Controlling Variable Air Volume Systems

Terminal Unit Maximum Flow - Where Does It Come From?

Presented By:

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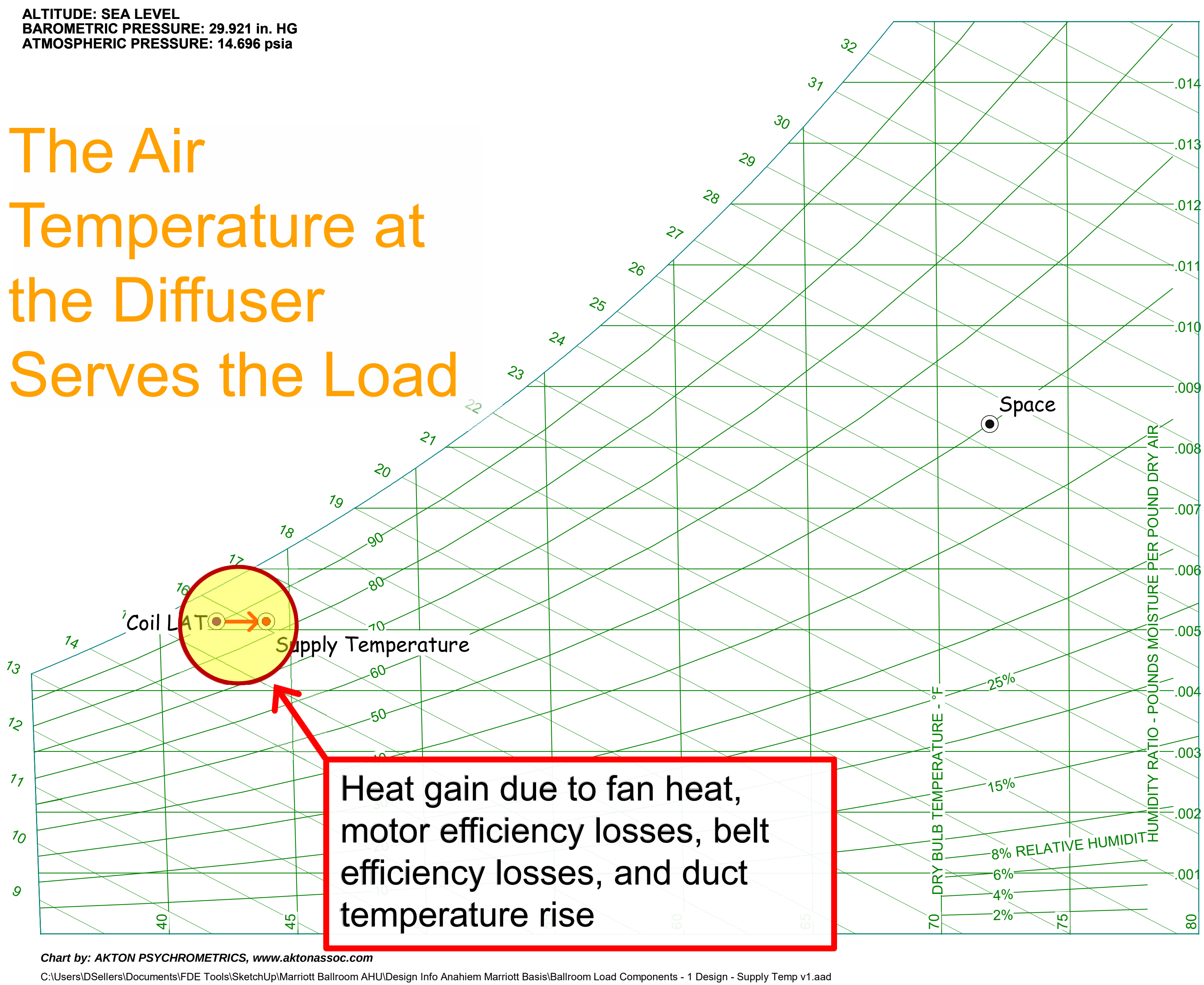
Senior Engineer

NAVFAC DDC Training

The Air Temperature at the Diffuser Serves the Load



What is in This Module?

