimensions HxPxT(mm)	No. of corr. (N)	Length (mm)	Movement (mm)		Spring force (kg/mm)		Effective dia. (mm)	Effective area (cm <sup>2</sup> )	Weight (kg)
					X	Y	X	Y			
50	185	16x16x0.6-3P	5	280	±5	±2	38.5	40.4	66.9	35.1	18
			10	360	±10	±8	19.3	5.1			19
65	205	18x18x0.6-3P	5	290	±6	±2	33.9	44.1	83.8	55.1	22
			10	380	±13	±9	16.9	5.5			25
80	220	18x18x0.6-3P	5	290	±6	±2	37.2	58.3	92.0	66.4	25
			10	380	±13	±8	18.6	7.3			29
100	255	24x22x0.8-3P	7	394	±11	±4	37.8	37.6	125.4	123.4	35
			10	460	±16	±9	26.5	12.9			39
			15	570	±25	±21	17.7	3.8			42
125	280	24x22x0.8-3P	7	394	±11	±4	45.3	64.5	150.1	176.9	43
			10	460	±16	±8	31.7	22.1			49
			15	570	±25	±18	21.1	6.6			53
150	340	30x28x1.0-3P	6	488	±12	±4	62.8	108.1	180.0	254.3	62
			12	656	±25	±15	31.4	13.5			71
			15	740	±32	±24	25.1	6.9			75
200	395	30x28x1.0-3P	6	488	±12	±3	80.0	224.0	229.5	413.5	89
			12	656	±25	±12	40.0	28.0			99
			15	740	±32	±19	32.0	14.3			104
250	375	30x28x1.0-3P	6	518	±12	±2	97.0	398.3	278.0	606.7	124
			12	686	±25	±10	48.5	49.8			137
			15	770	±32	±15	38.8	25.5			145
300	450	30x28x1.0-3P	6	568	±12	±2	114.6	657.2	328.5	847.1	184
			12	736	±25	±8	57.3	82.1			199
			15	820	±32	±13	45.8	42.1			206
350	485	36x28x1.2-3P	4	562	±9	±2	211.7	3454.8	369.4	1071.2	242
			8	674	±18	±3	105.9	431.9			261
			10	730	±23	±5	84.7	221.1			270
400	535	36x28x1.2-3P	4	612	±9	±1	239.5	5001.6	417.9	1370.9	284
			8	724	±18	±3	119.8	625.2			304
			10	780	±23	±5	95.8	320.1			315
450	590	36x28x1.2-3P	4	612	±9	±1	268.5	7042.9	468.4	1722.3	308
			8	724	±18	±3	134.2	8804.4			332
			10	780	±23	±4	107.4	450.8			342
500	650	36x28x1.2-3P	4	660	±9	-	300.4	-	524.2	2157.1	376
			8	774	±18	±2	150.2	1233.9			404
			10	830	±23	±4	120.8	631.8			416
600	750	36x28x1.2-3P	4	662	±9	-	358.6	-	625.7	3073.3	507
			8	774	±18	±2	179.3	2098.5			546
			10	830	±23	±3	143.4	1074.4			562

Design Cycles : The above movement value is based on 3000 cycles.

Weight : ANSI#150 flange is included.

\* We can manufacture products different from the above specifications if customer's request.

## ■ MSC (Single Control Ring Type)



Applications : hot water, high-pressure steam, oil pipes, and others

Pressure limits : 2~200kg/cm<sup>2</sup>

SINGLE - CONTROL RING TYPE (2~200kg/cm<sup>2</sup>)

Nominal diameter (N.D)	External diameter (mm)	Dimensions HxPxL(mm)	No. of corr. (N)	Length (mm)	Movement (mm)		Spring force (kg/mm)	Effective dia. (mm)	Effective area. (cm <sup>2</sup> )	Weight (kg)
					X	X				
50	185	25x25x0.8	5 10	325	±10	9.2	76.4	45.8	22	
				450	±20	4.9				29
65	205	25x25x0.8	5 10	325	±10	10.9	91.7	66.0	26	
				450	±20	5.5				35
80	220	25x25x0.8	6 12	350	±12	10.4	104.2	85.2	31	
				500	±24	5.2				42
100	255	30x30x0.8	5 11	390	±14	9.2	133.0	138.9	42	
				570	±32	4.2				59
125	280	30x30x0.8	5 11	390	±14	10.9	157.7	195.2	51	
				570	±32	4.9				69
150	340	40x40x1.0	4 8 10	480	±16	13.6	192.0	289.4	74	
				640	±32	6.8				101
				720	±40	5.5				114
200	395	40x40x1.0	4 8 10	480	±16	17.2	241.5	457.8	103	
				640	±32	8.6				136
				720	±40	6.9				152
250	375	50x50x1.2	3 6 8	500	±16	25.1	299.8	705.6	140	
				650	±32	12.6				182
				750	±42	9.4				211
300	450	60x50x1.5	3 6 7	550	±17	37.4	360.0	1017.4	210	
				700	±33	18.7				269
				750	±39	16				306
350	485	60x50x1.5	3 6 7	600	±17	41.1	395.5	1227.9	266	
				750	±33	20.5				329
				800	±39	17.6				353
400	535	60x50x1.5	3 6 7	650	±17	46.1	444.0	1547.5	311	
				800	±33	23				381
				850	±39	19.8				406
450	590	60x50x1.5	3 6 7	650	±17	51.3	494.5	1919.6	338	
				800	±33	25.7				415
				850	±39	22				446
500	650	60x50x1.5	3 6 7	700	±17	56.6	545.5	2335.9	410	
				850	±33	28.3				501
				900	±39	24.3				537
600	750	60x50x1.5	3 6 7	700	±17	67.1	646.5	3281.0	542	
				850	±33	33.6				647
				900	±39	28.8				688
700	1050	75x60x2.0	3 6 6	780	±19	98.2	764.0	4582.0	449	
				900	±32	58.9				532
				960	±38	49.1				576
800	1150	75x60x2.0	3 6 6	780	±19	111.7	869.0	5928.0	539	
				900	±32	67				622
				960	±38	55.9				680
900	1280	75x60x2.0	3 6 6	780	±19	124.2	966.0	7325.3	636	
				900	±32	74.5				738
				960	±38	62.1				809
1000	1380	75x60x2.0	3 6 6	780	±19	137.2	1067.0	8937.1	704	
				900	±32	82.3				811
				960	±38	68.6				892
1200	1600	75x60x2.0	3 6 6	840	±19	162.7	1265.0	12561.8	953	
				960	±32	97.6				1080
				1020	±38	81.3				1177
1500	1950	75x60x2.0	3 6 6	840	±19	201.8	1569.0	19324.8	1308	
				960	±32	121.2				1442
				1020	±38	100.9				1564
2000	2450	75x60x2.0	3 6 6	880	±19	266.6	2073.0	33734.0	1709	
				1000	±32	159.9				1920
				1060	±38	133.3				2020

Design Cycles : The above movement value is based on 3000 cycles.

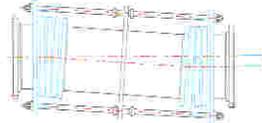
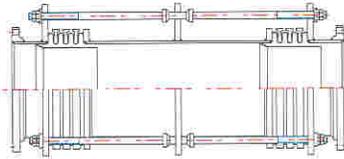
Weight : For models of lower than 600A, ANSI#150 flange is included, while for models of higher than 650A, flange is not included.

\* We can manufacture products different from the above specifications if customer's request.

## ■ MUT (Universal Tie Rod Type)

**Applications** : to prevent unequal sinking of the storage tank,  
and to absorb lateral movements

**Pressure limits** : 2kg/cm<sup>2</sup> ~ 50kg/cm<sup>2</sup>

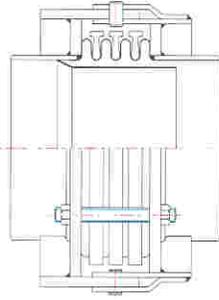


UNIVERSAL TYPE (10kg/cm<sup>2</sup>)

Nominal diameter (N.D.)	Max. O.D. (mm)	Division	Max Lateral Movement (Y)							
			50mm	100mm	150mm	200mm	250mm	300mm	350mm	400mm
80	250	y(mm)	700	1000	1400	1700	2100	2400	2700	3100
		weight(kg)	42	48	56	62	70	76	82	90
100	280	y(mm)	700	1100	1400	1800	2100	2500	2800	3200
		weight(kg)	56	66	74	84	92	102	110	120
125	320	y(mm)	800	1200	1600	2000	2300	2700	3100	3500
		weight(kg)	82	97	112	127	138	153	168	183
150	370	y(mm)	800	1200	1600	2000	2400	2800	3200	3600
		weight(kg)	106	121	136	151	166	181	196	211
200	430	y(mm)	900	1300	1700	2100	2500	2900	3300	3700
		weight(kg)	145	170	190	215	240	260	285	305
250	380	y(mm)	1000	1400	1800	2200	2600	3000	3300	3700
		weight(kg)	205	235	265	295	325	355	375	405
300	460	y(mm)	1000	1400	1800	2200	2600	3000	3300	3700
		weight(kg)	270	310	350	390	430	470	505	545
350	495	y(mm)	1100	1500	1900	2300	2700	3100	3400	3800
		weight(kg)	370	425	480	535	590	645	685	740
400	550	y(mm)	1200	1600	2100	2400	2800	3200	3600	4000
		weight(kg)	395	465	555	615	695	775	855	935
450	590	y(mm)	1200	1700	2200	2600	3100	3500	4000	4500
		weight(kg)	550	655	760	845	950	1035	1140	1245
500	650	y(mm)	1300	1800	2300	2800	3300	3800	4300	4800
		weight(kg)	645	745	845	945	1045	1145	1245	1345
550	700	y(mm)	1300	1900	2500	3000	3600	4100	4700	5300
		weight(kg)	660	790	920	1030	1160	1270	1400	1530
600	750	y(mm)	1400	1900	2500	3000	3600	4100	4700	5300
		weight(kg)	905	1025	1165	1285	1425	1545	1685	1825
650	1020	y(mm)	1400	1900	2500	3000	3600	4100	4700	5300
		weight(kg)	825	976	1100	1235	1385	1515	1665	1815
700	1070	y(mm)	1400	2000	2500	3000	3600	4100	4700	5300
		weight(kg)	860	1000	1120	1240	1380	1500	1640	1780
750	1120	y(mm)	1500	2100	2600	3100	3700	4200	4700	5300
		weight(kg)	1020	1170	1290	1420	1570	1695	1820	1970
800	1170	y(mm)	1500	2100	2700	3200	3800	4300	4800	5400
		weight(kg)	1080	1280	1360	1490	1640	1780	1890	2040
900	1280	y(mm)	1600	2200	2800	3400	4000	4600	5200	5800
		weight(kg)	1230	1440	1650	1860	2070	2280	2490	2700
1000	1440	y(mm)	1800	2600	3300	4100	4800	5500	6300	7000
		weight(kg)	1540	1830	2080	2330	2620	2830	3160	3410
1100	1150	y(mm)	1900	2800	3600	4400	5200	6000	6800	7600
		weight(kg)	1736	2124	2465	2807	3151	3494	3837	4180
1200	1680	y(mm)	2000	2900	3800	4700	5600	6500	7300	8200
		weight(kg)	2003	2442	2881	3322	3762	4200	4591	5036
1300	1800	y(mm)	2100	3100	4000	5000	5900	6900	7900	8800
		weight(kg)	2396	2961	3483	4021	4569	5141	5713	6228
1400	1900	y(mm)	2200	3200	4300	5300	6300	7400	8400	9400
		weight(kg)	2511	3116	3783	4390	4996	5662	6268	6874
1500	2000	y(mm)	2200	3400	4500	5600	6700	7600	8900	10000
		weight(kg)	2665	3428	4139	4844	5548	6126	6959	7664

Weight : For models of lower than 600A, ANSI#150 flange is included, while for models of higher than 650A, flange is not included.  
Please note that the above specifications are just for reference. We manufacture this product in a variety of specifications on customer's demand.

※ We can manufacture products different from the above specifications if customer's request.



## ■ MSH (Hinge Type-Single) MUH (Hinge Type-Double)

**Applications :** steam pipes, hot and cold water pipes, and others  
**Pressure limits :** 2~8kg/cm<sup>2</sup>

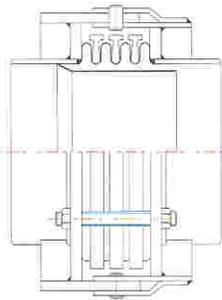
HINGE TYPE (2~8kg/cm<sup>2</sup>)

Nominal diameter (N.D)	Max. O.D (mm)	No. of corr. (N)	Single-type		Division	Maximum lateral movements for the double-type (Y)						
			Angular Movement (deg.)	Length(mm) Weight(kg)		Length product (mm)						
						1000	1500	2000	2500	3000	4000	5000
50	150	4	8.53	264	y(mm)	109	184	258	332	407	556	705
				20	weight(kg)	38	41	44	47	50	56	62
65	170	4	9.01	272	y(mm)	91	154	217	280	343	469	595
				25	weight(kg)	47	51	56	60	65	74	83
80	210	4	8.03	272	y(mm)	83	140	198	255	313	428	542
				29	weight(kg)	55	61	67	73	79	91	103
100	220	4	7.01	328	y(mm)	68	119	170	221	273	375	477
				40	weight(kg)	73	80	88	96	104	120	135
125	270	4	5.66	328	y(mm)	57	100	142	185	228	313	398
				47	weight(kg)	85	94	103	112	121	139	157
150	310	4	9.64	432	y(mm)	82	154	226	298	370	514	658
				68	weight(kg)	122	136	151	166	180	210	239
200	360	4	7.28	462	y(mm)	60	117	173	230	286	399	512
				89	weight(kg)	154	176	199	221	244	289	334
250	410	5	7.34	540	y(mm)	53	111	173	228	286	402	518
				120	weight(kg)	194	225	257	288	320	383	446
300	460	5	6.11	590	y(mm)	40	89	138	188	237	335	433
				166	weight(kg)	258	299	341	382	424	507	590
350	510	6	7.65	618	y(mm)	46	107	168	228	290	411	533
				208	weight(kg)	314	364	414	464	514	614	714
400	570	6	6.68	618	y(mm)	41	95	149	202	256	363	471
				261	weight(kg)	394	459	524	589	654	784	914
450	630	6	5.91	618	y(mm)	36	84	132	180	228	324	420
				295	weight(kg)	446	521	596	671	746	896	1046
500	700	6	5.24	618	y(mm)	32	75	118	161	204	290	375
				345	weight(kg)	517	582	647	712	777	907	1037

Design Cycles : The above movement value is based on 3000 cycles.

Weight : ANSI#150 flange is included.

\* We can manufacture products different from the above specifications if customer's request.



## ■ MSH (Hinge Type-Single) MUH (Hinge Type-Double)

**Applications :** high-pressure steam pipes, high-pressure cold & hot water pipes, and high-pressure gas pipes

**Pressure limits :** 5kg/cm<sup>2</sup> ~max. 200kg/cm<sup>2</sup>

The control ring was applied according to pressure level

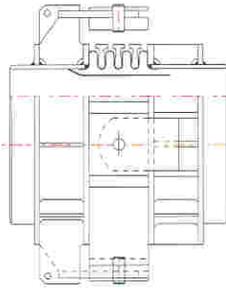
HINGE TYPE (5~200kg/cm<sup>2</sup>)

Nominal diameter (N.D)	Max. O.D (mm)	No. of corr. (N)	Single-type		Division	Maximum lateral movements for the double-type (Y)						
			Angular Movement (deg.)	Length(mm) Weight(kg)		Length product (mm)						
						1000	1500	2000	2500	3000	4000	5000
50	220	3	8.8	275	y(mm)	111	187	264	340	417	570	723
				23	weight(kg)	45	48	52	55	58	65	72
65	240	3	7.1	275	y(mm)	92	156	220	283	347	475	602
				29	weight(kg)	57	61	66	70	75	83	92
80	260	3	6.4	275	y(mm)	81	137	193	249	305	418	530
				34	weight(kg)	66	72	79	85	91	104	116
100	280	3	7.2	330	y(mm)	84	147	210	274	337	463	589
				45	weight(kg)	84	92	100	108	116	131	147
125	310	3	6.1	330	y(mm)	71	124	177	231	284	390	497
				56	weight(kg)	104	113	122	131	140	158	176
150	365	3	7.2	440	y(mm)	70	132	195	257	320	445	570
				83	weight(kg)	153	168	183	197	212	241	271
200	430	3	5.7	470	y(mm)	50	102	152	201	251	350	450
				139	weight(kg)	252	275	297	320	342	387	432
250	520	3	6	550	y(mm)	46	98	150	202	254	358	463
				195	weight(kg)	344	375	407	439	470	533	596
300	625	4	7	650	y(mm)		103	164	226	287	409	531
				310	weight(kg)		579	620	662	703	786	869
350	675	4	6.4	700	y(mm)		88	144	200	255	366	478
				368	weight(kg)		668	718	768	818	918	1018
400	740	4	5.7	700	y(mm)		79	128	178	227	326	425
				458	weight(kg)		832	897	962	1027	1157	1287
450	800	4	5.1	750	y(mm)		66	111	158	200	289	377
				546	weight(kg)		984	1059	1134	1209	1359	1509
500	850	4	4.6	750	y(mm)		60	100	141	181	262	342
				715	weight(kg)		1289	1354	1419	1484	1614	1744
600	950	4	3.9	800	y(mm)		47	81	115	149	217	285
				854	weight(kg)		1504	1579	1654	1729	1879	2029
700	1050	5	4.7	1000	y(mm)		51	92	133	171	257	339
				800	weight(kg)		1537	1622	1707	1792	1962	2132
800	1180	5	4.2	1000	y(mm)		44	81	117	153	226	298
				976	weight(kg)		1586	1986	2116	2246	2506	2766
900	1300	5	3.7	1100	y(mm)		33	66	99	131	196	262
				1263	weight(kg)		2352	2502	2652	2802	3102	3402
1000	1460	5	3.4	1150	y(mm)		27	57	86	116	175	234
				1523	weight(kg)		2823	2988	3153	3318	3648	3978
1200	1700	5	2.9	1300	y(mm)			40	65	90	140	190
				2130	weight(kg)			4074	4269	4464	4854	5244
1500	2020	5	2.3	1300	y(mm)			32	52	73	113	153
				2877	weight(kg)			5520	5765	6010	6500	6990

Design Cycles : The above movement value is based on 3000 cycles.

Weight : For models of lower than 600A, ANSI#150 flange is included, while for models of higher than 650A, flange is not included.

※ We can manufacture products different from the above specifications if customer's request.



## ■ MSG (Gimbal Type-Single) MUG (Gimbal Type-Double)

Applications : steam pipes, cold & hot water pipes, and gas pipes

Pressure limits : 10kg/cm<sup>2</sup>

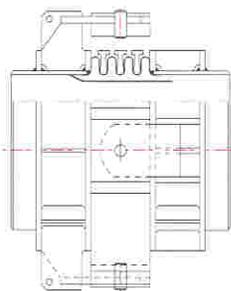
GIMBAL TYPE (lower than 10kg/cm<sup>2</sup>)

Nominal diameter (N.D)	Max. O.D (mm)	No. of corr. (N)	Single-type		Maximum lateral movements for the double-type (Y)							
			Angular Movement (deg.)	Length(mm) Weight(kg)	Division	Length product (mm)						
						1000	1500	2000	2500	3000	4000	5000
50	150	4	8.6	264	y(mm)	77	130	182	234	287	393	498
				23	weight(kg)	43	46	49	52	55	61	67
65	180	4	9.0	272	y(mm)	64	108	153	197	242	331	420
				28	weight(kg)	53	58	62	67	71	80	89
80	220	4	8.0	272	y(mm)	58	98	139	180	221	302	383
				33	weight(kg)	63	69	75	81	87	99	111
100	240	4	7.0	328	y(mm)	48	84	120	156	193	265	337
				48	weight(kg)	88	96	104	111	119	135	151
125	285	4	5.7	328	y(mm)	40	70	100	130	161	221	281
				56	weight(kg)	104	113	122	131	140	158	176
150	325	4	9.6	432	y(mm)	57	108	159	210	261	363	465
				82	weight(kg)	150	164	179	194	209	238	267
200	375	4	7.2	462	y(mm)	42	82	122	162	202	283	361
				107	weight(kg)	190	212	215	257	280	325	370
250	430	5	7.3	540	y(mm)	37	78	120	161	202	284	366
				140	weight(kg)	234	266	297	329	360	423	486
300	480	5	6.1	590	y(mm)	28	62	97	132	167	236	306
				193	weight(kg)	311	352	394	435	477	605	643
350	520	6	7.7	618	y(mm)	32	75	118	161	205	290	376
				237	weight(kg)	372	422	472	522	572	672	772
400	590	6	6.7	618	y(mm)	28	67	105	142	180	256	332
				302	weight(kg)	471	541	606	671	736	866	996
450	660	6	5.9	618	y(mm)	25	59	93	127	161	229	296
				341	weight(kg)	538	613	688	763	838	988	1138
500	730	6	5.2	618	y(mm)	22	53	83	113	144	205	265
				406	weight(kg)	640	705	770	835	900	1030	1160

Design Cycles : The above movement value is based on 3000 cycles.

Weight : ANSI#150 flange is included.

\* We can manufacture products different from the above specifications if customer's request.



