

Economizers: Design, Performance, and Commissioning Issues

Plotting Mixing on a Psych Chart

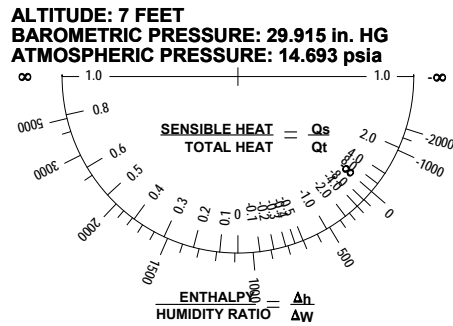


Instructor:

- David Sellers
- Senior Engineer
- Facility Dynamics Engineering
- February 8, 2018

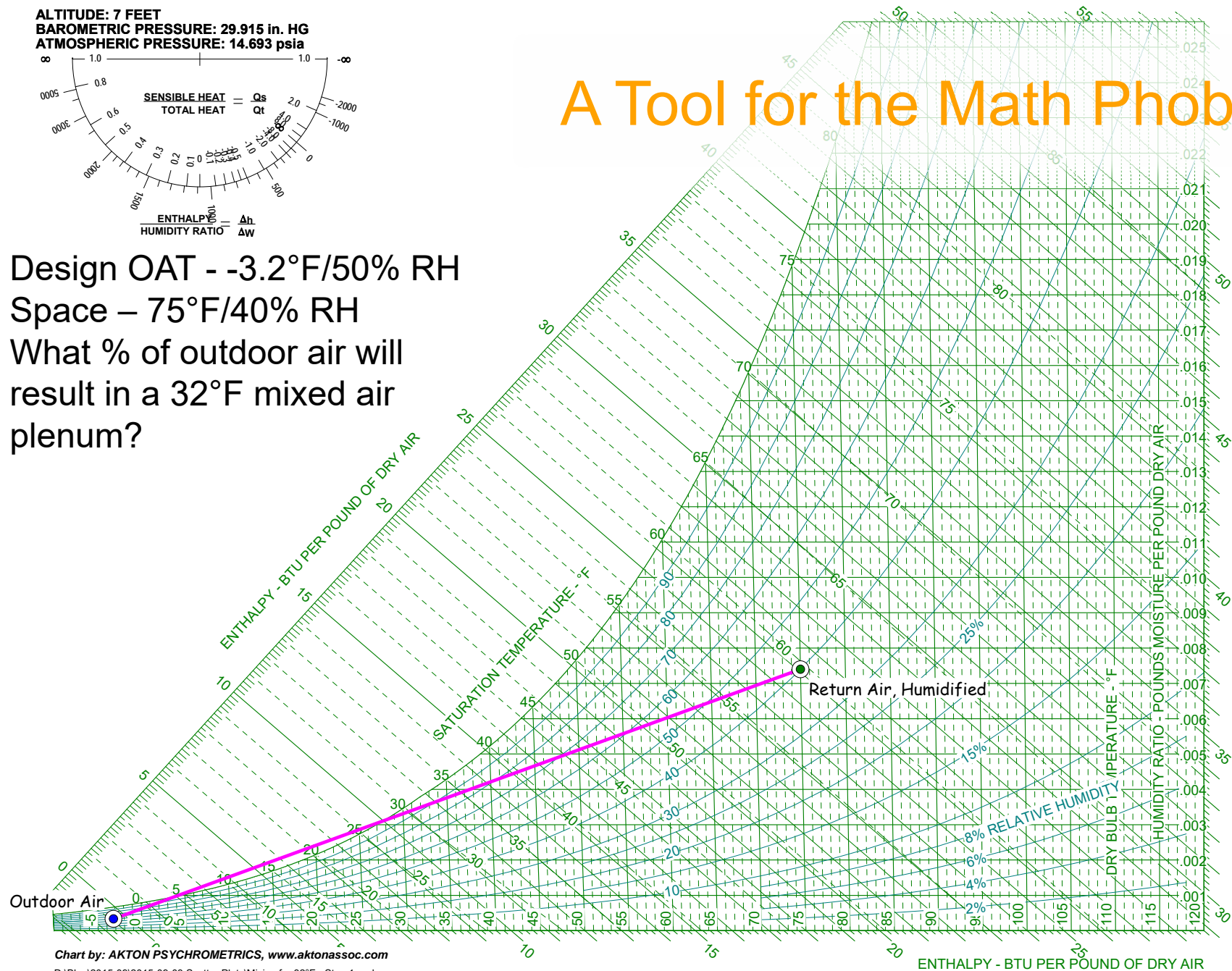
What's In This Module?

