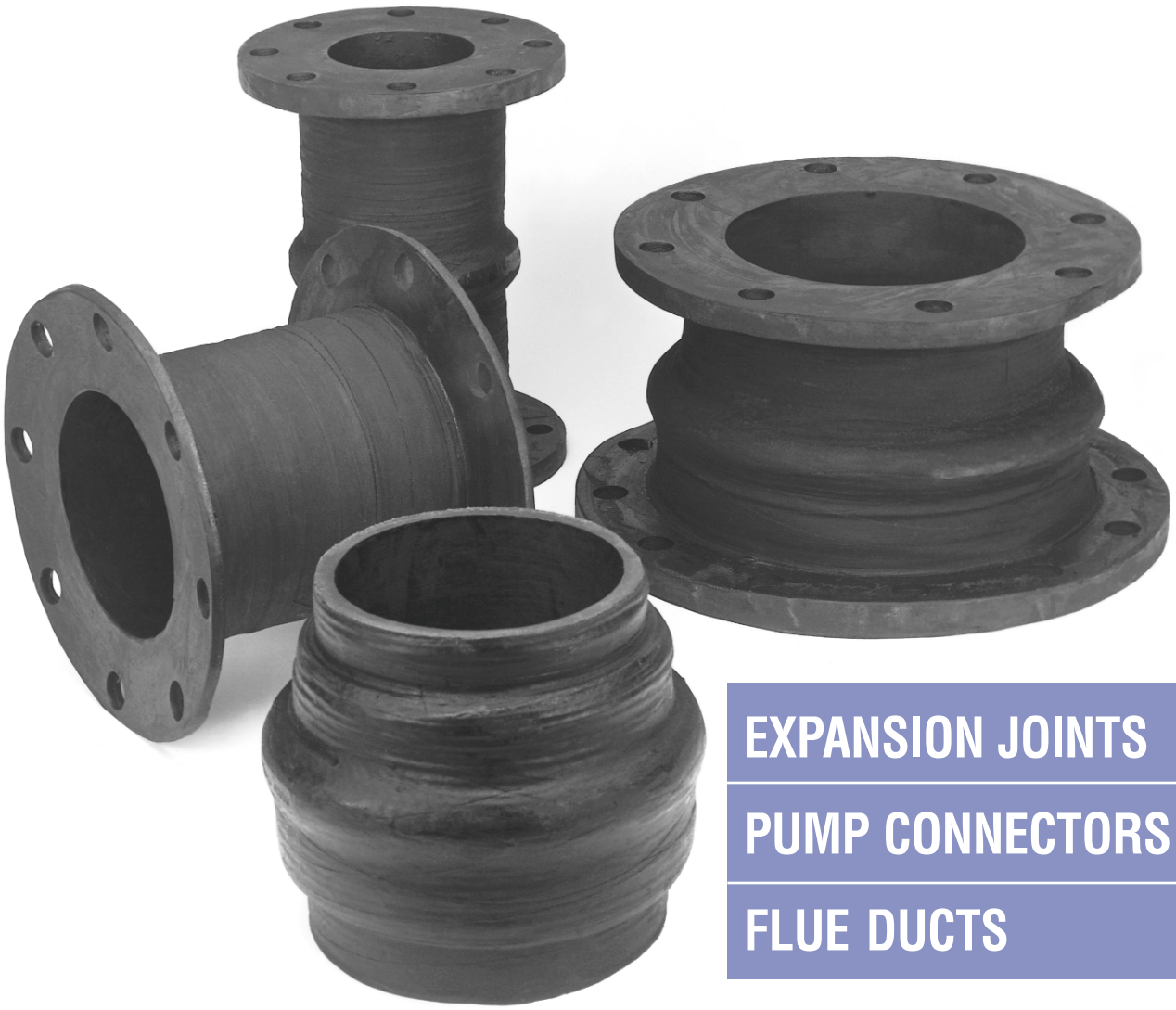
Prestige Rubber Manufacturing Corp.

ENGINEERED FLEXIBLE CONNECTORS



EXPANSION JOINTS

PUMP CONNECTORS

FLUE DUCTS

Introduction: Rubber Expansion Joints

Consulting engineers, mechanical contractors, pressure vessel designers, plant engineers and turn-key construction firms have specified and used rubber expansion joints for several years. They are installed to allow movement in piping runs, protect piping from expansion reactions and insure efficient and economical on stream operations.

Rubber expansion joints offer proven ways to accommodate pressure loads, relieve movement stresses, isolate vibration, reduce noise, prolong the life of motive equipment and compensate for misalignments when a plant goes on stream.

Designed by engineers and skillfully fabricated, rubber expansion joints are used in all systems moving fluids under pressure and/or vacuum at various temperatures:

- Process piping in paper and pulp, chemical, primary metal and petroleum refining plants.
- Sewage disposal and water-treatment plants.
- Central and ancillary power-generating stations in communities, factories, buildings and aboard ships.
- Air conditioning, heating and ventilating systems in commercial and institutional buildings, schools, apartments, stores, hospitals, motels, hotels and aboard ships.

Careful selection of the expansion joint design and material for a given application and properly engineered installations are important factors in determining performance. These factors should be fully evaluated when selecting and applying expansion joints for any application.

Flexible Connectors

The use of engineered flexible connectors in piping systems reduces noise and vibration under these conditions:

- Vibration from pumps and equipment and stress due to thermal expansion or contraction.
- Where protection is needed from damage due to vibration and movement in utility or process systems.
- To provide flexibility in use as either expansion joints or pump connectors.

Expansion joints are most often used to allow movement, but can also be effective in reducing vibration.

Pump connectors will not reduce excessive piping movement, but they offer excellent vibration damping and isolation.

Flue Duct Expansion Joints are designed to handle hot air or gases in industrial duct work, as well as those generated by power plant and pollution control equipment. They are custom constructed of rubber and fabric to absorb thermal movements and vibration in duct work and to aid in the elimination of noises caused by scrubber equipment and mechanical dust collectors. (See page 11 for typical flue duct installations).

Installation is easy and connectors and expansion joints are available in many materials and configurations.

Table of Contents

CHAPTER 1 Description of a Rubber Expansion Joint

A. DEFINITION

A flexible connector fabricated of natural or synthetic elastomers and fabrics and metallic reinforcements designed to provide stress relief in piping systems due to thermal changes.

Important performance features are flexibility of movements in either singular or multiple arch type construction, isolation of vibration and noise and resistance to abrasion and chemical erosion.

B. FUNCTIONS

Engineers can avoid anticipated problems of vibration, noise, shock, corrosion, abrasion, stresses and space by incorporating rubber expansion joints into designed piping systems.

