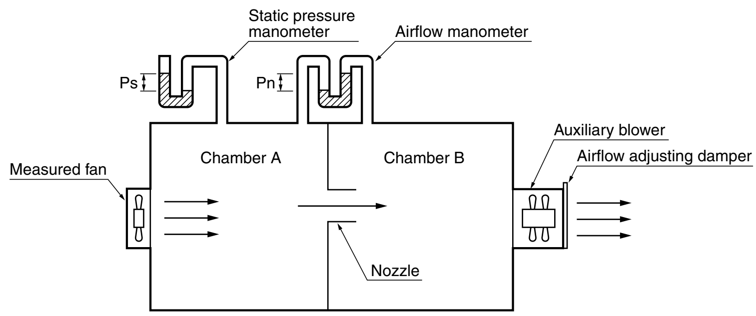
Technical Information

MEASUREMENT of AIRFLOW and STATIC PRESSURE

It is very difficult to measure airflow and static pressure, and there are cases where measured values vary depending on measuring devices. There are two kinds of measuring methods; double chamber method provided by JIS and AMCA (Air Moving and Conditioning Association) and wind tunnel method. Our company adopted the double chamber method, and therefore we will explain it hereinafter.
The auxiliary blower (fan) adjusts an inner pressure by sucking out air. At this moment, as airflow and static pressure are varied by opening or closing the damper, each value is read on the manometer.

Maximum airflow:
The damper opens, and the auxiliary blower sucks out air so that static pressure becomes zero. At this moment, the pressure differential (airflow differential pressure: Pn) in chambers A and B becomes maximum. The airflow whose Pn is measured and which is determined by using the equation shown at right is called the maximum airflow.

Maximum static pressure:
When the damper is completely closed, the pressure in chamber A becomes maximum. At this moment, the pressure differential (static pressure: Ps) in chambers A against atmospheric pressure is called the maximum static pressure.



1. Equation
Airflow Q =

$$60\times C\times\left(\frac{D}{2}\right)^2\times\pi\times\sqrt{\frac{2g}{\gamma}\times(Pn\times 9.81)}\quad (m^3/min)$$

In the above equation,
C: Flow coefficient of nozzle
D: Nozzle diameter (m)
γ: Air density =

$$\left[1.293\times\frac{273}{273+t}\times P\times 133.32\right]\ (kg/m^3)$$

t: Temperature(°C)
P: Atmospheric pressure(Pa)
g: 9.8(m/s^2)
Pn: Airflow differential pressure (Pa)
Ps: Static pressure (Pa)

2. Unit conversion table

1) Airflow

m^3/min.	ℓ/s	CFM (ft^3/min.)
1	16.678	35.334
0.06	1	2.1186
0.0283	0.472	1

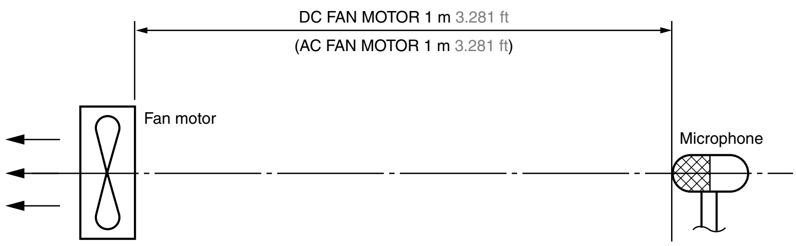
2) Static pressure

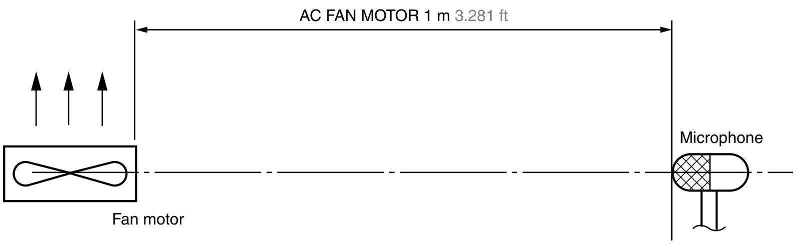
Pa	mmH$_2$O (mmAq)
1	0.10197
9.80665	1

NOISE MEASUREMENT

Operation noise is measured by hanging the fan in midair. For the DC fan, noise is measured in dB(A) 1 m from the front of the air-intake side. For the AC fan, noise is measured in dB(A) 1 m from the front of the air-intake side and the side of the fan.

The background noise complies with the section in JIS B8346 that states that it should be at least 10 dB lower than the target noise reading.
Our measurements were made in an anechoic chamber with a background noise of approximately 15 dB.



