Technical Support Tables

Expertise – Passion – Automation

Theoretical cylinder force [N]

(Nominal) Cylinder bore size [mm]	Piston rod diameter [mm]	Operation	Pressure [MPa] 0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
8	4	Extension	5	10	15	20	25	30	35	40	45	50
		Retraction	4	8	11	15	19	23	26	30	34	38
10	4	Extension	8	16	24	31	39	47	55	63	71	79
		Retraction	7	13	20	26	33	40	46	53	59	66
12	6	Extension	11	23	34	45	57	68	79	90	102	113
		Retraction	8	17	25	34	42	51	59	68	76	85
16	6	Extension	20	40	60	80	101	121	141	161	181	201
		Retraction	17	35	52	69	86	104	121	138	156	173
20	8	Extension	31	63	94	126	157	188	220	251	283	314
		Retraction	26	53	79	106	132	158	185	211	238	264
25	10	Extension	49	98	147	196	245	295	344	393	442	491
		Retraction	41	82	124	165	206	247	289	330	371	412
32	12	Extension	80	161	241	322	402	483	563	643	724	804
		Retraction	69	138	207	276	346	415	484	553	622	691
40	16	Extension	126	251	377	503	628	754	880	1.005	1.131	1.257
		Retraction	106	211	317	422	528	633	739	844	950	1.056
50	20	Extension	196	393	589	785	982	1.178	1.374	1.571	1.767	1.963
		Retraction	165	330	495	660	825	990	1.155	1.319	1.484	1.649
63	20	Extension	312	623	935	1.247	1.559	1.870	2.182	2.494	2.806	3.117
		Retraction	280	561	841	1.121	1.402	1.682	1.962	2.242	2.523	2.803
80	25	Extension	503	1.005	1.508	2.011	2.513	3.016	3.519	4.021	4.524	5.027
		Retraction	454	907	1.361	1.814	2.268	2.721	3.175	3.629	4.082	4.536
100	30	Extension	785	1.571	2.356	3.142	3.927	4.712	5.498	6.283	7.069	7.854
		Retraction	715	1.429	2.144	2.859	3.574	4.288	5.003	5.718	6.432	7.147
125	32	Extension	1.227	2.454	3.682	4.909	6.136	7.363	8.590	9.817	11.045	12.272
		Retraction	1.147	2.294	3.440	4.587	5.734	6.881	8.027	9.174	10.321	11.468
160	40	Extension	2.011	4.021	6.032	8.042	10.053	12.064	14.074	16.085	18.096	20.106
		Retraction	1.885	3.770	5.655	7.540	9.425	11.310	13.195	15.080	16.965	18.850
200	40	Extension	3.142	6.283	9.425	12.566	15.708	18.850	21.991	25.133	28.274	31.416
		Retraction	3.016	6.032	9.048	12.064	15.080	18.096	21.112	24.127	27.143	30.159
250	50	Extension	4.909	9.817	14.726	19.635	24.544	29.452	34.361	39.270	44.179	49.087
		Retraction	4.712	9.425	14.137	18.850	23.562	28.274	32.987	37.699	42.412	47.124

F [N] = p*A
p = pressure [MPa], 1 bar $\hat{=}$ 0.1 MPa
A = area [mm^2]

Air consumption [Nl/min] of cylinders for valve design max. cylinder speed (mm/sec)

