Vortex Blower model Selection Guide

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Wind water system division

Vortex Blower model Selection (Example)

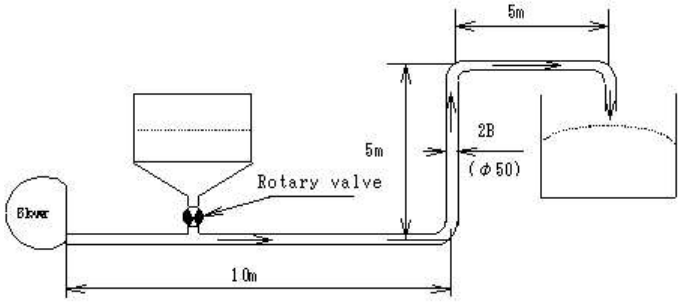
1).Pneumatic conveying
To select a blower for pneumatic conveying, the following conditions should be considered.

◆object conveyed	◆Pipe length
◆Pipe diameter	◆Convey quantity (kg/min, kg/hr)

[Calculation example]
Object conveyed: plastic pellet
Pipe diameter: 2B (φ50)
Pipe length:20m
Convey Quantity:15kg/min
<Pipeline diagram>
(discharge usage)

conversion table

item	SI Units	Usstandard
1.Volume	$1m^3$	$35.31ft^3$
2.Mass	1kg	2.22lb
3.Quantity	$1m^3/min$	$35.31ft^3/min(CFM)$
4.Pressure	1KPa	$4.02inH_2O$



◆wind quantity required (Q)

$$\text{From } Q = \frac{Gs}{1.2m} = 4.17(m^3/min)$$

$$\text{Then } Q = \frac{15}{1.2\times 3} = 4.17(m^3/min)$$

GS : Convey quantity (kg/min)
m : Mixed ratio(=3)

◆Wind velocity required (◆◆)

From the table 1, the wind velocity of 30m/s is supposed

◆Pipe Diameter(d)

$$\text{From } d = \sqrt{\frac{4Q}{60\pi v}}$$

$$\text{Then } d = \sqrt{\frac{4\times 4.17}{60\times\pi\times 30}} = 0.0543(m) = 54.3(mm)$$

※ The wind velocity can be found from the pipe diameter which is designed by user.

From $Q=60Av$

Then $v=\dfrac{4.17}{60\times(\pi/4)\times 0.05^2}=35.4(m/s)$

This necessary wind velocity is satisfied.

A : The area of pipe cross section ($m^2=\dfrac{\pi}{4}d^2$)

◎If the pipe diameter designed by user is greatly different from the pipe diameter found from the wind velocity required, that is, the pipe diameter designed by user is bigger, then the designed pipe diameter should be changed, or the wind velocity required should be changed.

◆Necessary stillness pressure(Ps)

From $Ps=\lambda\dfrac{L}{d}\dfrac{\gamma}{2g}v^2$

Then $Ps=0.025\times\dfrac{25}{0.05}\times\dfrac{1.203}{2\times 9.8}\times 35.4^2=961.4(mmAq)$

Take a redundancy of 20%.

Then $Ps=961.4\times 1.2=1154(mmAq)$

λ : Friction coefficient

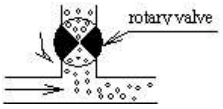
γ : Air specific gravity (=1.203)

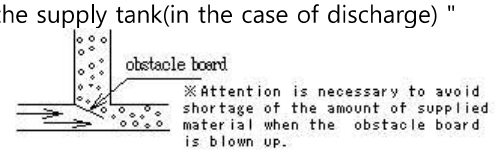
※The length of the up-rise pipe part is calculated for two times in case of the pneumatic conveying. Therefore, in this case, the equivalent length is calculated as 5×2=10 (m)

According to the above calculation, from the discharge character of the characteristic curve of the blower, a VB-040-E2 * 1 unit should be selected in the case of 50Hz.

[Notice]

◆The establishment of the rotary valve and the obstacle board is necessary for the sake of "avoiding putting much conveyed material in the pipeline.", and " preventing the countercurrent of the air to the supply tank(in the case of discharge) "





[Others]

◆Compressor, Roots Blower and Turbo Blower could be used instead of Vortex Blower in the case of the pneumatic conveying.
Compressor and Roots Blower can transport high-density material by a thin pipe.
Vortex Blower is used for the pneumatic conveying of the middle and small size materials.

2).Scrap collection

The method to select a blower for Scrap collection is fundamentally the same for pneumatic conveying. Thus, the necessary condition for the selection is the same.