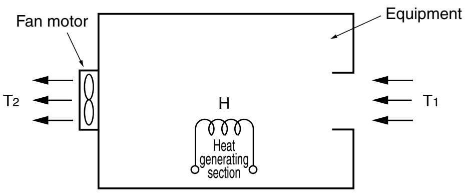


COUNTERMEASURES AGAINST MOISE

Our fan motors are designed placing great importance on low noise. However, take into consideration the following points because noise is influenced depending on the mechanism design used.
1) Leave a space between the rear side of the fan suction opening and the cooled object.
2) When using two or more fan motors, leave a space between the fans.
3) According to the mounting hole dimensions (page 23), design so that the mounting face and blades are not crossed.
4) Grease in the bearings will deteriorate and noise will gradually increase as the fan is used. The replacement period will differ depending on the conditions of use and allowable sound level. We recommend periodic replacement.

METHOD OF SELECTING FAN MOTOR

When selecting a fan motor, for normal use the following method is used.
1) Determine the amount of heat generated inside the equipment.
2) Decide the permissible temperature rise inside the equipment.



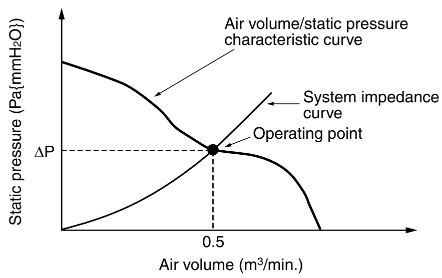
3) Calculate the volume of air necessary from Equation (1).
Equation (1)

$$Q=\frac{50\times H}{T_2-T_1}=\frac{50\times H}{\Delta T}\ (m^3/min)$$

where
Q: Air volume (m^3/min.)
H: Heat generated (kW)
T_1: Inlet air temperature(°C)
T_2: Exhaust air temperature(°C)
ΔT: Temperature rise(°C)

4) Determine the system impedance of the equipment by means of Equation (2). For the flow of air to the equipment, there is a loss of pressure due to the resistance to the flow of air from the components inside the equipment. This loss varies in accordance with the flow of air. This is referred to as the system impedance.
$\Delta P=KQ^n$.........Equation (2)
where
ΔP: Pressure drop(Pa{mmH_2O})
K: Constant determined for each equipment
Q: Air volume (m^3/min.)
n: Coefficient determined by air flow
In this equation, it is generally considered that n = 2.
Also, it is difficult to calculate the value of K, since there is no good method other than an actual test measurement with the equipment.
Example:
When the heat generated is 100 W with ΔT = 10°C 50°F, the following is the result.

$$Q=\frac{50\times 0.1}{10}=0.5\ (m^3/min)$$

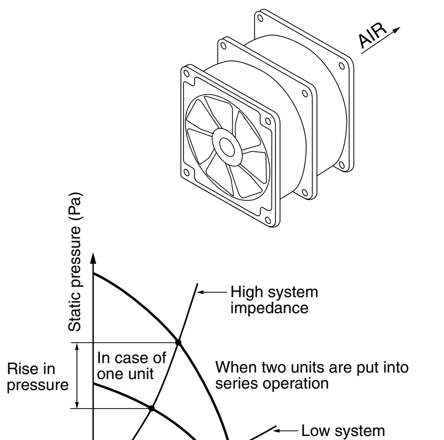


The intersection of the air volume/static pressure characteristic curve with the system impedance curve is called the operating point. This shows the condition with the fan motor operating.
In actuality, the system impedance is approximately assumed, a fan motor is decided from the catalogue, the temperature difference "ΔT" and air volume "Q" are measured, and from this data the fan is judged as suitable or not as the ordinary method. If the temperature difference "ΔT" is high indicating the air volume "Q" is not satisfactory, because the system impedance is higher than the assumed value, a change should be made to a fan motor with a greater air volume.

FAN MOTOR SERIES/PARALLEL OPERATION

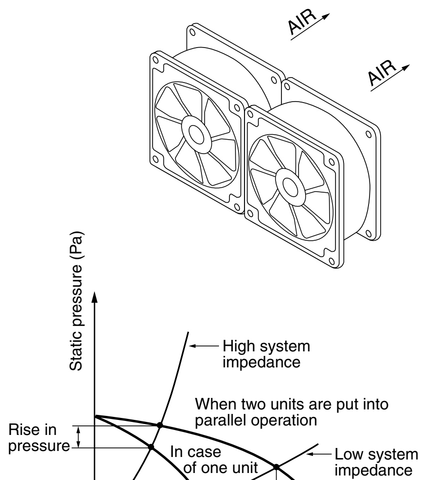
When one fan motor does not satisfy a sufficient cooling capacity;
Series operation: Higher pressure characteristic obtained. (Nearly double)
Parallel operation: Larger airflow characteristic obtained. (Nearly double)

1. In case of series operation



• In case of high system impedance, static pressure rises.
• In case of low system impedance, airflow slightly increases.

2. In case of parallel operation



• In case of low system impedance, airflow increases.
• In case of high system impedance, pressure slightly rises.