INTRODUCTION TO STANDARD AIR CONDITIONERS AND HEAT PUMPS

When people travel on business or pleasure and rent a room at a hotel, they expect comfort, quality, and especially the air conditioning in their room to be reliable, easy to control, and quiet. In order to maximize guest satisfaction, hotel owners and managers must keep these customer needs in mind when choosing the most reliable and affordable air conditioning options.

Understandably, the demand for an appropriate level of comfort for guests to enjoy a restful environment while traveling is ever increasing. The quality of the guest room’s air conditioner plays a vital role in overall guest comfort and subsequent satisfaction through an array of benefits. Consider the advent of the 100 percent hotel satisfaction guarantee programs offered by some national hotel brands and the ability guests have to voice their feedback through online hotel reviews and social media. This ability to rate a hotel for quality and comfort leads to an ever-increasing sensitivity on the part of hotel owners to pay special attention to the guest experience.

INTRODUCTION TO PTACs AND PTHPs

Currently, most hotel rooms throughout the United States likely include a Packaged Terminal Air Conditioner (PTAC) or a Packaged Terminal Heat Pump (PTHP). Patented in Louisville, Kentucky in 1961 by General Electric, both PTACs and PTHPs were designed to provide air conditioning, heat, and dehumidification for the specific environment of a hotel room. Moreover, PTACs and PTHPs have conveniently retained the same dimensions, with a width of approximately 42 inches, a height of 16 inches, and a total depth of about 21 inches. These dimensions include the through-the-wall sleeve and the unit projecting out from the sleeve. However, these dimensions do not include the outdoor grill. Due to the PTAC and PTHP’s success, approximately 450,000 PTAC units are sold in the United States annually, which includes electric-resistance-only and heat pump models.
PTAC models are offered with electric resistance heat, while PTHPs offer heat pump heating along with back-up electric resistance heat. Both models provide air conditioning, but only PTHPs offer the efficiency of heating in heat pump mode. For cooling, a typical PTAC utilizes the R410A coolant and pulls air from the hotel room into the PTAC unit. The room air is drawn across a cold evaporator coil on the room side, where the heat is withdrawn and absorbed by the R410A refrigerant; the cooler air is then distributed back into the hotel room. In contrast, when a PTHP is heating in heat pump mode, the coolant reverses with the use of a reversing valve. When the refrigerant flow is reversed, heat is drawn from the outside air and deposited into the room.

Standard air conditioners do not have a reversing valve so they can only move the heat from inside the room to outdoors (cooling mode only). This marks the primary distinction between a standard air conditioner and a unit that features a heat pump, which is important for the hotel room environment. A heat pump has a reversing valve that moves the heat from inside a room to outdoors (cooling mode) or reverses the cycle and moves the heat from outdoors to inside the room (heating mode).

PTAC and PTHPs also offer versatility because they can be used in other markets. Although PTACs and PTHPs are primarily sold in the hospitality market for comfort in guest rooms, they also have applications for the property management, education, multi-family, health care and business industries, and are also often used in home additions and sunrooms.

Air Conditioning, Heating, and Dehumidification in One Package

Hotel guests are more comfortable when the humidity level is relatively low, so moisture removal is an important function of an air conditioner. Excessive humidity conditions may be a contributing factor to indoor air quality problems, especially in warmer climates with high precipitation. However, PTACs and PTHPs have the ability to deliver complete comfort for guests in the most humid regions. For proper dehumidification, sizing of the air conditioning system is extremely important. For instance, while using an oversized air conditioner may cool the room quickly, the oversized unit would not run long enough to dehumidify the air properly. A heat load analysis should be performed by a professional engineer to determine the air conditioning and heating requirements.

Some PTAC models offer technology that reduces the amount of moisture in a room by 20 to 35 percent over standard models. This is called a Dry Air Model. By using a Dry Air Model, guests are more comfortable in rooms with lower humidity. A room with a lower humidity level will feel more comfortable than the same room set a fewer degrees cooler that has higher humidity levels.

IMPORTANT FEATURES FOR CUSTOMERS AND HOTEL OWNERS

The overall benefits of PTACs and PTHPs is that they provide individual comfort control for hotel guests, all the while, providing ease of maintenance and low costs for hotel owners. PTACs and PTHPs offer reliability, efficiency, quiet operations, and an appealing appearance.

