Overview and characteristics of fan

Overview

A cooling fan is widely used to extend life of your system by cooling off heat of the system that many electrical components are mounted in a very high density and dissipating heat. Since we Sanyo Denki developed "San Ace" which is the first AC fan in Japan in 1965, we have increased fan motor lineup until now meeting customer's needs rapidly based on our tremendous career. We Sanyo Denki will continue to develop new fans with high air flow, low noise, low vibration, and energy - saving design.

Characteristics

We can roughly devide fan into two types which are AC and DC.

AC Fans

Sanyo Denki succeeded in the mass-production of AC fans in 1965. Sanyo Denki was the first Japanese manufacturer to have succeeded at this.

●High performance
●High reliability
●Safety

DC Fans

Sanyo Denki succeeded in the mass-production of DC fans in 1982.

●High performance
●Low power consumption
●Low vibration
●Low leakage of flux
●High reliability

Sanyo Denki currently has a wider variety of products like Long Life Fan, CPU cooler, Splash Proof Fan, and Oil Proof Fan etc to meet all customer needs.

Guideline in selecting a fan

How to select an appropriate fan

The following example is a guideline regarding how to select an appropriate fan for cooling your system

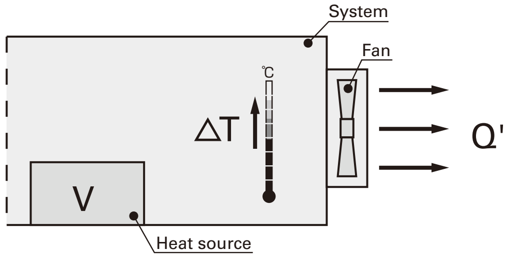
1. Determining of your system specifications and conditions

Determine the temperature rise inside your system and obtain the total heating value inside your system on the basis of its inputs and outputs.

Example

V : Total heating value of your system (W) =100 (W)

$\triangle T$: Inside temperature rise (K) =15 (K)



2. Calculating the Required Air flow for Cooling

After the equipment specifications and conditions of your system have been determined, calculate required air flow to meet the conditions.(Note that the formula shown below only applies when the heat radiation is performed only by cooling air from the fan.)

Example

Q': Motion air flow (m^3/min)

$$Q' = \frac{V}{20\triangle T} = \frac{100\ (W)}{20\times 15\ (K)} \fallingdotseq 0.33\ (m^3/min)$$

3. Selecting the Fan

After the motion air flow has been calculated, select an appropriate fan motor based on the value.The motion air flow when the fan motor is actually mounted in your system can be obtained using the air flow-static pressure characteristics curve and system impedance.However, the system impedance cannot be measured without a measuring equipment, so fan with 1.5 to 2 times higher air flow than the actual maximum air flow should be selected (operating air flow is one-third to two-thirds of maximum air flow).

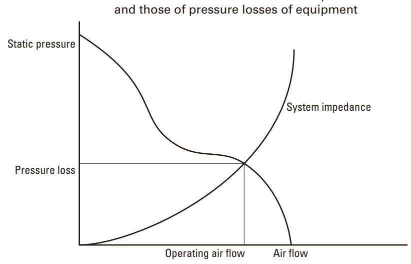
Example

Q: Maximum air flow (m^3/min)

$Q' = Q\times 2/3$

$Q = Q'\times 3/2 = 0.33\times 3/2 \fallingdotseq 0.5$ (m^3/min)

Characteristics of air flow versus static pressure and those of pressure losses of equipment



Next, In case that you select a fan having an air flow of 0.5 (m^3/min.) or more and a appropriate size for the space inside your system.

For example, If you need a fan of 80mm square, 25mm thickness and 100V, you should select is 109S030 (maximum air flow = 0.55^3/min.).

4. Confirming the Selected Fan

Calculate the temperature rise inside your sysetem when your sysetem having 100 (W) of total heating value is forcefully cooled down by a 109S030 fan.

Example

$Q' = Q\times 2/3 = 0.53\times 2/3 \fallingdotseq 0.367$ (m^3/min)

$\triangle T = V/20Q' = 100\ (W) / 20\times 0.367\ (m^3/min) \fallingdotseq 13.6\ (K)$

From the above, the temperature rise inside your system is calculated as 13.6 (K).

