Flow Calculation by Measuring

Horizontal Pipe Discharge

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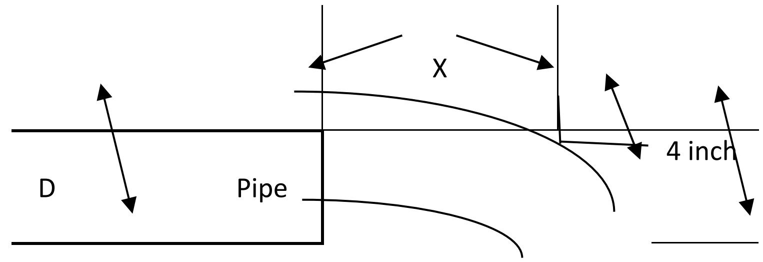
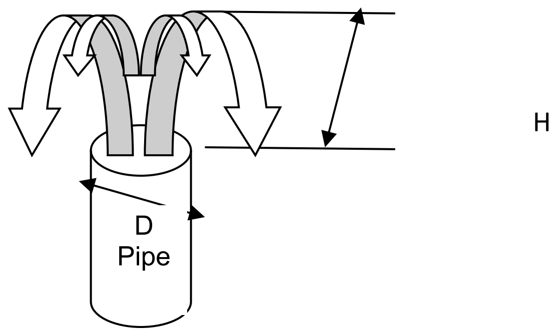


X Distance Inches	Gallons per Minute Discharge for a given Nominal Pipe Diameter D (Inches)											
	1	**1-¼**	**1-½**	**2**	**2-½**	**3**	**4**	**5**	**6**	**8**	**10**	**12**
4	6	10	13	22	31	48	83					
5	7	12	17	27	39	61	104	163				
6	8	15	20	33	47	73	125	195	285			
7	10	17	23	38	55	85	146	228	334	580		
8	11	20	26	44	62	97	166	260	380	665	1060	
9	13	22	30	49	70	110	187	293	430	750	1190	1660
10	14	24	33	55	78	122	208	326	476	830	1330	1850
11	16	27	36	60	86	134	229	360	525	915	1460	2020
12	17	29	40	66	94	146	250	390	570	1000	1600	2220
13	18	31	43	71	102	158	270	425	620	1080	1730	2400
14	20	34	46	77	109	170	292	456	670	1160	1860	2590
15	21	36	50	82	117	183	312	490	710	1250	2000	2780
16	23	39	53	88	125	196	334	520	760	1330	2120	2960
17		41	56	93	133	207	355	550	810	1410	2260	3140
18			60	99	144	220	375	590	860	1500	2390	3330
19				110	148	232	395	620	910	1580	2520	3500
20					156	244	415	650	950	1660	2660	3700
21						256	435	685	1000	1750	2800	3890
22							460	720	1050	1830	2920	4060
23								750	1100	1910	3060	4250
24									1140	2000	3200	4440

When brink depths are greater than 0.5D, the more general purpose Purdue pipe method developed by Greve (1928) should be used, rather than the California pipe method. The Purdue method applies equally well to both partially and completely filled pipes. The Purdue method consists of measuring coordinates of the upper surface of the jet as shown above. If the water in the pipe is flowing at a depth of less than 0.8D at the outlet, the vertical distance, Y, can be measured at the end of the pipe where X = 0. For higher rates of flow, Y, may be measured at horizontal distances, X, from the pipe exit of 6, 12, or 18 inches. The most accurate results will be obtained when the pipe is truly horizontal. If it slopes upward, the indicated discharge will be too high. If it slopes downward, the indicated discharge will be too low.

Vertical Pipe Discharge



The following formula is an approximation of the output of a vertical pipe.

$$GPM = \sqrt{H} \times K \times D^2 \times 5.68$$

GPM = gallons per minute
H = height in inches
D = diameter of pipe in inches
K = constant from 0.87 to 0.97 for diameters of
2 to 6 inches and height (H) up to 24 inches

Example: K = 0.97, 6 inch diameter with 10 inch height ≈ 626 GPM

Lawrence and Braunworth (1906) noted that two kinds of flow occur from the end of vertical pipes. With a small rise of water (up to 0.37*d*) above the end of the pipe, the flow acts like a circular weir. When the water rises more than 1.4*d*, jet flow occurs. When the rise is between these values, the mode of flow is in transition. When the height of the jet exceeded 1.4*d*, as determined by sighting over the jet to obtain the maximum rise, the discharge is given by:

$$Q = 5.01d^{1.99}h^{0.53}$$

where:

Q = rate of flow, gallons per minute
d = inside diamter of the pipe, inches
h = height of jet, inches

When the rise of water above the end of the pipe is less that 0.37*d*, discharge is given by:

$$Q = 6.17d^{1.25}h^{1.35}$$