1. **Reduce Vibration.** Rubber expansion joints isolate or reduce vibration caused by equipment. Some equipment requires more vibration control then others. For example, reciprocating pumps and compressors generate greater unbalanced forces then centrifugal equipment. However, rubber pipe and expansion joints subdue undesirable disturbances of harmonic overtones – vibrations caused by centrifugal pump and fan blade frequency based on actual tests conducted by a nationally recognized independent testing laboratory. Rubber expansion joints reduce transmission of vibration and protect equipment from the adverse effects of vibration.
2. **Dampen Sound Transmission.** As operations start, normal wear, corrosion, abrasion and erosion eventually bring about imbalance in motive equipment, generating undesirable noises transmitted to occupied areas. Rubber expansion joints tend to dampen transmission of sound because of the steel-rubber interface of joints and mating flanges. Thick-wall rubber expansion joints reduce considerably the transmission of sound compared with their metallic counterparts.
3. **Compensate Lateral, Torsional and Angular Movements.** Pumps, compressors, fans, piping and related equipment can move out of alignment due to load stresses wear, 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. **Compensate Axial Movements.** Compensating for axial movements, expansion and contraction movements due to thermal changes or hydraulic surge effects are unrestrained with strategically located rubber expansion joints.

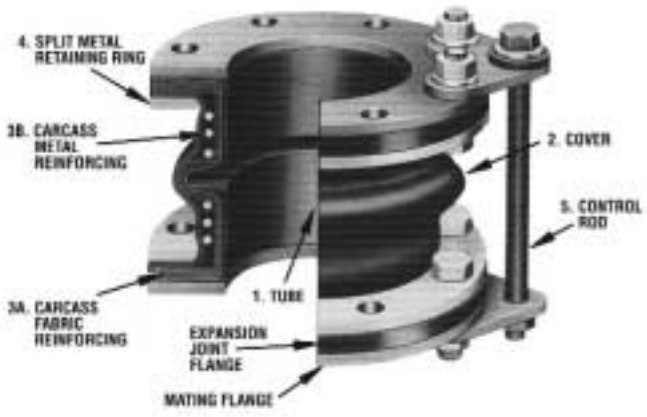


FIGURE 1: Cross Sectional View of Standard Spool "Arch" Type Expansion Joint

C. ADVANTAGES

The industry has worked with designers, architects, contractors and erectors in designing and fabricating rubber expansion joints under rigid standards to meet present day operating conditions. The industry developed technological advances in rubber compounding and synthetic fabrics to provide rubber expansion joints having advantages not available in other materials.

1. **Minimal Face-To-Face Dimensions.** Minimal face-to-face dimensions in rubber expansion joints offer significant economies when compared with more costly expansion bends or loops. The cost of the pipe itself may be less or no more than a rubber expansion joint, however, total costs are higher when considering plant space, installation labor, supports and pressure drops.
2. **Lightweight.** Rubber expansion joints are relatively light in weight, requiring no special handling equipment to position, contributing to lower installation labor costs.
3. **Low Movement Forces Required.** The flexibility of rubber expansion joints permits almost unlimited flexing to recover from imposed movements, requiring less force to move, thus preventing damage to motive equipment.
4. **Reduced Fatigue.** The inherent characteristics of natural and synthetic elastomers are not subject to fatigue breakdown or embrittlement and prevent any electrolytic action because of the steel-rubber interface of joints and mating flanges.
5. **Reduced Heat Loss.** Rubber expansion joints reduce heat losses giving long maintenance-free service. The added piping required for loops contribute to higher operating costs after going on stream due to increase in heat losses.
6. **Corrosion, Erosion Resistant.** A wide selection of natural, synthetic and special purpose elastomers and fabrics are available. Materials are treated and combined to meet a wide range of practical pressure/temperature operating conditions, corrosive attack, abrasion and erosion. Standard and special sizes of rubber expansion joints are available with TFE/FEP liners, fabricated to the configurations of the joint body, as added insurance against corrosive attack. Teflon possesses unusual and unique characteristics of thermal stability, non-sticking surface, extremely low co-efficient of friction and resistance to practically all corrosive fluids and forms of chemical attack.

D. CONSTRUCTION DETAILS

1. **Tube.** A protective, leakproof lining made of synthetic or natural rubber as the service requires. A seamless tube that extends through the bore to the outside edges of the flanges. Its purpose is to remove the possibility of the materials being handled penetrating the carcass

and weakening the fabric. The tubes can be designed to cover service conditions for chemical, petroleum, sewage, gaseous and abrasive materials.

2. **Cover.** The exterior surface of the joint is formed from natural or synthetic rubber, depending on service requirements. The cover protects the carcass from outside damage or abuse. Special polymers can be supplied to resist chemicals, oils, sunlight, acid fumes and ozone. Also a protective coating may be applied to the exterior of the joint for additional protection.
3. **Carcass.** The carcass or body of the expansion joint consists of fabric and metal reinforcement.

   A. Fabric Reinforcement. The carcass fabric reinforcement is the flexible and supporting member between the tube and cover. Standard constructions normally utilize high quality synthetic fabric but natural fabrics are also used depending on pressure and temperature requirements. All fabric plys are impregnated with rubber or synthetic compounds to permit flexibility between the fabric plys allowing for service strain.

   B. Metal Reinforcement. Reinforcements imbedded in the carcass are used as strengthening members of the joint. This serves to permit the rated working pressure required and supplies the rigidity to the joint for vacuum service.

Chapter 2
Types of Rubber Expansion Joints and Connectors

A. STANDARD SPOOL "ARCH" 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 MIL-E-15330D, Class A-Type 1-Series C. Both types are available in several construction design series, based on the application pressure requirements.

1. **Single Arch Type.** Constructed of fabric and rubber and metal reinforced. The full face flanges are integral with the body of the joint and drilled to conform to the bolt pattern of the companion metal flanges of the pipeline. This type of rubber faced flange is of sufficient thickness to form a tight seal against the metal flanges without the use of gaskets. The shortest face-to-face dimensions are available with this type of construction. (See Diagram A1, page 7.)
2. **Multiple Arch Type.** Joints with two or more arches may be manufactured to accommodate movements greater than those of which a Single Arch Type joint is capable. Multiple arch joints of most manufacturers are composites of standard sized arches and are capable of movements of a single arch multiplied by the number of arches. The minimum length of the joint is dependent upon the number of arches. In order to maintain lateral stability and prevent sagging when the joint is installed in a horizontal position, a maximum number of four (4) arches is recommended. (See Diagram A2, page 7.)
3. **Lightweight Type.** Both the Single Arch and Multiple Arch Types are available in a lightweight series. Dimensionally the same as the standard product, except for reduced body thickness, this series is designed for very low pressure and vacuum applications.

