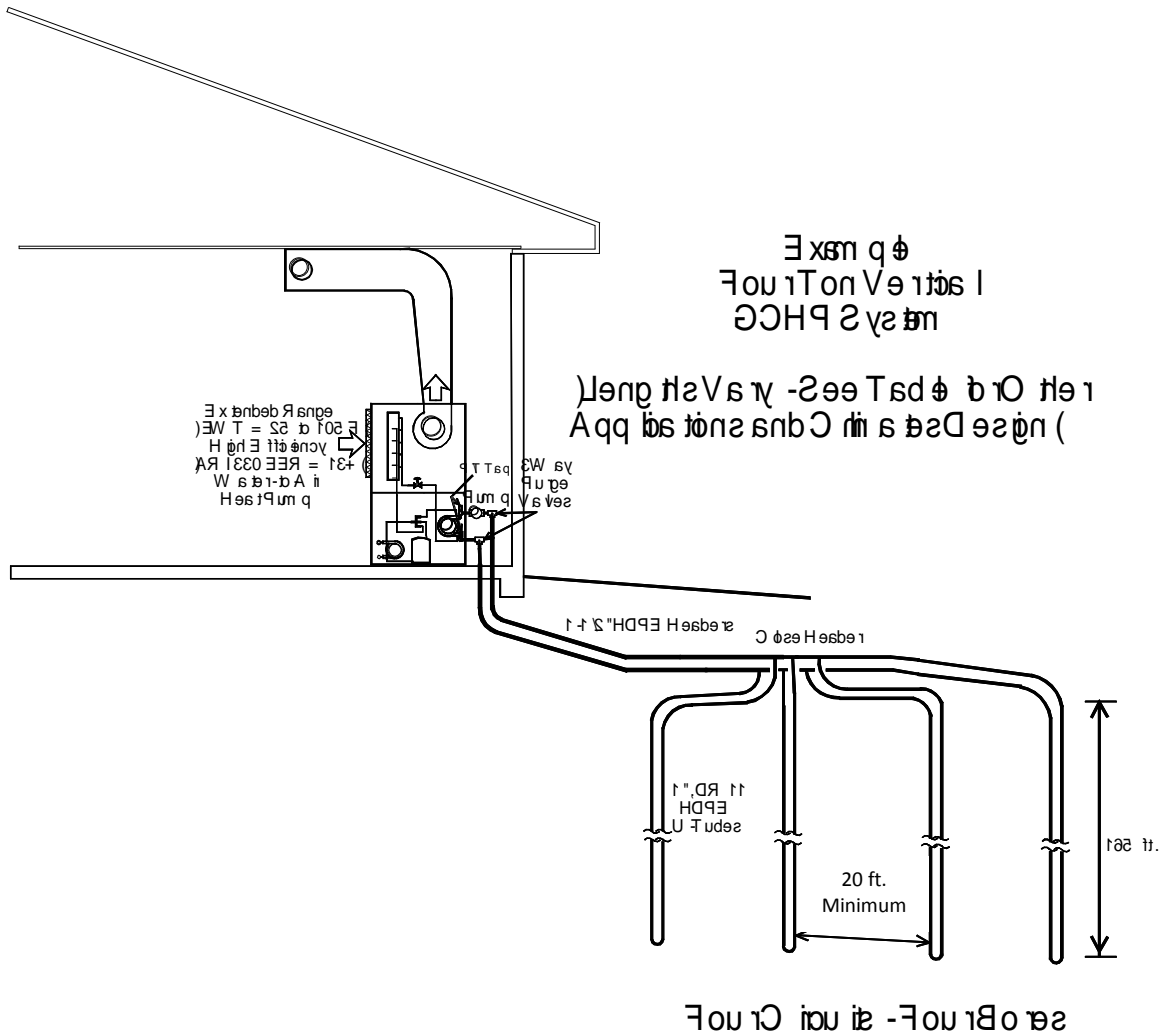


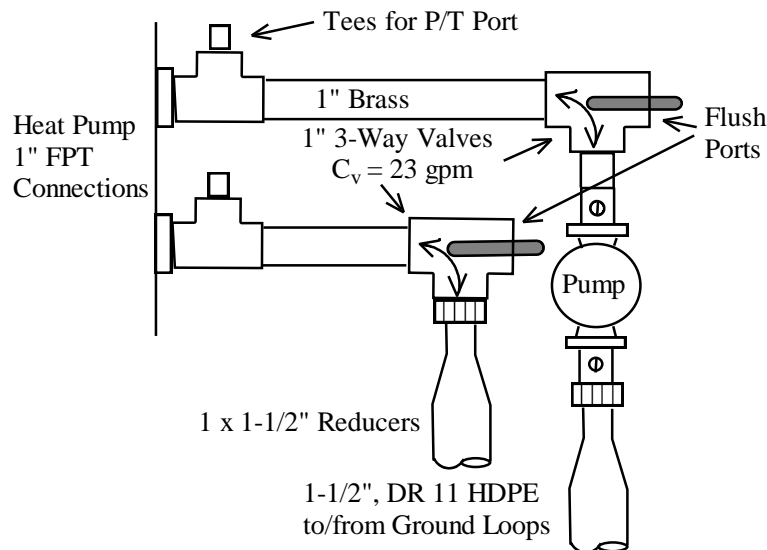
Using E-Pipelator.xls for a Small GSHP System

E-Pipelator is a piping design program that includes provisions for high density polyethylene (HDPE) that is used in ground source heat pump systems. The system below is a typical installation for a residential or small commercial vertical loop. The program will be used to compute the system head loss.

