

SELECTING THE CYLINDER

To select the proper size cylinder for the job, you must first determine the maximum push and/or pull force needed to accomplish its task. Add an additional 10% to both the push and pull force for friction in the cylinder and also pressure drop in the lines. Using the charts below, select the proper bore and rod combination to best suit your application.

PULL FORCES AND DISPLACEMENT

ROD (INCHES)	ROD AREA (SQ. IN.)	ROD DIAMETER FORCE IN POUNDS (AT VARIOUS PRESSURES)										DISPLACEMENT PER INCH OF STROKE (GALLONS)
		25	50	65	80	100	250	500	1000	2000	3000	
0.625	0.31	8	16	20	25	31	78	155	310	620	9130	0.0013
1.000	0.79	20	40	51	65	79	198	395	790	1580	2370	0.0034
1.375	1.49	37	75	97	119	149	373	745	1490	2980	4470	0.0065
1.750	2.41	60	121	157	193	241	603	1205	2410	4820	7230	0.0104
2.000	3.14	79	157	204	251	314	785	1570	3140	6280	9420	0.0136
2.500	4.91	123	245	319	393	491	1228	2455	4910	9820	14730	0.0213
3.000	7.07	177	354	460	566	707	1767	3535	7070	14140	21210	0.0306
3.500	9.62	241	481	625	770	962	2405	4810	9620	19240	28860	0.0416
4.000	12.57	314	628	817	1006	1257	3143	6285	12570	25140	37710	0.0544
4.500	15.90	398	795	1034	1272	1590	3976	7950	15900	31800	47700	0.0688
5.000	19.63	491	982	1276	1570	1963	4908	9815	19630	39260	58890	0.0850
5.500	23.76	594	1188	1544	1901	2376	5940	11880	23760	47520	71280	0.1028
7.000	38.48	962	1924	2501	3078	3848	9620	19240	38480	76960	115440	0.1666
8.000	50.27	1257	2513	3267	4021	5027	12568	25135	50270	100540	150810	0.2176
9.000	63.62	1590	3181	4135	5090	6362	15905	31810	63620	127240	190860	0.2754
10.000	78.54	1964	3927	5105	6283	7854	19635	39270	78540	157080	235620	0.3400

NOTE: TO DETERMINE CYLINDER PULL FORCE OR DISPLACEMENT SUBTRACT THE FORCE OR DISPLACEMENT OF THE ROD SIZE FROM SELECTED PUSH FORCE OR DISPLACEMENT OF THE BORE SIZE IN CHART ABOVE

PUSH FORCES AND DISPLACEMENT

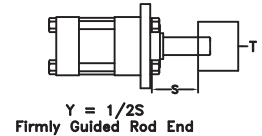
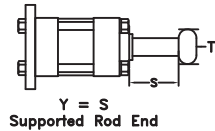
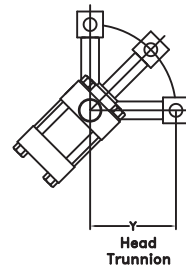
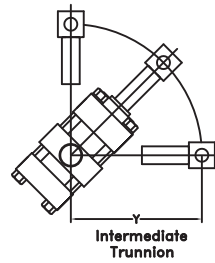
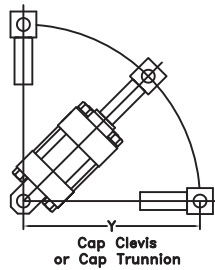
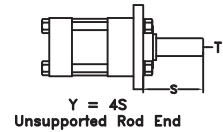
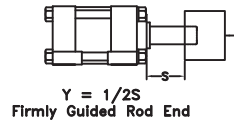
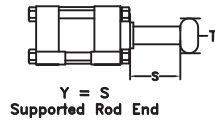
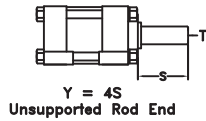
CYLINDER BORE SIZE (INCHES)	PISTON AREA (SQ. IN.)	CYLINDER PUSH FORCE IN POUNDS (AT VARIOUS PRESSURES)										DISPLACEMENT PER INCH OF STROKE (GALLONS)
		25	50	65	80	100	250	500	1000	2000	3000	
1.50	1.77	44	88	115	142	177	443	885	1770	3540	5310	0.0077
2.00	3.14	79	157	204	251	314	785	1570	3140	6280	9420	0.0136
2.50	4.91	123	245	319	393	491	1228	2455	4910	9820	14730	0.0213
3.25	8.30	208	415	540	664	830	2075	4150	8300	16600	24900	0.0359
4.00	12.57	314	628	817	1006	1257	3143	6285	12570	25140	37710	0.0544
5.00	19.64	491	982	1277	1571	1964	4910	9820	19640	39280	58920	0.0850
6.00	28.27	707	1414	1838	2262	2827	7068	14135	28270	56540	84810	0.1224
7.00	38.49	962	1924	2502	3079	3849	9623	19245	38490	76980	115470	0.1666
8.00	50.26	1257	2513	3267	4021	5026	12565	25130	50260	100520	150780	0.2176
10.00	78.54	1964	3927	5105	6283	7854	19635	39270	78540	157080	235620	0.3400
12.00	113.10	2828	5655	7352	9048	11310	28275	56550	113100	226200	339300	0.4896
14.00	153.94	3849	7697	10006	12315	15394	38485	76970	153940	307880	461820	0.6664
16.00	201.06	5027	10053	13069	16085	20106	50265	100530	201060	402120	603180	0.8704
18.00	254.46	6362	12724	16541	20358	25447	63618	127235	254470	508940	763410	1.1016
20.00	314.16	7854	15708	20420	25133	31416	78540	157080	314160	628320	942480	1.3600

