

KIOSK ACOUSTIC NOISE

While all customers are asking for greater airflow and less application generated noise, the two simply have to find some reasonable balance to achieve the required cooling effects.

Noise is to a large extent, very subjective, even to the extent that men and women will have distinctly different ideas while listening to the exact same fan. The industry has come to describe the phenomenon as “OBJECTIONABLE NOISE”. There are many ways in which to measure the various degrees of noise and use those for technical applications, many taking into effect the psycho acoustical characteristics and how those affect the noise on humans.

The factors of greatest importance to the kiosk designers are the psychological influences on the person rather than the physical influences on the sound on the human ear, thus the subjective nature of the objectionable noise. In order to fully evaluate the noise generated from the fan within the kiosk, the application needs to be located and evaluated in an environment in which is normal for the application. Noise evaluation in a quiet room, for an application which is normally located in a high traffic area, is not going to provide a true review of the kiosk generated objectionable noise.

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Noise rating systems have four standard methods of determining noise levels. Preferred Speech Interference (PSIL), Weighted Sound Pressure Level (dbA), Noise Power Emission Level (NPEL) and Freely Suspended. The dbA system is typically used by government agencies is determining compliance with OSHA. This rating is determined directly by a sound level meter, having a filtering system to filter out both the high and low frequency portions of the audible spectrum, measured at a distance of 3 feet from the fan.

System disturbances are the biggest causes of fan noise in the kiosk. Fan locations should be designed to create the least amount of objectionable noise. Inlet and outlet disturbances caused by various internal components, or a punched, or laser cut fan guards are considered to cause the greatest amount of objectionable noise.

When placing a fan in a kiosk, care should be taken in locating internal components whenever possible. Often times, this can only be accomplished by trial and error and different locations will have very specific affects upon the internal cooling, as well as the fan generated noise. If components are placed right up on the fan, the system might develop a large pure tone, much like placing your hand very close to a room cooling fan on the intake side.

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Guidelines to follow in order to assist in reducing fan generated noise in kiosks.

1. System impedance should be reduced to the lowest reasonable level so that least noise and highest airflow is obtained. The inlet and outlets of the kiosk can make up between 60-80% of the total system impedance, which is much too high for the desired objectionable noise results. Stamped, laser cut, louvered, wood cutout's all lead to creating poor cooling and higher noise related issues.
2. Obstructions to the airflow must be avoided at both the inlet and outlets. When turbulent air enters the fan, objectionable noise is created, often is can be as high as 10 dbA, which when added to the existing fan noise, can become very considerable.
3. Fan size and speed are considerations. Fans which have a smaller size don't equate to less noise. Many applications can use a standard 120mm 75CFM fan and operate at a much lower dbA rating than an 80mm 30 CFM fan.
4. Ambient temperature requirements drive the airflow volume. If ambient temperatures can be increased slightly, that may offer a designed the ability to choose a lower CFM fan, thus reducing the fan speed and noise levels.
5. Certain kiosk applications, the fan might be isolated to reduce vibration transmissions. Fans operate at a low frequency and are light in weight, so any isolation material must be very soft and flexible. Vibration issues are seldom observed if the proper tightening of the fan to the kiosk is done during assembly.

Establishing Cooling Requirements

One of the most efficient ways to dissipate heat generated by electronic components is forced convection cooling. Axial cooling fans provide forced cooling in an easy to integrate package. Once a decision has been made to use forced (fan) cooling, several design characteristics must be considered prior to fan selection.

Prior to fan selection, the airflow required to dissipate the heat generated must be determined. The density of the air and amount of heat to be dissipated must be known. Noted below is a basic heat transfer equation:

$$q = C_p \times W \times \Delta T$$

q = quantity of heat transferred

C_p = specific heat of air

Delta T = temperature rise within the cabinet

W = mass flow (CFM x Density)

After the airflow has been determined, the amount of resistance can be found. Airflow resistance is referred to as system impedance, or static pressure as a function of flow in CFM. It is possible to specify a fan, once the volume of air and the static pressure of the system to be cooled are known. A key principle in fan selection is that any given fan, can only deliver one flow at one pressure in a given application.

Impact of Fan Guard on Airflow

To test the impact of fan guard resistance on the fan performance, three typical fans were used, all within the 100CFM range. The tests were performed in free air, so the effects of pressurization were not present. Pressurization plays a part, as a fan handling denser air, will have a slightly higher pressure capability.

Wire Fan Guard

The wire fan guard is typically manufactured from 1.6-2.0mm in diameter. Depending upon the size of the guard, there are between 2 and 15 concentric circular rings, with 2-4 mounting legs. The round wire creates the least amount of airflow resistance of all the fan guard styles. Typical wire fan guards create a blockage of between 5-7%, when the center motor hub is taken into consideration. The noted blockage, or static pressure, will see a specific drop in airflow when the wire fan guard is introduced to the application. These results will vary, depending upon the over strength of the motor and its ability to overcome the system impedance.

Airflow (CFM) testing when the wire fan guard is introduced typically produces a drop in airflow of 4-5%, depending upon the specific fan manufacturer. The net effect is that a fan designed to deliver 100CFM, will provide 95-96CFM when a wire fan guard is introduced. The wire fan guard consistently provides the best guard performance data as it relates to airflow and noise.