Reliability

The reliability of PTACs and PTHPs starts with a simplified structure, which provides ease for day-to-day maintenance as well as a reasonable investment in regular servicing from an air conditioning technician. For instance, the premium guard corrosion protection keeps each part performing at peak condition, for long-lasting results. In addition, PTACs and PTHPs have integrated structural components for additional ease of maintenance and support. PTACs and PTHPs also offer a durable design. For example, a rustproof SMC base pan is available on some models that is as durable as metal and will not chip. Technicians can also diagnose problems quickly by accessing the service diagnostics port available with some manufacturers. With some manufacturers the thermostat, central desk control, and external fan can be connected quickly, offering multiple options for room control and comfort.

Also, some PTAC/PTHP units are equipped with universal heaters allowing installation flexibility and fewer on site spare chassis. These units are connected to the building power supply by a unique power connection kit. By utilizing a separate universal power connection kit, each unit is capable of providing various outputs of electric resistance heat to more closely meet the heating requirements of the particular room, thereby increasing the installation flexibility of the particular chassis. The appropriate kit is determined by the voltage, the means of electrical connection (cord and plug or permanently connected) and the desired resistance heat output required for the space and supported by the branch circuit.

Efficiency

Hotel owners are also concerned with efficiency in their air conditioning units, and for good reason. Some heat pump brands offer models that are 300 percent more efficient than electric resistance models. In addition, some models can operate in heat pump mode for heating a typical sized hotel room down to 25 degrees Fahrenheit. The lower the temperature that a heat pump model can operate, the higher the savings for the hotel owner.

The Coefficient of Performance (COP) of a heat pump is the ratio of the heating provided over the electrical energy consumed. The COP provides the measure of performance for PTHP heat pumps. The relative efficiency of a heat pump compares the efficiency of the
heat pump unit to electric resistance models. Consider an average electric-resistant model, which produces approximately 1 unit of heat for every 1.0 unit of electricity that it utilizes. For a PTHP with a COP of 3.0, the PTHP will produce three times as much heat for the same electric input wattage used for an electric resistance heat model. This means that for every dollar of electrical cost going into a heat pump, an equivalent of 3.0 units of heat is produced. This comparison between average electric-resistant models and heat pump models shows significantly clear distinction where energy efficiency is concerned.

Over the lifetime of a standard heat pump model, a hotel owner could potentially save thousands of dollars per unit, depending on the market. This is because the lower the temperature that a PTAC operates in heat pump mode, the longer the heat pump will operate, providing more savings.

FEATURES THAT CONtribute TO AN EFFICIENT AND QUIet PTAC/PTHP PRODUCT

Energy Measurement
In the United States the PTAC and PTHP industry measures cooling efficiency in EER (Energy Efficiency Ratio). EER is the ratio of cooling provided in British Thermal Units (BTU’s) to the energy consumed in watt hours (measure of electrical energy equivalent to a power consumption of one watt for one hour). A higher EER rating translates to better efficiency. Some PTACs even have EER ratings as high as 13.4 and COP ratings as high as 4.0, offering excellent efficiency and savings opportunities to hotel owners.

When considering power consumption efficiency as it relates to guest comfort, there is a substantial difference between heat pump models and the temperature they can operate at when utilizing the heat pump mode. While some PTHP models can effectively operate at 25 degrees Fahrenheit, others can only operate in heat pump mode down to 42 degrees Fahrenheit. Because some markets have outdoor temperatures ranging between 25 and 42 degrees Fahrenheit for several weeks at a time, the potential savings between PTACs can be substantial when comparing the COP differences.

Switchover Point
As the outside temperatures fall, the heat pump cannot extract as much heat from the outside air. Therefore, at some point the PTHP is unable to provide sufficient heat to adequately warm the room. For this reason, Packaged Terminal Heat Pumps also provide electric resistance heaters as backup to heat pump operations. The PTHP units cease the heat pump operation and change to a more expensive electric resistance heat at a predetermined outdoor temperature to compensate for the inability of the heat pump to get enough heat from the outdoors to maintain room temperature. This operation is called the switchover point.

Balance Point
An important consideration in the features of a PTHP unit is the balance point of the installation. The balance point refers to the threshold at which the heat pump is unable to produce enough heat to compensate for the heat loss of the room or area being heated. Every room environment is unique with different insulation, floorplans, dimensions, types of windows, etc. In addition, each space features different kinds of construction materials and directional exposures. All of these variables, in addition to geographical location, must be considered in order to determine the heat loss of the room. For these reasons a consulting engineer should be engaged to calculate the heat loss and specify which heat pump unit is required.

