Honeywell

JADE™ Economizer

Referential Enthalpy Changeover Boundaries

Enthalpy economizers: The A,B,C and D enthalpy changeover curves were developed for analog economizers used in the Honeywell electronic analog economizers developed in the 1980's, 90's and early 2000. With the analog design it is impossible to determine the temperature, humidity and dew point in the logic module as the input from the sensor is an analog signal so the curves were used to determine the changeover points between OK to economize and Not OK to economize.

Today, the industry is ready for an economizer that is able to provide more accurate changeover based on dry bulb, enthalpy and dew point. Honeywell developed the JADE economizer to fill this industry need with a microprocessor based digital controller and sensors that input a digital signal for temperature and humidity to the economizer controller. The economizer controller then makes the determination for changeover based on the temperature, enthalpy and dew point. We created new boundaries which, it turns out, are quite similar to the theoretical boundaries described by Taylor Engineering in the ASHRAE Journal article “Why Enthalpy Economizers Don’t Work”, November 2010.

Single (OA only) Enthalpy economizers: With the digital JADE economizer controller, there are 5 enthalpy curves defined for Single Enthalpy Control, ES1 thru ES5. Each curve is defined by dry bulb temperature, enthalpy, and dew point temperature. They can be defined by specifying 2 points, P1 and P2.

The enthalpy setpoint is calculated from the temperature and humidity setpoints for P1.

The dew point setpoint is calculated from the temperature and humidity setpoints for P2.

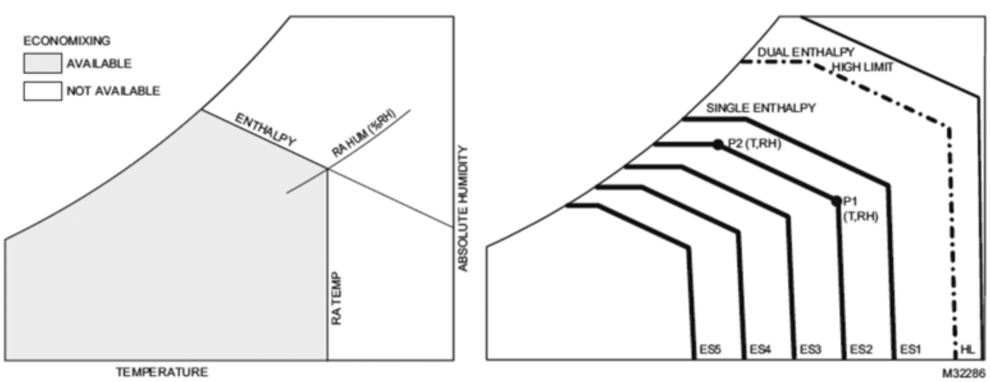


Fig. 15. Single Enthalpy curve and boundaries.

Table 6. Single Enthalpy and Dual Enthalpy High Limit Curves.

Enthalpy Curve	Temp. Dry-Bulb (°F)	Temp. Dewpoint (°F)	Enthalpy (btu/lb/da)	Point P1		Point P2	
				Temp. °F	Humidity %RH	Temp. °F	Humidity %RH
ES1	80.0	60.0	28.0	80.0	36.8	66.3	80.1
ES2	75.0	57.0	26.0	75.0	39.6	63.3	80.0
ES3	70.0	54.0	24.0	70.0	42.3	59.7	81.4
ES4	65.0	51.0	22.0	65.0	44.8	55.7	84.2
ES5	60.0	48.0	20.0	60.0	46.9	51.3	88.5
HL	86.0	66.0	32.4	86.0	38.9	72.4	80.3

When the Outside Air (OA) Sylk Bus sensor is connected and the Return Air Sylk Bus sensor is NOT connected, the JADE will configure itself to operate in Single Enthalpy mode.

The JADE calculates the OA Enthalpy from OA Temperature and OA Humidity sensors. The OA Enthalpy Setpoint is calculated from the OA Economizer Temperature and OA Economizer Humidity Setpoints (P1).

The JADE calculates the OA Dew point from OA Temperature and OA Humidity sensors. The OA Dew point Setpoint is calculated from the OA Economizer Temperature and OA Economizer Humidity Setpoints (P2).

When the outside air temperature is lower than the OA Economizer Temperature Setpoint, AND the OA Enthalpy is lower than the OA Enthalpy Setpoint, AND the OA Dew point Temperature is below the OA Dew point Setpoint, the outside air conditions are desirable for free cooling and the JADE displays Economizing available YES in the Status menu.

