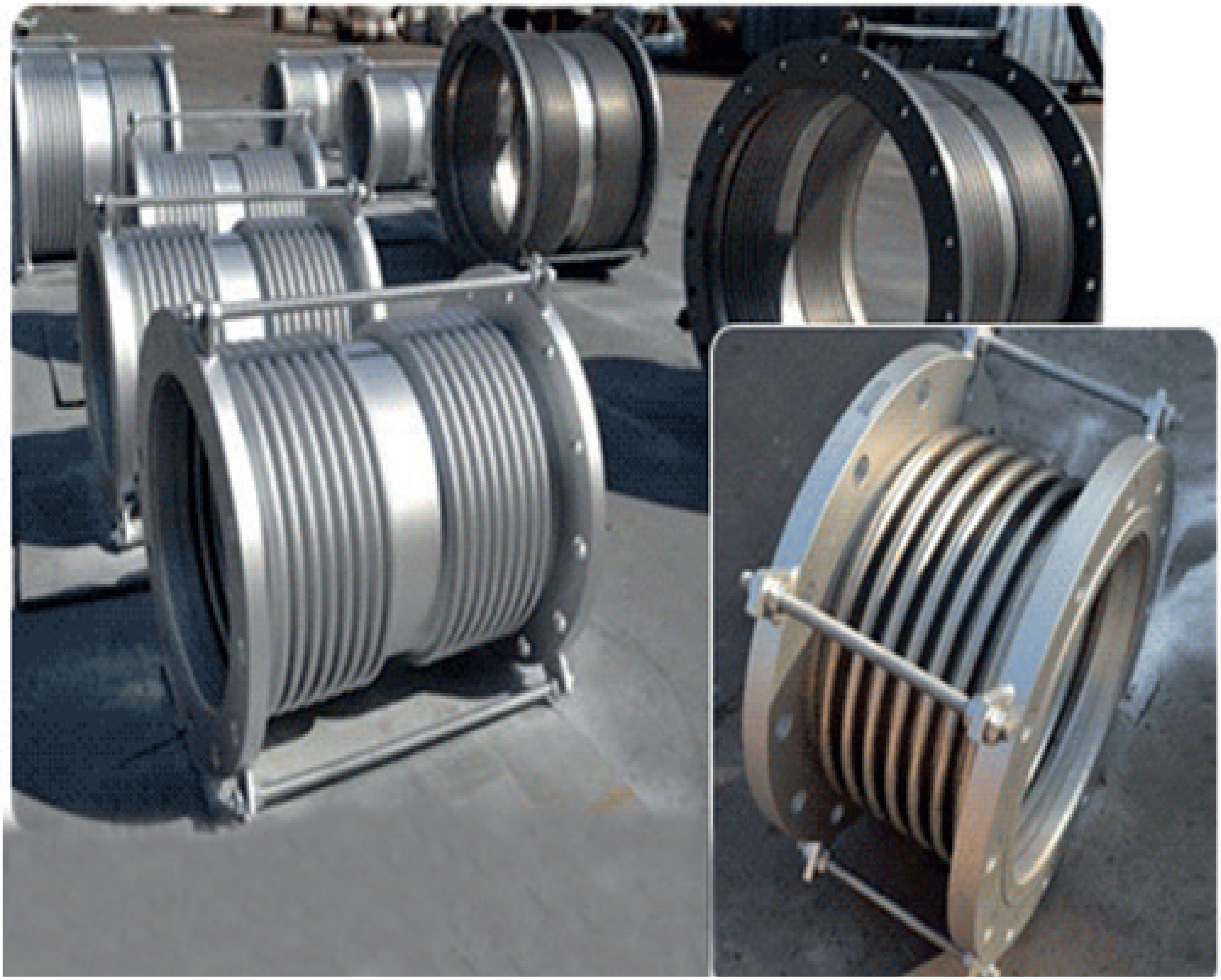
METALLIC EXPANSION JOINT

BOSON ENGINEERING PVT LTD.



CONTACT US:

Corporate Office: 22 Richard Court, Stanley Road London W3 8FT, London, UK

India Office: BC – 121, Sector – I, Saltlake, Kolktata – 700 064

Mobile: +91 98302 26444. Phone: 0044 (0)20 7193 7286

E-mail: sales@bosonengineers.co.in, Website: www.bosonengineers.co.in

ABOUT METALLIC EXPANSION JOINT

Metallic Expansion joints are flexible pipe/Duct Line elements suitable for the absorptions of movements (Expansions, vibrations. Rotations etc.) which arising in pipe/Duet systems due to pressure/ Tempreture/Guide or Anchor arrangements.