- Plotting a Mixing Process on a Psych Chart

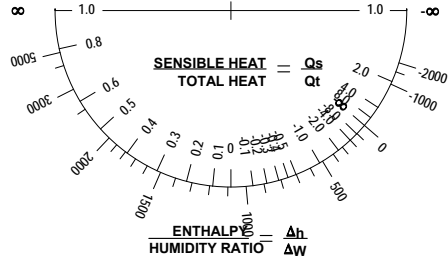


A Tool for the Math Phobic

Design OAT - -3.2°F /50% RH
 Space - 75°F /40% RH
 What % of outdoor air will
 result in a 32°F mixed air
 plenum?



ALTITUDE: 7 FEET
 BAROMETRIC PRESSURE: 29.915 in. HG
 ATMOSPHERIC PRESSURE: 14.693 psia



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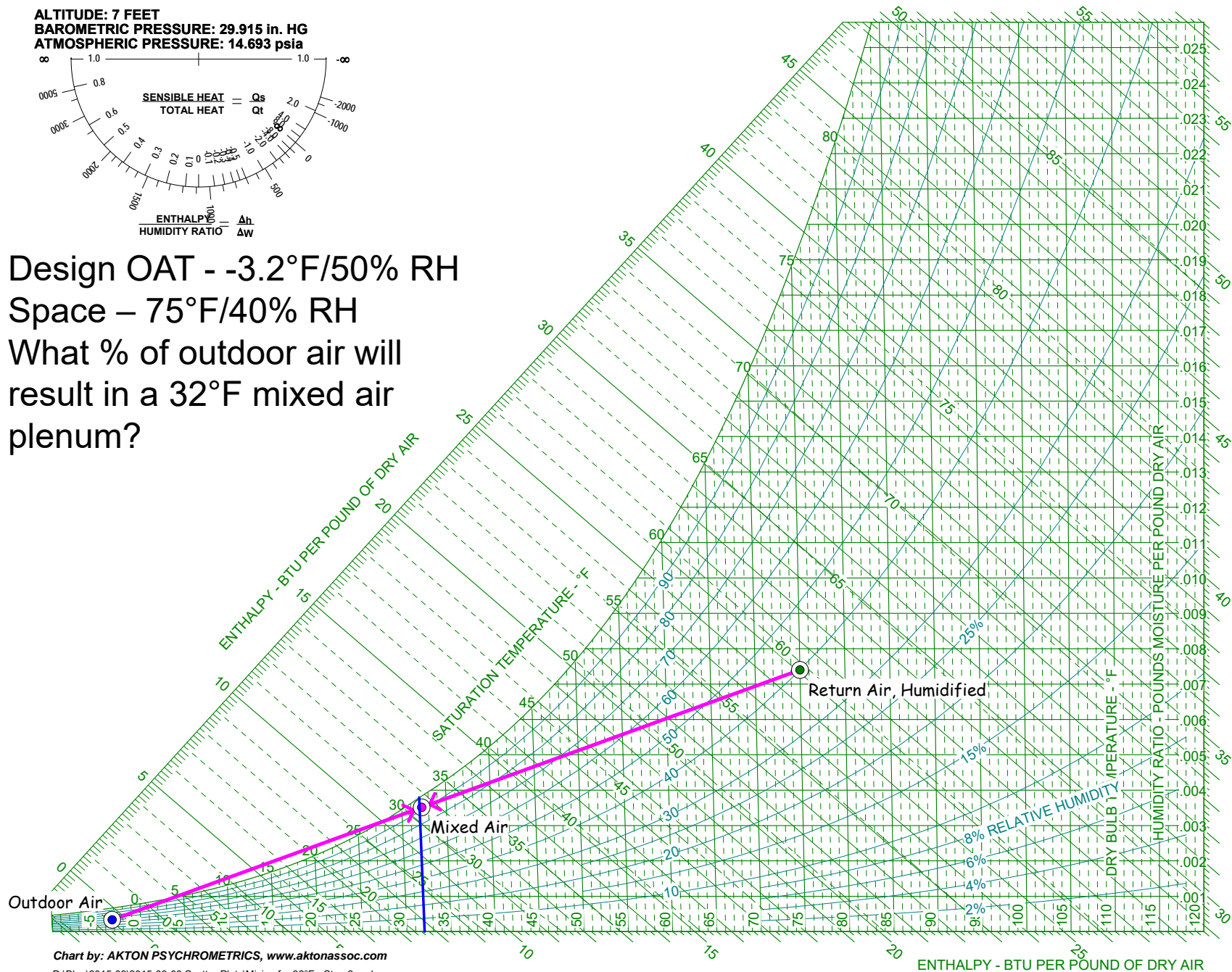
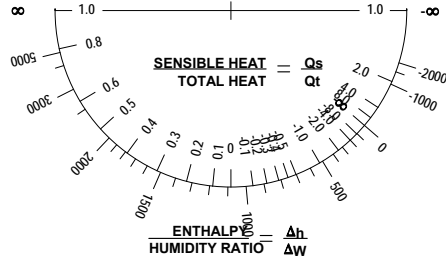