B. CONCENTRIC & ECCENTRIC REDUCER TYPES

Tapered expansion joints are used to connect piping of unequal diameters. Some are manufactured as concentric taper joints with the axis of each end concentric with each other or as eccentric taper joints having the axis of each end offset from each other. Tapers in excess of 15° are not desirable. Recommendations concerning the degree of taper and working pressures should be obtained before specifying. Normally, pressures are based on the larger of the two inside dimensions. Available with or without arches. See Diagrams B1 and B2, page 7. Diagram B2 shows an eccentric reducer of a No Arch "U" Type Connector.

C. SLEEVE TYPE

This joint is of the same design as the Standard Spool "Arch" Type except that capped sleeve ends have an I.D. dimension equal to the O.D. of the pipe. These joints are designed to slip over the straight ends of the open pipe and be held securely in place with "King" clamps or "Knox" sectional clamps. Other types of clamps may be used at the discretion of the customer. This type joint is recommended only for low pressure service because of the difficulty of obtaining adequate clamp sealing (Diagram C, page 7).

D. SPECIAL FLANGE TYPES

Most of the expansion joint types depicted in this chapter are available with modifications to the flanges. These modifications include enlarged flanges, and different drill patterns.

Enlarged Flange Type. Expansion joints utilizing a full face integral flange design can be furnished with an enlarged flange on one end. For example, an 8" expansion joint can be fabricated with a flange to mate to an 8" pipe flange on one end; and a 12" flange on the other end to mate to a 12" pipe flange. Additionally, drilling of different specifications may be furnished. For example, an expansion joint can be furnished with one end drilled to ANSI B16.5, Class 150, other end drilled to MIL-F-20042C. (See Diagram D1, page 7.)

E. DESIGNS FOR REDUCTION OF TURBULENCE

The open-arch design of the Standard Spool Type Expansion Joint may be modified to reduce possible turbulence and to prevent the collection of solid materials that may settle from the solution handled and remain in the archway.

Filled Arch Type. Standard arch type expansion joints may be supplied with a bonded-in place soft rubber arch filler to provide a smooth interior bore. Filled arches built as an integral part of the carcass decrease the flexibility of the joint and should be used only when necessary. Movements of expansion joints with filled arches are limited to 1/2 the normal movements of comparable size expansion joints with unfilled (open) arches. (See Diagram D2, page 7.)

F. RETAINING RINGS AND CONTROL UNITS

Split Metal Retaining Rings. Retaining rings must be used to distribute the bolting pressure and assure a pressure tight seal. Rings are coated for corrosion resistance and drilled as specified. (See Appendix A – Common Flange Dimension/Drilling, page 9).

continued on page 6

Table I Comparative Properties of Typical Elastomers

ANSI/ASTM D1418-77		NR/IR	CR	NBR	CIIR	CSM	EPDM	FKM	AFMU
Elastomer Common Name		Gum/Natural	Neoprene	Nitrile/Buna-N	Chlorobutyl	Hypalon®	EPDM/EPT	Viton®/Flourel®	Teflon®
Chemical Name Definition		Polyisoprene	Poly-Chloroprene	Butadiene Acrylo-Nitrate	Chloro-Isobutylene Isoprene	Chloro-Sulfonated Polyethylene	Ethylene Propylene Polymer	Fluorinated Hydrocarbon	Tetrafluoro-Ethylene Resin
Hardness Range: Duro A		30-90	40-95	40-95	40-75	40-95	40-90	55-95	—
Specific Gravity of Base		0.93	1.23	1.00	0.92	1.12-1.28	0.86	1.85	—
Low Temp.- Min. Service °F		–20 to –60	–10 to –50	+30 to –40	–10 to –60	–30 to –60	–20 to –60	+10 to –10	–120
High Temp.- Max. Service °F		185	220	240	250 to 300	275	300	400 to 600	450
RESISTANCE AND CHEMICAL PROPERTIES COMPARISON	Abrasion	Excellent	Excellent	Good	Good	Excellent	Good to Excellent	Good	Good
	Absorpsion, Water	Very Good	Good	Good	Very Good	Very Good	V. Good to Excel.	Very Good	—
	Acid-Concentrated	Fair to Good	Excellent	Good	Good	Very Good	Excellent	Excellent	Excellent
	Acid-Dilute	Fair to Good	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Excellent
	Adhesion to Fabrics	Excellent	Excellent	Good	Good	Good	Good	Good to Excellent	Fair to Good
	Adhesion to Metals	Excellent	Excellent	Excellent	Good	Excellent	Good to Excellent	Fair to Good	Fair to Good
	Chemicals	Fair to Good	Fair to Good	Fair to Good	Excellent	Excellent	Excellent	Excellent	Excellent
	Cold	Excellent	Good	Fair to Good	Good	Good	Excellent	Good	Excellent
	Dielectric Strength	Excellent	Good	Poor	Excellent	V. Good to Excel.	Excellent	Good	—
	Dynamic Properties	Excellent	Fair	Good to Excellent	Fair	Fair	Good to Excellent	Good to Excellent	—
	Electrical Insulation	Good to Excellent	Fair to Good	Poor	Good to Excellent	Good	Excellent	Fair to Good	—
	Flame	Poor	Good	Poor	Poor	Good	Poor	Excellent	Excellent
	Heat	Good	Very Good	Good	Very Good	Excellent	Excellent	Outstanding	Excellent
	Heat Aging	Fair	Good	Good	Very Good	Very Good	Excellent	Outstanding	Excellent
	Hydrocarbons-Aliphatic	Poor	Fair to Good	Excellent	Poor	Fair to Good	Poor	Excellent	Excellent
	Hydrocarbons-Aromatic	Poor	Fair	Good	Poor	Fair	Poor	Excellent	Excellent
	Hydrocarbons-Oxygenated	Fair to Good	Poor	Poor	Good	Poor to Fair	Good to V. Good	Poor	Excellent
	Impermeability	Fairly Low	Low	Low	Very Low	Low to Very Low	Fairly Low	Very Low	—
	Oil-Animal& Vegetable	Poor to Good	Good	Very Good	Very Good	Good	Good	Excellent	Excellent
	Oil & Gasoline	Poor	Good	Excellent	Poor	Good	Poor	Excellent	Excellent
	Oxidation	Good	V. Good to Excel.	Good	Excellent	Excellent	Excellent	Outstanding	Excellent
	Ozons	Poor to Fair	V. Good to Excel.	Fair	Excellent	Outstanding	Outstanding	Outstanding	Excellent
	Radiation	Excellent	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Fair to Good
	Rebound-Cold	Excellent	Very Good	Good	Poor	Fair to Good	Very Good	Fair to Good	—
	Rebound-Hot	Excellent	Very Good	Good	Very Good	Good	Very Good	Good	—
	Set, Compression	Good	Fair to Good	Good	Fair	Fair	Good	Fair to Good	—
	Solvents, Lacquer	Poor	Poor	Fair	Fair to Good	Poor	Poor to Fair	Poor to Fair	Excellent
	Steam	Fair to Good	Fair	Fair to Good	Good	Fair	Excellent	Fair to Good	—
	Sunlight Aging	Poor	Very Good	Poor	Very Good	Outstanding	Outstanding	Outstanding	Excellent
	Swelling in Oil	Poor	Good	Very Good	Poor	Good to Excellent	Poor	Excellent	—
	Tear	Good to V. Good	Good	Fair	Good	Fair	Fair to Good	Fair	—
	Tensile Strength	Excellent	Good	Good to Excellent	Good	Fair	Good to Excellent	Good to Excellent	—
	Water	Fair to Good	Fair	Fair to Good	Good	Fair	Excellent	Fair to Good	Excellent
	Weather	Fair	Excellent	Fair	Good to Excellent	Excellent	Excellent	Excellent	Excellent
Generally Resistant to:		Water, Air and Average Concentration Acids, Bases Alcohols, Salts Ketones. Best Abrasion Resistance.	Moderate Acids and Chemicals. Ozone, Oils, Fats and many Solvents. Only Abrasive Applications.	Most Hydrocarbons, Fats, Oils, Greases, Hydraulic Fluids, Chemicals and Solvents.	Animal and Vegetable: Oils, Fats, Greases. Air, Gas, Water, many Oxidizing Chemicals and Ozone.	Strong Acids and Bases. Freons, Hydroxides, Ozone, Alcohols. Etching Alkaline and Hypochloride Solutions.	Vegetable and Animal Fats, Oils. Ozone, many Strong and Oxidizing Chemicals, Ketones, and Alcohols.	All Aromatic, Aliphatic and Halogentated Hydrocarbons. Many Acids, Animal and Vegetable Oils.	Most known Fluid Chemicals.
Generally Affected or Attacked by:		Not for: Ozone, Strong Acids, Bases, Oils, Alcohols, Salts Solvents, most Hydrocarbons.	Not for: Oxidizing Acids, Esters and Ketones, Aromatic, Chlorinated and Nitro Hydrocarbons.	Not for: Ozone, Ketones, Esters, Aldehydes, Nitro and Chlorinated Hydrocarbons, Polar Solvents, MEK.	Not for: Oils, Solvents, Aromatic Hydrocarbons.	Not for: Ketones, Esters, certain Chlorinated Oxidizing Acids, Chlorinated Nitro and Aromatic Hydrocarbons.	Not for: Mineral Oils, Solvents, Aromatic Hydrocarbons.	Not for: Ketones, Esters, and Nitro Containing Compounds.	Not for: Molten Alkali Metals, Fluorine and Related Compounds.