According to application or system requirement Metallic expansion joints can be of.

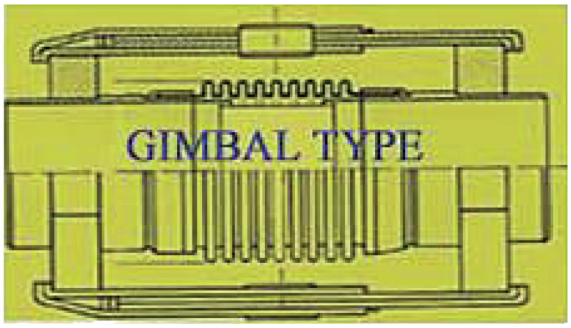
1) Single walled
2) Two or Multiwalled
3) Single Sleeved
4) Weld Neck End Connector
5) Flanged End Connector
6) With Control Units
7) Without Control Units

Such Expansion Joints are divided into the categories following according to their movement style.

1) Axial Expansion Joints
2) Lateral Expansion Joints
3) Angular Expansion Joints
4) Universal Expansion Joints

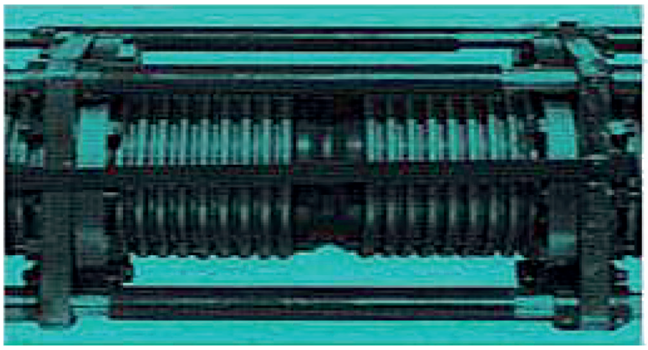
Axial Expansion Joints: This type of expansion joints can be single/Multi walled with or without inner protective sleeve and either weld neck or flanged end connector type for used to compensate axial movements. However, specially designed Bosoflex Axial joints are available which can compensate the lateral and angular movement. Axial Expansion joints can used in single or dual arrangements for higher values of movements duel Fitment is recommended.

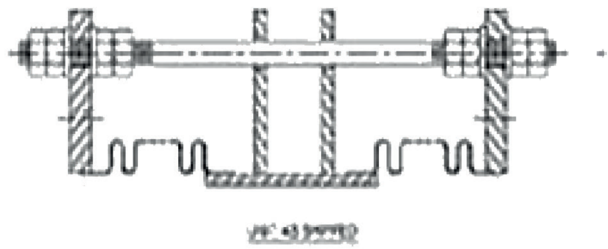
Angular Expansion Joints: This type of expansion joints can be single/Multi walled with or without inner protective sleeve and either weld neck or flanged end connector type, this type of Expansion joints are designed to accommodates angular rotation in any plane. Bosoflex Specailly Designed angular Expansion Joints are fitted with gimbal ring. Hinges and pin for restrain the trust due to the internal and external pressure. Generally to get the optimum fuctional property angular expansion joints should be installed in sets of two or more.



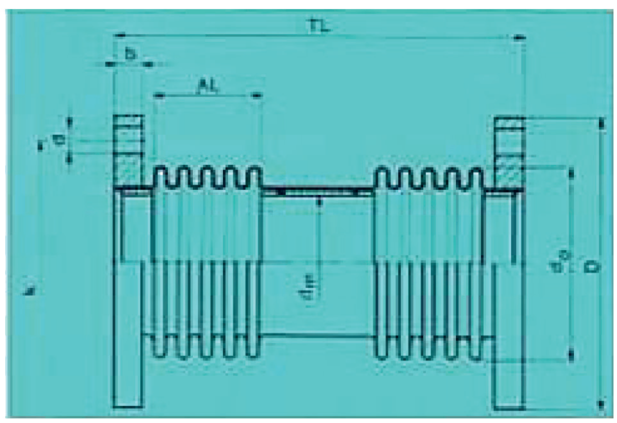
Lateral Expansion Joints: This type of Expansion joints can be of single walled. Two or multi walled with or without inner protective sleeve and Either weld neck or flanged end connector type for used to compensate lateral movements (Axial Misalignments), generally they are Fitted with the ties to take-up the thrust ot the expansion joints due to internal/External reaction force.

