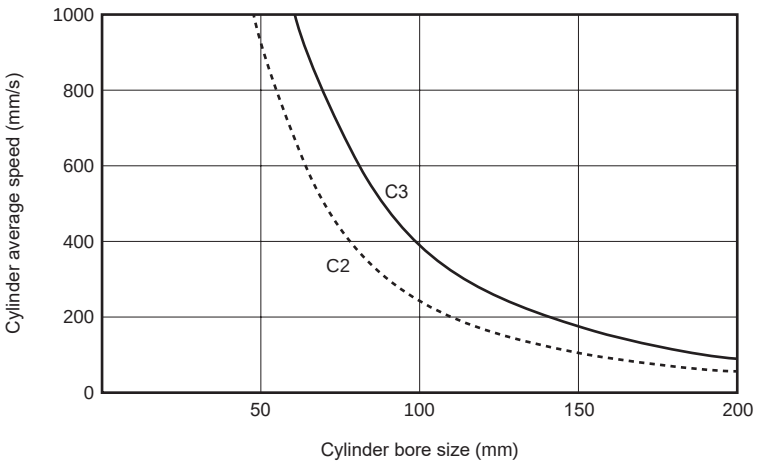
Technical data ❶ Pneumatic system selection guide

(1) The cylinder average speed is obtained from the combination of W4G4 Series and piping system. It is expressed as the cylinder's piston speed calculated by dividing the Stroke by the time that the piston rod takes from start to end of movement with the cylinder rod installed facing upward. When the load factor is 50%, the average speed should be approximately the cylinder's piston speed multiplied by 0.5.
(2) The cylinder average speed described in "Pneumatic system components selection guide" is that when one cylinder is operated alone.
(3) The effective cross-sectional area of the solenoid valve used for the calculation below is the 2-position value.
(4) This selection guide is for reference. With the CKD sizing program, confirm conditions to be actually used.
(5) Effective cross-sectional area S and sonic conductance C are converted as S ≈ 5.0 x C.

Standard system table

Valve	System No.	Speed controller	Silencer	Piping	Composite effective cross-sectional area (mm^2) pipe length 1 m
W4GB410	C2	SC1-8	SLW-8A	ø10xø7.2	9.7
	C3	SC1-10	SLW-10A	ø15xø11.5	15.6



How to use the guide

Device selection guide is used to select the optimum model at a glance.

● Fluid control components selection

Whether the cylinder bore size and cylinder being used are driven with relative high or low speed is determined as a condition. Using the table shown below as a reference, select the theoretical reference speed of the cylinder.

Degree of cylinder speed	Theoretical reference speed (mm/s)
Low speed	250
Medium speed	500
High speed	750
Ultra high speed	1,000

Using the table in the device selection guide 1 (next page), select the equivalent bore size of cylinder tube and the proper standard system No. corresponding to theoretical reference speed.

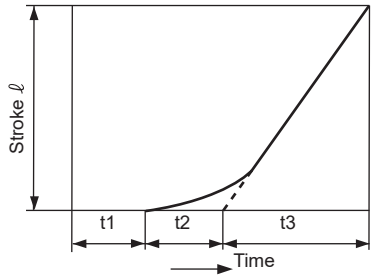
Explanation of technical terms

● Theoretical reference speed: indicates degree of cylinder speed, expressed as the following formula. (This value matches speed with no load. When load is applied, speed drops considerably.)

$$vo=1920\times\frac{S}{A}\ 2445\times\frac{S}{D^2} \quad \text{——————} (1)$$

vo: Theoretical reference speed (mm/s)
A : Cylinder sectional area (cm^2)
S : Composite effective cross-sectional area of circuit (exhaust air side) (mm^2)
D : Cylinder bore size (cm)

When expressed as a graph, the theoretical reference speed is the speed within the range where the cylinder moves at a uniform speed



$$vo=\frac{\ell}{t3}(A/s)$$

t1 : Time until movement starts
t2 : Time of primary delay
t3 : Operating time with constant velocity
ℓ : Stroke

● Note:t1 and t2 differ depending on load.
Can be effectively ignored with no load.

● Required flow rate: indicates instantaneous flow rate for operating a cylinder with velocity *vo*, expressed with the following formula. Values in the table are when P = 0.5 MPa. The required flow rate is a value necessary to select clean air system components.

$$Q=\frac{Avo(P+0.101)\times60}{0.101\times10^4}=\left[\frac{Avo(P+1.03)\times60}{1.03\times10^4}\right] \quad \text{——————} (2)$$

Q: Required flow rate (RX) (ANR)
P: Supply pressure (MPa)

● Required effective sectional area: indicates composite effective cross sectional area for the exhaust circuit required for moving the cylinder at speed *vo*. (Composite effective cross-sectional area of valve, speed controller, silencer or piping)

● Proper standard system: indicates the most appropriate combination of valve, speed controller, silencer and bore size for operating a cylinder with velocity *vo*. The combination in the table is for a pipe length of 1 m.

Calculation method of flow rate

Depending on the actual unit, they are shown as follows.