## ■ MSG (Gimbal Type-Single) MUG (Gimbal Type-Double)

**Applications** : high-pressure steam pipes, high-pressure cold & hot water pipes, and high-pressure gas pipes

**Pressure limits** : higher than 10kg/cm<sup>2</sup>

The control ring was applied according to pressure level

GIMBAL TYPE (10kg/cm<sup>2</sup>)

Nominal diameter (N.D)	Max. O.D (mm)	No. of corr. (N)	Single-type		Division	Maximum lateral movements for the double-type (Y)						
			Angular Movement (deg.)	Length(mm) Weight(kg)		Length Product (mm)						
						1000	1500	2000	2500	3000	4000	5000
50	230	3	8.8	275	y(mm)	78	132	186	240	294	402	511
				29	weight(kg)	56	59	63	66	70	77	83
65	250	3	7.1	275	y(mm)	65	110	155	200	245	335	425
				36	weight(kg)	69	74	78	82	87	95	104
80	270	3	6.4	275	y(mm)	57	96	136	176	215	295	374
				41	weight(kg)	79	86	92	98	104	117	129
100	300	3	7.2	330	y(mm)	59	103	148	193	238	327	416
				57	weight(kg)	107	115	123	131	139	155	170
125	320	3	6.1	330	y(mm)	50	87	125	163	200	275	351
				80	weight(kg)	129	138	147	156	165	183	202
150	385	3	7.2	440	y(mm)	49	93	137	181	226	314	402
				102	weight(kg)	189	204	218	233	248	277	306
200	450	3	5.7	470	y(mm)	36	72	107	142	177	247	318
				164	weight(kg)	302	324	347	369	392	437	482
250	540	3	6	550	y(mm)	32	69	106	142	179	253	327
				225	weight(kg)	404	435	467	499	530	593	656
300	650	4	7	650	y(mm)	29	72	115	159	202	289	375
				352	weight(kg)	619	660	702	743	785	868	951
350	700	4	6.4	700	y(mm)		62	101	141	180	258	337
				423	weight(kg)		778	828	878	928	1028	1128
400	770	4	5.7	700	y(mm)		55	90	125	160	230	300
				572	weight(kg)		980	1045	1110	1175	1305	1435
450	830	4	5.1	750	y(mm)		46	78	109	141	204	266
				632	weight(kg)		1156	1231	1306	1381	1531	1681
500	890	4	4.6	750	y(mm)		42	70	99	127	185	241
				823	weight(kg)		1505	1570	1635	1700	1830	1960
600	990	4	3.9	800	y(mm)		33	57	81	105	153	201
				1014	weight(kg)		1821	1896	1971	2046	2196	2346
700	1090	5	4.7	1000	y(mm)		36	65	94	123	181	239
				976	weight(kg)		1887	1972	2057	2142	2312	2482
800	1230	5	4.2	1000	y(mm)		31	57	82	108	159	210
				1174	weight(kg)		2248	2378	2508	2638	2898	3158
900	1350	5	3.7	1100	y(mm)		23	46	69	92	138	185
				1513	weight(kg)		2852	3002	3152	3302	3602	3902
1000	1520	5	3.4	1150	y(mm)		19	40	60	82	123	165
				1846	weight(kg)		3466	3631	3796	3961	4291	4621
1200	1760	5	2.9	1300	y(mm)			28	45	63	98	134
				2552	weight(kg)			4915	5110	5305	5695	6085
1500	2080	5	2.3	1300	y(mm)			22	36	51	79	108
				3429	weight(kg)			6622	6867	7112	7602	8092

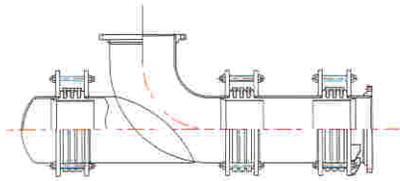
Design Cycles : The above movement value is based on 3000 cycles.

Weight : For models of lower than 600A, ANSI#150 flange is included, while for models of higher than 650A, flange is not included.

\* We can manufacture products different from the above specifications if customer's request.

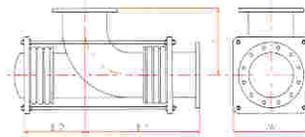
## ■ MSB / MUB

### (Pressure Balance "L" Type-Single/Universal)



Applications : ventilators, oil pipes, X-overs, BFPT, and others

Pressure limits : 2kg/cm<sup>2</sup> ~ 100kg/cm<sup>2</sup>



L type Balance Single Style

Nominal diameter (N.D)	Max. O.D (mm)	No. of corr. (N)	H (mm)	ø 1 (mm)	ø 2 (mm)	L (mm)	Movement(mm)		Working load (kg/mm)	Weight (kg)
							X	Y		
100	280	11+11	200	650	640	1290	±32		8.4	130
150	370	8+8	260	740	670	1410	±32		13.6	230
200	430	8+8	320	800	710	1510	±32		17.2	310
250	500	6+6	370	850	760	1610	±32		25.2	420
300	610	6+6	430	930	810	1740	±33		37.4	630
350	650	6+6	480	1000	830	1830	±33		41.0	760
400	750	6+6	530	1080	940	1920	±33		46.0	1010
450	800	6+6	590	1130	970	2100	±33		51.4	1130
500	850	6+6	640	1200	1000	2200	±33		56.6	1320
600	1000	6+6	750	1300	1200	2500	±33		67.2	1720
700	1070	5+5	870	1400	1300	2700	±32		117.8	1630
800	1170	5+5	1000	1540	1390	2930	±32		134.0	2100
900	1280	5+5	1100	1640	1540	3180	±32		149.0	2590
1000	1440	5+5	1220	1740	1630	3370	±32		164.6	3131
1200	1680	5+5	1440	1980	1780	3760	±32		195.2	4450
1500	2000	5+5	1750	2280	2060	4340	±32		242.2	6420

L type Balance Double Style

Nominal diameter (N.D)	Max. O.D (mm)	No. of corr. (N)	H (mm)	ø 1 (mm)	ø 2 (mm)	L (mm)	Movement(mm)		Working load (kg/mm)		Weight (kg)
							X	Y	X	Y	
100	280	7+7+7	200	1400	520	1920	±20	±100	6.3	0.04	160
150	370	8+8+8	260	1700	670	2370	±32	±130	10.2	0.07	300
200	430	8+8+8	320	1900	710	2610	±32	±120	12.9	0.1	500
250	500	6+6+6	370	2000	760	2760	±32	±100	18.9	0.2	590
300	610	6+7+7	430	2200	810	3010	±33	±100	26.7	0.3	880
350	650	6+7+7	480	2300	830	3130	±33	±100	29.3	0.4	1060
400	750	6+7+7	530	2500	940	3440	±33	±100	32.9	0.5	1380
450	800	6+7+7	590	2600	970	3570	±33	±100	36.7	0.7	1540
500	850	6+7+7	640	2900	1000	3900	±33	±100	40.5	0.7	1770
600	1000	6+7+7	750	3000	1200	4200	±33	±100	47.9	1.1	2240
700	1070	5+6+6	870	3500	1300	4800	±30	±100	83.5	1.8	2136
800	1170	5+6+6	1000	3700	1390	5090	±30	±100	95.0	2.4	2830
900	1280	5+6+6	1100	4000	1540	5540	±30	±100	105.6	2.8	3550
1000	1440	5+6+6	1220	4000	1630	5930	±30	±100	116.6	3.1	4220
1200	1680	5+6+6	1440	5000	1780	6780	±30	±100	138.3	3.7	5910
1500	2000	5+6+6	1750	5900	2060	7960	±30	±100	171.5	4.9	8610

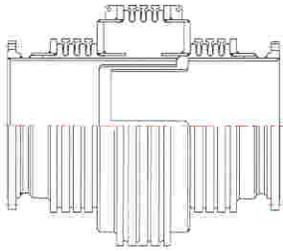
Design Cycles : The above movement value is based on 3000 cycles.

Weight : For models of lower than 600A, ANSI#150 flange is included, while for models of higher than 650A, flange is not included.

\* We can manufacture products different from the above specifications if customer's request.

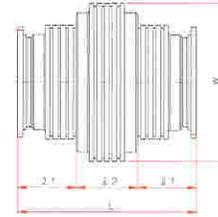
## ■ MSS / MUS

### (Pressure Balance "S" Type-Single/Universal)



Applications : oil pipes, ventilators, steam pipes, and others

Pressure limits : 2kg/cm<sup>2</sup> ~100kg/cm<sup>2</sup>



S type balance

Nominal diameter (N.D)	Max. O.D (mm)	No. of corr. (N)	∅ 1 (mm)	∅ 2 (mm)	L (mm)	변위(mm) X	작동하중 (kg/mm)	중량 (kg)
100	265	11+8+11	560	450	1460	±30	12.8	198
150	370	8+6+8	540	480	1500	±38	14.5	313
200	450	8+6+8	560	480	1520	±40	18.9	424
		10+7+10	610	560	1730	±48	15.7	513
250	530	6+6+6	560	480	1520	±38	27.8	547
		8+7+8	610	580	1770	±48	21.6	678
300	600	6+6+6	560	500	1560	±41	32.9	723
		7+7+7	610	550	1710	±48	28.2	833
350	650	6+6+6	560	525	1610	±41	36.1	839
		7+7+7	610	575	1760	±48	31.0	959
400	720	6+5+6	580	550	1680	±39	40.0	917
		7+6+7	630	600	1830	±47	33.8	1057
450	800	6+5+6	580	550	1680	±39	44.7	1062
		7+6+7	630	600	1830	±47	37.8	1227
500	880	6+5+6	580	575	1730	±41	54.1	1240
		7+6+7	630	625	1880	±48	45.8	1340
600	1040	5+5+5	580	575	1730	±39	64.2	1419
		6+6+6	640	625	1890	±47	53.5	1593
700	1190	5+5+5	600	600	1800	±42	84.8	1465
		6+6+6	660	660	1980	±50	70.7	1662
800	1380	5+5+5	600	600	1800	±42	96.6	1956
		6+6+6	660	660	1980	±50	80.5	2196
900	1460	5+5+5	600	600	1800	±42	107.4	2180
		6+6+6	660	660	1980	±50	89.5	2444
1000	1630	5+5+5	600	600	1800	±42	118.6	2528
		6+6+6	660	660	1980	±50	98.9	2798
1200	1900	5+5+5	600	630	1860	±32	333.2	3197
		6+6+6	660	690	2040	±38	277.7	3466
1500	2340	5+5+5	600	630	1860	±32	413.3	4548
		6+6+6	660	690	2040	±38	344.4	3889
1800	2770	5+5+5	700	650	2000	±32	493.4	6243
		6+6+6	760	710	2180	±38	411.2	6655
2000	3050	5+5+5	700	650	2000	±32	546.2	7631
		6+6+6	760	710	2100	±38	455.7	8115

Design Cycles : The above movement value is based on 3000 cycles.

Weight : For models of lower than 600A, ANSI#150 flange is included, while for models of higher than 650A, flange is not included.

☞ We can manufacture products different from the above specifications if customer's request.

## ■ Materials applied according to use conditions of each expansion joint component

※ Classification based on temperature

Part	Temp.	-200℃~-20℃	-20℃~350℃	350℃~450℃	450℃~600℃
Flange		STS304	SS400, S25C	SF45, F-12	F-12
Pipe		STS304	SS400,SGP,STPG	STPG, SB410	STS304, STS321
Stiffener		STS304	STS400	SB410	F-12
Bellows		STS304	STS304	STS316	STS321
Control ring		STS304	SS400,SC20	SS400, SC20	STS304
Tie rod		STS304	SC20, SCM3	SCM-3	STS304,SCM-3
Sleeve		STS304	SS400	SB410	STS304STS304

※ Material applied according to type of fluid

Type of fluid	Temp.	30℃	Intermediate Temp.	Near boiling point
Nitric acid		STS304	STS304	STS304
Sulfuric acid		STS316	INCOLOY 825	INCOLOY 825
Sulfurous acid		STS316	STS316	INCOLOY 825
Acetic acid		STS304, STS316	STS316	STS316L
Phosphoric acid		STS304	STS316	INCOLOY 825
Hydrochloric acid		STS316	INCOLOY 825	-
Alkali		STS304	STS304, STS304L	STS304L
Ammonia		STS304	STS304, STS304L	STS304L
Brine		STS316	M-5	INCOLOY 825

# FLEXIBLE JOINT

## ■ Composition of a flexible hose

A flexible hose is generally composed of metal hose, braids, and end fittings such as unions, flanges, nipples, and sockets.

### 1) Metal hose

Made of stainless steel strips, metal hoses are highly elastic. Corrugated forming methods enhance metal hoses' flex resistance and flexibility, reducing vibration at joints of mobile devices and vibration piping. We manufacture high quality metal hoses by comprehensively processing stainless steel strips with the automatic forming machine and then heat-treating them in the automatic continuous bright annealing furnace. There are two types of metal hoses: spiral type, which is suitable for general use under medium pressure and annular type, which is suitable for use under high pressure.

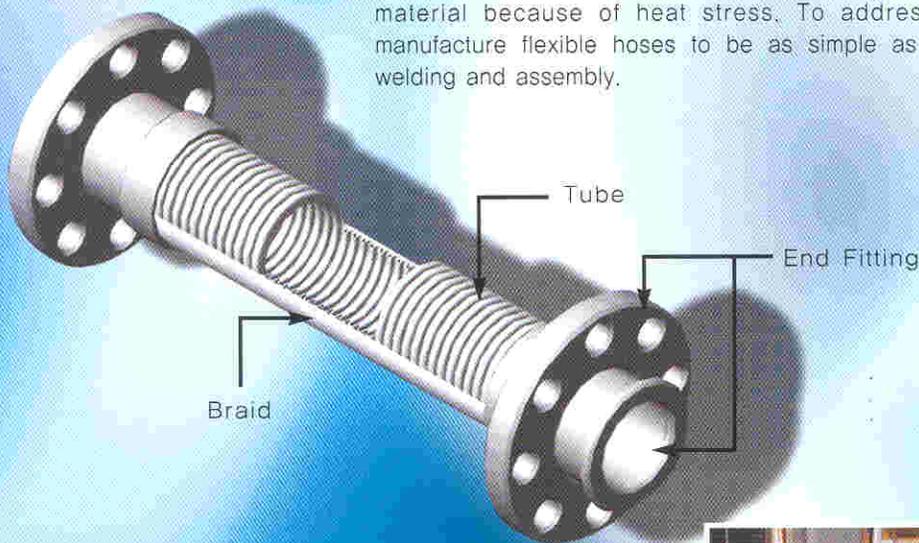


### 2) Braid

When fluid pressure is under work inside the metal hose, the hose stretches length-wise. Should this occur, the braid restrains stretching and protects the metal hose from external shock. Hankook Raseonkwan's hoses are manufactured with stainless steel wire up to 200A. When manufacturing a braid, we always consider working pressure and temperature.

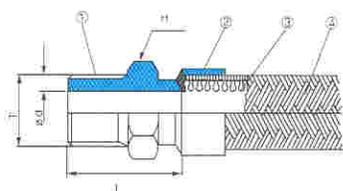
### 3) End Fitting

Flexible hoses are usually fixed by welding end fittings to the ends of metal hose. The welding part is weaker at corrosion than parent material because of heat stress. To address this problem, we manufacture flexible hoses to be as simple as possible to facilitate welding and assembly.



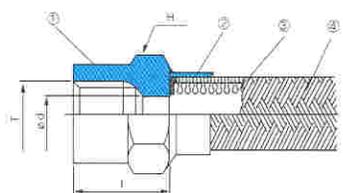
## ■ Types of Connection

### SM type



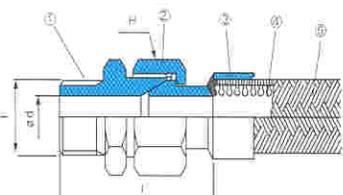
Nominal diameter	T	D	l	H
8A	PT 1/4	7	27	17
10A	PT 3/8	9	28	21
15A	PT 1/2	19	33	26
20A	PT 3/4	19	36	32
25A	PT 1	24	42	38
32A	PT 1,1/4	32	44	46
40A	PT 1,1/2	37	49	54
50A	PT 2	48	52	63

### SF type



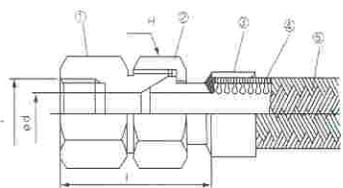
Nominal diameter	T	D	l	H
8A	PT 1/4	6	22	21
10A	PT 3/8	10	23	26
15A	PT 1/2	12	28	29
20A	PT 3/4	19	30	35
25A	PT 1	25	34	50
32A	PT 1,1/4	32	37	63
40A	PT 1,1/2	38	38	71
50A	PT 2	50	43	85

### SNM type



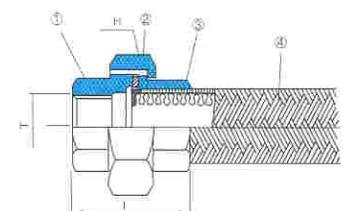
Nominal diameter	T	D	l	H
8A	PT 1/4	4	41	19
10A	PT 3/8	7	46	21
15A	PT 1/2	10	56	26
20A	PT 3/4	16	61	32
25A	PT 1	21,5	71	38
32A	PT 1,1/4	27,5	80	46
40A	PT 1,1/2	33	80	54
50A	PT 2	44	90	67

### SN-F type



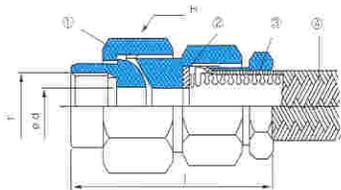
Nominal diameter	T	D	l	H
8A	PT 1/4	7	27	17
10A	PT 3/8	9	28	21
15A	PT 1/2	19	33	26
20A	PT 3/4	19	36	32
25A	PT 1	24	42	38
32A	PT 1,1/4	32	44	46
40A	PT 1,1/2	37	49	54
50A	PT 2	48	52	63

### FU type



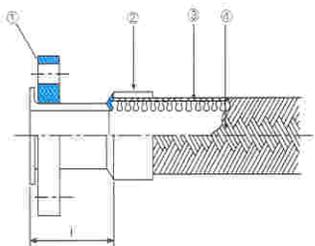
Nominal diameter	T	l	H
8A	PT 1/4	35	34
10A	PT 3/8	38	38
15A	PT 1/2	42	43
20A	PT 3/4	50	49
25A	PT 1	55	59
32A	PT 1,1/4	61	70
40A	PT 1,1/2	68	78
50A	PT 2	74	93

### HU type



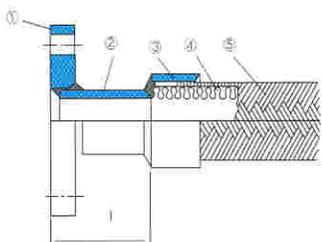
Nominal diameter	T	D	l	H
8A	PT 1/4	6	62	32
10A	PT 3/8	10	65	33
15A	PT 1/2	12	73	41
20A	PT 3/4	19	81	50
25A	PT 1	25	98	63
32A	PT 1.1/4	32	114	71
40A	PT 1.1/2	38	113	85
50A	PT 2	50	152	102

### LF type



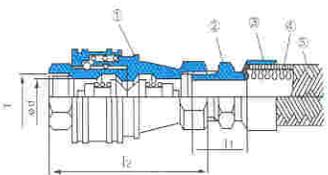
Nominal diameter	l	H
8A	30	* The dimensions for flange follow the standards such as KS, JIS, and ANSI.
10A	30	
15A	30	
20A	50	
25A	50	
32A	50	
40A	50	
50A	50	

### FF type



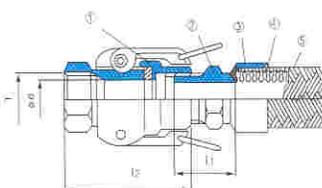
Nominal diameter	l	H
50A	65	* The dimensions for flange follow the standards such as KS, JIS, and ANSI.
65A	65	
80A	65	
100A	70	
125A	75	
150A	85	

### SM+C type



Nominal diameter	T	D	l <sub>1</sub>	l <sub>2</sub>
8A	PT 1/4	8	22	66
10A	PT 3/8	10	23	72
15A	PT 1/2	15	27	78
20A	PT 3/4	20	29	94
25A	PT 1	25	37	124
32A	PT 1.1/4	32	40	140
40A	PT 1.1/2	40	43	150
50A	PT 2	50	47	160

### SM+Q type



Nominal diameter	T	D	l <sub>1</sub>	l <sub>2</sub>
15A	PT 1/2	14	27	57
20A	PT 3/4	19	29	59
25A	PT 1	22	37	80
32A	PT 1.1/4	27	40	86
40A	PT 1.1/2	35	43	92
50A	PT 2	45	47	96

## ■ Flexible Hose-FHM



### Application

used for piping of oil tanks to prevent vibration generated by air compressors/ to prevent heat stress used for exhaust gas pipes inside high-speed diesel engine

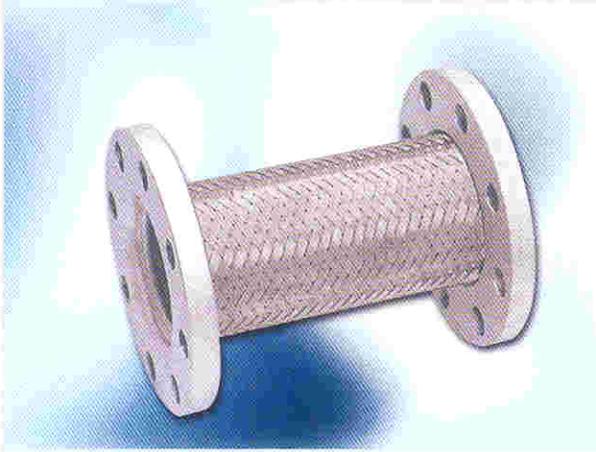
### Pressure limits

2kg/cm<sup>2</sup> ~ 20kg/cm<sup>2</sup>

Nominal Dia. (N.D)	Min. Bend Radius (mm)	Lateral Deflection Y (mm)									
		Overall Length (mm)									
		500	600	800	1000	1200	1500	1800	2000	2500	3000
50A	450	30	50	120	210	330	550				
65A	490	25	45	105	180	285	470				
80A	650	20	40	85	150	235	400				
100A	750		35	75	130	200	340	500			
125A	840			50	95	150	260	400	500		
150A	950			40	75	110	195	200	380		
200A	1200			30	60	90	160	245	315	520	
250A	1250			35	50	80	135	210	270	440	
300A	1300				40	60	75	165	215	350	540
350A	1500				33	55	65	145	190	300	480

※ We can manufacture products different from the above specifications if customer's request.

