

PRODUCT APPLICATION GUIDE

A technical bulletin for engineers, contractors and students in the air movement and control industry.

Energy Recovery Ventilators – Stand Alone vs. Bolt-on systems

Many HVAC system designers have realized the benefits of using Energy Recovery Ventilators (ERVs) in commercial and institutional buildings. However, as with many newly adopted technologies, questions of how best to apply this product are being raised. One application issue in particular is whether to apply an ERV as a stand alone unit on its own curb, or as a bolt-on accessory to a rooftop air conditioning unit.

What is the difference between the two systems? Although both systems require an exhaust air stream as an energy source to pre-condition outdoor air, the primary difference between the two systems is where the exhaust air is taken from. The drawings at the right illustrate this difference and help visualize how the ERVs tie into the HVAC ventilation system.

Some system designers may show a preference for the bolt-on ERV. This may be because they perceive that the installation cost will be lower, or they prefer having a single point of responsibility for the ERV/rooftop unit.

Note: The above points that favor the bolt-on units are usually promoted by air conditioning equipment sales people attempting to lump the ERVs with the air conditioning equipment.

In most cases, a system design that incorporates the stand alone ERV is superior to the bolt-on system. The fundamental reasons for this can be

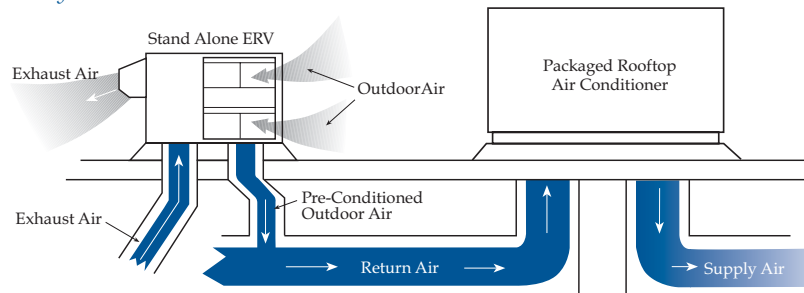
found by taking a look at more than just the outdoor air requirements. If we consider both the outdoor air and exhaust air requirements of commercial buildings, the advantages of the stand alone system become apparent.

Overall System Efficiency

The stand alone ERV system provides the most efficient method of ventilating a building because it steals energy from air that has to be exhausted anyway. The bolt-on ERV is not tied into the exhaust system allowing the conditioned air to escape into the atmosphere. In many commercial buildings, the

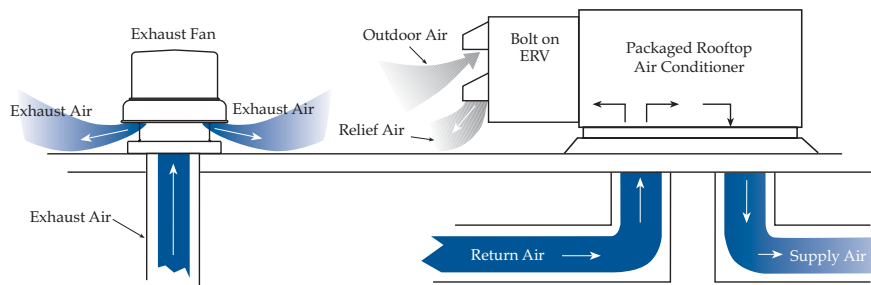
Stand Alone ERV System

A stand alone ERV system is capable of exhausting air from spaces that need to be exhausted anyway (i.e., restrooms, offices, breakrooms, etc.). An exhaust fan is eliminated by the ERV.



Bolt-On ERV System

A bolt-on ERV system draws its exhaust air from the return duct only. An exhaust fan is still required for spaces such as restrooms, offices, and breakrooms.



exhaust air code required is roughly half of the outdoor air volume. This means compared to the bolt-on unit, the stand alone ERV can recover energy from twice as much air leaving the building. The net impact is nearly double the effectiveness for the stand alone system.

To illustrate this point, let's compare a stand alone unit to a bolt-on system based upon the following:

- A commercial building requires 3,000 cfm of outdoor air based on ASHRAE Standard 62.
- Based on codes, the minimum exhaust is 1,500 cfm from areas such as restrooms and conference rooms.
- The building is to have a slight positive pressure and specifies total exhaust/relief air of 2,700 cfm (10% positive).
- Outdoor air design point is 95db/78wb and room air is specified at 75db/50% rh.

