

### How to choose a suitable fan for our equipment ?

Concerning to choose a suitable fan for your equipment, users shall consider following objectives

- To optimize airflow efficiency
- To minimize size and fit
- To minimize acoustic disturbance
- To minimize power consumption (if the system power supplied by battery)
- To maximize reliability and service life
- To justify the total cost

While making selection of the fan motor for ordinary use, the following methods are very useful

- To determine the amount of heat generated inside the equipment
- To decide the permissible temperature rise inside the equipment
- To calculate the air volume requirement from equation
- To estimate the system impedance in the unit
- To select the fan by performance curve shown in the catalogue or data sheet

### How to measure noise level ?

The acoustical sound level is measured in anechoic room with background noise less than 15 dBA. The fan is hung under the hanging rod and running in free air with microphones at following three position.

One is at a distance of one meter from the right front side of the inlet.

Another one is at a distance of one meter from the center of the outlet, 45 degree left from the outlet section of the fan.

The other is at a distance of one meter from the center of the outlet, 45 degree right from the outlet section of the fan.

Sound Pressure Level (SPL) is environmentally dependent and Sound Power Level (PWL) are defined as :

$$\text{SPL} = 20 \log_{10} P/P_{\text{ref}} \text{ and}$$

$$\text{PWL} = 10 \log_{10} W/W_{\text{ref}} \text{ where,}$$

P = Pressure  
 Pref = A reference pressure  
 W = Acoustic power of the source  
 Wref = An acoustic reference power

Fan noise data is usually plotted as Sound Power Level against the octave frequency bands. Following is an indication of the effect of dBA changes :

- 3dB Barely noticeable
- 5dB Noticeable
- 10dB Twice as loud

Noise Change :

- 0 to 20 dB -- Very faint
- 20 to 40 dB -- Faint
- 40 to 60 dB -- Moderate
- 60 to 80 dB -- Loud
- 80 to 100 dB -- Very loud
- 100 to 140 dB -- Deafening

### What's the difference between noise level and abnormal noise ?

Noise level is measured by the anechoic room. It is the sound created by airflow and normal friction from mechanical structure. Abnormal noise may come from the improper assembly, mechanical tolerance, or component failure.

### How to test abnormal noise ?

We set up prototype samples for abnormal noise for every different fan model. Our quality control department check every pieces of fan according to the standard acceptable level. The QC staff are well trained and are sent to the hospital for audiology check-ups annually.

### How to reduce noise ?

The following are 8 check points to minimize fan noise:

1. System Impedance  
Higher airflow will create higher noise level. Likewise, the higher system impedance created by the system, the higher airflow is required in order to achieve the cooling effect. That is, users need to reduce the system impedance as low as possible in order to achieve the least noise of airflow.
2. Flow Disturbance  
The turbulent air generated by the obstructions along the path of airflow will raise the system noise. Therefore, users have to avoid any obstructions in the critical inlet and outlet area as much as possible.
3. Fan Speed  
As you know, a higher speed fan will generate greater noise compared to a low speed fan. Users have to try their best to choose a lower speed fan as much as possible.
4. Fan Size  
A larger size fan will generate a much lower noise level than a smaller size fan does while creating the same airflow. Users shall try to use larger fan with lower speed if space is allowed.
5. Temperature Rise  
Airflow is inversely proportional related to the allowable temperature increase in a system. A little change in the allowable temperature rise will lead to a significant change in the airflow requirement. If there is a little compromise to the limit imposed on allowable temperature rise, there will be a considerably less amount of airflow required. It will lead to remarkably reduction in the noise level.

6. Vibration and Resonance

We recommend using some soft and flexible isolator to avoid vibration transmission.

7. Voltage

The higher voltage applied to the fan; the higher vibration it will generate as will as rpm, Correspondingly, it will create a higher noise level.

8. Fan Design

Users have to choose reliable fans to avoid higher acoustic noise caused by improper mechanical and electrical design of the fan.

