

EXPANSION / CONTRACTION

Expansion and Contraction

All conduit pipe and fittings expand and contract with changes in temperature. All materials' expansion and contraction rates are represented by coefficients of thermal expansion.

A general rule of thumb is that for every 100°F temperature change in a 100 ft. run of PVC conduit, the conduit will undergo 3.6" of expansion or contraction.

Use of Expansion Joints

In installations where the expected temperature variation exceeds 25°F expansion joints must be used. An expansion joint consists of two tubes, one telescoping inside another. When installing expansion joints alignment of the piston and barrel is important. Straps should be placed approximately one foot on either side of the joint to ensure that any movement is directed squarely into the joint.

When expansion joints are required the following steps should be followed:

1. DETERMINE NUMBER OF JOINTS REQUIRED:

Use the following formula to calculate the total expected expansion in the run.

$$\text{Total expansion} = \frac{\text{Total temp. change } ^\circ\text{F}}{10} \times \frac{\text{Length of run ft.}}{100} \times .36$$

The expansion joints should then be installed at even intervals throughout the run.

$$\text{Number of joints} = \frac{\text{Total expansion}}{4}$$

EXAMPLE:

Assume a 200 ft. run of conduit is to be installed in an unheated building where the temperature will vary from 10°F in the winter to 110°F in the summer. The installation will be carried out when the temperature is 60°F.

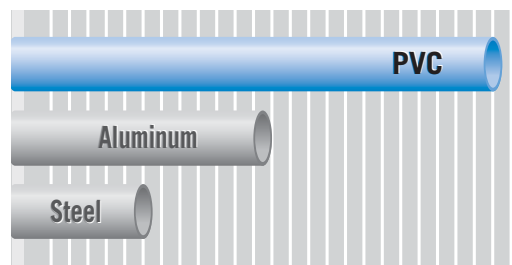
Using step 1 we determine the number of joints required.

$$\text{Total Expansion} = \frac{100 ^\circ\text{F}}{10} \times \frac{200 \text{ ft.}}{100} \times .36 = 7.2"$$

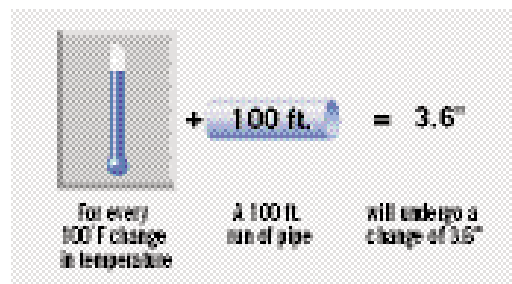
$$\text{Number of joints} = \frac{7.2}{4} = 1.8$$

Note: Always round off to the next highest number. Therefore in this example we see that two expansion joints are necessary.

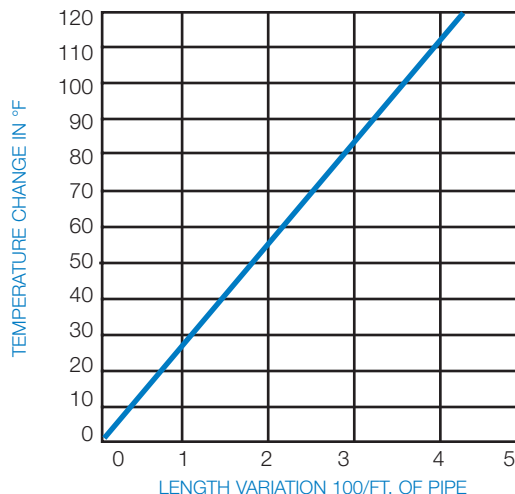
Expansion Comparison



Rule of Thumb for PVC Expansion



PVC PIPE LENGTH VARIATION DUE TO TEMPERATURE CHANGE (°F) Coefficient = 3.6×10^{-4} in./ft./°F



2. DETERMINE PISTON OPENING:

The expansion joint must be installed to allow both expansion and contraction of the conduit run. Because installation temperatures may vary, the piston setting must be determined. The correct piston opening is determined using the following formula:

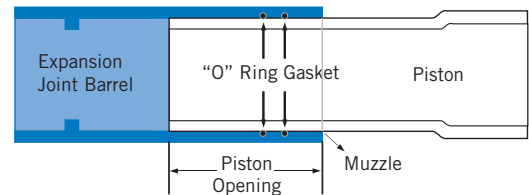
$$\text{Piston (in.)} = \frac{\text{max. temperature (°F)} - \text{installing temperature (°F)} \times 4}{\text{temperature change (°F)}}$$

EXAMPLE:

Using step 2 we determine the proper piston opening.

$$\text{Piston (in.)} = \frac{110\text{ (°F)} - 60\text{ (°F)} \times 4\text{''}}{100\text{ (°F)}} = 2\text{''}$$

Therefore this piston should be opened 2 inches when the joints are installed.



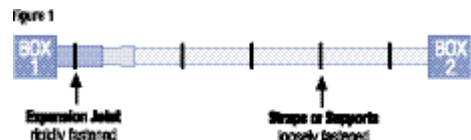
Location of Expansion Joints

Proper functioning of an expansion joint depends on three procedures:

1. The correct placement of the expansion joint.
2. The proper installation of rigid PVC conduit and the expansion joint.
3. The proper placement and fastening of support straps.