## ■ Flexible Joint-FJM



### Features

Manufactured by special bellows developed in Korea, this joint is small but flexible, absorbing vibrations at the joints, which connect small pipes to the device. They are usually used in connecting pumps and pipes.

### Specifications

Flange : Carbon Steel, Stainless Steel

Bellows : Stainless Steel 304

Braid : Stainless Steel 304

### ※ Flexible joint specifications

Nominal Dia. (N.D)	Length (mm)	Braid Type	Max. Working Pressure (kg/cm <sup>2</sup> )		Weight (kg)
			Single Braid	Double Braid	
25A	200	Stainless Wire S/S 304	24	45	4
32A	200		20	36	5
40A	230		18	34	5
50A	230		15	28	6
65A	230		12	20	8
80A	230		12	20	9
100A	230		12	20	13
125A	280		10	18	16
150A	280		10	18	20
200A	300		10	18	30
250A	330	Stainless Plate S/S 304	10	18	50
300A	350		10	184	70

※ We can manufacture products different from the above specifications if customer's request.

## ■ Pump connector for absorbing vibration (TTC)



### Features of pump connector for absorbing vibration

- Increased reliability by using multi-ply bellows
- No transmission of vibration due to the braid
- No friction noise generated because the tie rod absorbs thrusts and the rubber washer is used.
- Easy to install and replace this connector because two tie rods are used.
- Vibration condition : Axial  $\pm 3\text{mm}$ , Lateral  $\pm 3\text{mm}$

### \* Specifications for TTC (for 10kg/ cm<sup>2</sup>)

Nominal diameter (N.D)	Connection (Flange)	Overall length (mm)	Weight (kg)	Movement (mm)			Material		
				Axial		Lateral	Bellows	Flange	Tie Rod
				Ext	Comp				
25A	KS 10K DRILLING	80	3.0	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
32A	KS 10K DRILLING	80	3.8	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
40A	KS 10K DRILLING	100	4.0	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
50A	KS 10K DRILLING	115	5.5	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
65A	KS 10K DRILLING	120	7.0	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
80	KS 10K DRILLING	120	7.5	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
100A	KS 10K DRILLING	125	8.5	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
125A	KS 10K DRILLING	130	12.0	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
150A	KS 10K DRILLING	140	15.0	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
200A	KS 10K DRILLING	150	19.0	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
250A	KS 10K DRILLING	200	33.0	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
300A	KS 10K DRILLING	225	41.4	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
350A	KS 10K DRILLING	230	47.3	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
400A	KS 10K DRILLING	235	65.6	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
450A	KS 10K DRILLING	250	79.2	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel
500A	KS 10K DRILLING	260	90.3	3	12	3	Stainless Steel 304	Carbon Steel	Carbon Steel

We can apply different flange standards on customer's demand.

\* We can manufacture TTC of 30kg/cm<sup>2</sup> other than the above specifications

# NON-METALLIC EXPANSION JOINT

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NON-METALLIC EXPANSION JOINT

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RUBBER EXPANSION JOINT

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# INFORMATION ABOUT NON-METALLIC EXPANSION JOINT

## Definition of Product

The non-metallic expansion joints are flexible connectors designed to eliminate the thermal stress created by absorption of displacement from thermal changes in ducting systems. It also absorbs vibrations and compensates for minor installation errors in its ducting or equipment. They are fabricated from a wide variety of non-metallic materials, including synthetic elastomers, fabrics, insulation materials and fluoroplastics, depending on the designs.



## Major Applications

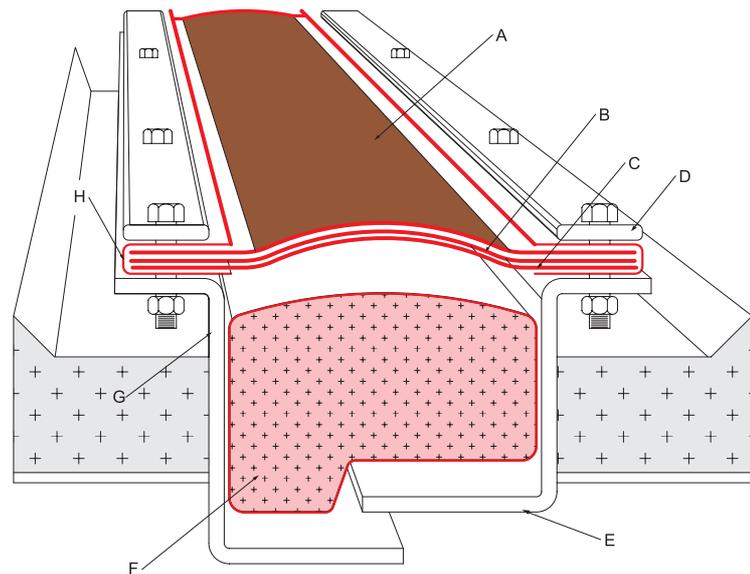
The range of use for non-metallic expansion joints has widened since its introduction in the early sixties. The stricter environmental regulations have resulted in the development of more sophisticated duct systems, requiring non-metallic expansion joints to solve those problems caused by the thermal and mechanical stresses generated in these complex systems.

Although the major user of the non-metallic joint continues to be the power generation industry, the use of this product has expanded into virtually every industry, which conveys gases. A partial list of those industries is as follows:

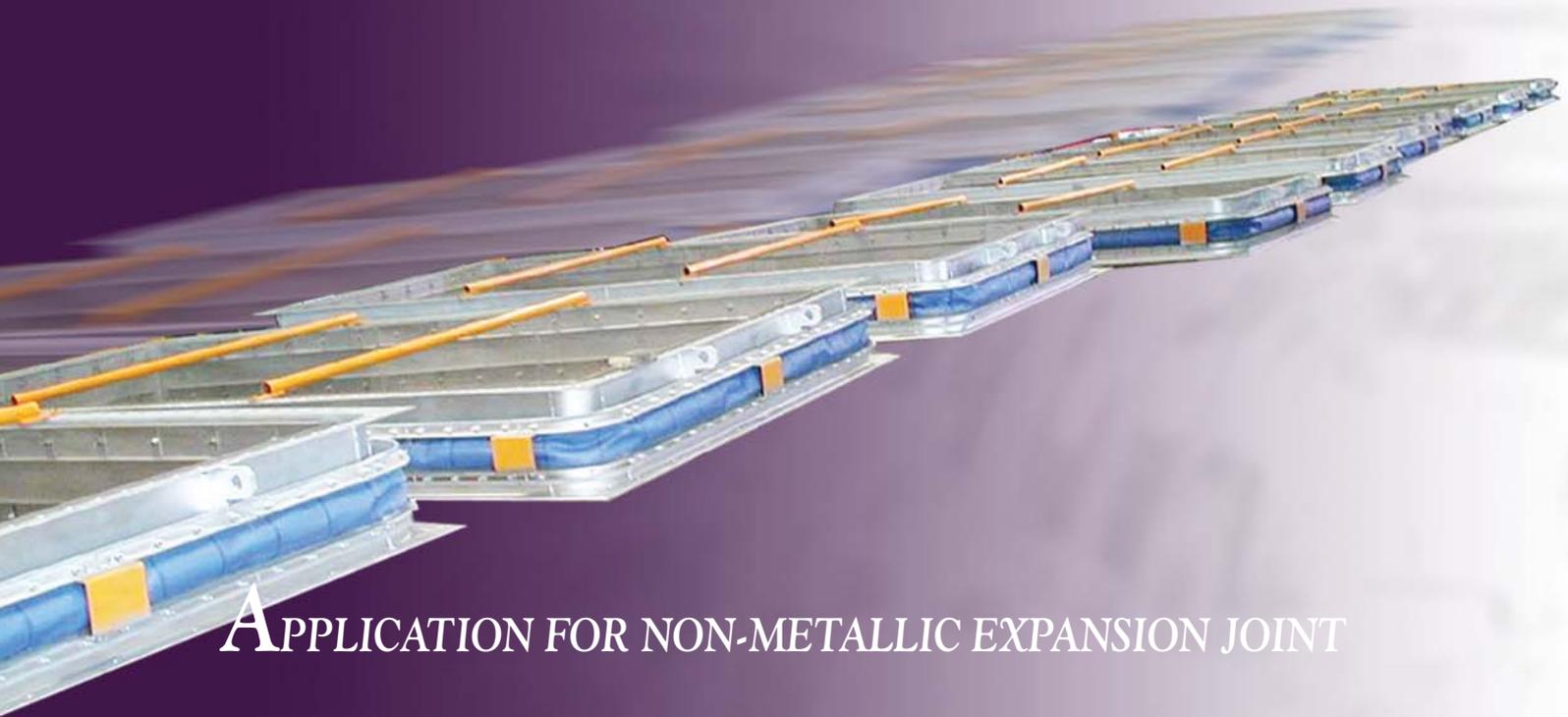
- |                          |                      |                                  |
|--------------------------|----------------------|----------------------------------|
| 1) Power generation      | 3) Refineries        | 7) Refuse Incineration           |
| - Fossil Fired Plants    | - Petroleum industry | 8) Marine                        |
| - Gas Turbine Plants     | - Chemical equipment | 9) Food Processing               |
| - Cogeneration Plants    | 4) Steel Mills       | 10) HVAC-Heating,                |
| - Nuclear Power Plants   | 5) Smelters          | Ventilating and Air Conditioning |
| 2) Pulp and Paper Plants | 6) Cement Plant      |                                  |



# STRUCTURE OF NON-METALLIC EXPANSION JOINT



- A. Gas Seal Membrane** — The gas seal membrane is intended to withstand system pressure and be resistant to chemical attack from the interior and the exterior. The gas seal must also have the flexibility to absorb thermal movements. Depending on system temperature, it may or may not require additional thermal protection.
- B. Insulating Layer** — The insulating layers provide a thermal barrier to ensure that the inside surface temperature of the gas seal membrane does not exceed its maximum service temperature. The insulating layer can also reduce condensation caused by the gas stream coming in contact with the “cool” surface of an un-insulated gas seal membrane.
- C. Insulating Retainer Layer** This layer is provided solely to keep the insulating layers in place in order to maintain thermal integrity. The retaining layer must be capable of withstanding gas stream temperatures and must be chemically compatible with system media.
- D. Back-Up Bars** — A back up bar, positioned at the flange attachment, uses clamping pressure to create the fabric-to-duct seal and restrains the fabric when it is subjected to the system pressure. The thickness and width of the back up bar should be sufficient to perform this function with the bolt spacing being used. The edges of the back up bar should have a radius to preclude cutting of the fabric.
- E. Metal Liner** — A liner designed to protect the gas seal membrane and insulating layers of the flexible element from abrasive particles, which may be present in the gas stream. A liner is also used to reduce flutter of the fabric element caused by turbulence, to help control the accumulation of duct or ash in the expansion joint cavity, and to reduce the temperature of the flexible element.
- F. Accumulation Bag** — An accumulation bag is intended to deter fly ash from building up in the expansion joint cavity. It is typically used, in conjunction with a liner, in duct runs from boilers to air clean-up equipment such as precipitators, scrubbers and bag houses, or whenever high amounts of dust or ash are present in the gas. A fly ash barrier must be capable of retaining its strength and flexibility while being exposed to maximum system temperatures and media.
- G. Metal Frame** — Fabric attachment flanges are required to connect the flexible element to duct work. Properly designed, they can be attached directly to the duct work and thus eliminate the necessity for an adjoining duct flange. Flanges can be designed with a “landing bar” duct attachment, which allows some installation misalignment without affecting the flexible element. The flanges establish the stand off height of the fabric, which is necessary to achieve thermal integrity during all movement conditions. The edges of the flanges in contact with the Gas Seal Membrane should also have a radius to prevent damage.
- H. Gasket or Cuff** — Fabric belts with insulating layers require a special thermal insulating gasket to protect fabric components from hot attachment flanges and back up bars. Low temperature, single ply belt designs require flexible, chemically inert gasket.



# APPLICATION FOR NON-METALLIC EXPANSION JOINT

## APPLIED INDUSTRIES

### APPLICATIONS

Economizer to Air Heater  
 Gas Recirculation to Boiler  
 Air Heater to Precipitator  
 Recovery Boiler to Precipitator  
 Turbo-Expander to CO Boiler  
 CO Boiler to Precipitator



### SYSTEM DESIGN CONSIDERATIONS

#### Temperature:

700°F~900°F for continuous operation, excursions to 1200°F

#### Media:

Low pH Flue gas from the combustion of coal, oil, or caustic black liquor;  
 Flue gas from regeneration process.

#### Particulate:

Transferred with heavy fly ash from coal combustion, salt cake from black liquid fuel or catalyst carryover from the FCCU unit at a Refinery.

#### Insulation / Lagging:

Do not lag over the expansion joint. Also, remove lagging back away from the flanges to allow radiant cooling.

#### Pressure:

Slightly negative for balanced draft boilers, otherwise positive pressure as much as 40-50 inches water gage. Low pressure off the Turbo-Expander.

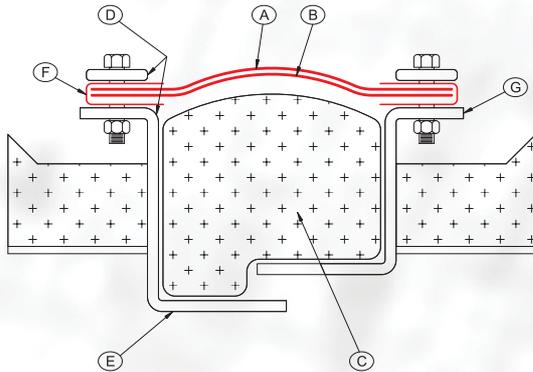
#### Operating Conditions:

Systems usually on line for 12 to 18 months. Refineries have longer durations between major outages. Only Power 'peaking' plants will cycle more frequently.

#### Movements:

Ductwork/boilers generally have large expansions and require joint system with large lateral and compression capabilities.

## DESIGN APPLICATIONS



Note: Above design is available for all applications. Different types of main body structures are available according to user's duct installation conditions.

## COMPONENTS AND FEATURES

### A Belt

High performance gas seal membrane  
Heat Seal Splice  
Flexibility for large movements  
High tensile for particulate build up.  
Repairable  
Assembled by heating.

### B Insulation

Formed by needle insulation blanket.  
Reinforced with wire mesh  
Must not allow temperature to exceed belt maximum.

### C Accumulation Pillow

Reduce Fly ash build up in Cavity

### D Radiused Back-Up Bar and Frame Edges

Protects belt from damage

### E Telescoping Lingers

Shortens installation period.  
Eliminates direct impingement (abrasion)  
Reduces temperature at the belt element

### F Cuff-Flange insulation

Produced with woven glass fiber tape.  
Protects a belt from high hot flange and back-up bar.

### G Outboard Flanges

Allows radiant cooling  
Lower cost belt installation

## GAS SEAL MATERIAL CONSIDERATION

Wet/dry media	Optional chemical resistant barrier is not required since the system maintains temperatures greater than dew point so that fluids do not produce moisture while operating. Regular operation may cause corrosive condensate. Chemical resistant barrier prevents corrosion.
Flutter	Eliminate the possibility of the mechanical damage due to flutter by using a composite design of bellows and accumulation pillow.
Pressure	Continuous pressures below 50 inches water gauge do not require special belt construction.
Abrasion	Above design avoids the direct effects of fly ash, salt cake or catalyst that will be present.
Gas / Air	Combustible gasses are produced by the combustion of fossil fuel or black liquid fuel, creating highly corrosive condensation.

# APPLICATION FOR NON-METALLIC EXPANSION JOINT

## APPLIED INDUSTRIES

### APPLICATIONS

Air Heater to Fossil Fired Boiler  
Air Heater to Coal Mills.



### SYSTEM DESIGN CONSIDERATIONS

#### Temperature:

600° F~750° F for continuous operation

#### Media:

Clean ambient air pushed from the FD Fan and from the Primary Air Fan thru the Air-heater to the Boiler both directly and thru the mills

#### Particulate:

Clean Air

#### Insulation / Lagging:

Do not lag over the expansion joint. Also, remove lagging back away from the flanges to allow radiant cooling.

#### Pressure:

Positive 5" water to as high as 80" of water for positive pressure boilers.

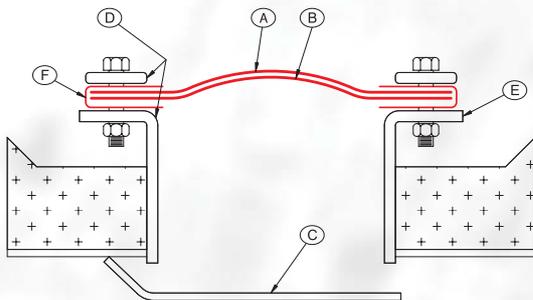
#### Operation:

After start up movement is nominal. Severe high pressure operating conditions may be experienced in the Primary Air Ducts of Positive Pressure Boilers.

#### Movements:

Moderate high temperatures will generate moderate compressive and movements when the unit is on line. Each change in direction in the ductwork will generate a resultant lateral offset.

## DESIGN APPLICATIONS



Note: Above design is available for all applications. Different types of main body structures are available according to user's duct installation conditions.

## COMPONENTS AND FEATURES

### A Belt

High performance gas seal membrane  
Heat Seal Splice  
Flexibility for moderate movements  
Repairable

### B Insulation

Formed by needle insulation blanket.  
Reinforced with wire mesh  
Must not allow temperature to exceed belt maximum.

### C Flow Liner

Increase Service Life  
Outage personnel safety

### D Radiused Back-Up Bar and Frame Edges

Protects belt from damage

### E Outboard Flanges

Allows radiant cooling  
Lower cost belt installation  
Easier belt access

### F Cuff-Flange Insulation

Produced with woven glass fiber tape.  
Protects a belt from high hot flange and back-up bar.

## GAS SEAL MATERIAL CONSIDERATION

Wet/dry media	Since temperatures are well above flue gas dew point temperature during continuous system operation the media will be dry and membranes without chemical film barriers may be used.
Flutter	Composite type of belt structure is inherently rigid enough to eliminate the possibility of mechanical damage due to flutter.
Pressure	No special belt design is required for continuous operation pressure below 50 inches water gage. However, if it is a positive pressure boiler, pressure may reach 75" to 80" of water resulting in the need for higher strength materials.
Abrasion	None
Gas / Air	The media is clean air drawn from the Fan thru the Air-heater to Boiler and the Mills.



# APPLICATION FOR NON-METALLIC EXPANSION JOINT

## APPLIED INDUSTRIES

### APPLICATIONS

Primary Air Fan to Air Heater  
 FD Fan Air to Air Heater  
 Primary Air to Recovery Boiler  
 Ambient Air to Turbine  
 FD Fan Air to Recovery Boiler



### SYSTEM DESIGN CONSIDERATIONS

**Temperature:**

Ambient air,  $-20^{\circ}\text{F} \sim 120^{\circ}\text{F}$

**Media:**

Ambient air

**Particulate:**

None

**Heat Insulation and Insulation:**

Heat insulation and insulation can be used on the outside of the product in the case of low operating temperatures.

**Pressure:**

Positive pressure, 40~50 inches water gauge or higher.

Turbine air inlets are slight negative pressure. Outlet at fans may produce pressure pulsations and/or extreme turbulence.

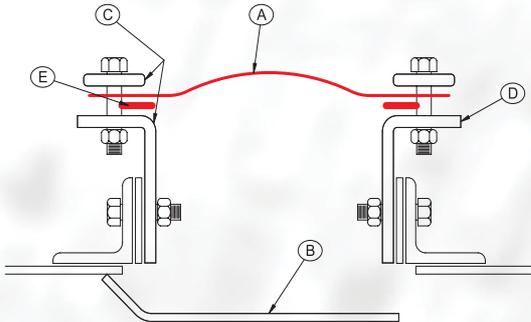
**Operation:**

Operational conditions have little effect on the airside ducts. Cyclical conditions and dew point have little effect as well.

**Movements:**

Joints at boilers subject to large movements. Fan outlet joints see little movement, primarily vibration.

## DESIGN APPLICATIONS



Note: Above design is available for all applications. Different types of main body structures are available according to user's duct installation conditions.

## COMPONENTS AND FEATURES

### A Belt

Gas Seal membrane  
 Moderate Flexibility  
 Medium Tensile Strength  
 Heat Seal  
 Repairable

### B Flow Liner

Increases product's service life.  
 Outage for personnel safety.

### C Radiused Back-Up Bar and Frame Edges

Prevents the damage to the belt.

