Elbows, Sweeps and Swoop™s

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Topics

- Pressure Drop in Pipe and Fittings
- NESEA Conference, Mar 7-9, Boston, MA
- ASHRAE, June 23-28, Long Beach, CA
  - 90.1, 189.1 Considering volume in pipe from source to use
- CEC Research Grant
  - How Low Can You Go? How Close Can You Get?
  - Estimated start date: June 2017

Pressure Drop in Pipe and Fittings

Pressure Drop in Pipe and Fittings

- Many materials and types of fittings
- Calculations vs. measured data
- Are the data we use representative of present day materials and fittings?

From the current ASHRAE Fundamentals Pipe Sizing chapter

- *Hegberg (1995) and Rahmeyer (1999a, 1999b) discuss the origins of some of the data shown in Tables 4 and Table 5.*
- *The Hydraulic Institute (1990) data appear to have come from Freeman (1941), work that was actually performed in 1895.*
- *The work of Giesecke (1926) and Giesecke and Badgett (1931, 1932a, 1932b may not be representative of current materials.*

Copper Tube: Fittings and Equivalent Length

Size *(in)*	Equivalent Length *(feet)*			
	90° Elbow	45° Elbow	Line Tee	Branch Tee
1/2	0.9	0.4	0.6	2.0
5/8	1.0	0.5	0.8	2.5
7/8	1.5	0.7	1.0	3.5
1 1/8	1.8	0.9	1.5	4.5
1 3/8	2.4	1.2	1.8	6.0
1 5/8	2.8	1.4	2.0	7.0
2 1/8	3.9	1.8	3.0	10.0
2 5/8	4.6	2.2	3.5	12.0

http://www.engineeringtoolbox.com/equivalent-length-copper-pipe-fittings-d_1670.html

Copper Tube: Fittings and Equivalent Length

Nominal or standard size, inches	Fittings					Valves			
	Standard ell		90° tee		Coupling	Ball	Gate	Btfly	Check
	90°	45°	Side branch	Straight run					
⅜	.5	-	1.5	-	-	-	-	-	1.5
½	1	.5	2	-	-	-	-	-	2
⅝	1.5	.5	2	-	-	-	-	-	2.5
¾	2	.5	3	-	-	-	-	-	3
1	2.5	1	4.5	-	-	.5	-	-	4.5
1¼	3	1	5.5	.5	.5	.5	-	-	5.5
1½	4	1.5	7	.5	.5	.5	-	-	6.5
2	5.5	2	9	.5	.5	.5	.5	7.5	9
2½	7	2.5	12	.5	.5	-	1	10	11.5
3	9	3.5	15	1	1	-	1.5	15.5	14.5
3½	9	3.5	14	1	1	-	2	-	12.5
4	12.5	5	21	1	1	-	2	16	18.5
5	16	6	27	1.5	1.5	-	3	11.5	23.5
6	19	7	34	2	2	-	3.5	13.5	26.5
8	29	11	50	3	3	-	5	12.5	39

CDA Publication A4015-14/16: Copper Tube Handbook, Table 14-7, Page 78

PEX Fittings and Equivalent Length

Type of Fitting	Equivalent Length of Tubing (ft.)			
	3/8" Size	1/2" Size	3/4" Size	1" Size
Coupling	2.9	2.0	0.6	1.3
Elbow 90°	9.2	9.4	9.4	10.0
Tee-branch	9.4	10.4	8.9	11.0
Tee-run	2.9	2.4	1.9	2.3

https://www.huduser.gov/portal/publications/pex_design_guide.pdf Page 79

PVC and CPVC: Fittings and Equivalent Length

Approximate Friction Loss For PVC and CPVC Fittings In Equivalent Feet Of Straight Pipe

