

Piping Pressure Drop Template -- For Liquids or Gases
Version 2.17

www.chemengsoftware.com by Stephen M. Hall, PE
Copyright 1999, 2000

All cells are locked except user-defined data; unlock sheet from Tools menu
VIEW-COMMENTS to see some additional explanations.


DATA INPUT			
Project Data			
Prepared by	S. Hall	Client	Sample
Date	24-Apr-2000	W.O.	10314
<input checked="" type="radio"/> English	<input type="radio"/> SI	Unit	Process
		Area	Tank Farm
Line ID			
Line Number:			Liquid Example
General Pipeline Data			
Service:		Raw Material Transfer	
Pipe Material Specification:	A	<< 150 lb Carbon Ste	
Insulation	None		
Ambient Temp (deg F)		80.00	
Process Data			
Fluid Name		Toluene	<input checked="" type="radio"/> Liquid <input type="radio"/> Gas
Molecular Weight	(Entry Ignored>>>)	92.13	
Actual Flow (gallons/minute)		150.00	
Maximum Flow (gallons/minute)		300.00	
Flowing Temperature (deg F)		59.00	
Nominal Pressure (psia)		75.00	
Specific Gravity		0.87 (<<< Entry Ignored)	
Absolute Viscosity (centipoise)		0.011 (<<< Entry Ignored)	
Size Selection Criteria			
<input checked="" type="radio"/> Economic	<input type="radio"/> Specific Diameter	<input type="radio"/> Target Velocity	
Physical Layout			
Length of pipeline (feet)			500
90 deg Ell	0	Globe Valve	0
Long Rad. Ell	8	Gate Valve	1
45 deg Ell	0	Ball Valve (reduce	0
180 deg Bend	0	Butterfly Valve	0
TEE-Line Flow	0	Plug Valve	0
TEE-Branch Flow	1	Angle Valve	0
Bell Mouth Inlet	0	Swing Check Valve	1
Square Mouth Inlet	0	Re-Entrant Pipe	0
Report Selection			
<input type="checkbox"/> Results Summary	<input type="checkbox"/> LIQFLOW		
<input checked="" type="checkbox"/> Datasheet Style	<input type="checkbox"/> EquivLength		
<input type="checkbox"/> Instructions	<input type="checkbox"/> OPTLIQ		

Summary

Results		
Line		Liquid Example
Service		Raw Material Transfer
Material		150 lb Carbon Steel
Fluid Name		Toluene
Actual Flow	(gallons/minute)	150.00
Maximum Flow	(gallons/minute)	300.00
Temperature	(deg F)	59.00
Specific Gravity		0.867
Absolute Viscosity	(centipoise)	0.62901
Roughness	(feet)	0.00015
Selected Size	(inches)	3.00
Equiv. Length	(feet)	574
Pressure Drop	(psi)	10.7
	(ft. water)	24.72
Velocity	(ft/sec)	6.5
Next Size	(inches)	4.00
Equiv. Length	(feet)	594
Pressure Drop	(psi)	2.8
	(ft. water)	6.49
Velocity	(ft/sec)	3.8