Chart by: AKTON PSYCHROMETRICS, www.aktonassoc.com
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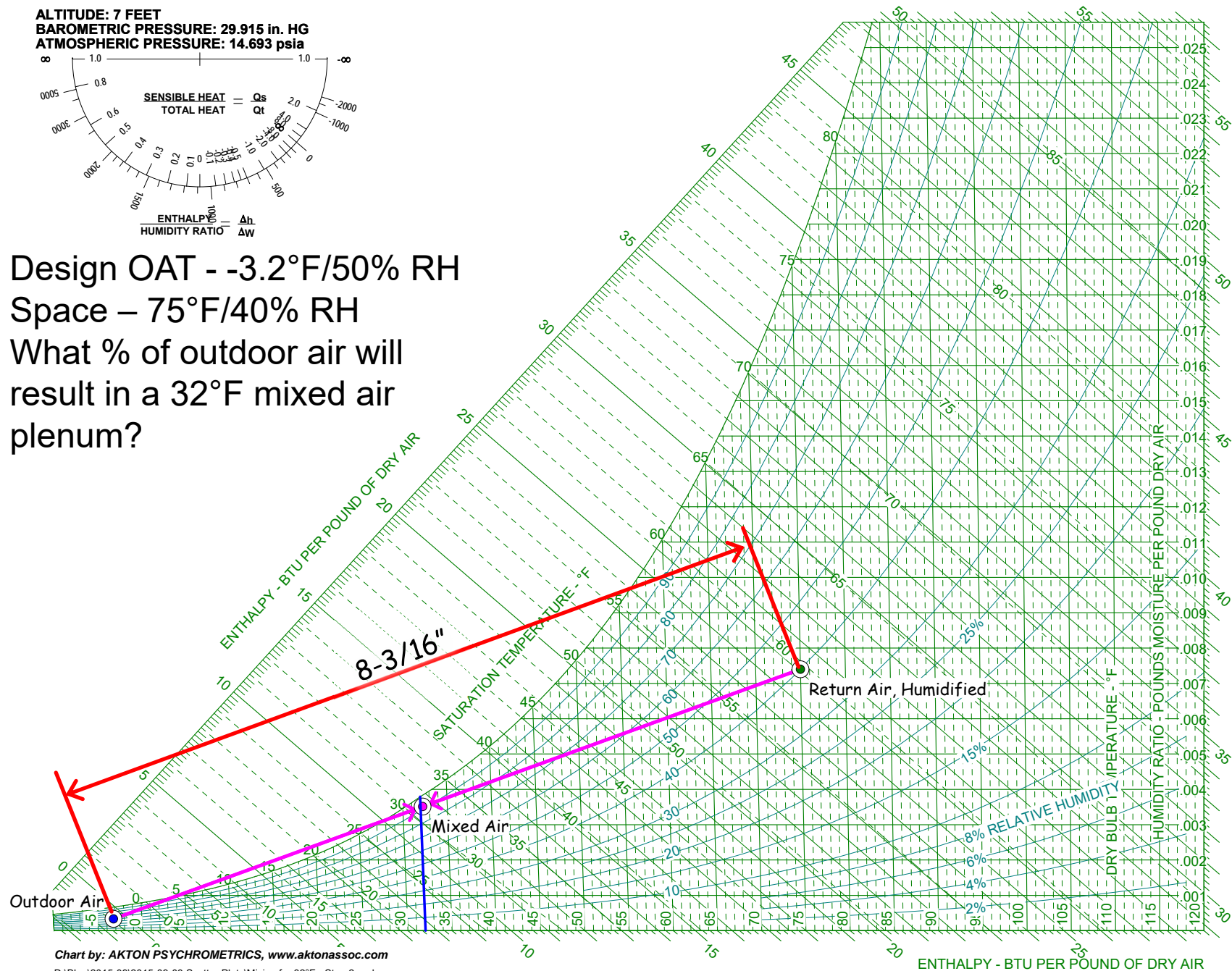


