

LINEAR EXPANSION



All pipes, metal or plastic, used for the transportation of hot water, are effected by linear expansion.

Teel BQ Americas PP-RCT composite pipe linear expansion is very similar to metal pipes, whereas Teel BQ's mono PP-RCT pipe has a linear expansion co-efficient similar to most plastic pipes.

The use of a composite pipe is recommended when transporting hot water with Teel BQ PP-RCT pipes. The following charts and equations should aid in calculating the co-efficient for linear expansion when using Teel BQ PP-RCT pipes.

Formula for calculating linear expansion:

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

Where:

ΔL = linear expansion (inches)

α = co-efficient constant for Teel BQ pipes 1.00×10^{-3} for mono pipe (in/ft°F) 2.33×10^{-4} for composite pipe (in/ft°F)

L = length of pipe (ft)

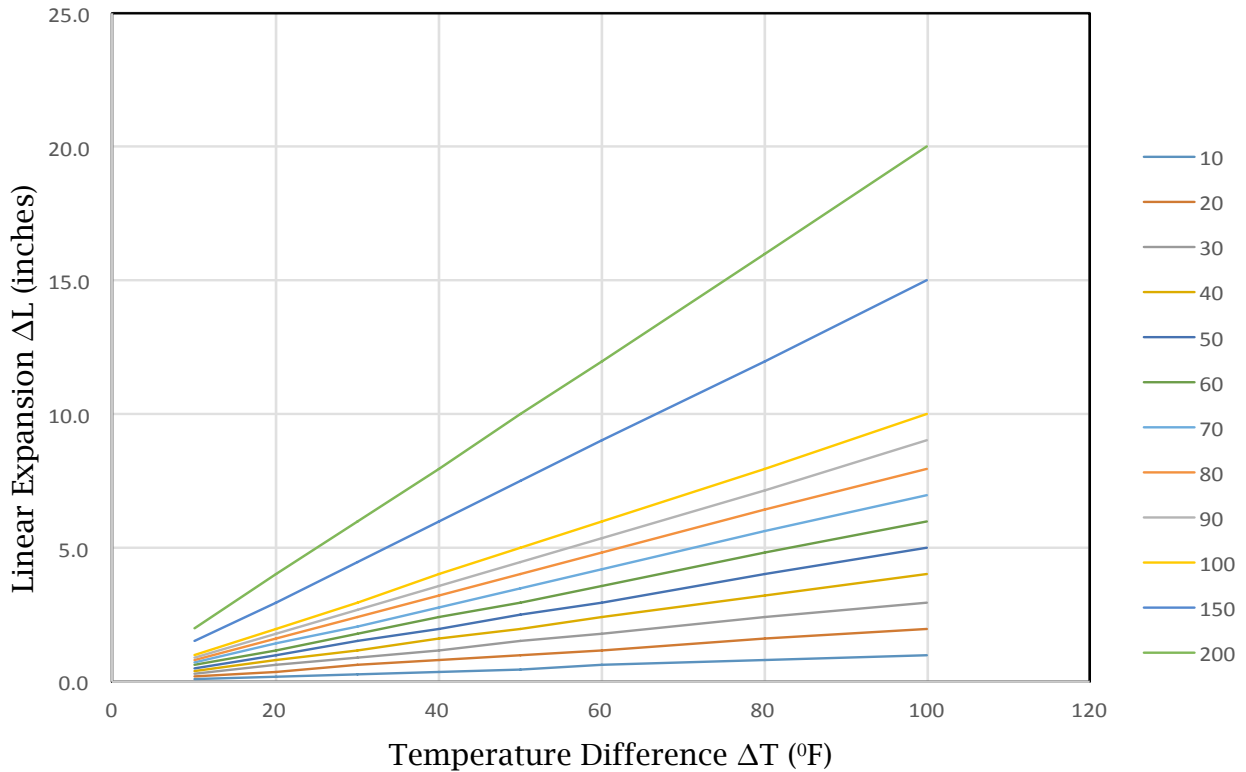
ΔT = Temperature difference (°F) between working temperature and ambient room temperature