Flourel is a registered trademark of 3M Companies. Hypalon, Viton and Teflon are registered trademarks of E.I. Dupont, Inc.

Table II Spool Type Expansion Joints Single Open Arch Pressure/Vacuum Rating

Nominal Pipe Size in Inches ID of Expansion Joint	High Pressure & Navy A Expansion Joints	
	Positive (+) Pressure PSIG	Negative (–) Inches of Hg
.5-4	200	26
8-12	190	26
14	130	26
16-20	110	26
22-24	100	26
26-30	90	26

Nominal Pipe Size in Inches ID of Expansion Joint	Lightweight	
	Positive (+) Pressure PSIG	Negative (–) Inches of Hg
.5-30	25	15

Nominal Pipe Size in Inches ID of Expansion Joint	Vacuum	
	Positive (+) Pressure PSIG	Negative (–) Inches of Hg
.5-3	180	26
3.5-6	155	26
6.5-10	145	26
11-14	125	26
15-20	75	26
21-24	70	26
25-30	60	26

Nominal Pipe Size in Inches ID of Expansion Joint	Extra High Pressure Expansion Joints	
	Positive (+) Pressure PSIG	Negative (–) Inches of Hg
.5-3	325	26
3.5-6	300	26
6.5-10	275	26
11-12	250	26
13-14	225	15
15-20	200	15
21-24	150	15
25-30	110	15

All Nominal Pipe Sizes	Flue Duct Positive (+) Pressure PSIG	Flue Duct Negative (–) Inches of Hg
1/4" Thick	3-5 Surge	8
3/8" Thick	5-8 Surge	10

Nominal Pipe Size in Inches ID of Expansion Joint	Vibration Pipe	
	Positive (+) Pressure PSIG	Negative (–) Inches of Hg
150 POUND		
.5-18	150	26
19-20	125	26
21-24	100	26
250 POUND		
.5-16	250	26

The rings are installed directly against the back of the flanges of the joint and bolted through to the metal flange of the pipe. Rings are normally 3/8" thick but can vary due to conditions. Special retaining rings may be required for many of the expansion joint types depicted in this Chapter.

WARNING: Control units must be used to protect expansion joints from excessive movement if piping is not properly enclosed.

Chapter 3
Flexible Rubber Pipe Connectors

INTRODUCTION

The two previous chapters have dealt primarily with rubber expansion joints manufactured in single or multiple arch type design. This arch design provides substantial flexibility to allow the expansion joint to absorb pipe movements, whether induced by thermal changes or other mechanical means. In certain applications, the features provided by arch type construction may not be of primary importance, and it is possible to manufacture no-arch type expansion joints. It is more common, however, the specify flanged pipe connectors having a substantially longer length than an expansion joint of the same pipe size, and this chapter covers the construction, usage and dimensions of these pipe connectors.

A. DEFINITION

A flexible rubber pipe connector is a reinforced straight rubber pipe fabricated of natural or synthetic elastomers and fabrics primarily designed to absorb noise and vibration in a piping system.

B. PERFORMANCE CHARACTERISTICS

1. **Sound Limiting Characteristic.** Rubber pipe connectors are frequently used in air-conditioning and heating installations because of their ability to limit or interrupt the transmission of sound from operating equipment to the piping system.
2. **Temperature Limits.** Standard Class I materials of construction are limited to 180°F. Standard Class II materials of construction are limited to 230°F. Special Class II materials of construction are available for temperatures over 230°F.