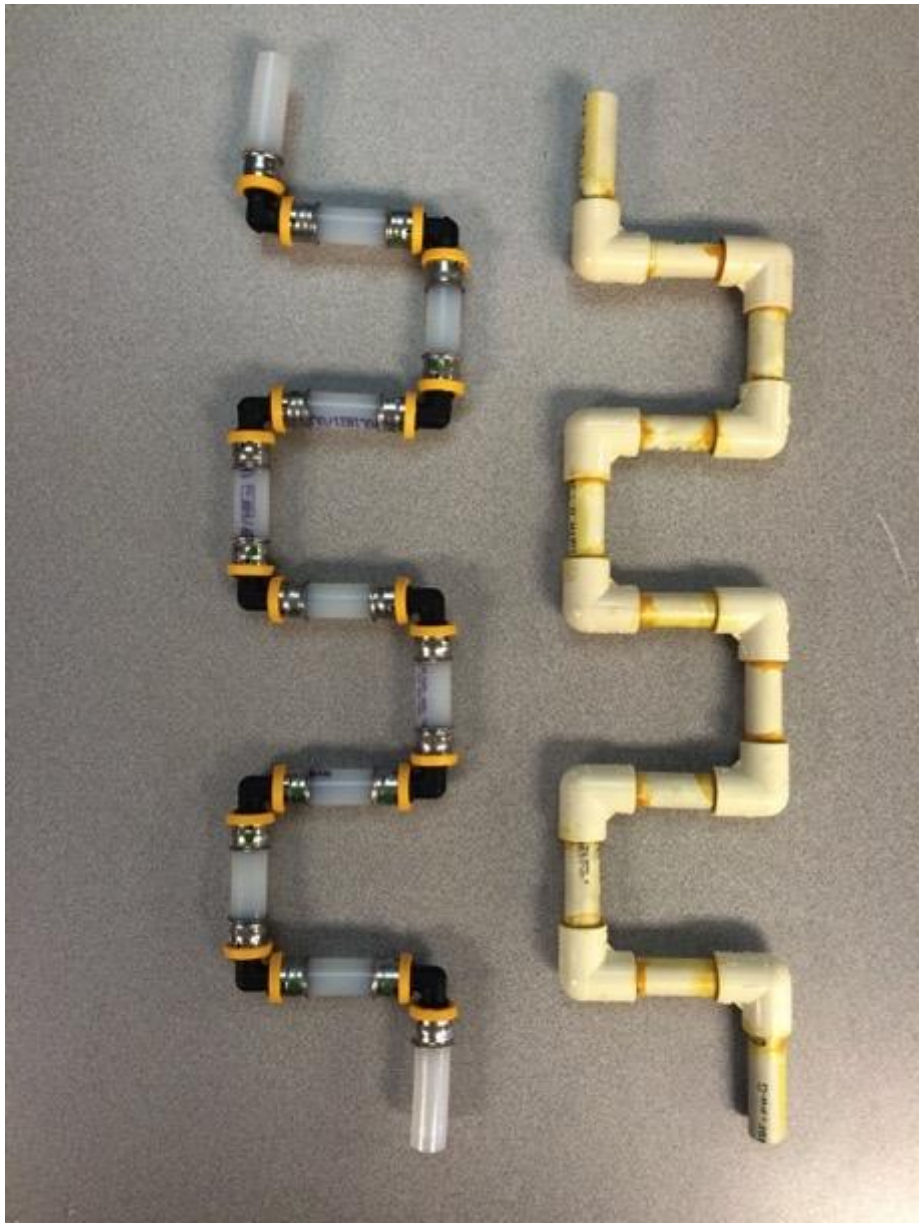
Fitting	½″	¾″	1″	1¼″	1½″	2″	2½″	3″	4″	6″	8″
Tee (Run)	1.0	1.4	1.7	2.3	2.7	4.3	5.1	6.2	8.3	12.5	16.5
Tee (Branch)	4.0	5.0	6.0	7.3	8.4	12.0	15.0	16.4	22.0	32.7	49.0
90° Elbow	1.5	2.0	2.5	3.8	4.0	5.7	6.9	7.9	12.0	18.0	22.0
45° Elbow	.80	1.1	1.4	1.8	2.1	2.6	3.1	4.0	5.1	8.0	10.6
Male/Female Adapter	1.0	1.5	2.0	2.75	3.5	4.5	5.5	6.5	9.0	14.0	—

http://www.charlottepipe.com/Documents/PL_Tech_Man/Charlotte_Plastics_Tech_Manual.pdf Page 48

