COLMAC COIL
Manufacturing Inc.

Technical Bulletin

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SUCCESSFUL REFRIGERATION DEPENDS ON GOOD AIRFLOW

Introduction

Very often we forget that air is the most commonly used heat transfer fluid in air-conditioning and refrigeration systems. We typically remove heat from a refrigerated space by circulating cooled air throughout the room and across the product being refrigerated. A good airflow pattern is critical to the success of any refrigerated space design. A poor airflow pattern will result in poor air cooler and system performance even though the equipment may be adequately sized for the cooling load.

Most refrigeration air coolers use propeller type fans for moving air across the coil and circulating the cooled air throughout the room. Propeller fans are typically low cost, move adequate quantities of air, and use roughly one half the power of centrifugal fans for a given quantity of air at the static pressures normally seen (less than 1 iwg TSP) in refrigeration applications. Proper selection of air cooler configuration and propeller fan design is the topic of this article.

Colmac offers several air cooler configurations to match different airflow requirements. The LP, HP, ICL, and ICH product lines are ceiling-hung with draw through fan/coil arrangement discharging air horizontally. This type of unit is used in relatively large, open rooms where air throw to an opposite wall is desired. Good airflow in the room will depend on a number of factors:

Placement of Air Coolers

Avoid mounting air coolers directly over door openings. Locating the unit(s) opposite door openings reduces infiltration and the amount of warm, humid air drawn into the air cooler. Also, locate air coolers so that the distance to the opposite wall does not exceed the unit's rated air throw distance.

Condition of Ceiling Surface

Smooth ceiling surfaces are always best. The air leaving an air cooler tends to "stick" to and "roll along" the ceiling. A rough ceiling surface will obviously dissipate the momentum in the airstream and reduce air throw. Obstructions on the ceiling, such as beams, piping, ductwork, etc. will also kill air circulation.

Shape of the Room

A wide room (approx. 3X air cooler width) gives the best air circulation. A narrow (2X or less air cooler width), long room is the worst case for air circulation. Here the use of air straighteners is required to promote good air movement.

Straighteners perform three functions:

a) Increase discharge velocity;
b) Reduce turbulence of the air stream; and
c) Increase the amount of entrained air leaving the unit.

Rooms with low ceilings can also create airflow problems. Here, efforts must be made to keep the discharge air stream moving along the ceiling to the opposite wall, such as use of turning vanes in room corners, along with smooth ceiling conditions. Air straighteners may also be used to direct air upwards to the ceiling if needed.

Colmac also offers air coolers suitable for applications where low velocity air movement is required, such as in rooms where workers are in close proximity, or where products are sensitive to high velocity air streams (i.e. flowers). The GF, LV, and AR product lines are designed to provide maximum cooling capacity with low velocity airflow for these types of applications.

Generally, these types of units are ceiling mounted and located throughout the room so air throw distance is not a large concern.

For applications requiring airflow with higher static pressures, such as blast freezing, the Colmac BF line with blow through fan/coil configuration is available. In this case air throw distance is not so critical as: a) even distribution of discharged air, and b) high static pressure capability of the fans.

Depending on fan diameter and speed, the maximum external static pressure that can be generated by a propeller fan typically used on air coolers is approximately 0.25 to 0.50 iwg. Generally speaking, static pressure is generated at the tip of the fan blade. Increasing the tip speed will increase the static pressure for a given blade. Tip speed can be increased by increasing rotational speed and/or increasing fan diameter. Also, as static pressure requirements increase, the clearance between blade tip and venturi becomes more important (the closer the clearance the better the performance). So, if high static pressures are required, the best performance will be gotten from a fan with large diameter and the highest rotational speed practical.

Conclusion

In conclusion, proper air circulation depends on several considerations including: fan design, air cooler configuration, static pressure requirements, as well as shape and size of the room. To design high performance refrigeration systems using Colmac air coolers use the guidelines mentioned above for creating good room airflow patterns.

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