continued on page 9

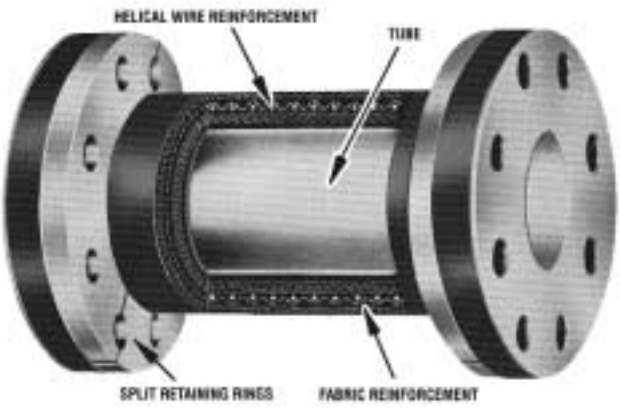


FIGURE 2: Cross Sectional View of Flanged Type Flexible Rubber Pipe

Typical Expansion Joints

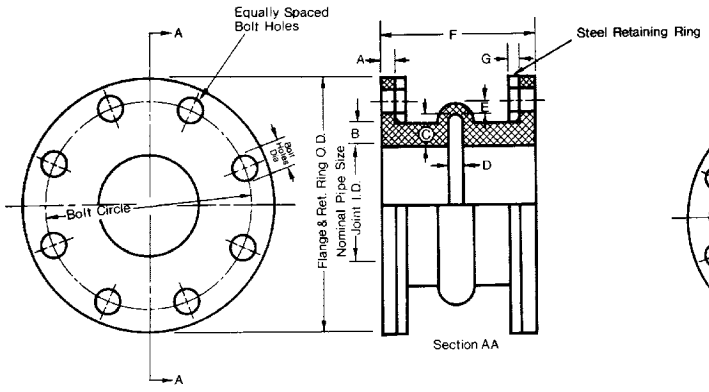


Diagram A1: Single Arch Type Expansion Joint

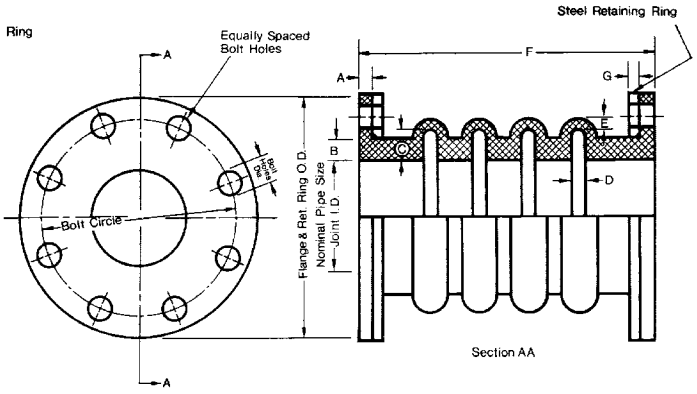


Diagram A2: Multiple Arch Type Expansion Joint

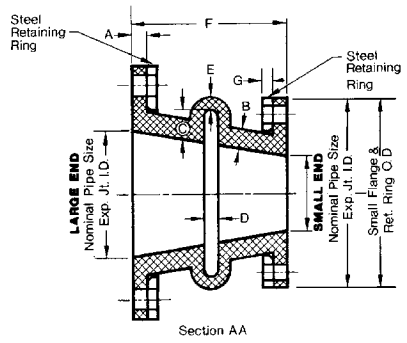


Diagram B1: Concentric Reducer Type Expansion Joint

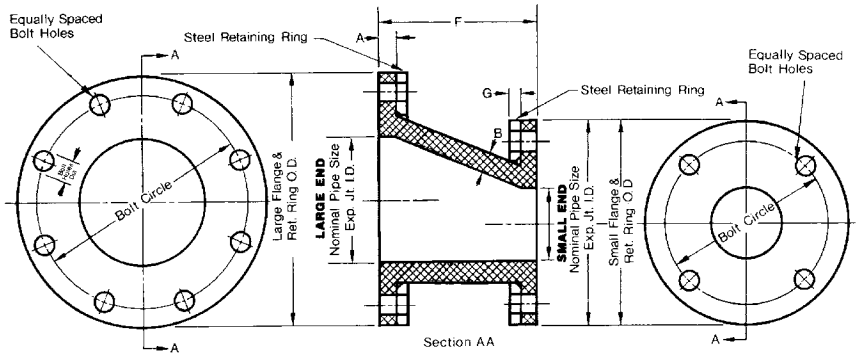


Diagram B2: Eccentric Reducer Type Expansion Joint

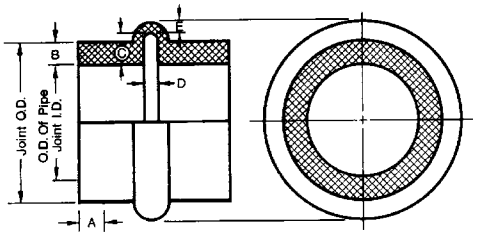


Diagram C: Sleeve Type Expansion Joint

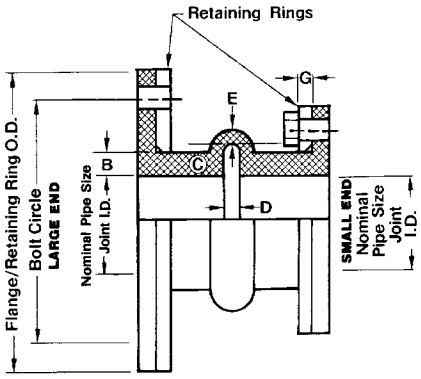


Diagram D1: Enlarged Flange Type Expansion Joint

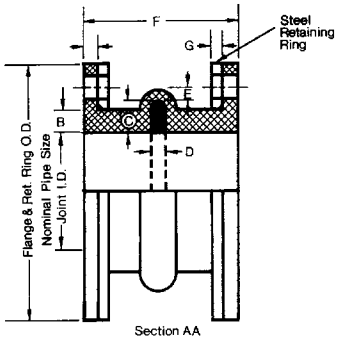


Diagram D2: Single Arch Type Expansion Joint with Filled Arch

Table III Expansion Joint Movement/Force/Spring Rate Capability

BASED ON SINGLE OPEN ARCH DESIGN

NOMINAL PIPE SIZE EXPANSION JOINT I.D. (INCHES)	RECOMMENDED FACE-TO-FACE MINIMUM LENGTH (INCHES)	MOVEMENT CAPABILITY					FORCE POUNDS					SPRING RATE		
		INCHES OF AXIAL COMPRESSION	INCHES OF AXIAL EXTENSION	INCHES OF LATERAL DEFLECTION	DEGREES OF ANGULAR MOVEMENT	DEGREES OF TORSIONAL MOVEMENT	TOTAL LOAD LBS. FOR RATED COMPRESSION	TOTAL LOAD LBS. FOR RATED EXTENSION	TOTAL LOAD LBS. FOR RATED LATERAL DEFLECTION	TOTAL LOAD FOOT LBS. FOR RATED ANGULAR MOVEMENT	FORCE POUNDS FOR 1" COMPRESSION MOVEMENT	FORCE POUNDS FOR 1" EXTENSION MOVEMENT	FORCE POUNDS FOR 1" LATERAL DEFLECTION	FORCE FOOT LBS. FOR 1° ANGULAR MOVEMENT
1 1/4	6	7/16	1/4	1/2	22.5	3	129	96	219	2	294	383	483	.1
1 1/2	6	7/16	1/4	1/2	18.5	3	154	115	262	3	353	459	524	.15
2	6	7/16	1/4	1/2	14.5	3	185	138	350	4	423	552	700	.3
2 1/2	6	7/16	1/4	1/2	11.5	3	232	172	381	6	530	689	762	.5
3	6	7/16	1/4	1/2	10.0	3	278	207	412	8	635	828	824	.1
3 1/2	6	7/16	1/4	1/2	8.3	3	324	241	444	11	742	965	888	1.3
4	6	7/16	1/4	1/2	7.5	3	371	276	476	14	848	1,104	952	1.9
5	6	7/16	1/4	1/2	6.0	3	463	344	546	22	1,058	1,376	1,092	3.7
6	6	7/16	1/4	1/2	5.0	3	556	413	617	32	1,271	1,652	1,234	6.4
8	6	11/16	3/8	1/2	5.5	3	971	689	753	70	1,412	1,837	1,506	12.7
10	8	11/16	3/8	1/2	4.5	3	1,214	861	809	109	1,766	2,296	1,618	24.2
12	8	11/16	3/8	1/2	3.75	3	1,456	1,033	948	158	2,118	2,755	1,896	42.1
14	8	11/16	3/8	1/2	3.25	2	1,274	904	1,117	160	1,853	2,411	2,234	49.2
16	8	11/16	3/8	1/2	2.75	2	1,456	1,033	1,286	209	2,118	2,755	2,572	76
18	8	11/16	3/8	1/2	2.5	1	1,638	1,163	1,420	266	2,382	3,101	2,840	106
20	8	13/16	7/16	1/2	2.5	1	2,152	1,505	1,588	381	2,649	3,440	3,176	152
22	10	13/16	7/16	1/2	2.25	1	2,367	1,656	1,648	463	2,913	3,785	3,296	205
24	10	13/16	7/16	1/2	2.0	1	2,582	1,807	1,706	549	3,178	4,130	3,412	274
26	10	15/16	1/2	1/2	2.3	1	2,869	1,990	1,829	659	3,060	3,980	3,658	292
28	10	15/16	1/2	1/2	2.0	1	3,090	2,143	1,952	765	3,296	4,286	3,904	382
30	10	15/16	1/2	1/2	2.0	1	3,311	2,297	2,075	875	3,532	4,594	4,150	437

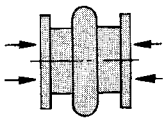
NOTES:

A. MOVEMENT CAPABILITY

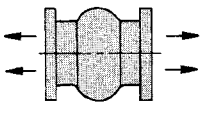
1. "Filled Arch" construction reduces above movement by 50%.
2. The degree of Angular Movement is based on the maximum extension shown.
