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Friction Loss for Industrial ASTM & DIN Piping

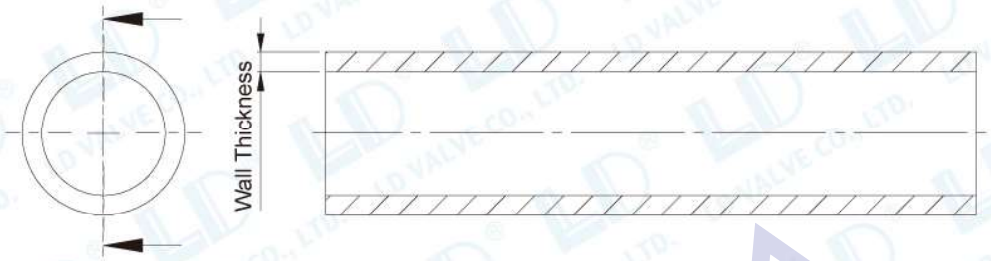
Note: Independent variables: Gallons per minute and nominal O.D. pipe size
Dependent variables: Velocity, friction head and pressure drop per 100 feet of pipe, interior smooth.

Flow Rate		Flow Velocity V	Friction Head Loss	Friction Loss	Flow Velocity V	Friction Head Loss	Friction Loss	Flow Velocity V	Friction Head Loss	Friction Loss	Flow Velocity V	Friction Head Loss	Friction Loss	Flow Velocity V	Friction Head Loss	Friction Loss	Flow Velocity V	Friction Head Loss	Friction Loss	Flow Velocity V	Friction Head Loss	Friction Loss	Flow Velocity V	Friction Head Loss	Friction Loss
Gallon/min	Liter/min	feet/sec	feet/100ft	psi/100ft	feet/sec	feet/100ft	psi/100ft	feet/sec	feet/100ft	psi/100ft	feet/sec	feet/100ft	psi/100ft	feet/sec	feet/100ft	psi/100ft	feet/sec	feet/100ft	psi/100ft	feet/sec	feet/100ft	psi/100ft	feet/sec	feet/100ft	psi/100ft
		1/2" (20mm)																						
1	3.8	1.48	2.24	0.97	3/4" (25mm)																			
2	7.6	2.95	8.08	3.50	1.57	1.73	0.75	1" (32mm)																
5	18.9	7.39	44.12	19.13	3.92	9.45	4.10	2.33	2.67	1.16	1-1/4" (40mm)													
7	26.5	10.34	82.27	35.66	5.49	17.62	7.64	3.27	4.98	2.16	1.82	1.20	0.52	1-1/2" (50mm)										
10	37.9	14.77	159.26	69.04	7.84	34.11	14.79	4.67	9.65	4.18	2.59	2.32	1.01	1.88	1.05	0.46	2" (63mm)							
15	56.8				11.76	72.27	31.33	7.00	20.44	8.86	3.89	4.91	2.13	2.81	2.23	0.97	1.68	0.63	0.27	2-1/2" (75mm)					
20	75.7							9.33	34.82	15.09	5.19	8.36	3.62	3.75	3.80	1.65	2.23	1.07	0.46	1.56	0.45	0.20	3" (90mm)		
25	94.6	4" (110mm)						11.66	52.64	22.82	6.49	12.64	5.48	4.69	5.74	2.49	2.79	1.63	0.71	1.95	0.68	0.29	1.25	0.23	0.10
30	114	0.86	0.08	0.03				14.00	73.78	31.98	7.78	17.71	7.68	5.63	8.04	3.49	3.35	2.28	0.99	2.34	0.95	0.41	1.49	0.32	0.14
35	132	1.00	0.11	0.05				16.33	98.16	42.55	9.08	23.56	10.21	6.57	10.70	4.64	3.91	3.03	1.31	2.73	1.26	0.55	1.74	0.43	0.19
40	151	1.14	0.14	0.06				18.66	125.70	54.49	10.38	30.17	13.08	7.50	13.70	5.94	4.47	3.88	1.68	3.12	1.62	0.70	1.99	0.54	0.23
45	170	1.28	0.17	0.07	5" (125/140mm)						11.68	37.53	16.27	8.44	17.05	7.39	5.03	4.83	2.09	3.51	2.01	0.87	2.24	0.68	0.29
50	189	1.43	0.21	0.09	0.90	0.07	0.03				12.97	45.61	19.77	9.38	20.72	8.98	5.58	5.87	2.54	3.90	2.44	1.06	2.49	0.82	0.36
60	227	1.71	0.30	0.13	1.08	0.10	0.04				15.57	63.93	27.71	11.26	29.04	12.59	6.70	8.22	3.56	4.68	3.43	1.49	2.99	1.15	0.50
70	265	2.00	0.39	0.17	1.26	0.13	0.06										7.82	10.94	4.74	5.46	4.56	1.98	3.49	1.54	0.67
75	284	2.14	0.45	0.20	1.35	0.15	0.07	6" (150mm)									8.38	12.43	5.39	5.85	5.18	2.25	3.74	1.74	0.75
80	303	2.28	0.51	0.22	1.44	0.16	0.07	1.00	0.07	0.03							8.93	14.01	6.07	6.23	5.84	2.53	3.99	1.97	0.85
90	341	2.57	0.63	0.27	1.62	0.20	0.09	1.13	0.09	0.04							10.05	17.42	7.55	7.01	7.26	3.15	4.48	2.45	1.06