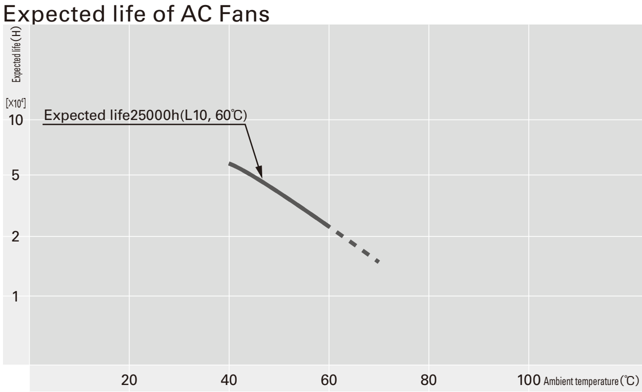
Since the value obtained from the above equation is only a rough target, final fan selection should be based on your actual installation test.

Characteristics calculation method and description

Reliability and Expected Life

A fan generally cools itself as well. The temperature rise of the motor is relatively low and the temperature rise of the grease in the bearings is also low, so expected life is longer than general some either motors. Since the service life of bearings is a theoretical value that applies when they are ideally lubricated, the life of lubricant can be regarded as expected life of the fan. The expected life of an AC fan used at an ambient temperature 60℃ is 25,000 hours. When the measurement conditions are: L10 (the remaining product life in the lifespan test is 90%), with an atmospheric temperature of 60 degrees, at the rated voltage and with continuous free air. The right table indicates the relationship between ambient temperature and expected life estimated on the basis of our life tests and same other tests conducted by Sanyo Denki. An accelerated life test is conducted on the basis of the concept that the expected life halves as the ambient temperature rises by about 15℃ (within the operating temperature range of lubricant.)

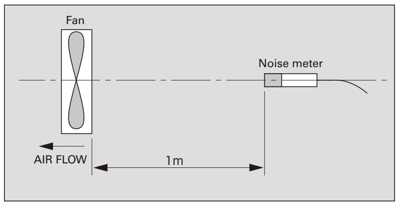
Expected life of AC Fans



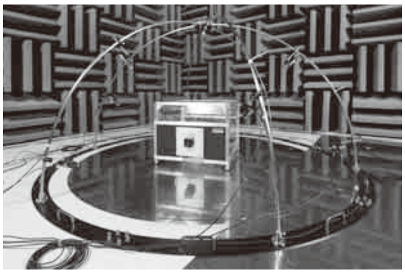
Rated voltage, continuously run in a free air state, survival rate of 90%

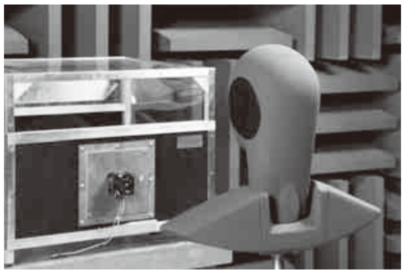
Noise characteristics

Noise is average value that measured at 1 meter away from air intake side of fan that is suspended on special frame in anechoic chamber (as per JIS B 8330).



Acoustic radio wave anechoic chamber



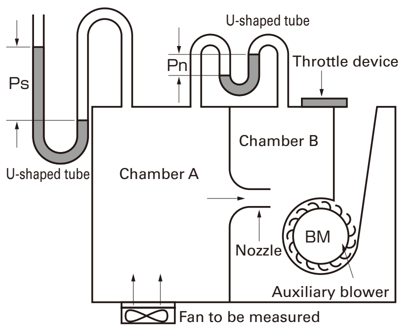


Noise characteristic measurement equipment

Measuring air flow and static pressure

It is very difficult to measure air flow and static pressure. In fact, the performance curve may vary greatly according to the type of measuring equiment.

The commonly-used type of measuring equipment is a wind tunnel using a Pitot tube. Sanyo Denki uses a very precise method using double chamber equipped with many nozzles.