3. If greater movements are desired, expansion joints can be supplied with two, three or four arches. Relatively longer "Face-To-Face" length dimensions are incorporated into designs of Multiple Arch Type expansion joints.
4. To calculate approximate movements of Multiple Arch Type expansion joints, take the movement shown in the above table and multiply by the number of arches.
5. Movements shown above are based on proper installation practice.

B. FORCE POUNDS/SPRING RATE

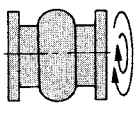
1. Forces required to move expansion joints are based on zero pressure conditions and room temperature in the pipe line.
2. These forces should be considered only as approximates which may vary with the elastomers and fabrics used in fabrication and the specific construction design of an individual manufacturer.



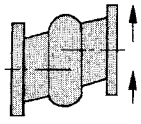
Axial Compression



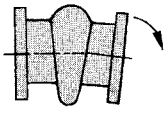
Axial Elongation



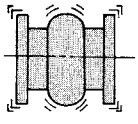
Torsional Movement



Lateral Movement



Angular Movement



Absorbing Vibration

3. **Pressure Characteristics.** Flexible rubber pipe can be furnished in either 150 PSIG or 250 PSIG working pressure construction designs, in both Standard Classes I and II, and Special Class II materials. See Tables I & III.
4. **Resistance To Fluids.** Rubber pipe corrosion resistance is the same as for elastomeric expansion joints. See Chapter 3, Section E and Table I.

C. CONSTRUCTION DETAILS

1. **Tube, Cover and Carcass.** Details concerning the tube, cover and carcass fabric reinforcement are the same as for expansion joints.
2. **Metal Reinforcement.** Helical-wound, steel reinforcement wire is imbedded in the carcass to provide strength for high pressure operations and to prevent collapse under vacuum. See Figure this page.

D. DIMENSIONS

The connector length recommended gives the optimum noise and vibration control for most applications utilizing this construction, individually manufactured depending on the application.

E. TYPES OF PIPE CONNECTORS

Flexible rubber pipe is available in Flanged Type.

1. **Flanged Type.** The most common type of rubber pipe incorporates a full face flange integral with the body of the pipe. The flange is drilled to conform to the bolt pattern of the companion metal flanges of the pipeline (See Appendix A). This type of a rubber faced flange, backed with a retaining ring, is of sufficient thickness to form a tight seal against the companion flange without the use of a gasket.

F. ANCHORING AND CONTROL UNITS

Flexible rubber connectors should always be installed in piping systems that are properly anchored so that the connectors are not required to absorb compression or elongation piping movements. If axial forces can act in the system to compress or elongate the connector, control units will be required to prevent axial movement. In general, control units are always recommended as an additional safety factor, preventing damage to the connector and associated equipment.

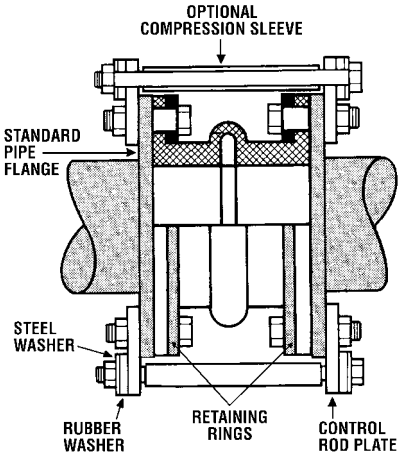
Appendix A
Common Flange Dimension/Drilling Chart

