ORION FANS

TECHNICAL TERMS

AIRFLOW/CFM

ECFM (Cubic Feet per Minute) indicates the volume of air that a fan will move in one minute at 0 (zero) STATIC PRESSURE. It is important to note that CFM specifications are stated at zero static pressure because this is the point at which airflow is highest. As static pressure increases airflow decreases. As a general guideline you should provide a vent hole area that is equal to approximately 1.5x the area of the fan venturi to prevent excessively high static pressure. (The venturi is the big hole in the center of the fan.) CFM is sometimes stated as “m3” (cubic meters per minute) or as “liters per second”. Both of these alternate airflow expressions can be translated into CFM by the application of simple equations. When you are trying to figure out how much air your fan needs to move to serve your purpose you can make an educated guess using simple math.

Here is how:

1.) Measure the inside volume of your application.

2.) Multiply the measurements in inches like this:

(Length X Width X Height) = (volume in cubic inches).

Divide that number by 1728.

The result is the volume of your application expressed in cubic feet.

Using the CFM specifications of a particular fan you can estimate how many times the air will be “turned over” in your application in 1 minute.

In a home entertainment center with the standard array of equipment you may need to simply “keep the air moving” (1 or 2 times per minute) and can use a smaller, quieter fan. In a cramped server room you may need to turn the air over 10 or 12 time per minute or more. Every application is a little different and only a thermometer placed in your hotspot will tell you whether you need more or less cooling.

BEARINGS

Ball Bearings are generally considered to be the highest quality bearing option for fans. Under normal operating conditions you can expect 90% of a given group of ball bearing fans to still be operating within specifications after 8 years of continuous use. In addition, ball bearings have the highest temperature ratings (-70C ~ +80C) available. It is a common belief that ball bearing fans are noisier than other bearing alternatives but in our testing we have not found this to be the case and make no noise distinction on our specification sheets between ball bearing vs. other bearing types. Please be aware that some manufacturers utilize a single ball bearing as opposed to the more common Dual Ball Bearing in order to cut costs. Not all are up front about this practice and the fans have a shorter life expectancy. Verify that what you are getting is a Dual Ball Bearing should you choose to purchase your fans elsewhere.

Sleeve bearing fans are a less expensive and less robust alternative to Ball Bearing fans. You can expect 90% of your sleeve bearing fans to be operating within specifications after 3 - 4 years of continuous use. Sleeve-type fans should only be mounted vertically (Air stream parallel to the ground). Mounting them in other orientations can cause the bearing lubricant to leak out and will cause premature failure.

Sealed Sleeve Bearing - Several manufacturers including ORION FANS have added this type to their list of bearing options. Essentially this is a standard Sleeve Bearing with an oil collection cup that catches the lubricant as it exits the bearing and recirculates it back into the fan thereby extending the fan life. It is slightly more expensive than a standard sleeve and slightly less expensive than a ball bearing and has a life expectancy somewhere between the two.

LIFE EXPECTANCY

The life expectancy of a fan is almost entirely dependent upon the bearing system. In the case of a ball bearing fan an engineer can expect a useful life of 60,000 - 70,000 hours (L10) under normal operating conditions (-40 ~ 50C at 75% RH). As a general rule however the life expectancy will normally increase when the temperature of the environment is cooler.

Many manufacturers will quote a 200,000+/- hour life expectancy by referring to MTBF curves rather than the more common L10 curve. Basically the difference between the two types of curves is the calculated failure rate. L10 specifically refers to the amount of time it takes for 10% of a group of fans to fail during testing. Stated another way: at the end of the specified life expectancy, 90% of a given fan population will still be operating within stated specifications.

MTBF (Mean Time Before Failure) as it relates to the fan industry refers to a 50% failure rate. MTBF curves USUALLY extend into the hundreds-of-thousands of hours for ball bearing fans. (Sleeve bearing fans typically have a life expectancy that is one half of what one would expect from an equivalent ball bearing unit.) ORION FANS typically have a MTBF rating of 250,000 - 300,000 hours.

The main problem with MTBF curves in relation to fans is that the calculations were originally designed to project the life expectancy of components that exhibit a RANDOM failure pattern. (In most other components MTBF actually calculates a 63.2% failure rate.) Fans in contrast experience increased frequency of failures as a given fan population ages.

MTBF calculations as provided by most fan manufacturers are actually “L50” calculations. That is to say that at the end of the stated life expectancy at least one half of a given population of fans will have failed.

Life Expectancy Curves are approximations and variations in environment will necessarily affect how long a fan will run. For instance - two identical fans will have vastly different life expectancies if one is run at or near maximum static pressure and the other is run in open air. Each environmental variation will affect lifespan in a positive or negative way.