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∞ 1.0 0.8 0.6 0.5 0.4 0.3 0.2 0.1 0 0.1 0.2 0.3 0.4 0.5 0.6 0.8 1.0 ∞

SENSIBLE HEAT = $\frac{Q_s}{Q_t}$
TOTAL HEAT

ENTHALPY - BTU PER POUND OF DRY AIR
HUMIDITY RATIO - POUNDS MOISTURE PER POUND DRY AIR

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The psychrometric chart displays the following data points and lines:

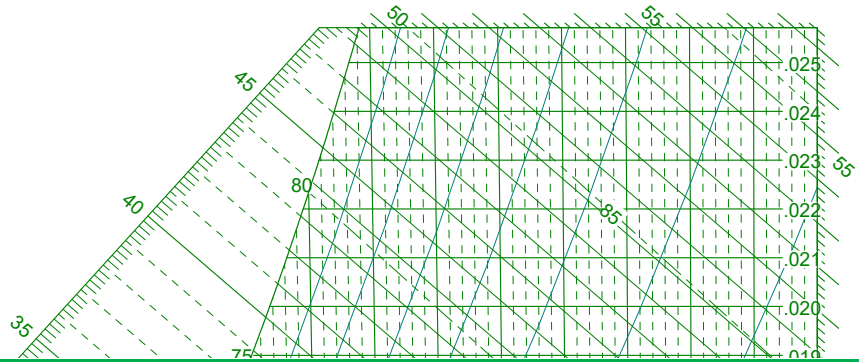
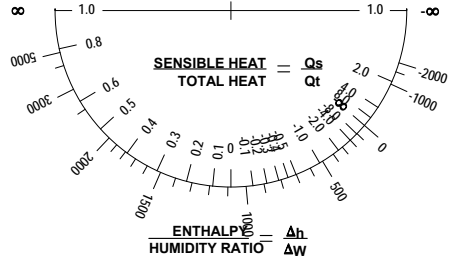
- Outdoor Air:** Located at approximately -3.2°F dry bulb temperature and 0.0015 lb/lb humidity ratio.
- Return Air, Humidified:** Located at 75°F dry bulb temperature and 0.008 lb/lb humidity ratio.
- Mixed Air:** Located at 32°F dry bulb temperature and 0.004 lb/lb humidity ratio.
- Process Lines:**
 - A red line connects Outdoor Air and Return Air, with a point marked at 8-3/16" (8.1875 inches).
 - A magenta line connects Outdoor Air and Mixed Air, with a point marked at 4-1/2" (4.5 inches).

