

## Engineering Information

### Hydraulic and Gas Engineering Hydraulic Memoranda

For the hydraulic fluid to do work, it must flow to the actuator and or motors, then return to a reservoir. The fluid is then filtered and re-pumped. The path taken by hydraulic fluid is called a hydraulic circuit of which there are several types. Open center circuits use pumps which supply a continuous flow. The flow is returned to tank through the control valve's *open center*; that is, when the control valve is centered, it provides an open return path to tank and the fluid is not pumped to a high pressure. Otherwise, if the control valve is actuated it routes fluid to and from an actuator and tank. The fluid's pressure will rise to meet any resistance, since the pump has a constant output. If the pressure rises too high, fluid returns to tank through a pressure relief valve. Multiple control valves may be stacked in series. This type of circuit can use inexpensive, constant displacement pumps.

Closed center circuits supply full pressure to the control valves, whether any valves are actuated or not. The pumps vary their flow rate, pumping very little hydraulic fluid until the operator actuates a valve. The valve's spool therefore doesn't need an open center return path to tank. Multiple valves can be connected in a parallel arrangement and system pressure is equal for all valves.

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Head over Centre	Velocity (Theor)	Velocity x .6	Orific Diameter (inches)					
			4	5	6	7	8	10
Ins.	Ft./m.	Ft./m. p.m.	G. p.m.	G. p.m.	G. p.m.	G. p.m.	G. p.m.	G. p.m.
10	439	272	148	231				
12	482	298	162	253	364			
14	519	321	175	273	392	535		
16	555	344	188	292	420	573	750	
18	586	363	198	308	447	606	792	
20	621	385	209	327	471	644	839	1312
22	652	404	220	344	495	675	881	1474
26	681	422	230	358	517	704	920	1437

The quality of water discharged over a 90° triangular noten where Q = quantity (cu.ft./min.) and H = Head of water in ins. is given by-Gal./min. =  $1,905^2 H^2 \sqrt{H}$ . Head measured from crest of notch to surface of still water.  
The discharged of water over a rectangular notch per inch. Width. For other widths, multiply by width in inches.

Head 7/8 In.	0 In.	1/8 In.	1/7 In.	7/8 In.	1/2 In.	4/8 In.	3/4 In.
Ins.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.
0		0.01	0.05	0.09	0.14	0.19	0.26
2	1.13	1.23	1.35	1.46	1.58	1.70	1.82
4	3.20	3.35	3.50	3.66	3.81	3.97	4.14
6	5.87	6.06	6.25	6.44	6.62	6.82	7.01
8	9.05	9.26	9.47	9.66	9.91	10.13	10.35
10	12.64	12.88	13.12	13.36	13.60	13.85	14.09
12	16.62	16.88	17.15	17.41	17.67	17.94	18.21
14	20.95	21.23	21.51	21.80	22.08	22.37	22.65
16	25.60	25.90	26.20	26.50	26.80	27.11	27.42
18	30.54	30.86	31.18	31.50	31.82	32.10	32.47
20	35.77	36.11	35.46	36.78	37.12	37.46	37.08

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THE ORETICAL VELOCITY OF WATER FT. PER MINUTE									
Velocity, ft. per sec = $8.025 \sqrt{H}$ ft. min. = $481.5 \sqrt{H}$									
H = 2.3 P									
Head	0	2'	4'	6'	8'	Pressure	Head		
Feet	1b/in2	.8670	1.7340	2.6010	3.4681	P 1b/in.	Feet		
0	0	680.94	963.0	1179.43	1369.89	0	0		
10	1522.64	1776.96	1801.63	1926.00	2042.81	4.3351	10		
30	2637.27	2723.80	2807.63	2889.00	2968.16	13.0032	30		
50	3404.73	3472.14	3538.30	3603.21	3667.01	21.6754	50		
70	4028.52	4085.67	4142.01	4197.62	4252.51	30.3455	70		
90	4567.89	4618.40	4668.34	4717.74	4766.61	39.0356	90		
200		400	600	800	1000	1b./in <sup>2</sup>			
0	6809.42	9630.00	11794.29	13618.82	15226.38	0			
25	7222.50	9926.36	12037.50	13830.30	15415.51	10.8377	25		
50	7613.19	10214.16	12275.89	14038.08	15602.38	21.6754	50		
75	7984.76	10494.05	12509.76	14242.96	15787.04	32.5130	75		