

Outside Air Economizers: Making Them Work Right for You

have a large cooling load, even when it is quite cool outside. As a result, in areas West of the Cascades, buildings can be cooled with outside air most of the year. This tactic is called an *outside air economizer system*. These systems can save significantly on energy bills, theoretically cutting the cooling load in half.

Recent field studies of outside air economizers find that up to 70% of them do not operate properly. In some cases, a faulty economizer uses more energy. As a result, the savings benefit is less. Fortunately, these units can be easily tested and repaired so that the full savings expected can be achieved.

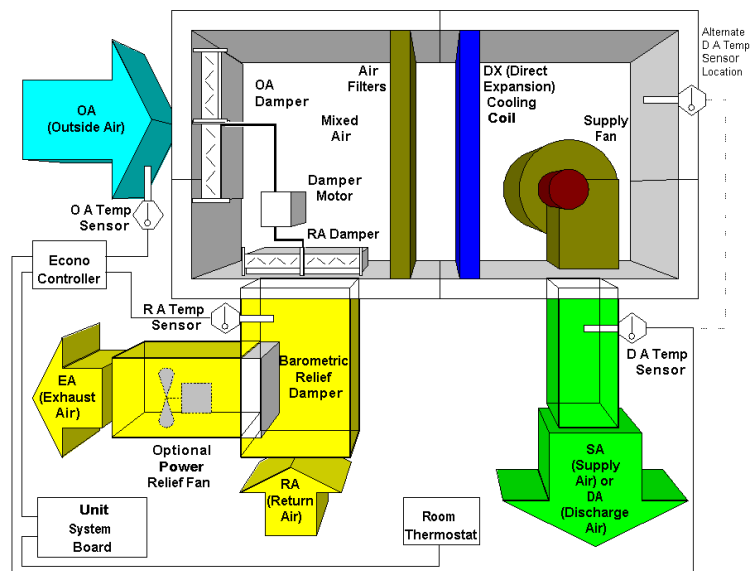
Economizer Functions

To better understand how an outside air economizer works, it is important to know what functions they must perform. The basic function is to open up an outside air damper and blow outside air (OA) into the space with the unit fan when OA is cool enough to provide cooling. This basic function is usually controlled with a modulating damper motor that is controlled by a discharge air (DA) or mixed air (MA) sensor.

Economizers also need a return air (RA) damper that closes as the outside air damper is opening. A third damper for exhaust air (connected to the return duct) helps avoid building over-pressurization. An optional relief or exhaust fan can make venting more effective.

When the room thermostat calls for cooling, the economizer control provides the right mix of outside and return air to cool the space. As outside air gets above 55°F, the outside air damper goes fully open. Then, the second stage of cooling on the room thermostat activates the cooling compressor, which provides cooling in addition to the outside air. The

Packaged Unit (DX cooling) Outside Air Economizer



discharge air controller modulates the dampers so the temperature supplied to the room is not too cold. When the dampers work together with the cooling coil, it is called an *integrated* economizer.

Ventilation is important for people in a building, so the economizer provides a set amount of *minimum outside air* whenever the fan is running.

More advanced economizers use a CO₂ sensor to adjust the minimum ventilation amount for actual occupancy in the space. These are appropriate for gymnasiums and auditoriums that have a large variation in occupancy. This type of control is called *Demand Controlled Ventilation (DCV)*.

Another important function of an economizer is the *outside air high temperature changeover*. This prevents use of excess outside air when it is too warm to use for cooling. The most effective method for western climates is a *dry-bulb differential* changeover. This restores the outside air dampers to the minimum position whenever the outside air is warmer than the return air.

In humid mid-west and south-east climates, an *enthalpy* sensor

is used to measure the humidity of the air. Humidity measurement can reduce the cooling energy used to remove moisture from the air. Enthalpy sensors are more complicated and less reliable than dry-bulb sensors. A dry-bulb sensor is recommended for the drier western climate.

