Technical information

FLUID

Most of WAIRCOM M.B.S. products can be fed with lubricated or unlubricated compressed air, thus means these components are greased on assembly so that they can work even without the use of a lubricator; however for a correct lubrication we advise to use the WAIRSOL grease class ISO 22, studied on purpose for pneumatic circuits, while the use of a filter element with a void fraction of at least 40 µm is essential. The condensate drainage system can be manual, semi-automatic or automatic and it is set up of a cock situated on the bottom of the bowl.
The working pressure range for each product is shown on every single relevant technical sheet and it is generally included between 1 to 10 bar.

PRESSURE

DEFINITION OF PRESSURE
It is the ratio between a force and the surface on which it acts; it is dimensionally expressed in force units per surface units.

$P_{(Pa)} = F_{(N)} / S_{(m^2)}$

ATMOSPHERIC PRESSURE
It is the pressure exerted on a surface of 1 cm^2 at sea level, at a temperature of 20 °C and with a relative humidity of 65%; it is equivalent to a column of water of 10,33 m or to 760 mmHg.

ABSOLUTE PRESSURE
It is the pressure of a fluid respect to the absolute vacuum and it is obtainable adding the atmospheric pressure to the gauge one.

GAUGE PRESSURE
It is the differential pressure of a fluid above and below the atmospheric pressure normally read on the pressure gauges.

UPSTREAM PRESSURE
Pressure of the compressed air at the inlet of the pneumatic component.

DOWNSTREAM PRESSURE
Pressure of the compressed air at the outlet of the pneumatic component.

DIFFERENTIAL PRESSURE (ΔP)
It is the difference between upstream and downstream pressure.

BOYLE-MARIOTTE'S LAW
The volume of a closed quantity of gas with constant temperature is inversely proportional to the absolute pressure, thus means that for a given quantity of gas the product between the absolute pressure and the volume is a constant value:

$P^1 \cdot V^1 = P^2 \cdot V^2 =$ Constant.

GAY - LUSSAC'S LAW
The volume of a quantity of gas with constant pressure is proportional to its temperature:

$V^1 / V2 = T^1 / T^2$

or even, with constant volume, the pressure of a quantity of gas is proportional to its temperature.

$P^1 / P2 = T^1 / T^2$

Then we obtain the General Equation of Gases:

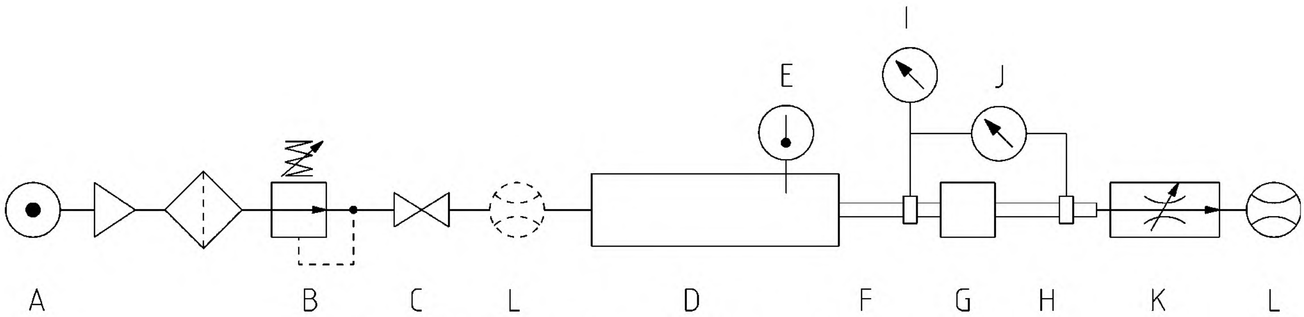
$P \cdot V = n \cdot R \cdot T$

where:
P = pressure (atm)
V = volume (Nl)
n = gram molecules of gas contained in the volume (mol)
R = perfect gas constant (0,0821 Nl · atm · K^{-1} · mol^{-1})
T = absolute temperature in Kelvin (273 K = 0 °C)

