General information

Typical properties of conduit raw material compound

Thermal	ASTM test	Typical values
Coefficient of thermal expansion-inch/ inch/°C (properties at 23 °C)	D696	3.38 x 10-5
Heat distortion °C at 264 psi	D648	71 °C
Thermal conductivity BTU (hr.) (ft.) (°C/in.)	–	1.3

Electrical	ASTM test	Typical values
Dielectrical strength volts/mil	D149	1100
Dielectric constant 60 Hz @ 30 °C	D150	4.00
Power factor 60 Hz @ 30 °C	D150	1.93

Mechanical	ASTM test	Typical values
Specific gravity	D792	1.43–1.6
Tensile strength (psi) @ 23 °C	D638	5,000–6,500
Izod impact ft. lb/in. of notch	D256	0.65–1.5
Flexural strength (psi)	D790	12,500
Compressive strength (psi)	D695	9,000
Hardness (Durometer D)	D2240	85

Impedance (volts lost per ampere per 100 feet)	Ø3 90% P.F.	80% P.F.	Ø1 90% P.F.	80% P.F.
Steel conduit	0.0118	0.0123	0.0136	0.0142
Schedule 40	0.0105	0.0106	0.0121	0.0122

Using 250 kcmil copper conductor comparable values for other conductor sizes.

Weight comparison

Carlon Schedule 40 rigid nonmetallic conduit compared to other rigid conduit in pounds per 100 feet (approx.)

Nom. size (in.)	Carlon Schedule 40 rigid nonmetallic conduit	Carlon Schedule 80 rigid nonmetallic conduit	Aluminum	Electrical metallic tubing (EMT)	Inter-mediate metal conduit (IMC)	Rigid metal conduit (RMC)
½	18	22	27	30	57	79
¾	23	29	36	46	78	105
1	35	43	43	66	112	153
1¼	48	60	70	96	114	201
1½	57	72	86	112	176	246
2	76	100	116	142	230	334
2½	125	153	183	230	393	527
3	164	212	239	270	483	690
3½	198		288	350	561	831
4	234	310	340	400	625	982
5	317	431	465	Not Made	Not Made	1344
6	412	592	612	Not Made	Not Made	1770

Wire fill

Maximum number of conductors in Schedule 40 PVC conduit (based on Table 1, Chapter 9 of the NEC)

Type letters	Conductor size AWG, kcmil	Conduit trade size (in.) ½	¾	1	1¼	1½	2	2½	3	3½	4	4¼	5	6	8
THWN	14	13	24	39	69	94	154								
	12	10	18	29	51	79	114	164							
THHN	10	6	11	18	32	44	73	194	160						
	8	3	5	9	19	22	36	51	71	106	136				
FEP (14 thru 2)	6	1	4	6	11	15	26	37	57	76	98	125	154		
	4	1	2	4	7	9	16	22	35	47	60	75	94	137	236
	3	1	1	3	6	8	13	19	29	39	51	64	90	116	201
FEPB (14 thru 4/0)	2	1	1	3	5	7	11	16	25	33	43	54	67	97	169
	1		1	1	3	5	9	12	18	25	32	49	59	72	125
	1/0		1	1	3	4	7	10	15	21	27	33	42	61	105
PFA (14 thru 8)	2/0		1	1	2	3	6	8	13	17	22	29	35	51	88
	3/0		1	1	1	3	5	7	11	14	18	23	29	42	73
	4/050		1	1	1	2	4	6	9	12	15	19	24	35	61
PFAH (14 thru 4/0)	250			1	1	1	3	4	7	10	12	16	20	28	49
	300			1	1	1	3	4	6	8	11	13	17	24	42
	350			1	1	1	2	3	5	7	9	12	15	21	37
	400				1	1	1	3	5	6	8	10	13	19	33
Z (14 thru 4/0)	500				1	1	1	2	4	5	7	9	11	16	27
	600				1	1	1	1	3	4	5	7	9	13	22
	700					1	1	1	3	4	5	6	8	11	19
	750					1	1	1	2	3	4	6	7	11	19
XHHW (4 thru 500)	6	1	3	5	9	13	21	30	47	63	81	102	128	185	320
	600				1	1	1	1	3	4	5	7	9	13	22
	700					1	1	1	3	4	5	6	7	11	19
XHHW	750					1	1	1	2	3	4	6	7	10	18