Economizer Testing

Your outside air economizer saves you energy only if it is working properly. While it can be time consuming for a specialized HVAC technician to test all the functions of an economizer, some simple functional testing by a building operator can determine if the economizer works and if more detailed troubleshooting is called for. The general tests listed are recommended every year or two. Many of these tests are more easily carried out with two people and a radio.

Safety First. When testing your unit, you may need to remove unit covers. If so, stay clear of electrical connections and moving mechanical equipment.

Use the schematic on the other side to locate the outside air damper, return air damper, and

sensors at the unit. Then, determine these things:

- **Changeover type.** Do you have differential changeover? You do if there is a sensor both in the return air duct and in the outside air.
- **Outdoor air sensor.** Determine location and if it is dry bulb or enthalpy (Honeywell enthalpy sensors are often model C7400, dry bulb are often 7650).
- **Primary control location.** The primary control or low-limit sensor can be located either in the *mixed air* (on either side of the filter) or in the *discharge air* (after the cooling coil).
- **Cooling type.** DX (direct expansion) cooling is self-contained or has small refrigerant pipes serving the unit. A chilled-water coil is served by larger pipes connected to a chiller.

□ **Test 1: “Off” Operation**

At the thermostat, turn the fan to the **auto** position and turn the system switch **off**. The fan should stop and the outside air damper should move fully closed.

□ **Test 2: Cooling Stage 1**

Turn the system switch to **cool** and lower the thermostat setting slowly until the first stage of cooling is called for. If it is warm outside (above 50°F), hang a bag of ice around the outside air sensor. The fan should come on, the outside air damper should open almost fully, and the cooling compressor should remain off.

□ **Test 3: OA Changeover**

Continuing after test 2 with the outside air dampers open, remove the bag of ice from the outside air sensor. If it is cool outside (below 75°F) use a hair dryer or hot pack

to warm up the outside air sensor. When the outside air is warm, the outside air damper should return to the minimum position, initiating the changeover to mechanical cooling and locking out the economizer.

Changeover Adjustment.

Many economizer controllers have a changeover setting marked A/B/C/D. If you have differential changeover, it should be set to the “D” position. For single sensor changeover, a different setting is right for relatively dry western climates. Set the A/B/C/D changeover dial to the “B+” position, halfway between “B” and “C”.

□ **Test 4: OA Minimum**

At the conclusion of test 3, the outside air dampers should move to the minimum position. In most cases, the outside air damper should be almost closed. If it is more than 20% open, the outside air minimum may need to be adjusted by a skilled technician.

If any of these tests appear to fail, call your HVAC service company to make adjustments or repairs.

Time to Upgrade?

If you have an older economizer, it probably does not meet our current *Western Premium* standards. Rebates are available for upgrading. You can look for the following things to see if a *Western Premium* upgrade would be beneficial:

Thermostat stages. Verify the number of stages of cooling your thermostat provides. If there is only one stage, then you can't get the full advantage out of your economizer. To get full savings you must install a thermostat with two-stages of cooling control and rewire the economizer controls. If

you install a new thermostat, a programmable model will provide added savings.

Dry-bulb differential changeover.

If you do not have a return air sensor, you will get more savings by installing one. If the outside air sensor is the enthalpy type, then you should replace it with a dry-bulb sensor. An enthalpy sensor is likely to be out of calibration after a few years anyway. Most controllers have differential logic built in; it just takes the addition of a dry-bulb return air sensor to get more savings from your economizer changeover.

Primary control placement.

Determine the type of cooling you have and make sure the primary sensor is in the right location if necessary.

With a direct-expansion (DX) cooling-coil (no chiller) you can get coil freezing problems and very cold discharge air with a mixed air sensor. With a DX coil, the primary controller should be after the cooling coil in the discharge or supply air duct.

If you have a chiller and a chilled water coil, it is appropriate to have the primary control sensor in the mixed air position, before the cooling coil. If it is after the cooling coil, you are missing some energy savings.

There are other specific requirements for a *Western Premium Economizer*. Your HVAC contractor or EWEB can review the requirements and rebate potential.

Call EWEB's energy experts at 541-685-7000 if you have questions about your outside air economizer.



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