

REZNOR[®]



HEATING AND VENTILATING INDOOR SWIMMING POOLS

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Enclosed swimming pools present an entirely new approach to heating and ventilating design. Because of their special use, such pools must meet unusual environmental conditions. ASHRAE suggests the following for pools and their enclosures.

1. The pool water temperature should be between 78° and 80°F.
2. The air temperature within 8 ft. above deck level should not be lower than 76°F.
3. Relative Humidity should be maintained at a maximum of 60%
4. Air velocity through the enclosure should not exceed 25 FPM.

These levels of control are intended for competitive swimming (US Swimming rules and Regulations 1987) and may seem too ambitious for most private and institutional pools. However, after each enclosed pool has been equipped and the control points established, the conditions in 1 through 4 will likely be closely mirrored. We offer these ASHRAE suggestions to those who may need to know where to target their initial design considerations.

RELATIVE HUMIDITY IS USUALLY VERY HIGH

The water in the pool continually vaporizes. Vaporization is accelerated because of the high water and air temperatures involved. Therefore, the relative humidity tends to be extremely high if allowed to find its own level. Evidence of high humidity is found when moisture deposits on windows and walls. (The vapor will condense when it is chilled). Reduced humidity is necessary to maintain acceptable environmental condition. With the amount of moisture present, using recirculating dehumidification equipment or desiccants would be costly. The most economical method for reducing or eliminating this problem is to ventilate the space with fresh, outside air (makeup air).

CHLORINE IS A SPECIAL PROBLEM

Chlorine is used to disinfect the water to allow the use of the same water on a continuing basis. Enclosed swimming pools require high temperatures for both the water and the air. Consequently, there will be heavy levels of chlorine laden vapor over the water. Because of chlorine's corrosive nature, the pool and enclosure must be initially constructed with corrosion resistant materials. Also, when chlorine vapor enters the combustion process of gas or oil heating apparatus, destructive corrosion can occur. The chlorine precipitates from the flame, and if it recondenses on the interior of a cold heat exchanger, hydrochloric acid is generated. **This acid is extremely corrosive and can destroy the heat exchanger very quickly.** Under the harshest conditions, failure of the heat exchanger can occur in a few months.

EQUIPMENT

It is possible to use indoor type equipment but not recommended unless separated combustion type equipment is used. To avoid premature failure, isolating the combustion and possibly the entire unit from the pool enclosure is necessary. This can be done by using separated combustion units or outdoor type heating and ventilating equipment. Boilers used to heat the pool water should also be located outside of the space to avoid contact with the chlorine. Boilers may not generate hydrochloric acid because they usually maintain elevated temperatures with the presence of hot water; however, the exterior may be attacked by the chlorine vapors.

Reznor outdoor packaged makeup air units are ideal for this type of application. They are capable of ventilating the space to reduce the humidity to an acceptable level and can provide heating and recirculation as needed. **They are constructed of metals that resist the attack of chlorine vapor in the recirculated air.** Because they are mounted on the roof or outdoor platform, they are not expected to pick up chlorine vapors in the combustion process, especially if the makeup air equipment is located on the prevailing wind side of the roof. See Fig. 1.

All Reznor models listed in the table below are suited for outdoor (roof-top) mounting.

All units may be curb or support mounted.

Matching roof curbs are available from Reznor.

DAMPER SYSTEMS TO BE CONSIDERED

Optional damper systems are available to provide a variety of air flow control. They are;

- Straight makeup air with on/off dampers
- Combination heating/makeup air where damper control for either 100% recirculated air or 100% outside air. (Indirect fired units only)
- Combination makeup air/ Recirculation with damper control from 100% outside air down to 25% outside air (Direct Fired - Model RDF - only where recirculated air is 75% of total air volume when at the minimum outside air adjustment).
- Mix of outdoor/recirculated air by using a proportioning humidistat.
- All damper motors may be interlocked to energize exhaust fans during ventilation or Make Up Air cycle.

FIRING RATES

INDIRECT FIRED units can be provided with optional staging based on 50% / 100% firing of the main burner.