### D Outboard Flanges

Easy access reduces installation and replacement labor cost

### E Gasket

Prevents gas leakage.  
 Easy to installation  
 Optional for some gas seal membranes

## GAS SEAL MATERIAL CONSIDERATION

Wet/dry media	Dry ambient clean air
Flutter	Direct air impingement is likely at the Primary Air Fan Outlet and at the FD Fan Outlet.
Pressure	Continuous positive pressure rating from 30 inches to 90 inches water gauge. Some gas seal membranes may require special belt construction. Turbine air inlet slightly negative and constant.
Abrasion	None
Gas / Air	Ambient air usually contains no contaminants that may be harmful to the gas seal membrane.



# APPLICATION FOR NON-METALLIC EXPANSION JOINT

## APPLIED INDUSTRIES

### APPLICATIONS

Re-Heater to Chimney  
 Precipitator to Induced Draft Fan  
 Induced Draft Fan to Chimney  
 Induced Draft Fan to Scrubber  
 Steam Generator to Stack  
 Precipitator to Chimney



### SYSTEM DESIGN CONSIDERATIONS

#### Temperature:

Continuous operation temperature, 350°F~500°F

#### Media:

Flue gas from precipitator drawn by Induced Draft Fan; Scrubbed Flue gas from Re-Heater going to Chimney. Turbine Exhaust Gas from Heat Recovery Steam Generator to Chimney.

#### Particulate:

Minimal before scrubber systems, negligible after scrubber systems.

#### Insulation / Lagging:

Temperatures allow lagging over the expansion joints without adverse effects.

#### Pressure:

-15"wg after precipitators and +15"wg after I.D fan

The ducts of scrubbers and steam generator ends are affected by the pressure -5~+5"wg.

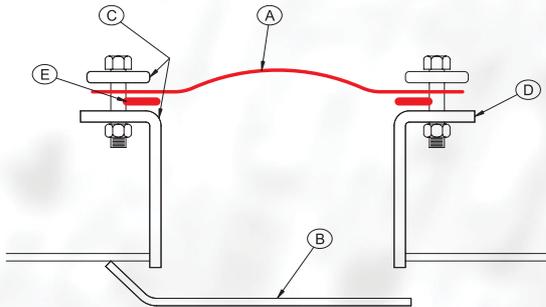
#### Operation:

Although movements are not severe temperatures will approach dew point present potential corrosion problems.

#### Movements:

Moderate compressive and lateral movements expected depending on ductwork configuration and length. Fan Joint usually see minimal movements.

## DESIGN APPLICATIONS



Note: Above design is available for all applications. Different types of main body structures are available according to user's duct installation conditions.

## COMPONENTS AND FEATURES

### A Belt

High performance gas seal membrane.  
Heat Seal Splice (No vulcanization)  
Flexibility for moderate movement.  
Repairable

### B Flow Liner

Increases product's service life.  
Outage personnel safety

### C Radiused Back-Up Bar and Frame Edges

Prevents the damage to the belt.

### D Outboard Flanges

Easy access reduces installation and replacement labor cost.

### E Gasket

Prevents gas leakage.  
Easy to installation.  
Selectively used according to the gas seal material in a belt.

## GAS SEAL MATERIAL CONSIDERATION

Wet/dry media	Since temperatures are above the flue gas dew point, media will dry during continuous operation. Membranes without chemical barrier may be used. If changes in system operation or frequent outages cause wet, corrosive conditions, an optional chemical barrier should be considered.
Flutter	Direct flue gas impingement is likely at the induced Draft Fan Outlet.
Pressure	The pressure range of continuous operation is under 50"WG, and a special stiffening structure is not necessary. However, if it is a positive pressure boilers, pressure may reach 75~80" of water resulting in the need for higher strength material.
Abrasion	None
Gas / Air	The combustion gas produced by fossil fuel or black liquid fuel creates corrosive condensate. Turbine exhaust is clean and non-corrosive.



# APPLICATION FOR NON-METALLIC EXPANSION JOINT

## APPLIED INDUSTRIES

### APPLICATIONS

Scrubber to Re-Heater  
 Scrubber Bypass to Scrubber  
 Scrubber Bypass to Re-Heater  
 Scrubber Outlet to Re-Heater



### SYSTEM DESIGN CONSIDERATIONS

**Temperature:**

Continuous operation temperature, 150° F~350° F

**Media:**

Dry flue gas to scrubber or bypass pushed by Induced Draft Fan; Wet flue gas at scrubber inlet; Wet, scrubbed flue gas from Scrubber (flue gas desulfurization) going to Reheater.

**Particulate:**

Minimal before scrubber systems, negligible after scrubber systems.

**Insulation / Lagging:**

Temperatures allow lagging over the expansion joints without adverse effects.

**Pressure:**

Positive after the Induced Draft Fan, as much as 15" wg. Slightly negative, -5"wg. to slightly positive, +5"wg after Scrubber depending on unit load and weather conditions.

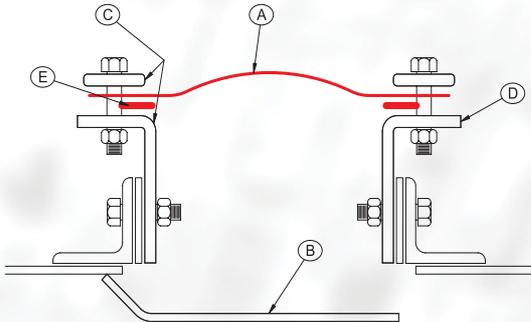
**Operation:**

Although movements are not severe temperatures will approach dew point and present potential corrosion problems. Wet Scrubber Service is potentially highly corrosive.

**Movements:**

Small movements expected.

## DESIGN APPLICATIONS



Note: Above design is available for all applications. Different types of main body structures are available according to user's duct installation conditions.

## COMPONENTS AND FEATURES

### A Belt

Chemical resistant barrier.  
High performance gas seal membrane.  
Heat Seal Splice (No vulcanization)  
Flexibility for moderate movements  
Repairable

### B Flow Liner

Increases product's service life.  
Outage for personnel safety

### C Radiused Back-Up Bar and Frame Edges

Prevents damage to the belt.

### D Outboard Flanges

Easy access reduces installation and replacement labor cost.

### E Gasketing

Chemical resistance required  
Prevents gas leakage.  
Easy to installation



## GAS SEAL MATERIAL CONSIDERATION

Wet/dry media	Temperatures are in or near the flue gas dew point; media will be wet during continuous operation. Membranes with chemical barrier should be used.
Flutter	Partially open Bypass damper or changes in direction of ductwork may create excessive gas stream turbulence resulting in direct flue gas impingement.
Pressure	Varies from positive to negative depending on system operation. Membrane may see more flexing than other applications. Good flexibility needed.
Abrasion	None
Gas / Air	Gas streams from fossil fuel or black liquor combustion processes may create corrosive condensation.



# APPLICATION FOR NON-METALLIC EXPANSION JOINT

## APPLIED INDUSTRIES

### APPLICATIONS

Diverter Bypass to Stack  
Diverter Exhaust to HRSG

Turbine Exhaust to Diverter Inlet  
Turbine Outlet Stack



### SYSTEM DESIGN CONSIDERATIONS

#### Temperature:

Continuous operation temperature, 1000°F~1200°F, excursions to 1350°F.

#### Media:

Turbine Exhaust Gas from combustion of natural gas or fuel oil. Dry and non-corrosive.

#### Particulate:

None

#### Insulation / Lagging:

Do not lag over the expansion joint. Also remove lagging back away from the flanges to allow radiant cooling.

#### Pressure:

Constant positive pressure generally no higher than 15 to 20 inches water gauge.

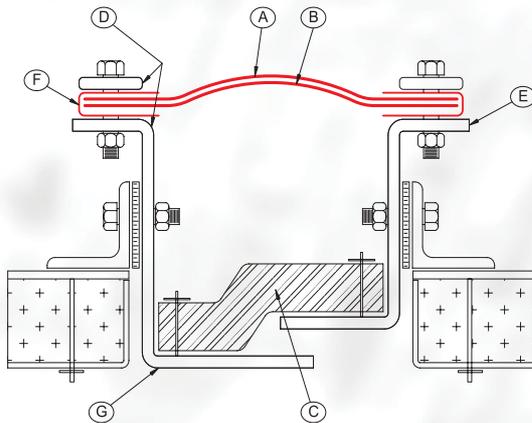
#### Operation:

Systems with heat recovery are usually on line for 12 to 18 months. Power 'peaking' plants may cycle frequently as much as once per day.

#### Movements:

Ductwork/ equipment expansions are large due to the temperature. Generally, lateral movements are small due to short, direct ductwork runs.

## DESIGN APPLICATIONS



Note: Above design is available for all applications. Different types of main body structures are available according to user's duct installation conditions.

## COMPONENTS AND FEATURES

### A Belt

High performance gas seal membrane.  
Heat Seal Splice  
Flexibility for large movements  
Repairable

### B Insulation

Formed by needle insulation blanket.  
Reinforced with wire mesh.  
Must not allow temperature to exceed belt maximum

### C Insulation Pillow

Critical for reducing cavity temperatures  
High performance insulation blanket  
Wire mesh/silica cloth cover for long life integrity

### D Radiused Back-Up Bar and Frame Edges

Prevents damage to the belt.

### E Outboard Flanges

Allows radiant cooling  
Lower cost belt installation

### F Cuff

Made of woven glass fiber tape.  
Protects a belt from Hot Flange and Back-Up Bar.

### G Telescoping Lingers

Required to install an insulation pillow properly.  
Dampens turbulence reduces temperature at the belt element

## GAS SEAL MATERIAL CONSIDERATION

Wet/dry media	Generally dry and non-corrosive. Extreme turbulence is generated near the turbine outlet.
Flutter	The composite belt design, insulation pillow and telescoping liners sufficiently dampen turbulence pulsations.
Pressure	Continuous pressure below 50 inches water gauge does not require special belt construction.
Abrasion	None
Gas / Air	Gas streams from Turbine combustion usually have no chemical effects on gas seal membranes. However, with the increased importance of emissions control, chemical additives to the turbine combustion process may require chemically resistance gas seal membranes.

# COMPARISON OF NON-METALLIC AND METALLIC PRODUCTS

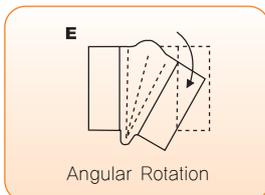
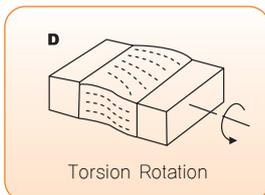
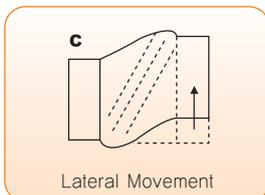
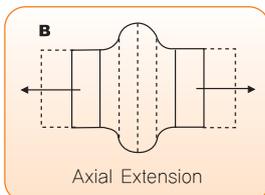
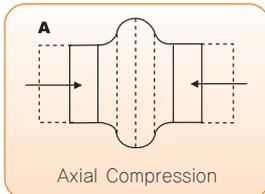
## Advantages of Non-Metallic Expansion Joint

- 1) **Large movements:** The non-metallic expansion joint offers multi-plane movement in a shorter face-to-face dimension.
- 2) **Low load:** Very small reaction force created by expansion amount.
- 3) **Corrosion Resistance:** Able to be used with a wide variety of elastomers, fabrics and fluoroplastics.
- 4) **Sound and Vibration elimination:** Superior reduction of vibration and noise.
- 5) **High Temperature Resistance:** Available for operating temperatures up to 2000°F.
- 6) **Cost Effective:** Cost effective design, reduction in number of devices and simple system structure
- 7) **Economical Material Cost:** Easy to apply non-corrosive materials.
- 8) **Cost Effective Transportation and Installation:** Lightweight and minimal field assembling cost.
- 9) **No Need for Gasket:** Product itself is a gasket.
- 10) **Economical Replacement Cost:** The time required for replacement is short.

## Advantages of Metallic Expansion Joint

- 1) **High Pressure Capability:** Can be used in high-pressure conditions.
- 2) **Low Temperature Application:** Can withstand large temperature extremes, including cryogenic.
- 3) **Fluid Transfer:** Can be designed for liquid or gaseous media
- 4) **Perfect Sealing:** Perfect sealing of gas or fluid
- 5) **Non-combustible**
- 6) **No Need for Maintenance & Repair:** Additional maintenance & repair is not necessary.

# EXPANSION JOINT DESIGN



## Movement Conditions

### 1) Type of Movements

- Axial Compression: The dimensional shortening of the expansion joint face-to-face gap parallel to its longitudinal axis.
- Axial Extension: The dimensional lengthening of the expansion joint face-to-face gap parallel to its longitudinal axis.
- Lateral Movement: The dimensional displacement of the inlet and the outlet flanges of the expansion joint perpendicular to its longitudinal axis.
- Torsion Rotation: The twisting of one end of the expansion joint with respect to the other end about its longitudinal axis.
- Angular Rotation: That movement which occurs when one flange of the expansion joint is moved to a put-of-parallel position with the opposite flange.
- Vibration: The rapid, small movements, back and forth that can occur in any single plane or multi-planes.

### 2) Independent or Concurrent Movement

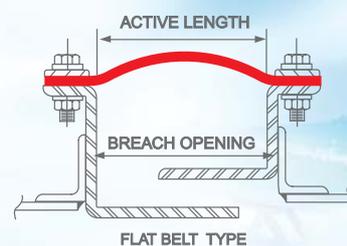
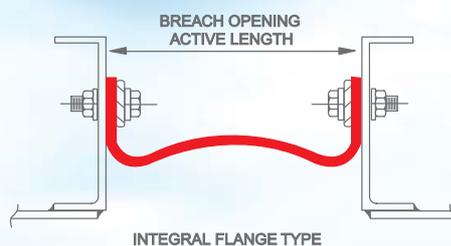
- Independent movement: Defined as acting along and in only one direction at one time.
- Concurrent movement: Defined as any two or more movements acting simultaneously.

### 3) Normal Operating and Excursion Movement

Consider design expansion by normal and excursion movement data.

### 4) Typical Movement Capabilities

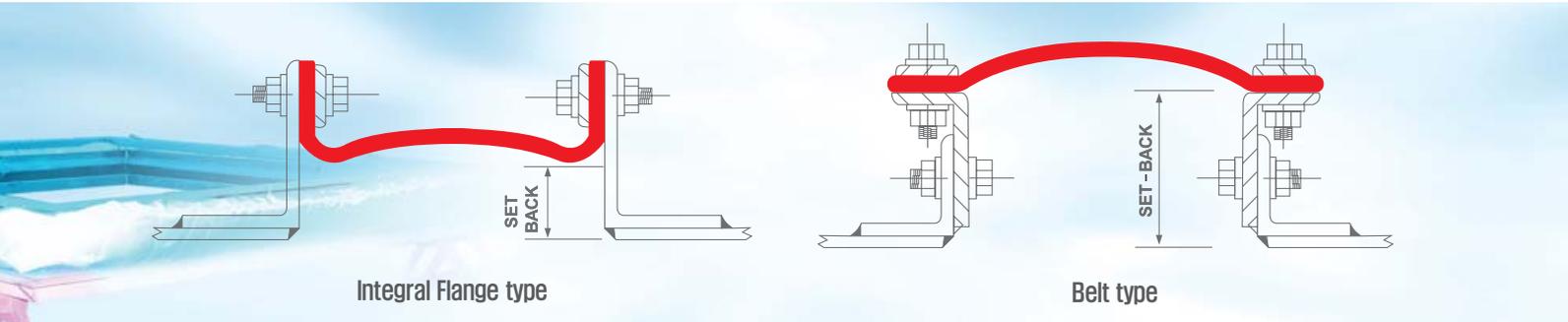
Type	Axial Compression	Active Length	Axial Expansion	Lateral Movement
Single Layer	150mm	40mm	13mm	25mm
	230mm	75mm	13mm	38mm
	305mm	100mm	25mm	50mm
	405mm	125mm	25mm	63mm
Composite type	150mm	25mm	13mm	13mm
	230mm	50mm	13mm	25mm
	305mm	75mm	25mm	38mm
	405mm	100mm	25mm	50mm



- ❖ The active length of the flexible element is a major design consideration. In general, by increasing the active length of the expansion joint, greater movements can be accommodated.
- ❖ Above movement range is applicable only to Independent movement, and Concurrent movement follows HKR standards.

### Set-Back (Stand-Off Height)

Consider set-back (stand-off height) when you determine the outside size of a duct. Set-back refers to the height from the inside of a duct to the bellows.



### HKR Standards for Set-back (by Type/Pressure Direction)

Active Length		150mm	230mm	305mm	405mm
Set-Back	Belt Type/ Positive Pressure	75mm	75mm	100mm	150mm
	Belt Type/ Negative Pressure	100mm	150mm	150mm	175mm
	Integral Flange Type/ Positive Pressure	25mm	38mm	50mm	63mm
	Integral Flange Type/ Negative Pressure	50mm	75mm	100mm	125mm

### Face to face or brench opening

The Face-to-Face distance or Breach Opening is the distance between the mating duct flanges in which the expansion joint is to be installed.

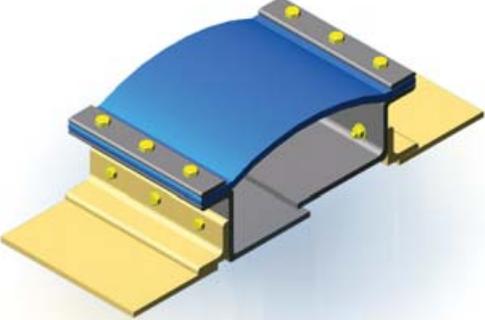
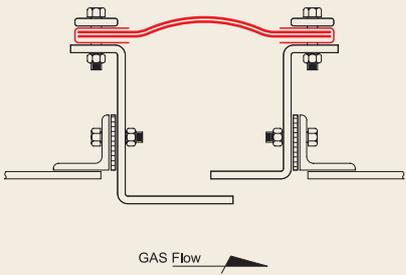
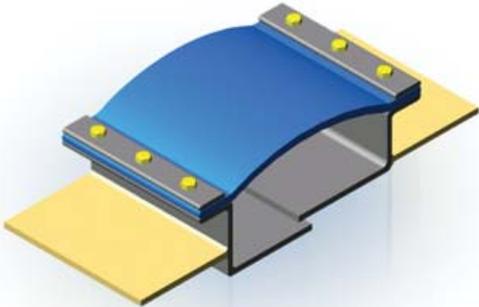
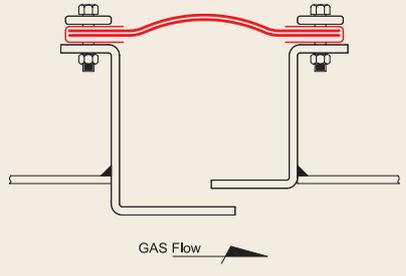
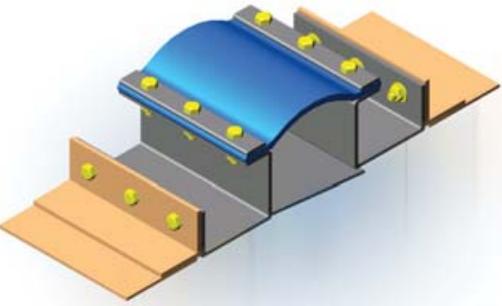
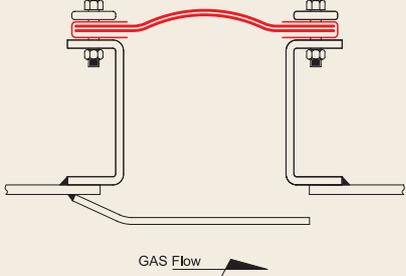
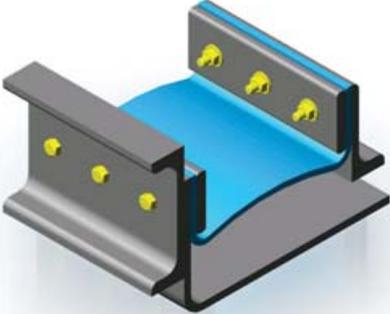
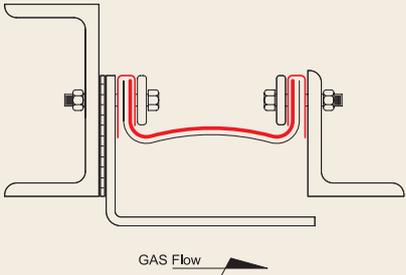
The active length of the flexible element is a major design consideration. When designing active length, both movements and system pressure must be considered.

### Back-Up Bar

- Composed of steel bar. Tightens the connection with belts and duct flanges or expansion joint structures
- Standard size Back-up Bars is 9mm thick and 50mm wide.
- All edges connected to flexible element should be grinded smooth or radiused so as not to damage the flexible element.
- Bolt hole spacing is standardized at 4 inch or 6 inch center-to-center distance.