Heat Pump Defrost
When the temperature/moisture content of the outdoor air reaches a specific level frost can accumulate on the outdoor coil during heat pump operation. Some heat pumps use microprocessors to determine the need for defrosting, based on a continuous compressor running time, outdoor coil temperature, and the rate of temperature change of the outdoor coil. When defrosting is required, some heat pump models reverse the flow of refrigerant to direct the hot gas into the outdoor coil to melt the frost buildup. This active defrost feature is advantageous in comparison to passive defrost models because passive defrost models must wait until the frost melts due to rising outdoor temperatures in order to reengage the heat pump operation. Based on weather conditions, it could take weeks for the outdoor temperature to reach temperature levels high enough to defrost the coils of a passive defrost unit.

Before and after the reverse-cycle defrosting, some models disengage the compressor to allow the refrigerant pressures to equalize throughout the system. This eliminates the possibility of a loud reversing noise. During these periods of pressure equalization, the full resistance heat capacity of the unit is activated to help assure room comfort conditions during the defrost cycle. The unit remains in the defrost cycle for a minimum of 3 minutes and up to a maximum of 9 minutes. The defrost cycle terminates when the outdoor coil reaches a temperature of 68 degrees Fahrenheit, or once the maximum time has been reached. Upon completion of the defrost cycle the unit automatically shifts back to normal heating operations.

Quiet Operations
Reliability and efficiency are of utmost importance to hotel owners, but guest comfort is also a top priority. The need for hotel guests to experience a quiet environment is paramount in the hospitality industry, so the ability to limit sound that transmits through or is produced from a PTAC unit is becoming increasingly important to hotel franchisees. Many hotel brands evaluate their guest satisfaction levels and take those satisfaction results very seriously, so if a guest sleeps poorly due to noise from the PTAC unit or from the outside, they complain and give the hotel low online ratings. These poor ratings will negatively influence potential guests and may lead them to choose a different hotel. Also, many hotels compensate guests if they have a complaint about the room or their stay. So a noisy PTAC could be causing a loss in revenue to the hotel property. Newer and well-designed PTACs can offer the necessary quiet that guests require, generating positive online ratings.

Where sound level is concerned, PTAC acoustics can be divided into three categories: sound transmission loss, operational sound, and sound quality. Sound transmission loss is a measure of the ability of a barrier to stop sound from passing through. Since the PTAC is a component of the building exterior (envelope), the ability of the PTAC to block sound from outdoors is often specified by architects designing the building.

Operational sound is a measure of the sound generated by the PTAC. The PTAC has three main sources that generate sound: the indoor fan, the outdoor fan, and the compressor. Operational sound level is recorded when all three sources are active, during high cool mode operation. The level is measured using AHRI 350 Standard for Sound Performance Rating of non-ducted, indoor air conditioning and heat pump equipment.
CONTINUING EDUCATION

Operational sound levels can be expressed in either sound pressure level or sound power. Sound pressure level is dependent on many factors, including the distance in which the measurement is taken from the PTAC unit and the specific environment in which the measurement is taken (room construction materials, carpets, furniture and so forth). On the contrary, sound power level does not depend on the location of the microphone or acoustic treatments in the room. Instead, it is dependent on the unit itself, which therefore makes sound power the preferred method of comparing PTAC sound levels.

The PTAC and PTHP design has three sources that generate sound: the indoor fan, the outdoor fan, and the compressor. The large cross-flow blower, two DC fan motors, and smart fan cooling and heating keep the unit quiet while providing efficient heating and cooling performance.

Features such as a DC fan that gradually ramp up in speed in order to reduce quick start-up sounds are important to minimize sound.

