

Compressed air

The cylinders have been designed for use with unlubricated air, in which case no maintenance is required. If lubricated air is used, lubrication must be continuous because the additional lubrication removes the lubricant applied at the factory. With reference to ISO/DIN 8573-1, the compressed air to use is class 3-4-3, i.e.:

- solid particle classe 3: 10.000 particles/m³ with d ≤ 1 micron and 500 particles/m³ with d ≤ 5 micron.
- humidity classe 4: Pressure dewpoint ≤ +3 °C
- oil classe 3: Concentration total oil ≤ 1 mg/m³.

Gasket material

Please refer to page 6.1/08 of the technical documentation for compatibility data.

Some families of Metal Work cylinders are available with gaskets made of different materials.

Polyurethane: the best in terms of long-life, resistance to wear and reduced friction.

Chemically compatible with:

- Pure aliphatic hydrocarbons (butane, propane, gasoline). Any impurities (moisture, alcohol, acid or alkaline compounds) can chemically attack polyurethane.
- Mineral oil and grease (some additives can chemically attack the material)
- Silicone oil and grease
- Water up to +50°C
- Resistance to ozone and ageing

Not compatible with:

- Ketones, esters, ethers
- Alcohols, glycols
- Hot water, steam, alkali, amines, acids.
- Good elasticity down to -35°C (for low temperature PU version only).

NBR: These gaskets have a shorter life than polyurethane gaskets. However, they are recommended for use in environments causing the formation of water condensate, such as tropical climates, where polyurethane gaskets may tend to deteriorate quickly due to hydrolysis.

Chemically compatible with:

- Methane, butane, propane, oily acids
- Aliphatic hydrocarbons
- Lubrication oils
- Gasoline

Not compatible with:

- Ozone and exposure to sunlight.
- Good elasticity down to -35°C (for low temperature NBR version only).

FKM/FPM: Can withstand temperatures as high as 150°C. This makes them ideal for use on rodless cylinders, high-speed applications, involving high temperatures at the sliding lips.

Chemically compatible with:

- Mineral oil and grease, slight swelling with oil grade ASTM no. 1 and 3.
- Silicon oil and grease
- Animal and vegetable oil and fat
- Aliphatic hydrocarbons (gasoline, butane, propane, natural gas)
- Aromatic hydrocarbons (benzol, toluene)
- Chlorinated hydrocarbons (tetrachloroethylene)
- Fuels
- Ozone, atmospheric agents, ageing

Not compatible with:

- Polar solvents (acetone, methylethylketone, diethyl ether, dioxane)
- Glycol-based brake fluids
- Ammonia gas, amines, alkali
- Superheated water vapour
- Low molecular organic acids (formic and acetic acid)

No-stick-slip cylinders:

Standard cylinders are designed to ensure trouble-free operation under any conditions, particularly at high speed. Operation tends to be irregular and jerky at very low speeds in the presence of side loads. In this case, no-stick-slip cylinders are recommended as they allow smooth operation. These versions feature specific tribological properties and polyurethane gaskets.

Radial oscillation of the piston rod

These cylinders have been designed to apply forces in the direction of the axis and not to withstand side loads. If you intend to use the cylinder piston rod with side loads, the play between the piston rod and guide bushing must be taken into account. Indicatively, each 100-mm stroke corresponds to 1-mm radial oscillation measured at the end of the piston rod.

Cylinder operating life

The life of cylinders depends on numerous factors including axial and radial loads, speed, frequency of use, temperature, shocks, air loss (limits). Below are a few factors that must be taken purely as a reference. They are not binding or guaranteed due to the variability of different factors.

Without radial load:

ISO 15552 cylinders and round cylinders with polyurethane gaskets: 15,000 km.

ISO 15552 cylinders and round cylinders with NBR gaskets: 8,000 km.

ISO 6432 cylinders, SSC cylinders and compact cylinders with polyurethane gaskets: 30 million cycles.