Double chamber measuring equipment

$Q = 60A\bar{v}$ (A)

where

Q = air flow (m^3/min)

A = cross sectional area of nozzle $= \frac{\pi}{4}D^2$ (m^2)

D = nozzle diameter

$\bar{v}$ = average air flow velocity of nozzle $= \sqrt{2g\frac{Pn}{\gamma}}$ (m/sec)

γ : Air specific gravity (kg/m^3)

(γ=1.2kg/m^3 at 20℃ , 1 atmospheric pressure)

g = acceleration of gravity = 9.8 (m/sec^2)

Pn = differential pressure (mm H_2O)

Ps = static pressure (mm H_2O)

The measuring equipment using double chanber is method to be calculated from air flow goes through nozzle and differential pressure between pressure of inside of chamber (Ps) and atomospheric pressure by measuring differetial pressure between air intake and exhaust of nozzle (Pn).

Conversion Table

Static pressure

1mm H_2O=0.0394inch H_2O

1mm H_2O=9.8Pa (Pascal)

1inch H_2O=25.4mm H_2O

1Pa=0.102mm H_2O

1inch H_2O=249Pa

Air flow

1m^3/min=35.31ft^3/min (CFM)

1CFM=0.0283m^3/min

1m^3/min=16.67ℓ /sec

1CFM=0.472ℓ /sec

1ℓ /sec=0.06m^3/min

AC Fan Common Specifications

Material ··················Frame:Aluminum,Impeller:Plastics

Expected Life ··············Varies for each model
(L10:Survival rate:90% at 60℃ ,rated voltage,and continuously run in a free air state)

Motor Construction ········Shaded coil motor (60mm sq. 80mm sq. 92mm sq. 120mm sq.)
Capacitor motor (160mm sq. Φ172mm)

Motor Protection System ··Burnout protection at locked rotor condition

Dielectric Strength ········50/60Hz 1500VAC 1minute
(between input terminal and frame or between lead conductor and frame *For details, refer to the appropriate page.)

Insulation Resistance ······10MΩ or more at 500VDC megger (between lead conductor and frame)

Sound Pressure Level(SPL) ··Expressed as the value at 1m from air inlet side

Operating Voltage Range ··±10%

Storage Temperature ······-30℃ to +70℃ (Non-condensing)

Lead Wire ················For details, refer to the appropriate page.

Overheating protection function

Protection Functions
If the fan blades are restricted, an overcurrent occurs and leads to a rise in the fan coil temperature. This can result in reduced performance, damage, or a fire. To prevent this from occurring, Sanyo Denki' s fans incorporate an overheating protection function.

Burnout protection function at locked rotor condition

●Impedance protection (60mm sq. 80mm sq. 92mm sq. 120mm sq.)
This system is used for shading coil-type fans. When the blades are restricted, the current is reduced by the impedance of the coil itself to prevent a temperature rise in the coil. However, if the applied voltage exceeds the specification range, an overcurrent can occur and result in overheating, and so care needs to be taken.

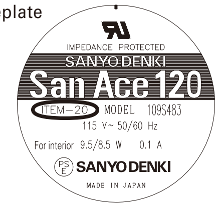
●Thermal protection (160mm sq. Φ172mm)
This system is used for condenser phase-type fans. A temperature sensor is incorporated in the coil so that if the temperature exceeds the specification temperature, the current is cut off to prevent overheating of the coil.

Specifications for AC fan sensor

Specifications of sensor circuit

	5V (ITEM-20*)	12V (ITEM-30*)
Example of model.no	109S405UL	
System	Speed detection, Auto-restart, Open collector	
Power supply	DC5V±10% At 5V, 6mA	DC12V±20% At 12V, 10mA
Recommend sensor circuit output	At Vp=5V, I=100mA max.	At Vp=12V, I=200mA max.
Trip point	Standard speed : 1,700min^{-1}±10% Low speed : 850min^{-1}±10%	
Response speed	Standard speed : Startup delay 18sec Detection delay 1sec Low speed : Startup delay 36sec Detection delay 2sec	
Insulation resistance	10 MΩ MIN. at a 500V DC megger (Note)	
Dielectric strength	50/60 Hz, 1,000V AC, 1 minute (Note)	
Ambient conditions	Temperature: −10 to +60℃ , humidity: 90%RH MAX. (at 40℃)	