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QUIZ

1. PTACs and PTHPs have the ability to deliver complete comfort for guests in even the most _______ areas.
   a. arid  b. arctic  c. humid  d. dry

2. Some PTAC models called Dry Air models offer technology that reduces the amount of moisture in a room by as much as ___ percent over standard models
   a. 5  b. 25  c. 50  d. 75

3. True or False: PTACs and PTHPs can only be used in the hospitality market for comfort in guest rooms.

4. A ______ COP measurement, means ______ efficiency from the PTAC while it is in heating mode.
   a. higher, more  b. higher, less  c. lower, less  d. lower, more

5. Some PTACs have EER ratings as high as ____, which results in offering excellent efficiency and savings opportunities to hotel owners.
   a. 5.0  b. 13.4  c. 20.0  d. 44.0

6. Much of the operational sound level is determined by measuring the sound that comes from __________, during high cool mode operation.
   a. the indoor fan and outdoor fan  b. both fans and outside environmental noises  c. the indoor/outdoor transmission  d. the indoor fan, outdoor fan, and compressor

7. Sound ______ does not depend on the location of the microphone or acoustic treatment in the room. Instead it is dependent on the unit itself which therefore makes sound ______ the preferred method of comparing PTAC sound levels.
   a. power  b. pressure  c. transmission  d. level

8. A bulkhead located in the chassis of a PTAC/PTHP covered completely in _______ can dramatically increase a PTAC/PTHP STC score
   a. aluminum  b. metal  c. mastic  d. porcelain

9. A PTAC and PTHP unit with makeup air utilizes a trusted and reliable packaged terminal air conditioner with an additional ______ system to provide and deliver makeup air directly to each individual room.
   a. back-up  b. dehumidification  c. comfort  d. operating

10. According to ________, rooftop make-up air systems must utilize individual ducts and fire dampers that lead to each individual room.
    a. OITC ratings  b. the agency listing  c. government regulated safety  d. current codes and standards

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The sound pressure in the room due to the PTAC operation is much like the temperature in the room; it will vary depending on where the measuring device (microphone or thermometer) is located. For instance, when the PTAC is in heating mode, the temperature will increase closer to the PTAC, much like how the sound pressure will increase closer to the PTAC. On the contrary, the sound power of the PTAC and the electrical power of the PTAC should remain the same regardless of the measurement location. For this reason, it is ideal to compare two sound power levels, not sound pressure levels when comparing PTACs.

Sound power is typically expressed in units of decibels (dB). It is a common practice for a third-party laboratory to measure the operational sound data. During this test, the PTAC is usually installed in a filler wall much like in ASTM E90, which is a standard test method for laboratory measurement of airborne sound transmission loss of building partitions and elements. Sound power results are then averaged for three PTACs tested (one for each manufacturer being compared) and rounded up to the nearest tenth.

**Sound Transmission**

We’ve discussed the importance of providing a quiet, peaceful environment for hotel guests, but standard outdoor noises such as those from traffic or airports present challenges to hotel owners everyday. Fortunately, PTAC and PTHP units are able to block most outdoor noise with some models reaching a sound transmission class (STC) of 29, which is among the highest PTAC ratings on the market. That means PTACs and PTHPs can help guests sleep better and support high guest ratings for hotel and motel properties.

When the sound from outdoor sources (such as traffic noise) reaches the PTAC, some of the sound is reflected back, some of the sound is absorbed by the unit, and the remainder of the sound is transmitted into the room. Sound transmission loss through a PTAC is usually measured in a filler wall much like in ASTM E90. However, the rating weighs heavily towards the lower frequencies. Since most traffic noise is dominated by the lower frequencies, OITC is considered a better indicator of PTAC’s ability to block sound from being transmitted from outside to inside in most hospitality installations. Like STC, a higher OITC rating indicates superior performance.

**ENVIRONMENTAL FACTORS AND ACCESSORIES AFFECT RELIABILITY**

You must consider environmental factors when specifying a PTAC/PTHP system. It is best to avoid bringing corrosive air (near the ocean, for instance) into the living space. With this in mind, makeup air systems and ICR units (defined later) are not recommended for installation within 2 miles of coastal areas.

In addition, there are detriments to under sizing or over sizing a unit. If the cooling capacity is less than what is required for a specific space, then the air conditioner is under sized. In the case of an undersized air conditioner, the unit will typically not be able to cool the space down to the desired temperature (thermostat set point). Additionally, the air conditioner may not be able to remove enough moisture from the air. The result of an undersized air conditioner would yield either a warm and humid space, or a warm and dry-conditioned space.

If the cooling capacity is greater than what is required for a specific space, then an air conditioner is oversized. In this case, the unit will typically cool the space down to the desired temperature (thermostat set point) too quickly and the compressor will turn off. Because dehumidification only takes place when the compressor is operating in the cooling mode, a typical result for an oversized air conditioner in a hot and humid climate could result in a cool but excessively humid space.

