FLUID POWER Design Data Sheet-

Womack

Revised Sheet 9 — Womack Design Data File

HYDRAULIC OIL FLOW THROUGH ORIFICES

The chart shows approximate pressure drops which may be expected at various flow rates through sharp edge orifices for petroleum type hydraulic oil. It may be used for designing limiting flow orifices in hydraulic systems. Chart values must be considered as approximate because a number of factors such as specific gravity, orifice efficiency, plumbing ahead of and behind the orifice may cause variations from the values shown.

By making the orifice with a knife edge, it becomes insensitive to temperature, and the flow and pressure drop will remain the same over a reasonable range of oil temperatures (and viscosity changes).

Specific gravity of the fluid makes a significant difference in the pressure drop through a given orifice, and increases approximately as the square of the increase in specific gravity. The chart was calculated for a fluid with 0.9 specific gravity, a close approximation for all petroleum hydraulic oils. Using a heavier fluid, a multiplying factor should be applied to chart values. For example, to find the pressure drop of water, with a specific gravity of 1.00:

$(1.00)^2 \div (0.9)^2 = 1.00 \div 0.81 = 1.23$ multiplying factor.

Multiply all chart values by 1.23 for water flow.

The chart was calculated from information furnished by Double A Products Co., in which the constant 23.5 was developed by trial and error for average orifices. For values not shown in the chart, use this formula:

$$\text{Pressure Drop } (\Delta P) = \left[\text{GPM} \div (23.5 \times A)\right]^2$$

in which, A = Orifice Area, Sq. In.

Figures in this chart are PSI pressure drops across sharp edge orifices, petroleum type hydraulic oil.

GPM	Orifice Diameter, Inches																	
	3/64	1/16	5/64	3/32	7/64	1/8	9/64	5/32	11/64	3/16	13/64	7/32	15/64	1/4	5/16	3/8	7/16	1/2
3	5440	1730	710	338	184	108	68	44	30	21	16	12	9	7	3	1	----	---
5	----	4800	1970	925	512	300	188	123	84	59	43	32	24	19	8	4	2	1
10	----	----	----	3700	2050	1200	750	490	336	238	172	128	97	75	31	15	8	5
15	----	----	----	----	4600	2700	1690	1100	757	534	388	288	219	169	69	33	18	11
20	----	----	----	----	----	4800	3000	1968	1345	950	690	513	390	300	123	59	32	19
30	----	----	----	----	----	----	6750	4430	3025	2135	1550	1155	875	675	275	135	72	42
40	----	----	----	----	----	----	----	----	5380	3800	2760	2050	1555	1205	495	235	128	75
50	----	----	----	----	----	----	----	----	----	----	4310	3205	2430	1880	770	370	200	118
60	----	----	----	----	----	----	----	----	----	----	----	----	4615	3500	2705	1110	535	288	170
70	----	----	----	----	----	----	----	----	----	----	----	----	----	4765	3685	1510	725	390	230
80	----	----	----	----	----	----	----	----	----	----	----	----	----	----	4810	1970	950	510	300
100	----	----	----	----	----	----	----	----	----	----	----	----	----	----	3080	1480	800	470

Chart Figures are PSI

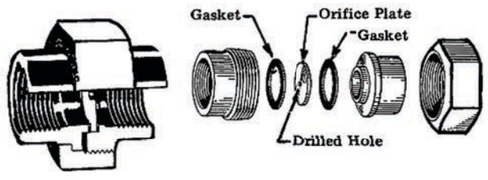

Figure 1. Orifice Plate Installed in Union

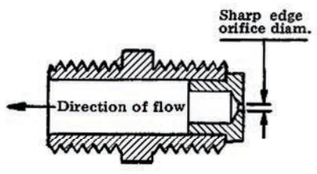

Figure 2. Orifice Plug Installed in a Fitting.

Caution! Calculated values of pressure drop are approximate. Drill orifice undersize to start and run a preliminary test; then enlarge as necessaary using standard twist drills. Countersink finished hole for a sharp edge.

Figure 1. Pipe Union Orifice. For low pressure applications using steel pipe, a very thin orifice plate may be installed in a gasket-type union as indicated in this figure.

