Fan Applications

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Fan Products

WPH

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The Air Movement and Control Association (AMCA International), Inc. is a not-for-profit international association of the world’s manufacturers of related air system equipment, primarily but not limited to: fans, louvers, dampers, air curtains, airflow measurement stations, acoustic attenuators, and other air system components for the industrial, commercial and residential markets.

AMCA International’s mission is to promote the health and growth of the air movement and control industry consistent with the interest of the public. AMCA International is a resource that assists the manufacturers of air system components to comply with the industry’s national consensus standards. AMCA International offers products and services to the industry that enable the industry to grow, and specify fans, dampers, and louvers need to be aware of the value of the AMCA International Certified Ratings Seal.

During the last 90 years of representing the air movement and control industry, AMCA International has provided value to its membership with the following services:

<table>
<thead>
<tr>
<th>AMCA International Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Certified Ratings Program</td>
</tr>
<tr>
<td>2) Unique state-of-the-art testing laboratory</td>
</tr>
<tr>
<td>3) Participation in the development of standards</td>
</tr>
<tr>
<td>4) Independent AMCA accredited laboratories in Malaysia, Korea, France, Dubai</td>
</tr>
<tr>
<td>5) Industry statistics and forecasting reports</td>
</tr>
</tbody>
</table>

1) AMCA International’s Certified Ratings Program (CRP) assures that a product line has been tested and rated in conformance with AMCA International’s test standards and rating requirements.

2) Performance seals may be displayed in literature and on equipment after a product has been tested and its cataloged ratings have been submitted to and approved by AMCA International’s staff. To maintain a ratings certification, each licensed product line is subject to retesting every 3 years. Published performance is checked for accuracy and validity.

3) An AMCA Certified Ratings Seal gives the buyer, specifier, and end-user of air movement and control equipment assurance that published ratings are reliable and accurate.

4) The AMCA certified ratings program assures buyers and specifiers that competitors’ ratings are based on standard test methods and procedures, and are subject to review by AMCA International as an impartial authority.

5) All AMCA certified products are listed online, so you can verify that the product you are buying is listed. Before you buy, check out the AMCA online Directory of Certified Products at www.amca.org.
C). Fans Testing and Standards

1) Air Performance Testing includes:
   - Development of the fan curves.
   - Measurement of airflow, pressure, power and efficiency.
   - Test standards that apply to air performance testing include:
     - AMCA 210-07, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
     - AMCA 220-05, Test Methods for Air Curtain Units.
     - AMCA 230-07, Laboratory Methods of Testing Air Circulator Fans for Rating.
     - AMCA 240-06, Laboratory Method of Testing Positive Pressure Ventilators for Rating.

2) Sound Testing includes:
   - Inlet sound power.
   - Outlet sound power.
   - Total sound power.
   - Test standards that apply to air performance testing include:
     - AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.

3) Energy Efficiency Testing includes:
   - The fans shall be classified for their fan efficiency by using the Fan Efficiency Grade (FEG).
   - Test standards that apply to air performance testing include:
     - AMCA 205-10, Energy Efficiency Classification for Fans.

D). Yilida与AMCA国际的关系

1) Yilida是AMCA国际的会员单位。
2) Yilida已有国内独家AMCA标准实验室——按AMCA标准建设的全性能实验室。
3) 大部分的产品都通过AMCA认证的评测程序（CRP）的测试，检验的样本都获得AMCA国际的工作人员批准，这些产品及其样本已被批准使用AMCA国际的认证等级标志。

4) Yilida获得的认证等级标志包括：风机的空气性能，风机的声音，风机效率等级（FEG）。

注意：
1) 有些生产厂商的印刷品中有下列类似断句“按照AMCA标准进行测试”，但请注意这与“产品被批准使用AMCA国际的认证等级标志”有本质区别，印有类似断句的印刷品仅表明该产品采用AMCA公司的标准进行测试，但其测试的数据不会被AMCA承认。
2) 另一个容易引起误解的地方是AMCA取得的认证等级标志与AMCA会员证书之间的差异，有些生产厂商会将AMCA会员证书贴在产品包装上，这容易让人误解为该产品已通过AMCA的测试及认证。红色的AMCA会员证书仅代表其为AMCA国际的会员，只有蓝黄色和绿色的认证等级标志，才表明该产品是通过AMCA认证的评测程序（CRP）的测试，并被批准使用AMCA国际的认证等级标志，如图1所示。

1) Yilida is a member of AMCA International, Inc.
2) Yilida has built the first AMCA Standard Laboratory in China. The laboratory was built in accordance to the AMCA Standard.
3) Most of the products are tested and certified by AMCA Certified Rating Program (CRP), and their catalog ratings are approved by AMCA International's staff. All these products and their catalogs are approved to use the AMCA International Certified Ratings Seal.
4) The Certified Rating Seals include: Air Performance, Sound and Fan Efficiency Grade (FEG).

