

PRODUCT APPLICATION GUIDE | ROOFTOP UNITS



APPLICATIONS FOR ROOFTOP UNITS AND DEDICATED OUTDOOR AIR SYSTEMS (DOAS)

Building designs of the 21st century have seen efficiency improvements like double-paned windows, lower-energy lighting, and improved insulation. In offices, bulky desktop computers have been replaced by laptops that give off less heat or by empty desks as employees work from home. These changes decrease the sensible (heating or cooling) load for HVAC systems, and therefore the total load. However, they do not diminish the latent (moisture) load, which now makes up a higher percentage of the total.

At the same time, ventilation requirements that ensure high indoor air quality (IAQ) are increasing. To maintain occupant comfort and the health of the building while meeting these requirements, humidity control is more important than ever.

Rooftop units (RTUs) as well as Dedicated Outdoor Air Systems (DOAS) have therefore been engineered to simultaneously control temperature and humidity while modulating to operate efficiently and minimize energy costs. Engineers often wonder when and where to apply each type of unit. This guide provides information on that topic as well as example application scenarios.

KEY COMPONENTS OF ROOFTOP UNITS AND DOAS

The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) categorizes unitary air conditioners and heat pumps using partial recirculation under Standard 340/360 if they have a heating and cooling capacity greater than 65,000 BTU/hour. Commercial and industrial units fall into this category. These are factory-made, electrically operated assemblies that include a cooling coil, an air moving device, and a combination of a condenser and compressor(s).¹

DOAS units, which are designed for 100% outdoor air (OA) applications and capable of providing cooling, are certified by AHRI under Standard 920. They must be able to dehumidify 100% outdoor air to a low dew point and provide “reheat that is capable of controlling the supply dry-bulb temperature of the dehumidified air to the designed supply air temperature. This conditioned outdoor air is then delivered directly or indirectly to the Conditioned Space(s).”²

Beyond these definitions are core features that a rooftop or DOAS unit must have to support healthy and comfortable buildings for the long haul.

- **Variable speed compressors:** These use an inverter scroll to control the compressor’s motor speed. This allows for speed to be adjusted during part load conditions to precisely modulate cooling capacity and efficiently meet the setpoint.
- **Injected foam-insulated cabinet construction:** This reduces air leakage, makes the unit quieter, and allows it to hold up in extreme weather.
- **The option for modulating hot gas reheat (HGRH):** This feature, commonly used on DOAS units to meet the reheat requirement, also allows an RTU to optimize comfort in an indoor environment. It uses hot refrigerant from the compressor discharge to reheat dehumidified air, controlling humidity without overcooling the space.
- **The option for a modulating gas furnace:** Modulation allows the furnace to adjust its heat output in small increments to closely match the heating demand, saving energy and providing consistent indoor temperatures.
- **Modulating direct drive fans:** These fans vary airflow based on real-time demand, controlling air pressure to create a more comfortable space with less infiltration. They also enhance energy efficiency with reduced wear and maintenance.



Regardless of whether you are using an RTU or DOAS unit, modulating components and injected foam-insulated cabinets are essential for ensuring space comfort and controlling operating costs over time.

DESIGN CONSIDERATIONS

RTUs are a common choice for commercial buildings where a single system can efficiently manage both comfort loads and ventilation. By mixing outdoor air with return air, these units provide heating, cooling, and required fresh air in one package. They are well-suited for offices, retail, schools, and other general-purpose buildings where internal loads from people, lighting, and equipment drive most of the HVAC demand. Their simplicity and cost-effectiveness make them a reliable option when ventilation requirements are moderate and can be balanced within the same system.

In contrast, DOAS are designed to handle ventilation independently, or decoupled, from space conditioning. These systems treat outside air only—often with advanced dehumidification and energy recovery—before delivering it directly to the space or to zone-level equipment like variable refrigerant flow (VRF) or fan coils. These units are especially valuable in humid climates, with high-occupancy spaces, or applications where indoor air quality and humidity control are critical. By decoupling ventilation from comfort conditioning, DOAS ensures consistent code compliance and optimized air quality regardless of space load.