In addition to the components shown in the drawings below, necessary inputs include:

- Required flow: 10 gpm
- Heat pump head loss: 12 ft. of water at 12 gpm with water at 60°F
- Distance between heat pump and close header: 80 ft.
- Distance between close header and most remote U-tube: 30 ft.
- Loop temperature/Fluid: water at 90°F





Heat Pump and Pump Connection Details

An output screen for E-pipelator is shown in the table below.

- The circulation fluid is water (selected with a drop down box)
- The average loop temperature was entered at 90°F
- The program computed the values for the fluid density and viscosity
- The only coil in the system is the heat pump with 1-inch connections, thru which 10 gpm is flowing in the coil that is rated to have a 12 ft. head loss at 12 gpm
- The program corrects the head loss for the actual flow and fluid conditions.
- The main header flow is 10 gpm flowing thru two 80 ft. headers (160 ft. total) of 1-1/2 in., DR 11 HDPE, 2-90° Elbows, two reducers and two 4-loop close headers (5-loop selected as nearest match). Losses are computed in the “HDPE Piping” section of the program.
- The flow splits into four parallel paths (2.5 gpm each, 1 inch DR 11 HDPE) and the longest loop consists of two-30 ft. horizontal runs, two-165 ft. vertical runs (390 ft. total) and 1 Uni-coil (U-tube). Losses are computed in the “HDPE Piping” section of the program.
- At the heat pump the 10 gpm passes thru two 3-way valves, two tees, and 1 ft. total of 1-inch brass pipe. Losses in the valves are considered in the “Other Fittings” section of the program and the brass pipe and tees in the “Steel/Brass” section.
- The system is a closed loop, so no elevation heads are required.
- The program commutes the total loss to be 14.1 ft of water.

Piping Loop Head Loss Calculator - System Designer for HVAC Systems - See "Using E-Pipelator" instructions
 See also *HVAC Simplified* (Kavanaugh, 2006) or *Geothermal Heating and Cooling* (Kavanaugh & Rafferty, 2014)
 available from ASHRAE for additional information and instructions.

