
CRITERIA FOR EVALUATION: SELECT-SERVICE HOTEL INDOOR AIR QUALITY

**ENEREF INSTITUTE EXAMINES AIR CONDITIONING
TECHNOLOGIES AVAILABLE FOR SELECT-SERVICE HOTELS.**

Demand for fresh air, or makeup air, in hotel guestrooms is driven by several imperatives: the necessity for thermal comfort, improved indoor air quality, and building code compliance. Because hospitality is a service industry and hotel guests spend much of their time indoors, thermal comfort and IAQ are especially consequential.

When done correctly, introducing fresh air into hotel guestrooms results in healthier IAQ, fewer airborne pathogens, and a lower risk of sick building syndrome.

SURVEY of HOTEL ENGINEERS

WHAT ARE THE MOST IMPORTANT REQUIREMENTS FOR YOUR IAQ SYSTEM TO ADDRESS?

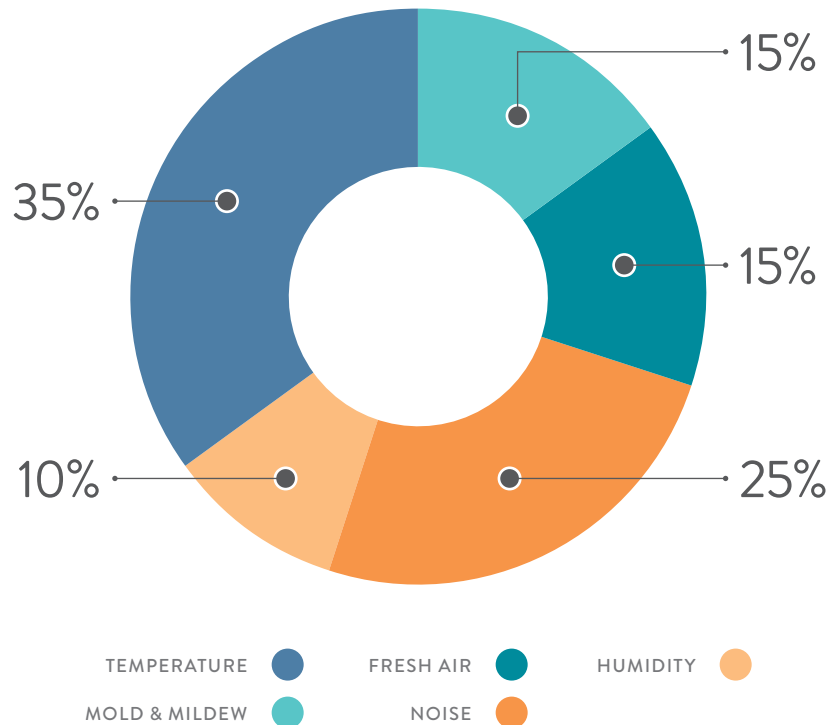
“I would tell you that fresh air has been front-burner for me for years,” explained Terry Smith, VP of Engineering Global Design Strategies at Marriott International, Inc. “When you don’t control outside air in buildings, it leads to significant temperature and humidity control problems for guests and increases the chance of bacterial growth.”

Further, scientific studies have demonstrated that building occupants who work in spaces with adequate levels of properly delivered fresh air are more productive.

Many solutions are available to meet the need for makeup air and improve IAQ. However, some of these solutions come at the cost of increased energy load. Efficiency is vital because, according to Blair Hildahl, Principal with Base4, guestroom energy consumption accounts for approximately 40% to 80% of a hotel’s total building energy use.

PTAC UNITS DELIVER COST-EFFECTIVE MAKE-UP AIR

To bring fresh air into guestrooms, select-service hotels, such as Marriott Courtyard or Hilton Garden Inn, prefer a dedicated outside air system with make-up air, hard ducted into each guestroom. Hotels employ a packaged terminal air conditioner (PTAC) unit where first-



cost-driven specifications demand lower cost or convenience.