Choked flow when $\frac{P_2+0.1}{P_1+0.1}\le b$

$$Q=600\times C(P_1+0.1)\sqrt{\frac{293}{273+t}} \quad \text{——————} (1)$$

Subsonic flow when $\frac{P_2+0.1}{P_1+0.1}>b$

$$Q=600\times C(P_1+0.1)\sqrt{1-\left[\frac{\frac{P_2+0.1}{P_1+0.1}-b}{1-b}\right]^2}\sqrt{\frac{293}{273+t}} \quad \text{——————} (2)$$

Q : Air flow rate [dm^3/min(ANR)], SI unit dm^3 (cubic decimeter) can also be expressed with ℓ (liter). 1 dm^3 = 1 ℓ
C : Sonic conductance [dm^3/(s·bar)]
b : Critical pressure ratio [-]
P_1 : Upstream pressure [MPa]
P_2 : Downstream pressure [MPa]
t : Temperature [°C]

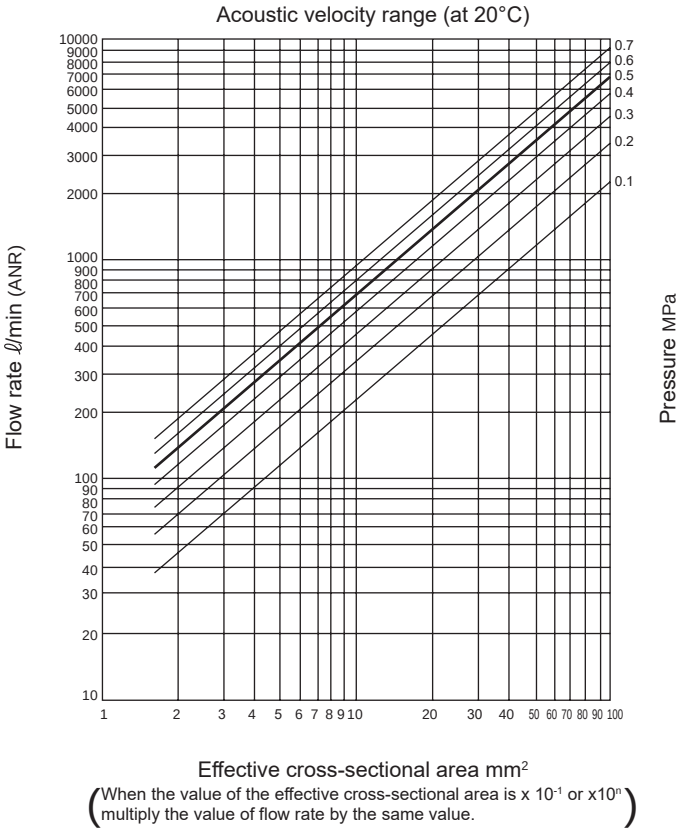
When calculating with effective cross-sectional area S, substitute value C obtained with C = S/5 in the above formula.
For subsonic flow, substitute b = 0.5 in formula (2).

[Device selection guide 1]

Cylinder bore size (mm)	Theoretical reference speed (mm/s)	Required flow rate (ℓ/min) (ANR)	Required effective sectional area (mm^2)	Proper standard system No. Exhaust with silencer
ø40	250	112	1.6	A
	500	224	3.3	B
	750	336	4.9	B
	1000	448	6.5	C1
ø50	250	175	2.6	A
	500	350	5.1	B
	750	526	7.7	C1
	1000	701	10.2	C2
ø63	250	278	4.1	B
	500	556	8.1	C2
	750	834	12.2	C2
	1000	1112	16.2	C3
ø80	250	448	6.5	C1
	500	897	13.1	C2
	750	1345	19.6	C3
	1000	1794	26.2	C4
ø100	250	701	10.2	C2
	500	1401	20.4	C3
	750	2102	30.7	C4
	1000	2803	40.9	D1
ø125	250	1095	16.0	C3
	500	1401	31.9	C4
	750	2102	47.9	D1
	1000	2803	63.9	D2

* Refer to page 1160 for system No.

[Effective cross-sectional area]



(When the value of the effective cross-sectional area is x 10^{-1} or x10^{n} multiply the value of flow rate by the same value.)

[Clean air system components]

Clean air system components

Part name	Model No.	Port size	Max. flow rate (ℓ/min, atmospheric pressure conversion value)
F.R.L. kit	C1000-6-W	Rc1/8	450
	C1000-8-W	Rc1/4	630
	C3000-8-W	Rc1/4	1280
	C3000-10-W	Rc3/8	1750
	C4000-8-W	Rc1/4	1430
	C4000-10-W	Rc3/8	2400
	C4000-15-W	Rc1/2	3000
F.R. unit	W1000-6-W	Rc1/8	830
	W1000-8-W	Rc1/4	1150
	W3000-8-W	Rc1/4	2150
	W3000-10-W	Rc3/8	2430
	W4000-8-W	Rc1/4	2500
	W4000-10-W	Rc3/8	4350
	W4000-15-W	Rc1/2	4750
Air filter (F)	F1000-6-W	Rc1/8	460
	F1000-8-W	Rc1/4	610
	F3000-8-W	Rc1/4	1230
	F3000-10-W	Rc3/8	1500
	F4000-8-W	Rc1/4	1320
	F4000-10-W	Rc3/8	2140
	F4000-15-W	Rc1/2	3000
Regulator (R)	R1000-6-W	Rc1/8	770
	R1000-8-W	Rc1/4	1350
	R3000-8-W	Rc1/4	2000
	R3000-10-W	Rc3/8	2600
	R4000-8-W	Rc1/4	2500
	R4000-10-W	Rc3/8	4400
	R4000-15-W	Rc1/2	5000
Lubricator (L)	L1000-6-W	Rc1/8	550
	L1000-8-W	Rc1/4	700
	L3000-8-W	Rc1/4	1100
	L3000-10-W	Rc3/8	2250
	L4000-8-W	Rc1/4	1000
	L4000-10-W	Rc3/8	1700
	L4000-15-W	Rc1/2	2700

Note) Max. flow rate: For FRL, FR and R, flow rate at 0.7 MPa primary pressure, 0.5 MPa set pressure, 0.1 MPa pressure drop. For air filter, flow rate at 0.7 MPa primary pressure, 0.02 MPa pressure drop. For lubricator, flow rate at 0.5 MPa primary pressure, 0.03 MPa pressure.