- What sets the maximum air flow in a VAV zone
- Why we have to do reheat

Setting the Maximum Flow Rate

$$Q_{\text{Btu per hour}} = 1.08 \times Flow_{\text{Cubic Feet per Minute}} \times \left(Temperature_{\text{In, °F}} - Temperature_{\text{Out, °F}}\right)$$

Where:

$Q_{\text{Btu per hour}} =$ Sensible load from the load calculations

$1.08 =$ Unit conversion constant for dry air at 70°F

$Flow_{\text{Cubic Feet per Minute}} =$ The flow rate required to offset the load

$\left(Temperature_{\text{In, °F}} - Temperature_{\text{Out, °F}}\right) =$ Supply air to room temperature difference, °F

Setting the Maximum Flow Rate

$$\frac{Q_{\text{Btu per hour}}}{\left(1.08 \times \left(Temperature_{\text{In, °F}} - Temperature_{\text{Out, °F}}\right)\right)} = Flow_{\text{Cubic Feet per Minute}}$$

Where:

$Q_{\text{Btu per hour}}$ = Sensible load from the load calculations

1.08 = Unit conversion constant for dry air at 70°F

$Flow_{\text{Cubic Feet per Minute}}$ = The flow rate required to offset the load

$\left(Temperature_{\text{In, °F}} - Temperature_{\text{Out, °F}}\right)$ = Supply air to room temperature difference, °F

Setting the Maximum Flow Rate

$$\frac{736{,}670 \text{ Btu/hr}}{\left(1.08 \times \left(72\ ^\circ\text{F} - 44.1\ ^\circ\text{F}\right)\right)} = Flow_{\text{Cubic Feet per Minute}} = 24{,}487 \text{ cfm}$$

Where:

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ALTITUDE: SEA LEVEL
BAROMETRIC PRESSURE: 29.921 in. HG
ATMOSPHERIC PRESSURE: 14.696 psia

The Air Volume Thus Calculated:

- Will be exactly cold enough,
- And exactly dry enough,

to offset the zone latent and sensible gains

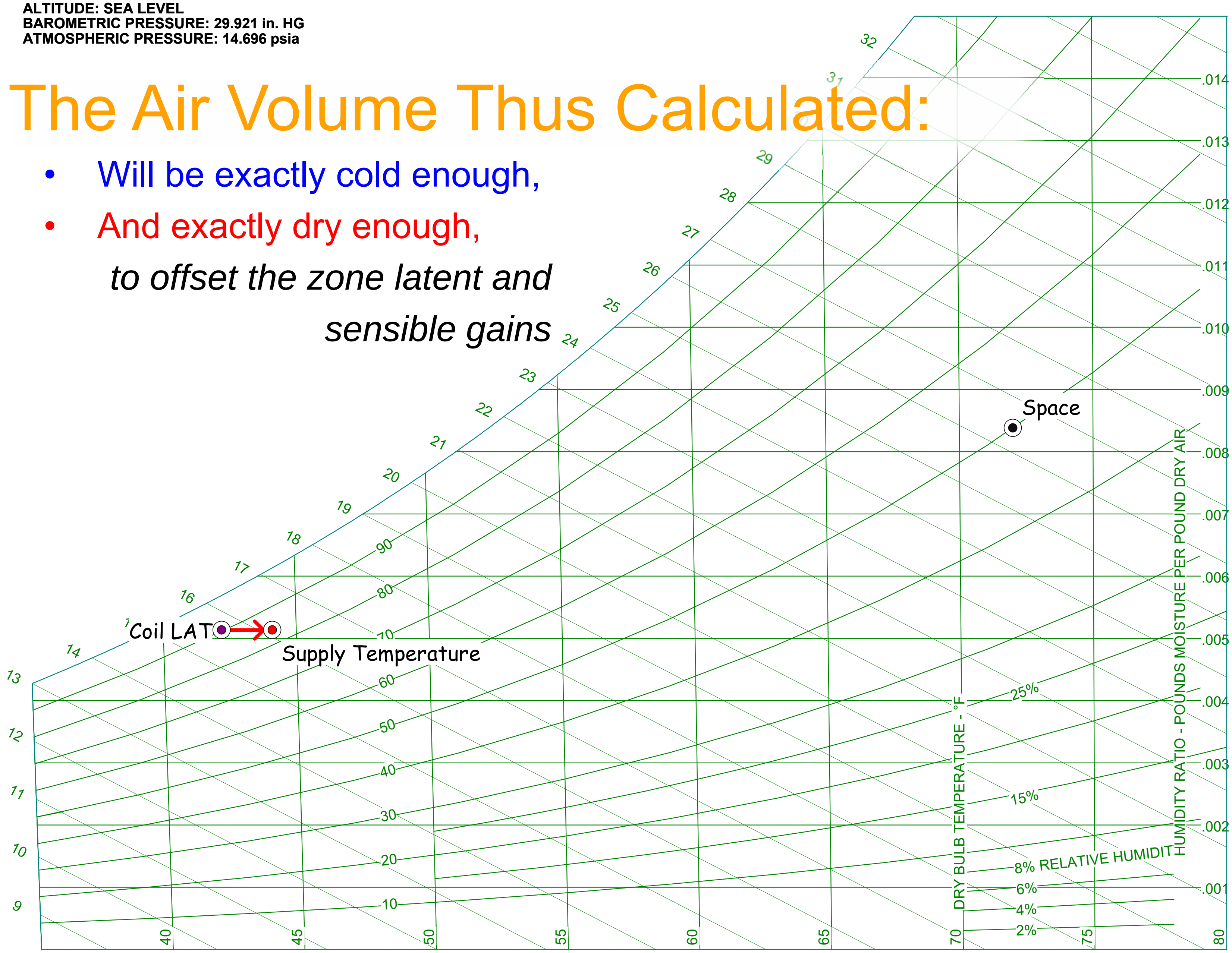

Chart by: AKTON PSYCHROMETRICS, www.aktonassoc.com

C:\Users\DSellers\Documents\FDE Tools\SketchUp\Marriott Ballroom AHU\Design Info Anaheim Marriott Basis\Ballroom Load Components - 1 Design - Supply Temp v1.aad

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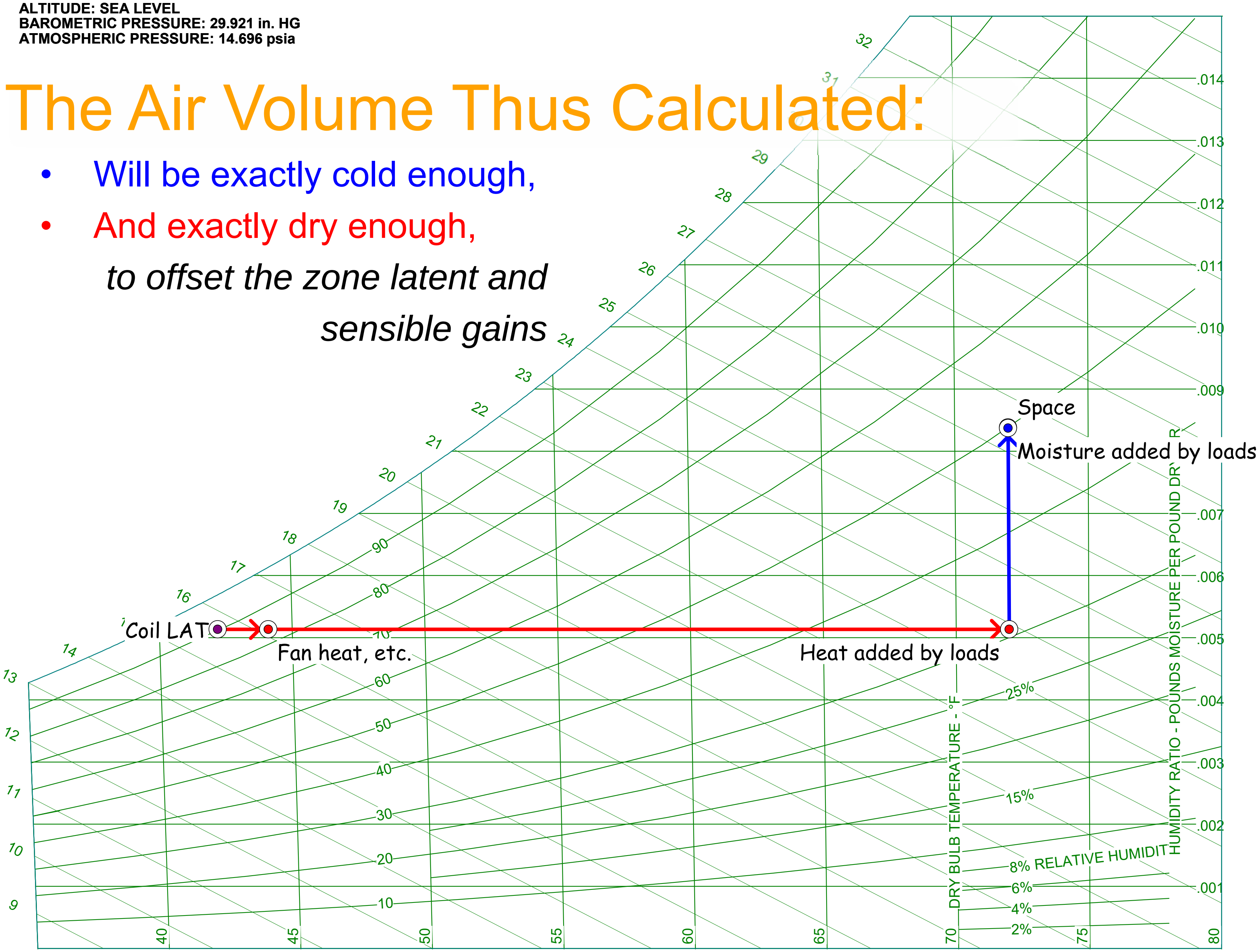

