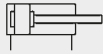

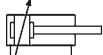

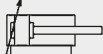



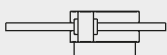

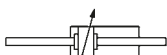


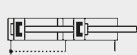
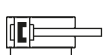
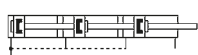

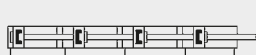

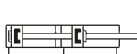
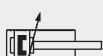
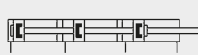
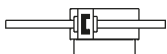
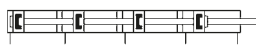


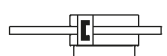
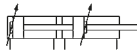




Pneumatic symbols

PNEUMATIC SYMBOLS

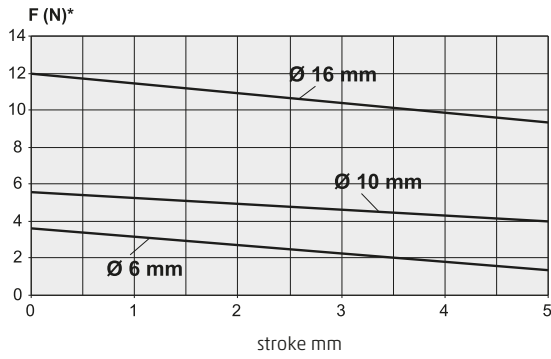
Symbol	Type	Symbol	Type
CD01	 Double-acting cylinder, cushioned	CD16	 Magnetic twin through-rod cylinders
CD02	 Double-acting cylinder, with adjustable front and rear cushioning	CD17	 Double-acting rotary cylinder
CD03	 Double-acting cylinder, adjustable rear cushion	CD18	 Double-acting rotary cylinder, magnetic
CD04	 Double-acting cylinder, adjustable front cushion	CD19	 Single-acting rotary cylinder
CD05	 Double-acting cylinder, through rod, cushioned	CD20	 Double-acting cylinder, magnetic, cushioned, roller rod
CD06	 Double-acting cylinder, through-rod, with adjustable front and rear cushioning	CD21	 Single-acting rotary cylinder
CD07	 Double-acting cylinder, magnetic	CD2T	 Magnetic tandem cylinder, two stages, cushioned, single rear supply, sole front supply
CD08	 Double-acting cylinder, magnetic, cushioned	CD3T	 Magnetic tandem cylinder, three stages, cushioned, single rear supply, sole front supply
CD09	 Double-acting cylinder, magnetic, with adjustable front and rear cushioning	CD4T	 Magnetic tandem cylinder, four stages, cushioned, single rear supply, sole front supply
CD10	 Double-acting cylinder, magnetic, adjustable rear cushion	CD5T	 Magnetic tandem cylinder, two stages, cushioned, separated rear supplies, sole front supply
CD11	 Double-acting cylinder, magnetic, adjustable front cushion	CD6T	 Magnetic tandem cylinder, three stages, cushioned, single rear supplies, sole front supply
CD12	 Double-acting cylinder, through rod, magnetic, cushioned	CD7T	 Magnetic tandem cylinder, two stages, cushioned, single rear supplies, sole front supply
CD13	 Double-acting cylinder, through rod, magnetic, with adjustable front and rear cushioning	CD8T	 Magnetic tandem cylinder, two stages, with adjustable front cushioning, separated rear and front supplies
CD14	 Double-acting cylinder, magnetic, through-rod	CD9T	 Non magnetic tandem cylinder, two stages, with adjustable front cushioning, separated rear and front supplies
CD15	 Magnetic twin rod cylinders	CDPP	 Multi-position, magnetic cylinder, cushioned

Symbol	Type	Symbol	Type
CD55	Double-acting, rodless cylinder, magnetic	CS15	Single-acting cylinder, rear spring, magnetic, roller rod, cushioned
CS01	Single-acting cylinder, front spring	CS16	Double-acting cylinder, rear spring, magnetic, roller rod, cushioned
CS02	Single-acting cylinder, front spring, cushioned	CS17	Double-acting cylinder, magnetic, rear spring, cushioned
CS03	Double-acting cylinder, front spring, cushioned	CS18	Double-acting cylinder, magnetic, front spring, cushioned
CS04	Single-acting cylinder, front spring, through rod, cushioned	HI01	Hydrocheck, regulated rod thrust
CS05	Double-acting cylinder, front spring, through rod, with adjustable rear cushioning	HI02	Hydrocheck, regulated rod return
CS06	Single-acting cylinder, front spring, magnetic, cushioned	HI03	Hydrocheck, regulated rod thrust with stop valve
CS07	Double-acting cylinder, front spring, magnetic, with adjustable rear cushioning	HI04	Hydrocheck, regulated rod return with stop valve
CS08	Single-acting cylinder, rear spring, magnetic, cushioned	HI05	Hydrocheck, regulated rod thrust with skip valve
CS09	Single-acting cylinder, magnetic, front spring	HI06	Hydrocheck, regulated rod return with skip valve
CS10	Single-acting cylinder, through rod, magnetic, cushioned	HI07	Hydrocheck, regulated rod thrust with skip and stop valve
CS11	Double-acting cylinder, front spring, magnetic, through rod, with adjustable rear cushioning	HI08	Hydrocheck, regulated rod return with skip and stop valve
CS12	Single-acting cylinder, front spring, magnetic, with adjustable rear cushioning	RDLK	Rod lock device
CS13	Single-acting cylinder, front spring, magnetic, through rod, with adjustable rear cushioning		
CS14	Double-acting cylinder, rear spring, magnetic, with adjustable front cushioning		