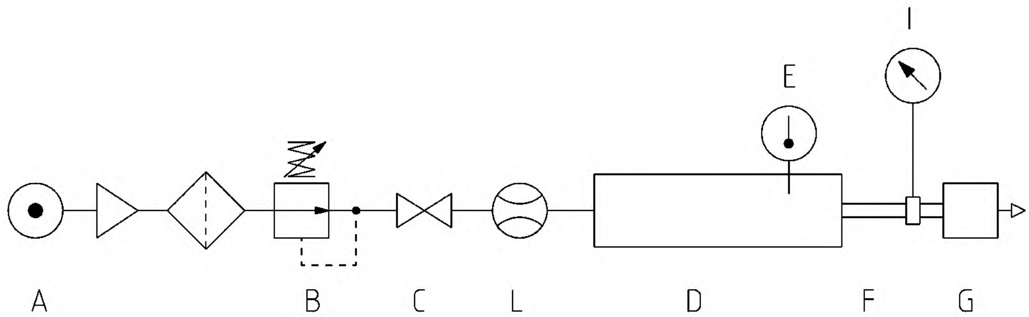
NORMAL CONDITIONS OF AIR
In the design of industrial pneumatic circuits are employed measures that refer to the "Normal conditions of air".
As "normal cubic meter of air" (1Nm^3) we refer to 1 m^3 of air at a temperature of 273 K (0 °C) and at a pressure of 1,0013 bar (pressure of the normal air at the sea level): 1 Nm^3 = 1000 Nl.

RATED FLOW RATE

It is the volume of fluid passing through a given section of measurement in a unit of time with an upstream gauge pressure P1=6 bar (7 absolute bar) and with a pressure drop ΔP=1 bar (thus means a downstream gauge pressure P2=5 bar, 6 absolute bar) with a fluid temperature of +20 °C.
The rated flow rate, generally expressed in normal liters per minute (Nl/m), can give some indications on the performances of the valves if the working conditions are the ones just described.
Herebelow are the circuits used in our company to test the flow rate measurements of products in according to the UNI ISO 6358 standard.



Testing circuit for components with input/output connections



Testing circuit for components with direct exhaust in the atmosphere

A – Filter and supply unit
B – Adjustable pressure regulator
C – Shut-off valve
D – Tube for temperature measurement
E – Device for the measure of temperature
F – Tube for upstream pressure measurement
G – Component on trial
H – Tube for downstream pressure measurement
I – Device for the measure of upstream pressure
J – Device for the measure of differential pressure
K – Flow regulator valve
L – Device for the measure of flow rate

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PROTECTION CLASS FOR COILS WITH CONNECTOR

For protection class, we mean the intrinsic ability of live electrical equipment to protect and to protect itself against casual contatcts and penetration of solid particles and water. It is defined with the abbreviation “I.P.” followed by 2 figures: the first, 0 to 6, defines the protection against casual contacts and penetration of foreign particles; the second, 0 to 8, the protection against water.
The tables shown below describe the various degrees.

Protection class against casual contacts and penetration of foreign particles

First figure	Denomination	Explanation
0	No protection.	No special protection for people against casual contacts with live parts or moving parts. No protection of the equipment against the penetration of foreign solid particles.
1	Protection against the penetration of large-sized solid particles.	Protection against casual contacts of large surfaces with live parts or moving parts inside the equipment, for example contacts with hands, but no protection against the voluntary access to these parts. Protection of the equipment against the penetration of solid particles with a diameter larger than 50 mm.
2	Protection against the penetration of fluid-sized solid particles.	Protection against contacts of fingers with live parts or moving parts inside the equipment. Protection against the penetration of solid particles with a diameter larger than 12 mm, such as fingers.
3	Protection against the penetration of small-sized solid particles.	Protection against contacts of tools, wires or the like, thicker than 2.5 mm with live parts of moving parts inside the equipment. Protection against the penetration of solid particles with a diameter larger than 2.5 mm, such as tools, wires, and so on.
4	Protection against the penetration of very small-sized solid particles.	Protection against contacts of tools, wires or the like, thicker than 1 mm with live parts or moving parts inside the equipment. Protection against the penetration of solid particles with a diameter larger than1 mm, such as thin tools and wires and so on.
5	Protection against dust deposits.	Full protection against contacts with means of any kind with live parts or moving parts inside the equipment. Protection against dust deposits. The penetration of dust is not fully eliminated, but it is reduced to such an extent as to assure the good operation of the equipment.
6	Protection against dust penetration.	Full protection against contacts with means of any kind with live parts or moving parts inside the equipment. Protection against dust deposits. Full protection against the penetration of dust.