Nameplate

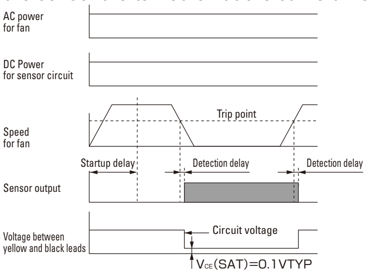


*[ITEM-20] and [ITEM-30] are printed on the fan nameplate.

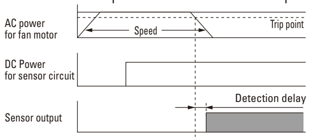
Note: Between one end that all sensor leads consisting of brown, yellow and black are tied together and the G terminal or power terminal of the fan.

Sensor scheme

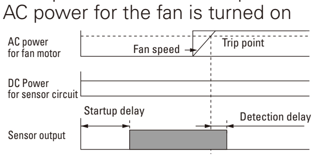
Example 1: When the AC power for the fan and the DC power for the sensor are turned on at the same time



Example 2: When the AC power for the fan is turned on first, then the DC power for sensor is powered on

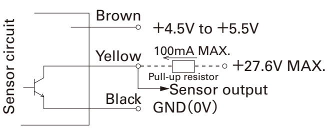


Example 3: When the DC power for sensor is first powered on, then the AC power for the fan is turned on

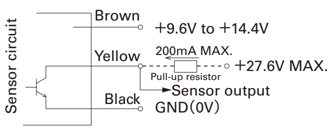


Sensor Output Circuit

5V (ITEM-20*)



12V (ITEM-30*)



GND (Black) should be shared in case that power supply for sensor circuit (Brown) and that for sensor pull-up (Yellow) are separated.

UPS, inverter, rectifier, high-voltage power supply, etc.

Cautions for use of a cooling fan in the vicinity of a power switching circuit (prevention of electrolytic corrosion)

Custom Product Refer to page 37

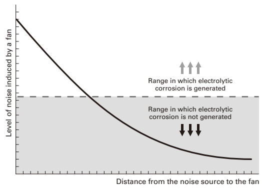
If a fan is installed near a large-power or high-voltage switching circuit, the heavy electromagnetic noise resulting from electromagnetic induction in such circuits or the influence of high-frequency noise imposed through the power line of the fan may induce current through the shaft bearing of the fan.Such current may damage the oil film on the bearing and even the friction surface of the bearing.This adverse effect is known as "electrolytic corrosion of the fan."Electrolytic corrosion affects the smooth revolution of the fan and may reduce its service life. An audible symptom is unusual noise emitted from the fan.This adverse effect is often observed and may partly be explained by the practice of mounting high-density parts, which reduces the gap between the switching circuits and the fan and the use of higher switching frequencies apt to provoke induction. Data processing/communications devices that operate at low voltages are not liable to electrolytic corrosion since they generate less electromagnetic noise.

A Case of Electrolytic Corrosion

Fans without anti-corrosion features installed near components that generate electromagnetic noise, such as inverter controllers, are liable to experience electrolytic corrosion.

No.	Use	Period until the occurrence of unusual noise
1	Switching power supply	6 months to 2 years
2	UPS	6 months to 2 years
3	General-purpose inverter	1 to 1.5 years

The curve shown in the graph below represents the relationship between the level of the electromagnetic noise induced by a fan and the distance from the fan to the noise source.

