

Ventilation Air for Indoor Pools

INTRODUCTION

This technical bulletin reviews the outdoor air ventilation requirements for indoor swimming pool enclosures. It provides in-depth analysis of what the existing standard means and how ventilation air should be introduced to the air handler/dehumidification system. A review of energy recovery and conservation is also included.

As with all rules and regulations, interpretations vary. DESERT AIRE has provided the following summary in order to address the issue of ventilation air. This bulletin is for discussion only and is not intended to overrule the opinion of the consulting engineer.

DEHUMIDIFIER SYSTEM AIR VOLUME

ASHRAE Standard 62, the industry accepted ventilation code for indoor air quality, defines the minimum volume of outdoor air which must be introduced into the indoor pool enclosure. This volume is generally only a small percentage of the total air volume required by a dehumidification system to maintain the space humidity. Air velocities across the pool surface must be minimized to avoid excessive evaporation. The design of the dehumidifier should target approximately four to eight air changes per hour.

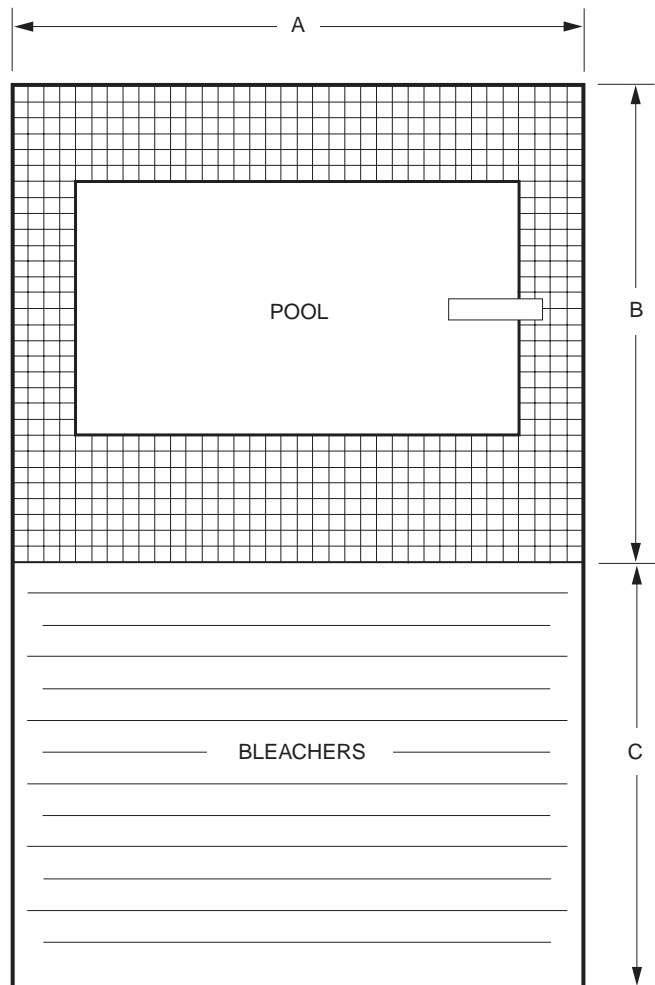
Ventilation Air Standard

- Pool Area:** 0.5 cfm / ft²
2.5 liters/s per m²
- Spectator Area:** 15 cfm / person
8.0 liters/s per person

ASHRAE 62 requires a ventilation air volume of 0.5 cfm per square foot of pool and deck area. In addition to this volume, an additional amount is required if the facility has a spectator area (bleachers). For these facilities, 15 cfm per person needs to be introduced during times that spectators are present.

DEFINITION OF POOL AND DECK AREA

The standard refers to pool and deck areas, but does not offer a detailed definition of the area. It is generally accepted that the deck area is a six to eight foot wide tile or concrete area surrounding the pool. Locker rooms, vestibules and hallways are not included in this measurement. (See Figure 1.)



$$\begin{aligned} \text{Pool and Deck Area} &= A \times B \\ \text{Spectator Area} &= A \times C \end{aligned}$$

Figure 1 - Pool, Deck, and Spectator Area Calculations

WATER CHEMISTRY AND ODOR

When planning natatoriums, designers are concerned about preventing any unpleasant odors. Typically, they design a ventilation system which brings in an excess amount of outdoor air in order to control any potential odor problems. While a complete analysis of pool water chemistry is beyond the scope of this bulletin, a quick review is required to eliminate some myths with respect to ventilation air requirements.

Many people often complain about a strong, objectionable “chlorine” odor found in pool rooms. Actually, this odor is not chlorine (which cannot be smelled by humans until it is above toxic levels), but an intermediate compound formed during the disinfection process. The odor is produced by the combination of chlorine and organics (sweat, oils and urine) in water. What we smell are chloramines, which are volatile. They are readily released to the air and are detectable by humans at low concentrations.