Note:
1) Some manufacturers have printed the following statement, "tested in accordance with AMCA standards" in their catalogs. Please note that there are essentially different from the statement of "the products are approved to use the AMCA International Certified Ratings Seal". These manufactures statements mean that their products are tested in accordance with AMCA Standards, but the tested data are not recognized and approved by the AMCA International.
2) Another statement that can easily lead to misunderstanding is the difference between the "AMCA International Certified Ratings Seal" and the "AMCA Membership Certificate". Some manufacturers have printed the "AMCA Membership Certificate" in their catalogs. This is misleading to let people believe that their products have tested and certified by AMCA.

Yilida committed that all fans and its catalogs affixed with the AMCA International Certified Ratings Seal. The fans are tested and certified by AMCA Certified Rating Program (CRP) and are approved to use the AMCA International Certified Rating Seal.
### 风机定律

### Fan Laws

该样本中风机性能均用在标准状态下的性能，即风机的气体状态为：

<table>
<thead>
<tr>
<th>空气压力</th>
<th>Air pressure</th>
<th>P = 101.325 kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>空气温度</td>
<td>Air temperature</td>
<td>t = 20 °C</td>
</tr>
<tr>
<td>空气密度</td>
<td>Air density</td>
<td>ρ = 1.2 kg/m³</td>
</tr>
</tbody>
</table>

风机定律方程式；

\[
\frac{Q_2}{Q_1} = \left(\frac{n_2}{n_1}\right)^\frac{1}{2} \frac{P_2}{P_1} = \left(\frac{n_2}{n_1}\right)^\frac{1}{2} \frac{P_2}{P_1} = \left(\frac{n_2}{n_1}\right)^\frac{1}{2} \frac{P_2}{P_1}
\]

应用一：风机转速的变化。  
a) 当风机尺寸、管网系统及空气密度都不变时，可得；

\[
\frac{Q_2}{Q_1} = \frac{n_2}{n_1} \quad \frac{P_2}{P_1} = \left(\frac{n_2}{n_1}\right)^\frac{1}{2} \frac{P_2}{P_1}
\]

\[\text{注意}：这个定理常用于解决现场风量大或者风量不足的情况。\]

例 1：一工程项目需要一台后向离心风机来送风。风量为 25000 m³/h，压力为 730 Pa，经选定，可得风机型号为 SYQ630R，转速为 1220 r/min，轴功率为 7.47 kW（电机功率为 11 kW），现场要求风量大于原设计风量，要求风量增加到 30000 m³/h。

求风机新的轴功率。

The maximum fan speed of SYQ630R is 1700 r/min, so it is not a problem for the fan speed to run 1464 r/min. Now, the shaft power is increased to 12.91 kW, so the original 11 kW motor cannot be used, the motor needs to be changed.

### E.g. 2: 在同一的案例下，客户要求增加风量，但不想在投资去更换电机。求此 11 kW 电机的条件下，允许增加多少转速？在这么新的转速下，风量和压力是多少？

解：11 kW 的电机功率减去 10% 的安全系数得出轴功率为 9.9 kW，

\[
\frac{P_2}{P_1} = \left(\frac{n_2}{n_1}\right)^\frac{1}{2} \frac{P_2}{P_1} = \left(\frac{9.9}{7.47}\right)^\frac{1}{2} \times 1220 \approx 1340 r/min
\]

\[\text{将此转速代入：} \quad \frac{Q}{q_1} = \frac{1340}{1220} \times 25000 = 27460 m³/h
\]

If the motor is not replaced, then the airflow can only be increased from 25000 m³/h to 27460 m³/h.

### 应用二：气体密度的变化。  

a) 当风机尺寸、管网系统及风速都不变时，可得；

\[
\frac{p_2}{p_1} = \frac{P_2}{P_1} = \left(\frac{n_2}{n_1}\right)^\frac{1}{2} \frac{P_2}{P_1}
\]

b) 当风机尺寸、管网系统及压力都不变时，可得；

\[
\frac{q_2}{q_1} = \frac{P_2}{P_1} = \left(\frac{n_2}{n_1}\right)^\frac{1}{2} \frac{P_2}{P_1}
\]

### E.g. 2: In the same case, the client requests for additional airflow, but do not want to invest to replace the motor. Under the same 11 kW motor conditions, what is the new fan speed? And in this new speed, what is the airflow and static pressure?

The safety factor is 10%, the shaft power will be 9.9 kW.

### Note: When the customer site needs to increase the airflow, please pay attention:

(1): If the new fan speed cannot exceed the maximum fan speed.  
(2): If the original motor cannot meet requirement of the new shaft power, then the motor needs to be replaced.
Fan Basics and Applications

Fan Basics and Applications

Example 3: A factory needs a fan to draw high temperature air from an oven which is delivering 20,000 m³/h of 120°C air against 450 Pa static pressure. Find the shaft power required for the fan.

- The air density at 120°C: 0.9 kg/m³
- The standard air density: 1.2 kg/m³

\[ q_1 = q_2 = \frac{20000 \text{ m}^3/\text{h}}{120°C} \]

Using the airflow 20,000 m³/h and the static pressure 600 Pa, under the standard air condition, the fan selected is SYQS 900E, the fan speed is 770 r/min, the shaft power is 4.93 kW (motor is 5.5 kW).

Application 3: Change in Fan Size.