Bolt Size	Flange Bolt Hole Spacing
1/2" bolt	4"
5/8" bolt	4" or 6"



Connection Method of the Product to Duct	Structure Features	
		<p><b>FF Type</b></p> <ul style="list-style-type: none"> <li>• Accommodates a flanged duct.</li> <li>• Same advantage as an "FW" type.</li> <li>• If bolting is necessary, holes matching the duct flange and welded nuts can be provided.</li> </ul>
		<p><b>FW Type</b></p> <ul style="list-style-type: none"> <li>• Best choice when liners are required.</li> <li>• Landing bar type fit permits duct misalignment.</li> <li>• Accommodates any flat belt selection.</li> <li>• Shipped fully assembled for easy installation.</li> <li>• Rectangular joints have full radius corners.</li> <li>• Low replacement cost of flexible element.</li> <li>• Best choice for attachment of fly ash barrier.</li> <li>• Flanges can act as duct stiffeners.</li> </ul>
		<p><b>WLW Type</b></p> <ul style="list-style-type: none"> <li>• Accommodates any flat belt selection.</li> <li>• Rectangular joints have full radius corners.</li> <li>• Shipped fully assembled, for easy installation.</li> <li>• Welded to ducts.</li> <li>• Liner welded at site.</li> </ul>
		<p><b>MC Type</b></p> <ul style="list-style-type: none"> <li>• Accommodates a flanged duct.</li> <li>• Bolting accessible from exterior of duct.</li> <li>• Liner is used selectively.</li> <li>• Economic installation cost.</li> </ul>

## System Temperature

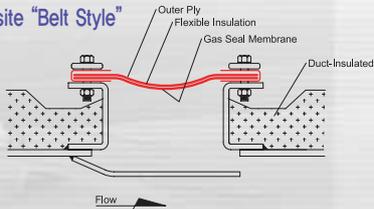
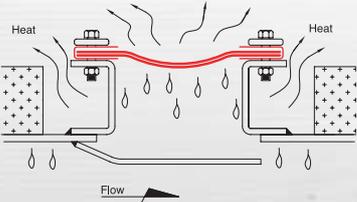
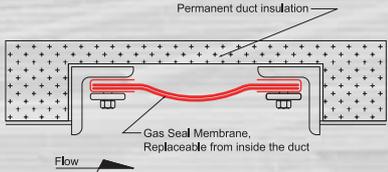
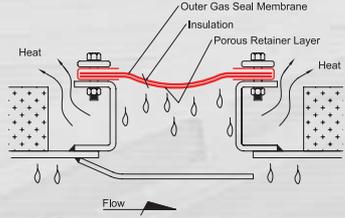
### Insulation and Condensation within the Ducting

High temperature ducting systems are often insulated to conserve energy and to prevent internal condensate. Expansion joint should be designed properly for this condition to avoid problems. The description below is an example of proper expansion joint and heat insulation design.

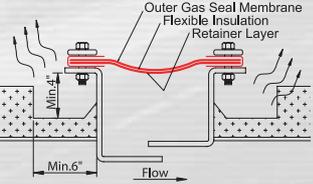
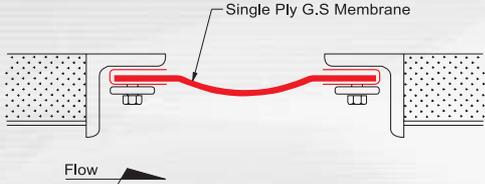
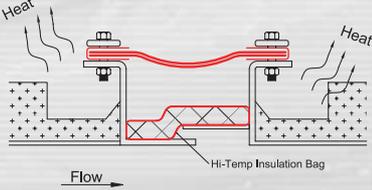
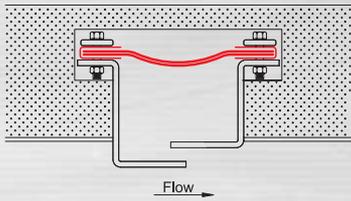
### Insulating Layers

The thermal barrier of a multi-layer fabric element must resist heat, moisture and acid attack. Additional retaining layers must be made of materials which remain strong and flexible when exposed to high temperatures and acids or condensates resulting from operation at or below the dew point.

**When the maximum continuous system, operating temperature is near the gas dew point and less than the allowable service temperature of the gas seal membrane material**

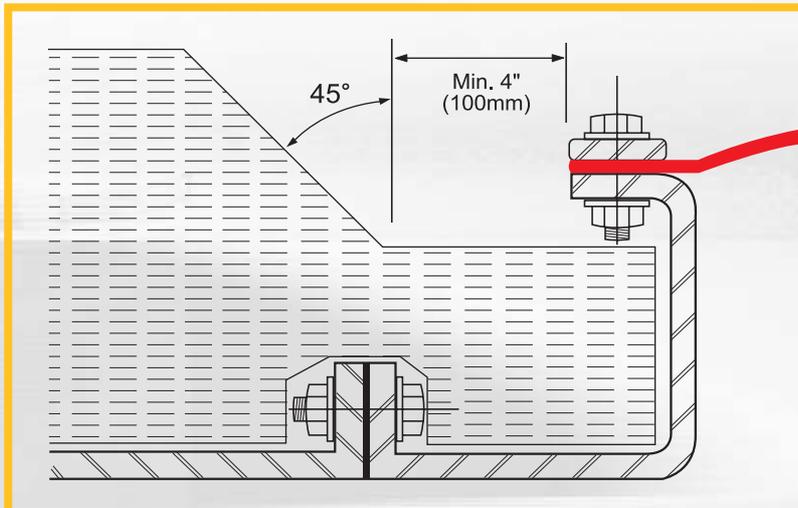
Good Design	Pool Selection Of Material Single Ply Seal Membrane
<p><b>Dew Point Composite "Belt Style"</b></p>  <p>Expansion joint flexible element is fully insulated to conserve energy, yet easily accessible for inspection and replacement.</p>	 <ul style="list-style-type: none"> <li>• Ducting and expansion joint are not properly insulated.</li> <li>• Severe condensation is possible. • Costly heat energy is lost.</li> </ul>
<p><b>Single ply "Belt style"</b></p> 	 <ul style="list-style-type: none"> <li>• Condensate infiltrates heat insulation material. • Heat loss.</li> <li>• Accelerated deterioration of fabric materials.</li> </ul>

**Operation temperature exceeds the minimum temperature of gas seal material**

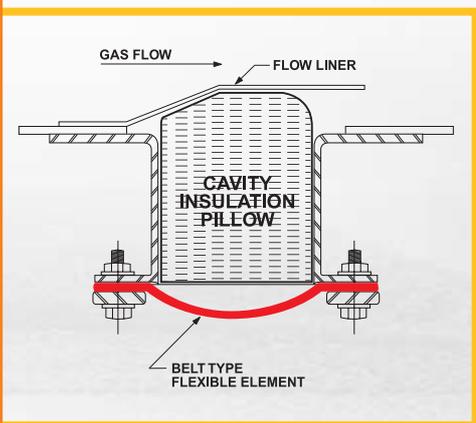
Good Design Example	Pool Selection Of Material & Construction Ply
 <p>Minimizes heat loss and permits optimum cooling of gas seal membrane. Flanges standoff reduces the temperature of the belt and the critical attachment area, thereby maximizing service life.</p>	 <p>Gas seal membrane is exposed to full system temperature. Accelerates deterioration of gas seal membrane, as the flange is not cooled due to insulation.</p>
 <p>Inserting additional insulation to the space of the product properly lowers the temperature affecting bellows properly.</p>	 <p>Gas seal membrane and frame are unable to be cooled due to insulation. This causes deterioration of efficiency.</p>

## Insulation

When insulating the ductwork care should be taken to properly insulate around the expansion joint assembly. Low temperature expansion joints, (below 500°F), may be insulated over with the concurrence of the expansion joint manufacturer. High temperature expansion joints, (over 500°F) should not be insulated over. The connection point between the expansion joint element and the mounting frame should allow for adequate cooling.



The Connection of Expansion Joint and Duct Flange



Prevention of Fly Ash Accumulation

## Insulation Pillow

The insulation pillow fills the cavity between flexible element and the metal liner and helps prevent the accumulate matter, and in some applications unburned fuel, from becoming trapped in the expansion joint cavity. If there is no cavity pillow, fly ash or other solid particulates can accumulate in the expansion joint cavity in such quantities that they can cause damage to the flexible element if they solidify to a cementations state. Also, certain non-cementatious particles (fly ash) can create a severe corrosive (acidic) environment when subjected to cooling (below  $H_2SO_4$  dew point) during a maintenance outage.

# EXPANSION JOINT MATERIAL

The efficiency of non-metallic expansion joint applied to various kinds of gas duct systems depends on operating circumstances and materials used. You should select materials considering required functional specifics as well as temperature features and chemical performance. Material used in a corrosive environment may have a severe effect at high temperature though they do not show any abnormal changes within heat resistant temperature range. On the other hand, the system operated below dew point generates highly corrosive condensate.

The fabric used for reinforced of elastomers and other coating material requires a mechanical component that is flexible and strong for the

pressure and expansion of the duct system expansion joint. Moreover, this fabric material is used for the intermediate layer or heat insulation layer of composite type bellows, meeting the temperature conditions and chemical requirements of the ducting system.

You use insulating material to lower the contacting temperature in order to maintain satisfactory performance and the service life of elastomer or coated material used for seal membrane. Apply a fiberglass blanket for up to 540°F and a ceramic blanket for higher temperatures, but have mechanical and chemical limitations.

The following is a summary of general information, in accordance with each material's general features.

## Commonly Used Elastomers and Coating Materials for Expansion Joint

### 1) Neoprene (CR):

Oil resistant—not affected by oil, grease and other petroleum products. Weatherproof—resistant to ozone and weather, and advantageous for outdoor use. Resistant to impact from abrasion, expansion and torsion.

### 2) Ethylene propylene (EPDM):

These have high tensile strength and elongation, oxygen and ozone resistance, superior expansion, fine chemical resistance. Reinforced EPDM expansion joints have been used in power plants and industrial plants.

### 3) Fluoroelastomer (FKM):

Commonly called Viton. Chemical resistance, oil resistance and heat resistance are superior to other elastomers. These products generally do not require protection (sleeve) from flue gas media.

### 4) Silicone (SL):

Silicones have good resistant to ozone and weather, but poor resistance to flue gas constituents. Accordingly, the use of reinforced silicone products is limited to exterior covering for a hot air duct or low temperature composite joint.

### 5) Fluoroplastics:

Fluoroplastics are thermoplastic resins commonly called Teflon, such as PTFE or FEP. Used as film or coating for variety fabric. The film type product provides chemical resistance when laminated.

Laminated products are much more impermeable than coated products. Teflon-coated or laminated products require a protector as they have poor abrasion resistance.

HEAT RESISTANCE RANGE(°F)	570	SL			FKM
	480				
400					
300		NBR		EPDM	
			CSM	ECO	
210		IIR	CR		
		4	3	2	1
		Comparing acidity resistance			

## Commonly Used Reinforcing Fabrics for Expansion Joints

Fiberglass and ceramic are mainly used as reinforcing materials for expansion joints. Other materials can be used, depending on purpose. The features of mainly used materials are described below.

Reinforcing Materials	Aramid	<b>Fiberglass</b>	Alloy Wire	Polyester	<b>Ceramic</b>
Temperature Capability (°F)	450	<b>700~1000</b>	2500	250	<b>1800</b>
Chemical Resistance					
Diluted H <sub>2</sub> SO <sub>4</sub>	B	<b>B</b>	A	B	<b>A</b>
Concentrated H <sub>2</sub> SO <sub>4</sub>	C	<b>C</b>	B	C	<b>A</b>
SO <sub>2</sub> and SO <sub>3</sub>	B	<b>B</b>	A	B	<b>A</b>
Caustic	B	<b>B</b>	B	B	<b>C</b>

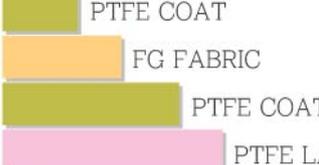
• A= Little or no effect    • B= Minor to moderate effect    • C= Severe effect



# COMPOSITION AND APPLICATION OF STANDARD PRODUCTS

## Structure of Standard Products

### 1) Single Layer- Low Temperature Applied Products

Model	Composition	Application Conditions
<b>NSE-300</b> NORMAL 6mm	 <p>EPDM FG FABRIC EPDM FG FABRIC EPDM</p>	<ol style="list-style-type: none"> <li>1. Continuous operation at 300°F(149°C)</li> <li>2. Pressure of 2108 mmW. G</li> <li>3. Wet/Dry flue gas</li> </ol>
<b>NSV-400</b> NORMAL 5mm	 <p>FKM FG FABRIC FKM FG FABRIC FKM</p>	<ol style="list-style-type: none"> <li>1. Continuous operation at 400°F(205°C)</li> <li>2. Pressure of 2108 mmW. G</li> <li>3. Wet/Dry flue Gas</li> <li>4. Exterior insulating allowed</li> </ol>
<b>NST-600</b> NORMAL 1.2mm	 <p>PTFE COAT FG FABRIC PTFE COAT PTFE LAM.</p>	<ol style="list-style-type: none"> <li>1. Continuous operation at 600°F(316°C)</li> <li>2. Pressure of 3505 mmW. G</li> <li>3. Wet/Dry flue Gas</li> <li>4. Exterior insulating allowed</li> </ol>

Note1.) NST needs additional gasket

Note2.) Model Numbering System

N: Non-metallic

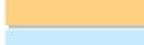
S: Single layer, M: Multi-layer

V: Cover material (V-Viton, E-EPDM, S-Silicon, T-Teflon)

XXX: Applied temperature range (°F)



## 2) Composite Type (Multi-Layer)- High Temperature Applied Products

Model	Composition	Application Condition
<b>NME-500</b> NORMAL 18mm	 EPDM/REINFORCED(3.2mm)  INSULATION(12mm)  TEFLON(0.125mm)  FG FABRIC(0.8mm)	<ol style="list-style-type: none"> <li>1. Continuous operation at 500°F(260℃)</li> <li>2. Pressure of 1397 mmW. G</li> <li>3. Dry chemical gas</li> </ol>
<b>NMS-600</b> NORMAL 17mm	 SILICONE/REINFORCED(1.0mm)  FG FABRIC(0.8mm)  INSULATION(12mm)  TEFLON(0.125mm)  FG FABRIC(0.8mm)	<ol style="list-style-type: none"> <li>1. Continuous operation at 600°F(315℃)</li> <li>2. Pressure of 1397 mmW. G</li> <li>3. Dry hot air</li> <li>4. Non-corrosive</li> </ol>
<b>NMT-800</b> NORMAL 17.5mm	 TEX-FILM(0.86mm)  FG FABRIC(0.8mm)  TEFLON(0.125mm)  FG FABRIC(0.8mm)  INSULATION(12mm)  FG FABRIC(0.8mm)	<ol style="list-style-type: none"> <li>1. Continuous operation at 800°F(425℃)</li> <li>2. Pressure of 1397 mmW. G</li> <li>3. Dry flue gas/ Chemical gas</li> <li>4. Corrosive</li> </ol>
<b>NMT-1000</b> NORMAL 31mm	 TEX-FILM(0.86mm)  FG FABRIC(0.8mm)  TEFLON(0.125mm)  FG FABRIC(0.8mm)  INSULATION(25mm)  FG FABRIC(0.8mm)  FG FABRIC(0.8mm)	<ol style="list-style-type: none"> <li>1. Continuous operation at 1000 1000°F(540℃)</li> <li>2. Pressure of 1397 mmW. G</li> <li>3. Dry flue gas/ Chemical gas</li> <li>4. Corrosive</li> </ol>
<b>NMT-1200</b> NORMAL 33mm	 TEX-FILM(1.12mm)  FG FABRIC(0.8mm)  TEFLON(0.125mm)  FG FABRIC(0.8mm)  CERAMIC INSULATION(25mm)  CERAMIC FAB(1.6mm)  CERAMIC FAB(1.6mm)	<ol style="list-style-type: none"> <li>1. Continuous operation at 1200 1200°F(650℃)</li> <li>2. Pressure of 1397 mmW. G</li> <li>3. Dry flue gas/ Chemical gas</li> <li>4. Corrosive</li> </ol>

Note.1) Above product codes are in accordance with the layer constitution followed by commonly temperature application

Note.2.) A cover material allows change, depending on fluid type and demands.

# INFORMATION ABOUT RUBBER EXPANSION JOINT



## Product Definition

Rubber expansion joint is flexible connector coefficient that is produced by reinforcing natural rubber or synthetic rubber with fiber or metal to release the piping stress caused by thermal and mechanical vibration and displacement in piping systems. Products have flexibility, absorb composite displacement, reduce noise and vibration and are consumption resistant to chemical abrasion.

## Functions

An engineer is able to solve vibration, noise, impact, corrosion, abrasion, stress and space problems by using a rubber expansion joint.

### 1) Reduce Vibration:

Rubber expansion joints reduce or isolate vibration caused by equipment. Some equipment demand more vibration control than others. For example, reciprocating pumps and compressors generate extensive and irregular force. Rubber expansion joints can decrease very loud noise and vibration produced by the vibration of a centrifugal pump or fan. This has been proved by practical experiments. Also, rubber expansion joints restrain and prevent vibration transfer.

### 2) Reduce Noise:

The abrasion caused by irregular operation of equipment and general aging such as corrosion and wear by steam can transmit noise around equipment. The rubber expansion joint reduces noise as it puts metal flanges in contact with rubber.

### 3) Compensate Lateral, Torsional and Angular Movements:

Pumps, compressors, fans, piping and related equipment move out of alignment due to wear, load stresses, relaxation and settling of supporting foundations. Rubber expansion joints compensate for lateral, torsional and angular movements—preventing damage and undue downtime of plant operations.

### 4) Compensation for Axial Movement:

Rubber expansion joints compensate for the extension and compression generated by thermal changes or hydraulic surge effects. This displacement is absorbed by the rubber expansion joint in a similar fashion to a helix spring application.

## Advantages

HKR has set a standard that meets clients and builder's expectations, considering various operational conditions, and manufactures and supplies products that meet this standard. Its products offer unique features by using synthetic rubbers and synthetic fabrics.

### 1) Minimal Face-to-Face Dimensions:

Maximum cost reduction, compared to expensive expansion bends or loops. Loop might cost less than pipe itself, but the total expense, including space, labor costs and supports, are much higher.

### 2) Lightweight:

No need to use special handling equipment. Lowers installation labor costs.

### 3) Low Movement Forces Required:

The inherent flexibility of rubber joints permits almost unlimited flexing to recover from imposed movements, requiring relatively less force to move, thus preventing damage to motive equipment.

### 4) Reduced Fatigue Factor:

The inherent characteristics of natural and synthetic elastomers are not subject to fatigue breakdown or embrittlement and prevent any electrical effects as they come in contact with flanges.



**5) Reduced Heat Loss:**

Loop type produces high operation costs due to the large amount of thermal loss though additional piping used for while transferring fluid. On the other hand, rubber expansion joints reduce thermal loss and are operated for long periods without maintenance or repair.

**6) Corrosion, Erosion Resistance:**

The rubber expansion joint can be composed of various kinds of natural rubber or synthetic rubber and fabrics, and be manufactured to meet each pressure and temperature condition and to withstand the effects of corrosion and abrasion. TFE/FEP lining structures are available as needed.

**7) No Gasket:**

As tubes and flanges are produced in one body, an additional gasket for connection is not required. Though the pipe flange is not flat, the flange of the rubber expansion joint can equalize the sealing of fluid.

**8) Noise Reduction:**

The rubber expansion joint reduces the noise and vibration of piping.

**9) Greater Shock Resistance:**

The rubber expansion joint can withstand against the shock stress caused by excessive hydraulic surge, water hammers or pump cavitation.

## Construction Details

**1) Tube:**

Lined with synthetic or natural rubbers to prevent leakage. Manufactured seamless from the inside to the end of a flange. Prevents holes in the body or weakening of fabric. These tubes can be designed to cover service conditions for chemical petroleum, sewage, gaseous and abrasive materials.

**2) Cover:**

Outer surface composed of synthetic or natural rubbers protects the frame from damage or severe conditions.

Special polymer is resistant to oil, sunlight, acid fumes and ozone, and it is additionally coated to protect the exterior surface.

**3) Carcass:**

The carcass or body of the rubber joint consists of fabric and, when necessary, metal reinforcement.

- **Fabric reinforcement:** Maintains tube and cover, being flexible. Made of fine quality synthetic fabric, but occasionally natural fabric used within acceptable temperature and pressure conditions. All fabric plies are impregnated with rubber or synthetic compounds to permit flexibility between the fabric plies.

- **Metal reinforcement:** Wire or solid steel rings maintain the rigidity of the joint, being inserted into the body. It extends the operational pressure range and ensures the product's rigidity in vacuum service.

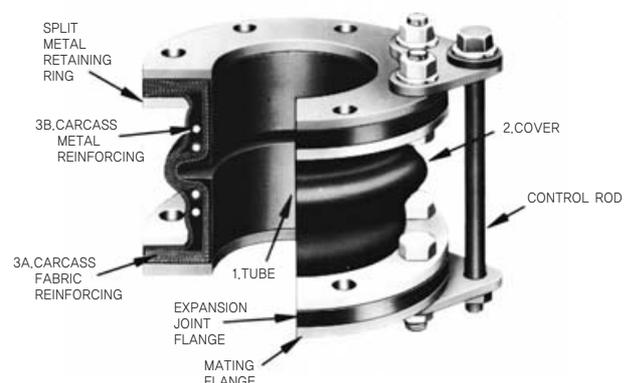


Figure : Corss Sectional View Of Standard Spool "Arch" Type Expansion Joint



# T TYPE OF RUBBER EXPANSION JOINTS

## SPOOL TYPE

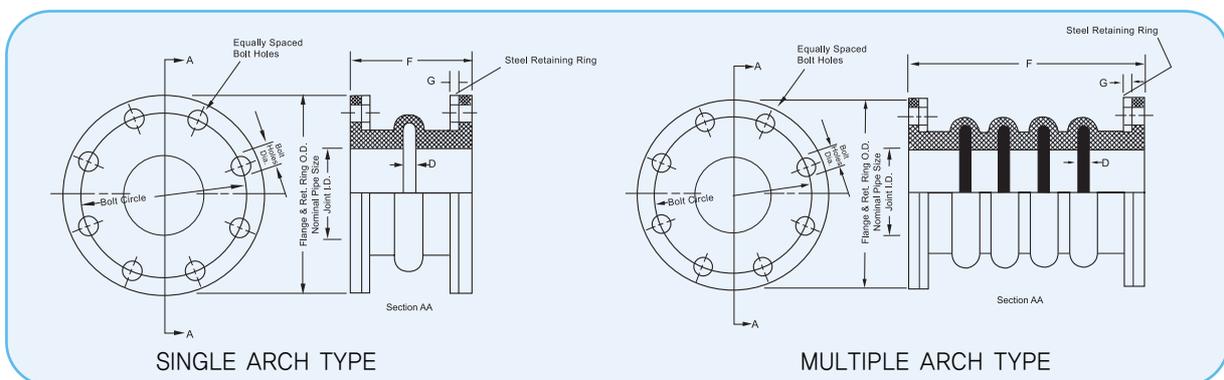
A full face integral flange design is available in both Single Arch and Multiple Arch Types. These basic types can be manufactured to meet the requirements of the related Code and Standards. These types are available in several construction design series, based on the application pressure requirement.

