Theoretical Push and Pull Forces for Pneumatic and Hydraulic Cylinders

The cylinder output forces are derived from the formula:
F = P X A

$$V_1 = \frac{(P_2 + 14.7)V_2}{14.7}$$

F = Force in pounds
P = Pressure at the cylinder in pounds per sq. inch, gauge
A = Effective area of cylinder piston in sq. inches

Free air refers to normal atmospheric conditions of the air at sea level (14.7 psi). Use cu. ft. free air required data (see chart below) to compute CFM required from a compressor at 80 cu. ft. of free air required. Other pressures can be calculated using the information below.

V_1 = Free air consumption per inch of stroke (cubic feet)
V_2 = Cubic feet displaced per inch of stroke
P_2 = Gauge pressure required to move maximum load

Push Force and Displacement

Cyl. Bore Size (Inches)	Piston Area (Sq. In.)	Cylinder Push Stroke Force in Pounds at Various Pressures										Cu. Ft. Free Air at 80 Lbs. Pressure, Required to move Max. Load 1 Inch	Displace. Per Inch of Stroke (Gallons)
		25	50	65	80	100	250	500	1000	2000	3000		
1	0.785	20	39	51	65	79	196	392	785	1570	2355	.00293	.00340
1 1/2	1.767	44	88	115	142	177	443	885	1770	3540	5310	.00659	.00765
2	3.14	79	157	204	251	314	785	1570	3140	6280	9420	.01171	.0136
2 1/2	4.91	123	245	319	393	491	1228	2455	4910	9820	14730	.01830	.0213
3 1/4	8.30	208	415	540	664	830	2072	4150	8300	16600	24900	.03093	.0359
4	12.57	314	628	817	1006	1257	3143	6285	12570	25140	37710	.04685	.0544
5	19.64	491	982	1277	1571	1964	4910	9820	19640	39280	58920	.07320	.0850
6	28.27	707	1414	1838	2262	2827	7068	14135	28270	56540	84810	.10540	.1224
7	38.49	962	1924	2502	3079	3849	9623	19245	38490	76980	115470	.14347	.1666
8	50.27	1257	2513	3268	4022	5027	12568	25135	50270	100540	150810	.18740	.2176
10	78.54	1964	3927	5105	6283	7854	19635	39270	78540	157080	235620	.29280	.3400
12	113.10	2828	5655	7652	9048	11310	28275	56550	113100	226200	339300	.42164	.4896
14	153.94	3849	7697	10006	12315	15394	38485	76970	153940	307880	461820	.57389	.6664

Deductions for Pull Force and Displacement

Piston Rod Dia. (Inches)	Piston Rod Area (Sq. In.)	Piston Rod Diameter Force in Pounds at Various Pressures To determine Cylinder Pull Force or Displacement, deduct the following Force or Displacement corresponding to Rod Size, from selected Push Stroke Force or Displacement corresponding to Bore Size in the table above										Cu. Ft. Free Air at 80 Lbs. Pressure, Required to move Max. Load 1 Inch	Displace. Per Inch of Stroke (Gallons)
		25	50	65	80	100	250	500	1000	2000	3000		
1/2	0.196	5	10	13	16	20	49	98	196	392	588	.00073	.0009
5/8	0.307	8	15	20	25	31	77	154	307	614	921	.00114	.0013
1	0.785	20	39	51	65	79	196	392	785	1570	2355	.00293	.0034
1 3/8	1.49	37	75	97	119	149	373	745	1490	2980	4470	.00554	.0065
1 3/4	2.41	60	121	157	193	241	603	1205	2410	4820	7230	.00897	.0104
2	3.14	79	157	204	251	314	785	1570	3140	6280	9420	.01171	.0136
2 1/2	4.91	123	245	319	393	491	1228	2455	4910	9820	14730	.01830	.0213
3	7.07	177	354	460	566	707	1767	3535	7070	14140	21210	.02635	.0306
3 1/2	9.62	241	481	625	770	962	2405	4810	9620	19240	28860	.03587	.0416
4	12.57	314	628	817	1006	1257	3143	6285	12570	25140	37710	.04685	.0544
4 1/2	15.90	398	795	1033	1272	1590	3975	7950	15900	31800	47708	.05929	.0688
5	19.64	491	982	1277	1571	1964	4910	9820	19640	39280	58920	.07320	.0850
5 1/2	23.76	594	1188	1544	1901	2376	5940	11880	23760	47520	71280	.08857	.1028
7	38.49	962	1924	2502	3079	3849	9623	19245	38490	76980	115470	.14347	.1666
8 1/2	56.75	1419	2838	3689	4540	5675	14187	28375	56750	113500	170250	.21157	.2455