Tech Note 27:
Expansion & Contraction

TN.27

Related Documents:
- Tech Note TN.02 Oils, Fuels & Viscous Liquid with Press-Fit
- Tech Note TN.04 Insulation & Stainless Steel (Lagging)
- Tech Note TN.20 Brackets & Supports

Allowing for Movement

As with all construction materials, pipework is no exception to the effects of thermal expansion and contraction. In addition to understanding and allowing for live load movement, temperature changes must also be considered in the design stage.

Temperature change can occur from conveying heated fluids, environmental such as direct sunlight, climatic daily min and max temperatures and other factors such as thermal bridging.

Note structural movement (building) is different and shall be referred to a qualified Structural or Hydraulic Engineer for assessment in these instances.

Material Thermal Coefficients

Each material has a different value attributed to how it behaves with temperature change. Referring to the list adjacent, materials with a small value (such as stainless grade 316L) will change in length *less* than a material with a higher value (such as HDPE) in the same conditions. Confirm product specific coefficients with the manufacturer.

Common Plumbing Materials	**Thermal Coefficient** (mm/K.m)
Carbon Steel	0.0117
Stainless Steel (316L)	0.0165
Copper	0.0168
Copper Nickel (90/10)	0.0170
PEX	0.0180
Aluminium	0.0231
uPVC	0.0504
ABS	0.0630
KG2000 (PP-MD)	0.0800
HDPE	0.1200
Polyethylene (PE)	0.1500
Values based on range 20 to 100°C.	

Calculate the Thermal Movement

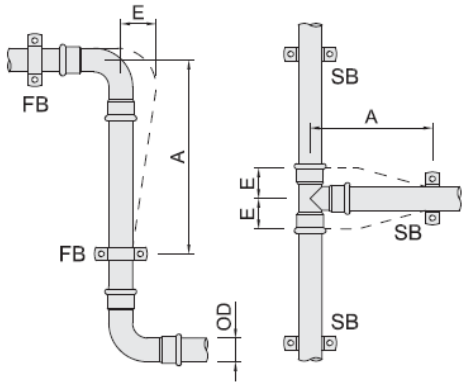
Using the formula below, you'll need to have known:
- The straight pipe length, in metres, from the nearest fixed point.
- The difference in temperature to be assessed. For example, installed may be 21°C, when commissioned the hot water may be set at 85°C so the difference is 85 – 21 = **64°C**.
- The material coefficient – refer to the table adjacent or contact the supplier.

	Tube (Run) Length (m)		**Difference in Temp** (°C)		**Thermal Coefficient** (mm/K.m)		**Result** (mm)
Formula:	Length of tube from nearest fixed point in metres.	x	Media temp minus the ambient temp.	x	Constant value (from the table above).	=	Expansion over the entire length.
Example:	20	x	**64**	x	0.0165	=	21.12

Example: *A 20 metre straight, 85°C hot water line, in grade 316L stainless press-fit is being installed and the expansion amount from installation temperature (21°C) to commissioning at full temperature is required.*
Answer: *The pipe line will expand ~21.12mm over the entire 20 metre length, or around 1mm per metre.*

Managing Thermal Movement

Various methods can be used to manage this movement including fixed brackets to direct the movement away from the fixed point, sliding brackets that allow longitudinal movement in a fixed direction, our drainage systems employ movement compensation in each rubber ring seal join, and fitting arrangements can compensate movement in the form or Z, T, U expansion loops or axial expansion bellows.

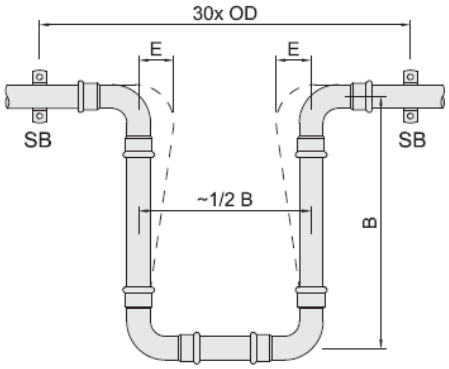


Allow for Movement

The expansion distance 'E' must be allowed for, particularly in long pipe runs, where expansion compensator arrangements can be used.

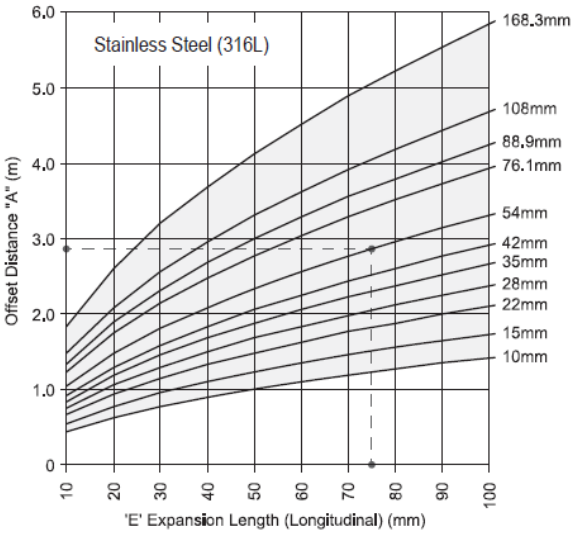
FB = Fixed Bracket (no pipe movement).

SB = Sliding Bracket (supported pipe movement).

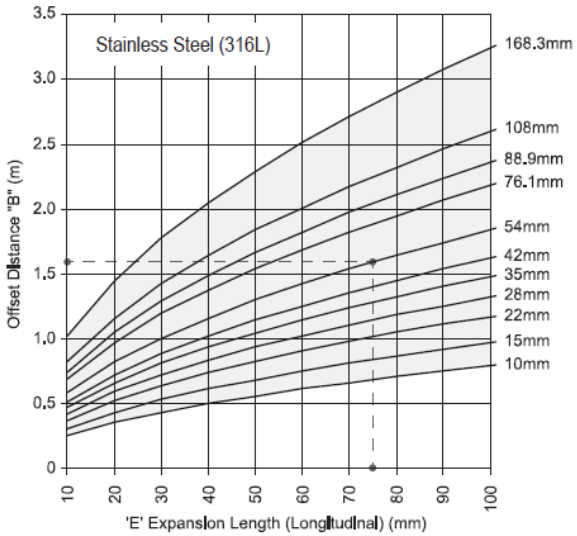


Above: 'Z & T' Shape Arrangements. Can also be achieved with cold bending the tube (up to 35mm). Use the chart below to calculate measurement 'A' based on the diameter.

Above: 'U' Shape Arrangement. Can also be achieved with cold bending the tube (up to 35mm). Use the chart below to calculate measurement 'B' based on the diameter.



Above: 'Z' & 'T' Shaped Arrangements - based on A = 0.045 x $\sqrt{(\text{Tube OD x E})}$.
In the equation, for CuNiFe use the constant 0.054; for Copper use 0.061.



Above: 'U' Shaped Arrangements - based on B = 0.025 x $\sqrt{(\text{Tube OD x E})}$.
In the equation, for CuNiFe use the constant 0.031; for Copper use 0.032.

Design Considerations

- Insulation – Applying insulation to pipework before the final temperature is reached may result in gaps as the pipework expands greater than the insulation.
- Drainage Sockets – Our stainless and KG2000 drainage pipe and fittings make allowance for expansion with each socket accepting ±10mm as part of the system.

Further Information

For additional or specific information, please contact technical@auspress.com.au