Sheet Metal Punched Fan Guards

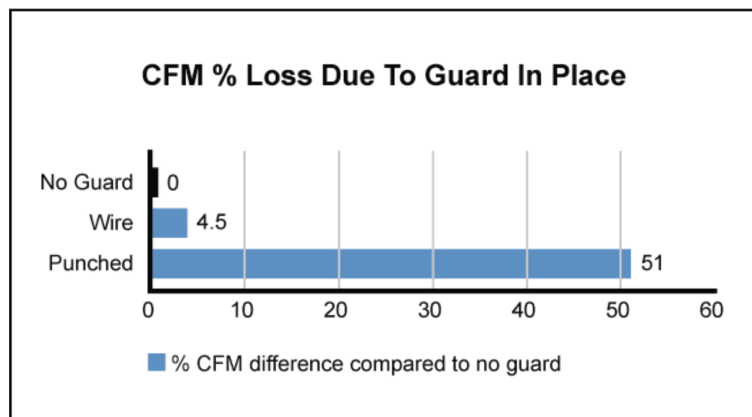
The punched, or laser cut fan guard is created by cutting or punching voids in a solid piece of sheet metal typically between 0.9-1.5mm thick. This design is typically used in an effort to reduce the overall cost of the product. Typical applications would include fan trays, servers, PC's and power supplies. This type of design can produce as much as 12-18% higher Sound Pressure Levels

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Sheet Metal Punched Fan Guards (Continued)

The typical punched fan guard has an open airflow passage area of about 50% of the entire guard. The design (type of cut) of the punch does show some slight effect upon the airflow passage, but is negligible in the overall test results. Common cut patterns are square cuts (as many as 200 per 120mm fan), circle cuts of 350 per 120mm fan, honeycomb and swirl designs. The punching/cutting methods also add additional airflow restriction if the exhaust of the fan is on the backside of the cut. The backside produces a sharp edge as the press comes down on the sheet metal this sharp edge creates additional resistance and further degrades the fan performance.

Airflow (CFM) testing when the punched guard is introduced produces a drop in airflow as much as 51%, with very slight differences between fan manufacturers. The net effect is that a cooling fan with much greater initial airflow is required in order to meet the originally calculated system cooling requirements. In this scenario, the 100CFM fan will deliver as little as 40CFM. To achieve the required cooling performance, a higher airflow fan must be selected. This greatly increases the power required to operate a much higher CFM fan, as well as significantly increases the overall system noise in order to meet the original design cooling requirements.



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Net Result

The purpose of the cooling fan is to provide the least amount of air movement required to reduce the system generated heat and insure that system components are maintained at approved operational temperature values. While this test data doesn't take into account any placement of specific internal components and their effect upon airflow and noise generated by the fan, it does entirely focus on how to maximize airflow and reduce guard generated noise to create the most efficient cooling system.

The net effect is that by using the proper fan guard, systems can take advantage of lower CFM cooling fans, reduce energy consumption and noise for the end user.

References/Products Used in Evaluation

Comair Rotron(Application Engineering), Fantec(fans), Qualtek(fan accessories), NMB(fans), Mechatronics(fans), ebmpapst(fans), Extech Instruments(airflow instrument), Gardtec(fan accessories), Shiner + Associates(acoustical engineering).

KIOSK FORCED CONVECTION COOLING

There are many ways to dissipate (remove) heat in kiosks, forced convection cooling is the most efficient and cost effective approach.

Several important design concepts go into determining the proper cooling for any specific application. Forced convection cooling, using tubeaxial fans can be accomplished in two effective ways; evacuation, or pressurization of the kiosk.

Evacuation of a kiosk (fan on the exhaust side), the air distribution inside the kiosk is flexible. Openings in the kiosk can be placed at most locations so that the fan can insure the proper cooling in specific locations. Heat generated from the fan motor will not be dissipated into the cabinet. The evacuation design makes it very difficult if the application requires filtering with the fan filter located in the same port as the fan itself.

The preferred method of cooling the kiosk is pressurizing the system. This allows for normally cooler air to be brought into the system, and also filtered very efficiently with minimal reduction in airflow. Kiosk's that are under pressure with this approach have the added advantage of keeping dust and other contaminants from entering the kiosk. The fan, by handling cooler/denser air will allow for a higher pressure capability. Ambient air being brought over the fan does assist in both the life expectancy and reliability. However, air being brought over the fan tends to increase the heat being introduced into the system, but at levels that are inconsequential to the total pressurization approach.

KIOSK FORCED CONVECTION COOLING (CONTINUED)

The following are suggested considerations when created the most efficient forced convectional cooling system. These are considered the ideal design parameters and in most applications not all can be met and as such are suggested as reasonable guidelines during the design process.

1. Fan should be placed in a location which assures the lowest fan operating temperature. This allows for the fan to bring in the coolest available airflow.
2. Fan should be placed at the lowest level of the kiosk in order to allow the natural flow of warm air in an upward direction.
3. Locate those components with the highest temperature heat source at locations closest to the air exit.
4. Allow a distance of no less than 2 inches between the fan blade and components within the kiosk.

GREEN FAN CORD



GARDTEC GREEN FAN CORD

The Gardtec Green Fan Cord was designed to create a simple and extremely cost effective product to address a long term Kiosk cooling problem in the market.

Kiosk applications require cooling in order to insure stability and longevity of product life. Once the ambient temperature reaches 85 degrees Fahrenheit, electronic components begin a life degradation as much as 25-40% for each additional 5-7 degree increase in ambient temperatures. Air movement is the key to solving standard heat issues, but only needs to operate during those times when ambient temperatures reach critical levels.

The Gardtec Green Fan Cord is created by incorporating a bimetal thermostatic device into the standard fan cord. This requires no additional wiring, or programming, simply plug on the fan cord and your Kiosk is now ready to take advantage of noise reduction, reduced energy consumption and extended fan life, all while solving your Kiosk heat concerns.