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Outdoor percentage based on outdoor air, return air, and supply air temperature

Mixed air temperature (MAT) =	32.0 °F	$\%OutdoorAir = \frac{(t_{MixedAir} - t_{ReturnAir})}{(t_{OutdoorAir} - t_{ReturnAir})}$				
Return air temperature (RAT) =	75.0 °F					
Outdoor air temperature (OAT)=	-3.2 °F					
Supply flow (SAF) =	20,000 cfm					
Outdoor air flow (OA Flow) =	10,997 cfm					
Outdoor air percentage =	55%					
RA Flow =	9,003 cfm					

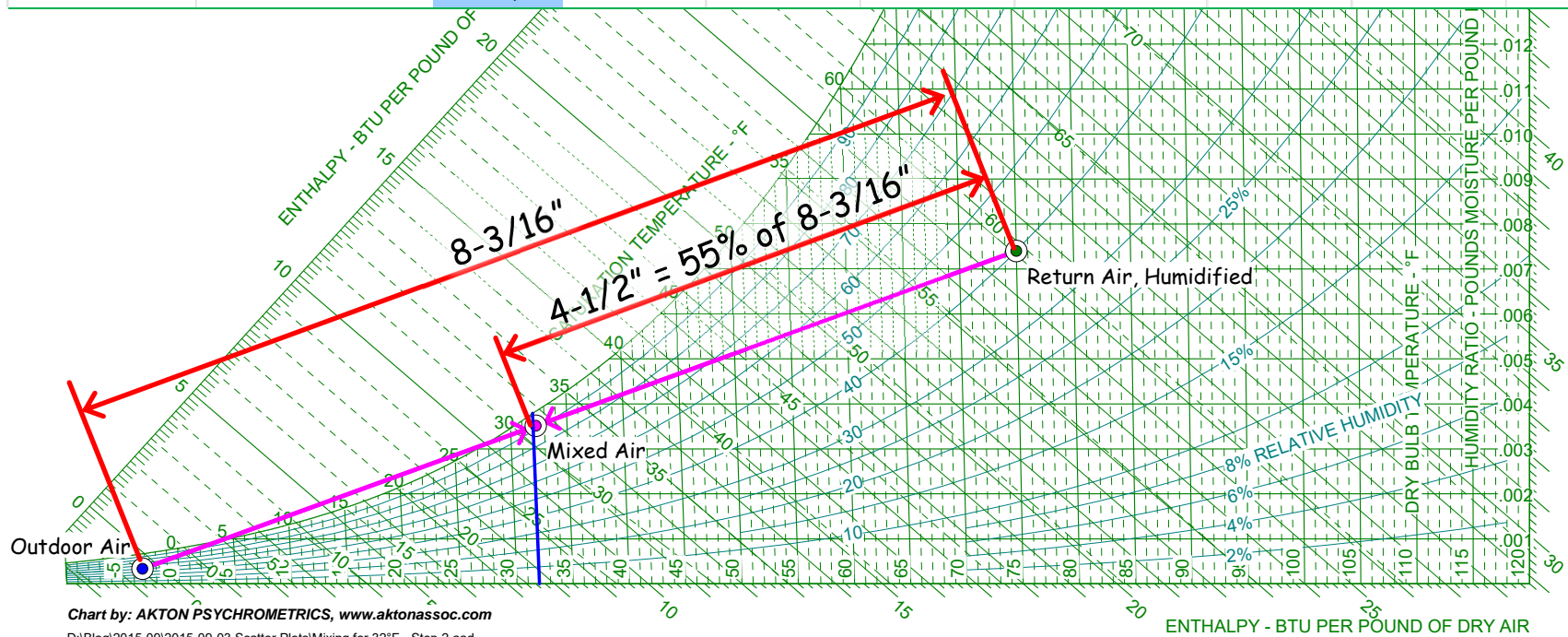
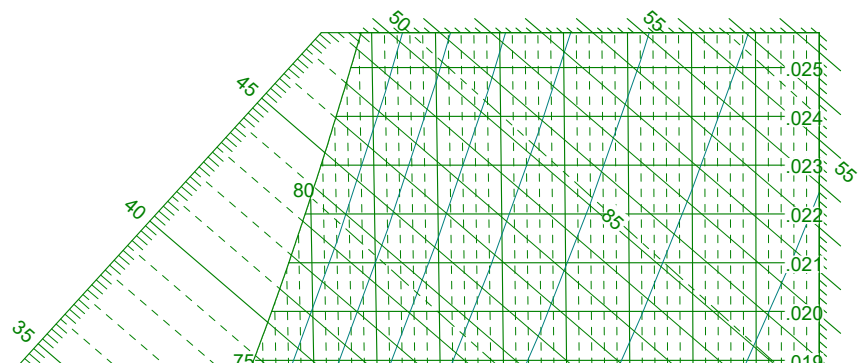
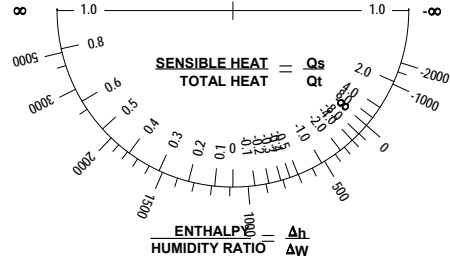


