OUTDOOR ENERGY RECOVERY

Extended Outdoor Air System with Energy Recovery

Every commercial pool requires the introduction of outdoor ventilation air during occupied times. The rate of introduction is dependent on the pool size, deck space, and occupancy. The introduction of this ventilation air helps to maintain air quality in the space. Refer to DESERT AIRE Technical Bulletin #5 for a detailed summary of the requirements in current standards.

DESERT AIRE offers its SelectAire™ with Extended Outdoor Air system option to integrate ventilation air into the dehumidification package when there is the need for higher airflow or purge capability. The return air is brought back to the dehumidifier where the air is exhausted to meet the design intent of the facility. The dehumidifier blower will act as the ventilation fan and supply air blower to provide all of the required ventilation air for the pool room. The integral exhaust air blower is balanced to establish and maintain a negative pressure in the space. It is important that the return air duct system be designed to meet the design supply air volume.

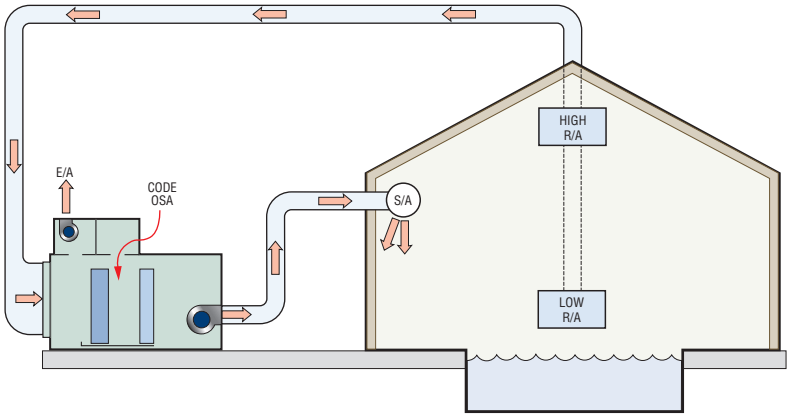

Figure 1 - Extended Outdoor Air System Conceptual Airflow Diagram

The SelectAire™ control system simplifies air balancing while maintaining the correct proportions of return air, supply air, exhaust air and outdoor air. The system works by monitoring and controlling the static pressure difference at three areas: the outdoor air intake, evaporator coil, and the zone/ambient. The pressure difference at the specially designed oriface in the outdoor air flow path controls the outdoor airflow. Monitoring the pressure drop through the evaporator and controlling the evaporator bypass damper maintains the flow rate through the evaporator and optimizing the moisture removal. Monitoring the difference between the zone pressure and ambient pressure controls the exhaust fan and helps to guarantee the negative static pressure within the space so critical to the building envelope. The control system then modulates the respective damper in response to the pressure readings to achieve the desired airflow.

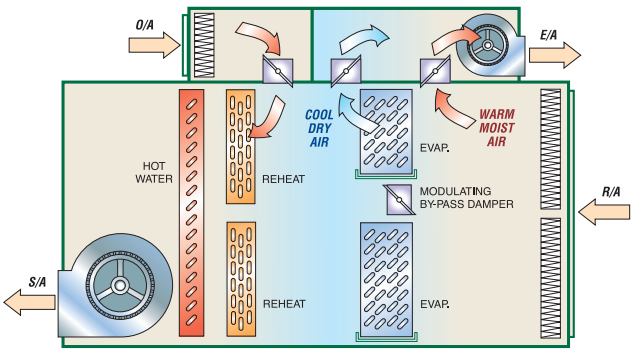

Figure 2 - Schematic for Outdoor Air

OUTSIDE AIR INTRODUCTION CONTROL

The DESERT AIRE SelectAire™ dehumidifier includes a modulating damper to divert a specific flow rate of air through the evaporator coil. This automatically provides a constant airflow and load for the evaporator coil and optimizes the moisture removal efficiency of the system. Similarly, even if outdoor air is preheated, it should always be introduced downstream of the evaporator coil. Cold and dry air introduced before the evaporator coil will lower the unit's dehumidification capacity.

In the SelectAire™ system outdoor air is filtered and a modulating motorized damper controls the introduction of outdoor air as follows:

Unoccupied Mode
OSA damper is closed. Unit will be in recirculation mode. The exhaust air fan will be adjusted to maintain a small negative air balance in the pool room.

