Non-Metallic Expansion Joint

4. Design Consideration of Non-Metallic Expansion Joint

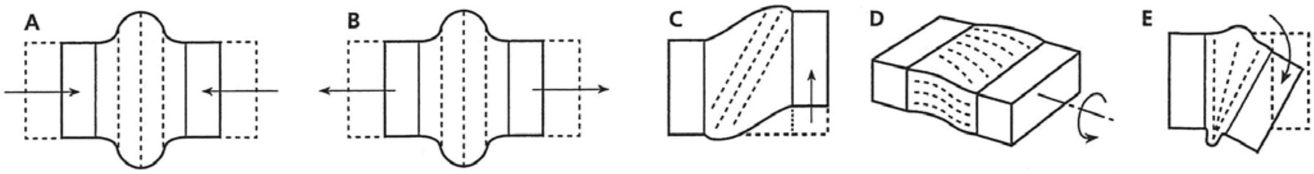
1. Types of movements

The face-to-face dimension of the expansion joint, as installed, is a major design consideration. In general, an increased face-to-face dimension results in greater movement capabilities.

Three dimensional system movements can occur five ways and in any combination. These movements are outlined below.

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

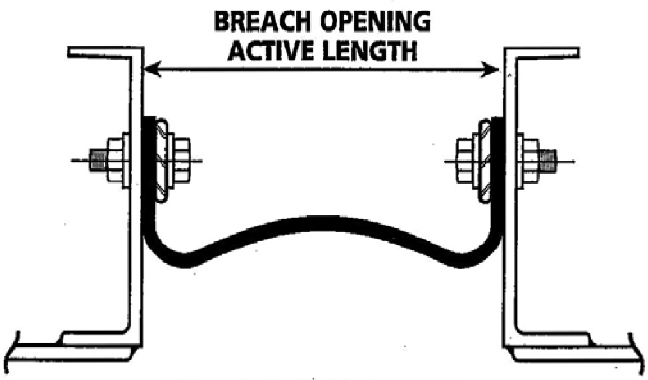
NOTE: The two rotational movements are usually given in degrees which can be calculated into inches, which in turn can be added to or subtracted from the three basic movements: compression, extension and lateral.



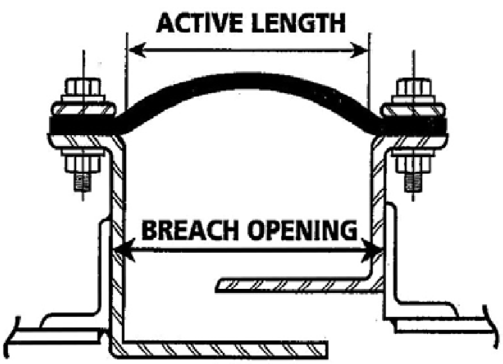
AXIAL MOVEMENT (COMPRESSION) | AXIAL MOVEMENT (EXTENSIONS) | LATERAL MOVEMENT | TORSION (ROTATION) | ANGULAR DEFLECTION (BENDING)

2. Typical Movement Capabilities:

Once the supporting structural steel and ducting system has been laid out, ducting anchor points should be located so that the ducting movements can be calculated at both the design and maximum excursion temperatures.
Since non-metallic expansion joints can handle combined axial, lateral, angular and torsional movements with just one unit, the expansion joint locations should be carefully selected to keep the number of expansion joints in the system to a minimum and still absorb all of the duct movements. Should an expansion joint location have very large axial and/or lateral movements, consult manufacturers for a recommendation on how these large movements can best be handled.
When all movements and expansion joint locations have been determined, the expansion joint geometry style should be selected for all locations in order to select the breach opening required and the recommended attachment method.



INTEGRAL FLANGE TYPE



BELT TYPE

MOVEMENT CHART

TYPE	ACTIVE LENGTH	AXIAL COMPRESSION	AXIAL EXTENSION	LATERIAL MOVEMENT
Single Layer Elastomer or Fluoroplastic Flexible Element	6”(150mm) 9”(230mm) 12”(305mm) 16”(405mm)	2”(50mm) 3”(75mm) 4”(100mm) 5”(125mm)	1/2”(13mm) 1/2”(13mm) 1”(25mm) 1”(25mm)	+/- 1" (25mm) +/- 11/2" (38mm) +/- 2" (50mm) +/- 2 1/2" (63mm)
Composite Type Flexible Element	6”(150mm) 9”(230mm) 12”(305mm) 16”(405mm)	1”(25mm) 2”(50mm) 3”(75mm) 4”(100mm)	1/2”(13mm) 1/2”(13mm) 1”(25mm) 1”(25mm)	+/- 1/2" (13mm) +/- 1" (25mm) +/- 1 1/2" (38mm) +/- 2" (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. These movements are shown solely as an example and do not reflect concurrent movements. Contact expansion joint manufacturers for specific movement capabilities.