(a) When the fan speed and the air density remain unchanged:

\[ p_1 = \left( \frac{D_2}{D_1} \right)^3 \]
\[ p_1 = \left( \frac{D_1}{D_2} \right)^3 \]
\[ P_1 = \left( \frac{D_1}{D_2} \right)^2 \]
\[ p_1 = \left( \frac{D_1}{D_2} \right)^2 \]
\[ \eta_{fr} = \frac{q_2}{q_1} \]

(b) When the tip-speed of fan and the air density remain unchanged:

\[ \eta_{fr} = \frac{q_1}{q_1} \]
\[ \eta_{fr} = \frac{q_2}{q_1} \]

Since each type and size of fan has different characteristics, fan selection must be made carefully.

E.g. 4: A fan manufacturer wishes to project data obtained for a 355 mm fan to a 710 mm fan. At one operating point, the airflow is 8000 m³/h and the static pressure is 300 Pa, the fan speed of the 400 mm fan is 784 r/min, the shaft power is 1.33 kW and its tip-speed is 14.57 m/s.

What will the projected airflow, static pressure, shaft power and tip-speed be for a 710 mm fan at the same fan speed (784 r/min)?

\[ q_1 = 8000 \text{ m}^3/\text{h} \]
\[ p_1 = \frac{710}{355} \]
\[ P_1 = \frac{710}{355} \times 300 = 1200 \text{ kW} \]

\[ u_1 = 14.57 \text{ m/s} \]
\[ u_2 = 14.57 \times 1.33 = 19.2 \text{ m/s} \]

┤ 注：这个定理一般为风扇设计人员所用，很少用于现场。

■ Note: This application is mostly used by the fan designers, it is rarely used at site.

Example 4: A factory manufacturer wishes to project data obtained for a 355 mm fan to a 710 mm fan. At one operating point, the airflow is 8000 m³/h and the static pressure is 300 Pa, the fan speed of the 400 mm fan is 784 r/min, the shaft power is 1.33 kW and its tip-speed is 14.57 m/s.

What will the projected airflow, static pressure, shaft power and tip-speed be for a 710 mm fan at the same fan speed (784 r/min)?
### System Resistance Curve

1) **System resistance is the total sum of all pressure losses through filters, coils, dampers, and ductwork.** The system resistance curve (Fig.3) is simply a plot of the pressure that is required to move the air through the system.

![Fig.3 System Resistance Curve](image)

![Fig.4 Operating Point](image)

![Fig.5 Change In System Resistance Curve——Air Volume Reduced](image)

2) **The pressure equation of a airflow system is:**

\[
P = k(qV)^2
\]

where:
- \(P\) is the static pressure
- \(qV\) is the volume flow rate
- \(k\) is a constant

3) For example, consider a system handling 1000 m³/h with a total resistance of 100 Pa SP. If the \(qV\) is doubled, the SP resistance will increase to 400 Pa, as shown by the squared value of the ratio given in Fig.3.

4) This curve changes, however, as filters load with dirt, coils start condensing moisture, or when outlet dampers change in position.

5) **Operating point:** The operating point (Fig 4) at which the fan and system perform is determined by the intersection of the system resistance curve and fan performance curve. Note that every fan operates only along its performance curve. If the system resistance designed is not the same as the resistance in the system installed, the operating point will change and the static pressure and volume delivered will not be as calculated.

6) If the actual system has more pressure loss than predicted in the design, such, air volume is reduced and static pressure is increased. (Fig.5) The shape of the kW curve typically would result in a reduction in BKW.

7) In many cases where there is a difference between actual and calculated fan output, it is due to change in system resistance rather than any shortcomings of the fan or motor. Frequently the mistake is made when taking the static pressure reading across the fan and concluding that if the static pressure is at or above design requirements the volume is also at or above design requirements. Fig 5 shows why this assumption is completely invalid.
风机的振动和平衡

普通的风机在运转时会引发振动，这种振动会使轴承、轴套等产生过大的负荷，大大降低它们的使用寿命。振动又会在支座及支承中造成非常不利的交变应力，并最终将其完全破坏，而且该机的性能也会由于功率被支撑结构吸收而降低。此外，振动还可以通过地板传递到邻近的机器，严重地影响其精度和正常的功能。

引起风机振动的原因有很多种，常见的情况如下：
(a) 转子（如风机叶轮、轴或皮带轮等）不平衡
(b) 联轴器不对中
(c) 基础、支座、支架等刚度不够
(d) 风机进口处及出口处的气流不均匀
(e) 轴承的紧固度不够等
其中，引起风机振动最大的原因是转子的动不平衡造成的。

风机的振动

Unbalanced fan can cause vibration during operation. This vibration in turn may cause excessive wear in shafts, bearings, bushings, etc., and greatly reduce their service lives. The vibration will then cause a very negative alternating stress in structural supports and frames which may eventually lead to their complete destroy. And the fan's performance will decrease due to the power absorbed by the supporting structure. In addition, the vibration can also be transmitted through the floor to the nearby machines, which can seriously affect their accuracy and proper function.

The main cause of the fan vibration is the unbalanced rotor.