PNEUMATIC AND FLUID POWER FORMULAS

FORMULA FOR:	EXPLANATION	FORMULA
FLUID PRESSURE <i>Pounds/ Square Inch</i>	PRESSURE = $\frac{\text{FORCE (Pounds)}}{\text{UNIT AREA (Square Inches)}}$	P = $\frac{F}{A}$ OR PSI = $\frac{F}{A}$
CYLINDER PISTON AREA <i>Square Inches</i>	AREA = $\pi \times \text{RADIUS}^2 (\text{Inches})$	A = πr^2
CYLINDER OUTPUT FORCE <i>Pounds, Push or Pull</i>	FORCE = PRESSURE (psi) x NET AREA (Square Inches)	F = $\text{psi} \times A$ or F =PA
CYLINDER VELOCITY OR SPEED <i>Feet/Second</i>	VELOCITY = $\frac{231 \times \text{FLOW RATE (GPM)}}{12 \times 60 \times \text{NET AREA (SQUARE INCHES)}}$	V = $\frac{231Q}{720A}$ OR V = $\frac{.3208Q}{A}$
CYLINDER VOLUME CAPACITY <i>Gallons of Fluid</i>	VOLUME = $\frac{\text{PISTON AREA (Square Inches)} \times \text{STROKE (Inches)}}{231}$	V = $\frac{A \times L}{231}$ OR <i>Length of Stroke</i>
CYLINDER FLOW RATE <i>Gallons Per Minute</i>	FLOW RATE = $\frac{12 \times 60 \times \text{VELOCITY (Feet/Sec.)} \times \text{NET AREA (Square Inches.)}}{231}$	Q = $\frac{720vA}{231}$ OR Q = $3.117vA$
PUMP OUTLET FLOW <i>Gallons/Minute</i>	FLOW = $\frac{\text{RPM} \times \text{PUMP DISPLACEMENT (Cu. In.Rev.)}}{231}$	Q = $\frac{nd}{231}$
PUMP INPUT POWER <i>Horsepower Required</i>	HORSEPOWER INPUT = $\frac{\text{FLOW RATE OUTPUT (GPM)} \times \text{PRESSURE}}{1714 \times \text{EFFICIENCY (Overall)}}$	HP_{IN} = $\frac{QP}{1714\text{Eff}}$ OR GPM x psi / 1714Eff
FLOW RATE THROUGH PIPING <i>Ft./Sec. Velocity</i>	VELOCITY = $\frac{.3208 \times \text{FLOW RATE THROUGH I.D. (GPM)}}{\text{INTERNAL AREA (Square Inches)}}$	v = $\frac{3208Q}{A}$
COMPRESSIBILITY OF OIL <i>Additional Required Oil To Reach Pressure</i>	ADDITIONAL VOLUME = PRESSURE (psi) x VOLUME OF OIL UNDER PRESSURE / 250,000	V_A = $\frac{PV}{250,000}$ (APPROXIMATELY 1/2% Per 1,000 psi.)
AIR USAGE-CFM <i>In Cubic Feet Per Minute of Pressure Air (PSIG) Displaced Per Stroke</i>	CFM = Cyl. Piston Area Sq. In. x Cyl. Stroke In. x In./Min. Piston Speed / 14.7 x 1728	CFM = $\frac{A \times \text{Stroke} \times \text{Speed}}{1728}$
FREE AIR USAGE <i>(Output Volume of Free Air in Cubic Ft.) Used to size a compressor</i>	FREE AIR (psia) = Cyl. Piston Area Sq. In. x Cyl. Stroke In. x In./Min. Piston Speed / 14.7 x 1728	FA (Cu. Ft.) = $\frac{A \times \text{Stroke} \times (\text{Force} + 14.7)}{14.7 \times 1728}$