Cylinder Ø [mm]	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
8	3	5	8	10	13	15	18	20	23	25	28	30	33	36	38
12	6	11	17	23	29	34	40	46	51	57	63	69	74	80	86
16	10	20	30	41	51	61	71	81	91	102	112	122	132	142	152
20	16	32	48	63	79	95	111	127	143	159	175	190	206	222	238
25	25	50	74	99	124	149	174	198	223	248	273	298	322	347	372
32	41	81	122	162	203	244	284	325	366	406	447	487	528	569	609
40	63	127	190	254	317	381	444	508	571	635	698	762	825	889	952
50	99	198	298	397	496	595	694	793	893	992	1.091	1.190	1.289	1.388	1.488
63	157	315	472	630	787	945	1.102	1.260	1.417	1.575	1.732	1.889	2.047	2.204	2.362
80	254	508	762	1.016	1.269	1.523	1.777	2.031	2.285	2.539	2.793	3.047	3.301	3.555	3.808
100	397	793	1.190	1.587	1.984	2.380	2.777	3.174	3.570	3.967	4.364	4.761	5.157	5.554	5.951
125	620	1.240	1.860	2.479	3.099	3.719	4.339	4.959	5.579	6.199	6.818	7.438	8.058	8.678	9.298
140	778	1.555	2.333	3.110	3.888	4.665	5.443	6.220	6.998	7.776	8.553	9.331	10.108	10.886	11.663
160	1.016	2.031	3.047	4.062	5.078	6.093	7.109	8.125	9.140	10.156	11.171	12.187	13.203	14.218	15.234
200	1.587	3.174	4.761	6.347	7.934	9.521	11.108	12.695	14.282	15.868	17.455	19.042	20.629	22.216	23.803
250	2.479	4.959	7.438	9.918	12.397	14.877	17.356	19.836	22.315	24.794	27.274	29.753	32.233	34.712	37.192

Qmax [Nl/min] = 1.4*v*A*(p2+1.0132)*6*10^{-5}
1.4 = compensation factor
v = max. cylinder speed [mm/s]
A = piston area [mm^2]
p2 = outlet pressure valve [bar]

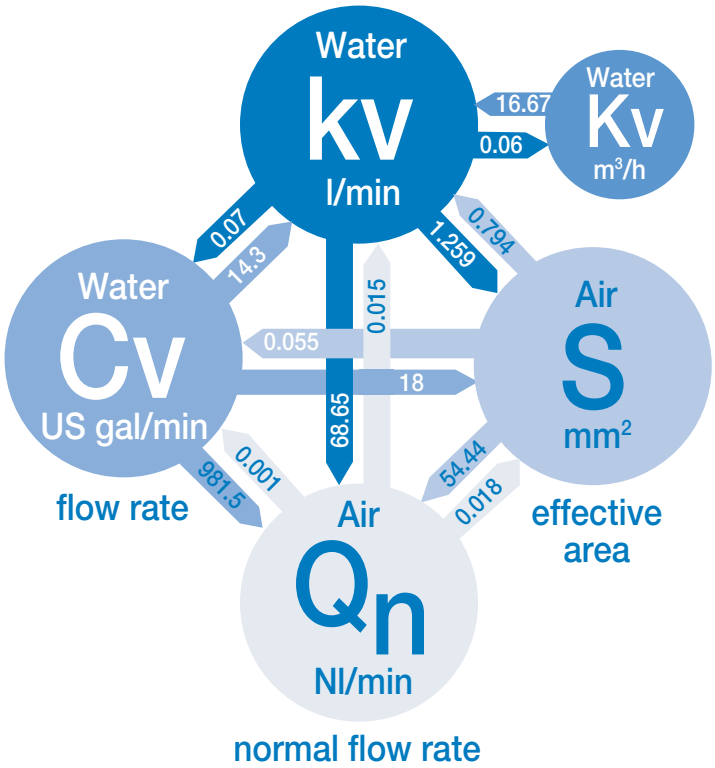
Flow in tubing and fittings

The table below shows the air flow in the different tube sizes and lengths. The **upper** value is only the tubing and **lower** is the tubing with a straight KQ2H fitting at one end and a KQ2L elbow fitting at the other end.

The flow (Q_n) is given in l_n/min. i.e.: IN = 0.6 MPa and OUT = 0.5 MPa.

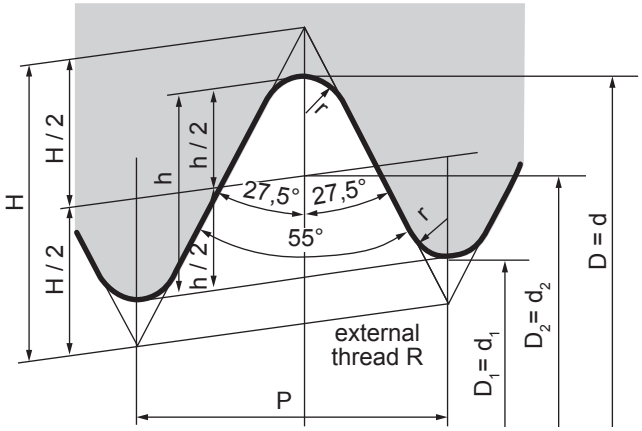
Tubing (outer/inner Ø)	0.5 m	1 m	2 m	5 m
3.2 mm / 2 mm	76	54	35	27
with fittings	61	48	33	26
4 mm / 2.5 mm	134	101	61	48
with fittings	98	82	56	45
6 mm / 4 mm	424	333	209	165
with fittings	314	272	191	156
8 mm / 5 mm	722	581	374	297
with fittings	473	426	321	268
8 mm / 6 mm	1105	906	569	476
with fittings	700	641	498	422
10 mm / 8 mm	2156	1826	1251	1012
with fittings	1083	1056	958	879
12 mm / 9 mm	2780	2387	1666	1355
with fittings	1662	1565	1419	1276