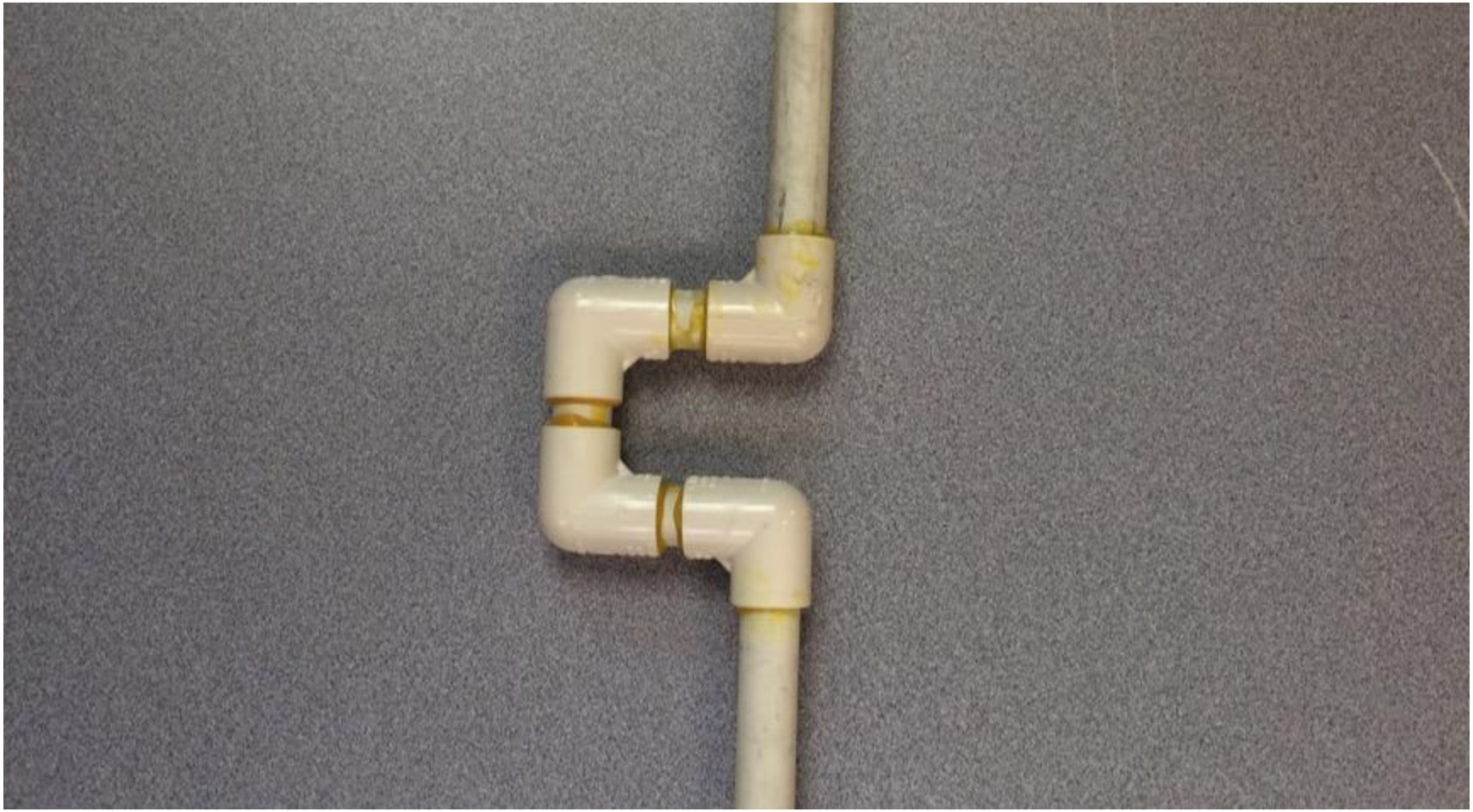
Pipe from ¼ inch to ¾ inch Nominal

Pipe from ¼ inch to ¾ inch Nominal

Close-coupled Elbows



Even Closer



90 Degree Elbows

90 Degree Bend Supports


Solar Water Heating System
Demonstration Unit

Pressure Drop Due to Elbows

	Equivalent Feet of 1/2" Tubing			
	Water Velocity in Tubing Feet per Second			
90° Elbow Type	**2 FPS**	**4 FPS**	**5 FPS**	**8 FPS**
PEX Crimp Insert	8.6	10.1	9.8	11.9
PEX Poly SS Press	7.9	8.9	8.9	9.6
PEX Cold Expansion	6.6	7.3	8.0	9.1
CPVC (Std Elb)	1.7	0.8	0.9	1.3
Copper (Std Tight Elb)	0.0	0.4	0.3	0.6

Pressure Drop Due to Elbows

Tight Spacing of Elbows	Equivalent Feet of 1/2" Tubing			
	Water Velocity in Tubing Feet per Second			
90° Elbow Type	2 FPS	4 FPS	5 FPS	8 FPS
PEX Poly SS Press	7.9		8.9	9.6
Tight Spacing	8.4		10.8	11.7
PEX Cold Expansion	6.6		8.0	9.1
Tight Spacing	7.9		9.3	9.4
CPVC (Std Elb)	1.7		0.9	1.3
Tight Spacing	0.7		1.3	1.5

Pressure Drop Due to Elbows

	Equivalent Feet of 3/4" Tubing			
	Water Velocity in Tubing Feet per Second			
90° Elbow Type	2 FPS	4 FPS	5 FPS	8 FPS
PEX Poly SS Press	7.0	6.3	6.7	7.1
PEX Cold Expansion	4.8	4.5	4.9	5.2
PEX Push to Connect	2.3	2.0	2.6	2.6
CPVC (Std Elb)	N/A	N/A	N/A	N/A
Copper (Std Tight Elb)	N/A	N/A	N/A	N/A

Nominal Diameter

1”

3/4”

5/8”

1/2”

3/8”

1/4”

1/8”

Swoop™s

Sweeps

Elbows

Ideal 90 Degree Bend?