SELECTING THE CYLINDER



STOP TUBE

Stop tubes are installed between the piston and front head on long stroke cylinders. The stop tube lengthens the distance between the piston and the rod bearing and reduces load when fully extended. To determine if a stop tube is required and the length, first determine the value of "Y" from one of the illustrations above.

If "Y" is less than 40", no stop tube is needed. If "Y" is over 40", a one inch stop tube is recommended for every 10" or fraction thereof over 40". (see Chart 27-A)

ROD DIAMETER SELECTION

In most applications the standard rod size is suitable. On long stroke or high thrust applications, an oversized rod may be required.

To arrive at the minimum rod size for your application, first determine the bore size, stroke, and thrust (See Page 106). Now select from the above illustration the type of mounting and determine the length "Y" with the piston rod in the fully extended position.

NOTE: "Y" or "S" are calculated from mounting point with rod extended.

CHART 27-A
STOP TUBE TABLE

"Y" (Inches)	Stop Tube Length (Inches)	"Y" (Inches)	Stop Tube Length (Inches)
0-40	0	101-110	7
41-50	1	111-120	8
51-60	2	121-130	9
61-70	3	131-140	10
71-80	4	141-150	11
81-90	5	151-160	12
91-100	6	161-170	13

Using Chart 27-B look for the maximum thrust for your cylinder, then look across for the "Y" length determined from the illustrations. If the exact value is not shown, continue to the next larger number. Now go to the top of the column and you will find the recommended rod size for your application.

CHART 27-B VALUE OF COLUMN LENGTH "Y" IN INCHES																	
Thrust in lbs.	PISTON ROD DIAMETER																
	5/8"	1"	1 3/8"	1 3/4"	2"	2 1/2"	3"	3 1/2"	4"	4 1/2"	5"	5 1/2"	7"	8"	9"	10"	
50	62																
100	55	112															
200	47	99															
250	43	94	146														
300	44	88	142														
400	37	83	134	186													
500	38	75	130	180													
700	30	68	118	168	202	275											
1,000	25	60	103	156	190	257	330										
1,400	24	53	92	142	174	244	308	385									
1,800	23	48	82	127	160	230	296	366	440								
2,400	19	45	75	114	145	213	281	347	415	488							
3,200	16	41	67	103	130	194	261	329	400	461							
4,000	12	31	62	96	119	175	240	310	378	446							
5,000	9	34	60	87	110	163	225	289	360	426	494						
6,000	5	30	56	82	102	152	208	274	342	410	476						
8,000	5	22	45	75	93	137	188	245	310	375	447						
10,000	4	21	40	67	89	125	172	222	279	349	412	482					
12,000	3	17	41	65	84	118	155	210	269	326	388	454					
16,000		9	34	57	75	110	142	188	235	292	350	420					
20,000			27	48	68	103	136	172	218	270	326	385					
30,000			12	40	55	87	120	156	189	230	285	330					
40,000				22	43	74	108	142	177	210	248	294					
50,000					15	30	66	96	130	165	200	234	269	408			
60,000						18	57	88	119	154	190	225	256	384			
80,000						16	36	71	104	137	170	204	240	336			
100,000							22	57	90	120	154	189	222	324	400		
120,000							21	45	77	108	140	175	207	313	377		
140,000							19	27	64	98	128	160	194	301	365		
160,000								26	47	86	118	148	182	279	350	421	
200,000									31	67	98	131	161	260	330	402	
250,000									28	36	72	109	141	236	301	375	
300,000									25	34	42	86	120	212	281	351	420
350,000											39	52	100	195	261	328	396
400,000												45	77	182	241	309	374
500,000												41	49	152	212	274	341
600,000													45	114	183	247	310
700,000														70	162	221	280
800,000														63	118	197	260