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PP-RCT Mono Pipe

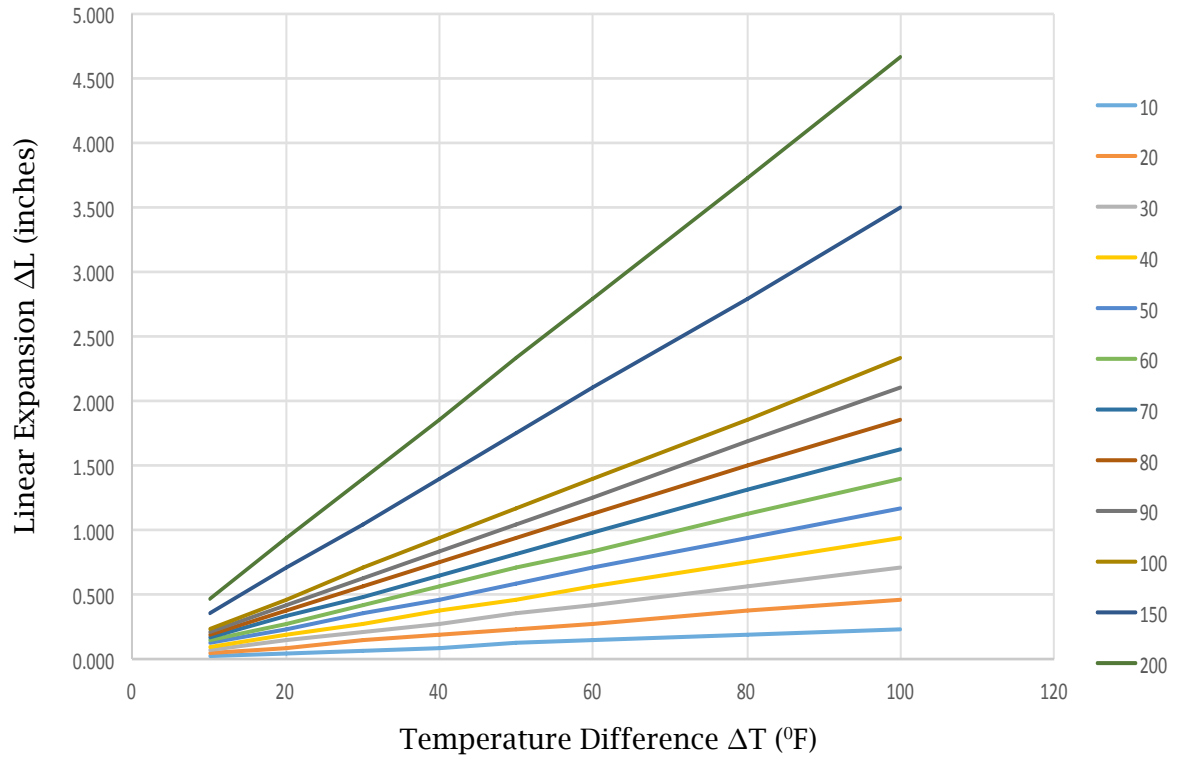
Expansion of Mono Pipes



| Difference in temperature ΔT | 10 $^{\circ}$ F | 20 $^{\circ}$ F | 30 $^{\circ}$ F | 40 $^{\circ}$ F | 50 $^{\circ}$ F | 60 $^{\circ}$ F | 70 $^{\circ}$ F | 80 $^{\circ}$ F | 100 $^{\circ}$ F |
|--------------------------------------|--------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| Pipe Length | Linear Expansion ΔL (inches) | | | | | | | | |
| 10 ft. | 0.1" | 0.2" | 0.3" | 0.4" | 0.5" | 0.6" | 0.7" | 0.8" | 1.0" |
| 20 ft. | 0.2" | 0.4" | 0.6" | 0.8" | 1.0" | 1.2" | 1.4" | 1.6" | 2.0" |
| 30 ft. | 0.3" | 0.6" | 0.9" | 1.2" | 1.5" | 1.8" | 2.1" | 2.4" | 3.0" |
| 40 ft. | 0.4" | 0.8" | 1.2" | 1.6" | 2.0" | 2.4" | 2.8" | 3.2" | 4.0" |
| 50 ft. | 0.5" | 1.0" | 1.5" | 2.0" | 2.5" | 3.0" | 3.5" | 4.0" | 5.0" |
| 60 ft. | 0.6" | 1.2" | 1.8" | 2.4" | 3.0" | 3.6" | 4.2" | 4.8" | 6.0" |
| 70 ft. | 0.7" | 1.4" | 2.1" | 2.8" | 3.5" | 4.2" | 4.9" | 5.6" | 7.0" |
| 80 ft. | 0.8" | 1.6" | 2.4" | 3.2" | 4.0" | 4.8" | 5.6" | 6.4" | 8.0" |
| 90 ft. | 0.9" | 1.8" | 2.7" | 3.6" | 4.5" | 5.4" | 6.3" | 7.2" | 9.0" |
| 100 ft. | 1.0" | 2.0" | 3.0" | 4.0" | 5.0" | 6.0" | 7.0" | 8.0" | 10.0" |
| 125 ft. | 1.3" | 2.5" | 3.8" | 5.0" | 6.3" | 7.5" | 8.8" | 10.0" | 12.5" |
| 150 ft. | 1.5" | 3.0" | 4.5" | 6.0" | 7.5" | 9.0" | 10.5" | 12.0" | 15.0" |
| 175 ft. | 1.8" | 3.5" | 5.3" | 7.0" | 8.8" | 10.5" | 12.3" | 14.0" | 17.5" |
| 200 ft. | 2.0" | 4.0" | 6.0" | 8.0" | 10.0" | 12.0" | 14.0" | 16.0" | 20.0" |