Lateral Expansion joints can be either single or dual fitment as required for system designing specify designed Bosoflex Lateral Expansion joints can move in all directions, prefferably dual fit expansion joints is more effective in systems.





Universal Expansion Joints: This type of expansion joints can be single/Multi walled with or without inner protective sleeve and either weld neck or flanged end connector type, this type of Expansion joints is pare of two bellows connected by a common spool piece to absorb any combination of movements (Axial Movements, Lateral Deflection and angular rotation) Boso flex specially design universal expansion joints generally fitted with control rods to distribute the movements between two bellows and stabilizing the common connector.



Elbow Pressure Balanced Unit: Bosoflex elbow pressure balanced expansion joints are designed to adopt axial and lateral deflection together while continuously restraining pressure force. Outer (un-operating) and opposite force to the working (in line) bellows.

The typical arrangement (as shown) is to have a balance side and a working side separated by an elbowed mid-section. Tie-roads are used to Equalising and restrain pressure forces.

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METHOD OF SELECTION THE METALLIC EXPANSION JOINTS

Nominal pressure: In accordance with DIN 2401 standard, the nominal pressure PN stated corresponds equally, under normal working conditions, to the highest applicable working pressure (Pw), at the reference temperature of 20° C. At higher working temperatures, the allowable working pressure for the expansion joints shall result from the reduction (Ap) of the capacity parameters at working temperature compared with the same parameters at 20° C. Therefore in the laying out and the selection of the expansion joint needed, additional stresses and loads—e.g. pressure strokes—should be taken into account and not go beyond the established working pressure (P_{all}). The nominal pressure will be determined as follows:

$$NP = \frac{p_W}{A_P}.$$ [to round up on full PN] Ap factor as per tabelle II

Pipe expansion: The selection of the expansion joint depends on the exact ascertainment of the pipe expansion (Δ_R), that is to be calculated, basing on the pipe guiding arrangement, the pipe lenght (L) as well as on the difference of temperature (Td).

$$\Delta_R = \frac{L \cdot Td \cdot \alpha}{1000} = \alpha\,[\mu m / m°C].$$ = temperature coefficient as per table III

Absorption of axial movement: The indicated numerical value of the movement absorption (Δ_{ax}.) is equivalent to that of the maximum allowable movement absorption ($\Delta ax._{all}$.) for 1000 cycles at the reference temperature of 20° C. At higher temperatures the factor (Af) reduces the allowable movement absorption, in accordance with the material parameters:

$$\Delta ax._{req.} = \frac{\Delta_R}{Af}.$$ Af factor as per table II

Cycle life: The above mentioned data are valid for a cycle life of 1000 cycles. In case of a bigger cycle life being required, the movement absorption (Δax) can be determined by means of the cycle coefficient (A_L).

$$\Delta ax._{req.} = \frac{\Delta ax.}{A_L}.$$ A_L factor as per table I

Data for sample calculation:

Steam piping	Ø Nominal Dis 150 mm in steel
Working pressure	Pw = 11.8 bar
Working temp.	Tw = +190°C
Minimum temp.	Tm = −10°C
Difference of temp.	Td = 200°C
Installation temp.	Ti = +20°C
Piping length	L = 24 metres
Piping weight	G = 37 daN/m
Cyber life	Cl = 2000 clydes

$$PN = \frac{11.8}{0.8}. = 14.75$$ PN 16 is selected

$$\Delta_R = \frac{24 \cdot 200 \cdot 12.1}{1000} = 58.1 mm.$$

$$\Delta ax._{req.} = \frac{58.1}{0.9} = 64.5 mm$$

$$\Delta ax._{req.} = \frac{64.5}{0.84} = 76.8 mm$$

expansion joint Dia 150 PN 16 is selected with
Δax_{all}. = ±43 = 86 mm
overall length = 429 mm

