

An Advanced Economizer Controller for Dual Duct Air Handling Systems

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The economizer cycle is currently one of the most popular energy conservation measures for air handling units (AHU) in buildings. There are two types of economizers, the temperature economizer and the enthalpy economizer. The temperature economizer maintains the mixed air temperature at the cold deck discharge air temperature when the outside air temperature is lower than the cold deck discharge air temperature. Consequently, the need for mechanical cooling is eliminated. When the outside air temperature is higher than the cold deck discharge air temperature, but lower than a change point temperature, which is generally a few degrees lower than the return air temperature, the temperature economizer uses maximum outside air to minimize the mechanical cooling. When the outside air temperature is higher than the change point temperature, the economizer uses minimum outside air to keep cooling energy consumption at the lowest level. If the outside air intake is determined by using air enthalpy, the economizer is called an enthalpy economizer. The enthalpy economizer generally saves more energy than the temperature economizer. However, an enthalpy economizer requires additional sensors to measure dew point temperature or the relative humidity. The economizers described above are called the normal economizers to distinguish with the advanced economizer developed in this paper.

Economizers can save a significant amount of cooling energy with little or no heating energy penalty for a single duct system. Researchers have simulated the potential economizer energy savings for a small office building in seven climates (Washington, D. C.; Nashville, TN; Madison, WI; Seattle, WA; Dodge City, KS; Lake Charles, LA; and Santa Maria, CA), and found that cooling energy savings varied from 1% to 77% depending on climatic conditions.

When economizers are applied to dual duct systems, a wide range of heating energy penalties are expected. Potential economizer savings were simulated for a large retail store in the same seven representative U. S. A. climates. The heating penalty varied

from a low of 6% in Lake Charles to a high of 30% in Madison. In all cases, the potential cooling energy savings are larger than the heating penalty regardless of the climates.

Advanced economizers have been developed for dual-duct systems to eliminate the risk of the energy waste and to prevent the potential indoor thermal environment and mechanical problems in all operation conditions. The significance of the advanced economizers is demonstrated by the measured results. A theoretical analysis is also performed to compare the normal and the advanced economizer in different operation conditions.