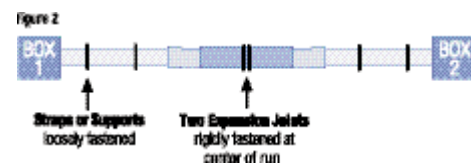
One Expansion Joint - Figure 1

If only one expansion joint is needed between two boxes, the barrel of the joint should be rigidly fastened close to the first box. Rigid PVC conduit should then be loosely supported with straps, allowing the conduit to move freely as it expands and contracts.



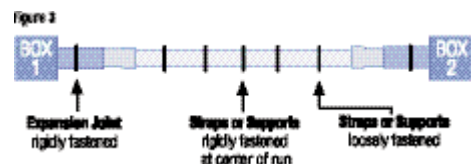
Two Expansion Joints - Figure 2

If two expansion joints are needed, the joints should be firmly fastened back to back at the center of the run. Rigid PVC conduit should be loosely supported with straps, allowing the conduit to move freely as it expands and contracts.



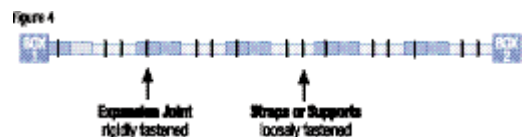
Two Expansion Joints (Alternative) - Figure 3

Alternatively, the center of the run and the two expansion joints (located at the boxes) should be rigidly fastened. All other support straps should be loosely fastened.



Three or More Expansion Joints - Figure 4

If more than two joints are needed in a very long run, they should be put in a series, one after the other. Each barrel must be rigidly fastened while conduit is loosely supported with straps allowing the conduit to move freely as it expands and contracts. When installed in a series, each section acts independently of the other. Spacing of conduit supports must be in accordance with NEC article 347-8.



EXPANSION / CONTRACTION (CONT'D)

Installation of Expansion Joints

Installation recommendations:

- Expansion joints should be mounted so the piston can travel in a straight line in the barrel. If the alignment is not straight, the piston will bind, preventing the joint from working correctly.
- The expansion joint barrel should be clamped tight, but the conduit mounted loose enough in its hangers to allow for movement as it expands and contracts.
- Kraloy nonmetallic straps are correctly sized and designed for proper support, and must be used to secure the conduit.
- When expansion joints are used in a vertical position, the piston should be mounted in a downward position so dirt cannot deposit between the barrel and piston at the muzzle of the expansion joints.



Common Mistakes

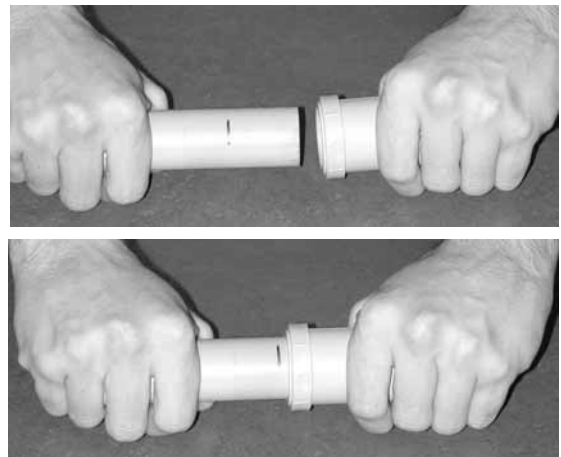
Three common mistakes are:

1. Forgetting to use expansion joints.
2. Not using enough expansion joints.
3. Overtightening of support straps.

It is more cost effective to use more expansion joints than needed, rather than too few. It is difficult to correct the problem after conductors are installed and in service. Failure to accommodate expansion/contraction may result in pipe fracture.

Installation of the One Piece Expansion Joint (OPEJ)

1. Solvent cement the PVC conduit into the conduit hub of the OPEJ and firmly secure the PVC conduit on the solvent cement side of the OPEJ using Kraloy pipe straps.
2. Set the expansion fitting by marking a line 1 1/2" from the end of the conduit to be inserted and insert the conduit into the OPEJ to this mark.
3. Secure and support the conduit raceway using Kraloy pipe straps.



APPLICABLE STANDARDS

Underwriters Laboratories

UL50 Enclosures for Electrical Equipment

UL514B Fittings for Cable & Conduit

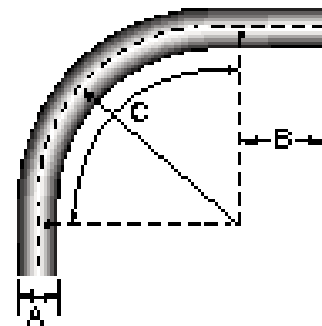
UL514C Nonmetallic Outlet Boxes, Flush-Device Boxes & Covers



CONDUIT FITTINGS

Schedule 40 Standard Radius 90° Elbows

Size (in.)	Part Number	Product Code	A (in.)	B (in.)	C (in.)
1/2	40STD0590	078540	0.840	1.500	4.000
3/4	40STD0790	078541	1.050	1.500	4.500
1	40STD1090	078542	1.315	1.875	5.750
1-1/4	40STD1290	078543	1.660	2.000	7.250
1-1/2	40STD1590	078544	1.900	2.000	8.250
2	40STD2090	078545	2.375	2.000	9.500
2-1/2	40STD2590	078546	2.875	3.000	10.500
3	40STD3090	078547	3.500	3.125	13.000
3-1/2	40STD3590	078548	4.000	3.250	15.000
4	40STD4090	078549	4.500	3.375	16.000
5	40STD5090	078550	5.563	3.625	24.000
6	40STD6090	078551	6.625	3.750	30.000



APPLICABLE
STANDARDS

CONDUIT FITTINGS