**Do fan blade shape and number of blades matter ?**

Different fan blade shape and the number of blades can affect both the airflow and air pressure. The more fan blades we have, the higher the air pressure we may generate. But the harder it is to maintain the plastic mold. However, special attention should be addressed to it's overall performance including balance status, noise level, and life span.

**What is a sleeve bearing fan ?**

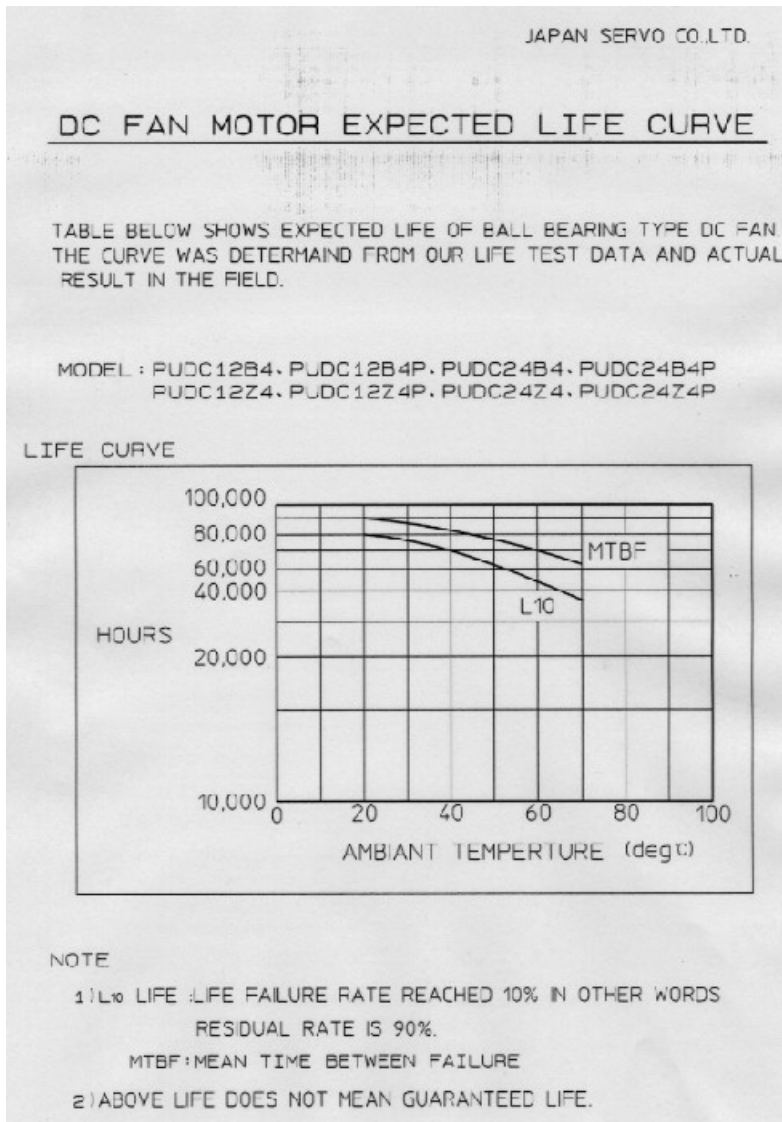
Sleeve bearing is a kind of bearing containing oil or lubricant within a friction contact when fan is rotating. The friction contact between sleeve bearing and the shaft is a face friction. The face friction will create higher noise levels and temperature. The higher the temperature caused by the friction, the greater the possibility for oil leakage. This causes the contact of the bearing to become rough and dry when the oil leaks after a certain period time. Furthermore, the uneven contact usually results in high temperature, abnormal noise and this can cause a malfunction on the fan. The lifespan of sleeve bearing fan is approximately 20K to 30K hours or 1/2 of the lifespan of ball bearing fans.