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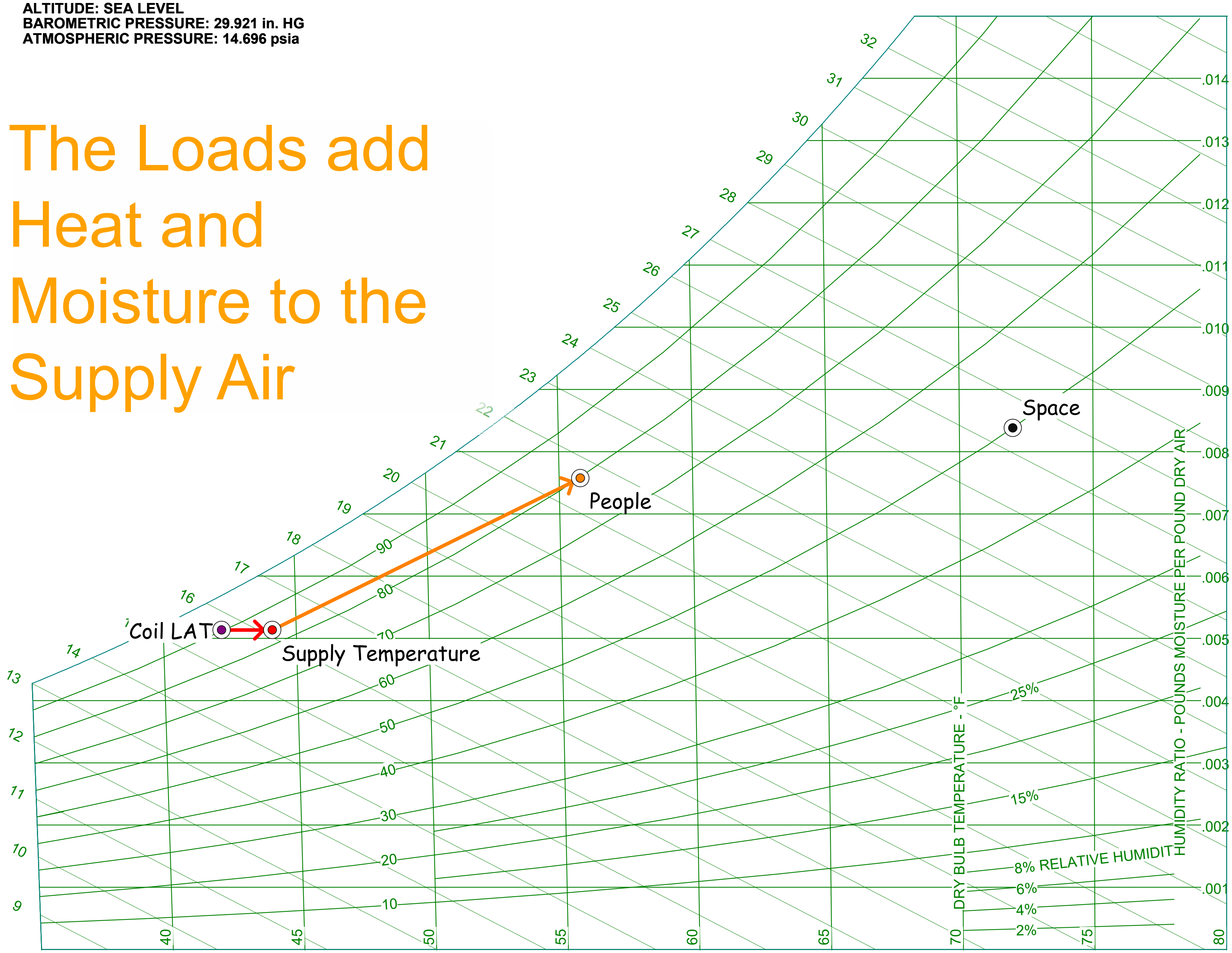
The Loads add Heat and Moisture to the Supply Air