PP-RCT Composite Pipe

Expansion of Composite Pipes



| Difference in temperature ΔT | 10 $^{\circ}$ F | 20 $^{\circ}$ F | 30 $^{\circ}$ F | 40 $^{\circ}$ F | 50 $^{\circ}$ F | 60 $^{\circ}$ F | 70 $^{\circ}$ F | 80 $^{\circ}$ F | 100 $^{\circ}$ F |
|--------------------------------------|--------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| Pipe Length | Linear Expansion ΔL (inches) | | | | | | | | |
| 10 ft. | 0.0" | 0.0" | 0.1" | 0.1" | 0.1" | 0.1" | 0.2" | 0.2" | 0.2" |
| 20 ft. | 0.0" | 0.1" | 0.1" | 0.2" | 0.2" | 0.3" | 0.3" | 0.4" | 0.5" |
| 30 ft. | 0.1" | 0.1" | 0.2" | 0.3" | 0.3" | 0.4" | 0.5" | 0.6" | 0.7" |
| 40 ft. | 0.1" | 0.2" | 0.3" | 0.4" | 0.5" | 0.6" | 0.7" | 0.7" | 0.9" |
| 50 ft. | 0.1" | 0.2" | 0.3" | 0.5" | 0.6" | 0.7" | 0.8" | 0.9" | 1.2" |
| 60 ft. | 0.1" | 0.3" | 0.4" | 0.6" | 0.7" | 0.8" | 1.0" | 1.1" | 1.4" |
| 70 ft. | 0.2" | 0.3" | 0.5" | 0.7" | 0.8" | 1.0" | 1.1" | 1.3" | 1.6" |
| 80 ft. | 0.2" | 0.4" | 0.6" | 0.7" | 0.9" | 1.1" | 1.3" | 1.5" | 1.9" |
| 90 ft. | 0.2" | 0.4" | 0.6" | 0.8" | 1.0" | 1.3" | 1.5" | 1.7" | 2.1" |
| 100 ft. | 0.2" | 0.5" | 0.7" | 0.9" | 1.2" | 1.4" | 1.6" | 1.9" | 2.3" |
| 125 ft. | 0.3" | 0.6" | 0.9" | 1.2" | 1.5" | 1.7" | 2.0" | 2.3" | 2.9" |
| 150 ft. | 0.3" | 0.7" | 1.0" | 1.4" | 1.7" | 2.1" | 2.4" | 2.8" | 3.5" |
| 175 ft. | 0.4" | 0.8" | 1.2" | 1.6" | 2.0" | 2.4" | 2.9" | 3.3" | 4.1" |
| 200 ft. | 0.5" | 0.9" | 1.4" | 1.9" | 2.3" | 2.8" | 3.3" | 3.7" | 4.7" |

Absorbing Linear Expansion

Linear expansion can be absorbed through the use of 90° elbows or the construction of an expansion loop. The table below has calculated the length of the bending stack needed to absorb the calculated linear expansion.

