Elongation – compensating members

Thermal expansions in installation systems generate stresses in pipes and appliance connectors. It is for this reason that compensation bends or expansion compensating members need to be fitted to long stretches of pipe.

Expansion compensating members are stretches of pipe with U or Z-shaped expansion bends which are able to absorb movement on account of their length and fastening method.

U- or Z-expansion compensating members

If the installation conditions facilitate the use of U- or Z-expansion compensating members, proceed as follows to calculate the associated expansion bend lengths:

1. Determine the maximum possible temperature difference ΔT
2. Identify the length of the pipe l_0

These values are used to calculate the total length which the section of pipe extends by the diagrams on the following pages illustrate the necessary pipe bend length L_{BZ} or L_{BU} for each pipe.

Example (see following pages)

1. The operating temperature is between 10 and 60 °C – therefore:
$$\Delta T = 50 \, K.$$
2. The section of pipe is: $l_0 = 20 \, m.$
3. The length expansion coefficient for stainless steel pipe is:
$$\alpha = 0.0165 \, [mm/mK].$$
4. Insert the values into the formula:
$$\Delta l = \alpha \, [mm/mK] \cdot L[m] \cdot \Delta T \, [K]$$

Result

The length expansion: $\Delta l = 0.0165 \, [mm/mK] \cdot 20 \, [m] \cdot 50 \, [K] = 16.5 \, mm$

5. Select a U- or Z-bend depending on the space available.
6. Take the necessary expansion bend length L_{BZ} from the U or Z diagram.
   In this example for Z-expansion bend:
   Go along the vertical axis at 16.5 mm horizontal to the line indicating the pipe size used and read the necessary expansion bend length from the horizontal axis below.

At the selected pipe nominal width $\varnothing 28 \, mm$, the expansion bend length $L_{BZ} = 1.3 \, m.$

Elongation of various materials

	Heat expansion-co-efficient α [mm/mK]	Elongation with pipe length = 20 m and ΔT = 50 K [mm]
Stainless steel 1.4401	0.0165	16.5
Stainless steel 1.4521	0.0108	10.8
Galvanised steel	0.0120	12.0
Copper	0.0166	16.6
Plastic	0.08 – 0.18	80.0 – 180.0

Tab. D — 6

Elongation

of various materials

Elongation of stainless steel pipes
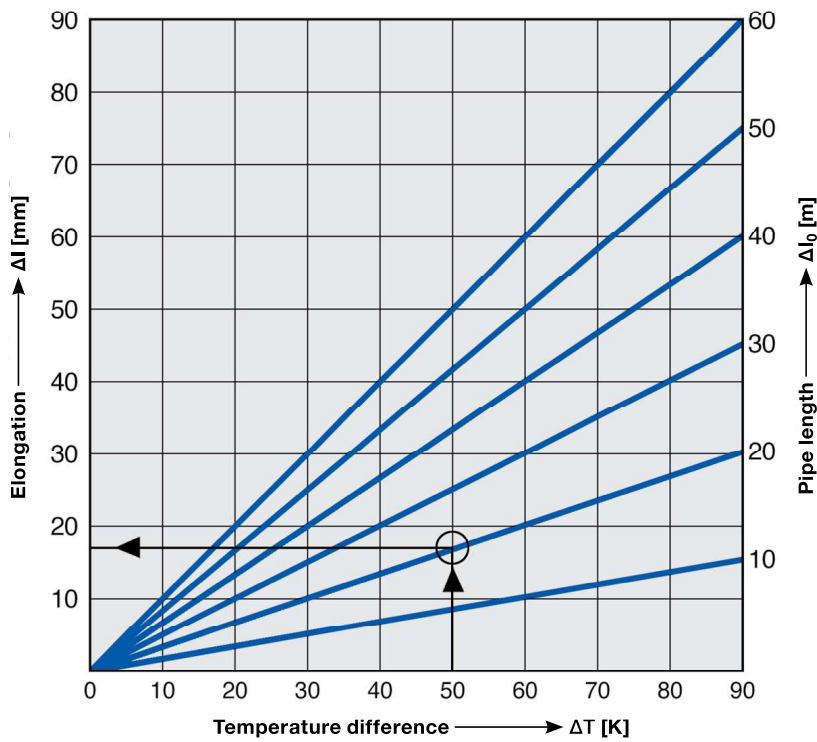
Fig. D — 31