Protection class against penetration of water

Second figure	Denomination	Explanation
0	No protection.	No special protection.
1	Protection against water drops falling perpendicularly.	Water drops that fall perpendicularly must not cause harmful effect.
2	Protection against water drops falling slantwise.	Water drops that fall at a slanted angle of up to 15° to the perpendicular direction must not cause harmful effect.
3	Protection against water dripping.	Water that falls at a slanted angle of up to 60° to the perpendicular direction must not cause harmful effect.
4	Protection against water sprays.	Water sprayed against the equipment from any direction must not cause harmful effect.
5	Protection against water jets.	Water jets fired against the equipment from any direction must not cause harmful effect.
6	Protection against inondation.	The water penetrating into the equipment due to a temporary flood, for example during rough sea conditions, must not cause harmful effect.
7	Protection against immersion.	Water must not penetrate in such a quantity as to damage the equipment, should the equipment itself be immersed for pre-established times and at pre-defined pressure.
8	Protection against submersion.	Water must not penetrate in such a quantity as to damage the equipment, should the equipment itself be submerged at pre-defined pressure and for an undetermined period of time.

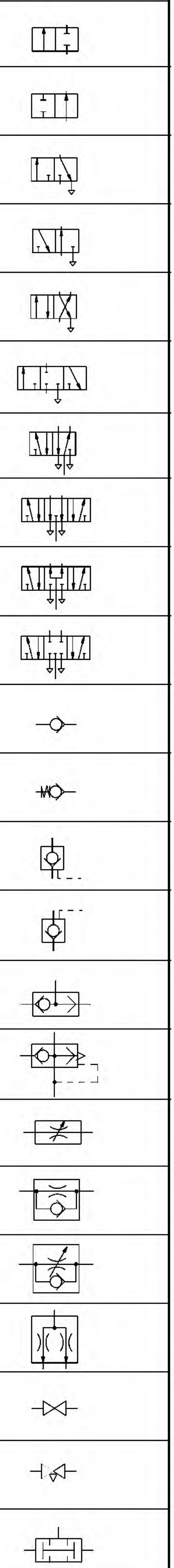
GRAPHIC SYMBOLS

Pipes and connections		
Designation	**Explanation**	**Symbol**
Pressure line	Line for the energy transfer	
Control line	Line for the transfer of the control energy (including regulation)	
Exhaust or leakage line		
Line connection	Fixed connection, e.g. welded,saldered, screwed (including fittings)	
Crossover	Crossing of unconnected lines	
Flexible line	Connectors of mobile parts	
Electric line	Line for transmitting electrical energy	
Pneumatic pressure source		
Discharge point or vent		
Air exhaust	With not threaded connection	
	With threaded connection	
Compressed air pick-up point	With plug	
	With connecting line	
Quick-acting couplings	Connected, without check valve	
	Connected, with check valve	
	Uncoupled with open end	
	Uncoupled, end blocked by check valve	
Rotating joint (device that allows a rotating movement)	1-way	
	3-way	
Silencer		
Pneumatic accumulator (capacity)		

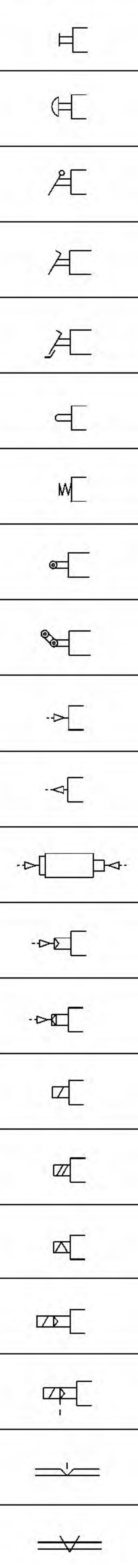
Air treatment equipment		
Designation	**Explanation**	**Symbol**
Air filter	Device for removing impurity	
Condensate separator	With manual draining	
	With automatic draining	
Filter with condensate separator	With manual draining	
	With automatic draining	
Air drier	Device in which the air is dried	
Lubricator	Device in which small quantities of oil are added to the air flowing through it	
Sequence valve	Valve which, by opening the outlet against the spring force, makes connection with further units	
Pressure reducer (valve which to a large extent holds the outlet pressure at a constant level, even with altered inlet pressure)	Without exhaust valve	
	With exhaust valve (Relieving)	
	Piloted pressure reducer with exhaust valve (Relieving)	
Pneumoelectric transducer	Device converting an input pneumatic signal into an output electrical signal	
Pressure switch	Device switching at an adjustable fixed pressure	
Filter - pressure reducer lubricator group (Detailed symbol)		
Filter - pressure reducer lubricator group (Simplified symbol)		
Filter - pressure reducer group		
Soft - start valve	Pneumatic actuated	
	Solenoid actuated	
Pressure gauge		
Thermometer		
Flowmeter		
Totalizator flowmeter		
Optical tester	Device indicating the presence of pressure by means of an optical reflector	

