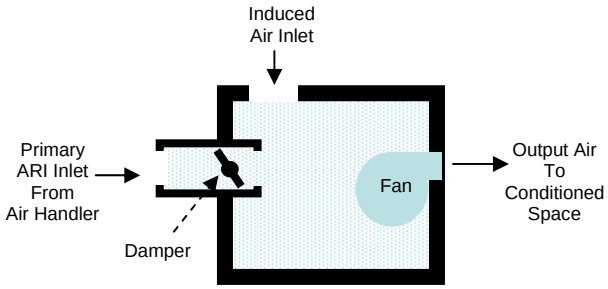
Air-Conditioning and Refrigeration Technology Institute

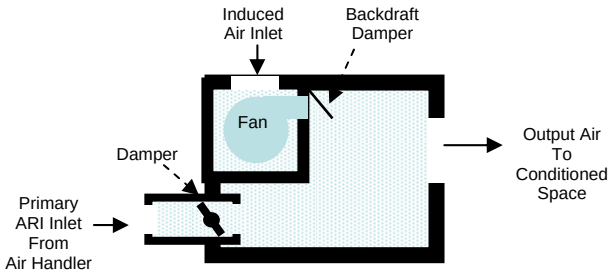
Project Summary

Comparison of Total Energy Consumption of
Series Fan Powered Terminal units versus Parallel Fan Power Terminal Units

Fan powered terminal units are used widely in commercial office buildings to distribute comfort cooling and heat to rooms or zones of a building. There are two types of designs for fan power terminal units; series and parallel.



Series Fan Powered Terminal



Parallel Fan Powered Terminal

In a series fan powered unit, the terminal's fan is located at the terminal's exit to the conditioned space and is "in line" or "series" with the airflow from the central air handler. Series fan terminals are typically used in constant volume (CV) terminal applications in which the fan runs continuously during the normal work day. In a parallel fan powered unit, the terminal's fan is located at the room induced air inlet and it is "parallel" with the airflow from the central air handler. The fan turns on and off during occupied hours, providing a variable air volume (VAV) air flow.

Since the fans on parallel fan terminals operate intermittently during the work day, it is commonly perceived that that the parallel design is more energy efficient design. However, results from this project indicate that the common perception is not always true.

In testing a number of fan powered terminal units, researchers found that typical parallel fan terminals experience considerable air leakage not only from the back-draft damper, but also from seams of the terminal box. This leakage short circuits a portion of the airflow from the central air handler and by-passes the room to be conditioned. The net result is more energy to move more air to maintain comfort in the conditioned space.

Leak rates for some of the parallel fan terminals tested were over 30%. The average leakage rate was between 10 to 20%. Subsequent computer modeling showed that air leakage has a significant impact on the relative energy consumption of the two types of fan powered terminal units. When there was no leakage the parallel fan terminals are more efficient, consuming 17% less energy than series fan terminals. When a 10% leakage rate

was introduced the parallel terminal unit's energy consumption was only 3 to 4% less; and when a 20% leakage rate was introduced the series terminal unit out performed the parallel unit - using 5.5% less energy.

This research was valuable to manufacturers and building design engineers by providing new insights into the magnitude of air leakage in parallel fan powered terminals and its impact on system operation and overall energy consumption. It also serves as a useful reference in prompting changes in building energy codes, standards, and design practices to provide more energy efficient building.

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