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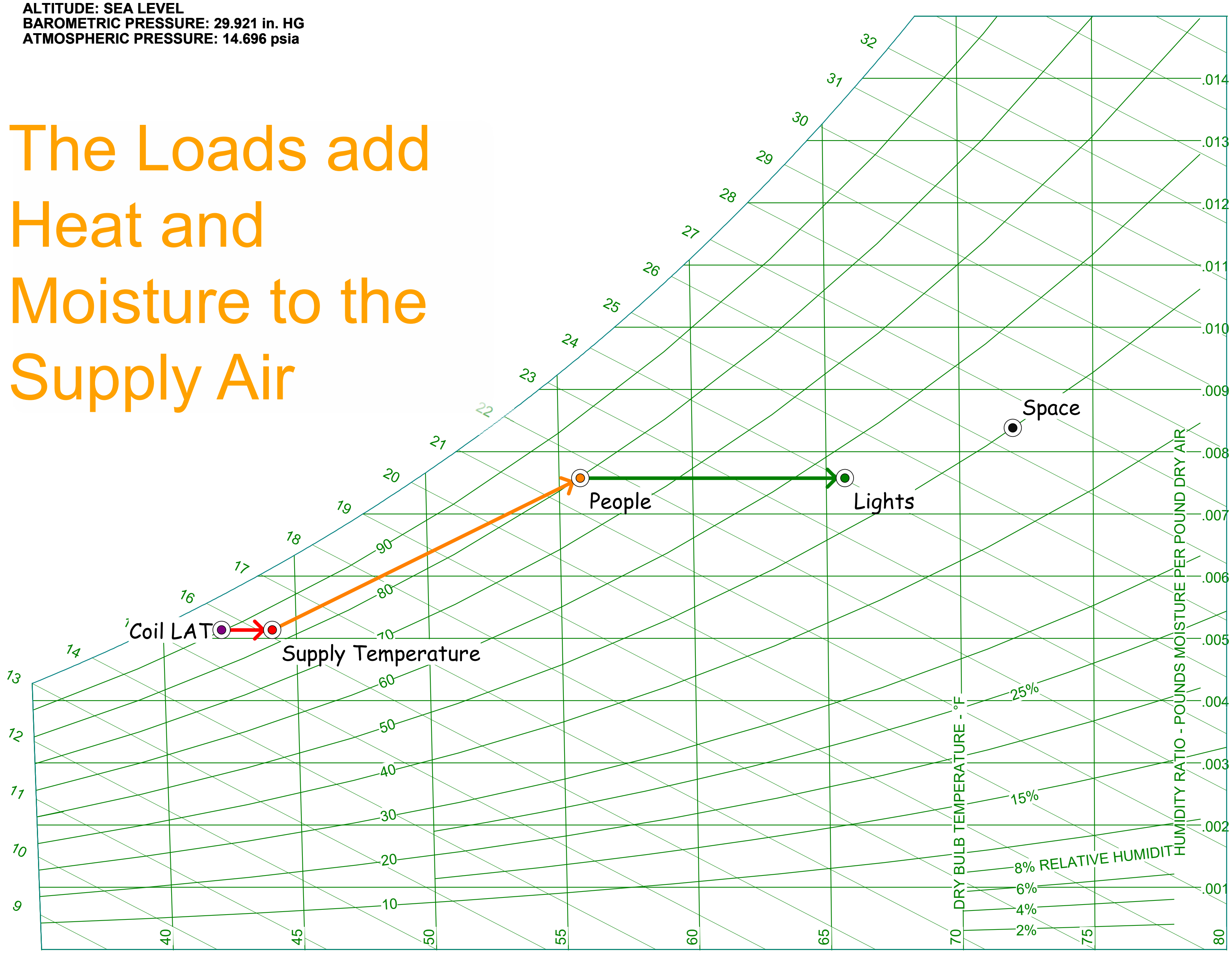