GRAPHIC SYMBOLS

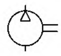
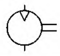
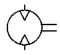
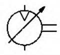
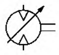
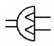
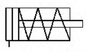
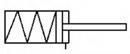
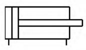
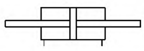
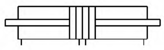
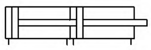
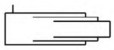
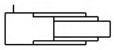
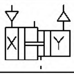
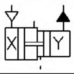
Distribution		
Designation	**Explanation**	**Symbol**
2/2 port valve	Two positions at rest, normally closed (N.C.)	
	Two positions at rest, normally open (N.O.)	
3/2 port valve	Two positions at rest, normally closed (N.C.)	
	Two positions at rest, normally open (N.O.)	
4/2 port valve	With two positions and one exhaust	
3/3 port valve	With three positions and closed the neutral one	
5/2 port valve	With two positions and two exhausts	
5/3 port valve	Open centre	
	Pressure centre	
	Closed centre	
Check valve	Unloaded (without spring)	
	Spring-loaded	
Controlled check valve	Pilot operated to close check valve	
	Pilot operated to open check valve	
Shuttle valve (OR type)	The inner port with the higher pressure is automatically connected to the outlet port, while the other inlet port is closed	
Quick-exhaust valve	When the inlet port is not supplied with air, the outlet port is exhausted directly into the atmosphere	
Flow regulator	Bidirectional	
	Unidirectional fixed	
	Unidirectional adjustable	
Flow divider	The flow is divided in two quite similar parts that are indipendent from the variations of pressure	
Shut-off valve	Two port	
	Three port	
Two pressure valve (AND type)	The outlet port is pressurized only when pressure is supplied to both of the inlet ports	

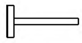
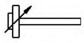
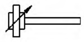
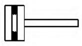
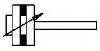
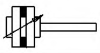
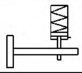


Controls		
Designation	**Explanation**	**Symbol**
Manual actuation	General (without specifying the type of control)	
	By push-button	
	By lever	
	By pedal	
	By pedal with safety device	
Mechanical actuation	By stem or key	
	By spring	
	By roller lever	
	By unidirectional roller lever	
Pneumatic actuation	Direct action by application of pressure	
	Direct action by pressure relief	
	Differential (i.e. pressure dominant pilot)	
	Indirect actuation by application of pressure to the pilot valve	
	Indirect actuation by relieving of pressure on the pilot valve	
Electrical actuation	By solenoid with one winding	
	By solenoid with two in-phase windings	
	By solenoid with two opposing windings	
Combined actuation	By solenoid with one pilot valve	
	By solenoid pilot assisted	
Detent	Device for maintaining a given position	
Release unit	Device for preventing the equipment from blocking at a dead spot	



GRAPHIC SYMBOLS

Energy conversion (actuators)		
Designation	**Explanation**	**Symbol**
Compressor	With constant displacement volume (only one direction of rotation)	
Pneumatic motor with constant displacement volume	With one direction of rotation	
	With two directions of rotation	
Pneumatic motor with variable displacement volume	With one direction of rotation	
	With two directions of rotation	
Pneumatic rotary cylinder	With rotary drive limited range of oscillation	
Single acting cylinder	Front spring	
	Rear spring	
Double acting cylinder		
Double acting cylinder through rod		
Tandem cylinder	Opposed	
	Double push	
	Double stroke	
Telescopic cylinder	Single acting	
	Double acting	
Pressure multiplier	For fluids with the same characteristics	
	For fluids with different characteristics	

Rod and piston unit options		
Designation	**Explanation**	**Symbol**
Rod and piston unit	Standard	
	With adjustable cushioning at one end	
	With adjustable cushioning at both ends	
	With magnetic piston	
	With magnetic piston and adjustable cushioning at one end	
	With magnetic piston and adjustable cushioning at both ends	
	With non-rotating piston rod device	
	With piston rod locking unit	

Technical information

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COMPARISON OF DESIGNATIONS FOR CONNECTIONS

Port	ISO 5599	Letter designations
Supply/inlet port	1	P
Working or outlet line	2	B
Exhaust line	3	S
Working or outlet line	4	A
Exhaust line	5	R
Pilot line that reset the output signal	10	Z
Pilot line	12	Y
Pilot line	14	Z
Pre-pilot exhaust line	82	—
Pre-pilot exhaust line	84	—

