

## CYLINDER

### Cylinders' theoretic force



Unit: N

Bore (mm)		12	16	20	25	32	40	50	63	80	100	125	150	200	
Rod (mm)		6	6	8	10	12	16	20	20	25	25	35	40	50	
Area (mm <sup>2</sup> )	A	113	201	314	491	804	1257	1963	3117	5027	7854	12272	17671	31416	
	B	85	173	264	412	691	1056	1649	2803	4536	7363	11310	16414	29453	
Operating pressure (MPa)	0.1	A	11	20	31	49	80	126	196	312	503	785	1227	1767	3142
		B	9	17	26	41	69	106	165	280	454	736	1131	1641	2945
	0.2	A	23	40	63	98	161	251	393	623	1005	1571	2454	3534	6283
		B	17	35	53	82	138	211	330	561	907	1473	2262	3283	5891
	0.3	A	34	60	94	147	241	377	589	935	1508	2356	3682	5301	9425
		B	26	52	79	124	207	317	495	841	1361	2209	3393	4924	8836
	0.4	A	45	80	126	196	322	503	785	1247	2011	3142	4909	7068	12566
		B	34	69	106	165	276	422	660	1121	1814	2945	4524	6566	11781
	0.5	A	57	101	157	246	402	629	982	1559	2514	3927	6136	8836	15708
		B	43	87	132	206	346	528	825	1402	2268	3682	5655	8207	14727
	0.6	A	68	121	188	295	482	754	1178	1870	3016	4712	7363	10603	18850
		B	51	104	158	247	415	634	989	1682	2722	4418	6786	9848	17672
	0.7	A	79	141	220	344	563	880	1374	2182	3519	5498	8590	12370	21991
		B	59	121	185	288	484	739	1154	1962	3175	5154	7917	11490	20617
	0.8	A	90	161	251	393	643	1006	1570	2494	4022	6283	9818	14137	25133
		B	68	138	211	330	553	845	1319	2242	3629	5890	9048	13131	23562
	0.9	A	102	181	283	442	724	1131	1767	2805	4524	7069	11045	15904	28274
		B	77	156	238	371	622	950	1484	2523	4082	6627	10179	14773	26508
	1.0	A	113	201	314	491	804	1257	1963	3117	5027	7854	12272	17671	31416
		B	85	173	264	412	691	1056	1649	2803	4536	7363	11310	16414	29453

### The method of calculation ( Cylinders' force )

$$F = P \times A - f$$

F:	Cylinders' force	(N)
P:	Air pressure	(MPa)
A:	Piston area	(mm <sup>2</sup> )
f:	Friction drag	(N)

### Pressure conversion chart

Pa	kPa	MPa	bar	mbar	kgf/cm <sup>2</sup>	cmH <sub>2</sub> O	mmH <sub>2</sub> O	mmHg	p.s.i.
1	0.001	0.000001	0.00001	0.01	0.0000102	0.0102	0.10197	0.0075	0.000145
1000	1	0.001	0.01	10	0.0102	10.2	101.97	7.5	0.145
1000000	1000	1	10	10000	10.2	10200	101970	7500	145
100000	100	0.1	1	1000	1.02	1020	10200	750.06	14.5
100	0.1	0.0001	0.001	1	0.00102	1.02	10.2	0.75	0.0145
98066.5	98.07	0.09807	0.98	980.67	1	1000	10000	735.56	14.22
98.0665	0.9807	0.0009807	0.00098	0.98	0.001	1	10	0.74	0.01422
9.80665	0.09807	0.00009807	0.00009807	0.09807	0.0001	0.1	1	0.07356	0.00142
133.32	0.13332	0.00013332	0.00133	1.33	0.00136	1.36	13.6	1	0.01934
6895	6.895	0.006895	0.06895	68.95	0.07031	70.31	703.07	51.71	1

### Compressed air consumption



Unit: l/min

Bore (mm)		12	16	20	25	32	40	50	63	80	100	125	150	200
Rod (mm)		6	6	8	10	12	16	20	20	25	25	35	40	50
Area (mm <sup>2</sup> )	A	113	201	314	491	804	1257	1963	3117	5027	7854	12272	17671	31416
	B	85	173	264	412	691	1056	1649	2803	4536	7363	11310	16414	29453
Operating pressure (MPa)	0.1	0.039	0.074	0.115	0.180	0.298	0.460	0.719	1.178	1.903	3.028	4.693	6.783	12.114
	0.2	0.059	0.111	0.172	0.269	0.446	0.689	1.076	1.764	2.850	4.535	7.028	10.158	18.140
	0.3	0.079	0.148	0.229	0.359	0.594	0.918	1.434	2.350	3.797	6.042	9.363	13.533	24.167
	0.4	0.098	0.186	0.287	0.448	0.742	1.147	1.792	2.937	4.744	7.548	11.698	16.908	30.193
	0.5	0.118	0.223	0.344	0.537	0.890	1.376	2.149	3.523	5.690	9.055	14.032	20.282	36.220
	0.6	0.137	0.260	0.401	0.627	1.038	1.605	2.507	4.109	6.637	10.562	16.367	23.657	42.247
	0.7	0.157	0.297	0.458	0.716	1.186	1.834	2.865	4.695	7.584	12.068	18.702	27.032	48.273
	0.8	0.177	0.334	0.516	0.806	1.334	2.063	3.222	5.281	8.531	13.575	21.037	30.407	54.300
	0.9	0.196	0.371	0.573	0.895	1.482	2.292	3.580	5.867	9.478	15.081	23.372	33.781	60.327
	1.0	0.216	0.408	0.630	0.984	1.630	2.521	3.937	6.453	10.425	16.588	25.707	37.156	66.353

● The table is for a complete cycle with 100mm stroke in one minute.

### The method of calculation ( Compressed air consumption )

$$Q_n = (A_a + A_b) \times L \times \frac{P + 0.101}{0.101} \times n \times 10^{-6}$$

Qn:	Compressed air consumption	(l/min)
Aa:	Piston area of A	(mm <sup>2</sup> )
Ab:	Piston area of B	(mm <sup>2</sup> )
L:	Stroke of cylinder	(mm)
P:	Air pressure	(MPa)
n:	Cycle of operation	(cycle/min)

### Flow rate conversion chart

m <sup>3</sup> /s	l/s	cm <sup>3</sup> /s	m <sup>3</sup> /h	m <sup>3</sup> /min	l/h	l/min	ft <sup>3</sup> /min (scfm)	gallon min UK	gallon min USA
1	1000	1000000	3600000	60	3600000	60000	2120	13200	15850
0.001	1	1000	3.6	0.06	3600	60	2.12	13.2	15.85
0.000001	0.001	1	0.0036	0.00006	3.6	0.06	0.0212	0.0132	0.01585
0.00028	0.28	280	1	0.01667	1000	16.67	0.59	3.67	4.4
0.01667	16.67	16670	60	1	60000	1000	35.31	219.97	264.17
0.00000028	0.00028	0.28	0.001	0.00001667	1	0.01667	0.00059	0.00367	0.0044
0.00001667	0.01667	16.67	0.06	0.001	60	1	0.03531	0.21997	0.264
0.00047	0.47	470	1.699	0.02832	1699	28.32	1	6.23	7.48
0.00007579	0.07577	75.77	0.273	0.00455	273	4.55	0.16	1	1.2
0.00006309	0.06309	63.09	0.227	0.00379	227	3.79	0.13	0.83	1