When the outside air temperature is higher than the OA Economizer Temperature Setpoint (plus differential), OR the OA Enthalpy is higher than the OA Enthalpy Setpoint (plus differential), OR the OA Dew point is higher than the OA Dew point Setpoint (plus differential), the outside air conditions are NOT desirable for free cooling and the JADE displays Economizing available NO in the Status menu.

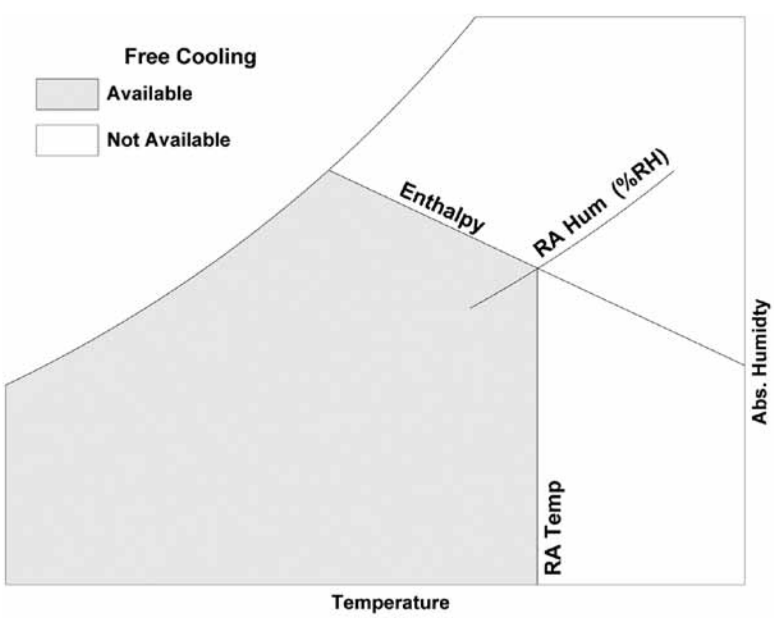
A 2°F and a 1 Btu/lb differential are used to reduce the cycling of the Economizer Available point.

Dual (or Differential) Enthalpy economizers: Dual Enthalpy economizer control compares the outside air conditions to the return air conditions to determine if outside air is desirable for free cooling. The outside air conditions are also compared to the high limit conditions.

The outside air enthalpy is calculated from outside air temperature and humidity sensors. The return air enthalpy is calculated from return air temperature and humidity sensors.

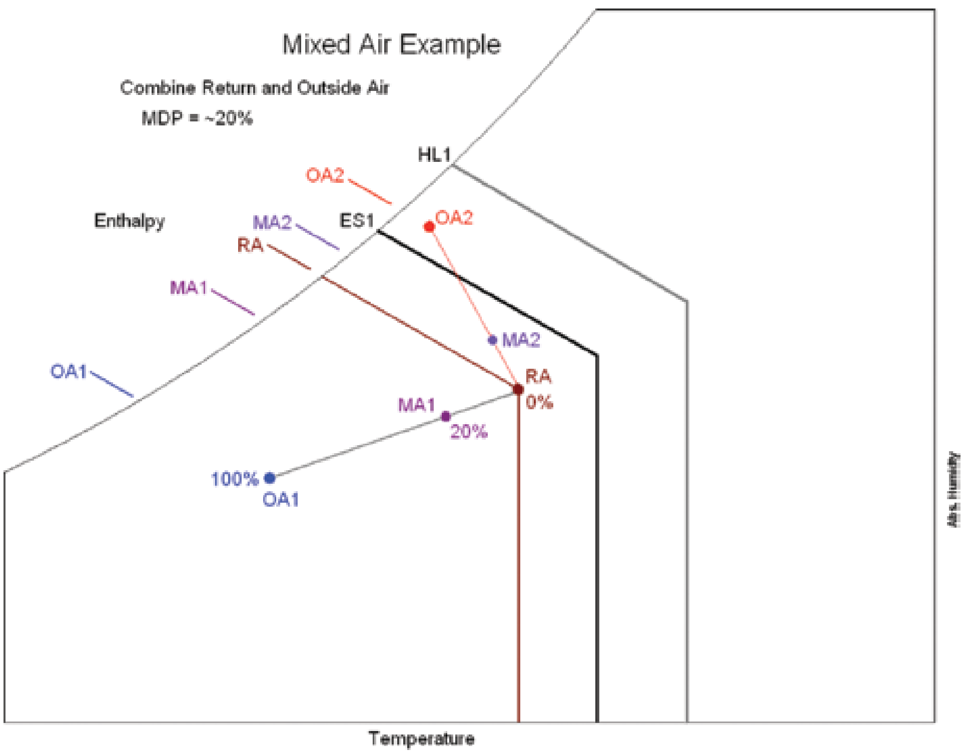
When the outside air temperature is below the return air temperature AND the outside air enthalpy is less than the return air enthalpy, the outside air is desirable for free cooling.