Calculating length of expansion bends for pipes Ø < 54 mm

Expansion bend

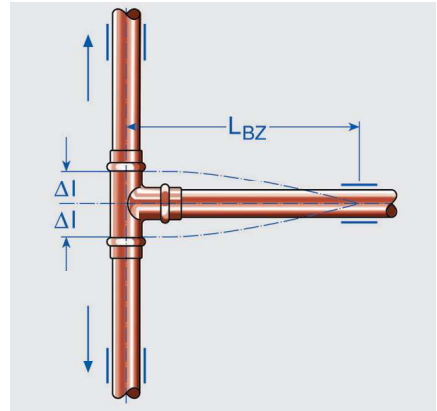Z-form with expansion bend L_{BZ} and as tee connection
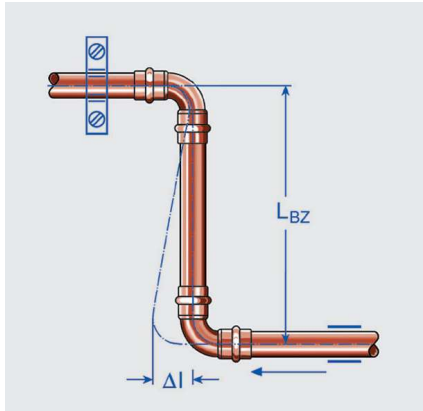
Fig. D — 32

Fig. D — 33
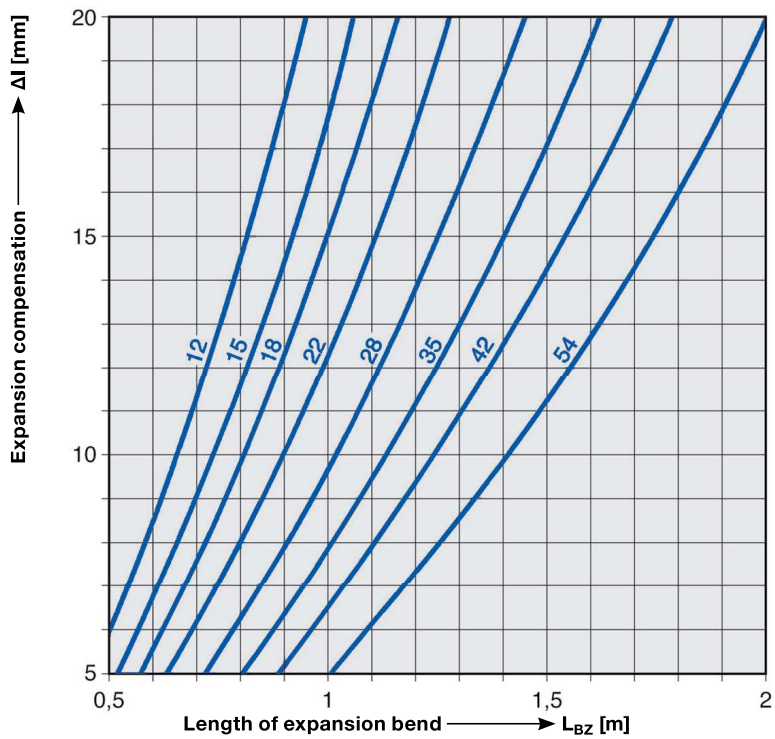
Length calculation

of expansion bends in Z- and T-form

Fig. D — 34
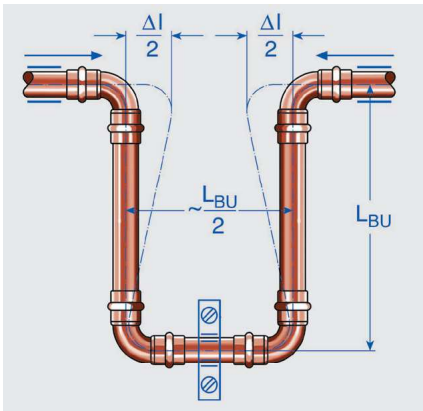
Fig. D — 35

Fig. D — 36

Calculating length of expansion bends of pipes Ø > 54 mm

Expansion bend

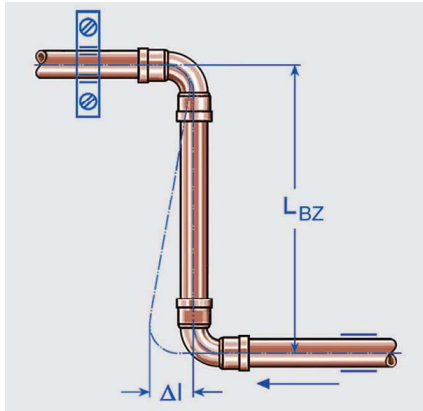In Z-form with expansion bend L_{BZ} and as tee connector

