1.0 PEARL Economizer Control

An Economizer Controller manages a modulating outside air damper part of a commercial Heating, Cooling, and Ventilation (HVAC) system. The economizer controller evaluates the outside air temperature and humidity levels, and, when the outdoor air levels are appropriate, it uses it to cool a room in a building.

1.1 Deciding When to Open the Outside Damper

At the beginning of a cooling cycle, if the outdoor temperature and/or humidity levels are within configured parameters, the PEARL will open the outside air damper to cool the space.

The cool outdoor air will be given the opportunity to provide all necessary cooling to condition the space. If the room's temperature rate-of-change is unacceptable, the PEARL will enable mechanical cooling to assist with outdoor cooling.

There are three PEARL configurations which affect when outdoor air will be used for cooling: *High Limit Shut Off*, *Activation Differential*, and *Fixed Enthalpy Limit*.

(a) *High Limit Shut Off*

Default = AUTO

High Limit Shut Off regulates the maximum allowable outdoor air temperature that can be used to cool a room. If the outdoor temperature is above this configured temperature limit, the PEARL will <u>NOT</u> open the outdoor damper for cooling and instead will enable mechanical cooling. Leaving this configuration BLANK, places the configuration into AUTO mode.

In AUTO mode: the PEARL looks at the difference (ΔT) between the room's temperature and the outdoor temperature to determine if the outdoor air can be used to assist in cooling the room. If the outside air temperature is cooler or less than the space temperature, by at least the configured *Activation Differential* (explained below), the PEARL will open the outdoor damper to cool the space.

AUTO configuration makes the High Limit Shutoff configuration more dynamic than setting a fixed limit and allows for more usage of the economizer.

(b) *Activation Differential*

Default = 2°F

The outdoor temperature must be this many degrees cooler or lower than the room's temperature for the PEARLto open the outdoor damper to cool the room. This is an adjustable parameter on a 2°F scale from 0°F to 6°F.

(c) *Fixed Enthalpy Limit*

Default = OFF

When configured to ON, if the PEARL reads the outdoor enthalpy levels beyond 28 BTU/lbs, or at higher elevations below the calculated enthalpy at 75°F and 50% relative humidity at that elevation, the PEARL will <u>NOT</u> open the outdoor damper for cooling and instead will enable mechanical cooling

Enthalpy levels are calculated by each PEARL. The PEARL looks at its local outside air temperature sensor, while receiving humidity levels and barometric pressure information from the Internet (this information is provided based on installation location zip code). These three data points are applied to an enthalpy calculation to generate the outdoor enthalpy level.

1.2 Economizer Sequence of Operation

If outdoor air cooling is within the configured PEARL parameters, the PEARL will open the outdoor damper.

If the outdoor temperature is below the room temperature and above the *Low Limit Temperature*: the PEARL will place the outdoor damper at 100% open.

If the outdoor temperature is below the *Low Limit Temperature*, the PEARL will place the outdoor damper at a calculated position to target a mixed air temperature equalling the *Low Limit Temperature*. The PEARL will continue to modulate the outdoor damper to maintain the *Low Limit Temperature*.

If the room's temperature rate-of-change is unreasonable, the PEARL will keep the outdoor damper open and enable mechanical cooling. The PEARL will modulate the outdoor damper to maintain the *Low Limit Temperature*.

(a) *Low Limit Temperature* (Pelican Technical Support Configuration)
Default = 56°F.
The *Low Limit Temperature* tells the PEARL what temperature it should modulate the outdoor damper too when outdoor air is being used to cool the space.

1.3 Additional Economizer Logic

If outdoor air is being used to cool a room, as long as the room's temperature is within 1°F of the thermostat's cool set-point, mechanical cooling will NOT be enabled. If the room's temperature rises to 1°F or above the cool set-point, mechanical cooling will be enabled to satisfy the cooling demand.

For example, if the cool set-point is 72°F and the economizer is active, as long as the space temperature is 72.9°F or less, mechanical cooling will be held off.

1.4 Limiting Temperatures

There are three PEARL configurations that limit or restrict the outdoor damper position:

(a) *Low Limit Temperature* (Pelican Technical Support Configuration)
> **Default = 56°F.**

The *Low Limit Temperature*, tells the PEARL what temperature it should modulate the outdoor damper too when outdoor air is being used to cool the space or when outdoor air and mechanical cooling are being used together.

(b) *Outside Air Low Limit Compressor Lock-Out*
> **Default = NONE**
>
> If the outdoor air temperature is below this configuration, the PEARL will not enable mechanical cooling. The PEARL will still follow the economizer logic as described above. If left blank, then there is no restricting on when the compressor is enabled in relation to the outdoor air temperature.

1.5 Economizer Fault Detection and Diagnostics

Economizer fault detection and diagnostics provides continuous feedback of proper outside damper operation. The PEARL has an input used to monitor a position feedback signal from the outside damper actuator.

(a) Outside Air Damper Faults

When the PEARL places the outdoor damper to a specific position, if the feedback signal from the outdoor damper actuator is not within 2% of the PEARL's output, one of the following faults will be generated at the Pelican EMS:

1. Not economizing when it should.
2. Economizing when it should not.
3. Damper not modulating.
4. Excess outdoor air.
5. Temperature sensor failure.