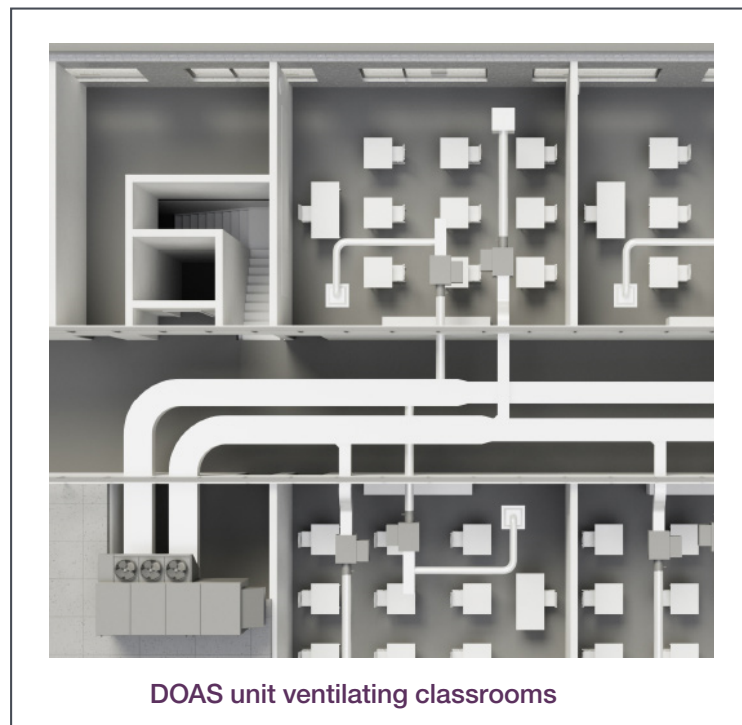
EXAMPLE APPLICATION #1: SCHOOL

Schools present many different indoor environments within the same building. Classrooms may differ from one another in temperature control needs due to teacher preference, shifting room occupancy, and other factors. Humidity can vary between spaces, especially in gymnasiums and locker rooms. ASHRAE 62.1 recommends maintaining indoor relative humidity below 65% to reduce the risk of mold and microbial growth. This standard also establishes baseline ventilation rates for schools based on occupancy and space type.

In classrooms, either an RTU or DOAS unit is an effective solution for providing the ASHRAE-recommended outdoor air rate of 10 cfm/person and 0.12 cfm/ft². They can deliver high OA percentages directly to each space as well as condition the air using multiple tempering options including direct expansion (DX) cooling, indirect gas, or an electric air-source heat pump. They also control humidity by removing moisture from the incoming airstream before it reaches the occupied space. Which type of unit to use depends on the application: RTU for mixed flow, DOAS for 100% outdoor air.

In a renovation as opposed to a new build, the ductwork and infrastructure are likely to have been designed around older RTUs that provide lower percentages of outside air without modulating components. In these situations, a newer RTU with greater efficiency, higher ventilation, and humidity control can replace the prior RTU within existing infrastructure.

In large, open spaces such as the cafeteria, RTUs provide consistent temperature control. By adjusting supply fan speed in response to space temperature, they reduce unnecessary energy use during part-load periods. They can also be used for administrative offices as part of a multi-zone variable air volume (VAV) system. An RTU is ducted to air terminal units (ATUs) serving each of the individual offices. The RTU is sized to handle the load of the recirculated air from the space and ventilate the entire system area at the required volume.