100	379	2.85	0.76	0.33	1.80	0.25	0.11	1.25	0.10	0.04							11.17	21.18	9.18	7.79	8.83	3.83	4.98	2.97	1.29
125	473	3.56	1.16	0.50	2.25	0.38	0.16	1.57	0.16	0.07	8" (200/225mm)						13.96	32.01	13.88	9.74	13.34	5.78	6.23	4.49	1.95
150	568	4.28	1.62	0.70	2.70	0.53	0.23	1.88	0.22	0.10	1.07	0.06	0.03							11.69	18.70	8.11	7.47	6.30	2.73
175	662	4.99	2.16	0.94	3.15	0.70	0.30	2.19	0.29	0.13	1.25	0.07	0.03							13.64	24.88	10.79	8.72	8.38	3.63
200	757	5.70	2.76	1.20	3.60	0.90	0.39	2.51	0.37	0.16	1.43	0.10	0.04										9.97	10.73	4.65
250	946	7.13	4.17	1.81	4.49	1.36	0.59	3.13	0.57	0.25	1.79	0.14	0.06	10" (250/280mm)									12.46	16.22	7.03
300	1136	8.55	5.85	2.54	5.39	1.90	0.82	3.76	0.79	0.34	2.14	0.20	0.09	1.36	0.07	0.03									
350	1325	9.98	7.78	3.37	6.29	2.53	1.10	4.39	1.05	0.46	2.50	0.27	0.12	1.59	0.09	0.04	12" (315mm)								
400	1514	11.41	9.96	4.32	7.19	3.24	1.40	5.02	1.35	0.59	2.86	0.34	0.15	1.81	0.11	0.05	1.28	0.05	0.02						
450	1703				8.09	4.04	1.75	5.64	1.68	0.73	3.21	0.43	0.19	2.04	0.14	0.06	1.44	0.06	0.03	14" (355mm)					
500	1893				8.99	4.90	2.12	6.27	2.04	0.88	3.57	0.52	0.23	2.27	0.17	0.07	1.60	0.07	0.03	1.33	0.05	0.02	16" (400mm)		
750	2839	18"						9.40	4.33	1.88	5.36	1.10	0.48	3.40	0.36	0.16	2.40	0.16	0.07	1.99	0.10	0.04	1.52	0.05	0.02
1000	3785	1.59	0.05	0.02	20"			12.54	7.37	3.19	7.14	1.87	0.81	4.54	0.62	0.27	3.20	0.27	0.12	2.65	0.17	0.07	2.02	0.09	0.04
1250	4731	1.99	0.07	0.03	1.61	0.04	0.02				8.93	2.83	1.23	5.67	0.94	0.41	4.01	0.40	0.17	3.32	0.25	0.11	2.53	0.13	0.06
1500	5678	2.39	0.10	0.04	1.93	0.06	0.03	24"			10.71	3.97	1.72	6.80	1.32	0.57	4.81	0.56	0.24	3.98	0.36	0.16	3.03	0.18	0.08
2000	7570	3.19	0.18	0.08	2.58	0.10	0.04	1.78	0.04	0.02				9.07	2.24	0.97	6.41	0.96	0.42	5.31	0.61	0.26	4.05	0.31	0.13
2500	9463	3.98	0.27	0.12	3.22	0.16	0.07	2.23	0.06	0.03				11.34	3.39	1.47	8.01	1.46	0.63	6.63	0.92	0.40	5.06	0.48	0.21
3000	11355	4.78	0.37	0.16	3.86	0.22	0.10	2.67	0.09	0.04							9.61	2.04	0.88	7.96	1.29	0.56	6.07	0.67	0.29
3500	13248	5.58	0.50	0.22	4.51	0.30	0.13	3.12	0.12	0.05							11.21	2.71	1.17	9.29	1.72	0.75	7.08	0.89	0.39
4000	15140	6.37	0.64	0.28	5.15	0.38	0.16	3.56	0.15	0.07										10.62	2.20	0.95	8.09	1.14	0.49
4500	17033	7.17	0.79	0.34	5.80	0.47	0.20	4.01	0.19	0.08													9.10	1.41	0.61
5000	18925	7.97	0.96	0.42	6.44	0.57	0.25	4.45	0.23	0.10													10.12	1.72	0.75
5500	20818	8.77	1.15	0.50	7.08	0.68	0.29	4.90	0.28	0.12															
6000	22710	9.56	1.35	0.59	7.73	0.80	0.35	5.35	0.33	0.14															
6500	24603	10.36	1.56	0.68	8.37	0.93	0.40	5.79	0.38	0.16															
7000	26495	11.13	1.79	0.78	9.02	1.07	0.46	6.24	0.44	0.19															
7500	28388				9.66	1.21	0.52	6.68	0.49	0.21															
8000	30280				10.30	1.37	0.59	7.13	0.56	0.24															
8500	32173							7.57	0.62	0.27															
9000	34065							8.02	0.69	0.30															
9500	35958							8.46	0.77	0.33															
10000	37850							8.91	0.84	0.36															