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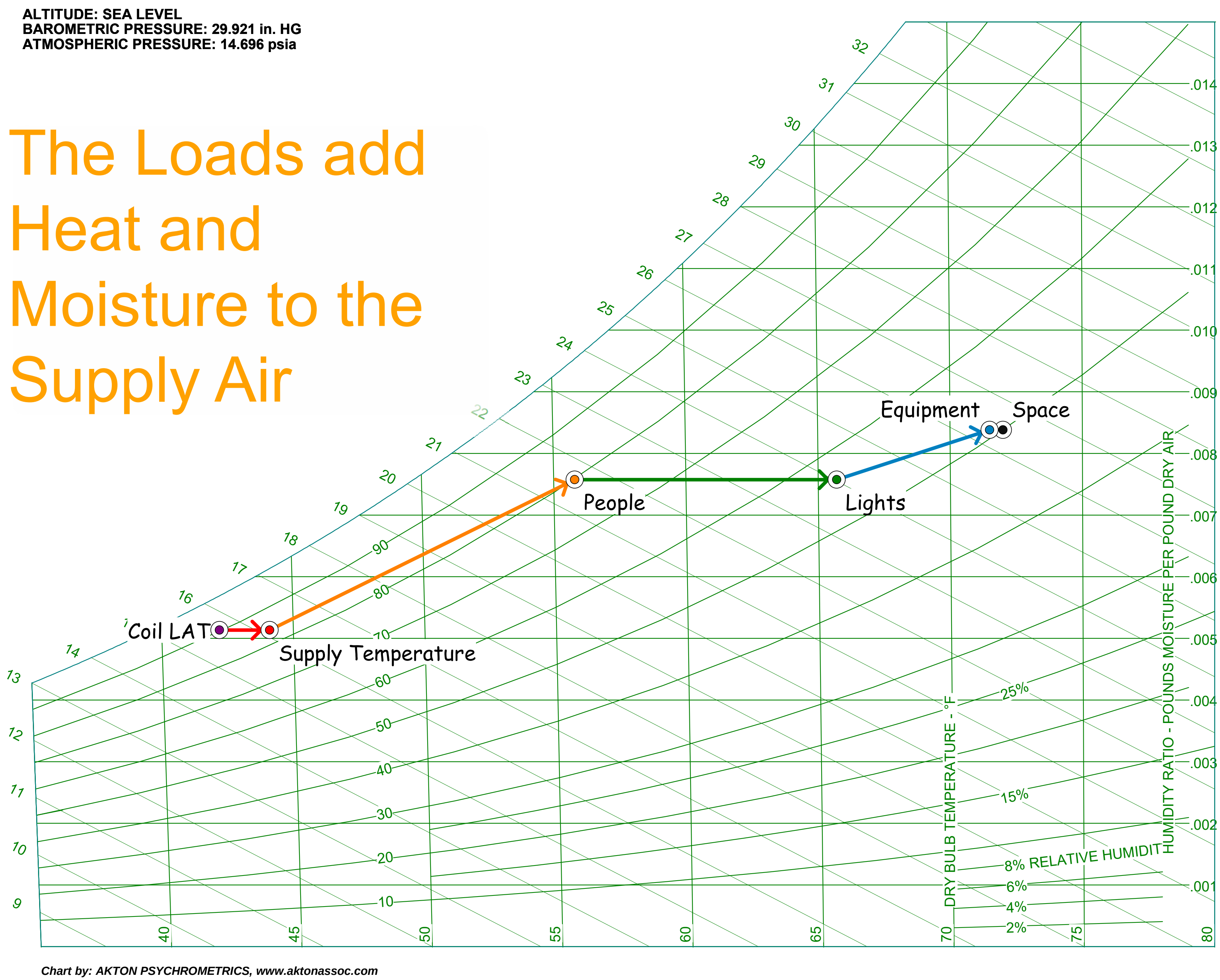