### 1) Single Arch Type:

Consists of fiber and rubber reinforced with metal rings or wire. Joint body and flange are in one body. Has same type of bolt holes as the metal flange of the pipe to be connected. The rubber flange is designed to be thick enough to avoid leakage without a gasket for connecting the other flange. Allows minimum face-to-face dimensions.

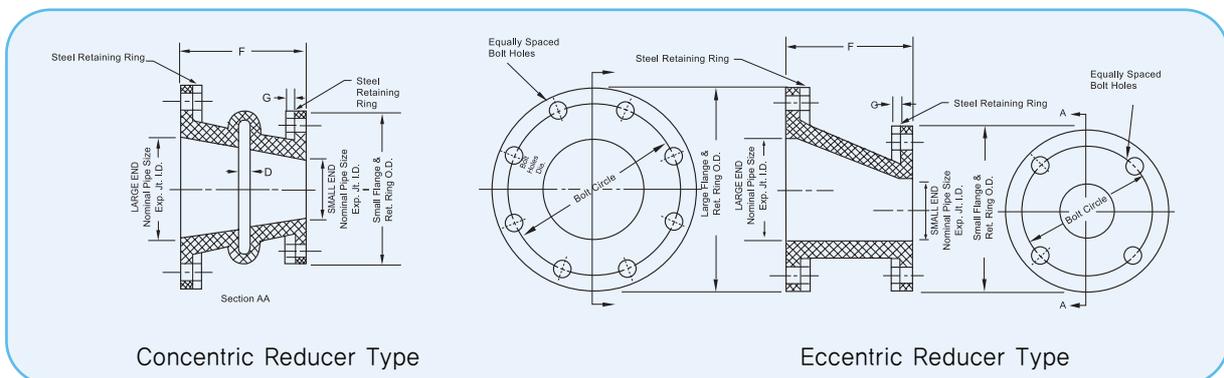
### 2) Multiple Arch Type:

Applied where a larger movement is required compared to single arch. Each arch of multiple arch type is able to absorb the same movements as one arch of single arch type does. Minimum length is in proportion to arithmetic, and maintains lateral stability and the joint installed horizontally generally requires a maximum of four scenes to prevent loosening.



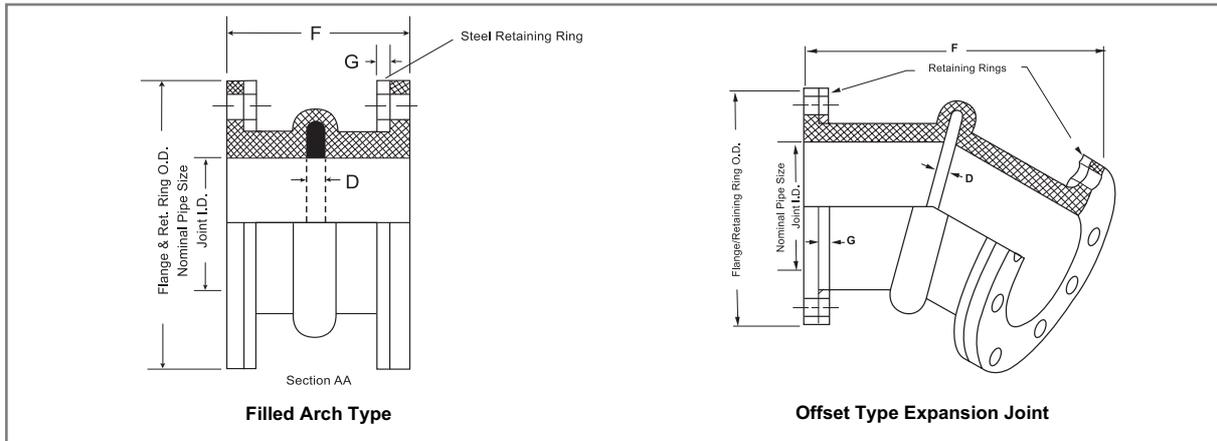
### 3) Reducer Type:

Applied when each side has a different diameter. Have two types: "Concentric Type" (both pipes have the same central axis line) and "Eccentric Type" (having the axis of each end offset from each other). Taper angle does not exceed 15°.



### 4) Filled Arch Type:

It fills a gap by inserting soft rubber into the inside gap, preventing separation of the rubber while operation. Movements of expansion joints with filled arches are limited to 50% of the normal movements of comparable size of expansion joint with unfilled (open) arches.

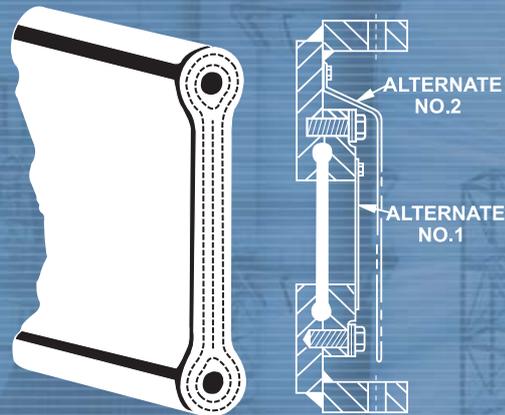


**5) Offset Type:**

Manufactured by request of client in the case of non-identical piping axis line. Occasionally used where it is difficult to compensate for the lineup errors.

**DOG-BONE TYPE BELT**

A molded construction of plies of rubber-impregnated fabric, rubber covered and spliced endless, to a specified peripheral dimension. Used as a flexible connection in central power stations on condensers. Designed for compression and lateral movements for full vacuum service and maximum pressure of 15 psig. Must be used with special clamping devices.



**RETAINING RING AND CONTROL UNITS**

**1) Retaining Ring:** Retaining rings must be used to distribute the bolting load and assure a pressure tight seal. They are coated for corrosion resistance and drilled as specified. The rings are installed directly against the back of the flanges of the joint and bolted through to the mating flange of the pipe. Ring has a thickness of 10mm, but can be used according to conditions. Ring in interior that is connected to rubber flange is round to avoid damage to the rubber.

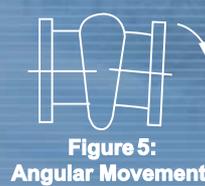
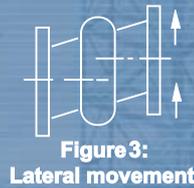
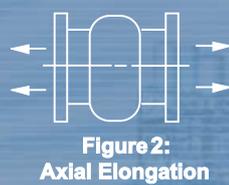
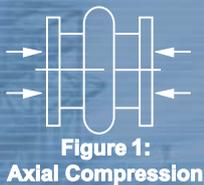
**2) Control Unit Assembly:** Install a suitable control unit in accordance with designed pressure conditions. It protects the product against excessive expansion of pipes, and as it is not designed to reinforce the anchor of pipes, this should be clearly indicated. Because of the direct installation of the pump flange, the back should be allowed sufficient space, considering installation length of bolt, nut and washer as well as the space for the plate.



# OPERATIONAL FEATURE OF RUBBER EXPANSION JOINT

## EXPANSION JOINT MOVEMENT

- 1) **Axial Compression:** Shortening displacement of distance, face-to-face
- 2) **Axial Elongation:** Lengthening displacement of distance, face-to-face
- 3) **Lateral Movement:** the movement or relating displacement of the two ends of the joint perpendicular to its longitudinal axis.
- 4) **Vibration:** Flexible connector absorbs the mechanical oscillations of the system. Usually high frequency.
- 5) **Angular Movement:** The angular displacement of the longitudinal axis of the expansion joint from its initial straight line position, measured in degrees. This is a combination of axial elongation and axial compression.
- 6) **Torsional Movement:** The twisting of one end of an expansion joint with respect to the other end about its longitudinal axis. Such movement is measured in degrees.
- 7) **Concurrent Movement:** the combination of two or more of the above expansion joint movements. This value is expressed as the resultant movement.



## OPERATING TEMPERATURE RANGE

The types of rubbers and reinforced fiber materials are generally classified by temperature.

Type of Elastomer	CLASS	Type of Fabric	CLASS
Gum Rubber	Std.I	Cotton	Std.I
Natural Rubber	Std.I	Rayon	Std.I
SBR/GRS/Buna-S	Std.I	Nylon	Std.II
Neoprene	Std.II	Polyester	Std.III
Buna-N/Nitrile	Std.II	Fiberglass	Std.III
Hypalon®	Std.II	Kevlar	Std.III
Butyl	Std.II	Nomex	Std.III
Chlorobutyl	Std.III		
EPDM	Std.III		
Viton®/Fluorel®	Std.III		
Silicone	Std.III		
Teflon®/TFE/FEP	Std.III		

STD I : Recommended up to 180°F  
 STD II : Recommended up to 230°F  
 STD III : Recommended for over 230°F  
 (Note: Each material has different temperature limits.)

Table 1. List of Elastomers Used in Expansion Joints

MATERIAL DESIGNATION		RATING SCALE CODE	ELASTOMER PHYSICAL AND CHEMICAL PROPERTIES COMPARISON															
ANSI/ASTM D1418-77	ASTM D-2000 D1418-77	7-Outstanding 6-Excellent 5-Very Good 4-Good 3-Fair to good 2-Fair 1-Poor to Fair 0-Poor X-Contact Mtg.	CHEMICAL WATER	ANIMAL & VEG. OIL	ALKALI, CONC. DILUTE	OXYGENATED HYDRO LACQUERS OIL & GASOLINE	ALPHAHTIC HYDRO. AROMATIC HYDRO.	ACID, CONC. DILUTE	WATER ABSORP RADIATION SWELLING IN OIL	ELE. INSULATION	TENSILE STRENGTH DIELECTRIC STR.	REBOUND-COLD COMP. SETT	REBOUND-HOT	ABRASION IMPERMEABILITY DYNAMIC	FLAME TEAR	HEAT COLD	WEATHER SUNLIGHT OXIDATION	OZONE
		COMMON NAME CHEMICAL GROUP NAME																
<b>CR</b>	BC BE	<b>NEOPRENE</b> CHLOROPRENE	4 3 4 0	4 4 0 1	2 3 4 6	4 5 4 3	5 4 2 4	5 4 2 4	4 4 4 4	5 5 6 5								
<b>NR</b>	AA	<b>GUM RUBBER</b> POLYISOPRENE, SYNTHETIC	5 3 X X	X 0 0 4	0 0 3 3	0 6 5 5	6 6 4 6	6 6 2 7	5 0 5 2	4 0 2 0								
<b>IR</b>	AA	<b>NATURAL RUBBER</b> POLYISOPRENE, SYNTHETIC	5 3 X X	X 0 0 4	0 0 3 3	0 6 5 5	6 6 4 6	6 2 2 6	5 0 5 2	4 0 2 0								
<b>IIR</b>	AA	<b>BUTYL</b> ISOBUTENE-ISOPRENE	5 6 5 4	4 0 3 4	0 0 4 6	0 4 5 5	5 4 3 0	5 2 6 4	4 0 4 5	6 5 5 6								
<b>CIIR</b>	AA BA	<b>CHLOROBUTYL</b> CHLORO-ISOBUTENE-ISOPRENE	5 6 5 4	4 0 3 4	0 0 4 6	0 4 5 5	5 4 3 0	5 2 6 4	4 0 4 5	6 5 5 6								
<b>NBR</b>	BE BK CH	<b>BUNA-N/NITRILE</b> NITRIL-BUTADIENE	4 3 5 0	4 5 2 0	4 6 4 4	5 5 4 1	0 0 5 4	4 5 4 4	3 0 3 4	4 0 2 2								
<b>SBR</b>	AA	<b>SBR/GRS/ BUNA-S</b> STYRENE-BUTADIENE	5 3 X 2	4 0 0 4	0 0 3 3	0 6 5 5	4 5 4 4	4 4 2 5	3 0 5 3	2 0 2 0								
<b>CSM</b>	CE	<b>HYPALON®</b> CHLORO-SULFONYL-POLYETHYLENE	5 6 4 4	4 4 3 1	2 3 4 6	4 5 4 3	5 2 2 2	4 2 4 4	3 4 4 4	6 7 6 7								
<b>FKM</b>	HK	<b>VITON®*/FLUOREL®**</b> FLUOROCARBON ELASTOMER	5 6 6 0	4 6 1 0	6 6 6 5	6 5 5 3	5 5 6 2	4 5 5 5	2 6 2 7	7 7 7 7								
<b>EPR</b>	BA CA DA	<b>EPDM</b> ETHYLENE-PROPYLENE-DIENE-TERPOLYMER	5 6 5 6	6 0 3 6	0 0 4 6	0 7 6 6	7 5 4 6	6 5 4 5	4 0 5 6	6 7 6 7								
<b>AFMU</b>		<b>TEFLON/TFE/FEP</b> FLUORO-ETHYLENE-POLYMERS	7 7 7 7	7 7 7 7	7 7 7 7	7 3 7 X	XXX X	XXX 4	XXX 7	7 7 7 7								
<b>SI</b>	GE	<b>SILICONE</b>	5 5 5 0	2 X 0 2	0 0 2 6	2 5 6 6	4 0 3 6	6 0 2 0	2 2 6 7	6 6 6 6								

-Above conditions are only general guide.

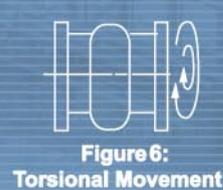
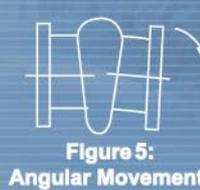
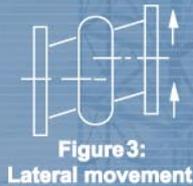
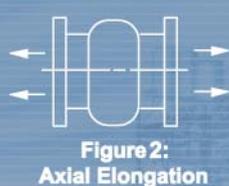
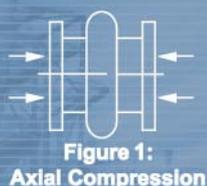




# OPERATIONAL FEATURE OF RUBBER EXPANSION JOINT

## EXPANSION JOINT MOVEMENT

- 1) **Axial Compression:** Shortening displacement of distance, face-to-face
- 2) **Axial Elongation:** Lengthening displacement of distance, face-to-face
- 3) **Lateral Movement:** the movement or relating displacement of the two ends of the joint perpendicular to its longitudinal axis.
- 4) **Vibration:** Flexible connector absorbs the mechanical oscillations of the system. Usually high frequency.
- 5) **Angular Movement:** The angular displacement of the longitudinal axis of the expansion joint from its initial straight line position, measured in degrees. This is a combination of axial elongation and axial compression.
- 6) **Torsional Movement:** The twisting of one end of an expansion joint with respect to the other end about its longitudinal axis. Such movement is measured in degrees.
- 7) **Concurrent Movement:** the combination of two or more of the above expansion joint movements. This value is expressed as the resultant movement.



## OPERATING TEMPERATURE RANGE

The types of rubbers and reinforced fiber materials are generally classified by temperature.

Type of Elastomer	CLASS	Type of Fabric	CLASS
Gum Rubber	Std.I	Cotton	Std.I
Natural Rubber	Std.I	Rayon	Std.I
SBR/GRS/Buna-S	Std.I	Nylon	Std.II
Neoprene	Std.II	Polyester	Std.III
Buna-N/Nitrile	Std.II	Fiberglass	Std.III
Hypalon®	Std.II	Kevlar	Std.III
Butyl	Std.II	Nomex	Std.III
Chlorobutyl	Std.III		
EPDM	Std.III		
Viton®/Fluorel®	Std.III		
Silicone	Std.III		
Teflon®/TFE/FEP	Std.III		

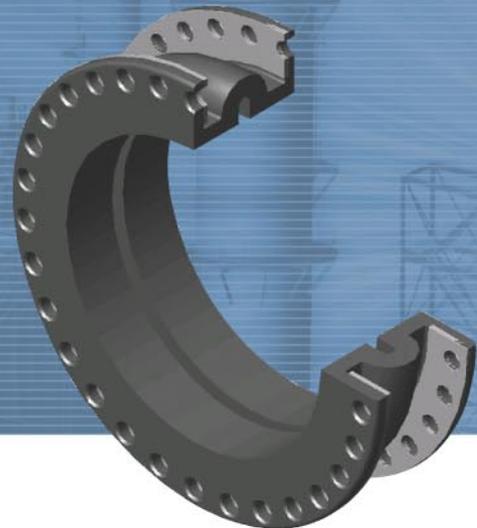
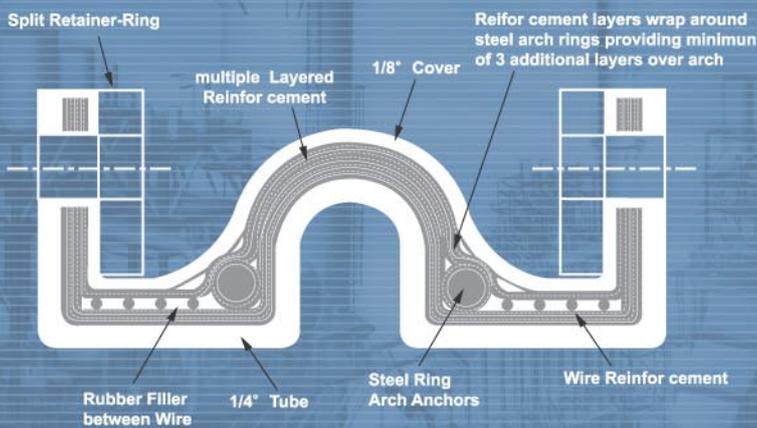
STD I : Recommended up to 180°F  
 STD II : Recommended up to 230°F  
 STD III : Recommended for over 230°F  
 (Note: Each material has different temperature limits.)