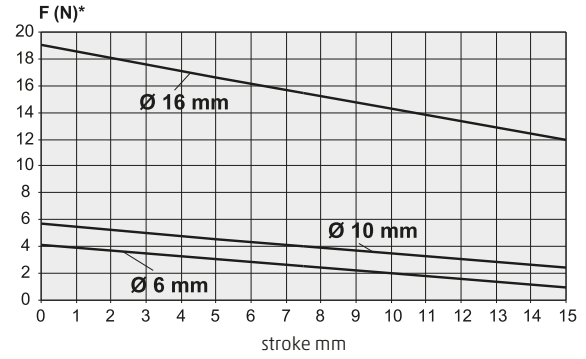
Spring loads cylinders

SPRING LOADS CYLINDERS

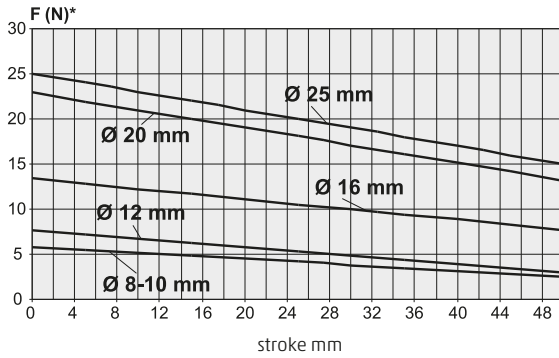
Series 14 - stroke 5 mm



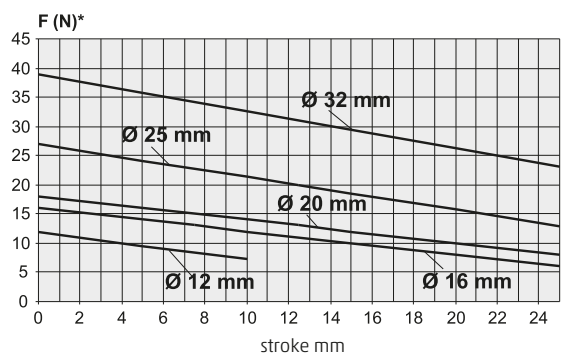
Series 14 - stroke 10 and 15 mm



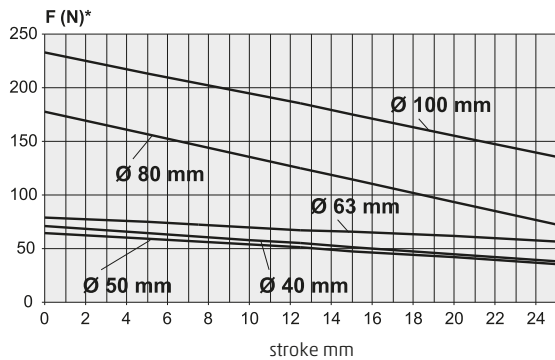
Series 16-24



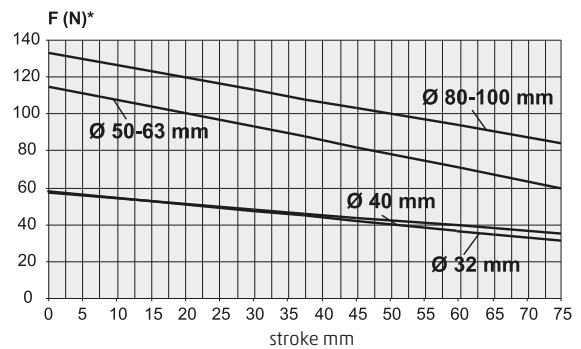
Series 31-32



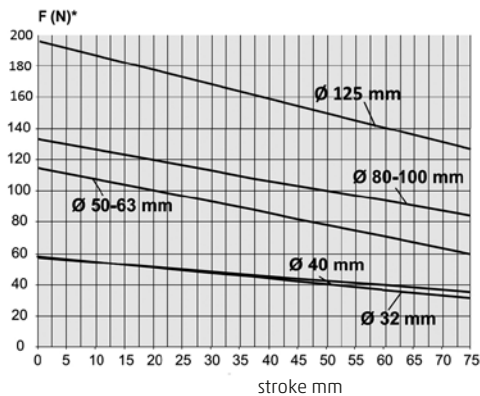
Series 31-32



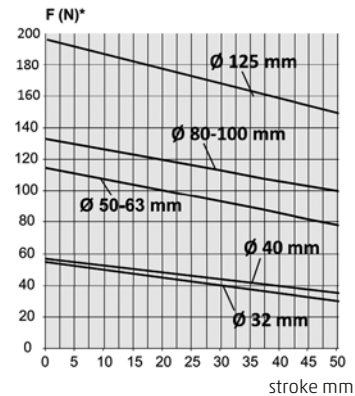
Series 60-61-42-90



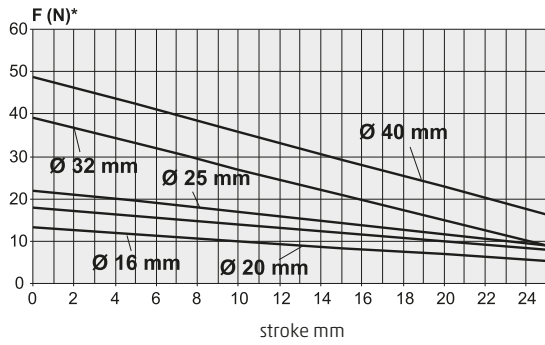
Series 63 - front spring



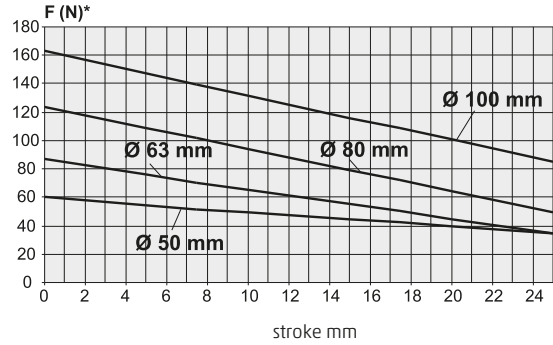
Series 63 - rear spring



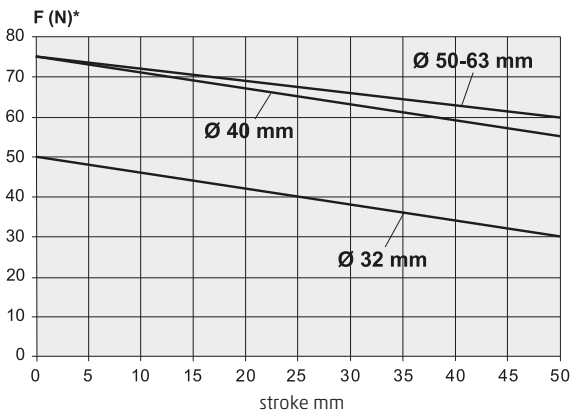
Series QP



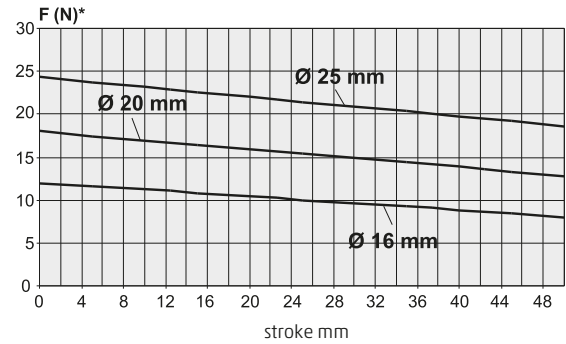
Series QP



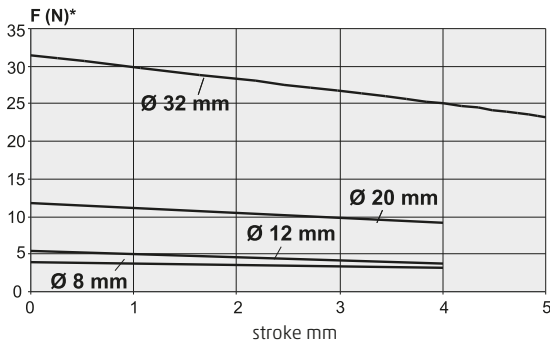
Series 90-97



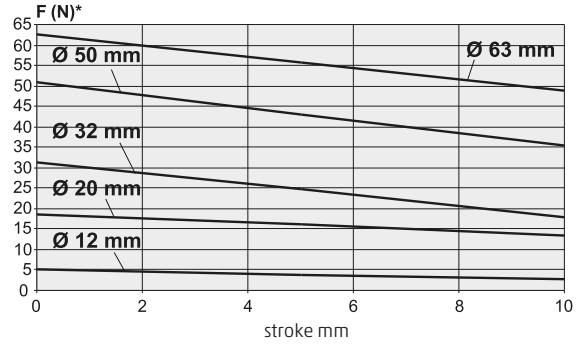
Series 94



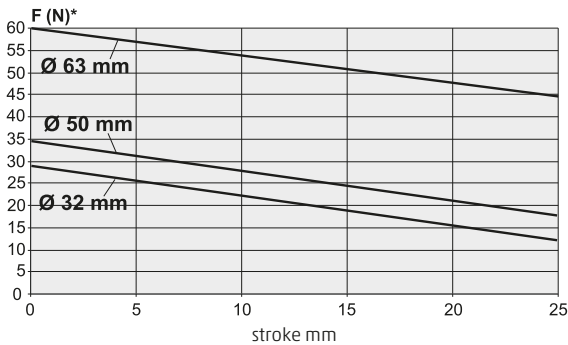
Series QN - stroke 4 and 5 mm



Series QN - stroke 10 mm



Series QN - stroke 25 mm



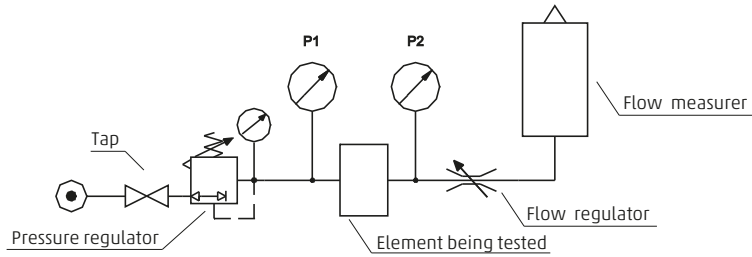
* F = spring force

Flow and speed cylinders

Valves and solenoid valves

Flow survey instruments.

The flow rate indicated in the catalogue is obtained with
P1 = 6 bar and P2 = 5 bar.



Maximum speeds obtainable combining a certain flow regulator (mm/sec) with a cylinder

Mod.	Cylinders diameter (mm)						
	32	40	50	63	80	100	125
GSCU-1/8"; GSVU-1/8"; GMCU-1/8"; GSCU-1/8"	1000	986	629	395	246	158	100
GSCU-1/4"; GSVU-1/4"; GMCU-1/4"; GSCU-1/4"	-	1000	911	573	357	229	145
RFU 452 M5	204	-	-	-	-	-	-
RFU 482-1/8"	227	145	93	58	36	-	-
RFU 483-1/8"	520	333	212	133	83	53	-
RFU 444-1/4"	-	739	471	296	185	118	75
RFU 446-1/4"	-	-	847	532	332	213	135
SCU M5 - SVU M5	154	-	-	-	-	-	-
SCU-1/4"; SVU-1/4"; MCU-1/4"; MVU-1/4"	-	1000	660	415	259	166	105
SCU-1/8"; SVU-1/8"; MCU-1/8"; MVU-1/8"	604	387	247	155	97	62	-
SCU-3/8"; MCU-3/8"	-	-	-	622	388	249	158
SCU-1/2"; MCU-1/2"	-	-	-	-	1000	869	-

To obtain the above indicated speeds, the connected tubing should have a certain diameter and not exceed, if indicated, the max length (m)

Mod.	Tube diameter (mm) and max length (m)				
	4/2	6/4	8/6	10/8	12/10
GSCU-1/8"; GSVU-1/8"; GMCU-1/8"; GSCU-1/8"	-	0,4	8	25	-
GSCU-1/4"; GSVU-1/4"; GMCU-1/4"; GSCU-1/4"	-	-	4,5	18	24
RFU 452 M5	3,5	25	-	-	-
RFU 482-1/8"	3	25	-	-	-
RFU 483-1/8"	0,25	10	-	-	-
RFU 444-1/4"	-	2	17	-	-
RFU 446-1/4"	-	-	5	20	-
SCU M5 - SVU M5	5	-	-	-	-
SCU-1/4"; SVU-1/4"; MCU-1/4"; MVU-1/4"	-	0,4	8	25	-
SCU-1/8"; SVU-1/8"; MCU-1/8"; MVU-1/8"	-	7	-	-	-
SCU-3/8"; MCU-3/8"	-	-	3,5	-	-
SCU-1/2"; MCU-1/2"	-	-	-	0,25	3,5

Air flow required by the valve (6 bar) to obtain the above indicated speeds (NI/min)

Mod.	Cylinders diameter (mm)						
	32	40	50	63	80	100	125
GSCU-1/8"; GSVU-1/8"; GMCU-1/8"; GSCU-1/8"	336	517	517	517	517	517	517
GSCU-1/4"; GSVU-1/4"; GMCU-1/4"; GSCU-1/4"	-	525	750	750	750	750	750
RFU 452 M5	69	-	-	-	-	-	-
RFU 482-1/8"	76	76	76	76	76	-	-
RFU 483-1/8"	175	175	175	175	175	175	-
RFU 444-1/4"	-	388	388	388	388	388	388
RFU 446-1/4"	-	-	697	697	697	697	697
SCU M5 - SVU M5	52	-	-	-	-	-	-
SCU-1/4"; SVU-1/4"; MCU-1/4"; MVU-1/4"	-	525	543	543	543	543	543
SCU-1/8"; SVU-1/8"; MCU-1/8"; MVU-1/8"	203	203	203	203	203	203	-
SCU-3/8"; MCU-3/8"	-	-	-	815	815	815	815
SCU-1/2"; MCU-1/2"	-	-	-	-	2100	2846	-