ISO 6432 cylinders and SSC cylinders with NBR gaskets: 15 million cycles

Rodless cylinders: 5,000 km

Stroke tolerances

The actual cylinder stroke has a tolerance with respect to the nominal stroke, in compliance with any applicable laws, within the following ranges:

• ISO 15552 cylinders	32-50	-0	+2	mm
	63-200	-0	+2.5	mm
• ISO 6432 6432	8-25	-1	+1	mm
• Round cylinders	32-50	-0,5	+1.5	mm
• SSC cylinders	12-50	-1	+1	mm
	63-100	-1	+1.5	mm
• Compact cylinders	12-100	-0,5	+1.5	mm
• Compact cylinders ISO 21287	20-100	-0,5	+1.5	mm
• Rodless cylinders	16-40	-1	+2	mm

Strokes exceeding the maximum value specified in the catalogue

Metal Work can supply cylinders with strokes greater than those specified in the catalogue, considering the production technological limits. The Metal Work Sales Department can provide you with full details. However, it is up to the end user to use these special cylinders properly, by guiding the piston rod, avoiding peak loads, etc.

Magnetic sensors

The magnetic field generated by permanent magnets housed in the piston assembly changes in shape and intensity depending on the presence of magnetic metal masses in the vicinity of the cylinder. These masses may prevent the sensors from switching correctly, in which case non-magnetic materials should be used. In particular, the tie rods of short-stroke and compact cylinders should preferably be made of stainless steel.



CALCULATING PEAK LOAD ON THE PISTON ROD

During operation, the piston rod of the cylinder behaves like a rod subjected to peak load (bending + compression). In the case of long strokes, it is necessary to make sure the diameter of the piston rod is correct for the load applied and the type of cylinder and piston rod mounting. The following formulae can be used to do this.

A. Calculating the maximum force with a given stroke and piston rod diameter:

$$F \leq \frac{20.350 \cdot \varnothing^4}{C^2 \cdot K^2}$$

B. Calculating the minimum acceptable piston rod diameter with a given stroke and force:

$$S \geq \sqrt[4]{\frac{F \cdot C^2 \cdot K^2}{20.350}}$$

Where:

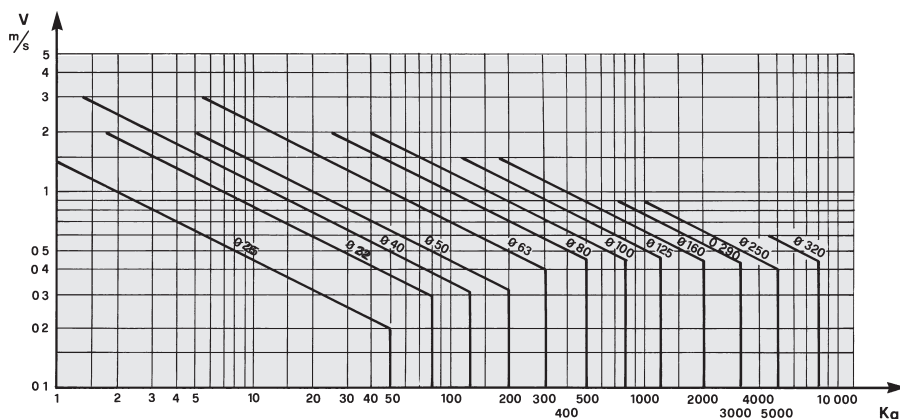
- F force applied [N]
- \varnothing diameter of the piston rod [mm]
- C stroke [mm]
- K free length coefficient depending on the mounting – see diagrams

CONSTRAINT

CONSTRAINT	K
	2
	0.7
	0.5
	2
	1
	1.5

CHART OF SPEED / MAXIMUM ABSORBABLE LOAD

For the cylinder to reach the end-of-stroke position without suffering damaging impact due to intensity and repetition, it is necessary to annul the kinetic energy of the moving mass and the relative work generated. The maximum absorbable load depends on the transference speed and the absorption capacity of the standard pneumatic cushion in the various cylinders. The chart gives the speed and absorbable mass in various diameters at a pressure of 6 bar.