[Calculation example]

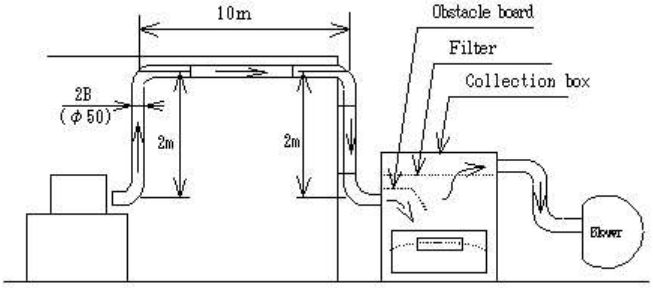
Physical object◆Fcasting powder(powder-shaped thing)

Pipe diameter: 2B (◆◆50)

Pipe length◆F15m

Collection quantity◆F5kg/min (It is unnecessary because generally the amount of Scrap is not specified in case of Scrap collection use.)

<Pipeline diagram>



* Wind velocity reQuired (u)
From the table 1, 35m/s is supposed
* Wind Quantity reQuired (Q)
From $Q=60Av$

$$Q=60\times\frac{\pi}{4}\times0.05^2\times35=4.12(m^3/min)$$

conversion table

item	SI Units	Usstandard
1.Volume	$1m^3$	$35.31ft^3$
2.Mass	1kg	2.22lb
3.Quantity	$1m^3/min$	$35.31ft^3/min$(CFM)
4.Pressure	1KPa	$4.02inH_2O$

Necessary stillness pressure(Ps)

$$\text{From } Ps=\lambda\frac{L}{d}\frac{\gamma}{2g}v^2$$

$$=0.025\times\frac{18}{0.05}\times\frac{1.203}{2\times9.8}\times35^2=676.7(mmAq)$$

Take a redundancy of 20%.
Then Ps=676.7*1.2=812(mmAq)

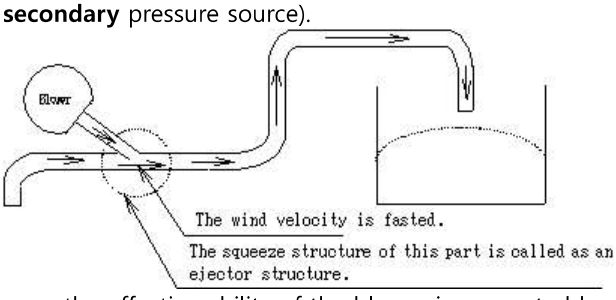
According to the above calculation, from the induction character of the characteristic curve of the blower, a VB□030□E2 * 1 unit is selected in case of 60Hz.

[Notice]

- It's possible that the scrap can't be sucked in to the pipe if the space between the scrap material and the suction mouth is far away. In principle, you should make the scrap touches the suction mouth, or let the scrap drop to the mouth.
- A collection tank is necessary because the collected scrap can't be put into the blower directly. A filter (change its eye size corresponding to the size of the scrap) must be set in the tank. It is better to set anther filter (VBLF type) between the blower and the tank as well.
- It's better to put a drawer-type box in the collection tank for the sake of convenience when the collected scrap is to be abandoned. Leave no gap between the drawer and the body of the collection tank to avoid the leakage of the collected scrap.

[Others]

- For scrap collection the method of discharging by blowing can be used too(used as a **secondary** pressure source).



In this case, the effective ability of the blower is computed by a factor of about 1/3.

3).Suction carriage

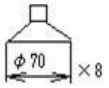
To select a blower for suction carriage, the following conditions should be considered.

・Weight of the Suction object	・Pipe diameter
・Suction pad size	・Pipe length

[Calculation example]

carried object : Iron plate

Weight : 50kg

Suction pad : 

conversion table

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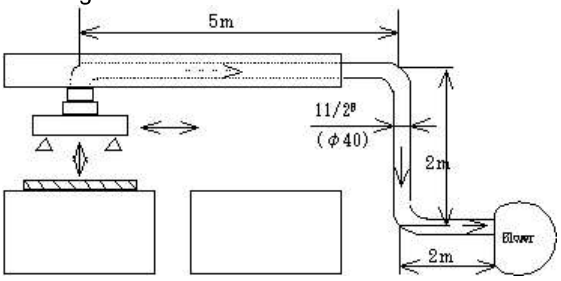
<Pipeline diagram>



◆Necessary stillness pressure(Ps)

From $F = Ps \cdot A$

Then $Ps = \frac{F}{A} = \frac{50}{(\pi/4)\times 0.07^2 \times 8} = 1624(mmAq)$

According to the above calculation, from the induction character(under the completely closed pressure) of the characteristic curve of the blower, a VB-015-G * 1 unit should be selected in the case of 50Hz.