The formation of chloramines happens only when there is not enough free chlorine in the pool. To rid a pool of chloramines, it must be “shocked” by adding seven times the amount of combined chlorine present. A pool water treatment company can analyze the pool water and recommend appropriate solutions. When people smell “chlorine,” the pool water chemistry is out of control and more, not less, chlorine must be added. Properly installed and maintained chemical feed systems will eliminate this odor.

Proper ventilation can assist with maintaining water quality by removing the airborne chloramines. This process will cause more waterborne chloramines to release into the air, allowing the free chlorine in the water to better do its job. Please refer to DESERT AIRE Technical Bulletin #9 for a more complete description of this interaction.

Alternative disinfection systems, such as ozonation, UV treatments and ionization, are increasingly being used. Since these methods do not produce volatile intermediates, complaints about odor will decrease.

INTERPRETATION OF THE VENTILATION CODE

The standard exists to protect the health of pool users. Proper interpretation, however, can also enhance energy conservation by reducing the volume of outdoor air required to the minimum allowed by code.

The interpretation is based on the following assumptions:

- 1) that normal pool user load is small and spectator crowds will be handled as an exception;**
- 2) that automatic chemical feed systems are installed and operational; and**
- 3) that a dehumidifier is installed and operational.**

Ventilation may be regulated based upon occupancy. When the facility is unoccupied, outdoor air flow may be closed. During normal operation, outdoor air flow may be set to a minimum code-approved level. For higher-than-normal occupancy (such as a swim meet), an increased outdoor air flow rate is engaged. (See Figure 2.) Optimizing outdoor air will have a dramatic effect on operational heating and cooling costs.

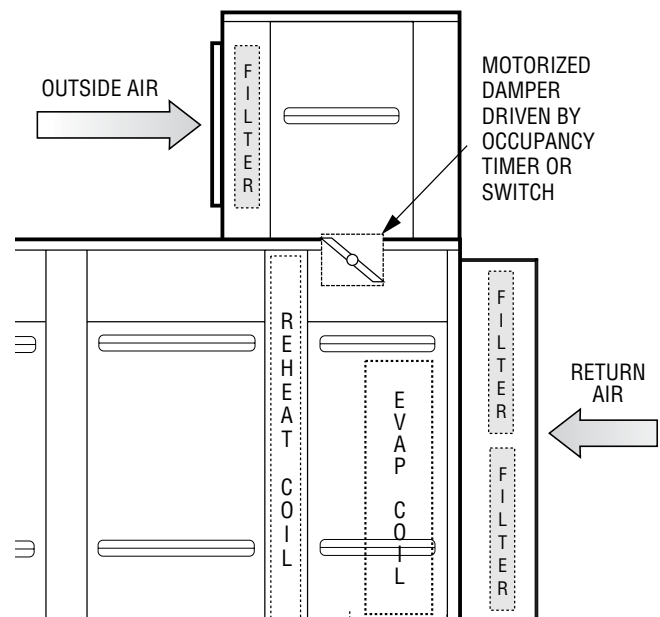


Figure 2 - Damper Assembly

The control of outdoor air dampers can be accomplished in two ways: a manual switch or a timer.

For either of these two actuation methods, the system will establish three control points to automate the outdoor air damper: closed for unoccupied conditions; minimum code ventilation for normal activity; and an event mode to handle spectator load requirements.

Spectator occupancy is not constant in most facilities except during swim meets or shows. Spectator ventilation air can be introduced by a dedicated outdoor air system (DOAS) that has its duct work flush spectators with clean, fresh air. The DOAS can also produce temperatures that are a couple of degrees lower than the pool space temperature to help keep fully clothed spectators cooler. To further reduce energy costs, the code ventilation for this area can be controlled via a manually activated switch or a building management system with a scheduling program. In this way the facility can reduce its energy costs by conditioning the air only when spectators are present.

I INTRODUCTION OF OUTDOOR AIR

The dynamics of a pool enclosure are unique because of the need for humidity control. Most other applications can accept outdoor air upstream of the air handler without affecting the system's performance. This is not true in the case of a dehumidifier. If outdoor air is introduced into the return air duct, two problems can occur in cold weather (winter). The first problem is condensation in the duct when cold air meets the moist return air from the pool room. The second problem is that the mixed air temperature will be lower than the pool return air and will decrease the moisture removal capacity of the dehumidifier.

To eliminate these problems, the outdoor air should be introduced downstream of the evaporator (see Figure 3.) Then the dehumidifier has maximum moisture removal capacity and the reheat and auxiliary heating coils can raise the temperature of the outdoor air, avoiding cold drafts to the swimmers.