CONSUMPTION OF AIR IN THE CYLINDERS

Cylinder bore D mm	Piston rod diameter d mm	Motion	Useful area cm ²	Air consumption during thrust and traction in Nl/cm of stroke, depending on the working pressure P in bar at 20°C.									
				1 bar	2 bar	3 bar	4 bar	5 bar	6 bar	7 bar	8 bar	9 bar	10 bar
12	4	thrust	1,13	0,0023	0,0034	0,0045	0,0057	0,0068	0,0079	0,0090	0,0102	0,0113	0,0124
		traction	1,00	0,0020	0,0030	0,0040	0,0050	0,0060	0,0070	0,0080	0,0090	0,0100	0,0110
16	6	thrust	2,01	0,0040	0,0060	0,0080	0,0100	0,0121	0,0141	0,0161	0,0181	0,0202	0,0221
		traction	1,73	0,0035	0,0052	0,0069	0,0086	0,0104	0,0121	0,0138	0,0156	0,0173	0,0190
20	8	thrust	3,14	0,0063	0,0094	0,0126	0,0157	0,0188	0,0220	0,0251	0,0283	0,0314	0,0346
		traction	2,64	0,0053	0,0079	0,0106	0,0132	0,0158	0,0185	0,0211	0,0238	0,0264	0,0290
25	12	thrust	4,91	0,0098	0,0147	0,0196	0,0245	0,0295	0,0344	0,0393	0,0442	0,0491	0,0540
		traction	3,78	0,0076	0,0113	0,0151	0,0189	0,0227	0,0264	0,0302	0,0340	0,0378	0,0415
32	12	thrust	8,04	0,016	0,024	0,032	0,040	0,048	0,056	0,064	0,072	0,080	0,088
		traction	6,91	0,014	0,021	0,028	0,035	0,042	0,049	0,058	0,063	0,070	0,076
40	16	thrust	12,56	0,025	0,038	0,050	0,063	0,076	0,088	0,100	0,113	0,126	0,138
		traction	10,55	0,021	0,032	0,042	0,053	0,063	0,074	0,088	0,095	0,106	0,116
50	20	thrust	19,63	0,039	0,059	0,079	0,098	0,118	0,137	0,157	0,177	0,196	0,216
		traction	16,49	0,033	0,050	0,066	0,082	0,099	0,115	0,132	0,149	0,165	0,181
63	20	thrust	31,16	0,062	0,093	0,125	0,156	0,187	0,218	0,249	0,280	0,312	0,343
		traction	28,02	0,056	0,084	0,112	0,140	0,168	0,196	0,224	0,252	0,280	0,308
80	25	thrust	50,24	0,100	0,150	0,200	0,250	0,301	0,351	0,402	0,452	0,502	0,552
		traction	45,36	0,091	0,138	0,181	0,227	0,272	0,318	0,363	0,408	0,454	0,500
100	32	thrust	78,54	0,157	0,238	0,314	0,382	0,471	0,549	0,628	0,706	0,785	0,862
		traction	70,50	0,141	0,211	0,282	0,352	0,423	0,493	0,564	0,635	0,705	0,775
125	32	thrust	122,66	0,245	0,368	0,490	0,613	0,736	0,859	0,981	1,104	1,226	1,349
		traction	114,67	0,229	0,344	0,459	0,573	0,688	0,803	0,917	1,032	1,147	1,262
160	40	thrust	201,06	0,402	0,603	0,804	1,005	1,206	1,407	1,608	1,809	2,010	2,211
		traction	188,49	0,377	0,565	0,754	0,942	1,130	1,319	1,508	1,696	1,884	2,073
200	40	thrust	314,15	0,628	0,942	1,257	1,571	1,885	2,199	2,513	2,827	3,145	3,456
		traction	301,59	0,603	0,905	1,206	1,508	1,810	2,111	2,413	2,714	3,016	3,318

FORCE OF SPRINGS IN SINGLE-ACTING CYLINDERS (THEORETICAL)

ISO 15552 SINGLE-ACTING CYLINDERS				SSC SINGLE-ACTING CYLINDERS			
Bore mm	Force with spring compressed N	Max. stroke mm	Force with spring extended N	Bore mm	Force with spring compressed N	Max. stroke mm	Force with spring extended N
32	63	250	35	12	6	25	1,5
40	88	250	51	16	7	25	3
50	102	250	64	20	12	25	4
63	102	250	64	25	14	25	5
ISO 6432 SINGLE-ACTING CYLINDERS				32	33	50	6
				40	45	50	15
50	70	50	20	50	70	50	20
63	81	50	25	63	81	50	25
$P = P_1 + \frac{(P_2 - P_1)}{C_{max}} \cdot C_x$ <p> <i>P</i>₁ = Force with spring extended <i>P</i>₂ = Force with spring compressed <i>C</i>_x = Required stroke <i>C</i>_{max} = Max stroke </p>				ROUND SINGLE-ACTING CYLINDERS			
				Bore mm	Force with spring compressed N	Max. stroke mm	Force with spring extended N
				32	86	250	34
				40	95	250	50
				50	108	250	62
				SINGLE-ACTING CARTRIDGE CYLINDERS			
Bore mm	Force with spring compressed N	Max. stroke mm	Force with spring extended N				
6	3.7	5	-				
10	7.8	5	-				
16	7.2	5	-				
6	3.9	10	-				
10	9.6	10	-				
16	13.3	10	-				
6	3.9	15	-				
10	9.1	15	-				
16	13.3	15	-				