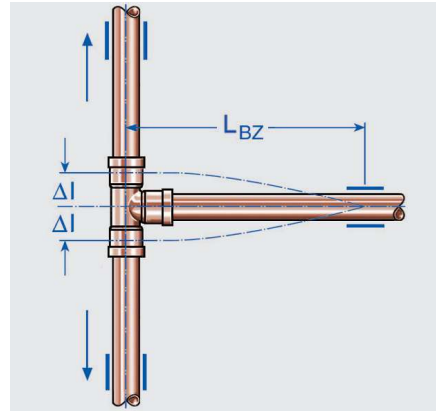*Fig. D — 37*
Z expansion compensating bend with XL-connector

Fig. D — 38
Expansion compensation length of pipe bend

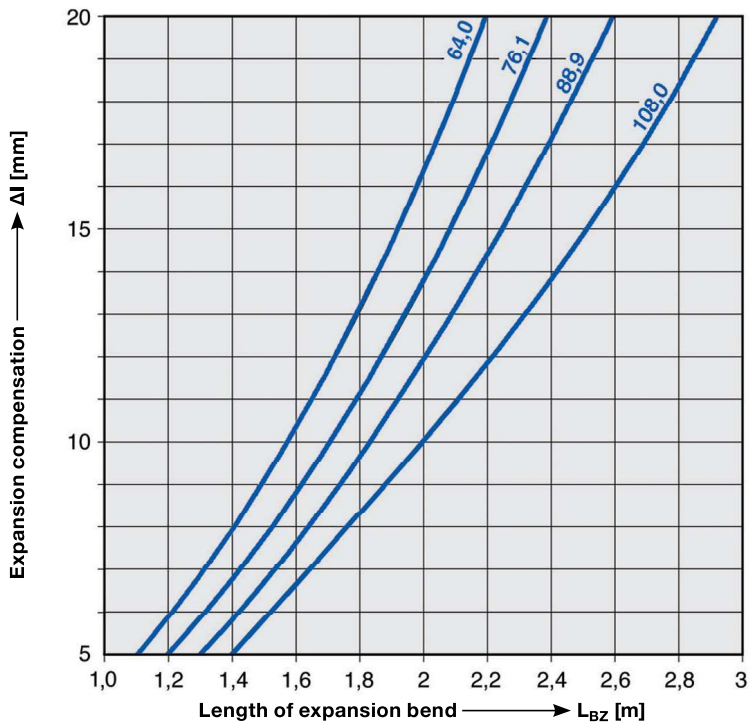**Length calculation**

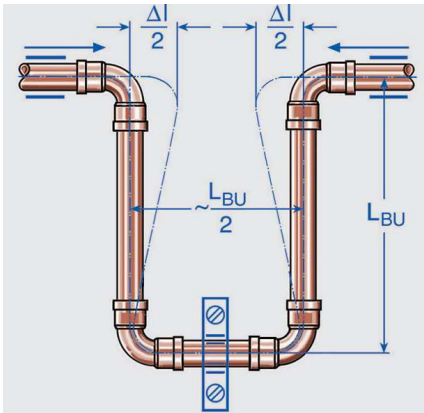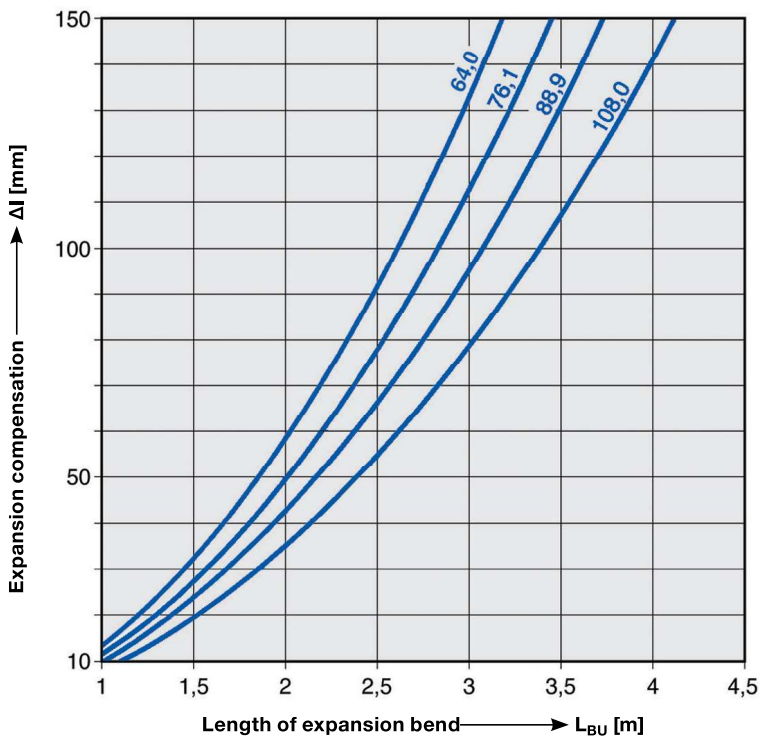For expansion bend in Z- and T-form