风机的平衡

The effects of the fan trim balancing are:
(a) To improve the fan performance
(b) To reduce the vibration
(c) To reduce the noise
(d) To improve the lifetime of the bearings
(e) To reduce the fatigue and the disturbance of the operators
(f) To reduce the energy losses

转子的平衡精度等级

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Table 1 - Guidance for balance quality grades for rotors in a constant (rigid) state

<table>
<thead>
<tr>
<th>转子类型举例</th>
<th>平衡精度等级</th>
<th>噪幅 Magnitude G ( \text{per} \ mm/s )</th>
</tr>
</thead>
<tbody>
<tr>
<td>汽车车轮、轴类、车用整体</td>
<td>G 630</td>
<td>630</td>
</tr>
<tr>
<td>汽车、货车和机车用的联合发动机的曲轴驱动装置</td>
<td>G 250</td>
<td>250</td>
</tr>
<tr>
<td>汽车、货车和机车用的联合发动机的曲轴驱动装置</td>
<td>G 100</td>
<td>100</td>
</tr>
<tr>
<td>汽车发动机的曲轴驱动装置</td>
<td>G 40</td>
<td>40</td>
</tr>
<tr>
<td>海轮（蒸汽）主推进器的齿轮箱</td>
<td>G 16</td>
<td>16</td>
</tr>
<tr>
<td>海轮（蒸汽）主推进器的齿轮箱</td>
<td>G 6.3</td>
<td>6.3</td>
</tr>
</tbody>
</table>

考虑到技术的先进性和经济上的合理性，国际标准化组织（ISO）于1940年制定了世界公认的ISO 1940平衡精度等级。它将转子平衡精度等级分为11个级别，每个等级之间以2.5倍为增益，平衡机从要求最高的G0.4到要求最低的G6000，每个等级的单位为mm/s。
Fan Vibration and Balancing

The Purpose of Balancing Machine

A balancing machine is necessary to detect, measure and determine the location of unbalance. The data measured by the balancing machine can be used to change the mass distribution of a rotor. When measuring is done accurately, it can balance the rotor.

Permissible Residual Unbalance

Since it is not possible to have 100% balancing, so there must be some unbalance in tolerance.

A wheel with radius R (mm) and weight M (kg), has a little overweight m (g) at a point. When the wheel is rotating, a centrifugal force F acts upon m and is transmitted to the rotating center. As the result, the axis is displaced from its original position and rotate around its original position to form a small circle. This displacement is called the eccentricity. See below

Fan Vibration and Balancing

平衡机的作用

由于任何转子不可能做到 100% 的平衡，因此剩余不平衡量总是存在的。

一个圆轮的半径为 R (mm)，重量为 M (kg)，在圆轮上有一重物 m (g)，当圆轮旋转时，有一离心力 F 作用在 m 上，并且传递到圆轮的轴上，轴中心由原来的静止位置产生位移，并围绕其原来位置形成一个很小的圈，这个位移称为偏心率。见下图

From the table, ISO suggested that the balance quality grade for the fans is G6.3. However, in order to have a better performance and a longer lifetime of the fans, YILIDA has balanced all the fans to a higher grade G2.5.

允许的剩余不平衡量

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亿利达风机的平衡

亿利达为了保证风机的运行更稳定，性能更好，寿命更长久，所以，每一个风机都经过三重的平衡，每一次的平衡都达到 ISO 平衡质量等级的 G2.5。

亿利达风机的三重平衡如下：

1. 本无余不平衡
   - This eccentricity \( e_{\text{per}} \) expresses its relationship with the wheel of weight M (kg), radius R (mm) and over weight point m (g) by the formula below:
   \[
   e_{\text{per}} = \frac{m \times R}{M} \quad \text{(g.mm/kg) or (\mu m)}
   \]
   \( e_{\text{per}} \) is also called the residual unbalance.

2. 国际标准化组织 (ISO) 以下公式：
   - The International Organization for Standardization (ISO) uses the following formula:
   \[
   e_{\text{per}} = \frac{1000 \times G \times (\text{mm/s})}{60 \times 1000G \times \omega} \quad \text{(g.mm/kg) or (\mu m)}
   \]

3. 来表最大剩余不平衡 \( e_{\text{max}} \) (g.mm/kg) 与平衡质量等级 G (mm/s) 及转速 n (r/min) 之间的关系（见表 2）。

例 1：SYT10-10L（DK）风机的叶轮，最高转速为 1800 r/min，因要求平衡质量等级为 G2.5，求它的允许剩余不平衡量和校正平面上剩余不平衡量。

(1) 求允许剩余不平衡量：
   - SYT10-10L 叶轮质量为 3.23kg，平衡轴质量为 4.446kg，合计为 7.677kg。
   - \( e_{\text{per}} = \frac{9550 \times G \times 9550 + 2.5}{1800} \) = 13.26 \( \mu \)m
   - The mass of SYT10-10L fan Wheel is 3.23kg; the mass of balance shaft is 4.446kg. Add up to 7.677kg.

(2) 求校正平面上剩余不平衡量：
   - SYT10-10L 现为双进风离心风机，需要校正左右两个平面的半径。
   - \( m = \frac{\bar{U}}{2\pi} = \frac{13.26 \times 7.677 \times 101.8}{2 \times 141} \) = 0.361 g = 361 mg

ISO 1940-1:2003(E)

NOTE The white area is the generally used area, based on common experience.
The sound is a travelling oscillation. The sound that the human can hear is within the frequency range from 20 Hz to 20,000 Hz. Sound source can be from the vibration of the solid or fluid (liquid and gas).

