

The Effects of Temperature on PVC Pipe

Polyvinyl Chloride (PVC) is a thermoplastic, and as such, its physical properties change with temperature variations. Dimensions, pressure capacity, and stiffness are all affected by temperature changes. The published dimensions and performance ratings for PVC pipe and conduit products are usually applicable only for 73°F. The following will help to explain how PVC pipe and conduit products are affected by operating temperatures other than 73°F

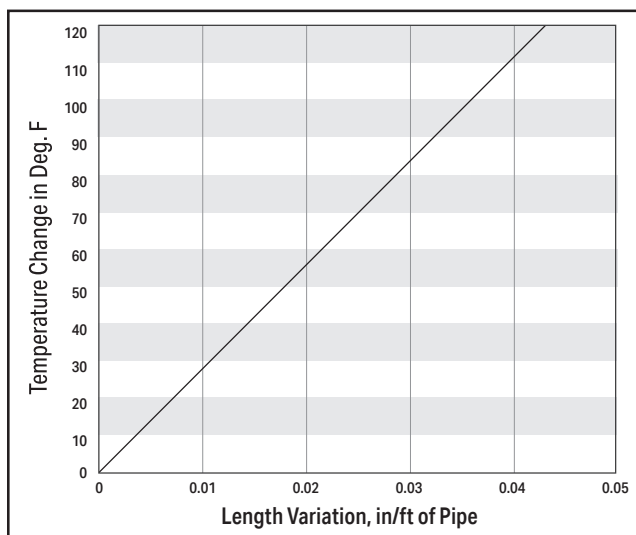
Dimensions

Like all materials, PVC expands with increasing temperatures and contracts with decreasing temperatures. The coefficient of thermal expansion for PVC is:

$$3.0 \times 10^{-5} \text{ in/in/}^{\circ}\text{F}$$

Because the length-to-diameter ratios of PVC pipe and conduit products are generally very large, length change from temperature variation is the most noticeable. A good rule of thumb in design of PVC pipe and conduit systems is to allow $\frac{3}{8}$ " length variation for every 100 feet of pipe for each 10°F change in temperature. (This rule is independent of pipe size.) Table 1 can also be used to determine the effects of temperature changes on the length of PVC pipe and conduit.

Table 1: Length Variation Due to Temperature Change



Pressure Capacity

PVC pipe exhibits increasing pressure capacity with decreasing temperature, and decreasing pressure capacity with increasing temperature. The pressure ratings given for PVC pipe are for a 73°F operating temperature. To reduce the pressure ratings of PVC pressure pipe for operating temperatures above 73°F, multiply the pressure rating or pressure class by the derating factors in Table 2. For applications below 73°F, use the published pressure ratings since they will be conservative.

The maximum recommended operating temperature for PVC pressure pipe is 140°F.

Table 2: Pressure Capacity Derating Factors for Operating Temperatures Above 73°F

At 90°F	Multiply by	0.93
At 100°F	Multiply by	0.88
At 110°F	Multiply by	0.84
At 120°F	Multiply by	0.79
At 130°F	Multiply by	0.75
At 140°F	Multiply by	0.70

Pipe Stiffness

PVC pipe and conduit becomes stiffer with decreasing temperature and more flexible with increasing temperature. As with dimensions and pressure capacity, published pipe stiffness figures are applicable only for 73°F operating temperatures.

Use Table 3 to reduce the published pipe stiffness of PVC pipe and conduit if the operating temperature exceeds 73°F.

Table 3: Pressure Capacity Derating Factors for Operating Temperatures Above 73°F

At 80°F	Multiply by	0.88
At 90°F	Multiply by	0.75
At 100°F	Multiply by	0.62
At 110°F	Multiply by	0.50
At 120°F	Multiply by	0.40
At 130°F	Multiply by	0.30
At 140°F	Multiply by	0.22

For applications below 73°F, use the published pipe stiffness since they will be conservative.

Table 3 is also applicable as a temperature correction chart for the modulus of elasticity (**E**) for PVC pipe and conduit.



Longitudinal Bending of PVC Pipe

Water/Irrigation Pressure Pipe - IPS-Sized - 20' Lengths

Trade Size (in)	O.D. (in)	R (ft)	Z (ft)
½	0.840	14.0	12.0
¾	1.050	17.5	10.2
1	1.315	21.9	8.5
1¼	1.660	27.7	6.9
1½	1.900	31.7	6.1
2	2.375	39.6	4.9
2½	2.875	47.9	4.1
3	3.500	58.3	3.4
4	4.500	75.0	2.7
5	5.563	92.7	2.1
6	6.625	110.4	1.8
8	8.625	143.8	1.4
10	10.750	179.2	1.1
12	12.750	212.5	0.9

Gravity Sewer Pipes - 20' and 14' Lengths

Trade Size (in)	O.D. (in)	R (ft)	Z (ft)
20' Lengths			
4	4.215	54.9	3.6
6	6.275	81.7	2.4
8	8.400	109.4	1.8
10	10.500	136.7	1.5
12	12.500	162.8	1.2
15	15.300	199.2	1.0
14' Lengths			
4	4.215	54.9	1.8
6	6.275	81.7	1.2
8	8.400	109.4	0.9
10	10.500	136.7	0.7
12	12.500	162.8	0.6
15	15.300	199.2	0.5

Pressure Pipe - PIP-Sized - 20' Lengths

Trade Size (in)	O.D. (in)	R (ft)	Z (ft)
6	6.140	102.3	1.9
8	8.160	136.0	1.5
10	10.200	170.0	1.2
12	12.240	204.0	1.0
15	15.300	255.0	0.8

Electrical Conduit/Ducts - 20' and 10' Lengths

Trade Size (in)	O.D. (in)	R (ft)	Z (ft)
20' Lengths			
½	0.840	10.9	13.7
¾	1.050	13.7	12.2
1	1.315	17.1	10.4
1¼	1.660	21.6	8.6
1½	1.900	24.7	7.7
2	2.375	30.9	6.2
2½	2.875	37.4	5.2
3	3.500	45.6	4.3
3½	4.000	52.1	3.8
4C	4.350	56.6	3.5
4	4.500	58.6	3.4
5	5.563	72.4	2.7
6	6.625	86.3	2.3
8	8.625	112.3	1.8
10' Lengths			
½	0.840	10.9	4.3
¾	1.050	13.7	3.5
1	1.315	17.1	2.8
1¼	1.660	21.6	2.3
1½	1.900	24.7	2.0
2	2.375	30.9	1.6
2½	2.875	37.4	1.3
3	3.500	45.6	1.1
3½	4.000	52.1	1.0
4C	4.350	56.6	0.9
4	4.500	58.6	0.9
5	5.563	72.4	0.7
6	6.625	86.3	0.6
8	8.625	112.3	0.4