Table I
Cycle life factor

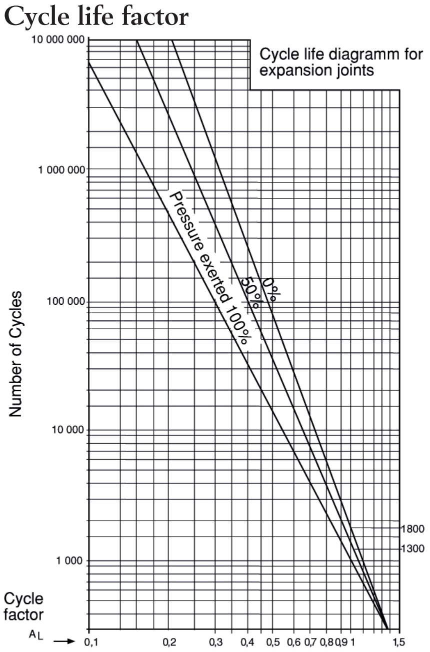

Table II
Reduction factors according to tamperature

°C	Compensating factor for working pressure Ap			Compensating factor for movement absorption Af		
	ASt 35	Chrome-Nickel Steel 1.4541		ASt 35	Chrome-Nickel Steel 1.4541	
	1.0346	1.4571	1.4828	1.0346	1.4571	1.4828
20	1	1		1	1	
100	0,9	0,9		1	1	
150	0,85	0,85		0,95	0,95	
200	0,8	0,8		0,9	0,9	
250	0,75	0,75		0,84	0,87	
300	0,6	0,67		0,8	0,85	
350	0,52	0,64		0,74	0,83	
400	0,42	0,61		0,7	0,8	
450		0,59			0,77	
500		0,57			0,75	
550		0,55			0,72	
600		0,5	0,33		0,7	
700			0,15			0,68
800			0,07			0,67
900			0,03			0,65
1000			0,015			0,6

Table III
Tamperature coefficient

$$\alpha = \mu m / m°C$$

for temperatures of °C.	heat resisting steel for pipes	Austenite 1.4541 1.4571 1.4828	Ni-alloys, Incoloy, Monel	Tombac, Bronze
–190 bis 0	–	12,3	11	–
0 bis 100	11,1	16,3	14,1	17,9
101 bis 200	12,1	17	15,2	18,75
201 bis 300	12,9	1,78	15,7	18,6
301 bis 400	13,5	18,5	15,9	19,9
401 bis 500	13,9	19	16	19,94
501 bis 600	14,1	19,25	16,5	20,3
601 bis 700	–	19,5	17	20,7
701 bis 800	–	20	17,45	21

α = data with sufficient precision for pipeline expansions

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Pipe anchor loads:

The forces (F) that load on pipe anchors, at the extremities of a pipeline length to be compensated, are resulting from:

Thrust load F_A Deflection force F_C Pipe friction F_R

The pressure thrust load (F_A) of the expansion joint, that loads on the pipe anchor both sides, is the product of thrust area (Ae) multiplied by working pressure (Pw):

$$F_A = Pw \cdot A_B [daN] \quad A_B = \frac{(di^2 + da^2)\pi}{8} \quad = 11.8 \cdot 292 = 3445.6\,daN.$$

The deflection force (F_C) is the force required to obtain movement in an expansion joint and is mentioned in the specification sheets as the axial elasticity constant for ± 1 mm movement absorption. This deflection force is calculated as follows:

$$F_C = C_a \cdot 0{,}5[\Delta_R] \quad = 15 \cdot 29 = 435\,daN.$$

Pipe friction forces depend on the pipe friction coefficient (say 0.35) on pipe supporting its design as well as on the pipeline weight (G) and they are calculated as follows:

$$F_R = \mu \cdot G \cdot L \quad = 0.35 \cdot 27 \cdot 23.5 = 304\,daN.$$

Load on main anchor

$$F_H = F_A + F_C + F_R \quad = 3445.6 + 435 + 304 = 4184.6\,daN.$$

Load on immediate anchor

$$F_Z = F_C + F_R \quad = 435 + 304 = 739\,daN.$$

Presetting and installation length

Presetting resp. the right installation length of an axial expansion joint that depends on the installation temperature (Ti)—(pipe wall temperature)—is determined as follows:

Td = Tw – Tm = 190°C –(–10°) = 200°C difference of temperature
Tdl = Ti – Tm = 20°C –(–10°) = 30°C difference of temperature between installation and minimum temperatur

$$\text{Presetting } P = \Delta_R\left(0.5 - \frac{Tdl}{Td}\right) = 58\left(0.5 - \frac{30}{200}\right) = 20.3.$$

Installation length L_E = overall length ± presetting = 429 + 20.3 = 449.3 mm

Distances between pipe alignment guides:

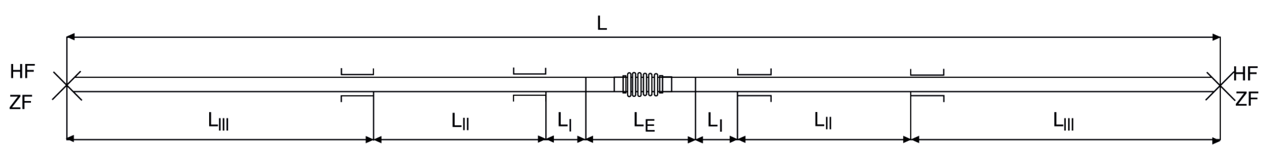
Distance $L_I = 0.5\Delta ax. + DN$
$L_{II} = 0.6 \cdot \text{pipe span}$
$L_{III} = \text{pipe span}$