Output forces double-acting cylinders

Thrust side

Values in Newton

SERIES >		16	24	25	27	31	32	QP	QN	QCT	QCB	QCBF	QCTF	40	41	42	50	52	60	61	62	63	90	92	94	95	97			
∅	Thrust side	Pressure																												
		MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)		
mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)																			
8	0,50	4,44	8,9	13,3	17,7	22,2	26,6	31,0	35,5	39,9	44,4																			
10	0,79	6,93	13,9	20,8	27,7	34,7	41,6	48,5	55,4	62,4	69,3																			
12	1,13	9,98	20,0	29,9	39,9	49,9	59,9	69,9	79,8	89,8	99,8																			
16	2,01	17,74	35,5	53,2	71,0	88,7	106,5	124,2	141,9	159,7	177,4																			
20	3,14	27,72	55,4	83,2	110,9	138,6	166,3	194,1	221,8	249,5	277,2																			
25	4,91	43,32	86,6	130,0	173,3	216,6	259,9	303,2	346,5	389,9	433,2																			
32	8,04	70,97	141,9	212,9	283,9	354,9	425,8	496,8	567,8	638,7	709,7																			
40	12,56	110,89	221,8	332,7	443,6	554,5	665,4	776,2	887,1	998,0	1108,9																			
50	19,63	173,27	346,5	519,8	693,1	866,3	1039,6	1212,9	1386,2	1559,4	1732,7																			
63	31,16	275,08	550,2	825,2	1100,3	1375,4	1650,5	1925,6	2200,7	2475,7	2750,8																			
80	50,24	443,57	887,1	1330,7	1774,3	2217,8	2661,4	3105,0	3548,6	3992,1	4435,7																			
100	78,50	693,08	1386,2	2079,2	2772,3	3465,4	4158,5	4851,5	5544,6	6237,7	6930,8																			
125	122,66	1082,93	2165,9	3248,8	4331,7	5414,7	6497,6	7580,5	8663,5	9746,4	10829,3																			
160	200,96	1774,28	3548,6	5322,8	7097,1	8871,4	10645,7	12419,9	14194,2	15968,5	17742,8																			
200	314,00	2772,31	5544,6	8316,9	11089,2	13861,5	16633,8	19406,1	22178,4	24950,8	27723,1																			
250	490,62	4331,73	8663,5	12995,2	17326,9	21658,6	25990,4	30322,1	34653,8	38985,6	43317,3																			
320	803,84	7097,10	14194,2	21291,3	28388,4	35485,5	42582,6	49679,7	56776,8	63873,9	70971,0																			

SERIES >		QX											
∅	Thrust side	Pressure											
		MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)		
10	1,58	14,22	28,44	42,66	56,88	71,1	85,32	99,54	113,76	127,98	142,2		
16	4,02	35,48	71	106,4	142	177,4	213	248,4	283,8	319,4	354,8		
20	6,28	55,44	110,8	166,4	221,8	277,2	332,6	388,2	443,6	499	554,4		
25	9,82	86,64	173,2	260	346,6	433,2	519,8	606,4	693	779,8	866,4		
32	16,08	141,94	283,8	425,8	567,8	709,8	851,6	993,6	1135,6	1277,4	1419,4		

Traction side

Values in Newton

SERIES >		16	24	25	40	41	42	60	61	62	63	90	92	94	95	97
∅	Thrust side	∅ rod	Traction side	Pressure												
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	
mm	cm ²	mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)			
8	0,50	4	0,38	3,33	6,7	10,0	13,3	16,6	20,0	23,3	26,6	29,9	33,3			
10	0,79	4	0,66	5,82	11,6	17,5	23,3	29,1	34,9	40,8	46,6	52,4	58,2			
12	1,13	6	0,85	7,49	15,0	22,5	29,9	37,4	44,9	52,4	59,9	67,4	74,9			
16	2,01	6	1,73	15,25	30,5	45,7	61,0	76,2	91,5	106,7	122,0	137,2	152,5			
20	3,14	8	2,64	23,29	46,6	69,9	93,1	116,4	139,7	163,0	186,3	209,6	232,9			
25	4,91	10	4,12	36,39	72,8	109,2	145,5	181,9	218,3	254,7	291,1	327,5	363,9			
32	8,04	12	6,91	60,99	122,0	183,0	244,0	305,0	365,9	426,9	487,9	548,9	609,9			
40	12,56	16	10,55	93,15	186,3	279,4	372,6	465,7	558,9	652,0	745,2	838,3	931,5			
50	19,63	20	16,49	145,55	291,1	436,6	582,2	727,7	873,3	1018,8	1164,4	1309,9	1455,5			
63	31,16	20	28,02	247,36	494,7	742,1	989,4	1236,8	1484,2	1731,5	1978,9	2226,2	2473,6			
80	50,24	25	45,33	400,25	800,5	1200,8	1601,0	2001,3	2401,5	2801,8	3202,0	3602,3	4002,5			
100	78,50	25	73,59	649,76	1299,5	1949,3	2599,0	3248,8	3898,6	4548,3	5198,1	5847,8	6497,6			
125	122,66	32	114,62	1011,96	2023,9	3035,9	4047,8	5059,8	6071,8	7083,7	8095,7	9107,6	10119,6			
160	200,96	40	188,40	1663,38	3326,8	4990,2	6653,5	8316,9	9980,3	11643,7	13307,1	14970,5	16633,8			
200	314,00	40	301,44	2661,41	5322,8	7984,2	10645,7	13307,1	15968,5	18629,9	21291,3	23952,7	26614,1			
250	490,62	50	471,00	4158,46	8316,9	12475,4	16633,8	20792,3	24950,8	29109,2	33267,7	37426,1	41584,6			
320	803,84	63	772,68	6822,02	13644,0	20466,1	27288,1	34110,1	40932,1	47754,1	54576,2	61398,2	68220,2			

SERIES >		QX													
∅	Thrust side	∅ rod	Traction side	Pressure											
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	
mm	cm ²	mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)		
10	1,58	6	1,0148	9,1332	18,2664	27,3996	36,5328	45,666	54,7992	63,9324	73,0656	82,1988	91,332		
16	4,02	16	3,02	26,62	53,2	79,8	106,4	133	159,6	186,2	213	239,6	266,2		
20	6,28	20	4,72	41,58	83,2	124,8	166,4	208	249,6	291	332,6	374,2	415,8		
25	9,82	24	7,56	66,68	133,4	200	266,6	333,4	400	466,8	533,4	600	666,8		
32	16,08	32	12,06	106,46	213	319,4	425,8	532,2	638,8	745,2	851,6	958,2	1064,6		

OUTPUT FORCES DOUBLE-ACTING CYLINDERS

Traction side

Values in Newton

SERIES > 31 32													
∅	Thrust side	∅ rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm ²	mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
12	1,13	6	0,85	7,49	15,0	22,5	29,9	37,4	44,9	52,4	59,9	67,4	74,9
16	2,01	8	1,51	13,31	26,6	39,9	53,2	66,5	79,8	93,1	106,5	119,8	133,1
20	3,14	10	2,36	20,79	41,6	62,4	83,2	104,0	124,8	145,5	166,3	187,1	207,9
25	4,91	10	4,12	36,39	72,8	109,2	145,5	181,9	218,3	254,7	291,1	327,5	363,9
32	8,04	12	6,91	60,99	122,0	183,0	244,0	305,0	365,9	426,9	487,9	548,9	609,9
40	12,56	12	11,43	100,91	201,8	302,7	403,6	504,6	605,5	706,4	807,3	908,2	1009,1
50	19,63	16	17,62	155,53	311,1	466,6	622,1	777,6	933,2	1088,7	1244,2	1399,7	1555,3
63	31,16	16	29,15	257,34	514,7	772,0	1029,4	1286,7	1544,0	1801,4	2058,7	2316,1	2573,4
80	50,24	20	47,10	415,85	831,7	1247,5	1663,4	2079,2	2495,1	2910,9	3326,8	3742,6	4158,5
100	78,50	25	73,59	649,76	1299,5	1949,3	2599,0	3248,8	3898,6	4548,3	5198,1	5847,8	6497,6

SERIES > QP													
∅	Thrust side	∅ rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm ²	mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
12	1,13	6	0,85	7,49	15,0	22,5	29,9	37,4	44,9	52,4	59,9	67,4	74,9
16	2,01	8	1,51	13,31	26,6	39,9	53,2	66,5	79,8	93,1	106,5	119,8	133,1
20	3,14	10	2,36	20,79	41,6	62,4	83,2	104,0	124,8	145,5	166,3	187,1	207,9
25	4,91	10	4,12	36,39	72,8	109,2	145,5	181,9	218,3	254,7	291,1	327,5	363,9
32	8,04	12	6,91	60,99	122,0	183,0	244,0	305,0	365,9	426,9	487,9	548,9	609,9
40	12,56	16	10,55	93,15	186,3	279,4	372,6	465,7	558,9	652,0	745,2	838,3	931,5
50	19,63	16	17,62	155,53	311,1	466,6	622,1	777,6	933,2	1088,7	1244,2	1399,7	1555,3
63	31,16	20	28,02	247,36	494,7	742,1	989,4	1236,8	1484,2	1731,5	1978,9	2226,2	2473,6
80	50,24	25	45,33	400,25	800,5	1200,8	1601,0	2001,3	2401,5	2801,8	3202,0	3602,3	4002,5
100	78,50	25	73,59	649,76	1299,5	1949,3	2599,0	3248,8	3898,6	4548,3	5198,1	5847,8	6497,6

