Establishing Cooling Requirements

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 = Cp x W x Delta T
- q = quantity of heat transferred
- Cp = specific heat of air
- Delta T = temperature rise within the cabinet
- W = mass flow (CFM x Density)
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- 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.

. Styles of Fan Filters

Fan filters, are incorporated into applications for purposes of filtering out various airborne contaminates that may cause internal problems of systems, as foreign particulate builds up on various electronic components causing a condition which allows for overheating and thus reduced life expectancy. Most filtering assemblies consist of three components, a retainer, filter media and fan guard, which also serve a safety

purpose in keeping objects from coming into contact with the moving fan blade.

Fan filters have a direct and extremely significant effect upon the volume of airflow within a system, as well as the total fan noise, depending upon the style of fan filter selected. For purposes of this study, three basic styles of fan filter assemblies were evaluated, each style used the industry standard 45PPI(pores per inch), polyurethane foam media, which is treated to UL94HF-1 a smoke generation test. The industry also offers 30/60/100PPI media and that test data is available upon request.

. **Impact of Fan Filter on Airflow**

To test the impact of fan filter resistance on the fan performance, three typical fans were used, all within the 100CFM range, data was collected and averaged. The tests were performed in free air, so the effects of application pressurization were not present, only standard air pressure.

. Fan Filter Assemblies

The fan filter is typically made up of three specific components. The plastic fan guard is normally attached to the fan, or directly to the application enclosure using 4 mounting holes. The polyurethane filter media is normally “sandwiched” between the guard and the plastic retainer, which snaps over

the guard in most industry standard designs. This design allows for the end customer to easily snap off the retainer and change the filter in an expedited manner. The fan guard and retainer have various design patterns, the most effective designs are those with a swirl effect, allowing the air to move away from the fan in the most efficient manner, while creating the least amount of filter generated noise.

Also included in the evaluation is the filter assembly designed to filter EMI/RFI. The industry standard is made from a combination of stainless steel and aluminum, using a 30x30 wire mesh. In this type of filter, the end user is not

able to remove the filter material, this design is primarily used in clean room applications and is not intended to be used primarily to filter out airborne contaminates.

This report will focus on the four styles primarily used within the market and provide an analysis of each style, with airflow performance levels.

. Fan Filter Configuration

The fan filter configurations are broken down into two specific product categories, the plastic with replaceable filter media(Fig. 1-3) and the stainless steel/aluminum(Fig. 4).

The most popular fan filter in the industry, is the design(Fig. 1) in which the airflow is allowed the pass through the filter assembly with the least amount of resistance, thus allowing the performance of the fan to reach its highest airflow performance level. The primary design characteristics which allow for this filter assemble to offer the best performance, are related directly to both the thickness and design of the retainer portion of the assembly, as well as the filter media thickness. The back side of both the guard and retainer are designed with rounded edges, which allow the easy passage of air over through the assembly, during the

exhaust operation. This positive effect of rounded edges on the retainer and guard are negated when the application is designed to draw air into the system.

. Reference/ 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). Gardtec Wire Fan Guard SC120-W5, Gardtec Fan Filter Assembly SC120-P15/45, Gardtec EMI/RFI Filter Assembly AFM-120M, Fan Power Cords, including

Daisy Chain Fan Power Cords, Fan trays and Custom Wire Products.