**What is a ball bearing fan ?**

For ball bearing fans, there are several miniature steel balls surrounding the cylinder. When the fan rotates, the balls rotate too. Compared to sleeve bearing, it is point friction and has less friction. There are no oil leakage problems so its lifespan is longer, generally 40K to 50K hours for two ball bearing fans and 30K to 40K for 1 ball / 1 sleeve fan (C).

**What is the advantage for "1 ball" fan ?**

Ball bearing fan does not contain a sleeve bearing inside. The ball bearing is fixed on the fan set and offers the highest life time (see L10-curve).



### What is a 3-wire fan ?

It is a fan with rotation signal output to detect the RPM. It is called "tachometer function" or "pulse alarm output".

### What is hydro bearing?

#### Category of bearing

Originally, spindle motor adopted ball bearing but considering the cost issue, then change to sleeve bearing and hydro bearing. The table below is the comparison of the three different types of bearing.

For ball bearing, because of processing precision and external pressure, the irregular rolling is larger, and the material is harder. It is easier to create resonance while the motor spinning at high speed.

Sleeve bearing is sintered with metal powder, the lubricant is stored among the gap of metal parts. The friction is face to face. To compare with ball bearing, the material is softer. When rpm increased, the gap between shaft and bearing will be enlarged. As well, the lubrication of the sleeve bearing will be reduced because of seal effect and shorten its life expectancy.

Type	advantage	weakness
Ball bearing	1. suitable for lower speed 2. high precision 3. seal type, no oil leakage problem	1. high cost 2. irregular rolling is larger while the motor spinning at high speed and easier to create vibration 3. big vibration and big noise
Sleeve bearing	1. low cost 2. easy to produce	1. low life expectancy 2. face to face friction and easily to lead abrasion 3. material is softer
Hydro bearing	1. suitable for high speed 2. longer life expectancy 3. lower vibration	1. the lubrication is not good while low speed spinning

For hydro bearing, the shaft and bearing will be separate by hydro oil membrane in order to maintain lubrication. The effect of lubrication is not significant if the rpm is too slow. It requires a certain operating range. Since the hydro oil membrane has the anti-vibration effect therefore the vibration can be reduced. The material is harder than sleeve bearing

In order to satisfy the requirement of low cost, long life expectancy, high stability and high speed spinning, hydro bearing is the best choice.

#### The operation theory of hydro bearing

According to the test result, obviously the hydro bearing can reach similar stability of ball bearing. For example. That is, the hydro bearing already obtains the requirement of long life expectancy for computer system, telecommunication, measurement, and medical equipments. Compare to ball bearing, hydro bearing is much competitive because of lower noise, lower cost.

Sintered hydro bearing: The progress of hydro bearing processing is owing to the development of sintering technology. Under high pressure condition, to solid metal powder to a certain shape and sintered at high temperature. Through the processing procedure, it will generate many small holes among the metal powder. The total cubic content of the hole is around 15~30% of the bearing itself. Furthermore, to fill the lubricant into the holes by vacuum process. Besides, there is a recycle oil storage sink design on the bearing to ensure the constant operation of the lubricant.

Even the fan is not rotating, the special design of hydro bearing can ensure the lubrication. Even at the beginning of starting, the shaft will not be dry. While the fan is at rest, the Capillarity effect will generate a lubrication membrane between shaft and bearing so that the lubricant will not leak out. When the fan starts rotating, the slight pressure difference will generate hydro wave between the gap of shaft and bearing. The rotation of the shaft will conduct the lubricant recycled on the surrounding of bearing. The hydro wave of hydro bearing will be generated at the most narrow gap between shaft and bearing (where generate the most friction). To ensure the shaft and bearing won't touch.

At the most narrow gap between shaft and bearing, where with the most lubricant pressure, the pressure will fill the lubricant into the holes among metal powder and recycle. At the same time, the lubricant will flow from where with lower pressure to high pressure (where need lubricant) to maintain the balance of lubricant. This kind of recycling will keep on certain stability.