1) Sound Power Level

The sound power is the sound energy radiated constantly from a sound source. Sound power is expressed in watts (W). Sound power converted to the decibel scale is called sound power level (L<sub>W</sub>)

\[ L_W = 10 \log \frac{W}{W_0} \]

where
- \( L_W \) — sound power level, dB
- \( W \) — sound power, W
- \( W_0 \) — reference sound power, 1 x 10<sup>-12</sup> W

This value is the minimum sound level at 1,000 Hz that the human ear can hear.

2) Sound Intensity Level and Sound Pressure Level

The sound power from the sound source cannot be directly measured. The sound power is calculated from the sound pressure ... that measured from the sound source. Similarly, sound pressure level and sound intensity level are expressed as below:

\[ L_I = 10 \log \frac{I}{I_0} \]

\[ L_p = 20 \log \frac{p}{p_0} \]

where
- \( L_I \) — sound intensity level, dB
- \( I \) — sound intensity, W/m<sup>2</sup>
- \( I_0 \) — reference sound intensity, 1 x 10<sup>-12</sup> W/m<sup>2</sup>
- \( L_p \) — sound pressure level, dB
- \( p \) — sound pressure, Pa
- \( p_0 \) — reference sound pressure, 2 x 10<sup>-5</sup> Pa

This value is the minimum sound intensity that the human ear can feel, and is the human hearing threshold. The maximum sound intensity that the human ear can tolerate is \( L_I = 120 \) dB, known as the pain threshold.

3) Octave Bands and Sound Spectrum Characteristics

For the convenient measuring, this frequency range is divided into several small octave bands. The most commonly used in sound measurement is the octave bands and 1/3 octave bands. Spectrum is the graphs that the sound pressure level or the sound power level changes in three categories:

a) The maximum sound pressure level of the center frequency of the band below 500 Hz is called low-frequency noise.

b) The maximum sound pressure level of the center frequency of the band between 500 Hz and 1,000 Hz is called medium frequency noise.

c) The maximum sound pressure level of the center frequency of the band greater than 1,000 Hz is called high frequency noise.
二、声学测试方法

Sound Testing Method

声压级和声强级都可以通过声强级进行测量，声强级是常用的
测量方法，声压级的测量可以参考。

除了以上三种噪声的测量方法外，还有解析噪声的测量方法。
解析噪声的测量方法主要包括频谱分析和相位分析。其中，频
谱分析是指将声压信号分解成不同频率成分的方法，而相位分
析是指对信号的相位进行分析的方法。解析噪声的测量方法
可以提供关于噪声成分的详细信息，对于噪声控制和降低噪
声水平具有重要意义。除了以上三种方法外，还有其他一些
defined noise measurement methods, such as high-order harmonic analy
sis and intrinsic noise analysis. These methods can provide more det
ail information about noise components and are useful for noise con
trol and reduction.
The Basics of Sound

The Causes of the Noise Generated

There are three causes of the fan noise generated: aerodynamic, mechanical vibration, and the interaction between the aerodynamic and the vibration.

1) The noise generated by aerodynamic
(a) The impact noise
When the wheel is rotating at a high speed and the blade is moving periodically, the air particle is affected by the periodic force, which generates the sound at the speed sound to generate noise.
(b) Turbulence Noise
When the wheel is rotating at a high speed, there may have a swirl occurred at the inlet of the fan, then a noise is generated due to turbulence.

2) The noise from the mechanical vibration
When the unbalance wheel, the damaged bearing and others will cause vibration. The vibration will generate noise. If the blade is not rigid enough, it will vibrate when rotating that will also generate noise.

3) The noise generated from the interaction between the aerodynamic and the vibration
Vibration caused by the rotating blades and transmitted through the duct, then occur impact and swirl in the bending of the duct that increase the vibration and increase the noise. Especially when the air pressure wave frequency is same as the vibration frequency of the duct that cause a strong resonance, then the noise suddenly increases. It can result in serious damage to the fan.

The Control of the Noise of the Fans

1) Well-designed Fans
When design the fans, in order to prevent or reduce the generation of the source sound, should minimize the impact of the airflow, the size plate and the scroll must be smooth without uneven prominent, and avoid the sharp turn of the air flow. The fan speed must be selected correctly, and the gap between the cutout and the wheel must be controlled, as the smaller the gap, the greater the noise.

2) Silencer
Silencer can generally absorb the sound source and the noise generated from the inlet and outlet of the fans. Different types of fans will use different kinds of silencers.

The Principle of Fan Selection

First, we must determine the airflow and the pressure in the system. As the fan performance data in the catalog are usually given in the standard conditions, all the data of the operating point in the system must be converted to the standard atmospheric conditions before selection.

The standard atmospheric conditions are referred to altitude 0 m, temperature 20 °C, atmospheric pressure 101.325 kPa, and air density 1.2 kg/m³.