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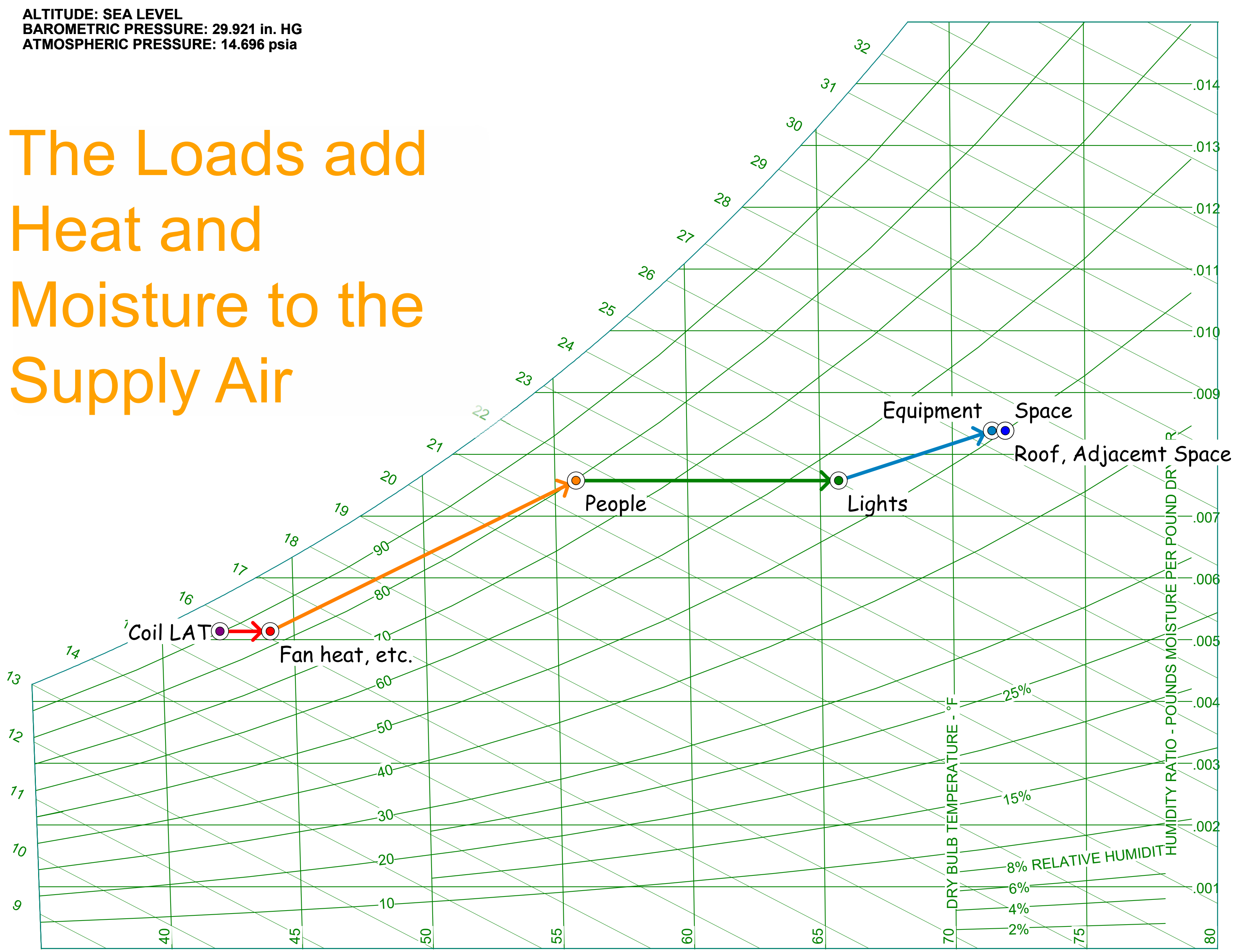

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Coil Leaving Conditions Below the Mid to Upper 40°F Range Can Be a Challenge