General information

Expansion and contraction

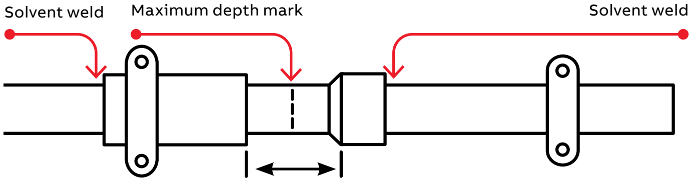
Temperature considerations for rigid nonmetallic conduit
Compensation for linear expansion
Like all construction materials, PVC will expand or contract with variations in temperatures. The coefficient of linear expansion in PVC conduit is 3.38 x 10-5 in./in./°C as compared to 1.2 x 10-5 for aluminum and 0.6-5 x 10-5 for steel. An expansion fitting is needed whenever the change in length due to temperature variation will be ¼ in. or greater.

Add 1 °C to the estimated temperature range when conduit is installed in direct sunlight to allow for radiant heating. An expansion fitting consists of two sections, one telescoping inside another. When installing expansion fittings, alignment of piston and barrel is important. Be sure to mount expansion fitting level for best performance.

For a vertical run, the expansion fitting must be installed close to the top of the run with the barrel jointing down, in order that rain water does not run into the opening. The lower end of the conduit run must be secured at the bottom so that any length change due to temperature variation will result in an upward movement.

Expansion characteristics of PVC rigid nonmetallic conduit
Coefficient of thermal expansion = 3.38 x 10-5 in./in./°C

Temp. change in ° F	Length change in inches per 100 ft. of PVC conduit	Temp. change in ° C	Length change in inches per 100 ft. of PVC conduit	Temp. change in ° C	Length change in inches per 100 ft. of PVC conduit	Temp. change in ° C	Length change in inches per 100 ft. of PVC conduit
5	0.2	12.8	2.2	40.5	4.2	68.3	6.3
10	0.4	15.6	2.4	43.3	4.5	71.1	6.5
15	0.6	18.3	2.6	46.0	4.7	73.9	6.7
20	0.8	21.1	2.8	48.9	4.9	76.7	6.9
25	1.0	23.9	3.0	51.6	5.1	79.4	7.1
30	1.2	26.7	3.2	54.4	5.3	82.2	7.3
35	1.4	29.4	3.4	57.2	5.5	85.0	7.5
40	1.6	32.2	3.6	60.0	5.7	87.8	7.7
45	1.8	35.0	3.8	62.7	5.9	90.6	7.9
50	2.0	37.8	4.1	65.5	6.1	93.3	8.1



Determine the piston opening
The expansion joint must be installed to allow both expansion and contraction of the conduit run. The correct piston opening for any installation condition should use the following formula:

$$O = \left[\frac{T\ max - T\ installed}{\Delta T} \right] E$$

Where:

O	=	Piston opening (in.)
T max	=	Maximum anticipated temperature of conduit (°C)
T inst.	=	Temperature of conduit at time of installation (°C)
ΔT	=	Total change in temperature of conduit (°C)
E	=	Expansion allowance built into each expansion fitting (in.)

Example
380 ft. of conduit is to be installed on the outside of a building exposed to the sun in a single straight run. It is expected that the conduit will vary in temperature from -17 °C in the winter to 60 °C in the summer (this includes the -1 °C for radiant heating from the sun). The installation is to be made at a conduit temperature of 32 °C. From the table, a 60 °C temperature change will cause a 5.7 in. length change in 100 ft. of conduit. The total change for this example is 5.7 in. x 3.8 = 21.67 in. which should be rounded to 22 in. The number of expansion fittings will be 22 in. x fitting range (4 in. for Carlon trade sizes ½ in. through 1½ in. and 8 in. for sizes 2 in. through 6 in.). If the E945D fitting is used, the number will be 22 in. x 4 = 5.50 which should be rounded to 6. The fitting should be placed at 62 ft. intervals (380 x 6). The proper piston setting at the time of installation is calculated as explained above.

$$O = \left[\frac{60\ °C - 32\ °C}{60\ °C} \right] 4.0 = 1.4\ in.$$

Insert the piston into the barrel to the maximum depth. Place a mark on the piston at the end of the barrel. To properly set the piston, pull the piston out of the barrel to correspond to the 2.1 in. calculated above. See drawing at lower left.