MULTIPLES AND SUB-MULTIPLES

Prefix	Symbol	Factor
yotta	Y	10^{24}
zetta	Z	10^{21}
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
etto	h	10^{2}
deca*	da	10
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	µ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}
zepto	z	10^{-21}
yocto	y	10^{-24}

* In the U.S.A. this prefix is commonly defined "deka"

CONSUPTION OF AIR TABLE

Cylinder bore D (mm)	Piston rod diameter d (mm)	Motion	Useful area cm²	Consumption of air in thrust and in traction expressed in Nl per cm of stroke as a function of the operating pressure P expressed 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	0,009	0,0102	0,0113	0,0124
		Traction	1	0,002	0,003	0,004	0,005	0,006	0,007	0,008	0,009	0,01	0,011
16	6	Thrust	2,01	0,004	0,006	0,008	0,01	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	0,019
20	8	Thrust	3,14	0,0063	0,0094	0,0126	0,0157	0,0188	0,022	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	0,029
25	12	Thrust	4,91	0,0098	0,0147	0,0196	0,0245	0,0295	0,0344	0,0393	0,0442	0,0491	0,054
		Traction	3,78	0,0076	0,0113	0,0151	0,0189	0,0227	0,0264	0,0302	0,034	0,0378	0,0415
32	12	Thrust	8,04	0,016	0,024	0,032	0,04	0,048	0,056	0,064	0,072	0,08	0,088
		Traction	6,91	0,014	0,021	0,028	0,035	0,042	0,049	0,058	0,063	0,07	0,076
40	16	Thrust	12,56	0,025	0,038	0,05	0,063	0,076	0,088	0,1	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	0,05	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	0,28	0,312	0,343
		Traction	28,02	0,056	0,084	0,112	0,14	0,168	0,196	0,224	0,252	0,28	0,308
80	25	Thrust	50,24	0,1	0,15	0,2	0,25	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	0,5
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	70,5	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	0,49	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	2,01	2,211
		Traction	188,49	0,377	0,565	0,754	0,942	1,13	1,319	1,508	1,696	1,884	2,673
200	40	Thrust	314,15	0,628	0,942	0,257	1,571	1,885	2,199	2,513	2,827	3,145	3,456
		Traction	301,59	0,603	0,905	1,506	1,508	1,81	2,111	2,413	2,714	3,016	3,318

The following formula is used to determinate the consumption of air:

Q = H x (S+T) x N where:

Q = consumption of air (Nl/min)

H = cylinder stroke (cm)

S = consumption of air per 1 cm of stroke in thrust

T = consumption of air per 1 cm of stroke in traction

N = number of cycles per minute

Technical information

0 CONVERSION TABLES

Torque

	inchounce (ozf·in)	inchpound (lbf·in)	footpound (lbf·ft)	kilogrammetro (kgf·m)	Newtonmetro (N·m)
1 inchounce =		0,0625	0,0052	$7{,}2 \cdot 10^{-4}$	$7{,}06 \cdot 10^{-3}$
1 inchpound =	16		0,0833	$1{,}152 \cdot 10^{-2}$	0,113
1 footpound =	192	12		0,1383	1,356
1 kilogrammetro =	1388,7	86,796	7,233		9,80665
1 Newtonmetro =	141,6	8,85	0,7375	0,102	

Length

	Inch (in)	foot (ft)	yard (yd)	millimeter (mm)	meter (m)
1 inch =		0,0833	0,0278	25,4	0,0254
1 foot =	12		0,333	304,8	0,304
1 yard =	36	3		914,4	0,9144
1 millimeter =	0,03937	0,0033	0,00109		0,001
1 meter =	39,37	3,2808	1,0936	1000	

Area

	$inch^2$ (in^2)	$foot^2$ (ft^2)	$yard^2$ (yd^2)	square millimeter (mm^2)	square meter (m^2)
1 $inch^2$ =		0,0069	0,00077	645,16	$6{,}45 \cdot 10^{-4}$
1 $foot^2$ =	144		0,111	92903	0,0929
1 $yard^2$ =	1296	9		836100	0,8361
1 $millimetro^2$ =	0,0016	$1{,}0764 \cdot 10^{-5}$	$1{,}196 \cdot 10^{-6}$		10^{-6}
1 $meter^2$ =	1550	10,764	1,196	10^6	