Occupied Mode
Outdoor air volume is established in the field during startup. The OA volume will be established between 0 and 50% of the supply air volume. Outdoor air is preheated as required to provide mixed air temperature at or above the space dewpoint. The preheater uses a feedback modulating control algorithm. The space auxiliary heater is controlled based on zone sensors. Compressors are activated as required by the SelectAire™ standard sequence.

Event Mode
The event mode outside air volume is established in the field between 0 to 50% of supply air volume. This is a higher rate than the Occupied Mode setting. The auxiliary heater is controlled based on zone sensors. Compressors are activated as required by the SelectAire™ standard sequence.

Purge Mode
A purge air is established at 50% of supply air volume. The auxiliary heater in this mode is controlled based on a leaving air temperature sensor located in the blower section, not on the zone sensors. Compressors are deactivated during purge mode and will remain off during the Purge Mode. Supply air temperature is heated as required to maintain a minimum temperature above the space dewpoint. This helps to prevent condensation on ducts and interior surfaces.

Heating Mode
For all integral heating elements the controller shall use a zone reset of supply air temperature sequence instead of an on/off method. The proportional plus integral loop will calculate a supply air temperature that maintains the pool air temperature in all modes defined above. The auxiliary heat must be sized for the maximum purge air volume at the local winter design condition.

Energy Recovery
SelectAire™ systems have two exhaust air dampers. One is upstream of the evaporator coil and one is downstream. This special design of the Select Aire option allows the system to take advantage of basic thermodynamic principles while not impacting the unit's sensible cooling capacity.

- When the space requires heating, air is exhausted after the evaporator coil which recovers the energy contained in the exhaust air prior to its discharge.
  Principle # 1: Exhaust air at its coldest point.

- In the cooling mode, air is exhausted before the evaporator coil which is warm and humid.
  Principle # 2: Exhaust air at its warmest point.

The SelectAire™ system uses the principle of a heat pump to recover energy in the heating mode by operating one of the two circuits in conjunction with exhaust air. Exhaust air consists of two energy components: sensible and latent. The cold evaporator coil absorbs both of these components. In addition to this energy the energy required to operate the compressors is returned in the form of heat. This option provides high COP efficiency to the exhaust air recovery cycle.

DESIGN FEATURES

The SelectAire™ is the most efficient method to recover the total energy of the exhaust air. Since the airflows and loads are maintained through the special airflow control sequence the amount of recovery can be optimized. Other systems that use passive heat exchangers cannot recover latent energy during the majority of the operation and the amount of sensible recovery is dependent on the outdoor temperature. In addition, their actual recovery effectiveness is variable as it changes based on the temperature differential. Passive heat exchangers require additional fan energy and cannot take full advantage of free outdoor air cooling unless bypass dampers and controls are installed. The Select Aire has a constant rate of energy recovery when activated and is always controlled automatically based on the zone condition.

The following table is an example of how the airflow ranges can be maintained in the extended outdoor options.

Dehumidification/Clg

	% of Supply Air			
	OSA	**Cool Exh.**	**Warm Exh.**	**Compressor**
Unoccupied	0%	0%	VFD	Enabled as required
Occupied	0 to 50%	0%	maintaines a	Enabled as required
Event	0 to 50%	0%	Neg. Pres.	Enabled as required
Purge	50%	0%	In all modes	Locked out

Energy Recovery / Heat Mode

	% of Supply Air			
	OSA	**Cool Exh.**	**Warm Exh.**	**Compressor**
Unoccupied	0%	0%	VFD	Enabled as required
Occupied	20% to 50%	20%	maintaines a	Enabled as required
Event	20% to 50%	20%	Neg. Pres.	Enabled as required
Purge	50%	0%	In all modes	Locked out

Additional design features of the SelectAire™ System with Extended Outdoor Air are:

- VFD for exhaust air
  A room pressurization scheme maintains a negative pressure in the space. A unit mounted pressure transducer is provided by Desert Aire. 1/8" pressure tubing is run to the space and to the outdoor air by the installing contractor. Suitable terminations are provided by Desert Aire.

- Outdoor Air Balance Plate
  Calibrated by Desert Aire to control outdoor air damper.

- Exhaust Air Balance Plate
  Calibrated by Desert Aire, installed between the cold air and warm air dampers to maintain the proper ratio of exhaust air from these two locations to ensure a building negative pressure.

- Return air static pressures up to 1.5 inch WC and supply air static can be up to 2.0 inch WC

For a more detailed analysis, please refer to DESERT AIRE Technical Bulletin 6 - SelectAire™ Heat Recovery System.

Covered by Desert Aire United States Patent # 5,682,754