Nominal Flow



Thread chart

External tapered screw pipe thread R
Internal tapered threads Rc

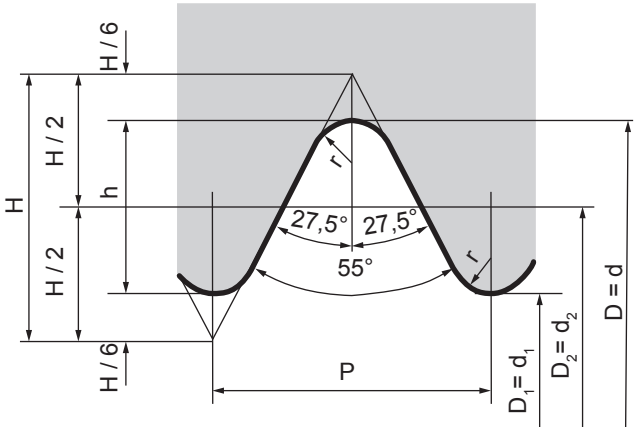


Taper: 1:16

P = 25,4 / n H = 0,960491P
h = 0,640327P
r = 0,137329P

Thread Designation	Major Diameter D = d	Pitch Diameter $D_2 = d_2$	Minor Diameter Male Thd. $D_1 = d_1$	Threads per Inch n	Pitch P
R,Rc 1/8	9,728	9,147	8,566	28	0,907
R,Rc 1/4	13,157	12,301	11,445	19	1,337
R,Rc 3/8	16,662	15,806	14,950	19	1,337
R,Rc 1/2	20,955	19,793	18,631	14	1,814
R,Rc 5/8	22,911	21,749	20,587	14	1,814
R,Rc 3/4	26,441	25,279	24,117	14	1,814
R,Rc 1	33,249	31,770	30,291	11	2,309
R,Rc 1 1/8	37,897	36,418	34,939	11	2,309
R,Rc 1 1/4	41,910	40,431	38,952	11	2,309
R,Rc 1 3/8	44,323	42,844	41,365	11	2,309
R,Rc 1 1/2	47,803	46,324	44,845	11	2,309
R,Rc 1 3/4	53,746	52,267	50,788	11	2,309
R,Rc 2	59,614	58,135	56,656	11	2,309
R,Rc 2 1/4	65,710	64,231	62,752	11	2,309
R,Rc 2 1/2	75,184	73,705	72,226	11	2,309
R,Rc 2 3/4	81,534	80,055	78,576	11	2,309
R,Rc 3	87,884	86,405	84,926	11	2,309
R,Rc 4	113,030	111,551	110,072	11	2,309
R,Rc 5	138,430	136,951	135,472	11	2,309
R,Rc 6	163,830	162,351	160,872	11	2,309