www.chemengsoftware.com				PIPELINE SIZING CALCULATION								
				CLIENT		LINE NO.						
				Sample		Liquid Example						
REV	PREPARED BY	DATE	APPROVAL	W.O.		REQUISITION NO.			SPECIFICATION NO.			
0	S. Hall	24-Apr-2000		10314					18103			
1				UNIT	AREA	PROCURED BY			INSTALLED BY			
2				Process	Tank Farm							
1	General											
2	Fluid Service			Raw Material Transfer								
3	Pipe Specification			A: 150 lb Carbon Steel								
4	Surface Roughness		(feet)	0.00015								
5	Insulation			None								
6	Ambient Temperature		(deg F)	80								
7												
8	Process Data											
9	Fluid Pumped			Toluene (liquid)								
10	Design Flow Rate		(gallons/minute)	150								
11	Maximum Flow Rate		(gallons/minute)	300								
12	Flowing Temperature		(deg F)	59								
13	Nominal Pressure		(psia)	75								
14	Specific Gravity			0.867 (= 54.10 lb/cu.ft.)								
15	Viscosity		(centipoise)	0.6290099								
16												
17	Basis for Sizing: Optimum Economic Diameter											
18												
19		Nom.		O.D.	Wall	I.D.	Reynolds	Friction	Pressure Drop/100 equiv ft			Velocity
20		Size	Sched	(in.)	(in.)	(in.)	Number	Factor	(psi)	(ft water)	(ft liq)	(ft/sec)
21		2	80	2.375	0.218	1.939	3.37E+05	0.0203	19.51	45.06	51.98	16.30
22	====>	3	40	3.500	0.216	3.068	2.13E+05	0.0193	1.87	4.31	4.97	6.51
23		4	40	4.500	0.237	4.026	1.62E+05	0.0191	0.47	1.09	1.26	3.78
24												
25	Physical Layout											
26	90 deg Ell	-	TEE-Line Flow	-	Globe Valve	-	Plug Valve	-				
27	Long Rad. Ell	8	TEE-Brnch Flow	1	Gate Valve	1	Angle Valve	-				
28	45 deg Ell	-	Bell Mouth Inlet	-	Ball Valve (red. port)	-	Swing Check Valve	1				
29	180 deg Bend	-	Sq. Mouth Inlet	-	Butterfly Valve	-	Re-Entrant Pipe	-				
30	Straight Feet of Pipe (measured through centerline of fittings):								500 feet			
31												
32	Heat Loss											
33		Nom.							Pipe is Uninsulated			
34		Size			units	Bare	0.5 in	1 in	1-1/2 in	2 in	3 in	
35		2			Btu/hr-ft	(15)	n/a	n/a	n/a	n/a	n/a	
36	====>	3			Btu/hr-ft	(24)	n/a	n/a	n/a	n/a	n/a	
37		4			Btu/hr-ft	(28)	n/a	n/a	n/a	n/a	n/a	
38												
39	Summary of Results											
40		Nom.	Eq Lgth	Pressure Drop			Heat Loss (Gain), But/hr					
41		Size	(ft)	(psi)	(ft water)	(ft liq)	Bare	0.5 in	1 in	1-1/2 in	2 in	3 in
42		2	551	107.53	248.39	286.5	(7,655)	n/a	n/a	n/a	n/a	n/a
43	====>	3	574	10.70	24.72	28.5	(11,787)	n/a	n/a	n/a	n/a	n/a
44		4	594	2.81	6.49	7.5	(13,950)	n/a	n/a	n/a	n/a	n/a
45												
46												
47												
48												
49												
50												
51												
52												

EFFECT OF FLOW VARIATION

				CLIENT		LINE NO.	
				Sample		Liquid Example	
REV	PREPARED BY	DATE	APPROVAL	W.O.	REQUISITION NO.	SPECIFICATION NO.	
0	S. Hall	24-Apr-2000		10314		18103	
1				UNIT	AREA	PROCURED BY	INSTALLED BY
2				Process	Tank Farm		

1	General						
2	Fluid Service	Raw Material Transfer					
3	Pipe Specification	A: 150 lb Carbon Steel					
4	Surface Roughness	(feet)	0.00015				
5	Insulation	None					
6	Ambient Temperature	(deg F)	80				
7							

8	Process Data						
9	Fluid Pumped	Toluene (liquid)					
10	Design Flow Rate	(gallons/minute)	150				
11	Maximum Flow Rate	(gallons/minute)	300				
12	Flowing Temperature	(deg F)	59				
13	Nominal Pressure	(psia)	75				
14	Specific Gravity	0.867 (= 54.10 lb/cu.ft.)					
15	Viscosity	(centipoise)	0.6290099				
16							