# STANDARD PRODUCT

## BASIC STRUCTURE OF STANDARD PRODUCT SPOOL

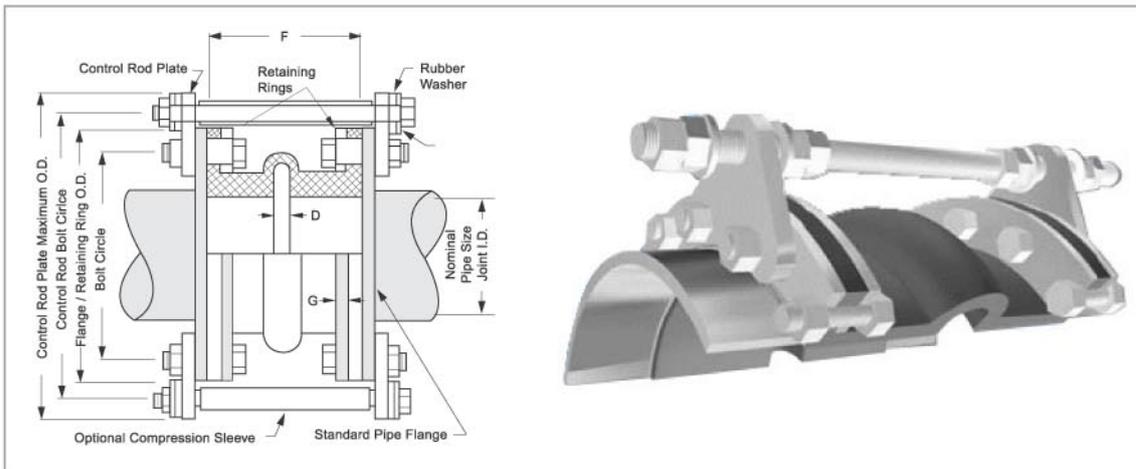
Composition		Use
Name	Material	
Tube	RUBBER	Prevention of fluid leakage
Cover	RUBBER	Protection of exterior/Weather resistance
Reinforced Fabric	SYNTHETIC FIBER	Formation of product
Steel Wire	CARBON STEEL	Formation/reinforcement of pressure
Steel Ring	CARBON STEEL	Formation/reinforcement of pressure
Retaining Ring	CARBON STEEL	Maintenance of flange/Dispersion of bolting load



## USING TEMPERATURE

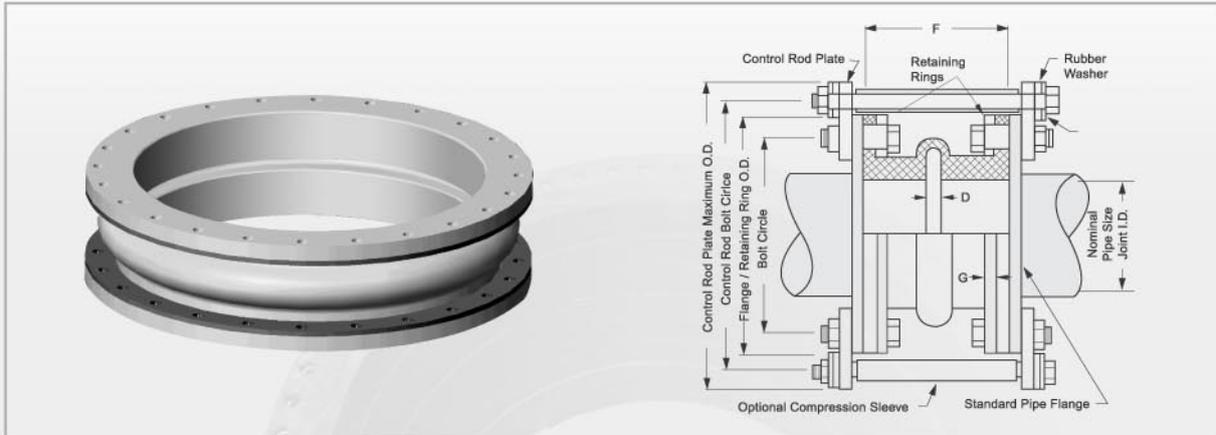
Rubber Type		Symbol	Maximum Operational Temperature(°F)
Inside Tube	Outside Cover		
BUTYL	BUTYL	BB	250
EPDM	EPDM	EE	350
HYPALON	HYPALON	HH	225
HYPALON	NEOPRENE	HN	225
NITRILE	NEOPRENE	NE	210
NEPORENE	NATURAL	NT	180
VITON	VITON	VV	400

## CONTROL UNIT DIMENSIONS AND RATINGS



CONTROL UNIT				Nominal Pipe Size Exp. Jt ID (Inches)	MAXIMUM SURGE OR TEST PRESSURE OF THE SYSTEMS				
Plants Thick-ness (Inches)	Rod Dia-master (Inches)	Standard Control Unit Assembly of :			Number of Control Rods ecommended				
		Rods	Plates		2	3	4	5	5
3/8	1/2	2	4	1/2	1328	--	--	--	--
3/8	1/2	2	4	3/4	1106	--	--	--	--
3/8	1/2	2	4	1	949	--	--	--	--
3/8	1/2	2	4	1-1/4	630	--	--	--	--
3/8	1/2	2	4	1-1/2	510	--	--	--	--
3/8	5/8	2	4	2	651	--	--	--	--
3/8	5/8	2	4	2-1/2	529	--	--	--	--
3/8	5/8	2	4	3	441	--	--	--	--
3/8	5/8	2	4	3-1/2	365	547	729	--	--
3/8	5/8	2	4	4	311	467	622	--	--
3/8	5/8	2	4	5	235	353	470	--	--
1/2	5/8	2	4	6	186	278	371	--	--
1/2	3/4	2	4	8	163	244	326	--	--
3/4	7/8	2	4	10	163	244	325	488	--
3/4	1	2	4	12	160	240	320	481	--
3/4	1	2	4	14	112	167	223	335	--
3/4	1-1/8	2	4	16	113	170	227	340	453
3/4	1-1/8	2	4	18	94	14	187	281	375
3/4	1-1/8	2	4	20	79	118	158	236	315
1	1-1/4	2	4	22	85	128	171	256	342
1	1-1/4	2	4	24	74	110	147	221	294
1	1-1/4	2	4	26	62	93	124	186	248
1-1/4	1-3/8	2	4	28	65	98	130	195	261
1-1/4	1-1/2	2	4	30	70	105	141	211	281
1-1/4	1-1/2	2	4	32	63	94	125	188	251
1-1/2	1-5/8	2	4	34	72	107	143	215	286
1-1/2	1-3/4	2	4	36	69	103	136	207	276
1-1/2	1-3/4	2	4	38	63	94	125	188	251
1-1/2	1-1/2	2	6	40	42	63	85	127	169
1-1/2	1-5/8	2	6	42	48	72	96	144	192
1-1/2	1-5/8	3	6	44	44	66	88	133	177
1-1/2	1-5/8	3	6	46	41	61	82	122	163
1-1/2	1-3/4	3	6	48	30	60	81	121	161
1-1/2	1-3/4	3	6	50	37	56	75	112	150
1-1/2	1-3/4	3	6	52	35	53	70	105	140
1-1/2	2	3	3	54	43	64	86	128	171
1-1/2	2	3	3	56	40	60	80	120	160
1-1/2	2	3	3	58	38	56	75	113	150
1-3/4	2	3	3	60	35	53	71	106	141
1-3/4	2	3	8	62	33	50	66	100	133
1-7/8	2	4	8	66	30	44	59	89	119
1-7/8	2	4	8	72	25	38	50	75	101
2	2-1/4	4	8	76	28	42	56	84	112
2-1/4	2-1/4	4	8	84	24	37	49	73	98
2-1/2	2-1/2	4	8	90	26	40	53	79	106
2-1/2	2-3/4	4	8	96	29	43	58	88	115
2-1/2	2-3/4	4	8	102	25	33	51	76	102
2-1/2	2-3/4	4	8	108	23	34	46	75	92
2-1/2	2-3/4	4	8	120	18	26	37	58	75
2-1/2	2-3/4	4	8	132	15	23	31	46	62
2-1/2	2-3/4	6	12	144	13	19	26	39	52

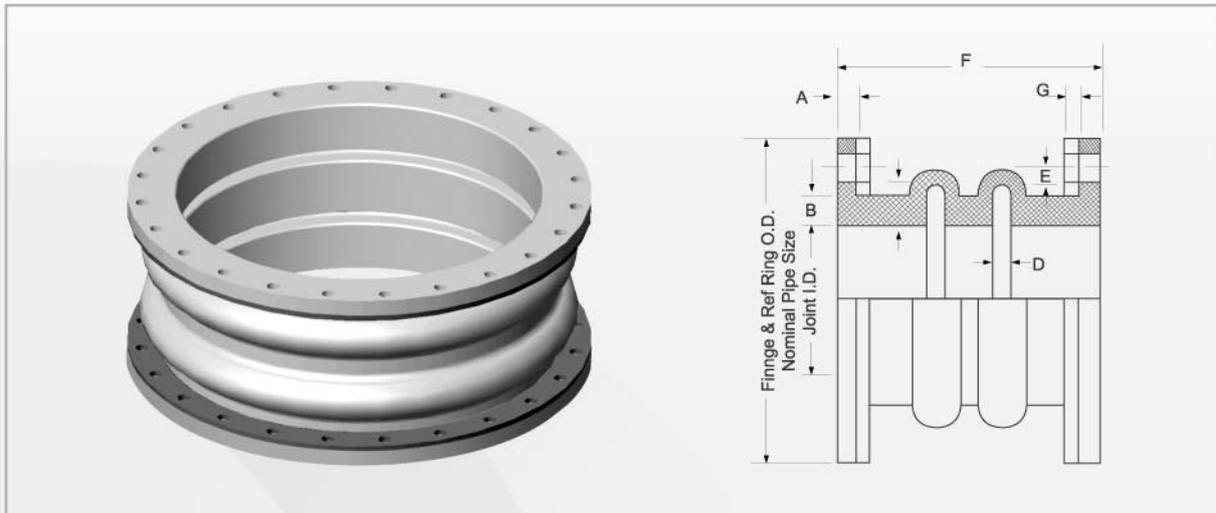
SPOOL TYPE / SINGLE ARCH



Pipe Size (ND)	Flange OD(in.)	Face to Face(in.)	Flange Th'k(in)	B.C.D (in)	No of Holes	Bolt Dia.(in.)	Axial Compl(in.)	Axial Ext(in.)	Lateral (in.)	Angular (deg)	Torsional (deg)	Working Pressure(psi)	Burst Pressure(psi)
2	6	6	7/8	4 3/4	4	5/8	7/16	1/4	1/2	14.5	3	165	660
2 1/2	7	6	7/8	5 1/2	4	5/8	7/16	1/4	1/2	11.5	3	165	660
3	7 1/2	6	7/8	6	4	5/8	7/16	1/4	1/2	10	3	165	660
4	9	6	7/8	7 1/2	8	5/8	7/16	1/4	1/2	7.5	3	165	660
5	10	6	7/8	8 1/2	8	3/4	7/16	1/4	1/2	6	3	140	560
6	11	6	7/8	9 1/2	8	3/4	7/16	1/4	1/2	5	3	140	560
8	13 1/2	6	7/8	11 3/4	8	3/4	11/16	3/8	1/2	5.5	3	140	560
10	16	8	7/8	14 1/4	12	7/8	11/16	3/8	1/2	4.5	3	140	560
12	19	8	7/8	17	12	7/8	11/16	3/8	1/2	3.75	3	140	560
14	21	8	1	18 3/4	12	1	11/16	3/8	1/2	3.25	2	85	340
16	23 1/2	8	1	21 1/4	16	1	11/16	3/8	1/2	2.75	2	65	260
18	25	8	1	23 3/4	16	1 1/8	11/16	3/8	1/2	2.5	1	65	260
20	27 1/2	8	1	25	20	1 1/8	13/16	7/16	1/2	2.5	1	65	260
22	29 1/2	10	1	27 1/4	20	1 1/4	13/16	7/16	1/2	2.25	1	65	260
24	32	10	1	29 1/2	20	1 1/4	13/16	7/16	1/2	2	1	65	260
26	34 1/2	10	1	31 3/4	24	1 1/4	15/16	1/2	1/2	2.3	1	55	220
28	36 1/2	10	1	34	28	1 1/4	15/16	1/2	1/2	2	1	55	220
30	38 3/4	10	1	36	28	1 1/4	15/16	1/2	1/2	2	1	55	220
34	43 3/4	10	1	40 1/2	32	1 1/2	15/16	1/2	1/2	1.75	1	55	220
36	46	10	1 1/8	42 3/4	32	1 1/2	15/16	1/2	1/2	1.5	1	55	220
40	50 3/4	10	1 1/8	47 1/2	36	1 1/2	15/16	1/2	1/2	1.5	1	55	220
42	53	12	1 1/8	49 1/2	36	1 1/2	1 1/16	9/16	1/2	1.5	1	55	220
44	55 1/4	12	1 1/8	51 3/4	40	1 1/2	1 1/16	9/16	1/2	1.5	1	55	220
48	59 1/2	12	1 1/8	56	44	1 1/2	1 1/16	9/16	1/2	1.25	1	55	220
50	61 3/4	12	1 1/8	58 1/4	44	1 3/4	1 1/16	9/16	1/2	1.25	1	55	220
54	66 1/4	12	1 1/8	62 3/4	44	1 3/4	1 1/16	9/16	1/2	1.25	1	55	220
56	68 3/4	12	1 1/8	65	48	1 3/4	1 1/16	9/16	1/2	1.25	1	55	220
60	73	12	1 1/8	69 1/4	52	1 3/4	1 1/16	9/16	1/2	1	1	55	220
62	75 3/4	12	1 1/8	71 3/4	52	1 3/4	1 1/16	9/16	1/2	1	1	55	220
66	80	12	1 1/8	76	52	1 3/4	1 1/16	9/16	1/2	1	1	55	220
72	86 1/2	12	1 1/8	82 1/2	60	1 3/4	1 1/16	9/16	1/2	0.9	1	45	180
78	93	12	1 1/8	89 3/4	64	2	1 1/16	9/16	1/2	0.9	1	45	180
84	99 3/4	12	1 1/8	95 1/2	64	2	1 1/16	9/16	1/2	0.8	1	45	180
90	106 1/2	12	1 1/8	102 1/4	68	2	1 1/16	9/16	1/2	0.7	1	45	180
96	113 1/4	12	1 1/8	108 1/2	68	2 1/4	1 1/16	9/16	1/2	0.7	1	45	180
98	115 1/2	12	1 1/4	110 3/4	68	2 1/4	1 1/16	9/16	1/2	0.7	1	40	160
100	117 3/4	12	1 1/4	113	68	2 1/4	1 1/16	9/16	1/2	0.6	1	40	160
102	120	12	1 1/4	114 1/2	72	2 1/4	1 1/16	9/16	1/2	0.6	1	40	160
108	126 3/4	12	1 1/4	120 3/4	72	2 1/4	1 1/16	9/16	1/2	0.4	1	40	160
120	140 1/4	12	1 1/4	132 3/4	76	2 1/4	1 1/16	9/16	1/2	0.56	1	30	120
132	153 3/4	12	1 1/4	145 3/4	80	2 1/4	1 1/16	9/16	1/2	0.51	1	30	120
144	167 1/4	12	1 1/4	158 1/4	84	2 1/4	1 1/16	9/16	1/2	0.47	1	30	120

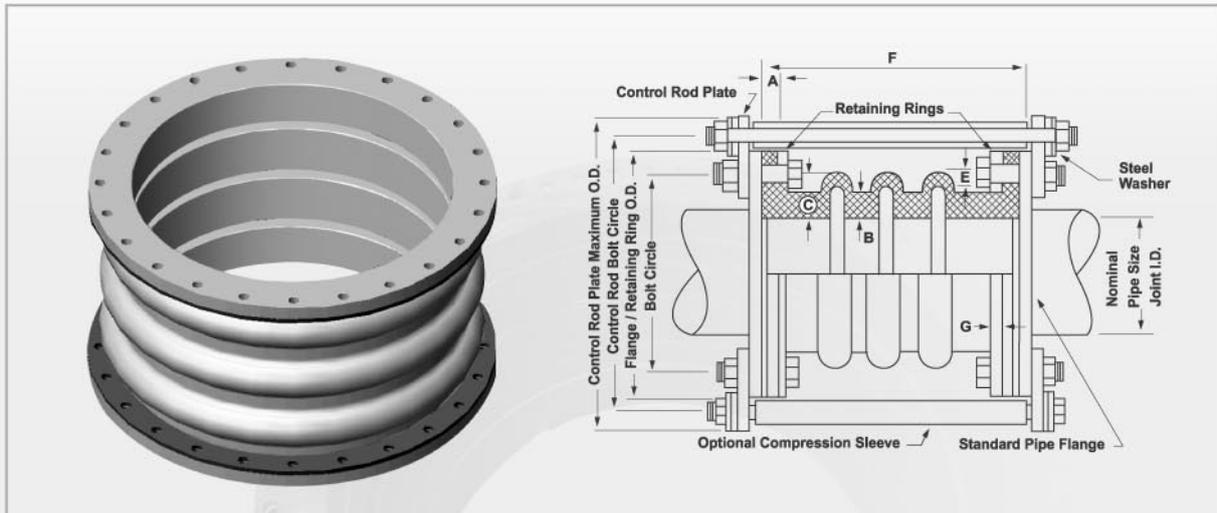
- Note 1) Above movement is decreased by 50% with the filled arch type.
- Note 2) Each movement value is the angle in maximum extension condition.
- Note 3) Multiple arch type movement is calculated as; above movement amount x number of arches
- Note 4) Contact HKR to inquire about force & spring rate.

SPOOL TYPE / DOUBLE ARCH



Pipe Size (ND)	Flange OD(in.)	Face to Face(in.)	Flange Th'k(in)	B.C.D (in)	No of Holes	Bolt Dia.(in.)	Axial Comp(in.)	Axial Ext(in.)	Lateral (in.)	Angular (deg)	Torsional (deg)	Working Pressure(psi)	Burst Pressure(psi)
2	6	10	7/8	4 3/4	4	5/8	1 1/2	1	1	19.5	5	165	660
2 1/2	7	10	7/8	5 1/2	4	5/8	1 1/2	1	1	16.5	5	165	660
3	7 1/2	10	7/8	6	4	5/8	1 1/2	1	1	15.5	5	165	660
4	9	10	7/8	7 1/2	8	5/8	1 1/2	1	1	12.5	5	165	660
5	10	10	7/8	8 1/2	8	3/4	1 1/2	1	1	11.0	5	140	560
6	11	10	7/8	9 1/2	8	3/4	1 1/2	1	1	10.5	5	140	560
8	13 1/2	10	7/8	11 3/4	8	3/4	1 1/2	1	1	10.0	5	140	560
10	16	12	7/8	14 1/4	12	7/8	2	1 1/4	1 1/4	9.5	5	140	560
12	19	12	7/8	17	12	7/8	2	1 1/4	1 1/4	8.8	5	140	560
14	21	12	1	18 3/4	12	1	2	1 1/4	1 1/4	8.3	4	90	360
16	23 1/2	12	1	21 1/4	16	1	2	1 1/4	1 1/4	7.8	4	70	280
18	25	12	1	23 3/4	16	1 1/8	2	1 1/4	1 1/4	7.5	3	70	280
20	27 1/2	12	1	25	20	1 1/8	2	1 1/2	1 1/4	7.5	3	70	280
22	29 1/2	14	1	27 1/4	20	1 1/4	3	1 1/2	1 1/4	7.3	3	70	280
24	32	14	1	29 1/2	20	1 1/4	3	1 1/2	1 1/4	7.0	3	70	280
26	34 1/2	14	1	31 3/4	24	1 1/4	3	1 1/2	1 1/4	7.0	3	70	280
28	36 1/2	14	1	34	28	1 1/4	3	1 1/2	1 1/4	7.0	3	60	240
30	38 3/4	14	1	36	28	1 1/4	3	1 1/2	1 1/4	7.0	3	60	240
34	43 3/4	14	1	40 1/2	32	1 1/2	3	1 1/2	1 1/4	6.8	3	60	240
36	46	14	1 1/8	42 3/4	32	1 1/2	3	1 1/2	1 1/4	6.5	3	60	240
40	50 3/4	14	1 1/8	47 1/2	36	1 1/2	3	1 1/2	1 1/4	6.5	3	60	240
42	53	16	1 1/8	49 1/2	36	1 1/2	3	1 3/4	1 1/2	6.5	2	60	240
44	55 1/4	16	1 1/8	51 3/4	40	1 1/2	3	1 3/4	1 1/2	6.5	2	60	240
48	59 1/2	16	1 1/8	56	44	1 1/2	3	1 3/4	1 1/2	6.5	2	60	240
50	61 3/4	16	1 1/8	58 1/4	44	1 3/4	3	1 3/4	1 1/2	6.3	2	60	240
54	66 1/4	16	1 1/8	62 3/4	44	1 3/4	3	1 3/4	1 1/2	6.3	2	60	240
56	68 3/4	16	1 1/8	65	48	1 3/4	3	1 3/4	1 1/2	6.3	2	60	240
60	73	16	1 1/8	69 1/4	52	1 3/4	3	1 3/4	1 1/2	6.0	2	60	240
62	75 3/4	16	1 1/8	71 3/4	52	1 3/4	3	1 3/4	1 1/2	6.0	2	50	200
66	80	16	1 1/8	76	52	1 3/4	3	1 3/4	1 1/2	6.0	2	50	200
72	86 1/2	16	1 1/8	82 1/2	60	1 3/4	3	1 3/4	1 1/2	5.9	2	50	200
78	93	16	1 1/8	89 3/4	64	2	3	1 3/4	1 1/2	5.9	2	50	200
84	99 3/4	16	1 1/8	95 1/2	64	2	3	1 3/4	1 1/2	5.8	2	50	200
90	106 1/2	16	1 1/8	102 1/4	68	2	3	1 3/4	1 1/2	5.8	2	50	200
96	113 1/4	16	1 1/8	108 1/2	68	2 1/4	3	1 3/4	1 1/2	5.7	2	50	200
98	115 1/2	16	1 1/4	110 3/4	68	2 1/4	4 1/2	2	2 1/4	5.6	2	30	120
100	117 3/4	16	1 1/4	113	68	2 1/4	4 1/2	2	2 1/4	5.6	2	30	120
102	120	16	1 1/4	114 1/2	72	2 1/4	4 1/2	2	2 1/4	5.6	2	30	120
108	126 3/4	16	1 1/4	120 3/4	72	2 1/4	4 1/2	2	2 1/4	5.4	2	25	100
120	140 1/4	16	1 1/4	132 3/4	76	2 1/4	4 1/2	2	2 1/4	5.4	2	25	100
132	153 3/4	16	1 1/4	145 3/4	80	2 1/4	4 1/2	2	2 1/4	5.3	2	25	100
144	167 1/4	16	1 1/4	158 1/4	84	2 1/4	4 1/2	2	2 1/4	5.1	2	25	100

