Friction Losses in Pipe Fittings																
Resistance Coefficient K (use in formula $hf = Kv^2/2g$)																
						Nominal Pipe Size										
g	LD	1/2	3/4	1	11/4	1½	2	21/2-3	4	6	8-10	12-16	18-24			
			K Value													
alve	55	1.48	1.38	1.27	1.21	1.16	1.05	0.99	0.94	0.83	0.77	0.72	0.66			
alve	150	4.05	3.75	3.45	3.30	3.15	2.85	2.70	2.55	2.25	2.10	1.95	1.80			
lve	3	0.08	0.08	0.07	0.07	0.06	0.06	0.05	0.05	0.05	0.04	0.04	0.04			
Valve							0.86	0.81	0.77	0.68	0.63	0.35	0.30			
alve	8	0.22	0.20	0.18	0.18	0.15	0.15	0.14	0.14	0.12	0.11	0.10	0.10			
alve	340	9.2	8.5	7.8	7.5	7.1	6.5	6.1	5.8	5.1	4.8	4.4	4.1			
anch Flow	90	2.43	2.25	2.07	1.98	1.89	1.71	1.62	1.53	1.35	1.26	1.17	1.08			
aightaway	18	0.48	0.45	0.41	0.40	0.38	0.34	0.32	0.31	0.27	0.25	0.23	0.22			
Plug Valve 3-Way Thru-Flow			0.75	0.69	0.66	0.63	0.57	0.54	0.51	0.45	0.42	0.39	0.36			
90°	30	0.81	0.75	0.69	0.66	0.63	0.57	0.54	0.51	0.45	0.42	0.39	0.36			
45°	16	0.43	0.40	0.37	0.35	0.34	0.30	0.29	0.27	0.24	0.22	0.21	0.19			
	g alve alve Valve alve alve alve arch Flow aightaway y Thru-Flow 90°	g LD alve 55 alve 150 alve 3 Valve 8 alve 340 anch Flow 90 raightaway 18 ry Thru-Flow 30 90° 30	LD 1/2	LD	LD	Sesistance Coefficient K (use in the large state of the large state	Sesistance Coefficient K (use in form N 1 1 1 1 1 1 1 1 1	LD	Nominal Pipe Nomi	Nominal Pipe Size LD 1/2 3/4 1 11/4 11/2 2 21/2-3 4 K Value S5 1.48 1.38 1.27 1.21 1.16 1.05 0.99 0.94 salve 150 4.05 3.75 3.45 3.30 3.15 2.85 2.70 2.55 1.49 3.08 0.08 0.07 0.07 0.06 0.06 0.05 0.	Nominal Pipe Size LD 1/2 3/4 1 11/4 11/2 2 21/2-3 4 6	Nominal Pipe Size LD 1/4 1/4 1/2 2 2/2-3 4 6 8-10	Nominal Pipe Size LD 1/2 3/4 1 11/4 11/2 2 21/2-3 4 6 8-10 12-16 K Value S5 1.48 1.38 1.27 1.21 1.16 1.05 0.99 0.94 0.83 0.77 0.72 alve 150 4.05 3.75 3.45 3.30 3.15 2.85 2.70 2.55 2.25 2.10 1.95 1.94 1.95 1.94 1.95			