Cylindrical threads G



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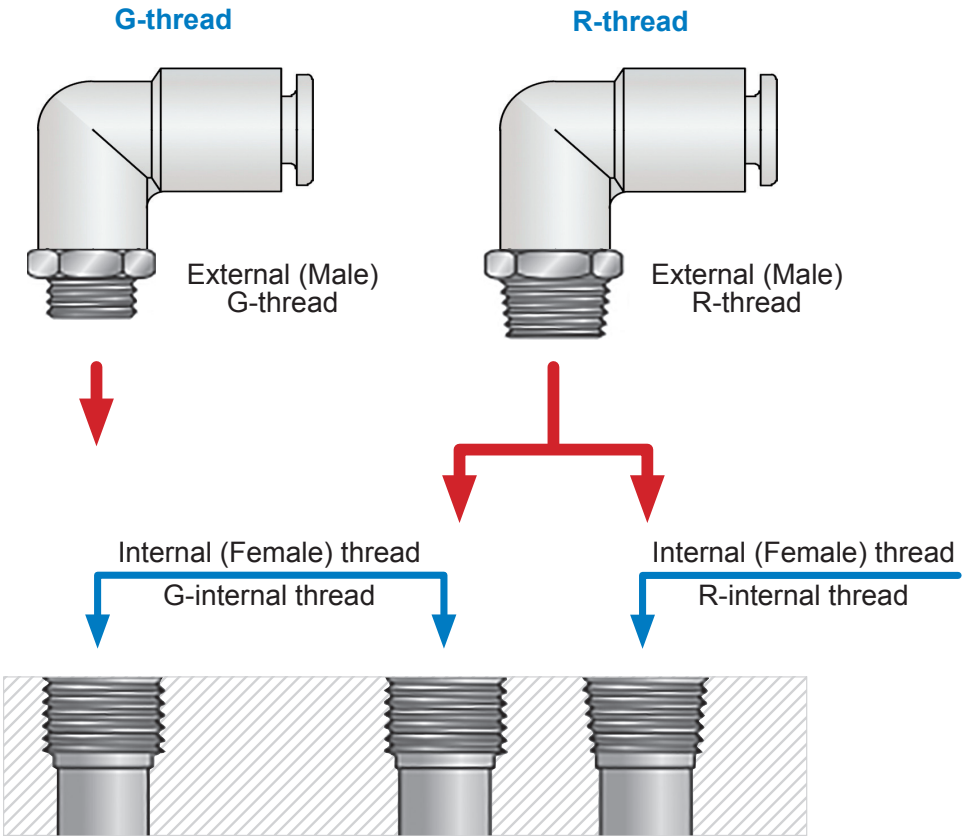
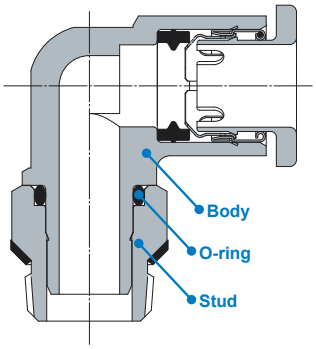
G 3/4	26,441	25,279	24,117	14	1,814
G 1	33,249	31,770	30,291	11	2,309
G 1 1/8	37,897	36,418	34,939	11	2,309
G 1 1/4	41,910	40,431	38,952	11	2,309
G 1 3/8	44,323	42,844	41,365	11	2,309
G 1 1/2	47,803	46,324	44,845	11	2,309
G 1 3/4	53,746	52,267	50,788	11	2,309
G 2	59,614	58,135	56,656	11	2,309
G 2 1/4	65,710	64,231	62,752	11	2,309
G 2 1/2	75,184	73,705	72,226	11	2,309
G 2 3/4	81,534	80,055	78,576	11	2,309
G 3	87,884	86,405	84,926	11	2,309
G 4	113,030	111,551	110,072	11	2,309
G 5	138,430	136,951	135,472	11	2,309
G 6	163,830	162,351	160,872	11	2,309

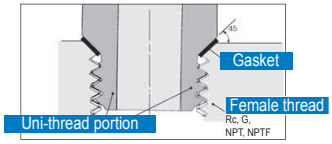
All dimensions in millimetres

Thread chart



Uni-thread





A ridge shape has been created as a Uni thread for common applications for Rc, G, NPT and NPTF. Drastically cuts piping work-hours with the gasket seal method.