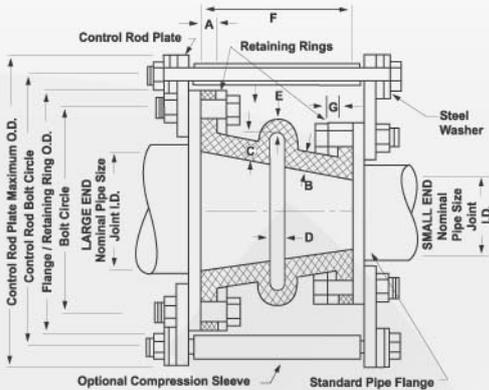
SPOOL TYPE / MULTIPLE ARCH



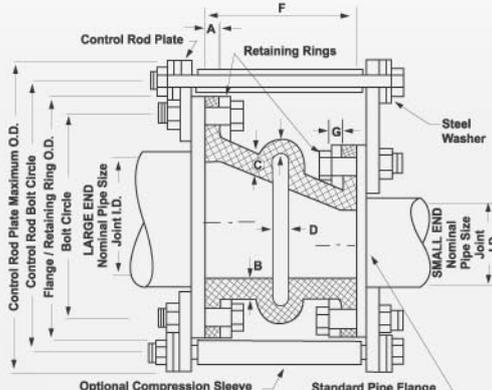
Pipe Size (ND)	Flange OD(in.)	Face to Face(in.)	Flange Th'k(in)	B.C.D (in)	No of Holes	Bolt Dia.(in.)	Axial Comp(in.)	Axial Ext(in.)	Lateral (in.)	Angular (deg)	Torsional (deg)	Working Pressure(psi)	Burst Pressure(psi)
2	6	14	7/8	4 3/4	4	5/8	2 1/4	1 1/2	1 1/2	24.5	7	165	660
2 1/2	7	14	7/8	5 1/2	4	5/8	2 1/4	1 1/2	1 1/2	21.5	7	165	660
3	7 1/2	14	7/8	6	4	5/8	2 1/4	1 1/2	1 1/2	19.5	7	165	660
4	9	14	7/8	7 1/2	8	5/8	2 1/4	1 1/2	1 1/2	17.5	7	165	660
5	10	14	7/8	8 1/2	8	3/4	2 1/4	1 1/2	1 1/2	16.5	7	140	560
6	11	14	7/8	9 1/2	8	3/4	2 1/4	1 1/2	1 1/2	15.5	7	140	560
8	13 1/2	16	7/8	11 3/4	8	3/4	2 1/4	1 1/2	1 1/2	15.0	7	140	560
10	16	16	7/8	14 1/4	12	7/8	3	1 7/8	1 7/8	14.9	7	140	560
12	19	16	7/8	17	12	7/8	3	1 7/8	1 7/8	12.8	7	140	560
14	21	16	1	18 3/4	12	1	3	1 7/8	1 7/8	12.8	6	90	360
16	23 1/2	16	1	21 1/4	16	1	3	1 7/8	1 7/8	12.8	6	70	280
18	25	16	1	23 3/4	16	1 1/8	3	1 7/8	1 7/8	12.5	5	70	280
20	27 1/2	16	1	25	20	1 1/8	3	1 7/8	1 7/8	12.5	5	70	280
22	29 1/2	18	1	27 1/4	20	1 1/4	3 3/4	1 7/8	1 7/8	12.4	5	70	280
24	32	18	1	29 1/2	20	1 1/4	3 3/4	2 1/4	1 7/8	12.0	5	70	280
26	34 1/2	18	1	31 3/4	24	1 1/4	3 3/4	2 1/4	1 7/8	12.0	5	70	280
28	36 1/2	18	1	34	28	1 1/4	3 3/4	2 1/4	1 7/8	12.0	5	60	240
30	38 3/4	18	1	36	28	1 1/4	3 3/4	2 1/4	1 7/8	12.0	5	60	240
34	43 3/4	18	1	40 1/2	32	1 1/2	3 3/4	2 1/4	1 7/8	11.8	5	60	240
36	46	18	1 1/8	42 3/4	32	1 1/2	3 3/4	2 1/4	1 7/8	11.5	5	60	240
40	50 3/4	18	1 1/8	47 1/2	36	1 1/2	3 3/4	2 1/4	1 7/8	11.5	5	60	240
42	53	20	1 1/8	49 1/2	36	1 1/2	4 1/2	2 5/8	2 1/4	11.5	4	60	240
44	55 1/4	20	1 1/8	51 3/4	40	1 1/2	4 1/2	2 5/8	2 1/4	11.5	2	60	240
48	59 1/2	20	1 1/8	56	44	1 1/2	4 1/2	2 5/8	2 1/4	11.5	2	60	240
50	61 3/4	20	1 1/8	58 1/4	44	1 3/4	4 1/2	2 5/8	2 1/4	11.3	4	60	240
54	66 1/4	20	1 1/8	62 3/4	44	1 3/4	4 1/2	2 5/8	2 1/4	11.3	4	60	240
56	68 3/4	20	1 1/8	65	48	1 3/4	4 1/2	2 5/8	2 1/4	11.3	4	60	240
60	73	20	1 1/8	69 1/4	52	1 3/4	4 1/2	2 5/8	2 1/4	11.0	4	60	240
62	75 3/4	20	1 1/8	71 3/4	52	1 3/4	4 1/2	2 5/8	2 1/4	11.0	4	50	200
66	80	20	1 1/8	76	52	1 3/4	4 1/2	2 5/8	2 1/4	11.0	4	50	200
72	86 1/2	20	1 1/8	82 1/2	60	1 3/4	4 1/2	2 5/8	2 1/4	10.9	4	50	200
78	93	20	1 1/8	89 3/4	64	2	4 1/2	2 5/8	2 1/4	10.9	4	50	200
84	99 3/4	20	1 1/8	95 1/2	64	2	4 1/2	2 5/8	2 1/4	10.8	4	50	200
90	106 1/2	20	1 1/8	102 1/4	68	2	4 1/2	2 5/8	2 1/4	10.8	4	50	200
96	113 1/4	20	1 1/8	108 1/2	68	2 1/4	4 1/2	2 5/8	2 1/4	10.7	4	50	200
98	115 1/2	20	1 1/4	110 3/4	68	2 1/4	6 3/4	3	3 3/8	10.6	3	30	120
100	117 3/4	20	1 1/4	113	68	2 1/4	6 3/4	3	3 3/8	10.6	3	30	120
102	120	20	1 1/4	114 1/2	72	2 1/4	6 3/4	3	3 3/8	10.6	3	30	120
108	126 3/4	20	1 1/4	120 3/4	72	2 1/4	6 3/4	3	3 3/8	10.4	3	25	100
120	140 1/4	20	1 1/4	132 3/4	76	2 1/4	6 3/4	3	3 3/8	10.4	3	25	100
132	153 3/4	20	1 1/4	145 3/4	80	2 1/4	6 3/4	3	3 3/8	10.3	3	25	100
144	167 1/4	20	1 1/4	158 1/4	84	2 1/4	6 3/4	3	3 3/8	10.1	3	25	100

REDUCER TYPE

CONCENTRIC REDUCERS  
TO Connect Pipe Unequal Diameters



ECCENTRIC REDUCERS  
For Equipment With Different Size Flanges



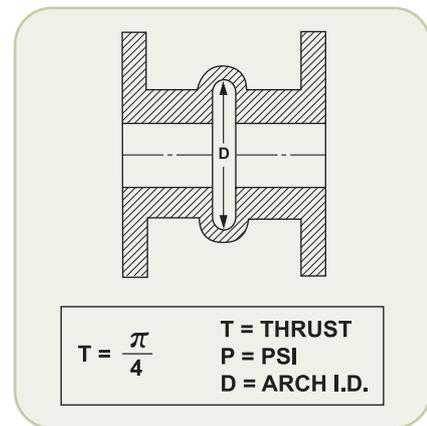
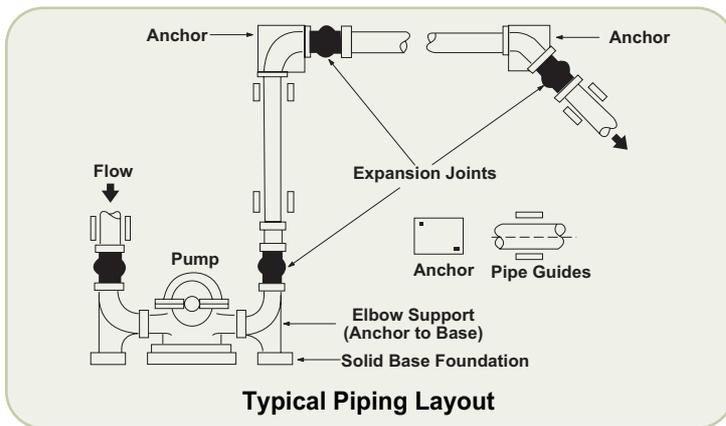
Pipe Size (ND)	OPEN ARCH TYPE/Movement Capability							Weight (Pounds)			Pressure	
	Face to Face(in.)	Axial Compln.)	Axial Ext(in.)	Lateral (±in.)	Angular (±deg)	Torsional (deg)	Thrust Factor	Open arch type	Filled arch type	Control Rod Assy	Positive (psi)	Negative (in.Hg)
2x1	6	1/2	1/4	1/2	18.4	3	12.69	5.1	5.6	6.0	200	26
2x1.5	6	1/2	1/4	1/2	15.9	3	14.32	5.5	6.0	6.3	200	26
2.5x1.5	6	1/2	1/4	1/2	14.1	3	16.04	7.1	7.6	7.1	200	26
2.5x2	6	1/2	1/4	1/2	12.5	3	17.87	8.1	8.7	7.4	200	26
3x1.5	6	1/2	1/4	1/2	12.5	3	17.87	8.2	8.8	7.1	200	26
3x2	6	1/2	1/4	1/2	11.3	3	19.79	8.3	8.9	7.0	200	26
3x2.5	6	1/2	1/4	1/2	10.3	3	21.60	9.5	10.1	7.1	200	26
4x2	6	1/2	1/4	1/2	9.5	3	23.92	10.8	11.4	7.1	200	26
4x2	7	1/2	1/4	1/2	9.5	3	23.92	10.9	11.5	7.1	200	26
4x2.5	6	1/2	1/4	1/2	8.8	3	26.15	10.9	11.6	7.6	200	26
4x2.5	7	1/2	1/4	1/2	8.8	3	26.15	11.8	12.4	7.6	200	26
4x3	6	1/2	1/4	1/2	8.2	3	28.46	12.0	12.8	7.5	200	26
4x3	7	1/2	1/4	1/2	8.2	3	28.46	12.9	13.7	7.5	200	26
5x3	6	1/2	1/4	1/2	7.1	3	33.38	13.4	14.2	11.5	190	26
5x4	6	1/2	1/4	1/2	6.4	3	38.70	14.4	15.2	10.1	190	26
5x4	8	1/2	1/4	1/2	6.4	3	38.70	16.9	17.8	10.1	190	26
6x2	8	1/2	1/4	1/2	7.1	3	33.38	13.6	14.4	11.6	190	26
6x2.5	6	1/2	1/4	1/2	6.7	3	35.99	13.8	14.6	11.9	190	26
6x3	6	1/2	1/4	1/2	6.4	3	38.70	15.6	16.0	12.3	190	26
6x3	9	1/2	1/4	1/2	6.4	3	38.70	16.6	17.4	12.5	190	26
6x4	6	1/2	1/4	1/2	5.7	3	44.41	15.9	16.4	10.6	190	26
6x4	8	1/2	1/4	1/2	5.7	3	44.41	17.8	18.6	11.0	190	26
6x4	9	1/2	1/4	1/2	5.7	3	44.41	19.3	20.1	11.0	190	26
6x5	6	1/2	1/4	1/2	5.2	3	50.51	17.1	18.6	10.5	190	26
6x5	9	1/2	1/4	1/2	5.2	3	50.51	18.6	19.4	11.9	190	26
8x3	6	3/4	1/4	1/2	7.8	3	56.64	20.5	21.3	20.4	190	26
8x4	6	3/4	1/4	1/2	7.1	3	63.49	22.9	23.7	18.6	190	26
8x4	8	3/4	1/4	1/2	7.1	3	63.49	25.2	24.0	19.5	190	26
8x4	11	3/4	1/4	1/2	7.1	3	63.49	23.8	24.6	21.0	190	26
8x5	6	3/4	1/4	1/2	6.6	3	70.76	21.4	22.2	18.4	190	26
8x5	11	3/4	1/4	1/2	6.6	3	70.76	26.1	26.9	20.6	190	26
8x6	6	3/4	1/4	1/2	6.1	3	78.42	23.0	23.8	17.5	190	26
8x6	8	3/4	1/4	1/2	6.1	3	78.42	25.6	26.6	18.1	190	26
8x6	11	3/4	1/4	1/2	6.1	3	78.42	28.1	28.9	19.6	190	26
10x5	8	3/4	1/4	1/2	5.7	3	86.46	29.4	30.2	27.0	190	26
10x6	8	3/4	1/4	1/2	5.3	3	94.90	29.0	29.8	26.0	190	26
10x6	12	3/4	1/4	1/2	5.3	3	94.90	33.4	34.2	27.5	190	26
10x8	6	3/4	1/4	1/2	4.8	3	112.95	29.9	30.7	24.5	190	26
10x8	8	3/4	1/4	1/2	4.8	3	112.95	34.6	35.8	25.3	190	26
10x8	12	3/4	1/4	1/2	4.8	33	112.95	40.1	40.9	27.8	190	26
12x6	8	3/4	1/4	1/2	4.8	3	113.10	38.8	39.7	29.0	190	26
12x6	14	3/4	1/4	1/2	4.8	3	113.10	45.0	46.0	30.5	190	26
12x8	6	3/4	1/4	1/2	4.3	3	132.57	37.6	38.6	28.0	190	26
12x8	8	3/4	1/4	1/2	4.3	3	132.57	42.0	44.5	28.8	190	26
12x8	14	3/4	1/4	1/2	4.3	3	132.57	48.6	49.6	30.1	190	26
12x10	8	3/4	1/4	1/2	3.9	3	153.76	47.8	48.0	24.3	190	26
12x10	14	3/4	1/4	1/2	3.9	3	153.76	60.0	61.0	26.1	190	26
14x8	8	3/4	1/4	1/2	3.9	2	177.09	45.8	46.8	29.0	190	26
14x10	8	3/4	1/4	1/2	3.6	2	201.46	53.5	54.6	29.4	130	26
14x12	8	3/4	1/4	1/2	3.3	2	277.40	63.6	64.6	26.6	130	26
16x10	8	3/4	1/4	1/2	3.3	2	277.40	55.8	56.8	35.8	110	26
16x12	8	3/4	1/4	1/2	3.1	2	254.91	61.8	62.8	36.0	110	26
16x14	8	3/4	1/4	1/2	2.9	2	283.99	69.6	70.6	36.5	110	26
18x12	8	3/4	1/4	1/2	2.9	1	283.99	65.5	66.5	37.0	110	26
18x14	8	3/4	1/4	1/2	2.7	1	314.65	67.4	68.4	37.0	110	26
18x16	8	3/4	1/4	1/2	2.6	1	346.88	78.7	79.7	33.8	110	26

# INSTALLATION



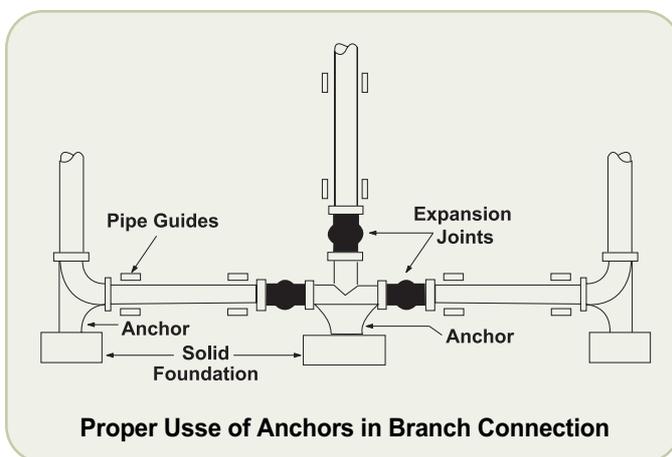
It can be stated generally that the proper location of rubber expansion joints is close to a main anchoring point. Following the joint in the line, a pipe guide or guides should be installed to keep the pipe in line and prevent undue displacement of this line.

## ANCHOR AND GUIDE OF PIPING SYSTEM



### 1) Anchors Are Required:

Observe the simple piping system example above. The piping should be careful to finish the section where pipe direction is changes or joint is installed with solid foundations. This joint is able to maintain the original layout of pipes through the use of an additional guide. The pump base, blocking the pipe thrust transferred through pump flanges, supports the elbow near pump safely. The solid foundations installed at 90° and 45° are designed firmly to withstand pipe thrust and force.



### 2) Thrust Calculation:

Thrust is generated by maximum pressure (design/test) of pipes and arch of a product.



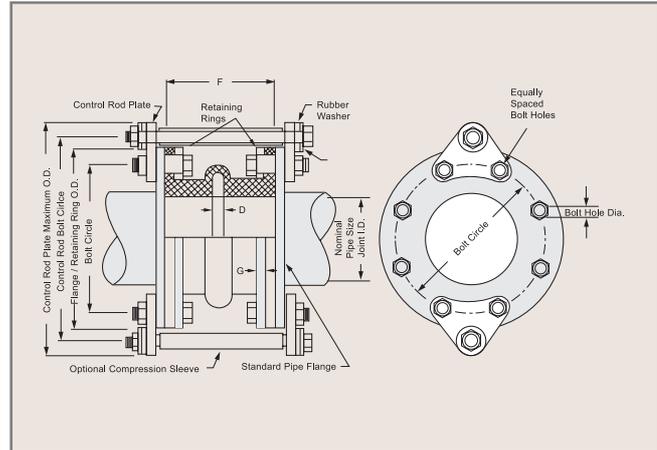
### 3) Branch Connection Anchors:

The picture at left shows how to install an anchor with branch connection. In designing an anchor, consider all the forces that affect the connecting part of the tee section and the elbow part. Indicate that a guide or anchor is required in the installation section of the joint.

## CONTROL UNIT

### 1) Definition and Purpose:

Designed to prevent damage to the product by connecting more than two control rods (tie rods) from the flange on one side to the flange on the other side. Extreme movement of piping may cause damage to pipe line or other devices. The control rod fixes the product within the allowed extension and compression range, and absorbs the thrust created by the pressure in a joint. Adding such safety materials minimizes the possibility of damage to a product and devices. Control units will adequately protect the joints, but the user should be sure that pipe flange strength is sufficient to withstand total force that will be encountered.



### 2) Use in Restraining the Piping System:

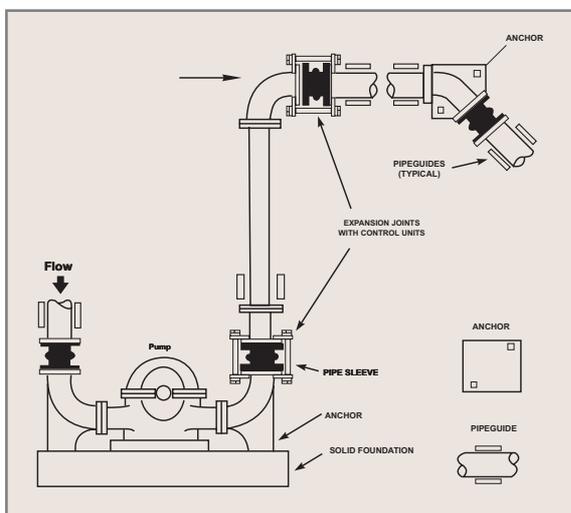
Control units may be required to limit both extension and compression movements.

**a. Extension:** Necessary when an appropriate anchors cannot be installed. In this case, the thrust created by pressure is extended to the control rod that is set to avoid excessive extension. Use control rods when you are unable to install a suitable anchors.

Joint can never be too strong, considering the fact that an anchor absorbs the essential thrust of pipes. Ignoring these principles can cause the early damage of a joint.

**b. Compression:** You can install a pipe sleeve over the control rod. Its purpose the prevent on of excessive compression of the joint. Select the pipe sleeve length, so as not to allow it to reduce greater than the compression range of joint.

**c. Specifics:** Number and size is chosen by installation pressure or test pressure. Indicate the flange thickness if a control unit is required.



### d. Use Example of Control Rod:

Picture shows a case where an anchor cannot be used. The anchor point at the upper 90° elbow in the discharge line has been eliminated. In this situation, it is necessary to employ properly designed control units with the joints located in this non-anchored line. If a control unit is not used, the pipe at the elbow 45° from the pump moves excessively through the elongation of expansion joint.

The expansion will keep proceed until the expansion joint is destructed. The control unit enables the pipe between the anchor and pump to the 45° elbow to be lengthened. Though each pipe is compressed, it is impossible for a joint to be expanded by the control unit, exceeding the set expansion range.



## PRECAUTIONS INSTALLATION

### 1. SERVICE CONDITIONS

Check the temperature, pressure, vacuum and movement conditions of a joint. If the required condition of the system does not meet the joint's use range, adjust it by consulting the manufacturer. Be aware of the chemical problems resulting from elastomer applied to fluid or gas.

### 2. ALIGNMENT

The expansion joint is not usually taken into account in the compensation value for piping misalignment errors. Therefore, pipe should be arranged within the error value, 1/8". Failure to properly arrange pipes decreases the expansion absorption capacity and causes extreme stress, consequently lowering the product's service life. The pipe guide assists in the alignment of pipes and prevents severe displacement.

### 3. ANCHORING

Solid anchoring is required at both sides of a joint where the piping direction is changed. If not, these may be extreme movement of a joint, resulting in damage.

### 4. PIPE SUPPORT

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

### 5. MATING FLANGE

Install a joint at the mating flange, and ensure the head of the bolt and washer meet the retaining ring. Face to face distance is the same as the pipe's installation space. Check that the contact point of the mating flange is clean and flat. Do not allow the raised face to protrude more than 1/16". Avoid using a split retaining rings next to wafer-type check valve or butterfly valve.

### 6. TIGHTENING BOLTS

Tighten bolts in stages by alternating around the flange. To tighten a rubber-surface flange, the side of the flange should bulge slightly between the retaining ring and the flange. Torque bolts sufficiently to assure leak-free operation at hydrostatic test pressure.

### 7. STORAGE

A dry and cool warehouse is recommended. Lay the flange side onto a palette or wooden board, and avoid placing other objects on the joint. Expected product life under ideal storage conditions is about 10 years. For outdoor storage, place the flange side onto a wooden board, not directly on the ground, covering it with a waterproof canvas such as tarpaulin.

### 8. LARGE JOINT HANDLING

Do not insert rope or rods into the bolt holes to lift it up. Use a pad or wooden support to disperse the weight when using an interior hole. Be careful not to allow a forklift truck leg to touch rubber side directly. Do not put pressure on the flange side edge during transportation or handling.