**Internal Condensate Removal Systems**

Condensate removal in the winter is an important factor that can potentially impact both the maintenance of a PTAC unit and the exterior installation within 2 miles of coastal areas. However, some PTAC’s and PTHP’s use baked on mastic on the entire length of the bulkhead to dampen sound entering the room. A similar material is installed in the doors of high end automobiles.
An Internal Condensate Removal system utilizes a small pump to lift water from the base pan and push it into a collector tray positioned above the indoor coil. If an excess amount of water is pumped to the indoor side, it is routed back to the outdoor portion of the base pan. wall of a property. Some PTAC models offer an Internal Condensate Removal (ICR) system. This system has been available since 1982 and thousands of them are in use. During heat pump operation, the ICR system utilizes a small pump to lift the water from the base pan and push it into a collector tray positioned above the indoor coil. The water drains from the collector tray and drips onto the warm indoor coil where it is evaporated into the room atmosphere.

However, if an excess amount of water is pumped to the indoor side, it is routed back to the outdoor portion of the base pan. This system minimizes the dripping of water on the building structure, windows, and sidewalk during the winter weather months and helps to prevent potentially dangerous icicles or frozen patches from forming beneath the unit.

Aesthetics

Of course, aesthetics play a large role in the hospitality industry as well. PTACs and PTHPs boast a sleek appearance and light color that blends in seamlessly with any hotel décor and room design. The industry-standard is 42 inches wide by 16 inches high, cutout with a shallow depth. These dimensions provide more open, usable space in the room itself. There are both standard and customized options for outdoor grills so outdoor walls look more styled and streamlined. The system interface should feature easy-to-use controls with a clear LED readout to provide a user-friendly experience for hotel guests, as well as an automatic dimming feature to ensure the LED lights are never too bright at night.

Architectural Window/Louver Installation

Many installations utilize an architectural window/louver combination to enhance the exterior appearance of the building. The exterior grill for the air conditioner is built as an integral part of the window frame. An internal drain system is highly recommended for these installations. When this type of installation is made, there must be a provision in the grill work for condensate water to drain to the exterior (including the overflow relief drain holes).

Featured Accessories

The sub-base, which hides the electrical connection, is an optional accessory for PTAC and PTHP units. Keep in mind that the decision to use a sub-base in the installation is a factor in the location of the wall opening for the unit.

National Electrical Code requires that air conditioning units connected to voltages in excess of 250 volts must be permanently connected. Permanent connection generally means that wiring to the unit must be contained in an enclosed chaseway where access to the wiring connections is more restrictive than a normal line cord plugged into a receptacle. National Electric Code (NEC) requirements may be met by using a flexible or rigid conduit to contain the wiring between the unit and the junction box that contains the wiring connections. The conduit is connected to the unit and to the junction box with connectors to hold the conduit in place. The junction box may be located in the floor or the wall of the structure but only approved connectors may be used outside the unit or the junction box.

There are some installations where units connected to voltage sources under 250 volts may also need to be permanently connected. When there is doubt about the requirements for a particular installation, consult a local electrical inspector as well as Article 440 of the NEC, which applies standards to electrically-driven air conditioning and refrigeration equipment. As a warning, these requirements are designed to protect personal safety and should be strictly followed. Although NEC is cited here as a reference, all electrical wiring and installations must conform to any and all local electrical codes and regulations.

Reliability

Reliability is related to durability, and some PTAC and PTHP units are well known for their durable design. For instance, the units feature a fan cover and a rustproof base pan, which comes standard with some manufacturers. In addition, the condenser coils should be accessible, making them easy to clean. The PTAC and PTHP design also has three sources that generate sound: the indoor fan, the outdoor fan, and the compressor. A large cross-flow blower, DC fan motors, and smart fan cooling and heating (available with some manufacturers) keep the unit quiet while providing efficient heating and cooling performance. Finally, special coatings on key parts keep the unit performing at peak condition for a long time. Some models offer mastic that covers the complete bulkhead of the unit helping to reduce noise from entering the hotel room.

Durable Design

PTAC and PTHP units have been converted to provide makeup air. A PTAC and PTHP unit with makeup air utilizes a trusted and reliable packaged terminal air conditioner.