16 ||0.43||0.40||0.37||0.35||0.34||0.30|

|0.54||0.50||0.46||0.44||0.42||0.38|

|0.32||0.30||0.28||0.26||0.25||0.23

|0.32||0.30||0.28||0.26||0.25||0.23|

0.46 0.43 0.39 0.37 0.36 0.32

|0.65||0.60||0.55||0.53||0.50||0.46|

|0.81||0.75||0.69||0.66||0.63||0.57

|1.03||0.95||0.87||0.84||0.80||0.72|

|0.92||0.85||0.78||0.75||0.71||0.65|| 0.61 |

|1.35||1.25||1.15||1.10||1.05||0.95||0.90||0.85||0.75||0.70|

|0.54||0.50||0.46||0.44||0.42||0.38|| 0.36 ||0.34||0.30||0.28|

|1.62||1.50||1.38||1.32||1.26||1.14||1.08||1.02||0.90||0.84|

|0.38||0.35||0.32||0.31||0.29||0.27||0.25||0.24||0.21||0.20

| 1.13 | 1.05 | 10.97 | 10.92 | 10.88 | 10.80 | 10.76 | 10.71 | 10.63 | 10.59

11.01 | 0.97 | 0.87

0.36

0.22

0.22

0.31

0.43

0.54

0.83

Standard Tee

90 Bends, Pipe Bends,

Flanged Elbows,

Butt-Welded Elbows

long radius

900

Thru-Flow

r/d=1

r/d=2

r/d=3r/d=4

r/d=6

r/d=8

r/d = 10

r/d=12

r/d = 14

r/d = 16

r/d = 18

Thru-

20

60

20

12 12

17

24

30

34

38

42

45

Close Return Bend

0.19

0.60

0.24

0.72

0.24

0.14

0.14

0.17

0.20

0.29

0.36

0.41

0.46

0.50

0.55

0.21

0.65

0.26

0.78

0.26

0.16

0.16

0.18

0.22

0.31

0.39

0.44

0.49

0.55

0.60

|0.29| |0.27| |0.24| |0.22|

0.34||0.30||0.28

0.20 0.18 0.17

0.29 | 0.26 | 0.24

0.41 0.36 0.34

|0.51| |0.45| |0.42|

0.58 0.51 0.48

0.68 | 0.65 | 0.57 | 0.53

0.78 0.69

0.17

|0.20||0.18

ı																- 1
	a=(0°	2 0.	05	0.05	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.02	
	a=1	5°	4 0.	11 (0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.05	0.05][
	a=3	0°	8 0.	22	0.20	0.18	0.18	0.17	0.15	0.14	0.14	0.12	0.11	0.10	0.10]
Mitre Bends	a=4	·5°	15 0.	41	0.38	0.35	0.33	0.32	0.29	0.27	0.26	0.23	0.21	0.20	0.18]
	a=6	50° 2	25 0.	68	0.63	0.58	0.55	0.53	0.48	0.45	0.43	0.38	0.35	0.33	0.30][
	a=7	/5°	10 1.	09 [1	1.00	0.92	0.88	0.84	0.76	0.72	0.68	0.60	0.56	0.52	0.48]
	a=9	0° (50 1.	62 [1	1.50	1.38	1.32	1.26	1.14	1.08	1.02	0.90	0.84	0.78	0.72	
Note: Fittings are standard with full openings.																
rote. I ittings are	Staridar	u with i	ин ор	enin	igs.]
rote. Fittings are	Standar			enin	1gs				N	omina	1 Pine	Size				<u>]</u>
ivec. Fittings are	Standar	Mini: Veloc	mum					1	_	omina	$\overline{}$	1				<u>]</u>]
Fitting	L/D	Mini	mum ity for		1/ ₂	3/4	1	11/4	N 1½	1	l Pipe	1	6	8-10	12-16] _ [i
		Mini Veloc	mum ity for	ft er		3/4	1	11/4	_	2	$\overline{}$	4	6	8-10	12-16] [1
		Mini Veloc Full Di General	mum ity for	ft er	1/2		1 2.30		1½	2 K	2½-3 Value	4		8-10		

		Minimum Velocity for Full Disc Lift		Nominal Pipe Size											
Fitting	L/D			1/2	3/4	1	11/4	1½	2	2½-3	4	6	8-10	12-16	18-24
		General ft/sec	Water ft/sec		K Value										
Swing Chaok Volva	100	35∀₹	4.40	2.70	2.50	2.30	2.20	2.10	1.90	1.80	1.70	1.50	1.40	1.30	1.20
Swing Check Valve	50	48√ <u>v</u>	6.06	1.40	1.30	1.20	1.10	1.10	1.00	0.90	0.90	0.75	0.70	0.65	0.60
Lift Check Valve	600	40√⊽	5.06	16.2	15.0	13.08	13.2	12.6	11.4	10.8	10.2	9.0	8.4	7.8	7.2
Lift Check valve	55	140∀⊽	17.7	1.50	1.40	1.30	1.20	1.20	1.10	1.00	0.94	0.83	0.77	0.72	0.66
Tilting Disc Check Valve	5	80√⊽	10.13						0.76	0.72	0.68	0.60	0.56	0.39	0.24
Thung Disc Check valve	15	30√₹	3.80						2.30	2.20	2.00	1.80	1.70	1.20	0.72
Foot Valve with Strainer Poppet Disc	420	15√⊽	1.90	11.3	10.5	9.70	9.30	8.80	8.00	7.60	7.10	6.30	5.90	5.50	5.0
Foot Valve with Strainer Hinged Disc	75	35√₹	4.43	2.00	1.90	1.70	1.70	1.70	1.40	1.40	1.30	1.10	1.10	1.00	0.90

Fitting	Description	All Pipe Sizes K Value
Pipe Exit	Projecting Sharp-Edged Rounded	1.00

Pipe Entrance	Inward Projecting	0.78			
	Sharp-Edged	0.50			
	r/d=0.02	0.28			
Dina Entranaa Eluah	r/d=0.04	0.24			
Pipe Entrance Flush	r/d=0.06	0.15			
	r/d=0.10	0.09			
	r/d<0.14	0.04			

The K values given below are for making estimates of friction loss in cases not covered in the previous tables.