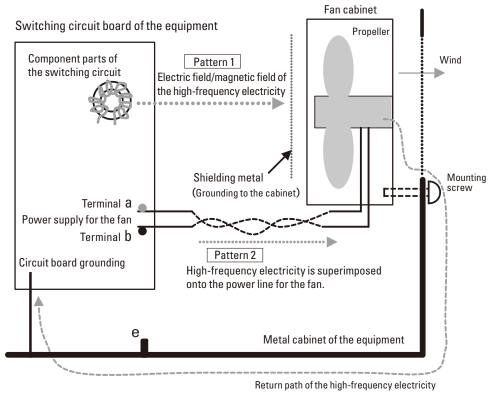


Occurrence of electrolytic corrosion Pattern 1

(1)The fan gets charged with high-frequency electricity by high-frequency noise (electric field/magnetic field) generated in the switching circuit.
(2)Because of high-frequency electricity charged in the fan, an electric current flows through the bearing of the fan.
(3)The electric current breaks the oil membrane on the surface of the bearing and the bearing gets abraded (electrolytically corroded).
(4)This symptom often occurs in equipment in which switching circuits are sped up and implemented in high density.
(5)Countermeasure 1: To provide a shield plate (Note 1) inside the fan (The plate should be such that does not interfere with air flow.)
(6)Countermeasure 2: To use a fan with ceramic bearings.

Occurrence of electrolytic corrosion Pattern 2

(1)High-frequency electricity flows from the circuit board into the inside of the fan superimposed with the power line for the fan.
(2)High-frequency electricity that has entered into the fan flows through the bearing.
(3)Oil membrane on the surface of the bearing gets broken and the bearing gets abraded (electrolytically corroded).
(4)Countermeasure 1: To remove high-frequency component between terminals "a" and "b", "a" and "e" and "b" and "e" of the power supply for the fan, or to insert a filter (Note 2) into the power line for the fan.
(5)Countermeasure 2: To use a fan with ceramic bearings
(6)Cables should be twisted in order to decrease induction to the power line for the fan.



Note 1 : Shielding metal plate
As an electromagnetic shield metal, "EMC Guard" is available from our company.
http://www.sanyodenki.co.jp/products/sanace/fanden.html
Certain shielding effect can be expected from mounting a general-purpose finger guard inside the fan.In each case, grounding to the cabinet is required.

Note2 : Filter
Insert a common mode filter when the high-frequency electricity is superimposed on both lines "a" and "b" in the same phase and, if not, insert a normal mode filter.

Measures against Electrolytic Corrosion

(1) Relocate fans far from all electromagnetic noise sources.
(2) Use anti-corrosion fans equipped with ceramic bearings.⇨ Refer to page 37
(3) As a power supply, the fan is wired from a circuit for which noise is not superimposed.

*The EMC guard could be effective against electromagnetic noise caused by radiation, but against heavy electromagnetic noise (electromagnetic induction) and conductive noise from the power supply line for a fan, we recommend the use of an "anti-electrolytic corrosion fan" with ceramic bearing.

Operating precautions

Operating precautions

Storage temperature

There is no performance problem when the system is used at between -30℃ and +70℃ . There is a possibility that same problem of lubricant and insulation inside motor might occur by condensing due to rapid surrounding temperature change. Therefore, please take care of non-condensing using desiccant or something during fan is in storage.

Tightening Torque

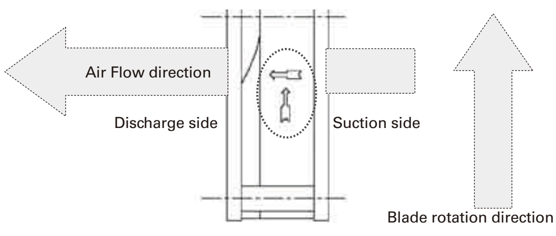
This shows the recommended values for the tightening torque when installing the fans. If the tightening torque is higher than the recommended values, the fan can be deformed or damaged. Use care when tightening.
Recommended screw torques
Fans : 0.44N · m (4.5kgf · cm) MAX. (with M3 screws)
Fans : 0.78N · m (8kgf · cm) MAX. (with M4 screws)
(160mm×160mm、φ172mm)

Handling precautions

The fan motor is equipped with a precision ball bearing. Therefore, please handle the motors carefully in order not to shock the bearings.

Installation

There are no limitations on the installation direction. Fans have symbols on the fan indicating the airflow direction and blade rotation direction. When installing, use these symbols to check the airflow direction.



Symbols indicating the fan airflow direction and blade rotation direction