Figure 2. High Pressure Systems. An orifice plug may be installed next to a nipple, elbow, or tee. A shoulder on the plug keeps it from being pushed out of place by hydraulic pressure. Be sure plug is installed with shoulder facing toward the pressure.

The orifice plug must be machined by the user. It should be a press fit in the fitting. Remember, the sharper the edge of the orifice, the less the flow and pressure drop will be affected by changes in the fluid viscosity and temperature.

COMPRESSED AIR FLOW THROUGH ORIFICES

Figures in the chart are theoretical SCFM air flows through perfect orifices (See text)

PSI Across Orifice	Orifice Diameter in Inches										
	1/64	1/32	1/16	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1
5	.062	.248	.993	3.97	15.9	35.7	63.5	99.3	143	195	254
6	.068	.272	1.09	4.34	17.4	39.1	69.5	109	156	213	278
7	.073	.293	1.17	4.68	18.7	42.2	75.0	117	168	230	300
9	.083	.331	1.32	5.30	21.2	47.7	84.7	132	191	260	339
12	.095	.379	1.52	6.07	24.3	54.6	97.0	152	218	297	388
15	.105	.420	1.68	6.72	26.9	60.5	108	168	242	329	430
20	.123	.491	1.96	7.86	31.4	70.7	126	196	283	385	503
25	.140	.562	2.25	8.98	35.9	80.9	144	225	323	440	575
30	.158	.633	2.53	10.1	40.5	91.1	162	253	365	496	648
35	.176	.703	2.81	11.3	45.0	101	180	281	405	551	720
40	.194	.774	3.10	12.4	49.6	112	198	310	446	607	793
45	.211	.845	3.38	13.5	54.1	122	216	338	487	662	865
50	.229	.916	3.66	14.7	58.6	132	235	366	528	718	938
60	.264	1.06	4.23	16.9	67.6	152	271	423	609	828	1082
70	.300	1.20	4.79	19.2	76.7	173	307	479	690	939	1227
80	.335	1.34	5.36	21.4	85.7	193	343	536	771	1050	1371
90	.370	1.48	5.92	23.7	94.8	213	379	592	853	1161	1516
100	.406	1.62	6.49	26.0	104	234	415	649	934	1272	1661
110	.441	1.76	7.05	28.2	113	254	452	705	1016	1383	1806
120	.476	1.91	7.62	30.5	122	274	488	762	1097	1494	1951
125	.494	1.98	7.90	31.6	126	284	506	790	1138	1549	2023

Values in the chart are taken from the Compressed Air and Gas Handbook, published by the Compressed Air and Gas Institute, 2130 Keith Building, Cleveland, Ohio 44115.

Chart is based on 100% coefficient of flow (theoretical). For well rounded entrance multiply values by 0.97. For sharp edged orifices with abrupt entrance, a multiplier of 0.65 may be used. All values are calculated, and are approximate. They are intended for estimating purposes only.

VACUUM FLOW THROUGH ORIFICES

Figures in the chart are estimated SCFM air flows through the influence of vacuum.

Vacuum, Inches Hg.	Orifice Diameter in Inches										
	1/64	1/32	1/16	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1
2"	.018	.074	.300	1.20	4.78	10.8	18.1	30.0	43.0	58.8	76.5
4"	.026	.100	.420	1.68	6.74	15.2	27.0	42.2	60.6	82.6	108
6"	.032	.128	.517	2.06	8.25	18.5	33.0	51.7	74.0	101	131
8"	.037	.148	.595	2.37	9.52	21.4	38.5	59.5	85.3	116	152
10"	.041	.165	.660	2.64	10.6	23.8	42.3	66.2	95.2	130	169
12"	.045	.180	.725	2.89	11.6	26.0	46.3	72.6	104	142	185
14"	.048	.195	.780	3.12	12.4	28.0	50.0	78.0	112	153	200
18"	.055	.220	.880	3.53	14.0	31.8	56.5	88.0	127	173	225
24"	.063	.250	1.00	4.04	16.2	36.4	64.6	101	145	198	258

This chart shows estimated flows through a practical orifice, and are about 2/3rds the theoretical flow calculated for a perfect orifice.

The chart may be useful in estimating the flow capacity of a vacuum pump used to furnish vacuum to grippers used in handling sheet material used in the packaging, printing, and similar industries.

Please remember these values are approximate, as many other factors in the system would cause variations in flow.

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