	T	ype of	Fitting			K Value							
Disk or W	obble N	Aeter				3.4 - 10							
Rotary M	eter (Sta	ar or Co	og-Wheel	Piston)				1	0				
Reciproca	ting Pis	ton Me	eter				1	5					
Turbine V	Vheel (I	ouble-	-Flow) Me	eter				5 -	7.5				
Bends w/	Corruga	ted Inn	er Radius			1.3 -	- 1.6 tim	es valu	ue for smo	oth bend	1		
Select the	6" angl approp	e valve riate K	e for Scheo value for ere K is the Pipe Size Inches Sch. 40	such and	d selec	t D and f f		dule 40	Pipe Size Inches Sch. 40	D feet	f		
1/2 3/4 1 1 1/4 1 1/2	0.0518 0.0687 0.0874 0.1150 0.1342	0.025 0.023 0.022	3 4 5	0.2058 0.2557 0.3355 0.4206 0.5054	0.018 0.017 0.016	12 14 16	0.8350 0.9948 1.0937 1.250 1.4063	0.013 0.013 0.013	30 36 42	1.8857 2.3333 2.8333 3.3333 3.8333	0.011 0.011 0.010		
	0.1723	1 1		0.6651		1	1.5678		1		0.010		

Friction Loss of Water in Pipe Fittings in Terms of Equivalent Length - Feet of Straight Pipe | Gota | Long | Std | Std | Swing | Angle Global

	Length - Feet of Straight Pipe															
Nominal pipe size	Actual inside diameter	Friction factor	-	90° elbow	Long radius 90° or	tee -	tee -	Close return	Swing check valve	valve -	valve -		90°Welding elbow		Mitre ben	
pipe size	inches d	f	full open	CIDOW	45° std elbow		branch flow	bend	- full open	full open	full valve			r/d =	45°	90°
1/2	.622	.027	.41	1.55	.83	1.04	3.11	2.59	5.18	7.78	17.6					
3/4	.824	.025	.55	2.06		1.37		3.43	6.86	10.3	23.3					
1	1.049	.023	.70	2.62		1.75		4.37	8.74	13.1	29.7					
11/4	1.380	.022	.92	3.45		2.30		5.75	11.5	17.3	39.1					
1½	1.610	.021	1.07	4.03		2.68		6.71	13.4	20.1	45.6					
2	2.067	.019	1.38	5.17		3.45		8.61	17.2	25.8	58.6	7.75	3.45	2.07		10.3
2½	2.469	.018	1.65	6.17		4.12		10.3	20.6	30.9	70.0	9.26	4.12	2.47		12.3
3	3.068	.018	2.04	7.67		5.11		12.8	25.5	38.4	86.9	11.5	5.11	3.07		15.3
4	4.026	.017	2.68	10.1		6.71	20.1	16.8	33.6	50.3	114	15.1	6.71	4.03		20.1
5	5.047	.016	3.36	12.6		8.41	25.2	21.0	42.1	63.1	143	18.9	8.41	5.05		25.2
6	6.065	.015	4.04	15.2		10.1	30.3	25.3	50.5	75.8	172	22.7	10.1	6.07		30.3
8	7.981	.014	5.32	20.0		13.3		33.3	33.3	99.8	226	29.9	13.3	7.98		39.9
10 12	10.02	.014	6.68	25.1		16.7		41.8	41.8	125 149	284 338	29.2	16.7	10.0	11	50.1
12	11.938 13.124	.013 .013	7.96 8.75	29.8 32.8		19.9 21.8		49.7	49.7 54.7	164	372	34.8 38.3	19.9 21.8	11.9 13.1		59.7 65.6
						_			34.7	104	312	36.3				
16	15.00	.013	10.0	37.5		25.0		62.5	62.5	188	425	31.3	25.0	15.0		75.0
18 20	16.876 18.814	.012 .012	16.9 12.5	42.2 47.0		28.1 31.4		70.3 78.4	70.3	210	478	35.2	28.1 31.4	16.9 18.8		84.4 94.1
20 24	22.628	0.12	15.1	56.6		37.7		94.3	78.4	235	533	39.2	37.7	22.6	28.3	
30	28	.011	18.7	70		46.7		117	94.3	283	641	47.1	46.7	28	35	140
36	34	.011	22.7	85	45.3	56.7	170	142					56.7	34	43	170
42	40	.010	26.7	100		66.7		167					66.7	40	50	200
48	46	.010	30.7	115	61.3	76.7	230	192					76.7	46	58	230

L/D

 $\frac{1}{2}$ to 6 = 100

24 to 48 =50