

# Constant Volume System Upgraded for VAV Energy Savings by Replacing Diffusers and Adding Variable Frequency Drive.

Therma-Fuser Thermally Powered VAV Diffusers Contribute to \$2,000 a Month Heating and Cooling Savings in the City of Phoenix Plaza Municipal Building.

PHOENIX, Arizona—When the City of Phoenix established its Energy Conservation Office (ECO) in 1978, it began a process that would eventually save taxpayers money by making city government offices more energy-efficient.

According to Scott Wilkins, an energy engineer with the ECO, one of the office's many success stories is the Plaza Municipal Building, where heating and cooling



Plaza Municipal Building

costs have been reduced by approximately \$2,000 a month.

"Incorporating thermally powered VAV diffusers into our system retrofit enabled us to cut fan energy requirements almost in half," says Wilkins. "The resulting savings on energy costs mean that the new system will pay for itself in approximately three years. And, employees working in the Plaza are more comfortable than they were with the previous system."

## An Energy Savings Plan

In the initial stage of the city's energy conservation plan, most costs were of the no cost/low cost type. The idea was to save energy with a minimal expenditure of money. Employees were urged to turn off lights, and office temperatures were often maintained in a range that bordered on the uncomfortable for some workers. However, the program was successful and, after three years, the ECO began more ambitious projects.

## Heating and Cooling Woes

Inefficient heating and cooling systems became the main target in Phase II of the energy saving program. Many of the city's administrative buildings used expensive mixed air systems. In these systems, air is both heated and cooled all year round and "mixed" to achieve the correct temperature for a given area. Needless to say, such a system is extremely inefficient.

This problem was fairly easily solved by turning off the boiler during the hot weather—which is most of the year in Phoenix—and by obtaining heating, when required, from the waste air of the air conditioning system.

A more difficult and expensive problem to solve existed in those buildings having

constant temperature/constant volume systems. The problem here, rather than the temperature of the air, was the amount of air required in the ductwork. In constant temperature/constant volume systems, the same amount of air must be moved constantly through the ducts, no matter what the heating or cooling requirements.

Such systems must be carefully "balanced" to work properly. If the fan speed slows, for example, only those rooms nearest the fan receive conditioned air, while those farther away get none.

## The Plaza Municipal Building

The Plaza Municipal Building, the second largest facility in the City of Phoenix's administrative complex, had a constant temperature/constant volume system. The six-story building (two parking levels and four floors of offices) has no windows except in the lobby area and the cafeteria.

The ECO had already run an experimental project which showed that the expenditure of energy in a building could be cut in half if the fan speed was reduced. However, this meant lower pressure in the ductwork, which meant that a thermostatic control of some sort was required to open and close special dampers located in the diffuser.

## The Therma-Fuser Thermally Powered VAV Diffuser Solution

According to Wilkins, the ECO had two options facing it. It could put thermostatic controls on every damper, which would have been expensive. In fact, it would have cost approximately twice the amount that was eventually spent. The second alternative was to install thermally powered VAV diffusers.

The ECO had been testing 12 such diffuser units, called Therma-Fusers, from Acutherm, an Emeryville, California-based company, in its Facilities Maintenance Building. "We were really pleased with the results," says Wilkins. "The Therma-Fusers enabled us to become more energy-efficient and, at the same time, increased the comfort level."

The Therma-Fusers have internal thermostats that sense temperature changes in a room. When the temperature begins to fluctuate from the set point in either direction, the unit responds automatically,

opening or closing its control blades to let air enter the room or to keep it out. Room temperature is usually maintained to within one and one-half degrees of the set point.

The old system was modified by placing approximately 292 Therma-Fuser units throughout the perimeter and interior of the building. Each fan motor was equipped with a variable frequency drive, which slowed the motor when air was not required. Static pressure sensors located downstream from the fans control the variable frequency drives.

The total retrofit cost \$65,000 for the 150,000 sq. ft. building. Because of the substantial energy savings, the system is expected to pay for itself in less than three years.

## Benefits

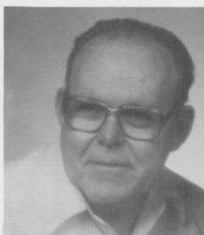
The Therma-Fuser units provide a major comfort component, because temperatures can be individually controlled. According to Wilkins, there were only two complaints after the system was installed.

"The two complainers were located within 50 feet of each other," he says. "We made a simple temperature adjustment on each one's Therma-Fuser, and they were happy. We have had no more complaints, and we used to have quite a few."

And, of course, the energy savings are substantial, at \$2,000 a month.

Installation costs were approximately half of what they would have been had the City of Phoenix used standard thermostats. And, the installation itself was easily accomplished by city maintenance personnel. Wilkins states that it took approximately 35–45 minutes per diffuser, including the time required to remove the old unit and disconnect and reconnect the ductwork.

"We're really pleased with the results we are obtaining," says Wilkins. "When we are saving this much money and energy, we have that much more of both to put back into the City of Phoenix."



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