

Thermal Length Change in Pipes

The pipe length changes due to thermal variations within systems. The extent of the change depends on the type of material of which the pipe is made. Slight changes in length can be absorbed by 'elasticity' in the pipe network. Larger changes in length demand action of some sort.

Installing length compensators, for instance, and/or by integrating a mixture of sliding and fixed clips, or expansion bolts/bends in the pipework.

The length that needs to be compensated for can be calculated by working out the length differences in the pipework prior to installation.

Expansion of pipes

The equation for calculating the change in the length of pipes is as follows:

$$\Delta L = L \times \alpha \times \Delta T$$

ΔL = total change in the length of the pipe [mm]

L = original pipe length [m]

α = linear expansion coefficient

ΔT = difference in temperature [°C]

Expansion coefficient α of	Expansion [mm/m °C]
steel	0.0120
stainless steel	0.0166
copper	0.0168
aluminium	0.0232
PE	0.1800
PVC	0.2000

Example 1:

Pipe material: steel

Pipe length: 30 metres

T-max. = +80 °C

T-min. = +15 °C

System temperature: +15 °C.

$$\Delta T = +80 \text{ °C} - +15 \text{ °C} = 65 \text{ °C}$$

$$\Delta L = 30 \times 0.0120 \times 60 = 23.4 \text{ mm}$$

Caution: If the system temperature exceeds T-min. (for instance with chilled water pipes), the pipe will shrink somewhat.

Example 2:

Pipe material: copper

Pipe length: 10 metres

T-max. = +30 °C

T-min. = -30 °C

System temperature: +15 °C.

$$\Delta T \text{ hot} = +30 \text{ °C} - +15 \text{ °C} = 15 \text{ °C}$$

$$\Delta T \text{ cold} = +15 \text{ °C} - -30 \text{ °C} = 45 \text{ °C}$$

$$\Delta T \text{ total} = \Delta T \text{ hot} + \Delta T \text{ cold} = 10 \text{ °C} + 50 \text{ °C} = 60 \text{ °C}$$

$$\Delta L = 10 \times 0.0186 \times 60 = 10.08 \text{ mm}$$

Expansion at a temperature difference of 30 °C.

Length of pipe [m]	Expansion of steel [mm]	Expansion of stainless steel [mm]	Expansion of copper [mm]	Expansion of aluminium [mm]	Expansion of PE [mm]	Expansion of PVC [mm]
10	4	5	5	7	54	60
25	9	12	13	17	135	150
50	18	25	25	35	270	300
75	26	37	38	52	405	450
100	35	50	50	70	540	600
150	53	75	76	104	810	900
200	70	100	101	139	1080	1200
300	105	149	151	209	1620	1800

Expansion at a temperature difference of 50 °C.

Length of pipe [m]	Expansion of steel [mm]	Expansion of stainless steel [mm]	Expansion of copper [mm]	Expansion of aluminium [mm]	Expansion of PE [mm]	Expansion of PVC [mm]
10	6	8	8	12	90	100
25	15	21	21	29	225	250
50	29	42	42	58	450	500
75	44	62	63	87	675	750
100	59	83	84	116	900	1000
150	88	125	126	174	1350	1500
200	117	166	168	232	1800	2000
300	176	249	252	348	2700	3000

Expansion at a temperature difference of 75 °C.

Length of pipe [m]	Expansion of steel [mm]	Expansion of stainless steel [mm]	Expansion of copper [mm]	Expansion of aluminium [mm]	Expansion of PE [mm]	Expansion of PVC [mm]
10	9	12	13	17	135	150
25	22	31	32	44	338	375
50	44	62	63	87	675	750
75	66	93	95	131	1013	1125
100	88	125	126	174	1350	1500
150	132	187	189	261	2025	2250
200	176	249	252	348	2700	3000
300	263	374	378	522	4050	4500