17	Smaller Pipe Size	2 in.		Flow	Reynolds	Friction	DeltaP/100 equiv ft		Velocity
18	Schedule	80		(gpm)	Number	Factor	(psi)	(ft water)	(ft/sec)
19	Outside Diameter	(in.)	2.375	30	67,335	0.0231	0.88	2.04	3.26
20	Wall Thickness	(in.)	0.218	60	134,670	0.0215	3.29	7.61	6.52
21	Inside Diameter	(in.)	1.939	90	202,005	0.0209	7.19	16.62	9.78
22				120	269,340	0.0206	12.58	29.06	13.04
23				150	336,674	0.0203	19.45	44.93	16.30
24				180	404,009	0.0202	27.80	64.22	19.56
25				210	471,344	0.0201	37.63	86.93	22.82
26				240	538,679	0.0200	48.94	113.06	26.08
27				270	606,014	0.0199	61.73	142.60	29.34
28				300	673,349	0.0199	76.00	175.56	32.60

29	Selected Pipe Size	3 in.		Flow	Reynolds	Friction	DeltaP/100 equiv ft		Velocity
30	Schedule	40		(gpm)	Number	Factor	(psi)	(ft water)	(ft/sec)
31	Outside Diameter	(in.)	3.500	30	42,556	0.0235	0.09	0.21	1.30
32	Wall Thickness	(in.)	0.216	60	85,112	0.0212	0.33	0.76	2.60
33	Inside Diameter	(in.)	3.068	90	127,669	0.0202	0.70	1.62	3.91
34				120	170,225	0.0197	1.21	2.80	5.21
35				150	212,781	0.0193	1.86	4.30	6.51
36				180	255,337	0.0190	2.64	6.10	7.81
37				210	297,893	0.0188	3.56	8.22	9.12
38				240	340,449	0.0187	4.61	10.65	10.42
39				270	383,006	0.0185	5.79	13.38	11.72
40				300	425,562	0.0184	7.11	16.43	13.02

41	Next Larger Pipe Size	4 in.		Flow	Reynolds	Friction	DeltaP/100 equiv ft		Velocity
42	Schedule	40		(gpm)	Number	Factor	(psi)	(ft water)	(ft/sec)
43	Outside Diameter	(in.)	4.500	30	32,430	0.0243	0.02	0.06	0.76
44	Wall Thickness	(in.)	0.237	60	64,860	0.0215	0.09	0.20	1.51
45	Inside Diameter	(in.)	4.026	90	97,289	0.0203	0.18	0.42	2.27
46				120	129,719	0.0195	0.31	0.72	3.03
47				150	162,149	0.0191	0.47	1.09	3.78
48				180	194,579	0.0187	0.67	1.54	4.54
49				210	227,009	0.0184	0.90	2.07	5.29
50				240	259,438	0.0182	1.16	2.67	6.05
51				270	291,868	0.0181	1.45	3.35	6.81
52				300	324,298	0.0179	1.78	4.10	7.56

EQUIVALENT LENGTH OF PIPE

				CLIENT			LINE NO.		
				Sample			Liquid Example		
REV	PREPARED BY	DATE	APPROVAL	W.O.			REQUISITION NO.		SPECIFICATION NO.
0	S. Hall	24-Apr-2000		10314					18103
1				UNIT AREA		PROCURED BY		INSTALLED BY	
2				Process Tank Farm					