NOMINAL PIPE SIZE EXPANSION JOINT I.D.	125/150 LB. DRILLING				250/300 DRILLING				NAVY DRILLING			
	SPECIFICATIONS				SPECIFICATIONS				SPECIFICATIONS			
	ANSI B16.1 – 1975 CLASS 125 ANSI B16.5 – 1973 CLASS 150				ANSI B16.5 – 1973 CLASS 300 MSS SP-44 – 1975 CLASS 300				MIL-F-20042C – 150 LB.			
	COMMON SIZE O.D.	COMMON SIZE B.C.	COMMON SIZE NO. OF HOLES	BOLT HOLE SIZE DIA.	COMMON SIZE O.D.	COMMON SIZE B.C.	COMMON SIZE NO. OF HOLES	BOLT HOLE SIZE DIA.	COMMON SIZE O.D.	COMMON SIZE B.C.	COMMON SIZE NO. OF HOLES	BOLT HOLE SIZE DIA.
1 1/4	4 5/8	3 1/2	4	5/8	5 1/4	3 7/8	4	3/4	4 1/2	3 3/8	4	9/16
1 1/2	5	3 7/8	4	5/8	6 1/8	4 1/2	4	7/8	5 1/16	3 15/16	6	9/16
2	6	4 3/4	4	3/4	6 1/2	5	8	3/4	5 9/16	4 7/16	6	9/16
2 1/2	7	5 1/2	4	3/4	7 1/2	5 7/8	8	7/8	6 1/8	5	6	9/16
3	7 1/2	6	4	3/4	8 1/4	6 5/8	8	7/8	6 5/8	5 1/2	8	9/16
3 1/2	8 1/2	7	8	3/4	9	7 1/4	8	7/8	7 3/16	6 1/16	8	9/16
4	9	7 1/2	8	3/4	10	7 7/8	8	7/8	7 11/16	6 9/16	8	9/16
4 1/2	9 1/4	7 3/4	8						8 3/16	7 1/16	10	9/16
5	10	8 1/2	8	7/8	11	9 1/4	8	7/8	9 1/16	7 13/16	10	11/16
5 1/2									9 9/16	8 5/16	10	11/16
6	11	9 1/2	8	7/8	12 1/2	10 5/8	12	7/8	10 1/8	8 7/8	12	11/16
6 1/2									10 5/8	9 3/8	12	11/16
7	12 1/2	10 3/4	8						11 5/16	10	12	11/16
7 1/2									11 7/8	10 9/16	12	11/16
8	13 1/2	11 3/4	8	7/8	15	13	12	1	12 3/8	11 1/16	14	11/16
8 1/2									12 15/16	11 5/8	14	11/16
9	15	13 1/4	12						13 15/16	12 3/8	14	13/16
9 1/2									14 1/2	12 15/16	14	13/16
10	16	14 1/4	12	1	17 1/2	15 1/4	16	1 1/8	15	13 7/16	15	13/16
11									16 9/16	15	16	13/16
12	19	17	12	1	20 1/2	17 3/4	16	1 1/4	17 5/8	16 1/16	18	13/16
14	21	18 3/4	12	1 1/8	23	20 1/4	20	1 1/4	19 1/8	17 3/8	19	15/16
15	22 1/4	20	16									
16	23 1/2	21 1/4	16	1 1/8	25 1/2	22 1/2	20	1 3/8	21 3/16	19 7/8	20	15/16
18	25	22 3/4	16	1 1/4	28	24 3/4	24	1 3/8	23 1/4	21 1/2	22	15/16
20	27 1/2	25	20	1 1/4	30 1/2	27	24	1 3/8	25 13/16	23 13/16	24	1 1/16
22	29 1/2	27 1/4	20	1 3/8	33	29 1/4	24	1 5/8	27 7/8	25 7/8	26	1 1/16
24	32	29 1/2	20	1 3/8	36	32	24	1 5/8	30	28	28	1 1/16
25									31 1/2	29 1/4	29	1 3/16
26	34 1/4	31 3/4	24	1 3/8	38 1/4	34 1/2	28	1 3/4	32 9/16	30 5/16	30	1 3/16
28	36 1/2	34	28	1 3/8	40 3/4	37	28	1 3/4	34 11/16	32 7/16	32	1 3/16
30	38 3/4	36	28	1 3/8	43	39 1/4	28	2	36 13/16	34 9/16	35	1 3/16

PLEASE NOTE: All flanges will be drilled to the above standard unless otherwise specified. Other drillings and flanges provided upon request.

Appendix B
Control Unit Dimensions and Ratings

CONTROL UNIT				NOMINAL PIPE SIZE EXPANSION JOINT I.D. (INCHES)	MAXIMUM SURGE OR TEST PRESSURE OF THE SYSTEM (PSIG)				
DIMENSIONS		STANDARD CONTROL UNIT ASSEMBLY OF:			NUMBER OF CONTROL RODS RECOMMENDED				
PLATE[1] THICKNESS (INCHES)	ROD[1] DIAMETER (INCHES)	RODS	PLATES		2	3	4	6	8
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**	830	—	—	—	—
3/8	1/2	2	4	**1 1/2**	510	—	—	—	—
3/8	5/8	2	4	**2**	661	—	—	—	—
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	141	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. Recommended plate thickness and rod diameter based on a yield strength of 36,000 PSI with a maximum allowable stress of 23,400 PSI (65% of yield). Rod and plate load based on thrust, calculated using diameter "D". Dimensions can vary with a manufacturer's grade of steel and material.
2. A "Standard Control Unit Assembly" is generally furnished when ordered, if specifications and/or order does not call out a specific number of control rods or a design/test pressure of system.

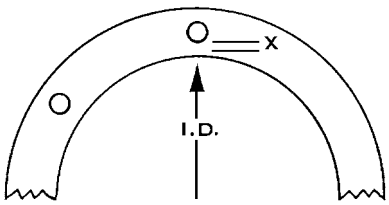
Appendix C
Pressure Terminology

1. **Operating Pressure.** The actual pressure at which the system works under normal conditions. This pressure may be positive or negative (vacuum).
2. **Design Pressure.** The highest or most severe pressure expected during operation. Sometimes used as the calculated operating pressure plus an allowance for safety margin.
3. **Surge Pressure.** Operating pressure plus the increment above operating pressure that the expansion joint will be subjected to for a very short time duration due to pump starts, valve closings, etc.
4. **Maximum Allowable Working Pressure**. This term is used by the expansion joint manufacturer to define the maximum continuous operating pressure recommended for a specific expansion joint.
5. **Test Pressure.** The hydrostatic test pressure used to demonstrate system capability. Normally 1.5 times maximum allowable working pressure.