Single furnace models utilize two stage while multiple furnace assemblies may have two stages of firing for each furnace module in the assembly.

Indirect fired units may also be equipped with modulating gas controls to graduate the burner flame from either 20% to 100%, or 50% to 100% of the rated input.

DIRECT FIRED units are equipped with modulating controls that graduate the flame from full fire to 4% of full fire.

Note: Please be advised that the DIRECT FIRED units are not recommended for use in sleeping quarters.

VENTILATION RATES FOR CONTROL OF HUMIDITY

Enclosed swimming pools must be ventilated with fresh outside air to control the humidity level. To be certain that the exhaust and makeup air equipment will do this, a **minimum rate of 2 CFM per square foot of pool surface area** should be established. For control of the humidity level, use a snap acting or modulating humidistat located in the space and wired into the unit damper system.

DETERMINING HEAT REQUIREMENTS

An accurate heat loss study must precede any equipment selection. Heat loss information should be based on ASHRAE suggestions. You may have this evaluation completed by an architect or engineer or you may enlist Reznor through one of their Factory Representatives or Reznor Distributor, to develop this study, using the Reznor computerized heat loss program. Be prepared to supply the Reznor personnel with pertinent dimensional and construction material data. Forms for such input are available from Reznor.

Reznor Models for Heating and Ventilating Indoor Swimming Pools

MODEL DESIGNATION	CABINET TYPE	NUMBER OF SIZES	STYLE	FUEL	BTU INPUT RANGE x 1000	AIR FLOW RANGE CFM
ADF	INDOOR/ OUTDOOR	4	DIRECT FIRED	NATURAL PROPANE	500 - 1250	2000 - 15500
RDF	INDOOR/ OUTDOOR	8	DIRECT FIRED	NATURAL PROPANE	400 - 3000	1000 - 28000
CRGB	OUTDOOR	9	INDIRECT FIRED	NATURAL PROPANE	75 - 360	585 - 7100
CRGBL		7	GRA VITY VENT		360 - 1080	2900 - 13200
RGB	OUTDOOR	11	INDIRECT FIRED	NATURAL PROPANE	75 - 400	585 - 7100
RGBL		7	GRA VITY VENT		400 - 1200	3100 - 14000
RPB	OUTDOOR	9	POWER VENT	NATURAL PROPANE	125 - 400	980 - 7100
RPBL		7	INDIRECT FIRED		400 - 1200	3100 - 14000
SCE	INDOOR	9	SEPARATED COMBUSTION	NATURAL PROPANE	125 - 400	1060 - 7100
SSCBL	INDOOR	7	SEPARATED COMBUSTION	NATURAL PROPANE	400 - 1200	3100 - 14000

SAMPLE STUDY FOR ENCLOSED POOL

The illustration below illustrates a swimming pool with enclosure. Building and pool measurements are given. A Reznor roof top heating, make up air unit is in use. Following are the factors used for sizing the heating and makeup air equipment for this example.

Heated space dimensions: 120 ft. x 75 ft. x 9 ft.
 Pool dimensions: 60 ft. x 51 ft.
 Pool surface area: 3,060 sq. ft.

The illustration below shows two exhausters, each capable of moving 3,060 CFM.

Makeup Air (Ventilation) requirements: 2 CFM per square foot of pool surface area
 2 CFM x 3,060 sq. ft. = 6,120 CFM

Indoor design temperature: 80°F

Outdoor design temperature: 20°F

Radiational loss (Building Heat Loss Calculation): 214,800 BTUH

Ventilation loss: 398,412 BTUH (Based on 6,120 CFM of makeup air)

