Air Flow Through Orifices

Figures in this chart show theoretical SCFM air flow through sharp edged orifices. In practice, only about 2/3rds of this flow is obtained. The chart may be useful for roughly estimating travel speed of a loaded air cylinder. Assume about 75% of the line PSI is actually working on the load, with the remaining 25% consumed in flow losses in the 4–way valve and connecting lines. Calculate 75% of your incoming line PSI and use this figure to enter the first column in this chart. Move across the table to the column headed by the actual port size of the 4–way valve in the circuit. Use about half the flow shown, because a 4–way valve is not a sharp edged orifice, and will usually pass only about half as much air as a sharp edged orifice.

After finding the SCFM (free air) flow, convert this to CFM (compressed air flow) at the pressure required to move the load. From this the speed of travel of the air cylinder can be estimated.

Chart shows approximate SCFM (free air) flow through sharp edged orifices.

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	0.062	0.249	0.993	3.97	15.9	35.7	63.5	99.3	143	195	254
6	0.068	0.272	1.09	4.34	17.4	39.1	69.5	109	156	213	278
7	0.073	0.293	1.17	4.68	18.7	42.2	75.0	117	168	230	300
9	0.083	0.331	1.32	5.30	21.2	47.7	84.7	132	191	260	339
12	0.095	0.379	1.52	6.07	24.3	54.6	97.0	152	218	297	388
15	0.105	0.420	1.68	6.72	26.9	60.5	108	168	242	329	430
20	0.123	0.491	1.96	7.86	31.4	70.7	126	196	283	385	503
25	0.140	0.562	2.25	8.98	35.9	80.9	144	225	323	440	575
30	0.158	0.633	2.53	10.1	40.5	91.1	162	253	365	496	648
35	0.176	0.703	2.81	11.3	45.0	101	180	281	405	551	720
40	0.194	0.774	3.10	12.4	49.6	112	198	310	446	607	793
45	0.211	0.845	3.38	13.5	54.1	122	216	338	487	662	865
50	0.229	0.916	3.66	14.7	58.6	132	235	366	528	718	938
60	0.264	1.06	4.23	16.9	67.6	152	271	423	609	828	1082
70	0.300	1.20	4.79	19.2	76.7	173	307	479	690	939	1227
80	0.335	1.34	5.36	21.4	85.7	193	343	536	771	1050	1371
90	0.370	1.48	5.92	23.7	94.8	213	379	592	853	1161	1516
100	0.406	1.62	6.49	26.0	104	234	415	649	934	1272	1661
110	0.441	1.76	7.05	28.2	113	254	452	705	1016	1383	1806
120	0.476	1.91	7.62	30.5	122	274	488	762	1097	1494	1951
130	0.494	1.98	7.90	31.6	126	284	506	790	1138	1549	2023

Vacuum Flow Through Orifices

This chart approximates the flow that might be expected through a practical orifice. Flows are about 2/3rds the theoretical flow obtained through a sharp edged orifice. At best, these figures are only approximate because the flow characteristic of your orifice can only be determined by actual measurement under specified conditions.

DESIGN NOTE: This chart shows that multiple-hole grippers work more efficiently at reasonably high vacuums. For example, looking at the chart for a 1/4˝ diameter hole, the first 6˝ Hg of vacuum flows 8.25 SCFM, while the increase in flow over the last 6˝, from 18˝ to 24˝, is only 2.2 SCFM. The more efficient design would be to use more smaller holes working at a higher vacuum.

Figures in body of chart are air flows in SCFM (standard cubic feet/minute).

Orifice Diam., Inches	Degree of Vacuum Across Orifice, Inches Mercury (˝Hg)								
	2˝	4˝	6˝	8˝	10˝	12˝	14˝	18˝	24˝
1/64	0.018	0.026	0.032	0.037	0.041	0.045	0.048	0.055	0.063
1/32	0.074	0.100	0.128	0.148	0.165	0.180	0.195	0.220	0.250
1/16	0.300	0.420	0.517	0.595	0.660	0.725	0.780	0.880	1.00
1/8	1.20	1.68	2.06	2.37	2.64	2.89	3.12	3.53	4.04
1/4	4.78	6.74	8.25	9.52	10.6	11.6	12.4	14.0	16.2
3/8	10.8	15.2	18.5	21.4	23.8	26.0	28.0	31.8	36.4
1/2	19.1	27.0	33.0	38.5	42.3	46.3	50.0	56.5	64.6
5/8	30.0	42.2	51.7	59.5	66.2	72.6	78.0	88.0	101
3/4	43.0	60.6	74.0	85.3	95.2	104	112	127	145
7/8	58.8	82.6	101	116	130	142	153	173	198
1	76.5	108	131	152	169	185	200	225	258