Force

	Newton (N)	kilopound (kp)	poundforce (lbf)
1 Newton =		0,10197	0,22481
1 kilopound =	9,80665		2,20463
1 poundforce =	4,4482	0,45359	

Density

	ounce / $inch^3$ (ozf / in^3)	pound / $foot^3$ (lbf / ft^3)	grams / $centimeter^3$ (g/cm^3)
1 ounce / $inch^3$ =		108	1,73
1 pound / $foot^3$ =	0,0092		0,016
1 gram / $centimeter^3$ =	0,578	62,43	

Mass

	ounce (oz)	pound (lb)	Kilogram (kg)
1 ounce =		0,0625	0,0283
1 pound =	16		0,4536
1 Kilogram =	35,274	2,2046	

Speed

	foot/second (ft/s)	foot/minute (ft/min)	mile/hour (mi/h)	meter/second (m/s)	Kilometers/hour (km/h)
1 foot/second =		60	0,6818	0,3048	1,097
1 foot/minute =	0,017		0,0114	0,00508	0,01829
1 mile/hour =	1,4667	88		0,447	1,609
1 meter/second =	3,28	196,848	2,237		3,6
1 Kilometer/hour =	0,9113	54,68	0,6214	0,278	

Temperature

	Kelvin (K)	Celsius degree (°C)	Fahrenheit degree (°F)
1 K =		K - 273,15	K · 9/5 - 459,67
1 °C =	°C + 273,15		°C · 9/5 + 32
1 °F =	5/9 · (°F - 32) + 273,15	(°F - 32) · 5/9	

Volume

	$inch^3$ (in^3)	US quart (liq qt)	Imperial gallon (UK) (Imp gall)	$foot^3$ (cu ft)	US gallon (gal)	liter (l)
1 $inch^3$ =		0,0173	0,0036	0,00058	0,0043	0,0164
1 US quart =	57,75		0,2082	0,0334	0,25	0,9464
1Imperial gallon =	277	4,8		0,1604	1,2	4,546
1 $foot^3$ =	1728	29922	6,23		7,48	28,317
1 US gallon =	231	4	0,8327	0,1337		3,785
1 liter =	61,024	1,0567	0,22	0,0353	0,264	

Pressure

	inch Hg	psi	atmosphere	torr	mm Hg	bar	Mpa	kg/cm^2
1 inch Hg =		0,491	0,0334	25,4	25,4	0,0339	0,00339	0,0345
1 psi =	2,036		0,068	51,715	51,715	0,0689	0,00689	0,0703
1 atmosphere =	29,921	14,696		760	760	1,0133	0,10133	1,0332
1 torr =	0,0394	0,0193	0,0013		1	0,0013	0,00013	0,00136
1 mm Hg =	0,0394	0,0193	0,0013	1		0,0013	0,00013	0,00136
1bar =	29,53	14,504	0,987	749,87	749,87		0,1	1,02
1 Mpa =	295,3	145,04	9,869	7498,7	7498,7	10		10,2
1 kg/cm^2 =	28,95	14,22	0,968	735,35	735,35	0,98	0,098	