SERIES > 27													
∅	Thrust side	∅ rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm ²	mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
20	3,14	8	2,64	23,29	46,6	69,9	93,1	116,4	139,7	163,0	186,3	209,6	232,9
25	4,91	10	4,12	36,39	72,8	109,2	145,5	181,9	218,3	254,7	291,1	327,5	363,9
32	8,04	12	6,91	60,99	122,0	183,0	244,0	305,0	365,9	426,9	487,9	548,9	609,9
40	12,56	16	10,55	93,15	186,3	279,4	372,6	465,7	558,9	652,0	745,2	838,3	931,5
50	19,63	16	17,62	155,53	311,1	466,6	622,1	777,6	933,2	1088,7	1244,2	1399,7	1555,3
63	31,16	20	28,02	247,36	494,7	742,1	989,4	1236,8	1484,2	1731,5	1978,9	2226,2	2473,6

SERIES > QCT QCB QCTF QCBF													
∅	Thrust side	∅ rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm ²	mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
20	3,14	10	2,36	20,79	41,6	62,4	83,2	104,0	124,8	145,5	166,3	187,1	207,9
25	4,91	12	3,78	33,34	66,7	100,0	133,3	166,7	200,0	233,4	266,7	300,0	333,4
32	8,04	16	6,03	53,23	106,5	159,7	212,9	266,1	319,4	372,6	425,8	479,1	532,3
40	12,56	16	10,55	93,15	186,3	279,4	372,6	465,7	558,9	652,0	745,2	838,3	931,5
50	19,63	20	16,49	145,55	291,1	436,6	582,2	727,7	873,3	1018,8	1164,4	1309,9	1455,5
63	31,16	20	28,02	247,36	494,7	742,1	989,4	1236,8	1484,2	1731,5	1978,9	2226,2	2473,6

Table showing air consumption of double-acting cylinders

Thrust side

Values in NI for each 10 mm of stroke

SERIES >		16	24	25	27	31	32	QP	QCT	QCB	QCBF	QCTF	40	41	42	50	52	60	61	62	63	90	92	94	95	97
∅	Thrust side	Pressure																								
		MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)															
8	0,50	0,001	0,002	0,002	0,003	0,003	0,004	0,004	0,005	0,005	0,006															
10	0,79	0,002	0,002	0,003	0,004	0,005	0,005	0,006	0,007	0,007	0,008															
12	1,13	0,002	0,003	0,005	0,006	0,007	0,008	0,009	0,010	0,010	0,011															
16	2,01	0,004	0,006	0,008	0,010	0,012	0,014	0,016	0,018	0,018	0,020															
20	3,14	0,006	0,009	0,013	0,016	0,019	0,022	0,025	0,028	0,031	0,035															
25	4,91	0,010	0,015	0,020	0,025	0,029	0,034	0,039	0,044	0,049	0,054															
32	8,04	0,016	0,024	0,032	0,040	0,048	0,056	0,064	0,072	0,080	0,088															
40	12,56	0,025	0,038	0,050	0,063	0,075	0,088	0,100	0,113	0,126	0,138															
50	19,63	0,039	0,059	0,079	0,098	0,118	0,137	0,157	0,177	0,196	0,216															
63	31,16	0,062	0,093	0,125	0,156	0,187	0,218	0,249	0,280	0,312	0,343															
80	50,24	0,100	0,151	0,201	0,251	0,301	0,352	0,402	0,452	0,502	0,553															
100	78,50	0,157	0,236	0,314	0,393	0,471	0,550	0,628	0,707	0,785	0,864															
125	122,66	0,245	0,368	0,491	0,613	0,736	0,859	0,981	1,104	1,227	1,349															
160	200,96	0,402	0,603	0,804	1,005	1,206	1,407	1,608	1,809	2,010	2,211															
200	314,00	0,628	0,942	1,256	1,570	1,884	2,198	2,512	2,826	3,140	3,454															
250	490,63	0,981	1,472	1,963	2,453	2,944	3,434	3,925	4,416	4,906	5,397															
320	803,84	1,608	2,412	3,215	4,019	4,823	5,627	6,431	7,235	8,038	8,842															

SERIES >		QX											
∅	Thrust side	Pressure											
		MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	
mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)		
10	1,58	0,003	0,005	0,006	0,008	0,009	0,011	0,013	0,014	0,016	0,017		
16	4,02	0,008	0,012	0,016	0,02	0,024	0,028	0,032	0,036	0,04	0,044		
20	6,28	0,012	0,018	0,026	0,032	0,038	0,044	0,05	0,056	0,062	0,07		
25	9,82	0,02	0,03	0,04	0,05	0,058	0,068	0,078	0,088	0,098	0,108		
32	16,08	0,032	0,048	0,064	0,08	0,096	0,112	0,128	0,144	0,16	0,176		

Traction side

Values in NI for each 10 mm of stroke

SERIES >		16	24	25	40	41	42	60	61	62	63	90	92	94	95	97
∅	Thrust side	∅ rod	Traction side	Pressure												
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)		
mm	cm ²	mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)			
8	0,50	4	0,38	0,001	0,001	0,002	0,002	0,002	0,003	0,003	0,003	0,004	0,004			
10	0,79	4	0,66	0,001	0,002	0,003	0,003	0,004	0,005	0,005	0,006	0,007	0,007			
12	1,13	6	0,85	0,002	0,003	0,003	0,004	0,005	0,006	0,007	0,008	0,008	0,009			
16	2,01	6	1,73	0,003	0,005	0,007	0,009	0,010	0,012	0,014	0,016	0,017	0,019			
20	3,14	8	2,64	0,005	0,008	0,011	0,013	0,016	0,018	0,021	0,024	0,026	0,029			
25	4,91	10	4,12	0,008	0,012	0,016	0,021	0,025	0,029	0,033	0,037	0,041	0,045			
32	8,04	12	6,91	0,014	0,021	0,028	0,035	0,041	0,048	0,055	0,062	0,069	0,076			
40	12,56	16	10,55	0,021	0,032	0,042	0,053	0,063	0,074	0,084	0,095	0,106	0,116			
50	19,63	20	16,49	0,033	0,049	0,066	0,082	0,099	0,115	0,132	0,148	0,165	0,181			
63	31,16	20	28,02	0,056	0,084	0,112	0,140	0,168	0,196	0,224	0,252	0,280	0,308			
80	50,24	25	45,33	0,091	0,136	0,181	0,227	0,272	0,317	0,363	0,408	0,453	0,499			
100	78,50	25	73,59	0,147	0,221	0,294	0,368	0,442	0,515	0,589	0,662	0,736	0,810			
125	122,66	32	114,62	0,229	0,344	0,458	0,573	0,688	0,802	0,917	1,032	1,146	1,261			
160	200,96	40	188,40	0,377	0,565	0,754	0,942	1,130	1,319	1,507	1,696	1,884	2,072			
200	314,00	40	301,44	0,603	0,904	1,206	1,507	1,809	2,110	2,412	2,713	3,014	3,316			
250	490,63	50	471,00	0,942	1,413	1,884	2,355	2,826	3,297	3,768	4,239	4,710	5,181			
320	803,84	63	772,68	1,545	2,318	3,091	3,863	4,636	5,409	6,181	6,954	7,727	8,500			

SERIES >		QX												
∅	Thrust side	∅ rod	Traction side	Pressure										
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm ²	mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)	
10	1,58	6	1,0148	0,002	0,003	0,004	0,005	0,006	0,007	0,008	0,009	0,010	0,011	
16	4,02	16	3,02	0,006	0,01	0,012	0,016	0,018	0,022	0,024	0,028	0,03	0,034	
20	6,28	20	4,72	0,01	0,014	0,018	0,024	0,028	0,032	0,038	0,042	0,048	0,052	
25	9,82	24	7,56	0,016	0,022	0,03	0,038	0,046	0,052	0,06	0,068	0,076	0,084	
32	16,08	32	12,06	0,024	0,036	0,048	0,06	0,072	0,084	0,096	0,108	0,12	0,132	

TABLE SHOWING AIR CONSUMPTION OF DOUBLE-ACTING CYLINDERS

Traction side

Values in NI for each 10 mm of stroke

SERIES > 31 32													
∅	Thrust side	∅ rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm ²	mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
12	1,13	6	0,85	0,002	0,003	0,003	0,004	0,005	0,006	0,007	0,008	0,008	0,009
16	2,01	8	1,51	0,003	0,005	0,006	0,008	0,009	0,011	0,012	0,014	0,015	0,017
20	3,14	10	2,36	0,005	0,007	0,009	0,012	0,014	0,016	0,019	0,021	0,024	0,026
25	4,91	10	4,12	0,008	0,012	0,016	0,021	0,025	0,029	0,033	0,037	0,041	0,045
32	8,04	12	6,91	0,014	0,021	0,028	0,035	0,041	0,048	0,055	0,062	0,069	0,076
40	12,56	12	11,43	0,023	0,034	0,046	0,057	0,069	0,080	0,091	0,103	0,114	0,126
50	19,63	16	17,62	0,035	0,053	0,070	0,088	0,106	0,123	0,141	0,159	0,176	0,194
63	31,16	16	29,15	0,058	0,087	0,117	0,146	0,175	0,204	0,233	0,262	0,291	0,321
80	50,24	20	47,10	0,094	0,141	0,188	0,236	0,283	0,330	0,377	0,424	0,471	0,518
100	78,50	25	73,59	0,147	0,221	0,294	0,368	0,442	0,515	0,589	0,662	0,736	0,810

SERIES > QP													
∅	Thrust side	∅ rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm ²	mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
12	1,13	6	0,85	0,002	0,003	0,003	0,004	0,005	0,006	0,007	0,008	0,008	0,009
16	2,01	8	1,51	0,003	0,005	0,006	0,008	0,009	0,011	0,012	0,014	0,015	0,017
20	3,14	10	2,36	0,005	0,007	0,009	0,012	0,014	0,016	0,019	0,021	0,024	0,026
25	4,91	10	4,12	0,008	0,012	0,016	0,021	0,025	0,029	0,033	0,037	0,041	0,045
32	8,04	12	6,91	0,014	0,021	0,028	0,035	0,041	0,048	0,055	0,062	0,069	0,076
40	12,56	16	10,55	0,021	0,032	0,042	0,053	0,063	0,074	0,084	0,095	0,106	0,116
50	19,63	16	17,62	0,035	0,053	0,070	0,088	0,106	0,123	0,141	0,159	0,176	0,194
63	31,16	20	28,02	0,056	0,084	0,112	0,140	0,168	0,196	0,224	0,252	0,280	0,308
80	50,24	25	45,33	0,091	0,136	0,181	0,227	0,272	0,317	0,363	0,408	0,453	0,499
100	78,50	25	73,59	0,147	0,221	0,294	0,368	0,442	0,515	0,589	0,662	0,736	0,810