Also note that the curves assume that a fan will be run 24 hours per day - 7 days per week at a specific temperature. If you instead run a fan for only 8 hours per day you have effectively tripled the life expectancy of your fan in real terms, assuming that you only run the fan at a specific temperature. Also note that “Ball” usually refers to a “Dual ball - double sealed bearing”. Single, ball bearing units will have a life expectancy that is somewhere between Dual Ball and Sleeve.

NOISE

The human ear's response to sound level is roughly logarithmic (based on powers of 10), and the dB scale reflects that fact. An increase of 3dB doubles the sound intensity but a 10dB increase is required before a sound is perceived to be twice as loud.

Therefore a small increase in decibels represents a large increase in intensity. For example - 10dB is 10 times more intense than 1dB, while 20dB is 100 times more intense than 1dB. The sound intensity multiplies by 10 with every 10dB increase. Following is a list of dB readings from various sources to act as a non-scientific point of reference:

130dB - Jack Hammer (at 5ft)
120dB - Rock Concert / Pain threshold
110dB - Riveter or a Heavy Truck at 50ft
90dB - Heavy Traffic (at 5ft)
70dB - Department Store or a Noisy Office
50dB - Light Traffic 30dB - Quiet Auditorium
20dB - Faint Whisper (at 5ft)
10dB - Soundproof room / anechoic chamber

There are a number of factors that can contribute to the relative noisiness of a fan. In terms of raw numbers our fans are tested in free air (zero static pressure) with the noise sensor positioned one meter from the outlet side of the fan. There are several factors that could affect the noise characteristics of your fan and make it seem louder than it is... or needs to be:

1. Inadequate venting can increase the noise produced by a fan. The efficiency of the fan is degraded by having to overcome a pressure differential. It decreases the effectiveness of the impeller, causes noise (dB) to increase and causes Airflow (CFM) to drop. Increasing the vent area to 1.5x the fan venturi (the big hole in the middle) should alleviate the noise if this is the problem.
2. Airflow obstructions can also increase fan noise. If there is an obstacle such as a PC board or light ballast within an inch or two of the fan inlet or outlet and directly in the airstream this can cause a localized increase (between the impeller and the obstruction) in static pressure. The effect is the same as if there was inadequate venting generally and can cause an increase in noise

3. Vibration can cause fan noise to increase. Often this is due to loose mounting screws. Other times it is caused by the fan being mounted on a thin metal, laminate or wooden surface. The fan will vibrate against the surface and the surface can act like a sound board, amplifying otherwise soft noise. This problem can often be solved by adding plastic or rubber grommets between the fan and mounting surface and which are commonly available at most home improvement stores.
4. Rattles, hums, squeals or clicking are usually balance or bearing issues. If your fan is a few years old and has been run more or less continuously the bearings may simply be worn out. If your fan has been running for less than 12 months and you experience any of these problems you should arrange for a replacement from the place where you purchased it (assuming that the unit has not been mishandled in some way). We guarantee our products against defects in materials and workmanship for 1 year from date of purchase.

SPEED

The RPM (Revolutions per Minute) of a fan's impeller blade when operated at or near nominal voltage. This is simply a statement of raw data. Fans from multiple manufacturers cannot be compared effectively against each other using RPM data. 5 equivalent fans from 5 different manufacturers can all have the same CFM but different RPM.

Differences in aerodynamic designs have a profound impact on air performance. Stated another way: Equivalent fans from different manufacturers can have identical RPM ratings but different CFM specifications.

ORION has improved CFM specifications on several fan models simply by changing the impeller designs - in one case by as much as 12% - without changing any other specifications, including RP.

STANDARD WIRE COLORS FOR ORION FANS

AC Fans
Black Wires for Wire Lead Fans

DC Fans
Black – Ground

Red - Vcc (Power Input to fan)

White - TACH Output from fan. Open Collector/Open Drain "A" models must be wired with an external pull-up resistor, typically 10K Ohm. Outputs square Wave @ 50% Duty Cycle. Typical models output two pulses per rotation. Divide the pulse frequency by 2, then multiply by 60 for RPM calculation. Consult the data sheet for individual fan interfacing requirements.

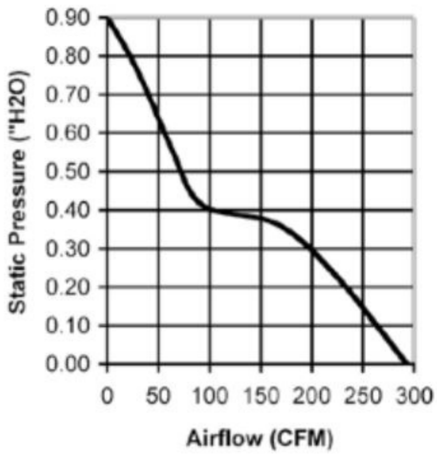
Blue – PWM input to fan. Provide a square wave with variable duty cycle to control the speed. Fan will run at 100% speed if Blue wire is left unconnected or at high state. Fan will run at lowest speed if wire is grounded.