Summary
1. Anticipate expansion and contraction of PVC conduit in above ground, exposed installation.
2. Use an expansion fitting when length change due to temperature variation will be ¼ in. or greater.
3. PVC conduit expands 4.1 in. for each 100 feet of run and a 37.8 °C temperature change.
4. Align expansion fitting with the conduit run to prevent binding.
5. Follow the instructions to set the piston opening.
6. Rigidly fix the outer barrel of the expansion fitting so it cannot move. Mount the conduit connected to the piston loosely enough to allow the conduit to move as the temperature changes.

General information

Corrosion resistance of carlon schedule 40 PVC conduit and fittings

Carlon Schedule 40 is generally acceptable for use in environments containing the chemicals below. These environmental resistance ratings are based upon tests where the specimens were placed in complete submergence in the reagent listed. Schedule 40 can be used in many process areas where chemicals not on this list are manufactured or used because worker safety requirements dictate that any air presence or splashing be at a very low level.

If there are any questions for specific suitability in a given environment, prototype samples should be tested under actual conditions.

- Acetic acid 0–20%
- Acetic acid 20–30%
- Acetic acid 30–60%
- Acetic acid 80%
- Acetic acid – glacial
- Acetic acid vapors
- Acetylene
- Adipic acid
- Alum
- Aluminum chloride
- Aluminum fluoride
- Aluminum hydroxide
- Aluminum oxychloride
- Aluminum nitrate
- Aluminum sulfate
- Ammonia-dry gas
- Ammonium bifluoride
- Ammonium carbonate
- Ammonium chloride
- Ammonium hydroxide 28%
- Ammonium metaphosphate
- Ammonium nitrate
- Ammonium persulfate
- Ammonium phosphate – neutral
- Ammonium sulfate
- Ammonium sulfide
- Ammonium thiocyanate
- Amyl alcohol
- Anthraquinone
- Anthraquinonesulfonic acid
- Antimony trichloride
- Aqua regia
- Arsenic acid 80%
- Arylsulfonic acid
- Barium carbonate
- Barium chloride
- Barium hydroxide
- Barium sulfate
- Barium sulfide
- Beet – sugar liquor
- Benzine sulfonic acid 10%
- Benzoic acid
- Bismuth carbonate
- Black liquor (paper industry)
- Bleach – 12.5% active CL_2
- Borax
- Boric acid
- Brine
- Bromic acid
- Bromine – water
- Butadiene
- Butane
- Butyl alcohol
- Butyl phenol
- Butylene
- Butyric acid
- Calcium bisulfite
- Calcium carbonate
- Calcium chlorate
- Calcium chloride
- Calcium hydroxide
- Calcium hypochlorite
- Calcium nitrate
- Calcium sulfate
- Carbonic acid
- Carbon dioxide gas – wet
- Carbon dioxide – aqueous solution
- Carbon monoxide
- Caustic potash
- Caustic soda
- Chloraceatic acid
- Chloral hydrate
- Chlorine gas (dry)
- Chlorine gas (moist)
- Chlorine water
- Chlorosulfonic acid
- Chrome alum
- Chromic acid 10%
- Chromic acid 30%
- Chromic acid 40%
- Chromic acid 50%
- Citric acid
- Copper chloride
- Copper cyanide
- Copper fluoride
- Copper nitrate
- Copper sulfate
- Cottonseed oil
- Cresylic acid 50%
- Crude oil – sour
- Crude oil – sweet
- Demineralized water
- Dextrin
- Dextrose
- Diglycolic acid
- Disodium phosphate