SERIES > 27													
∅	Thrust side	∅ rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm ²	mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
20	3,14	8	2,64	0,005	0,008	0,011	0,013	0,016	0,018	0,021	0,024	0,026	0,029
25	4,91	10	4,12	0,008	0,012	0,016	0,021	0,025	0,029	0,033	0,037	0,041	0,045
32	8,04	12	6,91	0,014	0,021	0,028	0,035	0,041	0,048	0,055	0,062	0,069	0,076
40	12,56	16	10,55	0,021	0,032	0,042	0,053	0,063	0,074	0,084	0,095	0,106	0,116
50	19,63	16	17,62	0,035	0,053	0,070	0,088	0,106	0,123	0,141	0,159	0,176	0,194
63	31,16	20	28,02	0,056	0,084	0,112	0,140	0,168	0,196	0,224	0,252	0,280	0,308

SERIES > QCT QCB QCTF QCBF													
∅	Thrust side	∅ rod	Traction side	Pressure									
				MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
mm	cm ²	mm	cm ²	0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)
20	3,14	10	2,36	0,005	0,007	0,009	0,012	0,014	0,016	0,019	0,021	0,024	0,026
25	4,91	12	3,78	0,008	0,011	0,015	0,019	0,023	0,026	0,030	0,034	0,038	0,042
32	8,04	16	6,03	0,012	0,018	0,024	0,030	0,036	0,042	0,048	0,054	0,060	0,066
40	12,56	16	10,55	0,021	0,032	0,042	0,053	0,063	0,074	0,084	0,095	0,106	0,116
50	19,63	20	16,49	0,033	0,049	0,066	0,082	0,099	0,115	0,132	0,148	0,165	0,181
63	31,16	20	28,02	0,056	0,084	0,112	0,140	0,168	0,196	0,224	0,252	0,280	0,308

SERIES > ARP													
Mod.	Volume (l)			Pressure (opening/closing)									
	open./clos.	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
		0,10 (1)	0,20 (2)	0,30 (3)	0,40 (4)	0,50 (5)	0,60 (6)	0,70 (7)	0,80 (8)	0,90 (9)	1 (10)		
ARP 001	0,03 0,03	0,05/0,05	0,08/0,08	0,11/0,11	0,13/0,13	0,16/0,16	0,19/0,19	0,21/0,21	0,24/0,24	0,27/0,27	0,29/0,29		
ARP 003	0,10 0,10	0,20/0,20	0,30/0,30	0,40/0,40	0,50/0,50	0,60/0,60	0,70/0,70	0,80/0,80	0,90/0,90	1,00/1,00	1,10/1,10		
ARP 005	0,20 0,30	0,40/0,60	0,60/0,90	0,80/1,20	1,00/1,50	1,20/1,80	1,40/2,10	1,60/2,40	1,80/2,70	2,00/3,00	2,20/3,30		
ARP 010	0,40 0,50	0,80/1,00	1,20/1,50	1,60/2,00	2,00/2,50	2,40/3,00	2,80/3,50	3,20/4,00	3,60/4,50	4,00/5,00	4,40/5,50		
ARP 012	0,49 0,64	0,98/1,28	1,47/1,92	1,96/2,56	2,45/3,20	2,94/3,84	3,43/4,48	3,92/5,12	4,41/5,76	4,90/6,40	5,39/7,04		
ARP 020	0,90 1,00	1,80/2,00	2,70/3,00	3,60/4,00	4,50/5,00	5,40/6,00	6,30/7,00	7,20/8,00	8,10/9,00	9,00/10,00	9,90/11,00		
ARP 035	1,69 1,90	3,38/3,80	5,07/5,70	6,76/7,60	8,45/9,50	10,14/11,40	11,83/13,30	13,52/15,20	15,21/17,10	16,90/19,00	18,59/20,90		
ARP 055	2,80 3,40	5,60/6,80	8,40/10,20	11,20/13,60	14,00/17,00	16,80/20,40	19,60/23,80	22,40/27,20	25,20/30,60	28,00/34,00	30,80/37,40		
ARP 055	2,80 3,40	5,60/6,80	8,40/10,20	11,20/13,60	14,00/17,00	16,80/20,40	19,60/23,80	22,40/27,20	25,20/30,60	28,00/34,00	30,80/37,40		
ARP 070	3,05 3,70	6,10/7,40	9,15/11,10	12,20/14,80	15,25/18,50	18,30/22,20	21,35/25,90	24,40/29,60	27,45/33,30	30,50/37,00	33,55/40,70		
ARP 100	5,52 5,90	11,04/11,80	16,56/17,70	22,08/23,60	27,60/29,50	33,12/35,40	38,64/41,30	44,16/47,20	49,68/53,10	55,20/59,00	60,72/64,90		
ARP 150	7,60 9,60	15,20/19,20	22,80/28,80	30,40/38,40	38,00/48,00	45,60/57,60	53,20/67,20	60,80/76,80	68,40/86,40	76,00/96,00	83,60/105,60		
ARP 250	8,50 9,80	17,00/19,60	25,50/29,40	34,00/39,20	42,50/49,00	51,00/58,80	59,50/68,60	68,00/78,40	76,50/88,20	85,00/98,00	93,50/107,80		
ARP 400	13,60 17,50	27,20/35,00	40,80/52,50	54,40/70,00	68,00/87,50	81,60/105,00	95,20/122,50	108,80/140,00	122,40/157,50	136,00/175,00	149,60/192,50		

Dimensioning guide for Shock Absorbers Series SA

In order to select the correct dimensions of Shock absorbers the following parameters are needed:

- Weight of the impact object m (kg)
- Impact speed v (m/s)
- Propelling or thrust force F (N)
- No. of impact cycles per hour C (/hr)

Some formulas	
1. Kinetic energy	$E_k = mv^2/2$
2. Drive energy	$E_d = F \cdot S$
3. Total energy	$E_t = E_k + E_d$
4. Free fall speed	$v = \sqrt{2g \cdot h}$

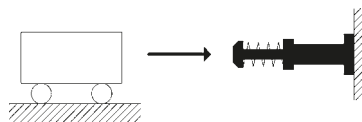
Some formulas	
5. Cylinder's traction force	$F = \frac{D^2 \cdot \pi}{4} \cdot P \cdot g/100$
6. Cylinder's thrust force	$F = \frac{(D^2 - d^2) \cdot \pi}{4} \cdot P \cdot g/100$
7. Maximum shock force (approx.)	$F_m = 1.2 E_t / S$
8. Total energy consumption per hour	$E_{tc} = E_t \cdot C$
9. Mass	$M_e = 2E_t/v^2$

Dimensioning guide: formulas and examples

Symbols description			Symbols description		
Symbol	Unit	Description	Symbol	Unit	Description
m		friction coefficient	F _m	(N)	maximum shock force
a	(rad)	angle of incline	g	(m/s ²)	gravity acceleration (9.81 m/s ²)
q	(rad)	side load angle	h	(m)	height
w	(rad/s)	angular velocity	m	(kg)	mass to be decelerated
A	(m)	width	M _e	(kg)	effective mass
B	(m)	thickness	P	(bar)	operating pressure
C	(/hr)	impact cycles per hour	R	(m)	radius
D	(mm)	cylinder diameter	R _s	(m)	shock absorber mounting distance from rotation center
d	(mm)	piston rod diameter	S	(m)	stroke (shock absorber)
E _d	(Nm)	drive energy per cycle	T	(Nm)	driving torque
E _k	(Nm)	kinetic energy per cycle	t	(s)	deceleration time
E _t	(Nm)	total energy per cycle	v	(m/s)	velocity of impact mass
E _{tc}	(Nm)	total energy per hour	vs	(m/s)	impact velocity at shock absorber
F	(N)	propelling force			

Example 1: Horizontal impact

Application data:
v = 1.0 m/s
m = 50 kg
S = 0.01 m
C = 1500 cycles/h



Calculation:

$$E_k = \frac{mv^2}{2} = \frac{50 \cdot 1^2}{2} = 25 \text{ Nm}$$

$$E_t = E_k = 25 \text{ Nm}$$

$$E_{tc} = E_t \cdot C = 25 \cdot 1500 = 37500 \text{ Nm/h}$$

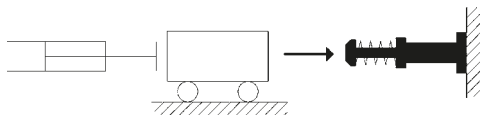
$$M_e = \frac{2E_t}{v^2} = \frac{2 \cdot 25}{1^2} = 50 \text{ kg}$$

The adequate Shock Absorber to use in this case is Mod. SA 2015 according to the technical data where we find that E_t (max) = 59 Nm, E_{tc} (max) = 38000 Nm/h and M_e (max) = 120 kg.

