

June 4, 2021

Return fans verses Exhaust fans

It is easy to understand what each type of fan does by virtue of its name but knowing when to apply an exhaust fan vs a return fan is not so obvious. This white paper explains when & how to apply these fans.

Return fan vs Exhaust (Relief) fan

Economizer applications usually require return or exhaust fans to properly control building pressure and minimum ventilation. They are not generally interchangeable for a given design and perform differently. In general:

- Return air fans (RAF) are best suited for ducted return systems (return ESP exceeds 0.4" to 0.5")
- Exhaust air fans (EAF) are best suited for open return systems (return ESP is less than 0.4" to 0.5")
- Supply air fan (SAF) selection depends on whether a return or exhaust fan is used.
 - RAF/SAF system handles only the supply ESP at design
 - EAF/SAF system handles both the supply and return ESP at design (EAF is off)

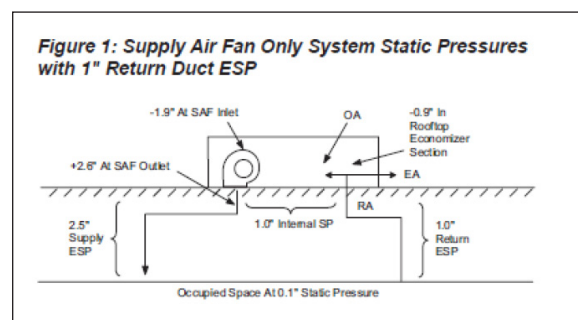


Fig 1 illustrates why SAF only units often can't control bldg pressure & ventilation, especially as return ESP increases.

- Desired space pressure is approximately 0.1" as shown
- No exhaust will occur from the rooftop because the economizer section must be at a negative pressure. Therefore, space pressure rises until exhaust occurs through doors and walls

- The air balancer must adjust the outdoor air damper to be "almost shut" and generate large pressure drops at minimum ventilation settings (about 0.9" in Figure 1). Otherwise, excess outdoor air would be pulled in. Ventilation control is much less accurate at the "almost shut" damper position, especially on VAV systems where minimum position varies with load

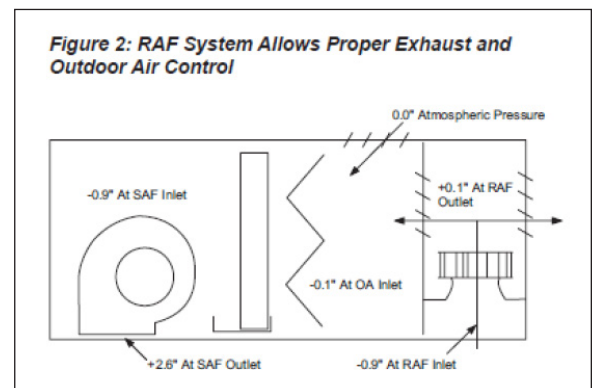


Figure 2 illustrates how the addition of a RAF corrects these problems. The RAF is responsible for return system ESP and maintains a slightly positive pressure in the economizer section (about +0.1" in Figure 2) to allow for proper exhaust and better ventilation control.

EAFs are very different from RAFs:

- EAFs provide less effective building pressure and ventilation control as return duct ESP increases. The EAF is normally off during non-economizer operation. During these minimum outdoor air conditions, the system essentially acts like a SAF only system.
- EAFs cannot maintain a slightly positive pressure in the economizer section, so ventilation control is no better than that of a SAF only system
- EAFs can successfully operate and save energy on designs with reduced return ESP for the following reasons:
 - EAFs and RAFs are generally much less efficient than SAFs. EAFs can sometimes be cycled off while RAFs must always run. SAFs have more static applied to them so operating points are typically more efficient.

- EAFs are designed for peak exhaust cfm which occurs during economizing. RAFs much be sized for design return cfm. Peak exhaust cfm generally is less than the design return cfm

When switching a design from RAF to EAF remember to add the additional static pressure the RAF handled to the SAF total static requirement.