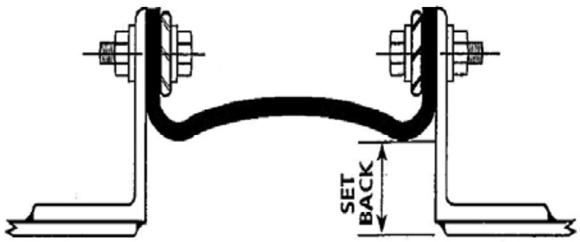
NOTE: 1. Manufacturers recommend that active length not exceed 16" (405mm)
2. Breach Opening Tolerances: Axial: 1/4" (6mm) extension, 1/2" (13mm) compression Lateral: 1/2" (13mm)
3. Lateral movements exceeding 3" (75mm) should be pre-of fset one half the required movement. Review offset requirements with manufacturer.

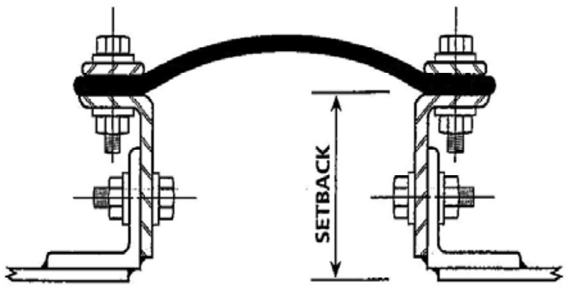
3. Setback and Flange Height

When establishing the dimensions of the duct mounting surfaces, the following must be considered:

(a) Setback (Stand-off Height)
The distance the expansion joint (flexible element) is moved outward from the gas stream to allow for lateral movements and to prevent the joint from protruding into the gas stream or rubbing on the baffle when operating under negative pressures. Proper setback also reduces the thermal transfer effect on the inner face of the expansion joint and prevents abrasion from particles in the gas stream. Consult an expansion joint manufacturer for recommended setback.

(b) Flange Height
The standard flange height for the integrally flange type is 3 inches. Variations are available to meet certain applications. To determine overall mating duct flange heights, expansion joint flange height plus the manufacturer's recommended setback must be considered. To accommodate deviations from standard dimensions, custom modifications to standard sized are available. Consult manufacturer.





SETBACK REQUIREMENT

ACTIVE LENGTH	6"(150mm)	9"(230mm)	12"(305mm)	16"(405mm)
Set Back: Flat Belt Positive Pressure	3”(75mm)	3”(75mm)	4”(100mm)	6”(150mm)
Flat Belt Negative Pressure	4”(100mm)	6”(150mm)	6”(150mm)	7”(175mm)
Integral Flange Negative Pressure	1”(25mm)	1 1/2”(38mm)	2”(50mm)	2 1/2”(63mm)
Integral Flange Negative Pressure	2”(50mm)	3”(75mm)	4”(100mm)	5”(125mm)

4. System Temperature

Insulation and Condensation within the Ducting

High temperature ducting systems are frequently insulated to conserve energy and help prevent internal condensation and corrosion of the ducting. Properly designed expansion joint elements meet these criteria. Poorly designed components will promote problems. The following examples help illustrate correct design methods for expansion joints and ducting insulation.

Insulating Layers

The thermal barrier of a multilayer 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

5. System Chemistry

(a) Gas/Air Composition
Generally the fuel being utilized will determine the pH of the exhaust gas. Fossil fuels like coal and oil will generate corrosive low pH environments. The paper industry, however, generates a caustic high pH gas from recovery boilers. Refuse to Energy systems operate with undefined media. Selection of the gas membrane should be with full consideration of the fuel being used and media generated.

(b) Corrosion
Concern should be directed in two areas, the fabric expansion joint element/insulation and the metal components. Any glass reinforce element or insulation system must be designed for protection from aqueous media. Wetted metal components are also suspect to corrosion and, therefore, appropriate materials should be selected to optimize performance.

(c) The Process
Processes such as wet scrubbers generate a saturated media and the need for a gas membrane that is specifically designed for wet conditions. It is important to understand whether the process contributes to a wet or dry environment.

(d) Dew Point
Whether dew point occurs continuously or cyclicly the expansion joint system will get wet. Understanding dew point temperatures will facilitate selection of the proper expansion joint materials.