※It's better to select a G series blower since the machines of this series can meet the requirement. Fundamentally, completely closed operation is required in the case of suction carriage.
※ There are wrinkles, concavity and convexity in the surface of those objects like paper, plastic plates, print circuit boards and stone plates, etc. The air can leaks out easily, so the blower is favorable (it can supply enough amount of air). In this case, it's necessary to select the blower of E series according to the amount of air leakage.
※Because the selection of machine to adsorb an object, where air can leak out, is fundamentally impossible by calculation, principally, a test should be conducted first to confirm the selection. Using the above calculation as a reference, a machine of two levels higher should be selected to conduct the test.

[Others]

◆In the case of suction carriage, except the Vortex Blower, the vacuum pump, the second pressure using of compressor, can also be considered too.

◆If using the vacuum pump or the compressor, dropping of the adsorbed object may occur because of air leakage, so the blower is favorable.

4).Blowing off

To select a blower for blowing off, the following conditions should be considered.

・Pipe length	・Nozzle number	(・Wind velocity required)
・Pipe diameter	・Nozzle slit dimension	

[Calculation example]

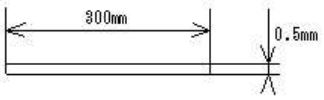
Used for the water drops removal on the washed steel board.

Pipe length : 3m

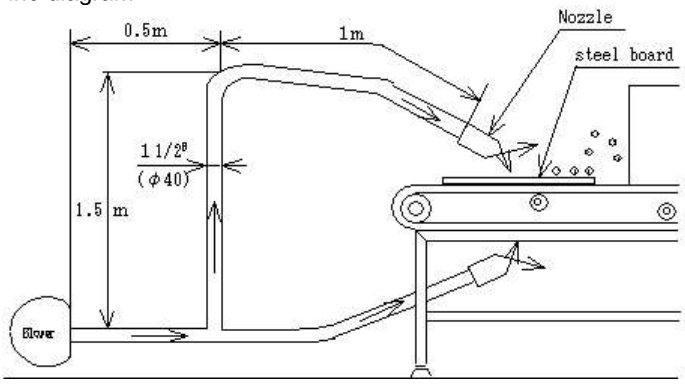
Pipe diameter : 11/2B(φ40)

Nozzle number : 2

Nozzle slit dimension :



<Pipeline diagram>



◆Wind velocity required (◆◆)

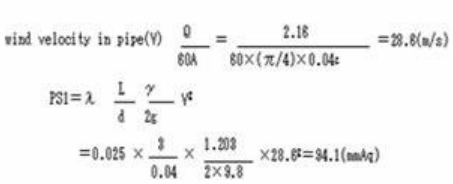
The wind velocity for blowing off doesn't specified clearly, a range of 100-150m/s is necessary by experience. Here 120m/s is assumed in calculation.

◆Wind quantity required (Q)

From Q=60A◆◆

Q=60 * 0.3 * 0.0005 * 2 * 120=2.16(m^3/min)

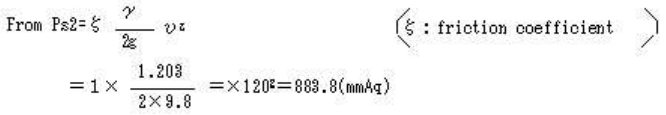
◆Stillness pressure required (Ps)



conversion table

item	SI Units	Usstandard
1.Volume	1m^3	35.31ft^3
2.Mass	1kg	2.22lb
3.Quantity	1m^3/min	35.31ft^3/min(CFM)
4.Pressure	1KPa	4.02inH_2O

Nozzle slit (outlet) Loss (Ps2)



Then

Ps=1.2(Ps1+Ps2)=1.2(94.1+883.8)=1173.5(mmAq)

According to the above calculation, from the discharge character of the characteristic curve of the blower,a VB-020-E2 * 1 unit is selected in the case of 60Hz.

[Notice]

◆It's better to draw a nozzle to the working object as close as possible, since the speed of air from the nozzle goes down due to the diffusion. Because of this fact, it's necessary to conduct a test beforehand to confirm your selection.

◆Increasing the air speed in the nozzle causes the noise in the nozzle becomes loud.(Generally the noise is louder than that of the blower). To decrease the noise, it can be covered with a soundproof box. Or lower the noise by decreasing the air speed. Because down the air speed is a countermeasure to the purpose primarily set, it's not a good way to do it.