Example 2: Horizontal impact with propelling force

Application data:
m = 40 kg
P = 6 bar
S = 0.01 m first hypothesis SA 1210
v = 1.2 m/s
D = 50 mm
C = 780 cycles/h

To facilitate the calculation, the pressure in the empty cylinder chamber is not considered (safety condition)



Calculation:

$$E_k = \frac{mv^2}{2} = \frac{40 \cdot 1,2^2}{2} = 28,8 \text{ Nm}$$

Consider the shock absorber with the lowest E_t but superior to 28.8 Nm: mod. SA 2015 S=0.015 m

$$E_d = F \cdot S = \frac{D^2 \cdot \pi}{4} \cdot P \cdot g/100 \cdot S = \frac{50^2 \cdot \pi}{4} \cdot 6 \cdot 9,81/100 \cdot 0,015 = 17,3 \text{ Nm}$$

$$E_t = E_k + E_d = 28,8 + 17,3 = 46,1 \text{ Nm}$$

$$E_{tc} = E_t \cdot C = 46,1 \cdot 780 = 35958 \text{ Nm/h}$$

$$M_e = \frac{2E_t}{v^2} = \frac{2 \cdot 46,1}{1,2^2} = 64,0 \text{ Kg}$$

The adequate Shock Absorber to use in this case is Mod.SA 2015 according to the technical data where we find that E_t (max) = 59 Nm, E_{tc} (max)=38000 Nm/h and M_e (max) = 120 kg.

Example 3: Free fall impact

Application data:

- h** = 0,35 m
- m** = 5 kg
- S** = 0.01 m
first hypothesis SA 1210
- C** = 1500 cycles/h



Calculation:

$$v = \sqrt{(2g \cdot h)} = \sqrt{(2 \cdot 9,81 \cdot 0,35)} = 2,6 \text{ m/s}$$

$$E_k = m \cdot g \cdot h = 5 \cdot 9,81 \cdot 0,35 = 17,2 \text{ Nm}$$

Consider the shock absorber with the lowest l'Er but superior to 17.2 Nm:
mod. SA 1412 S = 0.012 m

$$E_d = F \cdot S = m \cdot g \cdot s = 5 \cdot 9,81 \cdot 0,012 = 0,6 \text{ Nm}$$

$$E_r = E_k + E_d = 17,2 + 0,6 = 17,8 \text{ Nm}$$

$$E_{rc} = E_r \cdot C = 17,8 \cdot 1500 = 26700 \text{ Nm/h}$$

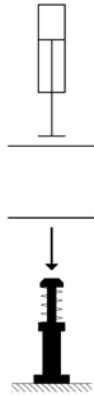
$$M_e = \frac{2E_r}{v^2} = \frac{2 \cdot 17,5}{2,6^2} = 5 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 1412 according to the technical data, where we find that Er (max) = 20 Nm, Erc (max) = 33000 Nm/h and Me (max) = 40 kg.

Example 4: Vertical impact downwards with propelling force

Application data:

- m** = 50 kg
- S** = 0.025 m
- P** = 6 bar
- D** = 63 mm
- C** = 600 cycles/h
- v** = 1,0 m/s



Calculation:

$$E_k = \frac{mv^2}{2} = \frac{50 \cdot 1^2}{2} = 25 \text{ Nm}$$

$$E_d = F \cdot S = (m \cdot g + \frac{D^2 \cdot \pi}{4} \cdot P \cdot g/100) \cdot S = (50 \cdot 9,81 + \frac{63^2 \cdot \pi}{4} \cdot 6 \cdot 9,81/100) \cdot 0,025 = 58,1 \text{ Nm}$$

$$E_r = E_k + E_d = 25 + 58,1 = 83,1 \text{ Nm}$$

$$E_{rc} = E_r \cdot C = 83,1 \cdot 600 = 49860 \text{ Nm/h}$$

$$M_e = \frac{2E_r}{v^2} = \frac{2 \cdot 84}{1^2} = 168 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 2725 according to the technical data, where we find that Er (max) = 147 Nm, Erc (max) = 72000 Nm/h and Me (max) = 270 kg.

Example 5: Vertical impact upwards with propelling force

Application data:

- m** = 50 kg
- h** = 0.3 m
- S** = 0.025 m
first hypothesis
Mod. SA 2525
- P** = 6 bar = 0,6 MPa
- D** = 63 mm
- C** = 600 cycles/h
- v** = 1,0 m/s



Calculation:

$$E_k = \frac{mv^2}{2} = \frac{50 \cdot 1^2}{2} = 25 \text{ Nm}$$

Consider the shock absorber with the lowest l'Er but superior to 25 Nm:
mod. SA 2015 S=0.015 m

$$E_d = F \cdot S = (\frac{D^2 \cdot \pi}{4} \cdot P \cdot g/100 - m \cdot g) \cdot S = (\frac{63^2 \cdot \pi}{4} \cdot 6 \cdot 9,81/100 - 50 \cdot 9,81) \cdot 0,015 = 20,1 \text{ Nm}$$

$$E_r = E_k + E_d = 25 + 20,1 = 45,7 \text{ Nm}$$

$$E_{rc} = E_r \cdot C = 45,1 \cdot 600 = 27060 \text{ Nm/h}$$

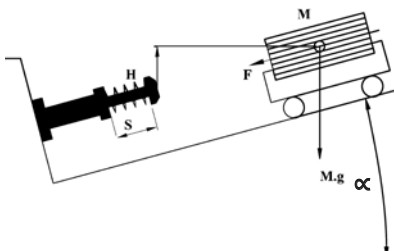
$$M_e = \frac{2E_r}{v^2} = \frac{2 \cdot 45,7}{1^2} = 91,4 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 2015 according to the technical data, where we find that Er (max) = 59 Nm, Erc (max) = 38000 Nm/h and Me (max) = 120 kg.

Example 6: Inclined impact

Application data:

- m** = 10 kg
- h** = 0,3 m
- S** = 0.015 m
- $\alpha = 30^\circ$
- C** = 600 cycles/h



Calculation:

$$v = \sqrt{(2g \cdot h)} = \sqrt{(2 \cdot 9,81 \cdot 0,3)} = 2,43 \text{ m/s}$$

$$E_k = m \cdot g \cdot h = 10 \cdot 9,81 \cdot 0,3 = 29,4 \text{ Nm}$$

$$E_d = F \cdot S = m \cdot g \cdot \sin \alpha \cdot s = 10 \cdot 9,81 \cdot \sin 30^\circ \cdot 0,015 = 10 \cdot 9,81 \cdot 0,5 \cdot 0,015 = 0,7 \text{ Nm}$$

$$E_r = E_k + E_d = 29,4 + 0,7 = 30,1 \text{ Nm}$$

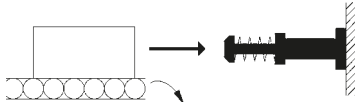
$$E_{rc} = E_r \cdot C = 30,1 \cdot 600 = 18060 \text{ Nm/h}$$

$$M_e = \frac{2E_r}{v^2} = \frac{2 \cdot 30,1}{2,43^2} = 10,2 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 2015 according to the technical data, where we find that Er (max) = 59 Nm, Erc (max) = 38000 Nm/h and Me (max) = 120 kg.

Example 7: Horizontal mass on conveyer

Application data:
m = 5 kg
v = 0,5 m/s
μ = 0,25
S = 0,006 m
C = 3000 cycles/h



Calculation:

$$E_k = \frac{mv^2}{2} = \frac{5 \cdot 0,5^2}{2} = 0,63 \text{ Nm}$$

$$E_D = F \cdot S = m \cdot g \cdot \mu \cdot s = 5 \cdot 9,81 \cdot 0,25 \cdot 0,006 = 0,07 \text{ Nm}$$

$$E_T = E_k + E_D = 0,63 + 0,07 = 0,7 \text{ Nm}$$

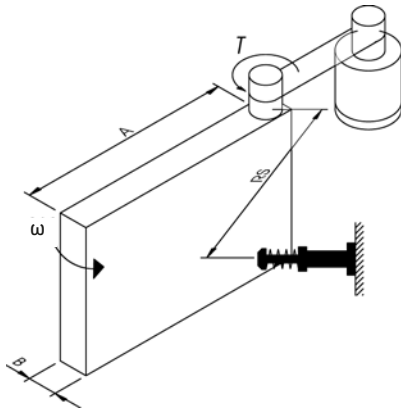
$$E_{Tc} = E_T \cdot C = 0,7 \cdot 3000 = 2100 \text{ Nm/h}$$

$$M_e = \frac{2E_T}{v^2} = \frac{2 \cdot 0,7}{0,5^2} = 5,6 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 0806 according to the technical data, where we find that E_T (max) = 3 Nm, E_{Tc} (max) = 7000 Nm/h and M_e (max) = 6 kg.

Example 8: Horizontal rotating door

Application data:
m = 20 kg
ω = 2,0 rad/s
T = 20 Nm
Rs = 0,8 m
A = 1,0 m
S = 0,015 m
C = 600 cycles/h



Calculation:

$$I = \frac{m(4A^2 + B^2)}{12} = \frac{20(4 \cdot 1,0^2 + 0,05^2)}{12} = 6,67 \text{ Kg} \cdot \text{m}^2$$

$$E_k = \frac{I\omega^2}{2} = \frac{6,67 \cdot 2,0^2}{2} = 13,34 \text{ Nm}$$

$$\theta = \frac{S}{R_s} = \frac{0,015}{0,8} = 0,019 \text{ rad}$$

$$E_D = T \cdot \theta = 20 \cdot 0,018 = 0,36 \text{ Nm}$$

$$E_T = E_k + E_D = 13,34 + 0,36 = 13,7 \text{ Nm}$$

$$E_{Tc} = E_T \cdot C = 13,7 \cdot 600 = 8220 \text{ Nm/h}$$

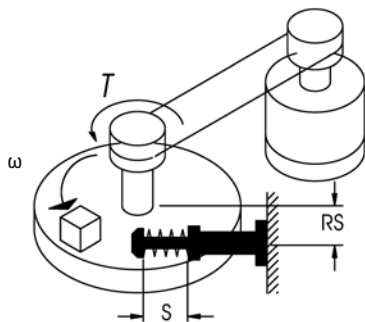
$$v = \omega \cdot R_s = 2,0 \cdot 0,8 = 1,6 \text{ m/s}$$

$$M_e = \frac{2E_T}{v^2} = \frac{2 \cdot 13,7}{1,6^2} = 10,7 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 1412 according to the technical data, where we find that E_T (max) = 20 Nm, E_{Tc} (max) = 33000 Nm/h and M_e (max) = 40 kg.