Figure below shows the region on the psychrometric chart. The shaded area indicates when free cooling is desirable (free cooling available).



Mixing Process: In the Figure below, OA1 shows a mixing process for outside air in the region that is desirable for free cooling. MA1 shows mixed air conditions at a minimum damper position. The enthalpy at MA1 is greater than enthalpy at OA1 showing it requires more mechanical cooling energy to remove the difference in energy if the damper remains at minimum position.

OA2 shows a mixing process for outside air in the region that is not desirable for free cooling. MA2 shows mixed air conditions at a minimum damper position. The enthalpy at OA2 is greater than enthalpy at MA2 showing it requires less mechanical cooling energy to remove the difference in energy if the damper remains at minimum position.



High Limit Strategy: There are applications, e.g., quick service restaurants, where the RA and the OA are high temperature and high humidity that using either supply air would not meet the comfort conditions required in the space. In these applications, the high limit strategy would be in effect when the OA and RA air is above (to the right) of the high limit boundary and the OA damper will close to minimum position and mechanical cooling will be staged on. The high limit strategy is defined by different boundaries taking into consideration whether a stage of mechanical cooling is in use or not. The high limit strategy for dual enthalpy (when no mechanical cooling stages are energized) is the single enthalpy curve ES1. When a mechanical cooling stage is energized, the high limit curve is defined by the high limit enthalpy curve HL.

This has the advantage that the lower high limit (ES1) curve will limit the outside air conditions to the comfort range of the psychrometric chart when no compressors are energized.

Dry Bulb (Temperature only) Control: When there is one (1) OA Temperature (20k NTC) sensor connected to the JADE economizer and no RA sensors connected, the JADE configures to single Outdoor Air (OA) temperature change over. When the OA temperature is above the set point, the economizer will modulate the OA damper to Minimum position.

When the OA temperature is below the setpoint, the economizer controller will modulate the dampers open to satisfy the MA temperature.

A 2°F differential is used to eliminate frequent cycling of the Economizer Available point.

Dual (Differential) Dry Bulb Control: When the OA Temperature (20K NTC) and RA Sylk Bus sensors are both connected to the JADE economizer and the OA Sylk Bus sensor is NOT connected, the JADE will configure itself to operate in Differential Dry-Bulb mode.

When the outside air temperature is below the return air temperature, the outside air conditions are desirable for free cooling and the economizer controller will modulate the dampers open to satisfy the MA temperature.

When the outside air temperature is above the return air temperature plus a differential, the outside air conditions are not desirable for free cooling and the economizer controller will modulate the damper to minimum position.

A 2°F differential is used to eliminate frequent cycling of the Economizer Available point.

Some engineers in the industry have expressed a concern that the humidity sensors are not accurate and will drift over time and refuse to specify enthalpy in their designs. Using a dry bulb change over economizer is not the solution for energy savings over an enthalpy economizer in every climate zone. The installer/designer must consider the climate zone and choose the best control strategy for their climate whether it is dry bulb, comparative dry bulb, single enthalpy or differential enthalpy. And they have to consider the cost of the sensors. Yes, the humidity sensors may not be as accurate over time but you cannot ignore humidity in some areas. JADE has an option where the operator can compensate for drifting humidity sensors, described in the next section.

Humidity sensors: Humidity sensors are calibrated in the factories at 55 degrees F and 50% RH to be within the stated accuracy, 5%, 3% or 2%. Humidity sensors are very hard to keep in calibration and will drift as they are normalized in their environment. When the sensors are shipped from the factories there is no way to add a calibration offset in to the devices. However, Honeywell has added a patent pending calibration in the JADE economizer to allow the field technician the ability to "offset" the temperature or humidity input from the sensor in the JADE unit. This feature is found in the "Advanced Setup" menu feature and allows the operator to offset both temperature and/or humidity for each sensor in the system. The cost of accurate humidity sensors would be prohibitive in the HVAC industry so Honeywell has designed the controller to compensate. When the sensor is replaced, the offset must be reset for the new sensor.

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