Vacuum pads model selection

Lifting force determination

The theoretical lifting force (without safety factor) is determined by the vacuum pressure and the contact area of the vacuum pad.

$$\text{lifting force} = \frac{\text{theoretical lifting force}}{\text{safety factor } \mathbf{t}}$$

Safety factor for horizontal lifting: 4
Safety factor for vertical lifting: 8

Theoretical lifting force = P x S x 0.1

Pad diameter (ø 2 to ø 50)

(N)

Pad diameter (mm)		ø 2	ø 4	ø 6	ø 8	ø 10	ø 13	ø 16	ø 20	ø 25	ø 32	ø 40	ø 50
Pad area (cm^2)		0.03	0.13	0.28	0.50	0.79	1.33	2.01	3.14	4.91	8.04	12.6	19.6
Vacuum pressure (kPa)	**–85**	0.27	1.07	2.40	4.27	6.67	11.3	17.1	26.7	41.7	68.3	107	167
	–80	0.25	1.00	2.26	4.02	6.28	10.6	16.1	25.1	39.3	64.3	101	157
	–75	0.24	0.94	2.12	3.77	5.89	10.0	15.1	23.6	36.8	60.3	95	147
	–70	0.22	0.88	1.98	3.52	5.50	9.3	14.1	22.0	34.3	56.3	88	137
	–65	0.20	0.82	1.84	3.27	5.10	8.6	13.1	20.4	31.9	52.2	82	127
	–60	0.19	0.75	1.70	3.01	4.71	8.0	12.1	18.8	29.4	48.2	76	118
	–55	0.17	0.69	1.55	2.76	4.32	7.3	11.1	17.3	27.0	44.2	69	108
	–50	0.16	0.63	1.41	2.51	3.93	6.7	10.0	15.7	24.5	40.2	63	98
	–45	0.14	0.57	1.27	2.26	3.53	6.0	9.0	14.1	22.1	36.2	57	88
	–40	0.13	0.50	1.13	2.01	3.14	5.3	8.0	12.6	19.6	32.2	50	78

Pad diameter (ø 63 to ø 340)

(N)

Pad diameter (mm)		ø 63	ø 80	ø 100	ø 125	ø 150	ø 250	ø 300	ø 340
Pad area (cm^2)		31.2	50.2	78.5	122.7	176.6	490.6	706.5	907.5
Vacuum pressure (kPa)	**–85**	265	427	667	1043	1501	4170	6005	7714
	–80	250	402	628	982	1413	3925	5652	7260
	–75	234	377	589	920	1325	3680	5299	6806
	–70	218	351	550	859	1236	3434	4946	6353
	–65	203	326	510	798	1148	3189	4592	5899
	–60	187	301	471	736	1060	2944	4239	5445
	–55	172	276	432	675	971	2698	3886	4991
	–50	156	251	393	614	883	2453	3533	4538
	–45	140	226	353	552	795	2208	3179	4084
	–40	125	201	314	491	706	1962	2826	3630

Oval pad diameter (ø 63 to ø 340)

(N)

Pad size (mm)		2 x 4	3.5 x 7	4 x 10	5 x 10	6 x 10	4 x 20	5 x 20	6 x 20	8 x 20	4 x 30	5 x 30	6 x 30	8 x 30
Pad area S (cm^2)		0.07	0.21	0.36	0.44	0.52	0.76	0.94	1.12	1.46	1.16	1.44	1.72	2.26
Vacuum pressure (kPa)	**–85**	0.60	1.79	3.06	3.74	4.42	6.46	7.99	9.52	12.41	9.86	12.24	14.62	19.21
	–80	0.56	1.68	2.88	3.52	4.16	6.08	7.52	8.96	11.68	9.28	11.52	13.76	18.08
	–75	0.53	1.58	2.70	3.30	3.90	5.70	7.05	8.40	10.95	8.70	10.80	12.90	16.95
	–70	0.49	1.47	2.52	3.08	3.64	5.32	6.58	7.84	10.22	8.12	10.08	12.04	15.82
	–65	0.46	1.37	2.34	2.86	3.38	4.94	6.11	7.28	9.49	7.54	9.36	11.18	14.69
	–60	0.42	1.26	2.16	2.64	3.12	4.56	5.64	6.72	8.76	6.96	8.64	10.32	13.56
	–55	0.39	1.16	1.98	2.42	2.86	4.18	5.17	6.16	8.03	6.38	7.92	9.46	12.43
	–50	0.35	1.05	1.80	2.20	2.60	3.80	4.70	5.60	7.30	5.80	7.20	8.60	11.30
	–45	0.32	0.95	1.62	1.98	2.34	3.42	4.23	5.04	6.57	5.22	6.48	7.74	10.17
	–40	0.28	0.84	1.44	1.76	2.08	3.04	3.76	4.48	5.84	4.64	5.76	6.88	9.04