The Effects of Temperature and Altitude

Some fans are used in a high altitude and different temperature conditions, where the air density will vary accordingly. The effects of the temperature and the altitude must be considered, when doing selection.

1) The effect of the altitude to the atmospheric pressure can be expressed as the following formula:

\[ p_1 = p_0 \times (0.885)^{Z/1000} \]

Note: \( p_0 \) —— actual atmospheric pressure, \( p_1 \) —— standard atmospheric pressure, \( Z \) —— altitude.

2) The effects of the temperature and the atmospheric pressure to air density can be expressed as the following formula:

\[ e = \frac{p_1 - 273 \times t_1}{273 + t_1} \]

where:
\( p_1 \) —— air density in the standard atmospheric condition, \( p_0 \) —— standard atmospheric pressure, \( Z \) —— temperature in the standard atmospheric condition, \( t_1 \) —— actual temperature, \( p_0 \times (0.885)^{Z/1000} \) —— actual atmospheric pressure, air density and temperature.

From the above, the following table can be calculated.
The Effects of Temperature and Altitude The Effects of Temperature and Altitude

From the above data, the fan selected is SYQ 900 E, fan speed is 933 r/min, brake horsepower is 8.124 kW and the motor power is 11 kW. After some times, the fan is moved to a location at altitude 3200 m and temperature 60 °C, then find that the static pressure is not enough, so the solution is to replace the motor and the drive package with a larger motor.

From the above data, the fan selected is SYQS 450K, fan speed is 735 r/min, brake horsepower is 11.35 kW and the motor power is 15 kW. So, to solve the problem, the motor and the drive package must be changed to satisfy the requirement.
Roof Fan

屋顶风机

浙江亿利达风机股份有限公司特此声明，此处所示WPH系列屋顶风机获得了美国AMCA印章的授权。所示额定值按照AMCA出版物211和AMCA出版物311所示进行测试和程序确定，并符合AMCA认证的分目标计划的要求。这里描述的所有屋顶风机都已经取得了AMCA印章，其认证数据见第031页到043页。

Zhejiang Yilida Ventilator Co., Ltd. certifies that the WPH Roof fans shown herein are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.

All the Roof Fans described herein are licensed to bear the AMCA Seal, and their certified ratings are shown on pages 031 through 043.

The WPH Series fans mainly consist of the housing, impeller, motor, safety net, eliminator and gravity shutter, since the vertical blinds and other accessories.

1. Housing

屋顶风机机壳采用航空级高强度铝合金拉伸或折叠而成，有效降低自重，进口和出口整体拉伸成型，使得整体结构紧凑，外形美观，气动性能均匀，而且完全避免了风机底板的浮力问题。

WPH Series fans mainly consist of the housing, impeller, motor, safety net, eliminator and gravity shutter, since the vertical blinds and other accessories.

1. Housing

Roof fan housing uses high-strength aircraft grade aluminum alloy made of stretching or bending, reduce weight. inlet and the baseplate are made of stretching forming, for compact structure, beautiful shape, smooth airflow, and completely avoiding the problem of water creep.

Roof Fan

屋顶风机

屋顶风机按所配风机形式分为离心式和轴流式两大类：离心式屋顶风机是本公司在国内率先采用开发的无轴承风机的高效风机，配合航空级高强度铝合金材质机壳设计而成，产品结构紧凑，外形美观，气体流动均匀，风机可以安装在各种建筑，可根据形成方形法兰或法兰安装，是厂房屋顶排风的首选产品。

The Roof fan is divided into two types: centrifugal type and axial type: centrifugal roof fan is using the plug fan impeller with high-strength aircraft-grade aluminum alloy casing. Compact structure, beautiful shape, the air flow smooth; fans can be installed in a variety of roofs, which can be accessed round or square flange or flashing installation. These fans are ideal for factory roof discharge.

WPH SERIES

WPH 系列风机产品说明

The WPH Series Roof Fan

WPH SERIES

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WPH 系列风机产品说明

The WPH Series Roof Fan
产品结构

2. 后向斜流叶轮

后向斜流叶轮，采用无叶扩压技术，有效提高风机效率。叶
轮材质采用特殊材质，方式，叶轮和电机采用无间隙配合，最
大限度的减少了由于叶轮轴向和电机轴向造成的装配误差，
避免了平衡的破坏，提升了平衡等级。

3. 电机

WPH系列风机标准电机的绝缘等级为F级，防护等级为IP54
连续运转的温度范围为-20 °C ~ 40 °C，其它的运行条件见
要求。

4. 防鸟网和挡鸟板

WPH系列风机采用优质不锈钢铁丝网，C型挡水铝板挡鸟耐
腐蚀，安装可靠。

5. 叶轮叶片

优质铝合金材质的叶片在水中，尺寸可根据水深大小定，有
效的防止气蚀现象。

很多屋顶送风机未设置地机后防止空气倒灌的装置，或是屋顶风
机进气口开启的靠条，对于压低较大的间歇其事故不可
低估，大家经常可以看到无风压装置的屋顶风机和地送风机，在
直压作用下风压快速逆转，这一现象降低热造成的效果相当
大，风筒内的风速可达2.0 ~ 3.0m/s以上，风机翻转对电动机
启动很不利，可能因启动电流过大而损坏。

注：样本中第31页到40页的产品性能曲线内容包含自重百叶。

Product Features

2. Impeller

Backward-curved aluminum alloy impeller with vanless diffusion

technology, effectively improve the efficiency of the fan.