Example 9: Horizontal rotating door

Application data:
m = 200 kg
ω = 1,0 rad/s
T = 100 Nm
R = 0,5 m
Rs = 0,4 m
S = 0,015 m
C = 100 cycles/h



Calculation:

$$I = \frac{mR^2}{2} = \frac{200 \cdot 0,5^2}{2} = 25 \text{ Kg} \cdot \text{m}^2$$

$$E_k = \frac{I\omega^2}{2} = \frac{25 \cdot 1,0^2}{2} = 12,5 \text{ Nm}$$

$$\theta = \frac{S}{R_s} = \frac{0,015}{0,4} = 0,0375 \text{ rad}$$

$$E_D = T \cdot \theta = 100 \cdot 0,0375 = 3,75 \text{ Nm}$$

$$E_T = E_k + E_D = 12,5 + 3,75 = 16,25 \text{ Nm}$$

$$E_{Tc} = E_T \cdot C = 16,25 \cdot 100 = 1625 \text{ Nm/h}$$

$$v = \omega \cdot R_s = 1,0 \cdot 0,4 = 0,4 \text{ m/s}$$

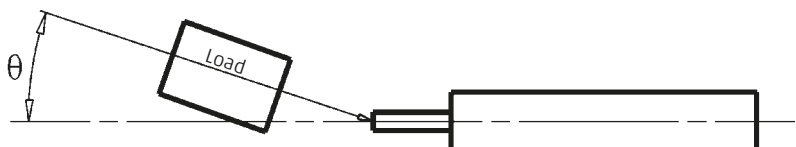
$$M_e = \frac{2E_T}{v^2} = \frac{2 \cdot 16,25}{0,4^2} = 203 \text{ Kg}$$

The adequate shock absorber to use in this case is Mod. SA 2015 according to the technical data, where we find that E_T (max) = 59 Nm, E_{Tc} (max) = 38000 Nm/h and M_e (max) = 720 kg.

Perpendicularity of the load

To ensure the lifetime of the shock absorber, the movement of the impact body must be perpendicular to the shock absorbers axial centre.

Note: The maximum allowable eccentricity $\theta \leq 2,5^\circ$ (0,044 rad).



Quality: our priority commitment

Research, technological innovation, training, respect for personnel, employee and environmental safety and total customer care are all factors that Camozzi considers strategic in the achievement of quality.

To Camozzi quality is a system that ensures excellence, not only of the final product but throughout the entire business process.

QUALITY: OUR PRIORITY COMMITMENT



Our certifications

Camozzi's main goals include quality and safety, the protection of the environment and compatibility of our activities with the territories in which they are performed.

Since 1993 Camozzi has been certified in accordance with the ISO 9001 standard for quality management. In 2003 the company obtained ISO 14001 certification for environmental management.

In the same year, DNV, the global quality assurance and risk management company, certified Camozzi's Integrated Management System, which includes both ISO 9001 and ISO 14001 standards. Furthermore, in 2013 Camozzi obtained ISO/TS 16949 certification for the Series C-Truck and Series 9000 fuel fittings, then transitioned to the new edition of the IATF 16949 standard in 2018.

From 1 July 2003, all products sold in the European Union and destined to be used in potentially explosive areas, had to be approved according to directive 94/9/CE, also known as ATEX.

This directive covered both electrical and non-electrical parts, including for instance pneumatic power and control equipment.

Mandatory directives

- Directive 99/34/EC concerning liability for defective products modified by Legislative Decree 02/02/01 n° 25.
- Directive 2014/35/EU "Equipment designed for use within certain voltages".
- Directive 2014/30/EU "Electromagnetic Compatibility EMC" and relative additions.
- Directive 2014/34/EU "Atex".
- Directive 2006/42/EC "Machinery".
- Directive 2014/68/EU "Pressure Equipment Directive".
- Directive 2001/95/EC "General product safety".
- Regulation 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Technical standards

- ISO 4414 - Pneumatic fluid power - General rules and safety requirements for systems and their components

Environmental notes

- Packaging: we respect the environment, so use materials which can be recycled, including recyclable PE and paper.
- Green Design Project: in the study of new products, the environmental impact is always taken into consideration (real project, elaboration, etc.).

Information for the use of Camozzi products

In order to ensure proper functioning of Camozzi products these general guidelines should be noted.

Air quality

While resources such as electricity, water and gas are normally supplied by external companies to guaranteed standards, compressed air is produced from the ambient atmosphere. It is therefore the user that has to guarantee compressed air quality.

High quality air is essential for proper functioning of pneumatic systems. One cubic metre of air at atmospheric pressure typically contains the following:

- more than 150 million solid particles with dimensions from 0,01 μm to 100 μm ,
- fumes due to combustion,
- water vapour, with volume depending on temperature; at 30° there are about 30 g/m³ of water
- oil, up to about 0,03 mg
- micro organisms
- plus a variety of chemical contaminants, odours etc ...

The further the air is compressed, the higher the air quantity in the same volume and therefore the higher the amount of contaminants.

In order to reduce unwanted contents, compressors are fitted with filters, driers and oil separators at the inlet and outlet.

In spite of these precautions, the air, during its passage along pipes and tubes or while in storage tanks, can collect contaminants such as flakes of rust. Further, water vapour contained in the air can cool down and liquefy, then absorb and retain oil fumes.

For this reason it is advisable to fit compressed air systems and pneumatic machinery with air treatment equipment.

Air treatment: classification according to ISO 8573-1-2010 standard

ISO 8573-1-2010 Class	Solid particles			Max Concentration mg/m ³	Water		Oil Total content (liquid, aerosol and vapour) mg/m ³	
	Max. Number of Particles per m ³ 0,1 - 0,5 μm	0,5 - 1 μm	1 - 5 μm		Water pressure dew point °C	Liquid g/m ³		
0	More strict than class 1, defined by the device user							
1	≤ 20,000	≤ 400	≤ 10	-	≤ - 70°	-	≤ 0,01	
2	≤ 400,000	≤ 6,000	≤ 100	-	≤ - 40°	-	≤ 0,1	
3	-	≤ 90,000	≤ 1,000	-	≤ - 20°	-	≤ 1	
4	-	-	≤ 10,000	-	≤ + 3°	-	≤ 5	
5	-	-	≤ 100,000	-	≤ + 7°	-	-	
6	-	-	-	≤ 5	≤ + 10°	-	-	
7	-	-	-	5 - 10	-	≤ 0,5	-	
8	-	-	-	-	-	0,5 - 5	-	
9	-	-	-	-	-	5 - 10	-	
X	-	-	-	> 10	-	> 10	-	

Different types of air treatment equipment have different functions: isolation valves, pressure regulators, soft-start valves and of course filters. In some applications lubricators are still used, but this is increasingly unusual. Regarding filtering, there are international standards, such as ISO 8573-1-2010, that classify air according to its quality.

ISO 8573-1-2010 classifies compressed air according to the presence of three contaminating categories: solid particles, water or water vapour, and concentration of micro mist or oil vapours. In general, if not specified otherwise in the characteristics of the single component, Camozzi products require an ISO 8573-1-2010 class 7-4-4 air quality.

- **class 7** = air has a maximum concentration of SOLID PARTICLES of 5 mg/m³. The filtering elements are designed to separate solid particles with a dimension of more than 25 μm .

The air exiting from our filters and therefore the air at the inlet of all other components can contain solid particles with a maximum concentration of 5 mg/m³ and with a maximum dimension of 25 μm .

- **class 4** = the compressed AIR temperature has to be ≤ 3°C in order for entrained water vapour to condense and become liquid. Conventional filters have characteristics that separate the humidity in the air only if it is in a liquid or near-liquid state. It is the cooling of the air that enables condensation and removal of water vapour.

The air flow entering the bowl of the filter sustains a minimum expansion phase, (according to the Gas Law when gas suddenly expands, its temperature drops) followed by a vortex, this enables the heavier particles and the water vapour (condensing due to the expansion) to adhere to the sides of the bowl and slide down towards the drain.

Except for specific versions, users of Camozzi filters have to install driers in their compressed air production systems that, by cooling the air, dehumidify it.

- **class 4** = the concentration of OIL PARTICLES must be of maximum 5 mg/m³. It should be noted that compressors use oil for lubrication and that this can be carried into the compressed air system in the form of aerosol, vapour or liquid.

This oil, as with all other contaminants, can be transported by the air into the pneumatic circuit. It can then contact the seals of the components and subsequently pass into the environment through the outlets of the solenoid valves. In this case coalescing filters are used to aggregate those micro-molecules of oil suspended in the air and remove them.

The use of Camozzi coalescing filters enable to reach classes 2 and 1.

It is important to keep in mind that best performance is reached only by means of a multi-phase filtering process with subsequent phases.

As illustrated, different filters have different characteristics - a very efficient filter for a certain contaminant may not be so effective for other contaminants.

The filtering elements determine the class of the filters, these elements should be replaced after a specified period or after a specified number of working hours. These parameters vary according to the characteristics of the incoming air.

Camozzi filters are subdivided into different groups:

- Filtering element of 25 μm , class 7-8-4
- Filtering element of 5 μm , class 6-8-4
- Filtering element of 1 μm , class 2-8-2 with pre-filter class 6-8-4
- Filtering element of 0,01 μm , class 1-8-1 with pre-filter class 6-8-4 residual oil content of 0,01 mg/m³
- Activated carbon, class 1-7-1 with pre-filter class 1-8-1 residual oil content of 0,003 mg/m³

The components are factory greased with special products and do not need an additional lubrication. In case it should be necessary, use ISO VG 32 oil. The quantity of oil introduced into the circuit depends on the applications. Camozzi suggests a maximum dosage of three drops per minute.