THREADS COMPARISON TABLE

Ø external (mm)	Ø core (mm)	lead* - turns/inch	metric coarse pitch	metric fine pitch	BSP, G	NPT	UNF
3,8 ÷ 3,9	3,2 ÷ 3,4	0,7	M 4				
4 ÷ 4,2	3,4 ÷ 3,6	36					No. 8-36
4,6 ÷ 4,8	4,0 ÷ 4,2	32					No.10-32
4,8 ÷ 4,9	4,1 ÷ 4,3	0,8	M 5				
5,7 ÷ 5,9	4,9 ÷5,2	1	M 6				
7,7 ÷ 7,9	6,9 ÷ 7,2	1		M 8 x 1			
7,7 ÷ 7,9	6,6 ÷ 6,9	1,25	M 8				
7,7 ÷ 7,9	6,8 ÷ 7,1	24					5/16 x 24
maximum 7,9	minimum 6	27				1/16	
9,5 ÷ 9,7	8,5 ÷ 8,8	28			1/8		
9,7 ÷ 9,9	8,9 ÷ 9,2	1		M 10 x 1			
9,7 ÷ 9,9	8,6 ÷ 8,9	1,25		M 10 x 1,25			
9,7 ÷ 9,9	8,4 ÷ 8,7	1,5	M 10				
maximum10,3	minimum 8,3	27				1/8	
10,9 ÷ 11,1	9,7 ÷ 10	20					7/16 x 20
11,7 ÷ 11,9	10,6 ÷ 10,9	1,25		M 12 x 1,25			
11,7 ÷ 11,9	10,4 ÷ 10,7	1,5		M 12 x 1,5			
11,6 ÷ 11,9	10,1 ÷ 10,4	1,75	M 12				
12,5 ÷ 12,7	11,3 ÷ 11,7	20					½ x 20
12,9 ÷ 13,2	11,4 ÷ 11,9	19			¼		
13,6 ÷ 13,9	11,8 ÷ 12,2	2	M 14				
maximum 13,7	minimum 10,7	18				¼	
15,7 ÷ 15,9	14,4 ÷ 14,7	1,5		M 16 x 1,5			
15,6 ÷ 15,9	13,8 ÷ 14,2	2	M 16				
15,7 ÷ 15,9	14,4 ÷ 14,7	16					5/8 x 16
16,4 ÷ 16,7	14,9 ÷ 15,4	19			3/8		
maximum 17,1	minimum 14,2	18				3/8	
17,6 ÷ 17,9	15,3 ÷ 15,7	2,5	M 18				
18,8 ÷ 19,1	17,3 ÷ 17,8	16					¾ x 16
19,7 ÷ 19,9	18,9 ÷ 19,2	1		M 20 x 1			
19,7 ÷ 19,9	18,4 ÷ 18,7	1,5		M 20 x 1,5			
19,6 ÷ 19,9	17,3 ÷ 17,7	2,5	M 20				
20,7 ÷ 20,9	18,6 ÷ 19,2	14			½		
maximum21,3	minimum 17,4	14				½	
21,7 ÷ 21,9	20,4 ÷ 20,7	1,5		M 22 x 1,5			
21,9 ÷ 22,6	20,3 ÷ 20,8	14					7/8 x 14
23,7 ÷ 23,9	22,4 ÷ 22,7	1,5		M 24 x 1,5			
23,6 ÷ 23,9	20,8 ÷ 21,3	3	M 24				
25,1 ÷ 25,4	23,1 ÷ 23,6	12					1 x 12
26,2 ÷ 26,4	24,1 ÷ 24,7	14			¾		
26,6 ÷ 26,9	24,8 ÷ 25,2	2		M 27 x 2			
maximum 26,7	minimum 22,5	14				¾	
28,3 ÷ 28,6	26,3 ÷ 26,8	12					1 1/8 x 12
29,7 ÷ 29,9	28,4 ÷ 28,7	1,5		M 30 x 1,5			
31,5 ÷ 31,7	29,5 ÷ 30	12					1 ¼ x 12
32,9 ÷ 33,2	30,3 ÷ 30,9	11			1		
maximum 33,4	minimum 28,5	11 ½				1	
35,7 ÷ 35,9	34,4 ÷ 34,7	1,5		M 36 x 1,5			
35,6 ÷ 35,9	33,8 ÷ 34,2	2		M 36 x 2			
37,7 ÷ 37,9	36,4 ÷ 36,7	1,5		M 38 x 1,5			
37,8 ÷ 38,1	35,8 ÷ 36,4	12					1 ½ x 12
41,6 ÷ 41,9	38,9 ÷ 39,6	11			1 ¼		
41,7 ÷ 41,9	40,4 ÷ 40,7	1,5		M 42 x 1,5			
41,6 ÷ 41,9	39,8 ÷ 40,2	2		M 42 x 2			
maximum 42,2	minimum 37	11 ½				1 ¼	
44,7 ÷ 44,9	43,4 ÷ 43,7	1,5		M 45 x 1,5			
47,9 ÷ 47,8	44,8 ÷ 45,5	11			1 ½		
47,6 ÷ 47,9	45,8 ÷ 46,2	2		M 48 x 2			
maximum 48,3	minimum 43,5	11 ½				1 ½	
59,3 ÷ 59,6	56,7 ÷ 57,3	11			2		
59,7 ÷ 59,9	58,4 ÷ 58,7	1,5		M 60 x 1,5			
maximum 60,3	minimum 55	11 ½				2	
79,7 ÷ 79,9	78,4 ÷ 78,7	1,5		M 80 x 1,5			

* for metric screw thread

metric = metric screw thread (coarse pitch = MA; fine pitch = MB)
G = Gas thread ("BSP" according to ISO standard)
NPT = tapered gas thread (used in the U.S.A.)
UNF = fine pitch thread (used in the Anglo-Saxon countries)