The required features of a PTAC system vary depending on the individual preferences of the specifying engineer. Some of the most sought-after attributes include increasing fresh air, controlling temperature and reducing mold, mildew, noise and humidity. Expenses associated with PTAC units include capital and operational expenses as well as maintenance costs.

Interviews with hotel engineers found that solutions to improve IAQ are property-

specific, with few being equally effective for any two hotels. While demand for PTAC systems must adhere to ventilation codes, engineers look at ventilating buildings holistically.

“There’s always variables,” explained John Seipp, Vice President, Capital Planning & Project Management at Management at Marriott.

IMPORTANCE OF VENTILATION FOR HUMIDITY CONTROL

“Fresh air gives an immediate feeling of clean, cool and calm—

which is exactly the guest experience hotel owners want to give their guests,” said Blair Hildahl of Base4.

Especially in coastal markets such as Florida or Alabama (and elsewhere during summer months), a common concern among hotel engineers is the need for building ventilation where accurate control of ventilation air will help reduce mold and mildew.

“When you don’t control the amount of ventilation air that you have coming in, you spend extra money,” said Lew Harriman, Director of Research & Consulting at Mason-Grant. “It’s expensive to take the humidity out if you don’t keep it out to begin with.”

Engineers look to reduce humidity to a 55% RH at 68-70 degrees Fahrenheit—the temperature at which water vapor condenses. Favorable humidity conditions range from 55% to 60% relative humidity. At higher dew points, people feel “sticky” because the increased water vapor in the air slows the evaporation of perspiration on skin.

“We want to keep the humidity below 60%,” said Rick Frey, Senior Director, Engineering Support Architecture & Construction at Hilton Hotels & Resorts. “You don’t want the bed sheets to feel damp.”

Beyond humidity control, energy efficiency is especially desirable in markets where potential government tax rebates or power utility rebates are available. However, just as important as efficiency is guest experience, including the noise level and aesthetics of the PTAC unit.

“Give me a \$400 PTAC that’s extremely noisy and I’ve lost,” said Marriott’s John Seipp. (Most PTAC chassis are in the \$600 range).

VENTILATION AS MEANS OF MAXIMIZING COMFORT AND HEALTH

Fresh air is needed to reduce humidity, toxins and pathogens inside hotel guestrooms.

“The more ventilation you provide, the lower the concentration of whatever contaminants there might be,” said Roger Hedrick, Principal Engineer with NORESO.

Toxic chemicals include carbon monoxide, radon, volatile organic compounds (VOCs), elemental particles, smoke and manmade fibers, and they can show up everywhere from furniture and carpet backing to rooms heavily sprayed with pesticides.

Living pathogens—found naturally in the environment—include molds, mildew, dust mites, spores, pollens, bacteria, microbes and viruses.

“Fungus and molds go hand-in-hand with ventilation and humidity control,” said Lew Harriman of Mason-Grant.

Buildings are now constructed to comply with tighter standards than in years past. While the airtight infrastructure offers superior insulation and energy efficiency, it can also lead to a lack of fresh air indoors.

HAZARDS OF UNCONDITIONED VENTILATION AIR

Select-service hotels often specify PTAC units—designed by manufacturers to specifically target the hospitality market—because of their lower cost.

To introduce outside air into the guestroom, PTAC units have traditionally incorporated a tiny lever, or fresh-air door. However, the air in these systems is neither measured nor conditioned. Rather, it’s simply raw, hot, humid outside air, which forces the PTAC units to work harder and worsens indoor comfort levels by introducing unconditioned air into the indoor loop.

WHY HOTELS SPECIFY PTAC UNITS

Despite the problems that unconditioned air can introduce, for many hotel chains, the benefits of PTAC units far

outweigh the disadvantages, especially with recent innovations for introducing makeup air.

Typically, PTAC systems are attractive, 42"-wide, self-contained, all-in-one package wall units with plastic fronts; they're installed below a window in order to discharge directly into the guestroom. These are combination air conditioners designed to provide the heating and cooling for individual guestrooms.

Select-service hotels use PTACs as an alternative to hard ducting outside air into all the guestrooms, where ceiling space in the corridor may limit the room for duct work.