Pneumatic cylinders

The choice of the correct cylinder mounting and also that of the rod attachment to any moving parts, are as important as the control of parameters relating to speed, mass and radial loads.

The control of these parameters has to be guaranteed by the user. The location of position sensors (reed switches), and their switching response times to magnetic fields, is dependent upon the type and bore size of the cylinder and the appropriate precautions need to be taken when fixing these items. (see notes on the pages about sensors).

We do not advise the use of a cylinder as a shock absorber or for pneumatic cushioning. If used at the maximum speed, we recommend gradual deceleration to avoid a violent impact between piston and the cylinder end cover.

As a general value, we calculate a maximum average speed of 1 m/sec. In this case no lubrication is required as the lubrication introduced during assembly is sufficient to guarantee good operation.

If faster speeds are required, we suggest lubrication in the quantities described above.

Directive ATEX 2014/34/EU: Products classified for the use in potentially explosive atmospheres



Since 19 April 2016 all products which are sold in the European Union and destined to be used in **potentially explosive atmospheres** have had to be approved according to new Directive 2014/34/EU, also known as ATEX. This Directive applies to both electrical and non-electric items, such as pneumatic drives.

Main changes introduced by Directive 2014/34/EU:

- Non-electric apparatus and devices, such as pneumatic cylinders, have to comply with the Directive.
- Equipment is classified into different categories, which identifies the potentially explosive zones in which they may be used.
- The products are identified with the CE mark Ex.
- The instructions for use and the declarations of conformity should be supplied with each product that is to be used in potentially explosive zones.
- The Directive applies to products intended to be used in zones that are potentially explosive due to the presence of dust as well as to zones where potentially explosive gases may be present.

A potentially explosive atmosphere could be composed of gas, mist, steam or dust, which may be present constantly, intermittently or created by processes conducted within the zone. An explosion can occur when there are one or more inflammable substances plus an ignition source present.

An ignition source could be:

- Electrical (electric arcs, induced current, heat generated by the Joule effect, i.e. heat created when an electric current flows through a resistance.)
- Mechanical (heat between surfaces caused by friction, sparks generated by the collision of metallic bodies, electrostatic discharges, adiabatic compression, i.e. compression of an atmosphere causing a temperature rise)
- Chemical (exothermic reactions between materials)
- Naked flames. The products which are subject to approval are those which, during their normal use or because of a malfunction, present one or more ignition sources within a potentially explosive atmosphere.

The manufacturer has to guarantee that the product conforms to the declarations and carries the appropriate markings. Moreover, the product should always be accompanied by the appropriate instructions.

The maker and/or user of the equipment should identify the risk zone(s), as defined by Directive 99/92/CE, in which the products are to be used and ensure all instructions are followed.

In the case where a product is made up of two or more components with different markings, the component which is classified in the lowest category defines the class to which the complete product belongs.

Example:
solenoid suitable for Category 3 marked ...
Ex - II 3 Ex...

and valve suitable for Category 2 ...
Ex - II 2 Ex...

The valve unit with solenoid can be used only in Category 3 or Zone 2/22.

Zones, groups and categories

In the places and for the types of equipment subject to Directive 99/92/CE, the user should identify the classification of the zones in relation to the danger of the creation of explosive atmospheres because of the presence of gas or dust.

Apparatus and equipment for the use in potentially explosive zones are divided in groups:

Group I > apparatus used in mines

Group II > apparatus used in installations above ground

Group I: Apparatus used in mines

CATEGORY M1
Functioning in explosive atmospheres

CATEGORY M2
Non-supplied equipment in explosive atmospheres

Group II: Apparatus for installations above ground

Product category	Gas	Dust
1	Zone 0	Zone 20
2	Zone 1	Zone 21
3	Zone 2	Zone 22

Classification of zones according to Directive 99/92/CE

- Category 1**
- Zone 0 - Area in which (permanently, for long periods or often) an explosive atmosphere is present, consisting of a mixture of air and inflammables in the form of gas, vapour or mist.
 - Zone 20 - Area in which (permanently, for long periods or often) an explosive atmosphere is present in the form of a dust/powder cloud which is combustible in air.
- Category 2**
- Zone 1 - Area in which, during normal activities, the formation of an explosive atmosphere is probable, consisting of a mixture of air and inflammables in the form of gas, vapours or mist.
 - Zone 21 - Area in which occasionally during normal activities the formation of an explosive atmosphere is probable, in the form of a dust cloud which is combustible in air.
- Category 3**
- Zone 2 - Area in which, during normal activities, the formation of an explosive atmosphere, consisting of a mixture of air and inflammables in the form of gas, vapour or mist is not probable and, whenever this should occur, it is only of a short duration.
 - Zone 22 - Area in which, during normal activities, the formation of an explosive atmosphere in the form of a combustible dust cloud is not probable and, whenever this should occur, it is only of a short duration.

Example of Marking: II 2 GD c T100°C (T5) -20°C ≤ Ta ≤ 60°C

II	II Group: Devices which are to be used in spaces exposed to risks of an explosive atmosphere, different from underground spaces, mines, tunnels, etc., classified according to the criteria in Annex I of the Directive 2014/34/EU (ATEX).
2	Category: Devices designed to function in compliance with the operational parameters determined by the manufacturer and guarantee a high protection level.
GD	Qualification gas and dusts: Protected against gas (G) and explosive dusts (D).
c	Non-electrical devices: Non-electrical devices for potentially explosive atmospheres. Protection through constructive security.
T 100°C	Max. temperature for components for dusts: Max. superf. temp. of 100°C regarding potential hazards resulting from striking within the vicinity of hazardous dusts.
T5	Max. temperature for components for gas: Max. superf. temp. of 100°C regarding potential hazards which may result from striking within gas environments.
Ta	Environmental temperature: -20°C ≤ Ta ≤ 60°C . Environmental temperature range (with dry air)

Group I: Temperature classes

Temperature = 150°C or = 450°C according to the level of dust on the apparatus.

Group II: Temperature classes

Temp. classes for gas (G)	Admissible surface temperatures
T1	450°C
T2	300°C
T3	200°C
T4	135°C
T5	100°C
T6	85°C

ATEX certified Camozzi products

APPARATUS classified as ATEX Group II

Cylinders

Series	Category	Zone	Gas/Dust
16*	2 DE-3 SE	1/21 DE -2/22 SE	G/D
24*	2 DE-3 SE	1/21 DE-2/22SE	G/D
25*	2 DE-3 SE	1/21 DE-2/22SE	G/D
31-32	2 DE-3 SE	1/21DE-2/22SE	G/D
31-32 Tandem/multi-position	2 DE	1/21 DE	G/D
40*	2 DE	1/21 DE	G/D
41*	2 DE	1/21 DE	G/D
60*	2 DE-3 SE	1/21 DE-2/22 SE	G/D
61*	2 DE-3 SE	1/21 DE-2/22 SE	G/D
62*	2 DE	1/21 DE	G/D
63*	2 DE-3 SE	1/21 DE-2/22 SE	G/D
27	2 DE	1/21 DE	G/D
QP-QPR	2 DE-3 SE	1/21 DE-2/22 SE	G/D
QN	3 SE	2/22 SE	G/D
42	2 DE-3 SE	1/21 DE-2/22 SE	G/D
ARP	2	1/21	G/D
QCT-QCB-QXT-QXB	2	1/21	G/D

Proximity switches

Series	Category	Zone	Gas/Dust
CSH/CST/CSV	3	2/22	G/D
CSG	3	2/22	G/D

Valves

Series	Category	Zone	Gas/Dust
P	3	2/22	G/D
W	3	2/22	G/D
Y	3	2/22	G/D

Solenoids

Series	Category	Zone	Gas/Dust
U70	3	2/22	G/D
H801**	2	1/21	G/D

Pressure switches

Series	Category	Zone	Gas/Dust
PM 11**	1	0/20	G/D

Freely installable **COMPONENTS** classified as ATEX Group II

Products

Products	Category	Zone	Gas/Dust
Silencers	2	1/21	G/D
Quick release couplings	2	1/21	G/D
Manifolds	2	1/21	G/D
Sub-bases	2	1/21	G/D
Feet	2	1/21	G/D
Caps	2	1/21	G/D
Plates	2	1/21	G/D

FRL

Series	Category	Zone	Gas/Dust
MC#	2	1/21	G/D
N	2	1/21	G/D
MX#	2	1/21	G/D
T	2	1/21	G/D
CLR	2	1/21	G/D
M	2	1/21	G/D
MD#	2	1/21	G/D

Valves

Series	Category	Zone	Gas/Dust
9#*	2	1/21	G/D
A#	2	1/21	G/D
2	2	1/21	G/D
3#	2	1/21	G/D
4#	2	1/21	G/D
NA (NAMUR) #	2	1/21	G/D
E (pneumatic)	2	1/21	G/D

* According to ISO standard

** Products with ATEX and IECEx certification

Without solenoid

>> The order code number of the certified products is obtained by adding "EX" to the standard article number

- Es. 358-015 standard solenoid valve
- Es. 358-015EX ATEX certified solenoid valve

Accessories available in Category 2 Zone 1/21: couplings, junctions, brackets, piston rod nuts, nuts, counter brackets, bushings, pins, clevis pins, caps, gaskets, diaphragm, sub-bases, plates, feet, hand operated valves, flow valves, flanges, screw, tie rods, automatic and blocking valves, silencers and pressure gauge, connector kits, clamps, rapid and super rapid push-in fittings, hoses, sealing rings, locking nuts. Accessories available in Category 3, Zone 2/22: adaptors, slot covers, extensions, connectors. For more information on this kind of products see the website:

<http://catalogue.camozzi.com> within the section: Downloads > Certifications > ATEX Directive 2014/34/EU > List of products excluded from the directive 2014/34/EU ATEX.