6. System Pressure

In the same way as temperature, pressure will affect the structure (type of fabric and number of layers) as well as type and geometry of the expansion joint assembly. The following types of pressures,

1. Positive Pressure
2. Negative Pressure
3. Variations in Pressure (pulsation)
4. Pressure surges
5. Design/Test Pressure

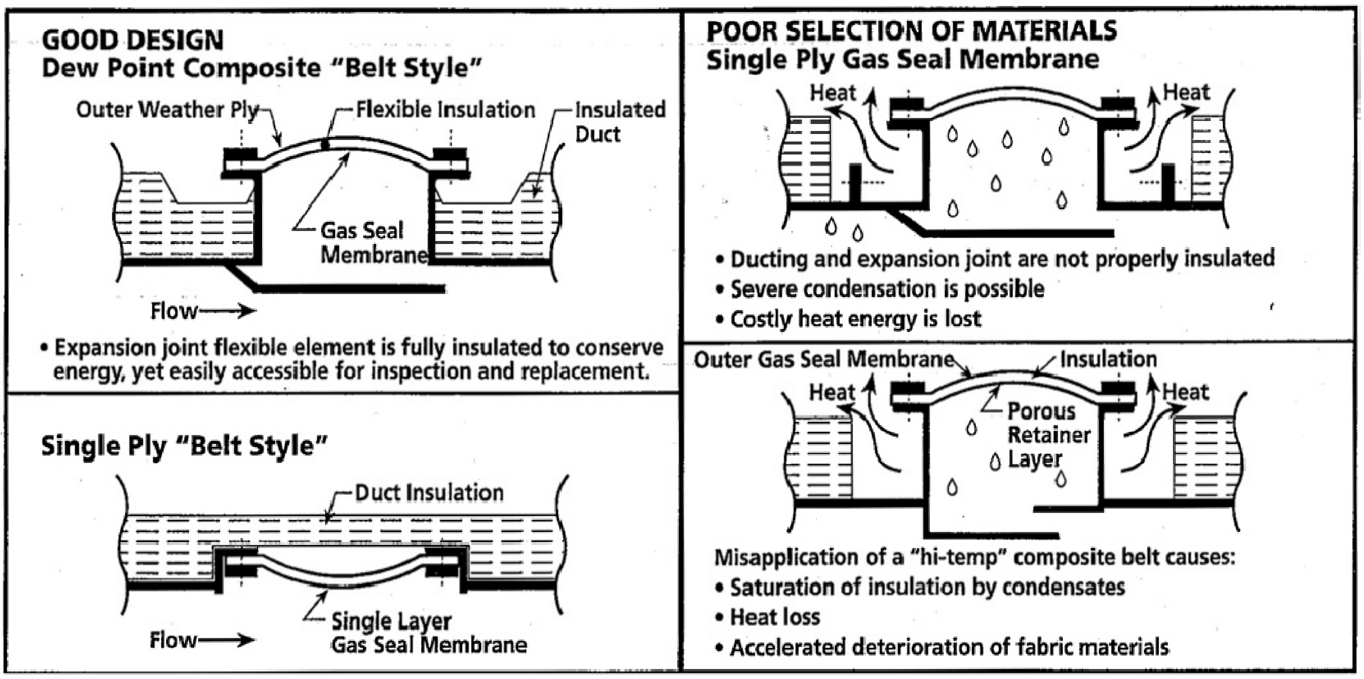
must all be taken into account when designing a suitable expansion joint. Elastomeric flue duct type expansion joints can be designed to a maximum pressure of 5 PSI@400°ΔF, with Flouroplastic types to 3 PSI@500°ΔF. As temperatures rise, maximum allowable operating pressures drop. Consult manufacturers for details.

