# Shop Tech Talk November 2009

## Drive Enclosure Cooling

**Whenever you have to install an ac or dc drive or for that matter any control product in an enclosure we need to know how much heat the particular piece of equipment puts out as a heat loss.**

**For an ac drive we can generally find this loss figure from the owner's manual. If we cannot discover what it is we can assume that the drive is roughly 97% efficient i.e. that the heat loss is 3% of the drive's nameplate rating. Drive manufacturers are continuously trying to increase the efficiency of their drives but it is a fact that some manufacturers have lower efficiencies than others so be sure to check.**

**So, if we have a 15 HP drive it would be rated at 15 x 746 watts/HP = 11,190 watts, so 3% of this would be roughly 336 watts.**

**What this means then is if we put this drive in an enclosed steel box, say, then it would be like enclosing a heater inside the box pumping out 336 watts of heat. Going back to the ac drive , then, this heat with no where else to go other than through the walls of the box would very soon begin to heat the electronic components of the drive itself.**

**Heat builds up rapidly in enclosed environments, compromising the performance and life span of equipment. Research shows that, for every 18°F (10°C) rise above normal room temperature, the life expectancy of your electronics drops by half........this from latest Hoffman catalog.**

**Most drives are designed to operate at a maximum temperature of 40°C = 104°F ,some are capable up to 50°C = 122°F without suffering temperature degradation.**

****For multiple drives in one cabinet, add the watts loss values of all drives to obtain the total watts loss that the fan/blower will be required to dissipate.****

**Because of these limitations it is imperative if we want long life out of our drives to remove as much of the heat being generated as we economically can. The 3 main methods used are....**

1. **Fans and Blowers and Louvers**
2. **Heat Exchangers**
3. **Air Conditioners**

**This article will only consider Fans and Blowers. My reason for doing this is that they represent the least costly solution , the easiest to figure out and the most likely choice .**

**All we need to know to figure out a suitable fan size is...**

1. **The total heat losses of equipment installed inside the enclosure**
2. **The maximum allowable internal temperature**
3. **The maximum ambient temperature**

**From the formula below the Fan CFM can be calculated**

$$\text{CFM} = \frac{\text{Heat Losses in watts} \times 3.17}{\text{Max. allowable internal temperature °F} - \text{Max. ambient temperature °F}}$$

**Note - The calculation above is exact, but adding an additional 25% to the CFM level is a standard safety factor.**

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## Additional Considerations for Good Installation of Blowers and Fans

**Blowers and fans use forced convection cooling, which means ambient air flows through a filter into the enclosure to cool heated components.**

**It is recommended that an exhaust filter be used in combination with the blower or filter fan to act both as an exhaust point for the hot internal air plus aid in the pressurization of the enclosure, reducing the chance of unfiltered air entering the enclosure.**

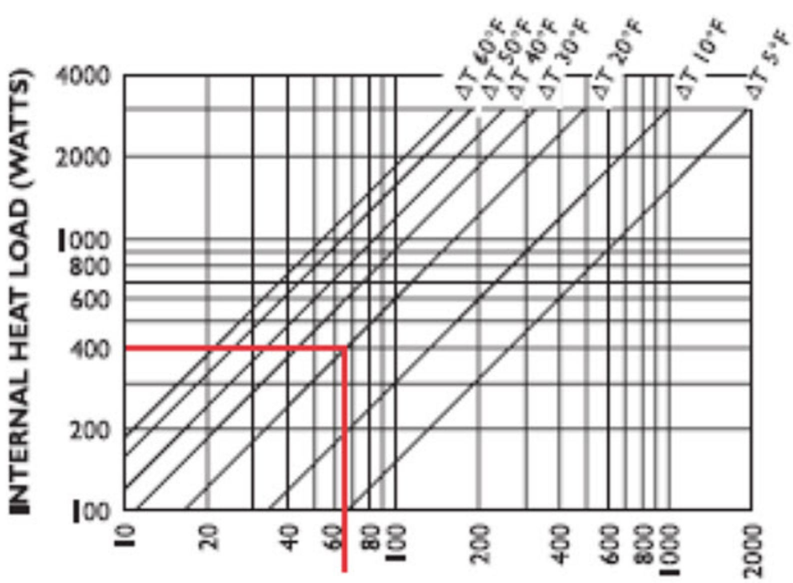
**Whenever possible, the blower or filter fan should be located in the bottom third of the enclosure and the filtered exhaust grill placed as high as possible on the opposing side. Performance levels can be further increased by adding a second exhaust filter.(If enclosure is Nema12 use Nema 12 fan/blower)**
**Note: Ambient Temperature must be lower than maximum internal temperature for fan/blower to be effective.**

***Example 1:***
**Approximate the amount of heat produced by three 5 Hp variable frequency drive (VFD) mounted with a disconnect and bypass contactors in an enclosure given a drive efficiency of 97%, (neglect motor efficiency).**

**3 VFD x 5 HP x 746 Watts/HP x (1-.97) eff. x 1.25**

**(factor for passive connections and other minor heat-producing components) = 419 Watts**

***Example 2:***
**I need to mount a 75HP ac drive in an enclosure, my max internal temp is 104°F and my max ambient is 80°F, so 1VFD x 75HP x 746 Watts/HP x (1-.97) x 1.25 = 75 x 746 x .03 x 1.25 = 2,098 watts and ΔT=24°F**
**From the Hoffman graph below we can make a choice, approx 300 CFM**




****ΔT = Max. allowable internal temperature °F – Max. ambient temperature °F**

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