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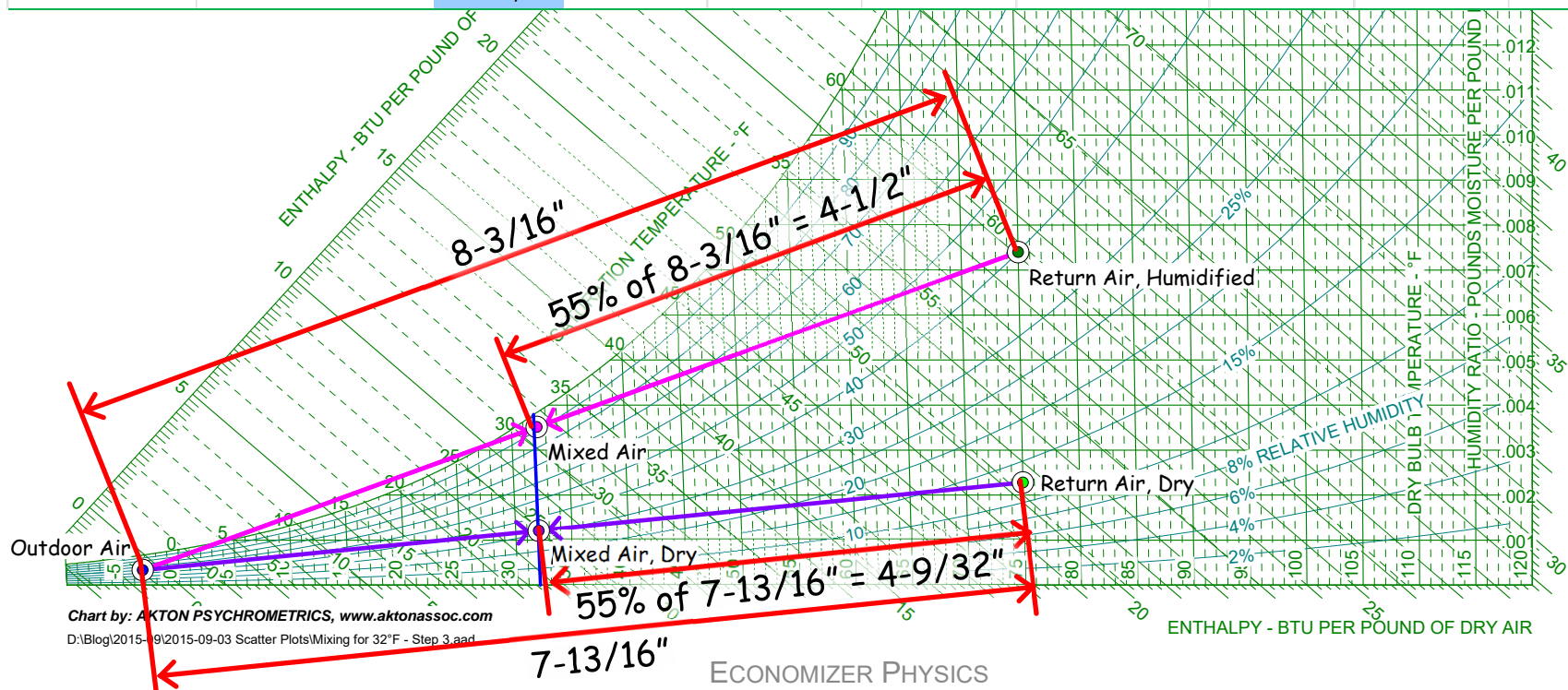
ECONOMIZER PHYSICS