LD-500 INDUSTRIAL ASTM & DIN - PVC/CPVC PIPE

LD Thermoplastic Pipe is Manufactured by the Following Standard Specifications

TYPE	MATERIAL STD.	DIMENSIONS	CELL CLASSIFICATION
PVC	ASTM D 1784	ASTM D 1785 DIN 8061/62	TYPE I, GRADE 1, PVC 12454
CPVC	ASTM D 1784	ASTM F 441 DIN 8079/80	TYPE IV, GRADE 1, CPVC 23447



Schedule 80 PVC ASTM D1785 and CPVC ASTM F441 Pipe Dimensions, Weights and Maximum Operation Pressure

NOMINAL PIPE SIZE	OUTSIDE DIAMETER		WALL THICKNESS		APPROX. INSIDE DIAMETER	NOMINAL WEIGHT		MAX. OPERATING PRESSURE
						PVC	CPVC	
inch	inch		inch		inch	lb/ft	lb/ft	psi
1/2"	0.840	±0.004	0.147	±0.020	0.53	0.21	0.23	850
3/4"	1.050	±0.004	0.154	±0.020	0.72	0.28	0.31	690
1"	1.315	±0.005	0.179	±0.021	0.94	0.41	0.45	630
1-1/4"	1.660	±0.005	0.191	±0.023	1.26	0.57	0.62	520
1-1/2"	1.900	±0.006	0.200	±0.024	1.48	0.69	0.76	470
2"	2.375	±0.006	0.218	±0.026	1.91	0.96	1.05	400
2-1/2"	2.875	±0.007	0.276	±0.033	2.29	1.46	1.60	420
3"	3.500	±0.008	0.300	±0.036	2.86	1.96	2.14	370
4"	4.500	±0.009	0.337	±0.040	3.79	2.86	3.12	320
5"	5.563	±0.010	0.375	±0.045	4.77	3.97	4.34	290
6"	6.625	±0.011	0.432	±0.052	5.71	5.46	5.96	280
8"	8.625	±0.015	0.500	±0.060	7.57	8.30	9.06	250
10"	10.75	±0.015	0.593	±0.071	9.49	12.30	13.43	230
12"	12.75	±0.015	0.687	±0.082	11.29	16.93	18.48	230
14"	14.00	±0.015	0.750	±0.090	12.41	20.30	22.16	220
16"	16.00	±0.019	0.843	±0.101	14.21	26.10	28.49	220
18"	18.00	±0.019	0.937	±0.112	16.01	32.66	35.65	220
20"	20.00	±0.023	1.031	±0.124	17.81	39.97	43.63	220
24"	24.00	±0.031	1.218	±0.146	21.42	56.70	61.89	210