Total BTUH OUTPUT required: 613,212 BTUH

For INDIRECT FIRED Equipment: $613,212 \div .77 = 796,379$ BTUH input

For DIRECT FIRED Equipment: $613,212 \div .94 = 652,353$ BTUH input

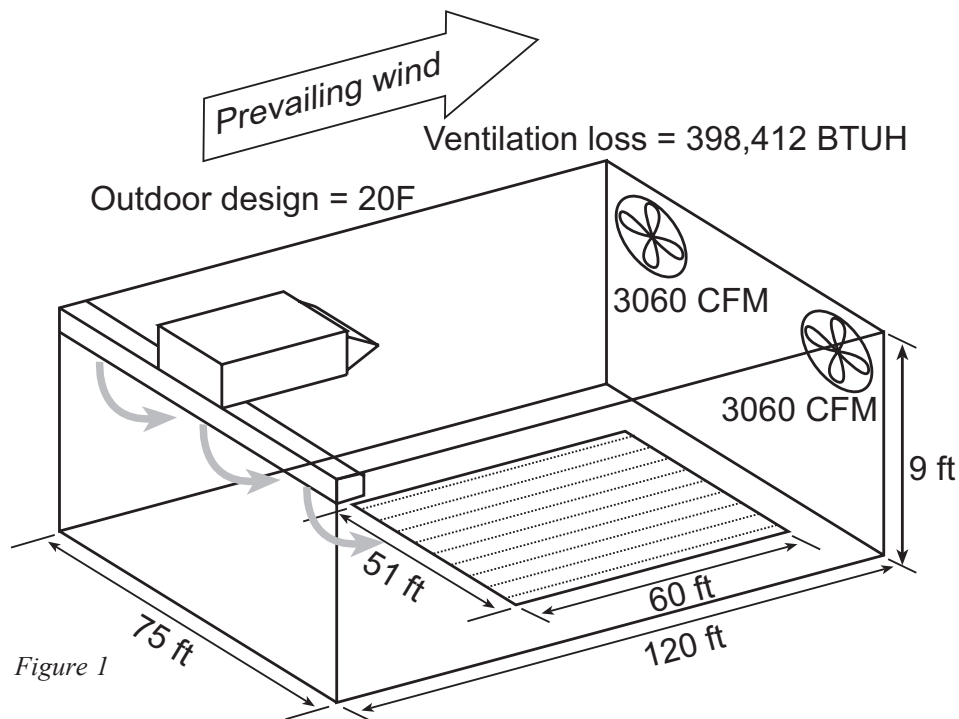
Rise through unit at 6,120 CFM: 93°F

UNIT SELECTION AS FOLLOWS:

Indirect Fired: RGLB or RPBL 800 (800,000 BTUH input)

Direct Fired: RDF 1-65 (750,000 Maximum Input. Burner is adjusted at factory to the desired input)

Either Direct or Indirect fired unit will provide a 93°F temperature rise.



SIZING THE EQUIPMENT

When sizing the make up air and heating equipment, you must be certain that there are enough BTU's available to temper the incoming outside air. This may be done by using the following formula:

$$BTUH_{MAKEUP\ AIR} = CFM \times 1.085 \times \Delta T$$

Then, by adding the $BTUH_{MAKEUP\ AIR}$ to the $BTUH_{HEAT\ LOSS}$, the total heater output can be determined, i.e.

$$BTUH_{OUTPUT} = BTUH_{HEAT\ LOSS} + BTUH_{MAKEUP\ AIR}$$

Infiltration BTUH losses are not included in the building loss total since the Makeup Air will be offsetting these losses.

HEATER INPUT DETERMINED BY DIVIDING OUTPUT BY:

- 78% for Gravity-Vented INDIRECT fired gas heating equipment
- 80% for Power-Vented INDIRECT fired gas heating equipment
- 92% for DIRECT fired gas heating equipment

SIZING THE EQUIPMENT (cont'd)

The INDIRECT FIRED unit may have a staged or modulated burner. Room override thermostats are available to ensure that the desired space temperature is maintained. Damper options may be selected to :

- 1) Modulate from 100% outside air to 100% recirculated air using a proportioning humidistat in the space, or;
- 2) Switch from all outside air to all return air utilizing a snap acting humidistat in the space.