| Pipe Dimension mm (inch) | Linear Expansion ΔL (inches) | | | | | | | | | | | |
|-----------------------------|----------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 1" | 2" | 3" | 4" | 5" | 6" | 7" | 8" | 9" | 10" | 11" | 12" |
| | Length of Bending Stack (inches) | | | | | | | | | | | |
| 20mm (1/2") | 13 | 19 | 23 | 27 | 30 | 33 | 35 | 38 | 40 | 42 | 44 | 46 |
| 25 mm (3/4") | 15 | 21 | 26 | 30 | 33 | 36 | 39 | 42 | 45 | 47 | 49 | 52 |
| 32 mm (1") | 17 | 24 | 29 | 34 | 38 | 41 | 45 | 48 | 51 | 53 | 56 | 58 |
| 40 mm (1-1/4") | 19 | 27 | 33 | 38 | 42 | 46 | 50 | 53 | 56 | 60 | 62 | 65 |
| 50 mm (1-1/2") | 21 | 30 | 36 | 42 | 47 | 52 | 56 | 60 | 63 | 67 | 70 | 73 |
| 63 mm (2") | 24 | 33 | 41 | 47 | 53 | 58 | 63 | 67 | 71 | 75 | 78 | 82 |
| 75 mm (2-1/2") | 26 | 36 | 45 | 52 | 58 | 63 | 68 | 73 | 77 | 82 | 85 | 89 |
| 90 mm (3") | 28 | 40 | 49 | 56 | 63 | 69 | 75 | 80 | 85 | 89 | 94 | 98 |
| 110 mm (3-1/2") | 31 | 44 | 54 | 62 | 70 | 76 | 83 | 88 | 94 | 99 | 104 | 108 |
| 125 mm (4") | 33 | 47 | 58 | 67 | 74 | 82 | 88 | 94 | 100 | 105 | 110 | 115 |
| 160 mm (6") | 38 | 53 | 65 | 75 | 84 | 92 | 100 | 106 | 113 | 119 | 125 | 130 |
| 200 mm (8") | 42 | 60 | 73 | 84 | 94 | 103 | 112 | 119 | 126 | 133 | 140 | 146 |
| 250 mm (10") | 47 | 67 | 82 | 94 | 105 | 115 | 125 | 133 | 141 | 149 | 156 | 163 |
| 315 mm (12") | 53 | 75 | 92 | 106 | 118 | 130 | 140 | 150 | 159 | 167 | 175 | 183 |
| 355 mm (14") | 56 | 79 | 97 | 112 | 126 | 138 | 149 | 159 | 168 | 178 | 186 | 195 |
| 400 mm (16") | 60 | 84 | 103 | 119 | 133 | 146 | 158 | 169 | 179 | 188 | 198 | 206 |
| 450 mm (18") | 63 | 89 | 109 | 126 | 141 | 155 | 167 | 179 | 190 | 200 | 210 | 219 |
| 500 mm (20") | 67 | 94 | 115 | 133 | 149 | 163 | 176 | 188 | 200 | 211 | 221 | 231 |
| 560 mm (22") | 71 | 100 | 122 | 141 | 158 | 173 | 187 | 199 | 212 | 223 | 234 | 244 |
| 630 mm (24") | 75 | 106 | 130 | 150 | 167 | 183 | 198 | 212 | 224 | 237 | 248 | 259 |

Formula for calculating the bending stack length using 90° elbow:

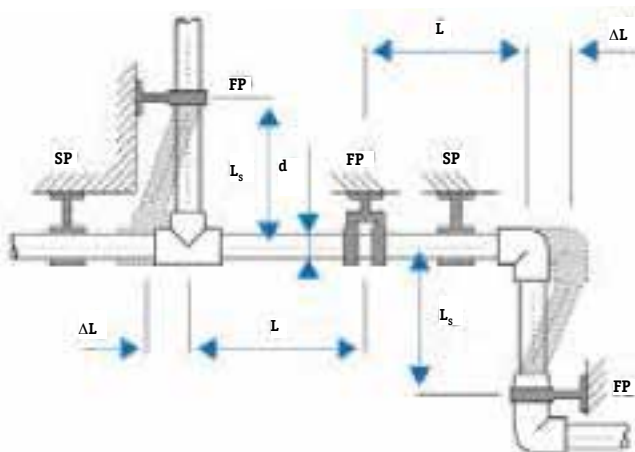
$$L_s = C \cdot \sqrt{d \cdot \Delta L}$$

L_s = length of bending stack (inches)

C = material constant 2.98

d = OD Pipe (mm)

ΔL = linear expansion (inches)



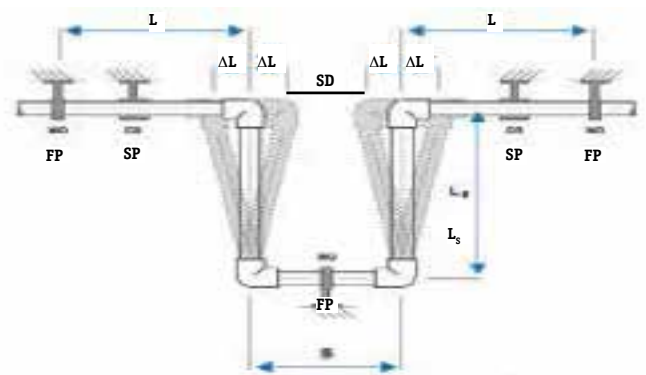
Formula for calculating the minimum distance needed for an expansion loop:

$$B_{min} = 2 \cdot \Delta L + SD$$

B_{min} = width of expansion loop (minimum 8")

ΔL = linear expansion (inches)

SD = safety distance (minimum 6")



B

FP = Fixed Point, SP = Sliding Point