[Others]

- ◆Though compressor can be used for blowing off, but because its wind amount is not enough in this case, only limited area can be blown off, a blower is more favorable for the area it can cover to blow off is larger.
- ◆The slit breadth of the nozzle which is suitable for the blower is about 0.5-2 ◆o. If the width beyond 2 ◆o, the required wind quantity grows big, and then it's not suitable.

5).Aeration

To select a blower for aeration in water, the following conditions should be considered.

・Pipe diameter	・Pipe length
・Depth of water	・Air hole Size, Number

[Calculation example]

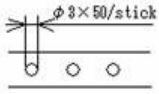
Used for water stirring inside plating tank.

Pipe diameter : 1 1/2B(φ40)

Pipe length : 15m

Depth of water : 1m(=1000 mm)

Air hole Size, Number :



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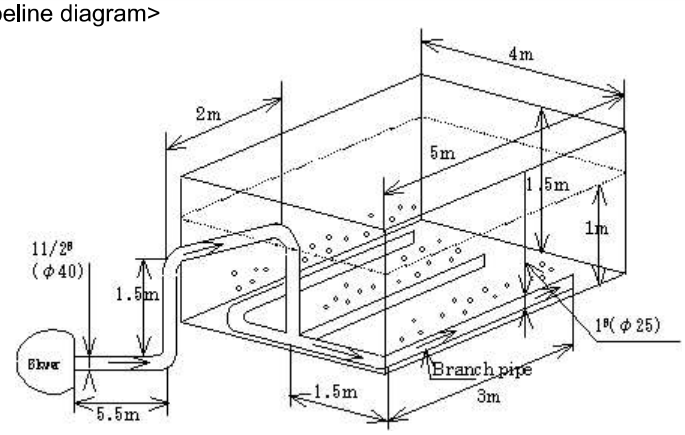
2.Mass	1kg	2.22lb
3.Quantity	$1m^3$/min	$35.31ft^3$/min(CFM)
4.Pressure	1KPa	$4.02inH_2O$

<Pipeline diagram>



◆Wind quantity required (Q)

In the case of aeration in water, often the necessary wind quantity is not specified clearly, $1m^3$/min is assumed in this case.

◆Necessary stillness pressure(Ps)

$$\text{main pipe : wind velocity in pipe(V)} = \frac{Q}{60A} = \frac{1}{60\times(\pi/4)\times 0.04^2} = 13.3(m/s)$$

$$Ps1 = \lambda \frac{L}{d}\frac{\gamma}{2g}V^2$$

$$= 0.025\times\frac{10.5}{0.04}\times\frac{1.203}{2\times 9.8}\times 13.3^2 = 71.2(mmAq)$$

$$\text{Branch pipe : wind velocity in pipe(V)} = \frac{1/3}{60\times(\pi/4)\times 0.025^2} = 11.3(m/s)$$

$$Ps2 = 0.025\times\frac{4.5}{0.025}\times\frac{1.203}{2\times 9.8}\times 11.3^2 = 35.3(mmAq)$$

Air hole : total area of holes per pipe(A)$=\frac{\pi}{4}\times 0.003^2\times 50=3.53\times 10^{-4}(m^2)$

The velocity of wind from hole (V)$=\frac{1/3}{60\times 3.53\times 10^{-4}}=15.7(m/s)$

From $Ps3=\zeta\frac{\gamma}{2g}V^2$

$=1\times\frac{1.203}{2\times 9.8}\times 15.7^2=15.1(mmAq)$

Depth of water : Ps4=1m=1000(mmAq)

Then

Ps=1.2(Ps1+Ps2+Ps3+Ps4)=1.2(71.2+35.3+15.1+1000)=1345.9(mmAq)

According to the above calculation, from the discharge character of the characteristic curve of the blower, a VB-015-G * 1 unit should be selected in the case of 50Hz.

※Although a VB-020-E can be selected according to the specification requirement, the performance is already close to its limitation, so it's better to select a G series machine. Since the range of usage of the G series machines is wider in comparison with the E series machines, in the case of aeration, G series blowers are used more often.

[Notice]

- In the case of aeration, except the culture pond, the necessary wind quantity is often not specified clearly. A rough standard from experience is shown in the following.

Plating tank : about 1m^3/min	Foaming for washing : 2~3m^3/min
Foaming bath for business : about 1m^3/min	Septic tank : more than 2~3m^3/min

- Special attention must be paid to this fact that, in the case of aeration, if no place of the blower or the pipe is higher than the surface of the water, water may flows into the blower backward.
- Check valve can be used for preventing countercurrent of water, but if the water pressure doesn't reach about 10m, the valve may not be closed tightly then water may leak out.