Model RDF Direct Fired unit must have a minimum of 25% outside air across the burner at all times. Damper arrangements may be selected to provide either Constant Air Volume or Variable Air Volume. The dampers may be modulated to provide up to a maximum of 75% recirculated air. (The RDF in the example will introduce a minimum of 1,530 CFM outside air in the space whenever it is operating.) A proportioning humidistat will be required to control the damper positions. A constant temperature rise through the unit may be maintained with either damper arrangement. The RDF can be provided with burner controls for

- 1) Constant Discharge Air Temperature
- 2) Constant Discharge Air Temperature with Room Thermostat Override (Resets discharge temperature up to 20 degrees above selected temperature - NOTE: Maximum discharge air temperature is 120 degrees)
- 3) Variable Discharge Air Temperature with Room Selectrstat to maintain the desired room temperature

Dampers may be selected to:

- 1) Modulate outside air flow from 6120 CFM down to 1530 CFM (variable air volume) or;
- 2) Provide constant flow of air at 6120 CFM (constant air volume). Outside air will modulate from 6120 CFM down to 1530 CFM. Damper system will recirculate 4,590 CFM when the Make Up Volume is modulated to the minimum CFM level.

A proportioning humidistat will be required to control the damper positions for 1 and 2 above.

With either DIRECT FIRED damper system 1 or 2, the temperature rise through the unit may be maintained at 93°F or may have one of the following reset controls in command of the temperature rise.

- 1) May be equipped with room thermostat that will increase the temperature rise up to 20°F if the room temperature should drop below the desired setting.
- 2) May be equipped with room thermostat that can increase the discharge temperature as needed for environmental heating or can lower the discharge temperature when the room temperature has climbed above desired set point. (a form of atmospheric cooling that may be needed when heat gain through people load, lighting and water temperature occurs).

NOTE: If either temperature reset control is selected, the BTUH input will have to be adjusted upward in order to allow for the greater rise. For 113°F rise capability, the total input will have to be adjusted to 743,702 BTUH (CFM X 1.085 X 113)

Notice in illustration on the next page how the makeup air is introduced to the space across the width of the building through the use of a distribution duct located near the ceiling. The exhaust fans are located at the opposite end of the building thus resulting in slightly more than 9 FPM velocity through the enclosure. This is well below the maximum 25 FPM velocity suggested by ASHRAE.

SIZING THE EQUIPMENT (cont'd)

Providing appropriate heating and ventilation to an enclosed swimming pool is extremely important if ample comfort is afforded those using the facility. Water and air temperatures must be within very narrow parameters and humidity must be maintained at an acceptable level. While Reznor does not participate in the water heating process, Reznor does have a wide variety of package systems that can produce the needed air temperature and humidity control. When you are selecting equipment to properly maintain the wanted environmental conditions for your enclosed swimming pool, be sure to look to Reznor for assistance and for the right equipment to do the job.

NOTICE:

This bulletin is intended for general information only. Please consult and abide by all local and national codes regarding particular applications. Also refer to manufacturer's specific installation instructions regarding application and installation of products.

REZNOR PRODUCT LINE

Reznor products include an extensive line of heating, cooling and ventilating systems, using gas, oil, hot water/steam or electric heat sources. Reznor equipment is designed for the commercial/industrial market. A national network of sales representatives and distributors are trained in Reznor products and possess technical tools to help you determine the best equipment for your particular application. Please feel free to contact these specialists when industrial heating and cooling is being considered.

NOTICE:

This bulletin is intended for general information only. In all cases, local and national mechanical and electrical codes must be followed. Also refer to and abide by the manufacturer's specific installation, operation and maintenance instructions for all equipment. Installation and service of equipment should be by licensed, qualified professionals only.

IMPORTANT:

Read manufacturer's installation, operation and maintenance manuals thoroughly regarding all INSTRUCTIONS, CAUTIONS, WARNINGS AND NOTICE STATEMENTS before specifying, installing, operating or servicing equipment.

WARNING

Improper specification, installation, operation or maintenance of equipment may cause:

- severe personal injury or death and/or
- conditions that may result in property damage.

The following precautions MUST be observed:

- Proper venting, gas and electrical supply according to national and local codes.
- Proper application, setup and operation of this product, as well as all other building equipment, to eliminate buildup of contaminants in the conditioned space.
- Proper environment/atmosphere or application to avoid fire or explosion from hazardous atmospheres containing flammable vapors or combustible dust.
- Specification of the proper equipment for the particular application.