Technical information

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SPECIAL OPTIONS TABLE FOR CYLINDERS

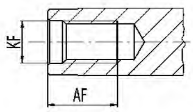
	U	P	UP	X	CPUI	CPA	CX	CPU	BU	B	BG	HB	Z	WR
S	■	■	■	■	■	■	■	■	■	■	■	■	■	■
S1				■	■		■	■				■		
S2	■	■		■	■		■	■	■	■	■	■		
S3	■	■	■	■	■		■	■	As standard	As standard		■		
S4					■		■	■						
S5				As standard	As standard		■	As standard						As standard
S6					■ Ø 125÷200		■ Ø 32÷200	■ Ø 32÷100						
S7	■	■	■	■	■	■	■	■	■	■	■	■	■	
S8	■	■	■	■	■	■	■	■	■			■		
S9	As standard	As standard	As standard	As standard	As standard		As standard	As standard	As standard	As standard		■		
S10	As standard	As standard		■	■	■	■	■	As standard	As standard		As standard	■	
S10A	■	■		■	■	■	■	■					■	
S10B	■	■		■	■	■	■	■					■	

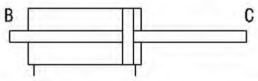
S- WAIRCOM M.B.S. drawing
S1- Oil proof seal (only scraper ring)
S2- Scraper ring for high temperatures
S3- Female threaded piston rod (dimension AF = 1,5 KF)

S4 - Nuts and tie rods made of AISI 303 stainless steel
S5 - Female threaded tie rods
S6 - Completed threaded and galvanized tie rods
S7 - Linear sliding
S8 - Through rod with different piston rod for side "B" and/or "C"

S9 - Piston rod with plane working for key
S10 - Without cushioning
S10A - With front cushioning
S10B - With rear cushioning

Feasible ■
Not feasible □





Example: Cylinder to ISO and VDMA standards Ø 63, through rod, 150 mm stroke, magnetic piston type with different piston rod on side "B" with dimensions: KK=M20x1,5 AM=45 and WH=60:
63R150 CPUI/M S8 B KK=M20x1,5 AM=45 WH=60

GENERAL TECHNICAL DATA FOR CYLINDERS

OPERATING LIFE

The life cycle of cylinders is affected by manifold factors including: loads (axial and radial), speeds and frequencies of use, average working temperatures, shocks, tolerances of the acceptable pneumatic leakage. Due to the variability of all the factors above mentioned it's not possible to give indications on the life of cylinders that would not be purely theoretical data. The intent of these indications is only to supply a reference value that could help the end user to planning properly during the implementation phase of any installation, and not binding or guaranteed towards the customer. In consideration of all the above, we can give the following values (without radial loads):

- 15,000 km for cylinders with polyurethane seals;
- 8,000 km for cylinders with NBR seals;
- 5,000 km for rodless cylinders.

STROKE TOLERANCES

The actual stroke of the cylinders has a tolerance with respect to the nominal stroke but always in compliance with the applicable standards, if any, or anyway within the following tolerances:

- -0/+1.5 mm for cylinders to ISO 6432 Ø 8 ÷ 25;
- -0.5/+1.5 mm for round cylinders Ø 32 ÷ 63;
- -0/+2 mm for cylinders to ISO 15552 Ø 32 ÷ 50;
- -0/+2.5 mm for cylinders to ISO 15552 Ø 63 ÷ 200;
- -0/+2.5 mm for compact cylinders to AFNOR Ø 20 ÷ 100;
- -0/+1 mm for compact cylinders Ø 12 ÷ 100;
- -0/+2.5 mm for rodless cylinders Ø 18 ÷ 63.

STROKES EXCEEDING THE MAXIMUM VALUE INDICATED IN THE CATALOGUE

Customer can address our commercial office even the "Demand for Feasibility" of cylinders having strokes exceeding the maximum value indicated in the catalogue. By and large Waircom will always be able to supply these cylinders, obviously with the physical limitations of the production technologies, but it will be care and responsibility of only the end user to realize proper solutions (e.g. guiding the piston rod, avoiding peaks loads, etc.) so that these cylinders with non-standard strokes could work properly and securely.

MAGNETIC SENSORS

The intensity and the shape of the magnetic fields generated by permanents magnets housed in the piston assembly depend on the presence of magnetic metal masses in the vicinity of the cylinders that could create mutual magnetic inductance. Therefore these masses may prevent the sensors from switching correctly, in which case non-magnetic materials should be used as, for instance, convenient stainless steel.