WEIGHT OF CYLINDERS

Micro-cylinder series "ISO 6432"					Round cylinder series RNDC				
Ø	Single-rod		Through-rod		Ø	Single-rod		Through-rod	
	Weight [g] Stroke=0	Weight [g] each mm	Weight [g] Stroke=0	Weight [g] each mm		Weight [g] Stroke=0	Weight [g] each mm	Weight [g] Stroke=0	Weight [g] each mm
8	40	0.234	55	0.334	32	404	1.44	455	2.04
10	41	0.257	59	0.371	40	660	1.58	808	3.14
12	77	0.419	111	0.635	50	1235	3.59	1507	6.03
16	93	0.491	133	0.708					
20	181	0.732	233	1.121					
25	241	1.100	334	1.722					

Short-stroke cylinder series "SSCY"								
Ø	Single-rod		Through-rod		Non-rotating		Oscillating	
	Weight [g] Stroke=0	Weight [g] each mm	Weight [g] Stroke=0	Weight [g] each mm	Weight [g] Stroke=0	Weight [g] each mm	Weight [g] Stroke=0	Weight [g] each mm
12	45	1.24	52	1.47	64	1.35		
16	63	1.65	72	2.05	88	1.6		
20	91	2.14	104	2.75	126	2.37		
25	144	3.04	167	3.65	189	3.25		
32	185	4.14	200	4.72	260	4.56	272	4.14
40	275	5.05	295	5.94	373	5.49	386	5.05
50	412	7.09	437	8.9	592	7.89	620	7.09
63	587	9.32	621	10.91	854	10.57	889	9.32
80	393	14.41	1485	16.9	1740	25.87		
100	673	21.94	2841	25.9	2692	30.77		

Compact cylinder								
Ø	Single-rod		Through-rod		Non-rotating		Through-rod non-rotating	
	Weight [g] Stroke=0	Weight [g] each mm	Weight [g] Stroke=0	Weight [g] each mm	Weight [g] Stroke=0	Weight [g] each mm	Weight [g] Stroke=0	Weight [g] each mm
12	96	1.59	104	1.82	105	1.90	114	2.12
16	105	1.51	124	1.90	109	1.81	129	2.20
20	171	2.35	204	2.95	181	2.78	214	3.39
25	201	2.73	233	3.32	220	3.15	252	3.76
32	246	3.17	282	4.05	306	3.96	343	4.84
40	370	4.41	408	5.29	457	5.20	495	6.08
50	552	6.42	605	7.98	709	7.64	768	9.21
63	779	7.34	656	8.90	977	8.56	1054	10.13
80	1468	12.57	1624	15.02	1851	14.33	2027	16.78
100	2988	16.11	3100	19.93	3710	17.87	3850	21.70

Cylinder series "ISO 15552", "ISO 15552" TWO-FLAT				
Ø	Single-rod		Through-rod	
	Weight [g] Stroke=0	Weight [g] each mm	Weight [g] Stroke=0	Weight [g] each mm
32	433	2.2	494	3.09
40	660	3.15	783	4.73
50	1087	4.57	1348	7.04
63	1443	5.03	1718	7.44
80	2815	7.49	3260	10.16
100	3897	8.79	4425	12.33
125	6988	13.42	8040	18
160	12979	22.92	13800	30
200	17000	28	18000	39

Cylinder series "ISO 15552" type A, "ISO 15552" type A TWO-FLAT				
Ø	Single-rod		Through-rod	
	Weight [g] Stroke=0	Weight [g] each mm	Weight [g] Stroke=0	Weight [g] each mm
32	460	3.09	576	3.98
40	716	4.08	916	5.66
50	1155	5.86	1513	8.33
63	1524	5.92	1945	8.33
80	2886	9.07	3520	11.74
100	3965	9.48	4779	13.02
125	7093	14.11	8642	18.69

Twin-rod cylinder series "TWNC"				
Ø	Standard		Single through-rod	
	Weight [g] Stroke=0	Weight [g] each mm	Weight [g] Stroke=0	Weight [g] each mm
32	725	2.57	790	3.79
40	945	2.81	1065	4.03
50	1499	3.96	1737	5.72
63	2360	5.72	2628	8.85
80	4300	9.59	4730	15.52
100	6270	10.89	6775	16.8