PVC DIN 8061/62 and CPVC DIN 8079/80 Pipe Dimensions, Weight and Maximum Operation Pressure

NOMINAL PIPE SIZE	OUTSIDE DIAMETER		WALL THICKNESS		APPROX. INSIDE DIAMETER	NOMINAL WEIGHT		MAX. OPERATING PRESSURE
						PVC	CPVC	
mm	mm		mm		mm	lb/ft	lb/ft	psi
20	20	+0.2	1.5	+0.4	16.80	0.22	0.24	850
25	25	+0.2	1.9	+0.4	21.00	0.29	0.33	690
32	32	+0.2	2.4	+0.5	26.95	0.43	0.47	630
40	40	+0.2	3.0	+0.5	33.75	0.60	0.65	520
50	50	+0.2	3.7	+0.6	42.30	0.72	0.80	470
63	63	+0.2	4.7	+0.7	53.25	1.01	1.10	400
75	75	+0.3	5.6	+0.8	63.40	1.53	1.68	420
90	90	+0.3	6.7	+0.9	76.15	2.06	2.25	370
110	110	+0.3	8.2	+1.1	93.05	3.00	3.28	320
125	125	+0.4	9.3	+1.2	105.80	3.15	3.44	290
140	140	+0.4	10.4	+1.3	118.55	4.17	4.56	280
160	160	+0.4	11.9	+1.4	135.50	5.73	6.26	280
180	180	+0.4	13.4	+1.6	152.40	6.31	6.88	280
200	200	+0.4	14.9	+1.7	169.35	6.94	7.57	250
225	225	+0.5	16.7	+1.3	190.95	8.72	9.51	250
250	250	+0.5	18.6	+2.1	211.75	9.59	10.46	230
280	280	+0.6	20.8	+2.3	237.25	12.92	14.10	230
315	315	+0.6	23.4	+2.6	266.90	17.78	19.40	220
355	355	+0.7	26.3	+2.9	300.95	21.32	23.27	220
400	400	+0.7	29.7	+3.2	339.00	27.41	29.91	220

NOTE: Maximum Operation Pressure is applied to 73°F/22°C.