Example: steam piping (with insulation) DN 150; G37 daN/m_1

$L_{III} = 8900\,mm; L_{II} = 5360\,mm; L_I = 180\,mm$

Expansion joint fitted at the pipe anchor

Expansion joint fitted in the middle of a pipelino



BOSOFLEX METALLIC BELLOW DESIGN DATA												
SIZE INCH	2	2.5	3	4	5	6	8	10	12	14	16	18
EFF. AREA SQ. INCH	6.3	9.6	12	20	30	43	72	110	150	180	234	290

METALLIC EXPANSION JOINTS

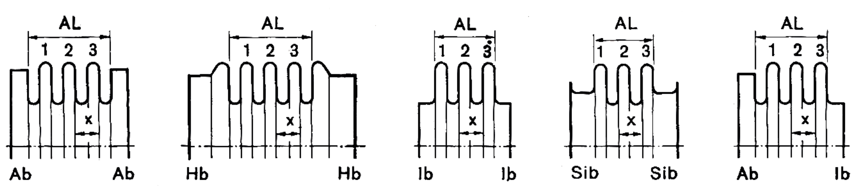
Boson use the following materials for the manufatcturing the expnasion joint's flexible element. Inner protective sleeve. Reinfor cemen, weld neck and connective flanges/controlaccessories.

INNER SLEEVE/ REINFORCEMENT	BELLOW	CONNECTOR
AISI - 310	AISI - 304	IS-2062, Gr-A
AISI - 316	AISI - 309	C.S.C - 45
AISI - 309	AISI - 310	ASTM - 534
AISI - 321	AISI - 316 TI	AISI - 304
INCOLOY	AISI - 321	AISI - 316TI
INCONEL	INCOLOY	AISI - 312
	INCONEL	AISI - 321

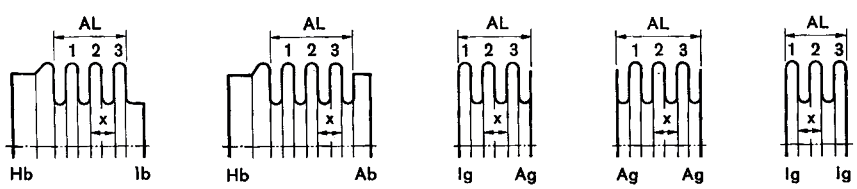
Active Length and Number of Corrugations

The active length (AL) is datermined by multiplying the number of corrugations times the corrugation pitch (X). It is further dependent on the details of the bellows ends. AL is defined as the distance between the first and the last corrugation side walls.

Example: Type M with 3 Corrugations.



AL = 3,5x AL = 3,5x AL = 2,5x AL = 2,5x AL = 3x



AL = 3x AL = 3,5x AL = 3x AL = 3,5x AL = 2,5x

METALLIC EXPANSION JOINTS

Bosoflex Special Application Joints

BOSOFLEX–EX-101 group of Expansion Joints are very much flexible, absorbing the lateral and axial both with min torsional displacement. Due to its inherent Designed properties.

- BOSOFLEX–EX-101 group of Expansion Joints are suitable for:
  a) Engine exhaust line
  b) Equipment installation mounting for ship building
  c) Boiler Air Services
  d) Low pressure oil/water line
  e) Boiler hot/normal air service
  f) Protection of Rotating Equipments
- BOSOFLEX–EX-101 group Expansion Joints are available with the following end connections:
  a) Weld neck design
  b) Threaded nipple design
  c) Fixed flange design
  d) Rotating/Floating flange design
- BOSOFLEX–EX-101 group Expension Joints are manufactured from thin stainless steel sheet formed into bellows. With swallow depth of corrugation. So, very low spring rate and traverse force resulting the very low pressure require to obtain the Maximum effect of the flexible parts low cost involvement for anchoring.

  Boson is manufacturing the EX-101 group of Expansion Joint with the following Materials:

  a) Bellow materials:
     Alsi-304
     Also-306
     Also-32

- Bosoflex metallic Expansion Joints contaning
  a) Expansions Joints.
  b) End connector
  c) Control units
- Bosoflex manufacturing variety of expansion joints for separate design/specifications and purposes.