- Ethyl alcohol
- Ethylene glycol
- Fatty acids
- Ferric chloride
- Ferric nitrate
- Ferric sulfate
- Ferrous chloride
- Ferrous sulfate
- Fluorine gas – wet
- Fluorine gas – dry
- Fluoroboric acid
- Fluorosilicic acid
- Formaldehyde
- Formic acid
- Fructose
- Gallic acid
- Gas – coke oven
- Gas – natural (dry)
- Gas – natural (wet)
- Gasoline – sour
- Gasoline – refined
- Glucose
- Glycerine (glycerol)
- Glycol
- Glycolic acid
- Green liquor (paper industry)
- Heptane
- Hexanol, tertiary
- Hydrobromic acid 20%
- Hydrochloric acid 0%–25%
- Hydrochloric acid 25%–40%
- Hydrocyanic acid or hydrogen cyanide
- Hydrofluoric acid 10%
- Hydrofluorosilicic acid
- Hydrogen phosphide
- Hydrogen sulfide – dry
- Hydrogen sulfide – aqueous solution
- Hydroquinone
- Hydroxylamine sulfate
- Iodine
- Kerosene
- Lactic acid 28%
- Lauric acid
- Lauryl chloride
- Lauryl sulfate
- Lead acetate
- Lime sulfur
- Linoleic acid
- Linseed oil
- Lubricating oils
- Magnesium carbonate
- Magnesium chloride
- Magnesium hydroxide
- Magnesium nitrate
- Magnesium sulfate
- Maleic acid
- Malic acid
- Mercuric chloride
- Mercuric cyanide
- Mercurous nitrate
- Mercury
- Methyl sulfate
- Methylene chloride
- Mineral oils
- Naphthalene
- Nickel chloride
- Nickel nitrate
- Nitric acid, anydrous
- Nitric acid 20%
- Nitric acid 40%
- Nitric acid 60%
- Nitrobenzene
- Nitrous oxide
- Oils and fats
- Oils – petroleum – (see type)
- Oleic acid
- Oxalic acid
- Palmitic acid 10%
- Perchloric acid 10%
- Phenylhydrazine hydrochloride
- Phosgene, gas
- Phosphoric acid – 0–25%
- Phosphoric acid – 25–50%
- Phosphoric acid – 50–85%
- Photographic chemicals
- Plating solutions
- Potassium bicarbonate
- Potassium bichromate
- Potassium borate
- Potassium bromide
- Potassium carbonate
- Potassium chloride
- Potassium chromate
- Potassium cyanide
- Potassium dichromate
- Potassium ferricyanide
- Potassium ferrocyanide
- Potassium fluoride
- Potassium hydroxide
- Potassium nitrate
- Potassium perborate
- Potassium perchlorite
- Potassium permanganate 10%
- Potassium persulfate
- Potassium sulfate
- Propane
- Propyl alcohol
- Silicic acid
- Silver cyanide
- Silver nitrate
- Silver plating solutions
- Sodium acetate
- Sodium arsenite
- Sodium benzoate
- Sodium bicarbonate
- Sodium bisulfate
- Sodium bisulfite
- Sodium bromide
- Sodium chlorate
- Sodium chloride
- Sodium cyanide
- Sodium dichromate
- Sodium ferricyanide
- Sodium ferrocyanide
- Sodium fluoride
- Sodium hydroxide
- Sodium hypochlorite
- Sodium nitrate
- Sodium nitrite
- Sodium sulfate
- Sodium sulfide
- Sodium sulfite
- Sodium thiosulfate (hypo)
- Stannic chloride
- Stannous chloride
- Stearic acid
- Sulfur
- Sulfur dioxide – gas dry
- Sulfur trioxide
- Sulfuric acid – 0–10%
- Sulfuric acid – 10–75%
- Sulfuric acid – 75–90%
- Sulfurous acid
- Tannic acid
- Tanning liquors
- Tartaric acid
- Titanium tetrachloride
- Triethanolamine
- Trimethyl propane
- Trisodium phosphate
- Turpentine
- Urea
- Vinegar
- Whiskey
- White liquor (paper industry)
- Wines
- Zinc chloride
- Zinc chromate
- Zinc cyanide
- Zinc nitrate
- Zinc sulfate