"Generally, the select-service hotels are relying on the outside air coming through the PTAC," explained Marriott's Smith.

Some PTAC manufacturers have lowered the carbon footprint of their units by using a more efficient refrigerant with a lower global warming potential (GWP), such as the refrigerant, R-32.

PTACs are also a more economical solution with the advantages of low cost, easy installation and simple maintenance. One disadvantage, however, is that PTACs don't employ the more efficient inverter-driven variable flow refrigerant (VFR) technology common with some larger

systems. That limitation, however, is about to change.

MICRO-COMPRESSORS: A SOLUTION FOR UNCONDITIONED AIR?

To eliminate the problem of unconditioned, raw, humid outside air entering guestrooms through the fresh-air door, Amana, GE, and other PTAC manufacturers have offered a solution: dropping in an independent, miniature 6" by 4" preconditioning coil module. Just about the size of a soup can, this micro-compressor sits on top of the primary system by the fresh-air door in the dead space of the PTAC unit. When the humidistat level reaches about 60%, the micro-compressor kicks on and dehumidifies the incoming air stream.

However, several engineers interviewed for this report expressed concern over the efficacy of such micro-compressors—doubting, for example, whether the PTAC miniature drop-in air conditioner module can bring a humid 35 CFM at 95 degrees Fahrenheit to 72 degrees Fahrenheit while also ringing out enough humidity to make that space neutral. While the fresh air "exhaust" fans on these systems are rated at 35 CFM (cubic feet per minute), the airflow may be hampered as it travels around various obstructions, which results in

increased resistance to flow and effectively cuts the CFM in half.

"With hot, humid air pouring into a building," Marriott's Terry Smith explained, "I must be sure that the dehumidification section can react fast enough to keep the incoming airstream at roughly room neutral — 70°F/50% RH."

Lastly, as with any mechanical system, adding more moving parts may also increase maintenance costs, energy load and noise level.

"I think the micro-compressor is a great idea. It is a cost-effective solution," said John Seipp, Vice President, Capital Planning & Project Management at Marriott International, Inc. "However, it probably is going to be noisier for the size and adds an additional energy load."

TAKING A STEP FORWARD WITH VARIABLE-SPEED INVERTERS

One significant development in energy efficiency for the next generation of PTAC units will be the introduction of advanced variable-speed inverter technology. Compared to a traditional constant-speed PTAC unit, a variable capacity inverter reaches a set point faster and maintains precise temperatures with minimal energy use.

Constant-speed PTAC units run

I WOULD TELL YOU THAT FRESH AIR HAS BEEN FRONT-BURNER FOR ME FOR YEARS.

TERRY SMITH | *VP of Engineering at Marriott*

at full capacity and then shut off. This stop-start cycle results in a higher power consumption than a variable-speed system. And unlike variable-speed technology, constant-speed units create wide temperature swings, because when the unit is off, it is not dehumidifying or cooling until it starts up again.

In variable-speed systems, on the other hand, the inverter varies the speed of the compressor motor to continuously regulate the temperature. At initial start-up, the unit reaches a designated set temperature and then reduces capacity as the set temperature is achieved by slowing the compressor speed, which in turn drops the refrigerant flow rate. The compressor never shuts off completely. The system maintains the set temperature by constantly monitoring the capacity needs—ramping up or down to meet those needs based on the demand.

Because variable-speed inverters work at a lower capacity, on average, less power is consumed, offering quieter operation and significant energy savings. Inverters allow the system to consume only the exact minimum

amount of power required at any given moment.

This precision is especially helpful because PTAC systems are often specified for the worst-case scenario—oversized, for maximum load. Inverter technology will allow hotels more flexibility in how they design. And because sharp fluctuations in the load are eliminated, the life of the system should be extended.

The disadvantage of inverter technology is that until inverters become more common, they'll add an additional level of complexity for field repairs.

EFFECTIVE, ENERGY-EFFICIENT INVERTER-COMPRESSOR VTAC

According to Marriott's Terry Smith, a significant advance in PTAC technology is about to change the industry's thinking.