1	General								
2	Fluid Service			Raw Material Transfer					
3	Pipe Specification			A: 150 lb Carbon Steel					

4									
5									
6									
7									

8									
9									
10									
11									
12									
13									

	Pipe Size	2 inch		3 inch		4 inch	
Fittings		Qty	Equiv. Ft.	Qty	Equiv. Ft.	Qty	Equiv. Ft.
15							
16	90 deg Ell	0	0.0	0	0.0	0	0.0
17	Long Rad. Ell	8	21.6	8	32.0	8	40.0
18	45 deg Ell	0	0.0	0	0.0	0	0.0
19	TEE-Line Flow	0	0.0	0	0.0	0	0.0
20	TEE-Branch Flow	1	10.0	1	14.0	1	19.0
21	180 deg Bend	0	0.0	0	0.0	0	0.0
22	Globe Valve	0	0.0	0	0.0	0	0.0
23	Gate Valve	1	2.6	1	2.8	1	2.9
24	Ball Valve (red. port)	0	0.0	0	0.0	0	0.0
25	Butterfly Valve	0	0.0	0	0.0	0	0.0
26	Plug Valve	0	0.0	0	0.0	0	0.0
27	Angle Valve	0	0.0	0	0.0	0	0.0
28	Swing Check Valve	1	17.0	1	25.0	1	32.0
29	Bell Mouth Inlet	0	0.0	0	0.0	0	0.0
30	Square Mouth Inlet	0	0.0	0	0.0	0	0.0
31	Re-Entrant Pipe	0	0.0	0	0.0	0	0.0
32							
33	Straight Pipe		500		500		500
34							
35	Total Equiv Feet		551		574		594

36									
37									
38									
39									

40

41 Equivalent lengths are calculated using a table of values.

42 If the fitting/size combination does not appear in the table, the "K Value" method is used.

43 "K Value" data are from the Hydraulic Institute, Pipe Friction Manual, regressed.

44

45

46

47

48

49

50

51

52

SELECTED PIPE DIAMETER

REV	PREPARED BY	DATE	APPROVAL	CLIENT	LINE NO.	
0	S. Hall	24-Apr-2000		Sample	Liquid Example	
1				W.O.	REQUISITION NO.	SPECIFICATION NO.
2				10314		18103
				UNIT AREA	PROCURED BY	INSTALLED BY
				Process Tank Farm		
General						
1						
2	Fluid Service	Raw Material Transfer				
3	Pipe Specification	A: 150 lb Carbon Steel				
4	Surface Roughness (feet)	0.00015				
5	Insulation	None				
6	Ambient Temperature (deg F)	80				
7						
Process Data						
8						
9	Fluid Pumped	Toluene (liquid)				
10	Design Flow Rate (gallons/minute)	150				
11	Maximum Flow Rate (gallons/minute)	300				
12	Flowing Temperature (deg F)	59				
13	Nominal Pressure (psia)	75				
14	Specific Gravity	0.867 (= 54.10 lb/cu.ft.)				
15	Viscosity (centipoise)	0.6290099				
16						
Economic Data						
17						
18	Purchase cost of new pipe, 1 inch diameter, \$/ft					\$1.75
19	Ratio of costs for fittings & installation to purch. cost of pipe					5
20	Factor relating pipe cost to diameter (exponential)					1.30
21	Frictional loss due to fittings and bends, % of straight pipe					35%
22	Operation, hours/yr					8,000
23	Cost of electricity, \$/kwhr					\$0.15
24	Efficiency of motor and pump, %					60%
25	Annual fixed charges for maintenance, % of pipe cost					20%
26						
Basis for Sizing: Optimum Economic Diameter						
27						
28	Optimum diameter calculated using Peters & Timmerhaus formula					3.11
29	Closest pipe size from specified material class					3
30						
31		Smaller	Selected	Next Larger		
32		Size	Size	Size		
33	Actual Size	inch nominal size	2	3	4	
34		inch actual inside diameter	1.939	3.068	4.026	
35	Velocity	feet/second	16.30	6.51	3.78	
36	Reynolds No.		336,674	212,781	162,149	
37	Friction Factor		0.0203	0.0193	0.0191	
38	Pressure Drop	psi/100 equiv ft	19.508	1.865	0.474	
39						
40	Calculated Costs, \$ per year per foot of installed piping:					
41			2	3	4	
42	Pumping Cost (power)		\$35.29	\$3.83	\$1.03	
43	Initial Piping (capital expenditure)		\$25.85	\$43.80	\$63.66	
44	Annual Piping (maintenance)		\$5.17	\$8.76	\$12.73	
45	Total		\$40.46	\$12.59	\$13.76	
46						
47						
48						
49						
50	Reference:	Peters & Timmerhaus				
51		Plant Design and Economics for Chemical Engineers				
52						
53						