CODE CHANGES IMPACT PTACS AND MAKEUP AIR

Historically in the hospitality industry, fresh air was usually provided from a rooftop system, pumping air into the hotel’s hallways and then under the guests’ doors. However, recent code revisions have dramatically changed the methods and requirements for providing fresh air to guest rooms. Currently those systems must utilize individual ducts and fire dampers that lead to each individual room.

As an alternative to an individual ducted rooftop system, PTAC and PTHP units have been converted to provide makeup air. A PTAC and PTHP unit with makeup air utilizes a trusted and reliable packaged terminal air conditioner.
with additional fans and dehumidification system to provide and deliver makeup air directly to each individual room.

The standard PTAC/PTHP system provides individual room zone control in both cooling and heating applications. The makeup air module (a relatively new product in the industry) is a secondary sealed system that usually delivers from 25 to 50 cubic feet per minute (cfm) of continuous makeup air and dehumidifies the air when outdoor humidity levels rise. Some makeup air PTACs even offer the flexibility of adjusting the fan from 25 to 50 cfm. With this in mind, heating and cooling load requirements must increase to account for the outdoor air being introduced into the room. Note that increasing the heating-related electrical system could impact the building’s electrical panel and service needs.

Most makeup air PTACs are designed to fit into standard 42 by 16 inch sleeves, and these are primarily intended for those new construction applications where in-room makeup air is necessary.

Agency Listing
Some makeup air PTAC modules are approved by Underwriters Laboratories (UL) government-regulated safety tests, the California Energy Condition (CEC), Natural Resources Canada (NRCAN), and the Air Conditioning and Refrigeration Institute (AHRI). In addition, these modules comply with American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) minimum efficiency requirements (ASHRAE 90.1-2013) for PTACs, which establishes the minimum energy efficiency requirements for building design and construction for high-rise structures.

Design Considerations for Makeup Air
In makeup air models, the makeup air module is an extra secondary system that provides continuous outdoor air. In addition, the supplemental dehumidification system operates when relative humidity levels rise above 55 percent. Be aware that the makeup air module will increase room load requirements for both heating and cooling. Consult with your local engineer to ensure proper sizing of the makeup air PTAC unit to accommodate the additional load.

Due to the additional heating and cooling load, energy costs of the room will increase with the use of makeup air. In addition, because makeup air increases room BTU load requirements and requires additional PTAC cooling or heating, the building’s electrical needs may be impacted. With the additional dehumidification of outside air, more condensate will be generated and therefore an internal or external piped drain line is also recommended. With the added pathway or opening for outside air, take care when specifying in areas with high exterior noise (traffic, airports, and so forth) so as to avoid unintentionally bringing that noise into the room, which would disturb the guests. PTACs have a modular design on the makeup air kit, making it easier to remove the kit for servicing.

In order to achieve the best control of air temperatures in the room, hotel owners should install a wall thermostat for guests to control the makeup air.

New Makeup Air Technology
New technology in Makeup Air models will soon be available in the marketplace that provides a variable speed fan that can adjust the CFM for the MUA kit. This provides more flexibility for hotels to meet the CFM required for the various size rooms and hotel applications. In addition these models will have a powered vent door that can be tied to an Occupancy Sensor where the vent door will close and the Makeup Air module will shut off when the hotel room is not occupied. These new features will meet future building code requirements AND save energy expenses for the hotel owner.

Vertical Units—SPVU
An alternative to the PTAC and PTHP discussed to this point is a unit called an SPVU (Single Package Vertical Unit). This unit is similar to the PTAC/PTHP where all components are packaged into one housing, but this unit is designed to fit into a small closet in the corner of the room and has the option to do multiple rooms.

The SPVU offers an excellent alternative to standard PTACs for cooling and heating a variety of rooms—giving guests and travelers home-like comfort wherever they go.

Addressing common complaints, like noise level and appearance, the SPVU offers quieter operation with greater temperature control. Closet installation allows for a more home-like appearance with extra room for versatile design. Most importantly, it provides the cost benefits of PTACs with the added flexibility of a central system, as the SPVU can serve a single room or multiple rooms.

CONCLUSION
With the benefits of PTACs and PTHPs, hotel guests will be provided with a comfortable, air-conditioned environment during their travels. They can expect the air conditioning operation in their room to be reliable, easy to control, and quiet. Hotel owners can also find satisfaction in the efficiency, easy maintenance, and convenience PTAC and PTHP units offer. In turn, the positive customer experiences will lead to higher satisfaction scores.