Input															Optional Input			Output	
Liquid	Water		→ Percent by Volume		Coils		Flow	Rated	Rated Δh	Inlet	Inlet	Re(in)	Rated	Re(rated)	Δh				
Temp	90 °F				Heat Pump		gpm	Flow	@ 60°F	Size	Vel	Vel			Ft. Liquid				
Den	62.1 lbm/ft³						10	12	12	1	4.1	38866	4.9	32898	8.2				
Vis	5.44E-04 lbm/ft-s		0.81 cps				0	0	0	0	0.0	0	0.0	0	0.0				
HDPE Piping - Dimension Ratio (DR)															Coil sub-total			8.2	
Flow	Nom. Dia.	DR	I.D.	Roughness	Vel	Re	Δh(ft)	Length	Fitting Type	Leqv	Qty.	Fitting Type	Leqv	Qty.	Fitting Type	Leqv	Qty.	Δh	
gpm	Inches	OD ÷ t	in.	ft.	fps		100 ft.	ft.		ft			ft			ft		Ft. Liquid	
10	1.5	11	1.55	7.0E-05	1.7	25002	0.89	160	Butt90	12	2	ButtRed	6	2	5-LoopHdrLastTC	30	2	2.3	
2.5	1	11	1.08	7.0E-05	0.9	9031	0.45	390	UniCoil	10	1	ButtRed	4		ButtTeeBr	7		1.8	
	2	11	1.94	7.0E-05	0.0	0	0.00		ButtTeeRun	4		ButtRed	7		ButtTeeBr	16		0.0	
	2	11	1.94	7.0E-05	0.0	0	0.00		ButtTeeRun	4		ButtRed	7		ButtTeeBr	16		0.0	
	1.5	11	1.55	7.0E-05	0.0	0	0.00		ButtTeeRun	3		ButtRed	6		ButtTeeBr	12		0.0	
	1.5	11	1.55	7.0E-05	0.0	0	0.00		ButtTeeRun	3		ButtRed	6		ButtTeeBr	12		0.0	
	1.5	11	1.55	7.0E-05	0.0	0	0.00		ButtTeeRun	3		ButtRed	6		ButtTeeBr	12		0.0	
	1.5	11	1.55	7.0E-05	0.0	0	0.00		ButtTeeRun	3		ButtRed	6		ButtTeeBr	12		0.0	
	1	11	1.08	7.0E-05	0.0	0	0.00		ButtTeeRun	3		ButtRed	4		ButtTeeBr	7		0.0	
	1	11	1.08	7.0E-05	0.0	0	0.00		UniCoil	10		ButtRed	4		ButtTeeBr	7		0.0	
	2	11	1.94	7.0E-05	0.0	0	0.00		Butt90	17		ButtRed	7		ButtTeeBr	16		0.0	
Steel/Brass/PVC (Schedule Dimensions)															HDPE sub-total			4.1	
Flow	Nom. Dia.	Schedule	I.D.	Pipe Mat'l	Vel	Re	Δh(ft)	Length	Fitting Selector	Leqv	Qty.	Fitting Selector	Leqv	Qty.	Fitting Selector	Leqv	Qty.	Δh	
gpm	Inches	40 or 80	in.	for Rghness in ft.	fps		100 ft.	ft.		ft			ft			ft		Ft. Liquid	
10	1	40	1.05	Brass-Bronze	3.7	37051	12.90	1	T-Straight	3.0	2	Reducer	1.0		Gate Valve	2.5	0	0.9	
	3	40	3.07	Steel-Old	0.0	0	0.00		Gate Valve	8.3		T-Straight	10.0		Gate Valve	8.3	0	0.0	
	3	40	3.07	Steel-Old	0.0	0	0.00		Gate Valve	8.3		T-Straight	10.0		Gate Valve	8.3	0	0.0	
	2	40	2.07	Steel-Old	0.0	0	0.00		T-Branch	44.8		90 L	5.6		Gate Valve	5.6	0	0.0	
	5	40	5.05	Steel-Old	0.0	0	0.00		90 L	14.0		T-Straight	16.8		Gate Valve	14.0	0	0.0	
	5	40	5.05	Steel-Old	0.0	0	0.00		90 L	14.0		T-Straight	16.8		Gate Valve	14.0	0	0.0	
Copper															Fe/Br/PVC sub-total			0.9	
Flow	Nom. Dia.	Type	I.D.	Drawn Tube	Vel	Re	Δh(ft)	Length	Fitting Selector	Leqv	Qty.	Fitting Selector	Leqv	Qty.	Fitting Selector	Leqv	Qty.	Δh	
gpm	Inches	K,L, or M	in.	Roughness in ft.	fps		100 ft.	ft.		ft			ft			ft		Ft. Liquid	
	2	L	1.99	New	0.0	0	0.00		90 L	5.6		T-Straight	6.7		Gate Valve	3.9		0.0	
	2	L	1.99	Aged	0.0	0	0.00		90 L	5.6		Reducer	2.2		90 L	5.6		0.0	
	2.5	M	2.50	Aged	0.0	0	0.00		T-Straight	8.0		Reducer	2.7		90 L	6.7		0.0	
	5	K	4.81	Aged	0.0	0	0.00		T-Straight	16.8		Reducer	5.6		90 L	14.0		0.0	
	5	K	4.81	Aged	0.0	0	0.00		T-Straight	16.8		Reducer	5.6		90 L	14.0		0.0	
	6	M	5.88	Aged	0.0	0	0.00		T-Straight	20.0		Reducer	6.7		90 L	16.7		0.0	
PEX															Copper sub-total			0.0	
Flow	Nom. Dia.	DR	I.D.	Drawn Tube	Vel	Re	Δh(ft)	Length	Fitting Selector	Leqv	Qty.	Fitting Selector	Leqv	Qty.	Fitting Selector	Leqv	Qty.	Δh	
gpm	Inches	OD ÷ t	in.	Roughness in ft.	fps		100 ft.	ft.		ft			ft			ft		Ft. Liquid	
	1.5	9	1.26	7.0E-05	0.0	0	0.00		90 L	4.2		T-Straight	5.0		Gate Valve	2.9		0.0	
	1	9	0.88	7.0E-05	0.0	0	0.00		90 L	2.5		Reducer	1.0		90 L	2.5		0.0	
	0.75	9	0.68	7.0E-05	0.0	0	0.00		T-Straight	0.0		Reducer	0.0		90 L	0.0		0.0	
Other Fittings & Valves															PEX sub-total			0.0	
								Cv	Quantity	Inlet	Inlet	Re(in)	Rated	Re(rated)				Δh	
								@ 60°F		Size	Vel		Vel					Ft. Liquid	
								gpm		inches	fps		fps					0.9	
								10	23	1	4.1	38866	9.4	63055				0.0	
										0.75	0.0	0	0.0	0				0.0	
										0.75	0.0	0	0.0	0				0.0	
										0.75	0.0	0	0.0	0				0.0	
										2	0.0	0	0.0	0				0.0	
										2	0.0	0	0.0	0				0.0	
Fitting sub-total															0.9				
Open Systems Only															Elevation			0	
Total Loss															(Ft. Liquid)			14.1	