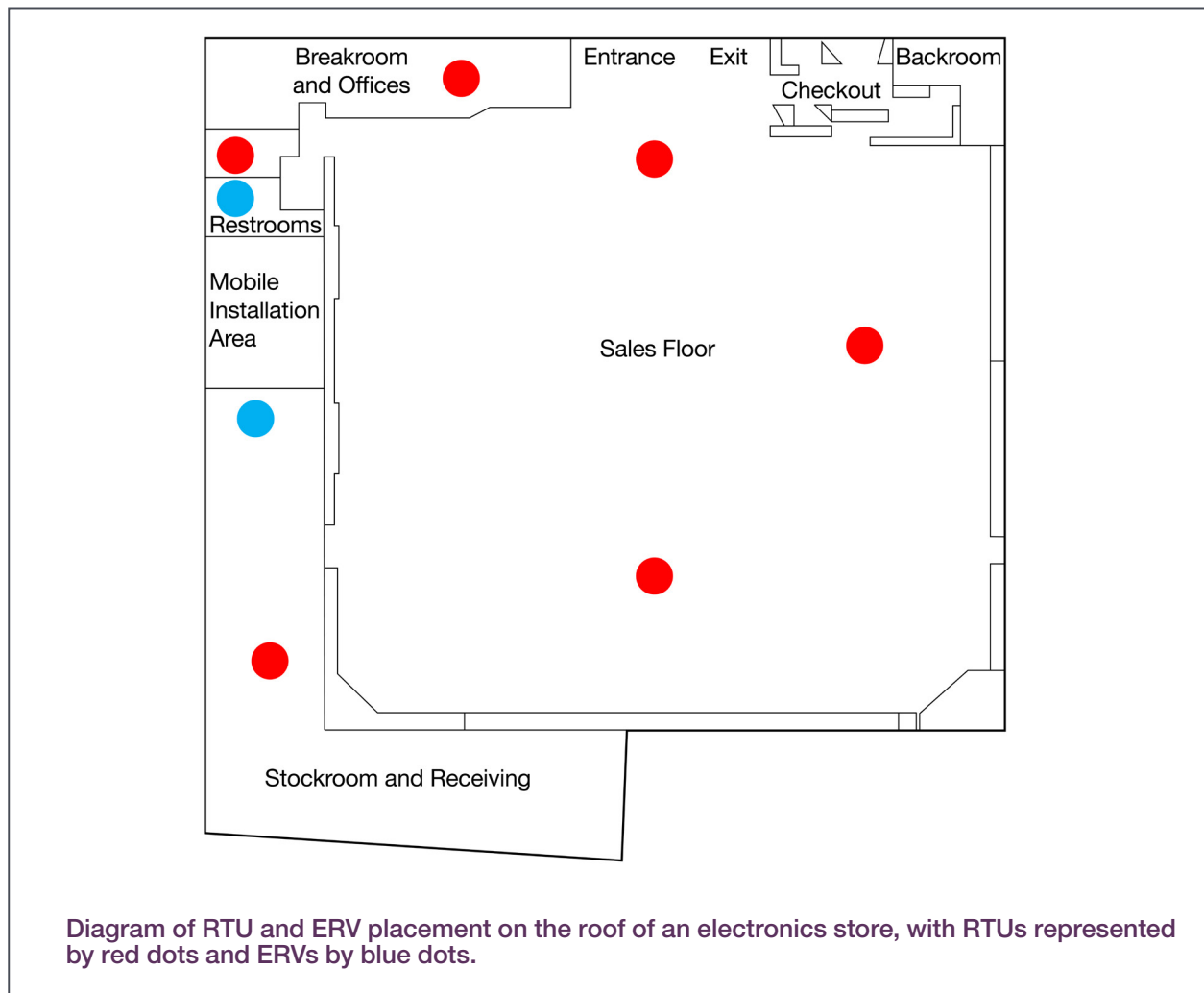


EXAMPLE APPLICATION #2: ELECTRONICS STORE

Indoor air quality is important for creating a retail environment that is inviting, comfortable, and healthy for both shoppers and staff. ASHRAE 62.1 guidelines for commercial buildings (which are not as stringent as those for schools) specify minimum ventilation rates based on occupancy type and floor area, ensuring adequate dilution of indoor contaminants.

A big box electronics store is primarily a single-zone VAV application. RTUs can effectively regulate temperature and humidity here. Humidity control not only decreases mold risk but enhances comfort so that the space does not feel over-cooled and clammy. Maintaining a proper dew point and avoiding excessive latent load buildup keeps the store comfortable even during peak summer conditions when outdoor air is hot and moist.

Stores with long operating hours can have high energy consumption. Energy recovery is therefore a useful way to keep operating costs down without compromising indoor air quality. Instead of routing return air directly to rooftop units, a portion can be directed through a decoupled energy recovery ventilator (ERV), which preconditions the incoming outdoor air. Since exhaust air is already required for depressurization and code compliance, capturing its energy for pre-treatment makes the ventilation process more efficient. Another option is to use RTUs with integral energy recovery, which requires each unit to have a ducted return from the space.



EXAMPLE APPLICATION #3: HOTEL

Wherever occupants are sleeping, indoor air quality is paramount. Hotels must provide ASHRAE-required ventilation and humidity control while allowing guests to customize the temperature in their rooms. Because guests consume different amounts of energy in the rooms, equipment efficiency is important.

ASHRAE 62.1 mandates an outdoor air rate of 5 cfm/person and 0.06 cfm/ft² in guest rooms. If 100% outdoor air is needed, DOAS should be used to ventilate rooms and corridors with dehumidified air, decoupling ventilation loads from other equipment. DOAS should also incorporate energy recovery and may be required to by code. Guest rooms will use smaller recirculation units such as fan coils for sensible heating and cooling, allowing guests to have control over their room temperature.

RTUs work well in areas that do not require 100% OA, such as lobbies, meeting rooms, and ballrooms. In these single-zone spaces where occupancy changes throughout the day and evening, RTUs can handle rapid load changes and provide responsive conditioning around the clock.

SUMMARY

As buildings have become more efficient, sensible loads have decreased more than latent loads. At the same time, code requirements and occupant expectations for high IAQ have grown. This makes humidity control more important than ever. Either an RTU that excels at precise heating and cooling with partial recirculation or a DOAS unit that focuses on decoupled 100% OA ventilation can control humidity and temperature to optimize comfort and save operating costs.

Whether you are applying a DOAS unit or an RTU, it is key to have access to features and options that adjust to building conditions, save energy, and help the unit last longer with lower maintenance. These include Mod HGRH, injected foam-insulated cabinet construction, a modulating gas furnace, modulating direct drive fans, and variable speed compressors. Incorporating these will give the system flexibility to meet high latent loads, efficiency requirements, and IAQ expectations now and in the future.

Schools, retail stores, and hotels are only a few potential applications for rooftop and DOAS units. For different scenarios and more information, talk to a [Valent expert](#) in your area.

NOTES

1. AHRI. *Performance Rating of Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment, ANSI/AHRI Standard 240/360-2022 (I-P)*. Secs 2.1.1, 3.4, pp. 1–2. Accessed September 5, 2025.
2. AHRI. *Performance Rating of DX-Dedicated Outdoor Air System Units, ANSI/AHRI Standard 920 (I-P)-2015*. Sec 3.3, p. 1. Accessed September 5, 2025.



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