

Hydraulic Flow Tables

Two sets of flow tables are presented within this design guide. **Tables 1a and 1b** are for pipes installed with varying gradients and the velocity and volumetric flow rate figures are based on the **Colebrook-White uniform steady flow equation** using an appropriate roughness coefficient for stainless steel.

For shallow gradients, the Colebrook-White formula underestimates flow rates as when gradient tends to 0%, velocity also tends to zero. As a result gradients below the line in Tables 1a and 1b flow rates are lower than Table 2.

Table 2 is for pipes installed with level or nearly level gradients where the uniform steady flow equations are not applicable. The performance figures therefore have been generated from the ACO hydraulic design program that is based on **spatially-varied flow theory** and which has been verified following full-scale laboratory testing.

Self Cleansing Velocity

Some pipe manufacturers often make many claims on self-cleansing velocity, but recent research has shown that there are no unique design criteria to achieve a self-cleansing installation. This is because the sediment type, size, concentration, flow rates and pipe size all play an important part in the self-cleansing process.

NOTE:

When draining storm or foul water applications, it is inevitable that sediment deposits will occur within the system. Sediment and scale deposits will reduce the flow rate through any pipe system and it is recommended that an allowance is made for this within the design.

Table 1a - for Rainwater/Stormwater Applications

Pipe Ø	50mm		75mm		110mm		160mm	
	Q = Flow Rate (l/s)		Q = Flow Rate (l/s)		v = Velocity (m/s)		v = Velocity (m/s)	
Gradient (%)	Q	v	Q	v	Q	v	Q	v
10.0	2.71	1.50	8.33	1.99	23.65	2.58	63.82	3.30
7.5	2.35	1.30	7.21	1.72	20.46	2.23	55.22	2.85
5.0	1.91	1.06	5.87	1.40	16.68	1.82	45.03	2.33
4.5	1.81	1.00	5.57	1.33	15.81	1.73	42.70	2.21
4.0	1.71	0.94	5.24	1.25	14.90	1.63	40.24	2.08
3.5	1.59	0.88	4.90	1.17	13.93	1.52	37.62	1.94
3.0	1.47	0.81	4.53	1.08	12.89	1.41	34.81	1.80
2.5	1.34	0.74	4.13	0.99	11.75	1.28	31.75	1.64
2.0	1.20	0.66	3.69	0.88	10.49	1.15	28.36	1.47
1.5	1.03	0.57	3.19	0.76	9.07	0.99	24.52	1.27
1.0	0.84	0.46	2.59	0.62	7.38	0.81	19.96	1.03
0.9	0.79	0.44	2.45	0.59	6.99	0.76	18.92	0.98
0.8	0.75	0.41	2.31	0.55	6.58	0.72	17.82	0.92
0.7	0.70	0.39	2.16	0.52	6.15	0.67	16.65	0.86

Flow rates based on Colebrook-White formula. **Roughness Coefficient $k_s = 0.6mm$**

Table 1b - for Soil/Foul Water Applications

Pipe Ø	50mm		75mm		110mm		160mm	
	Q = Flow Rate (l/s)		Q = Flow Rate (l/s)		v = Velocity (m/s)		v = Velocity (m/s)	
Gradient (%)	Q	v	Q	v	Q	v	Q	v
10.0	2.29	1.27	7.11	1.70	20.39	2.23	55.47	2.87
7.5	1.98	1.09	6.16	1.47	17.65	1.93	48.02	2.48
5.0	1.62	0.89	5.02	1.20	14.40	1.57	39.18	2.02
4.5	1.53	0.85	4.76	1.14	13.66	1.49	37.16	1.92
4.0	1.44	0.80	4.49	1.07	12.87	1.41	35.03	1.81
3.5	1.35	0.75	4.20	1.00	12.04	1.31	32.76	1.69
3.0	1.25	0.69	3.88	0.93	11.14	1.22	30.32	1.57
2.5	1.14	0.63	3.54	0.85	10.16	1.11	27.67	1.43
2.0	1.02	0.56	3.17	0.76	9.08	0.99	24.73	1.28
1.5	0.88	0.49	2.74	0.65	7.86	0.86	21.40	1.11
1.0	0.72	0.40	2.23	0.53	6.40	0.70	17.45	0.90
0.9	0.68	0.37	2.11	0.51	6.07	0.66	16.55	0.85
0.8	0.64	0.35	1.99	0.48	5.72	0.62	15.59	0.81
0.7	0.60	0.33	1.86	0.44	5.35	0.58	14.58	0.75

Flow rates based on Colebrook-White formula. **Roughness Coefficient $k_s = 1.5mm$**

Table 2 - Level or Nearly Level Gradients

Pipe Ø Length		Gradient % - Flow Rate Q (l/s)				
(mm)	(m)	0.0%	0.5%	1.0%	1.25%	1.5%
50	5	0.45	0.85	1.20	1.30	1.40
50	10	0.35	0.85	1.20	1.30	1.40
50	15	0.30	0.85	1.20	1.30	1.40
50	20	0.25	0.85	1.15	1.25	1.35
75	5	1.50	2.50	3.16	3.40	3.60
75	10	1.15	2.40	3.00	3.30	3.60
75	15	1.00	2.40	3.00	3.20	3.40
75	20	0.90	2.30	2.99	3.10	3.20
110	5	4.50	6.75	8.10	8.55	9.00
110	10	3.60	6.60	8.00	8.43	9.00
110	15	3.20	6.40	7.84	8.20	8.60
110	20	2.80	6.15	7.75	8.15	8.55
160	5	13.00	16.90	20.06	21.00	22.00
160	10	11.00	16.10	19.40	20.50	21.40
160	15	9.50	16.50	19.31	20.00	20.70
160	20	7.80	16.00	18.69	19.50	20.30

Flow rates based on spatially-varied flow formula. Manning Coefficient = 0.011