- One is which there is no extra pressure drop other than that due to the length of the bend

Swoop™

3/4”

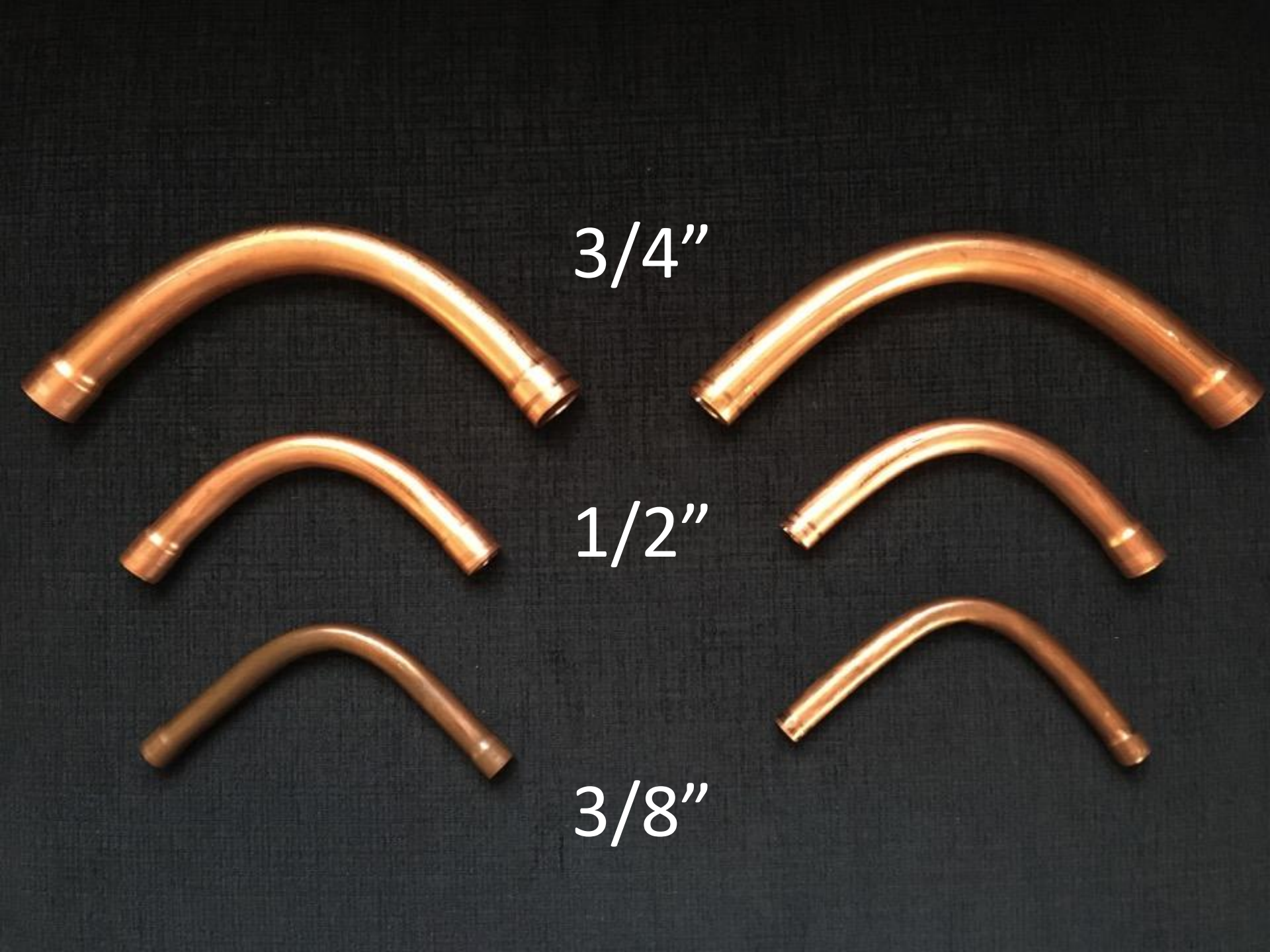
1/2”

3/8”

3/4”

1/2”

3/8”


3/4”
1/2”
3/8”

You can find Swoop™s at
www.waterheaterrescue.com