Yellow - Locked Rotor Alarm. Open Collector/Open Drain "A" models must be wired with an external pull-up resistor, typically 10K Ohm. Standard output models fans will hold line Low (0V DC) when operating. If the impeller is stopped this line will go High to either 5V or Vcc, depending on the option type (Open Collector/Open Drain vs TTL). Inverted Alarm outputs are available.

There are occasional variations to this rule but not as a standard

STATIC PRESSURE

Static pressure curve



Static pressure is usually sated either in inches of water (H2O) or in millimeters of water (mmH2O). It is essentially a measure of the differential air pressure between the air pressure inside an application vs ambient air pressure outside of an application, which for airflow calculation purposes is is usually 0 (zero). There is an inverse relationship between airflow and static pressure. As the pressure differential rises, airflow drops.

The vertical axis labeled “Inches of Water” describes relative air pressure. The horizontal axis labeled “Airflow (CFM)” describes Airflow volume in relation to air pressure.

The curve tells the user approximately how much air a fan will move for a given pressure reading. For instance - the curve meets the horizontal line at the bottom of the graph at about 290 (Cubic Feet/Minute). Look left along the bottom horizontal axis and notice that the air pressure (Inches of Water) is zero (No pressure difference at all between the inlet and outlet side of the fan).

Notice that the curve meets the vertical axis at about 0.90 (Inches of Water) and that airflow is 0 (zero).

TESTING

Life Testing

1. Thirty (30) samples are selected at random and tested to verify conformity to design specifications. They are evaluated on appearance, speed, current draw, start-up voltage and noise (dB). Data is then recorded for each fan to establish baseline performance.
2. The samples are then run at rated voltage in a temperature chamber at 55C. Samples are reevaluated and data recorded at 24 hours, 48 hours, 96 hours, 192 hours, 384 hours, 500 hours, 1000 hours, 1500 hours, 2000 hours, 3000 hours, 4000 hours and 5000 hours.
3. Data for each fan is plotted on a graph to verify normal operation. If any abnormality is detected during the testing process the sample fan in question is immediately removed and tested separately. A 30% drop from baseline RPM is defined as failure and the sample fan is removed from further testing.

Mechanical Protection:
ORION / Knight Electronics fans have integrated protection against rotor lock. Fans shall suffer no damage to winding or electrical components after 72 hours in rotor lock condition.

Drop Test:
Fans will withstand a 30cm drop on any face onto a 10mm thick wooden board.

Environmental Operating Temperature:
20 C ~ +70 C at 75% RH (High temperature [90C] and waterproof fans are available.)

Storage Temperature:
Fans will operate normally after 500 hours storage at -40 C ~ +70 C at 75% RH with a 24 hour acclimation time at room temperature.

Humidity:
Fans will operate within specifications after 96 hours in 95% RH at 40 C per MIL-STD202F, method 103B.

Thermal Shock:
Determined per MIL-STD-202F, method 107D.

Measurement Parameters Rated Current:
Current is measured after 30 minutes of continuous operation at rated voltage.

Rated Speed:
Speed is measured after 30 minutes of continuous operation at rated voltage.

Startup Voltage:
Minimum voltage required for fan startup.

Input Power:
Input power is measured after 30 minutes of continuous operation at rated voltage.

Locked Current:
Locked current is measured after 30 minutes of continuous operation and within one minute after rotor is locked.

Ariflow:
Airflow and static pressure is measured in accordance with AMCA standards or DIM 24163 specifications in a double-chamber test with intake-side measurement.

Noise Level:
Noise level is measured in accordance with DIM 45635 standards in an anechoic chamber with the microphone positioned 1 meter from the air intake.

VOLTAGE

Voltage and Voltage Range

Voltage or “Rated Voltage” refers to the nominal voltage at which the units will most closely follow the stated specifications. (e.g. 220VAC.) “Voltage Range” indicates the minimum and maximum voltages at which the fan will operate. (e.g. 160VAC ~ 240VAC for a 220VAC fan.) It should be noted that in most cases if you run a fan at lower than nominal voltage the fan will slow down and if you run at a higher than nominal voltage the fan will speed up.

AC & DC Voltage

Standard AC voltages in North America are 110, 115, 120V (standard household, outlet current) and 220, 230, 240V (standard household, large appliance current) Note that 110, 115 and 120V are considered equivalent for most applications as are 220, 230 and 240V. Power delivered from a public grid varies from place to place. In rural areas you may measure 110VAC from a wall outlet with a volt meter while in a city you may be able to measure AC power at levels as high as 127VAC.

There is no need to be concerned about these minor differences however as most electrical devices operate over a voltage range with varying efficiency levels. Other custom AC voltages are available by (200 piece) special order. The range of custom AC voltages is approximately 12VAC ~ 480VAC.

Standard DC voltages are 5, 12, 24 and 48VDC. Custom DC voltages are available by special order.