Impeller hub uses the way of locking sleeve, to make the impeller

fitted with the motor gasless, so it can endcap reducing the

assembly error caused by impeller hub fitting with motor shaft, to

avoid the destruction of the balance, improve the balance level.

3. Motor

WPH series equip standard motor, its insulation class is F,

ingress protection IP54, continuous operation temperature

ranges from -20 °C to 40 °C, the other operation condition see

the requirement.

4. Safety Net and Eliminator

WPH Series fans use high-grade stainless steel wire, C-type

eliminators using antris corrosion-resistant aluminum, safe and

developable.

5. Gravity Shutter

High-grade aluminum alloy shutters mounted on the flashing, the

size can be determined according to the size of the flashing. It
can effectively prevent air reflux.

Many roof fans do not set off the device to prevent backflow, or

after shutdown, the voltage can not be reliably shut down. It is a
thermoefficiency to be reckoned with. We often see the roof fans
run at high speed without backstep device, it turns out that thermal
pressure can cause a further speed at 2.0 ~ 3.0 m/s or more. It
perhaps causes damage for motor because of excessive starting

Note: The product performance curves on pages 31 to 40

of the sample do not contain gravity shutter.

性能性能

1. 风机性能的选型计算

包括屋顶风机时应按下的主要因素：
a. 风机型号的选择应根据建筑实际情况，尽量选取与屋顶口
尺寸相匹配的风机型号，使风量的选取更经济有效。如果风量
小于机组的供风能力时，应根据风量的选取，配置相应的
供风系统。
b. 风机选型要遵循风量、风压、风速、启动性能等。
c. 风机选用风量与风速的配置要合理，所以风量计算也

d. 用于局部供风计算，根据所选用的供风风量计算机

2. 风机选型示意图

型号

WPH710R

风量

Volume

q=11000 m³/h

压力

Static Pressure

P=650 Pa

压差

Dynamic Pressure

P=24 Pa

风速

Fan Speed

n=962 r/min

扬程

Shall Power

P=2.93 KW

AP功率级

A Sound Power Level

Lw=87 dB(A)

电动效率

Static Efficiency

η=80.3%

Performance Chart

1. Calculation of Selection

When you choose the roof fan you have to concern four main

points:
a. Fan model selection should be based on actual plant

conditions. Try to select the fan model to match original window

size, to achieve good ventilation effect. The outlet should not to
dose the buildings nearby, to prevent the impact of nearby

residents, as the air out of the indoor, you can install

spiraleads in the outlet for absorbing polutants.

b. Fan selection essential elements: airflow, airspeed, power,

speed, and so on.

c. Fan flow is the result that the velocity c multiply the duct

cross-sectional area. So the airflow calculation is very simple,
directly use of the formula 4-rot

Among: N—The number of the fans

V=Field area(m²)

q—Ventilation rate

2. Example Of Curve Reading

WPH710
1) When placing the order, it is necessary to state the type of fan, speed, air volume, air pressure, discharge direction, rotation direction, type of electric motor and its specifications. Special care should be taken in checking the shaft, wheel and bearings. If there is an indication of any damage, the damaged parts should be repaired or replaced before the fan is installed or commissioned.

2) The inside of the scroll and casing need to be checked to make sure that there are no foreign objects inside the housing, such as tools or loose parts.

3) The rotational directions of the motor and wheel should be checked to ensure that they are in compliance with the specification and purchase orders.

4) A flexible connector should be used between the fan outlet flange and its mating ductwork. The flexible connector should not be over-stretched.

5) Following the installation, the wheel should be turned by hand or with the use of a wrench to make sure that it turns freely without colliding with other parts of the fan. Once all this is done, the fan can be commissioned normally.

6) The rated motor power as calculated herein might not be sufficient to drive the fan with an unrestricted discharge flow. Operating the fan with an unrestricted discharge outlet will result in flow rate that exceeds the specified fan capabilities. Such operation will quickly burn the motor and damage the fan. Great care must be taken in operating the fan to make sure that the maximum rated flows, as provided on the performance charts in this catalog, are not exceeded.

7) The fan is limited for use in areas where air substances are non-corrosive, non-toxic and non-abrasive and where dust particles are less than 150mg/m³. Special care should be taken during transportation, load and unload.

8) When placing an order, the type of fan, speed, air volume, air pressure, discharge direction, rotation direction, type of electric motor and its specifications should be stated.

9) Special circumstances, please contact with our technical staff.
### Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheel diameter D</td>
<td>406 mm</td>
</tr>
<tr>
<td>Fan weight</td>
<td>m = 19 kg</td>
</tr>
<tr>
<td>Moment of inertia J</td>
<td>0.162 kg.m²</td>
</tr>
<tr>
<td>Speed limit n</td>
<td>max 1780 r/min</td>
</tr>
</tbody>
</table>

### Performance Curves

Performance certified is for installation type A: inlet free, outlet free.