Fig. D — 39

Fig. D — 40

Fig. D — 41

Length calculation

For U-form
expansion bend

Axial compensator

The alternatives to expansion joints are compensators. They are suitable for absorbing axial movements in the pipe installations with operating temperatures between 20 and 110 °C.

Fig. D — 42

- A space-saving alternative to expansion compensating members
- No pre-stressing required
- Noise-reducing
- Durable and resistant to corrosion
- Suitable for mixed installations

Assembly information

The pipes must be attached in such a way that unpermitted radial and torsional stresses are avoided. Fastening points must be assessed in such a way that they can absorb considerable forces arising through temperature-related changes in length. It is important to ensure the correct alignment of fixing points and sliding pipe routings.

- Install pipes in straight lines
- Remove any radial and torsional stress
- Only one compensator may be fitted between two fixing points
- Do not use compensators for changes in direction
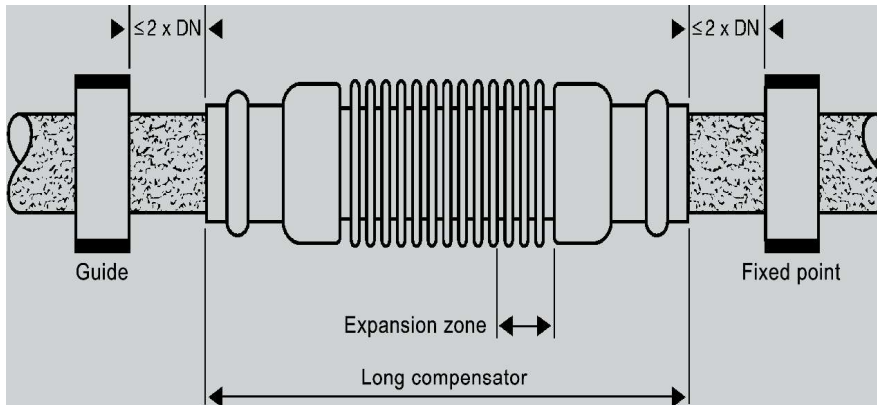- Protect stainless steel bodies from mechanical damage

Technical data

Fig. D — 43

Z-dimension compensator

Compensator d_i/DN	Pressure [bar]	Effective body cross section A [cm²]	Maximum fixing point load F_{max} [N]	Expansion compensation[1] [mm]
15/12	10	3.10	620	-7
18/15	10	3.97	794	-9
22/20	10	6.15	1230	-11,5
28/25	10	9.02	1814	-14
35/32	10	13.85	2770	-13
42/40	10	20.42	4048	-15,5
54/50	10	30.90	6180	-16

Tab. D — 7

[1] Positioning: 10,000 full movement cycles at the nominal pressure, installation temperature

Fixed Points / Gliding Points Function

Fixed points connect the pipes firmly with the supporting structure and guide the expansion movement in the desired direction.

A pipe which is not interrupted by a change in direction or one which does not contain an expansion joint only has to contain one fixed point. In the case of long pipes, the recommendation is to position these fixed points in the centre of the segment so that the expansion is steered in two directions.

Fig. D — 44

Fig. D — 45

Fixed point fastening

Gliding point fastening

Gliding points facilitate axial movements