7. Expansion Joint Leakage

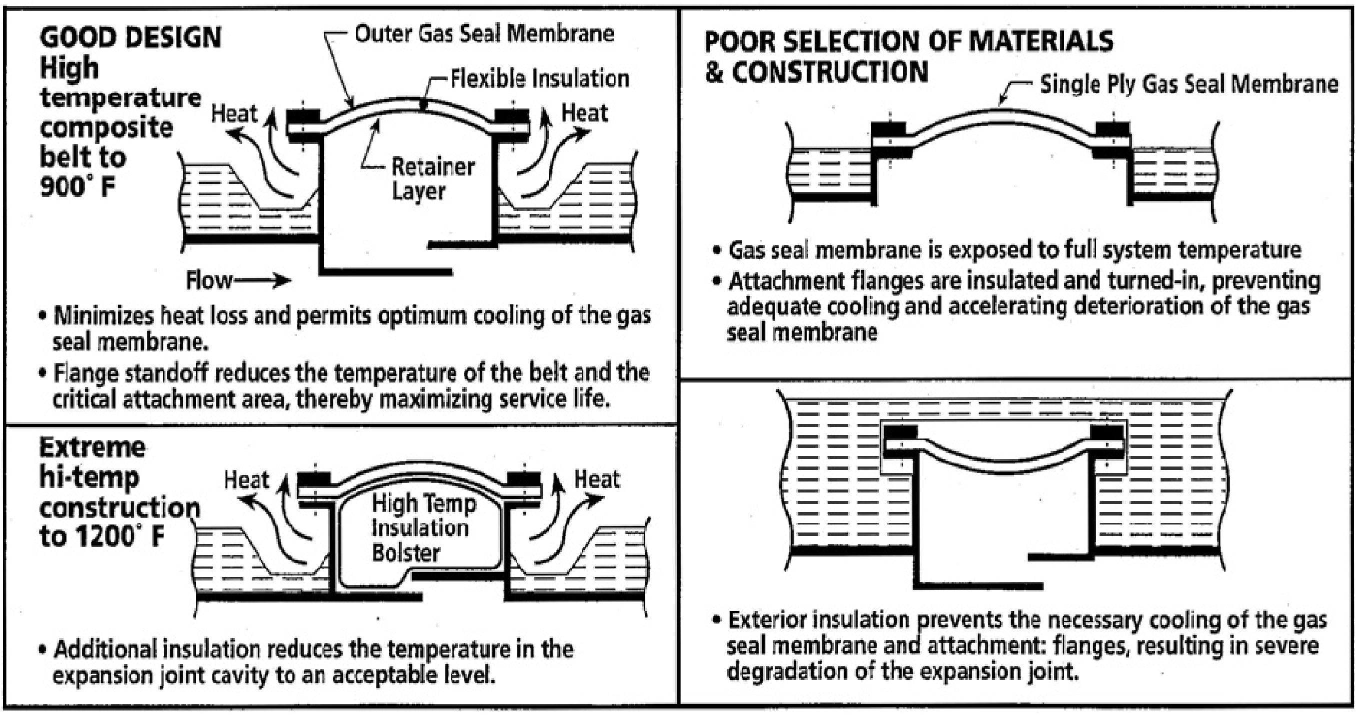
Fabric expansion joints are designed to be as leak tight as practical. When an unusual amount of liquid is present within the ducting, or leakage requirements are specified, special caulking or gasket materials can be used when attaching the fabric element to attain the desired results. In many industrial applications, minor leakage detectable by soap bubble solution, is considered acceptable.
When replacing a fabric element, leakage through bolt holes is minimized if holes are aligned and punched in the field as opposed to prepunching the holes at the factory. Back-up bar bolts should be tightened to the manufacturer's specified torque to ensure optimum clamping pressure. Contact manufacturers for details.

High temperature composite expansion joints should not be considered leak tight or zero leakage.

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.



WHEN THE MAXIMUM CONTINUOUS SYSTEM OPERATING TEMPERATURE EXCEEDS THE ALLOWABLE SERVICE TEMPERATURE OF THE GAS SEAL MEMBRANE MATERIAL



8. External Environment

Correct operation of high temperature expansion joints requires that a portion of the system heat be dissipated to the external environment. Abnormally hot ambient conditions or an adjacent heat source, reflective surface, or duct insulation may create temperatures which exceed the limits of the gas seal membrane and should be considered when designing the system.

An external cover may be desirable to help protect against falling objects or the accumulation of combustible materials such as coal or saw dust. Covers should be designed by the expansion joint manufacturer to ensure that proper air circulation requirements are satisfied.

9. Methods of Decreasing Fly Ash and Abrasive Particulate

Fly ash or other solid particulates can accumulate in the expansion joint cavity in such quantities that they can cause damage to the expansion joint if they solidify to a cementatious state. Also, certain noncementatious particles (fly ash) can create a severe, corrosive (acidic) environment when subjected to cooling (below H_2SO_4 dew point) during a maintenance outage.

Direct impingement of abrasive gas stream onto fabric expansion joints furnished without liners can cause deterioration of the expansion joint. To protect against erosion, liners or baffles should be specified.

Designs or accessories can be included that will aid in decreasing the accumulation of particulate. Such designs could include placing insulating materials in the cavity between the expansion joint and baffle, or by installing the elastomeric expansion joint flush with the ductwork I.D.

In some systems during abnormal operating conditions there is incomplete combustion, allowing the accumulation of unburned fuel in the baffle cavities which can cause fires resulting in damage to the expansion joint. These conditions should be guarded against by maintaining normal combustion