Properties of PVC & CPVC PIPE

ITEM	inch-lb unit			Test Method
	PVC	CPVC	unit	
GENERAL				
Cell Classification	12454	23447	–	ASTM D1784
Maximum Usable Temp.	140	200	℉	–
Specific Gravity @ 73℉(23℃)	1.42±0.02	1.55±0.02	g/cc	ASTM D792
Water Absorption % increase 24 hrs@ 73℉(23℃)	0.04	0.04	%	ASTM D570
Hardness, Rockwell	110 - 120	115 - 125	–	ASTM D785
Poisson's Ratio @ 73℉(23℃)	0.38	0.36	–	ASTM D638
MECHANICAL				
Tensile Strength @ 73℉(23℃)	7,100	7,700	psi	ASTM D638
Tensile Strength @ 194℉(90℃)	–	3,200	psi	"
Tensile Modulus of Elasticity @ 73℉(23℃)	410,000	380,000	psi	"
Tensile Modulus of Elasticity @ 194℉(90℃)	–	220,000	psi	"
Flexural Strength @73℉(23℃)	14,000	13,000	psi	ASTM D790
Flexural Modulus of Elasticity @ 73℉(23℃)	400,000	390,000	psi	"
Compressive Strength @ 73℉(23℃) ε = 10%	10,000	14,000	psi	ASTM D695
Compressive Modulus of Elasticity @ 73℉	110,000	145,000	psi	"
Izod Impact, notched @ 73℉(23℃)	1.5	3.0	ft-lb/in	ASTM D256
THERMAL				
Coefficient of Linear Expansion	2.5-3.5x10^{-5}	3.0-4.0x10^{-5}	in/in/℉	ASTM D696
Coefficient of Thermal Conductivity	1.20	0.90	BUT/in/hr/ft.2/℉	ASTM C177
Heat Deflection Temperature Under Load (264psi, annealed)	165	230	℉	ASTM D648
Specific Heat	0.27	0.26	Cal./℃/g	ASTM D2766
ELECTRICAL				
Volume Resistivity	>1.0 x 10^{15}	>1.0 x 10^{15}	ohm/cm	ASTM D257
Dielectric Strength	>1000	>1000	volt/mm	ASTM D149
Dielectric Constant	3	3	–	ASTM D150
Power Factor	0.01-0.02	0.01-0.02	–	"
Electrical Conductivity	Non Conductor	Non Conductor	–	–
FIRE PERFORMANCE				
Flammability Rating	_ 0	V-0,5VB,5VA	–	UL-94
Flame Spread Index	<10	<10	–	"
Average Time of Burning	<5	<5	sec	ASTM D635
Average Extent of Burning	<10	<10	mm	"
Burning Rate	Self Extinguishing	Self Extinguishing	mm/min	"
Limiting Oxygen Index (LOI)	45	60	LOI	ASTM D2863

Recommended Pipe Hangers for PVC and CPVC Piping Systems

PIPE RINGS

Adj. Swivel Ring
Split Ring Type
Fig. 1
2/4 to 8 in. pipe

Split Ring
Fig. 2
3/6 to 8 in. pipe

Adj. Ring
Fig. 6
½ to 8 in. pipe

Adj.Swivel Ring
Fig. 7
½ to 8 in. pipe

Adj. Clevis-Standard
Fig. 11
½ to 30 in. pipe

Adj. Clevis
For Insulated Lines
Fig. 12
3/4 to 8 in. pipe

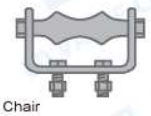
PIPE ROLLS

Adj.Steel Yoke
Pipe Roll
Fig. 3
2½ to 20 in. pipe

Adj. Swivel Pipe Roll
Fig. 4
2½ to 12 in. pipe

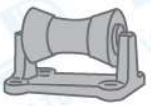
Single Pipe Roll
Fig. 8
1 to 30 in. pipe

Adj. Pipe Roll Support
Fig. 9
1 to 30 in. pipe



Roller Chair
Fig. 13
2 to 12 in. pipe

Roller Chair
Fig. 14
2 to 12 in. pipe



Pipe Roll Stand Complete
Fig. 16
2 to 42 in. pipe

STRAPS HOOKS

Wrought Strap Short
Fig. 5
½ to 4 in. pipe

One Hole Clamp
Fig. 10
3/6 to 4 in. pipe

Tin Strap
Fig. 15
½ to 2 in. pipe

Not Recommend

PIPE RINGS

Pipe Clamp Medium
Fig. 17
½ to 24 in. pipe

Double Bolt Pipe Clamp
Fig. 18
2/4 to 36 in. pipe

PIPE COVERING

Insulation Protection Shield
Fig. 19
½ to 24 in. pipe

BOLT

U Bolt
Fig. 20"
Standard
½ to 30 in. pipe
Light weight
½ to 10 in. pipe

NOTE: Hanger and support spacing of LD PVC & CPVC piping varies depending on pipe diameter and water temperature. Local regulations usually indicate minimum spacing. Use only smooth straps or hangers that do not place rough or sharp edges against the pipe. Vertical runs must be properly supported to prevent excessive loading on the lower fitting. Clamps and hangers must not compress, distort, cut, abrade or exert compressive stresses on the pipe, otherwise it could result in cracking or premature burst failure.