Appendix D
Dimension Inspection Procedure

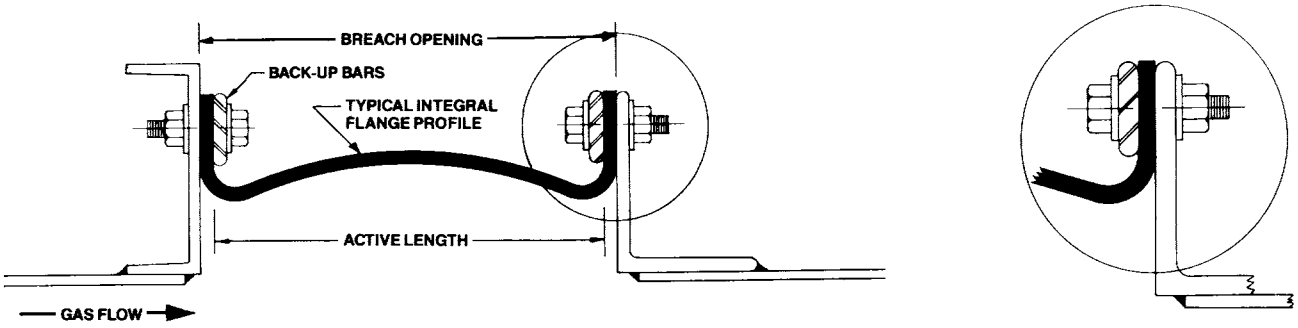
NOMINAL PIPE SIZE EXPANSION JOINT I.D.	TOLERENCES FOR RUBBER PIPE & EXPANSION JOINTS						
	EXPANSION JOINT I.D.[1]	NON-CRITICAL FLANGE O.D.[1]	BOLT LINE[3]	FACE-TO-FACE LENGTH "F"[2] (INCHES) ALL DIMENSIONS TO BE AVERAGE READING. APPLIES TO OPEN OR FILLED ARCH.			
				0 to 6	7 to 12	14 to 18	20 & Up
0 to 10	±3/16	±1/4	±3/16	±1/8	+1/8 –3/16	±3/16	+3/16 –1/4
12 to 22	±1/4	±3/8	±1/4	±1/8	+1/8 –3/16	±3/16	+3/16 –1/4
24 to 30	±3/8	±1/2	±5/16	+1/8 –3/16	±3/16	+3/16 –1/4	±1/4

NOTES:
1. All diameters to be measured with "Pi" tape.
2. All linear dimensions to be measured with a steel rule and averaged.
3. Bolt Line = Actual I.D. + 2 (Average "X" Dimension) + Bolt Hole Diameter.

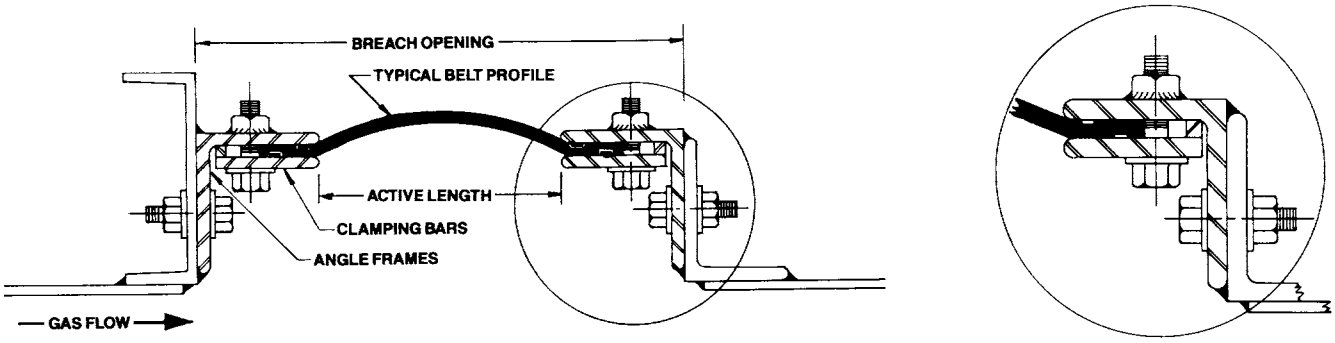


Typical Flue Duct Installations

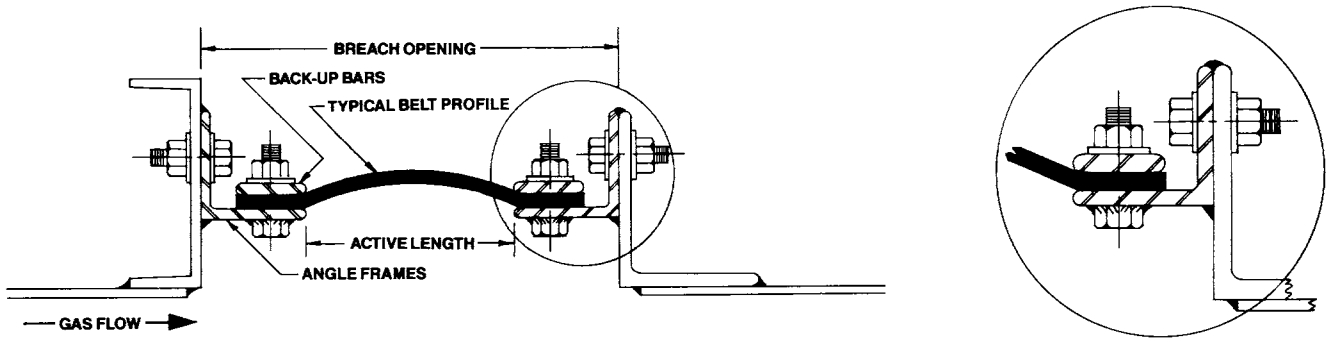
A solid product with one or more reinforcing plys, laminated with an elastomeric material which is vulcanized into a homogenous solid product. The overall thickness and number of reinforcing plys may vary depending upon application conditions and design concept.



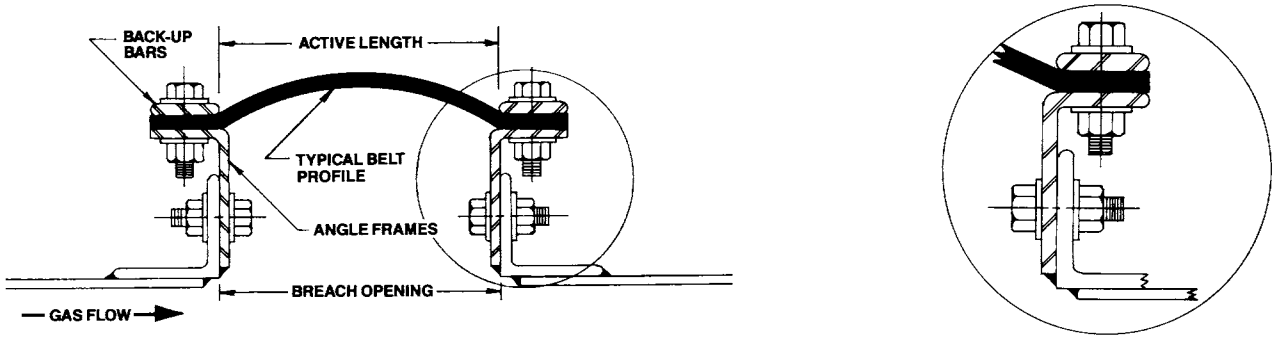
Externally Installed — Bolted Back-Up Bars



Internally Installed — Clamp-In Attachment



Externally Installed — Bolted Back-Up Bars



Externally Installed — Bolted Back-Up Bars

Rubber Manufacturing Corp.
11 Spielman Road
Fairfield, New Jersey 07004-9576
TOLL-FREE: 888-816-0708
Fax: 973-227-3306 • Outside USA Tel: 973-227-2505 ; www.prestigerubber.com