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Using Electrons

PG&E

PSYCHROMETRIC CHART NORMAL TEMPERATURE

I-P Units

SEA LEVEL

BAROMETRIC PRESSURE : 29.921 INCHES OF MERCURY

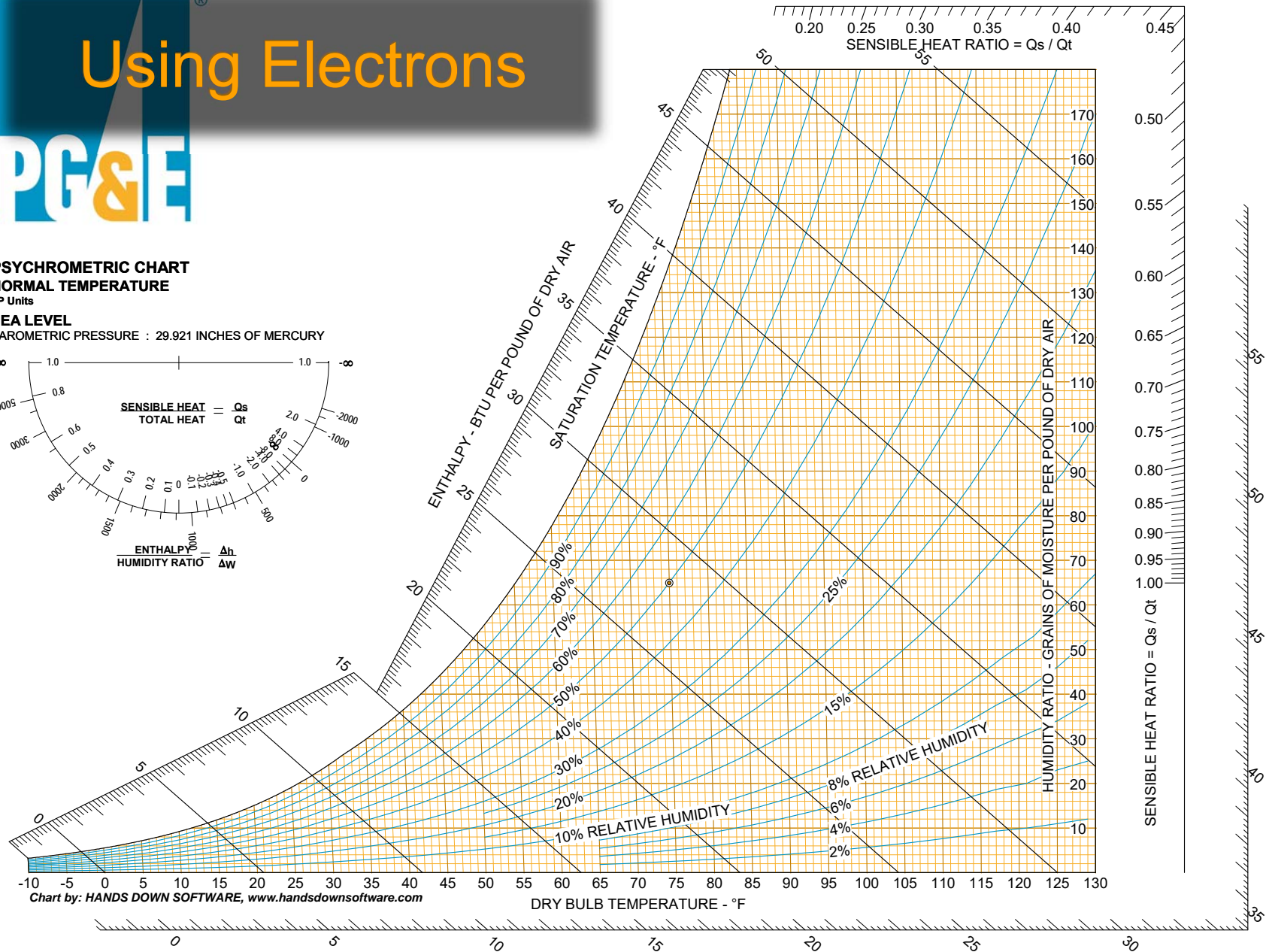
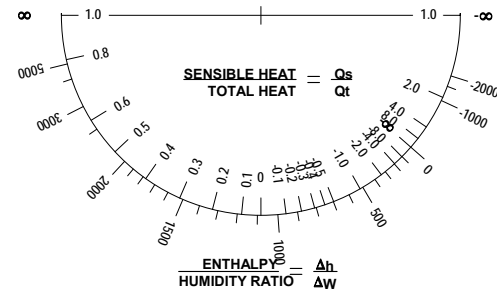
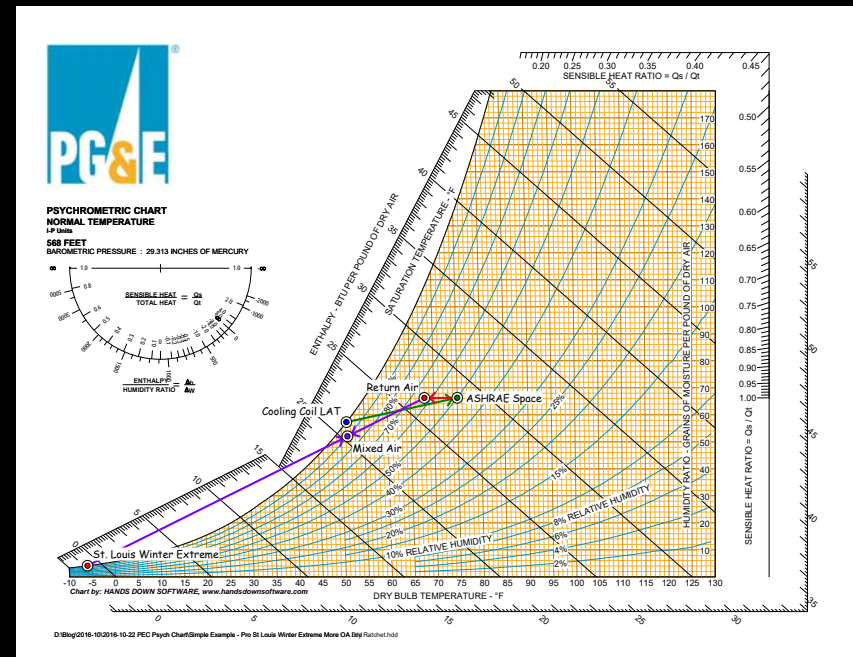
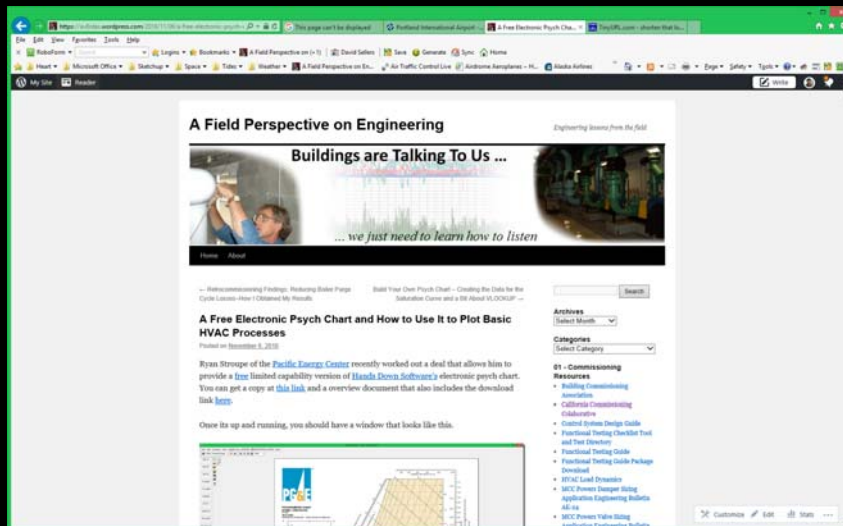


Chart by: HANDS DOWN SOFTWARE, www.handsdownsoftware.com

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Compromising Between Paper and Electrons



- Visit <http://tinyurl.com/PGEPsychChartOverview> for the free version of the psych chart and some basic information about it
- Visit <http://tinyurl.com/PGEPsychChartBasics> for examples of how to use it to do basic things

Bottom Lines

- Fundamental physical relationships can be used to describe our HVAC processes
 - Frequently, the complexity can be reduced by making appropriate simplifying assumptions and substitutions
 - A simplifying assumption is different from a simplifying substitution