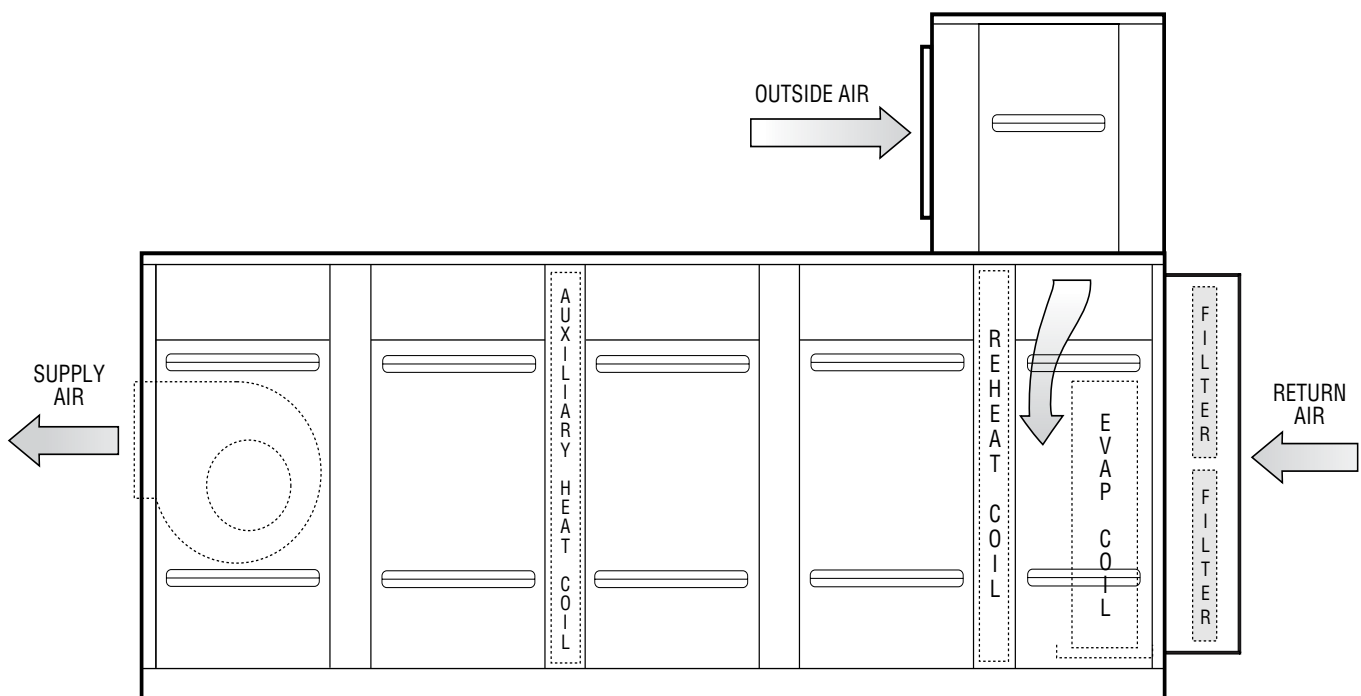


Figure 3 - Outdoor Air Introduction to Dehumidification System

ECONOMICS OF HEATING AND COOLING

WINTER

An indoor pool enclosure has several sources of energy loss:

- 1) *convection through the ceiling, windows, and walls*
- 2) *exhaust air*
- 3) *evaporation of the pool water*

The convection heat loss and the exhaust air heat loss in a pool enclosure is a function of the coolness of the outdoor air temperature. The greater the temperature differential between indoor and outdoor, the greater the loss of energy. Uncontrolled heat loss causes swimmer discomfort and also increases the pool water evaporation rate. Heat loss through ceilings, walls, and windows can be minimized by using adequate insulation and multipane windows. Heat loss through exhaust air can be minimized by eliminating exhaust during unoccupied times and by bringing in the minimum amount of outdoor air that code permits.

The water's heat loss can be minimized by maintaining the air temperature at several degrees above the water temperature. A key factor is maintaining the room relative humidity at 50-60 percent. Should the relative humidity drop below 50 percent, the evaporation rate will increase significantly. Relative humidity below 50 percent can occur when extra amounts of outdoor air are introduced in the wintertime.

The simplest method to calculate the effects of ventilation is the total enthalpy method. This method compares the difference in enthalpy (BTU/lb) of indoor versus outdoor air at different ventilation rates. A direct energy cost can then be calculated.

SUMMER

During the summer months, heat gain - not loss - is a problem. A higher volume of outdoor air increases the cooling demand and introduces extra moisture. The increased load requires a larger sensible cooling capacity, and the increased moisture requires a larger dehumidifier that must run longer. This effect must be included in the dehumidifier sizing calculation.

CONCLUSION

A dehumidification system in an indoor pool facility not only protects the structure and recovers energy, but it also allows a reduction of outdoor air, thereby increasing energy savings. If your state has adopted ASHRAE 62 ventilation codes, then the following design specifications should be incorporated into your plans:

- ◆ Dehumidification system - designed to provide four to eight air changes per hour while maintaining a relative humidity of 50 percent for unoccupied space and not greater than 60 percent for occupied (active) space.
- ◆ Automatic chemical feed system - designed to eliminate the need to introduce extra outdoor air to control the odor of treatment chemicals.
- ◆ Provide 0.5 CFM/square foot of pool and deck area during normal usage, and 0.5 CFM plus 15 CFM per spectator during swim meets or shows.
- ◆ Outdoor air introduced after the evaporator coil in the pool dehumidifier -maximizes the capacity of the unit. A DOAS can be used for the spectator outdoor air volume.



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