Stand Alone System: Because we can exhaust the restrooms and conference rooms with the ERV, we can recover energy from the total 2,700 cfm of exhaust/relief air. The resulting effectiveness at 3,000 cfm outdoor air and 2,700 cfm exhaust air is 75%. This pre-conditions the outdoor air from 95db/78wb to 80db/67wb. The air conditioning load is reduced by more than 11 tons.

Bolt-on System: Because we cannot recover air from the restrooms and conference rooms, there is only 1,200 cfm of relief air left to recover energy from. The resulting effectiveness at 3,000 cfm outdoor air and 1,200 cfm exhaust air is only 40%. Outdoor air is only pre-conditioned to 87db/72.5wb and the load is only reduced by 6 tons.

Ventilation Control

Combining outdoor air and exhaust air ventilation functions into a single unit help drive an important practice in good HVAC design—building ventilation balance. In layman's terms: What goes in must come out. Traditionally, the outdoor air needs and the exhaust air needs were calculated in separate thought processes. The designer would specify the minimum outdoor air and exhaust air volumes required by code, but would stop short of comparing the totals to check the ventilation balance. Frequently, this led to over pressurized

buildings where doorways were transformed into wind tunnels. In some cases, buildings became negatively pressurized and infiltration made indoor climate control difficult.

Stand alone ERV systems inherently remind the HVAC engineer to perform the building balance check because the outdoor air and exhaust air volumes are located on the same equipment schedule. Additionally, the outdoor air and exhaust air fans are interlocked within the ERV control center. This translates into the following benefits of a stand alone ERV compared to a bolt-on.

- The ventilation design is more likely to meet the engineer's intentions, typically a slightly positive building pressure.
- System balancing after installation is far easier on a stand alone system. Exhaust and outdoor air duct runs provide recommended locations for airflow measurement. Determining exhaust and outdoor air volumes in the bolt-on configuration is practically impossible.
- Exhaust fans and outdoor air fans are simultaneously energized so the building operates as it was designed. Separate controls, interlocks, and field coordination to maintain a balanced building are eliminated.

Note: In some traditional systems without energy recovery, exhaust fans were energized by occupancy sensors (i.e., motion detectors or light switches) in an effort to save energy. These systems prohibited a steady building balance and were counter-productive to proper ventilation and indoor environment control.

- Often, the system designer chooses to balance the air flow by increasing the exhaust air volume from areas such as restrooms and conference rooms. This results in fresher, better ventilated spaces and improved comfort for occupants.

Installation Cost

The installation cost of a stand alone ERV system is typically less than the installation cost of a bolt-on ERV system.

- With the stand alone ERV, the ERV is performing the function of an exhaust fan eliminating the need to purchase one.

- The exhaust ductwork is the same whether an exhaust fan or ERV is used.
- No additional roof or wall penetrations are needed for stand alone ERVs. The same penetrations that are needed for the ERV were needed for the exhaust fans as well. (In some cases, the ERV takes the place of several exhaust fans and penetrations are reduced.)
- The stand alone system is more efficient. This may allow greater down sizing of air conditioning equipment, lowering equipment cost.
- Ducting outdoor air from the ERV to the air conditioning unit is minimal. In most cases, the outdoor air is simply ducted to a return air trunk near the ERV. Additional duct work is usually less than 20 feet.

Economizer Operation

Another issue that is pertinent in a large portion of the U.S. is how to incorporate ERVs and economizers into the same system. Since the bolt-on ERV is mounted on the rooftop unit at the outdoor air intake, an economizer is not able to be incorporated into a bolt-on ERV system. This sacrifices the free cooling savings that many states require in their energy standards. See illustration above right.

Since stand alone ERVs are mounted on separate curbs and do not occupy the outdoor air intake of the rooftop air conditioning unit, the economizer section may still be easily used in conjunction with the ERV.

Note: Greenheck ERV control centers have separate contacts for exhaust fan, supply fan and wheel motors. During economizer operation, the ERV receives an economizer “make” signal from the rooftop unit and shuts down the supply fan and wheel. The exhaust fan continues to operate.

Summary

In summary, the stand alone ERV system has many advantages over the bolt-on system. When considering the total ventilation system, the stand alone ERV offers higher efficiencies, provides a more reliable means of controlling ventilation, minimizes installation costs and enables energy recovery and economizer technologies to be combined for maximum energy savings.