"Friedrich now has an inverter-compressor PTAC unit on the market," explained Smith. "Because of the inverter-compressor technology, the energy savings you get are unbelievable."

In fact, Friedrich already markets to the hotel industry an inverter-compressor VTAC (a vertical PTAC), which Marriott has successfully tested. VTACs are closet-mounted single-packaged units.

"We had Friedrich run some energy analysis for us on it," said Marriott's Terry Smith. "It's in the 2- to 3-year payback. Can be upward to 4, but it's pretty darn good."

Friedrich brands the vertical unit "VRP," and according to Blair Hildahl, Principal at Base4, the VRP is highly effective at providing in-room humidity control and addressing IAQ concerns.

Hilton's Rick Frey agrees: "Most PTACs and VTACs can control temperature, but any humidity control is subsequent, or ancillary, to the temperature control. The Friedrich VRP unit specifically cools and addresses room humidity."

TECHNOLOGY INNOVATION: INVERTER PTAC

Similar to Friedrich's VRP vertical unit, the new Friedrich inverter PTAC unit brings in fresh outside air through a distinctively unique method. The Friedrich PTAC bypasses the constraints of the secondary 6-inch coil module, opting instead to blow fresh air across the primary evaporator coil.

Rather than a separate micro-compressor—as other PTAC manufacturers employ to

precondition the incoming fresh air—the Friedrich inverter PTAC pulls the outside air, unrestricted, up through the series of fans and introduces it to the front primary evaporator coil that is already doing the normal workload of the system.

“We should get the same benefits out of the inverter-compressor PTAC that you get out of the inverter-compressor VTAC once its available,” said Marriott’s Terry Smith.

The efficiency of the Friedrich unit is twofold: the system eliminates the secondary micro-compressor found in other systems, and it is also the first variable refrigerant flow, inverter-compressor PTAC unit on the market. As the units should therefore bring in more outside fresh air, they will lessen the requirements for dedicated rooftop make-up air systems—allowing a downsizing of the whole building make-up air.

MEETING ASHRAE MINIMUM STANDARDS

Building codes require “ventilation for acceptable indoor air quality” in a guestroom whenever the space is occupied. There are two primary methods by which hotel owners meet ASHRAE and ICC/IBC code requirements: a full dedicated outdoor air system (DOAS) directly ducted to the

guestroom or an outdoor air PTAC/VTAC unit.

Hotel franchises, such as Hilton, Marriott, IHG and Hyatt, meet—and sometimes exceed—ASHRAE minimum fresh air ventilation rates for hotel guestrooms. To achieve LEED certification, buildings should comply with ASHRAE minimum fresh air requirements.

“In most cases, the codes are based on ASHRAE standard, so we would not want to go less than ASHRAE standard because doing so may not comply with local codes,” said Hilton’s Rick Frey.

MARKET SEGMENTATION

Very few major hotel brands own their building assets. While some assets not owned by the hotel brand are still managed and operated by the brand (who are thus incentivized to optimize energy savings), the majority of hotel building assets in the US are franchise properties, paying royalties and fees to the hotel brand.

The select-service product market has grown very price-competitive in recent years. About 2,800 investment ownership groups have possession of almost all franchise properties. Investors include pension funds, LLCs, insurance companies and owner-developers. The investment

community is short-term, first-cost driven, to the point that payback from energy efficiency ranks far down the ladder of importance.

SIGNIFICANT ENERGY SAVINGS AND MAKE-UP AIR NOW IN THE HANDS OF THE HOTEL INDUSTRY

With nearly 5 million guestrooms in the US, the hotel industry holds a tremendous opportunity to reduce America’s overall energy use. The number of installed PTAC units is expected to grow significantly, along with the growth of the industry itself.

More efficient PTAC units should be a logical inclusion in high-performance buildings. They are inexpensive first-cost units, with simple maintenance, in which downtime affects only one guestroom.

With the latest PTAC technology providing low-cost ventilation, thermal comfort and humidity control, the hotel industry can seize this opportunity and take a leading role in HVAC energy reduction, globally.



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