Values shown are for inlet L in, free outlet.
**Technical Data**

**WPH500 FEG71**

- Wheel diameter: D = 508 mm
- Fan weight: m = 23 kg
- Moment of inertia: J = 0.45 kg·m²
- Speed limit: n_max = 1595 r/min

**Performance Curves**

Performance certified is for installation type A; free inlet, free outlet. Performance ratings do not include the effects of appurtenances. The A-weighted sound power levels for installation type A; free inlet, free outlet.

**WPH560 FEG71**

- Wheel diameter: D = 570 mm
- Fan weight: m = 28 kg
- Moment of inertia: J = 0.74 kg·m²
- Speed limit: n_max = 1545 r/min

**Performance Curves**

Performance certified is for installation type A; free inlet, free outlet. Performance ratings do not include the effects of appurtenances. The A-weighted sound power levels for installation type A; free inlet, free outlet.
**Technical Data**

**Wheel diameter**  
D = 642 mm

**Fan weight**  
m = 36 kg

**Moment of inertia**  
J = 1.2 kg·m²

**Speed limit**  
n_{max} = 1545 r/min

---

**Technical Data**

**Wheel diameter**  
D = 720 mm

**Fan weight**  
m = 43 kg

**Moment of inertia**  
J = 2.43 kg·m²

**Speed limit**  
n_{max} = 1545 r/min

---

**Performance Curves**

Values shown are for inlet, free outlet.

---

**Performance Curves**

Values shown are for inlet, free outlet.
### Technical Data

**WPH800 FEG67**

- **Wheel diameter** $D = 813$ mm
- **Moment of inertia** $J = 4.88$ kg.m$^2$
- **Fan weight** $m = 53$ kg
- **Speed limit** $n_{max} = 1078$ r/min

**Performance Curves**

Performance certified for installation type A: free inlet, free outlet. Performance ratings do not include the effects of appurtenances (accessories). The A-weighted sound power levels for installation type A: free inlet, free outlet.

Measured in installation A according to AMCA Standard 230:

- **Gas Density** $1.2$ kg/m$^3$
- **State Efficiency** [0-100]%
- **Static Pressure** [0-2000] Pa
- **Volume Flow Rate** [0-10000] m$^3$/min

### Technical Data

**WPH900 FEG67**

- **Wheel diameter** $D = 914$ mm
- **Moment of inertia** $J = 7.32$ kg.m$^2$
- **Fan weight** $m = 68$ kg
- **Speed limit** $n_{max} = 1078$ r/min

**Performance Curves**

Performance certified for installation type A: free inlet, free outlet. Performance ratings do not include the effects of appurtenances (accessories). The A-weighted sound power levels for installation type A: free inlet, free outlet.

Measured in installation A according to AMCA Standard 230:

- **Gas Density** $1.2$ kg/m$^3$
- **State Efficiency** [0-100]%
- **Static Pressure** [0-2000] Pa
- **Volume Flow Rate** [0-10000] m$^3$/min

---

**The WPH Series Roof Fan The WPH Series Roof Fan**
Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheel diameter D</td>
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<tr>
<td>Fan weight m</td>
<td>73 kg</td>
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<tr>
<td>Moment of inertia J</td>
<td>11.94 kg·m²</td>
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<td>Speed limit n</td>
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</table>

Performance Curves

Measured in installation A according to AMCA Standard 210.

<table>
<thead>
<tr>
<th>Model</th>
<th>A</th>
<th>B</th>
<th>W</th>
<th>D</th>
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<tbody>
<tr>
<td>WPH 355</td>
<td>361</td>
<td>237</td>
<td>102</td>
<td>231</td>
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<tr>
<td>WPH 400</td>
<td>406</td>
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<td>WPH 500</td>
<td>508</td>
<td>332</td>
<td>143</td>
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</tr>
<tr>
<td>WPH 560</td>
<td>570</td>
<td>373</td>
<td>161</td>
<td>364</td>
</tr>
<tr>
<td>WPH 630</td>
<td>642</td>
<td>420</td>
<td>181</td>
<td>410</td>
</tr>
<tr>
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<td>720</td>
<td>474</td>
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<td>813</td>
<td>525</td>
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<td>585</td>
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<tr>
<td>WPH 1000</td>
<td>1015</td>
<td>687</td>
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### WPH Series Fan Overall Dimension

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<th>Model</th>
<th>C</th>
<th>I</th>
<th>M</th>
<th>N</th>
<th>V</th>
<th>D1</th>
<th>D2</th>
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<td>723</td>
<td>960</td>
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</table>

Unit: mm

### WPH Installation Measurement Chart

<table>
<thead>
<tr>
<th>Model</th>
<th>L (Length)</th>
<th>W (Width)</th>
<th>H (Height)</th>
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</thead>
<tbody>
<tr>
<td>WPH 355</td>
<td>645</td>
<td>485</td>
<td></td>
</tr>
<tr>
<td>WPH 400</td>
<td>695</td>
<td>535</td>
<td></td>
</tr>
<tr>
<td>WPH 450</td>
<td>695</td>
<td>535</td>
<td></td>
</tr>
<tr>
<td>WPH 500</td>
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