# Purchasing Advisor: Refrigeration: Walk-in Cooler Controllers

In virtually all coolers and freezers, small or large, air is cooled by forced-circulation evaporators containing propeller fans powered by fractional-horsepower motors. Typically these fans run continuously, even though, on average, full airflow is only required about half of the time. In the most common applications (those that use single-phase power), motors for the fans are typically shaded-pole or permanent-split-capacitor types, both of which are very inefficient.

Inexpensive controllers are currently available that slow these fans when full-speed operation is unnecessary. They do this simply and inexpensively by taking advantage of a basic principle of motor operation: The lower the voltage applied to a motor, the less rotational force it produces. Reducing the operating speed also reduces the energy consumption of the fan. In addition, the motor produces less heat at slower speeds, which means that the compressor has less heat to remove from the refrigerated compartment.

In field tests for controllers from one manufacturer, documented savings varied from 10 percent to 60 percent of overall refrigeration energy, and some users report paybacks as low as one year. Savings vary widely, however, as they are dependent primarily on duty cycle, evaporator motor power, and local utility rates.

Anecdotal evidence also suggests that product quality in walk-in coolers can be improved. Because less air is circulated when the fan speed is reduced, items such as flowers, produce, or meat do not dehydrate as much.

## What Are the Options?

**Figure 1: ENS Fansaver 5000**

The ENS Fansaver conserves energy by sensing refrigerant flow through walk-in cooler evaporators and reducing evaporator fan speeds when there is no flow.


Courtesy: RS Services

Evaporator fan controllers operate by cutting the voltage to the motor by almost 80 percent (from 110-115 volts to 20 volts in typical single-phase applications). This reduces the motor's speed-typically from about 1,600 to 400 rpm. The lower speed is considered the bare minimum required to provide defrosting and prevent air in the cooler from stratifying into layers of higher and lower temperature.

There are two manufacturers that produce evaporator fan controllers. One manufacturer, RS Services (formerly known as EnergyNSync Inc.) produces two models intended for walk-in coolers that use single-phase power evaporator fans: the ENS Fansaver 4000 and the ENS Fansaver 5000. These units reduce fan speed when they sense that the refrigerant has ceased to flow through the evaporator coil. Each can handle 10 amps of current, which is typically enough to control six fans on a single evaporator coil. The Fansaver 5000 also has a built-in datalogger that records time and power used in both low-speed and high-speed fan operation (**Figure 1**).
A personal computer can be connected to the unit via a serial port to access this data.

The other manufacturer, Energy Control Equipment Inc., produces a controller called Frigitek that can be used in either coolers or walk-in freezers

**Figure 2: The Frigitek evaporator fan controller**

This unit is for single-phase applications.


Courtesy: Energy Control Equipment Inc.

**Table 1: When to use an evaporator fan controller**

It is a little tricky ensuring that a particular walk-in cooler is a good candidate for installing an evaporator fan controller. Here are the most important things to look for.

| Do use controller if . . . | Do not use controller if . . . |
|---|---|
| The compressor *does not* run all the time, and | The compressor runs all the time, or |
| The evaporator fan runs at full speed all the time, and | The evaporator fan *does not* run at full speed all the time (for example, it turns off with the compressor or it switches between full speed and half speed), or |
| The evaporator fan motor in single-phase applications is of shaded-pole or permanent-split-capacitor design. | The evaporator fan motor in single-phase applications is any type *other than* shaded-pole or permanent-split-capacitor design. |

Source: Platts

(**Figure 2**). The Frigitek reduces fan speed in response to a signal from the thermostat to stop the flow of refrigerant. Though the Frigitek operates in a very similar way to the ENS Fansaver, its performance has not been independently verified. For single-phase power applications, it is available in configurations that can handle from 3.5 to 25.0 amps and from 115 to 480 volts (V). These units also have a field-adjustable low-speed setting to accommodate unique application requirements. For three-phase power applications, one available configuration uses a master control unit that can handle 480 V and motors of up to 20 horsepower. Additional power units are added for multiple evaporators.

For single-phase controllers, prices start at about $500. Three-phase applications are considerably more expensive, particularly if fans from multiple evaporators are to be controlled. Check with manufacturers (see Who Are the Manufacturers?) for current pricing. Installation costs for single-phase units are typically about $100 per unit, but they will vary depending on the region, the number of fans controlled, and the installer.

## How to Make the Best Choice

Controllers don't work for every application, so you should give some consideration to several issues (**Table 1**) before you decide to install one on a cooler.

The cost-effectiveness of the controller must be evaluated on a cooler-by-cooler basis. For coolers with three-phase fans, which are typically found in warehouses or distribution centers, cost-effectiveness calculations can be complicated. They need to factor in the cost of installing conduit and wiring to reach multiple evaporator coils potentially spread across a large area, and the number of master control and power units needed will vary widely by application. But because single-phase applications don't have these issues, and the controllers for single-phase fans and their installation are relatively inexpensive and usually highly cost-effective, evaluations for their cost-effectiveness need not be especially detailed or complicated. Both manufacturers offer tools to help evaluate the cost-effectiveness of the application of their products. In addition, to help determine the cost-effectiveness of single-phase systems where a single compressor serves a single walk-in cooler, we developed a simple calculation tool, available below. Before you begin, you must collect four pieces of information on site to use as input in the tool:

1. Evaporator fan power in kilowatts, which may be determined by any of the following techniques, listed in order of accuracy.
• Measure the power drawn by the evaporator fan motors using a wattmeter.
• Measure the current flowing through the evaporator fan motors using an ammeter, and measure the voltage applied to the motors using a voltmeter. Multiply these values and multiply this product by the power factor, which is about 0.6 for shaded-pole motors and about 0.9 for permanent-split-capacitor motors.
• Read the rated amperage and voltage located on the motor nameplates. Multiply these two values and multiply this product by the power factor (see previous item).

2. Compressor duty cycle in percent, which may be calculated by first wiring an analog clock in parallel with the compressor motor or by attaching a run-time logger to the compressor motor. The amount of time the compressor motor runs divided by the total time of the test equals the duty cycle. If possible, conduct the measurements during a two- to four-week period when conditions are average. For walk-in coolers exposed to outdoor conditions or with outdoor condensing units, conduct a regression analysis that correlates run hours to outdoor temperature.

3. Electric rate in U.S. dollars per kilowatt-hour, which may be obtained from a recent electric bill.

4. Purchase and installation cost in U.S. dollars, an estimate of which may be obtained from a refrigeration technician.

After you enter this information, click the calculation button. The tool produces outputs including annual savings, both in U.S. dollars and in kilowatt-hours, as well as simple payback period in months.

**Evaporator Fan Controller Cost-Effectiveness Estimator**