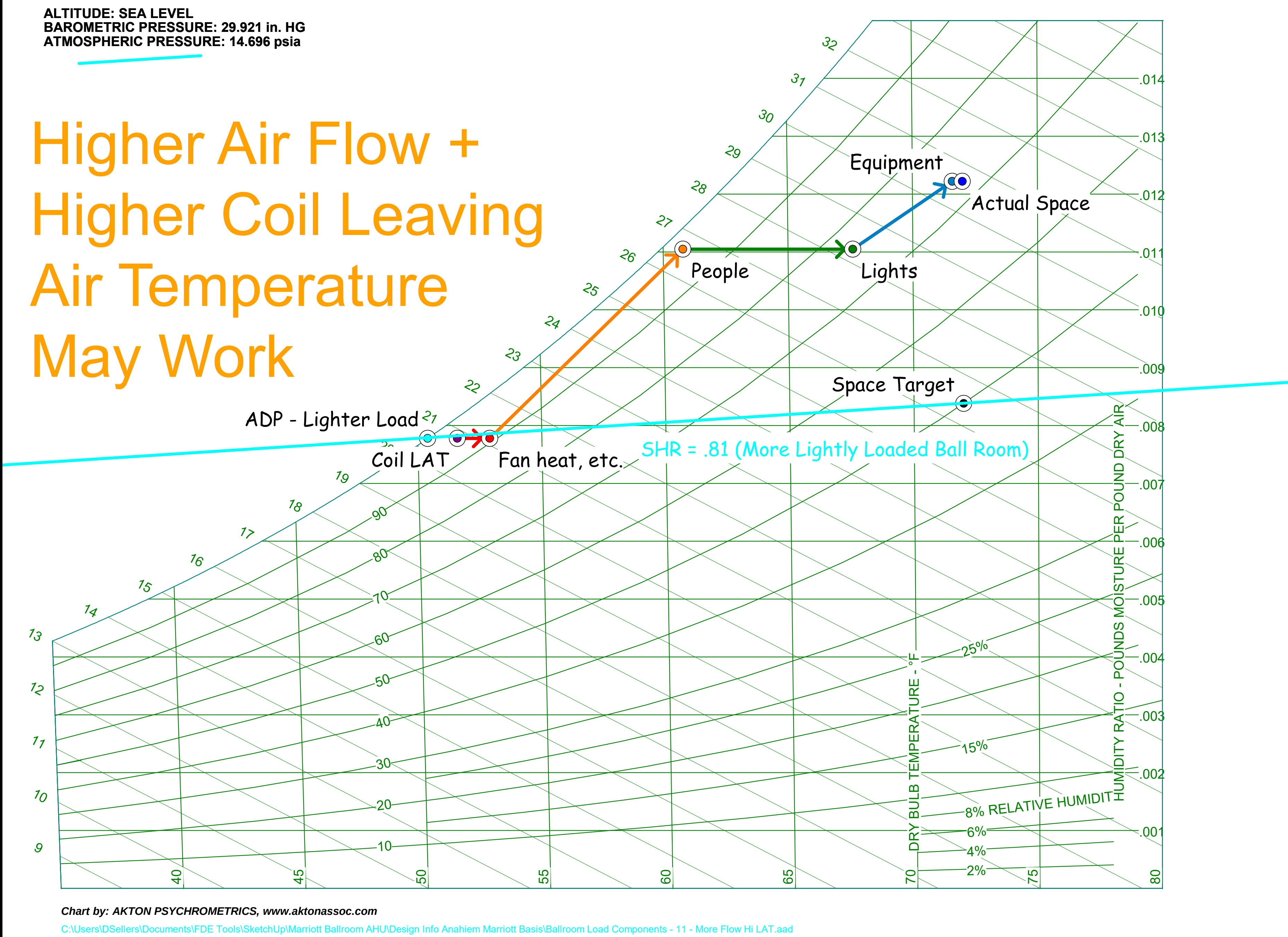
- Deep coils are required
  - Higher pressure drops
  - Harder to clean
  - Heavy condensation loads = potential carry-over of moisture

Coil Leaving Conditions Below the Mid to Upper 40°F Range Can Be a Challenge

- Colder refrigerant temperatures required
  - For direct expansion, refrigerant temperatures below 32° = frost on the coil
  - For chilled water, another heat transfer step is added
    - Air transfers heat to water
    - Water transfers heat to refrigerant
    - Refrigerant may be at or below freezing

Remember, there has to be a temperature difference for heat transfer to happen. Approaches closer than 5°F between the heat sink and source typically become prohibitively expensive

Higher Air Flow + Higher Coil Leaving Air Temperature May Work



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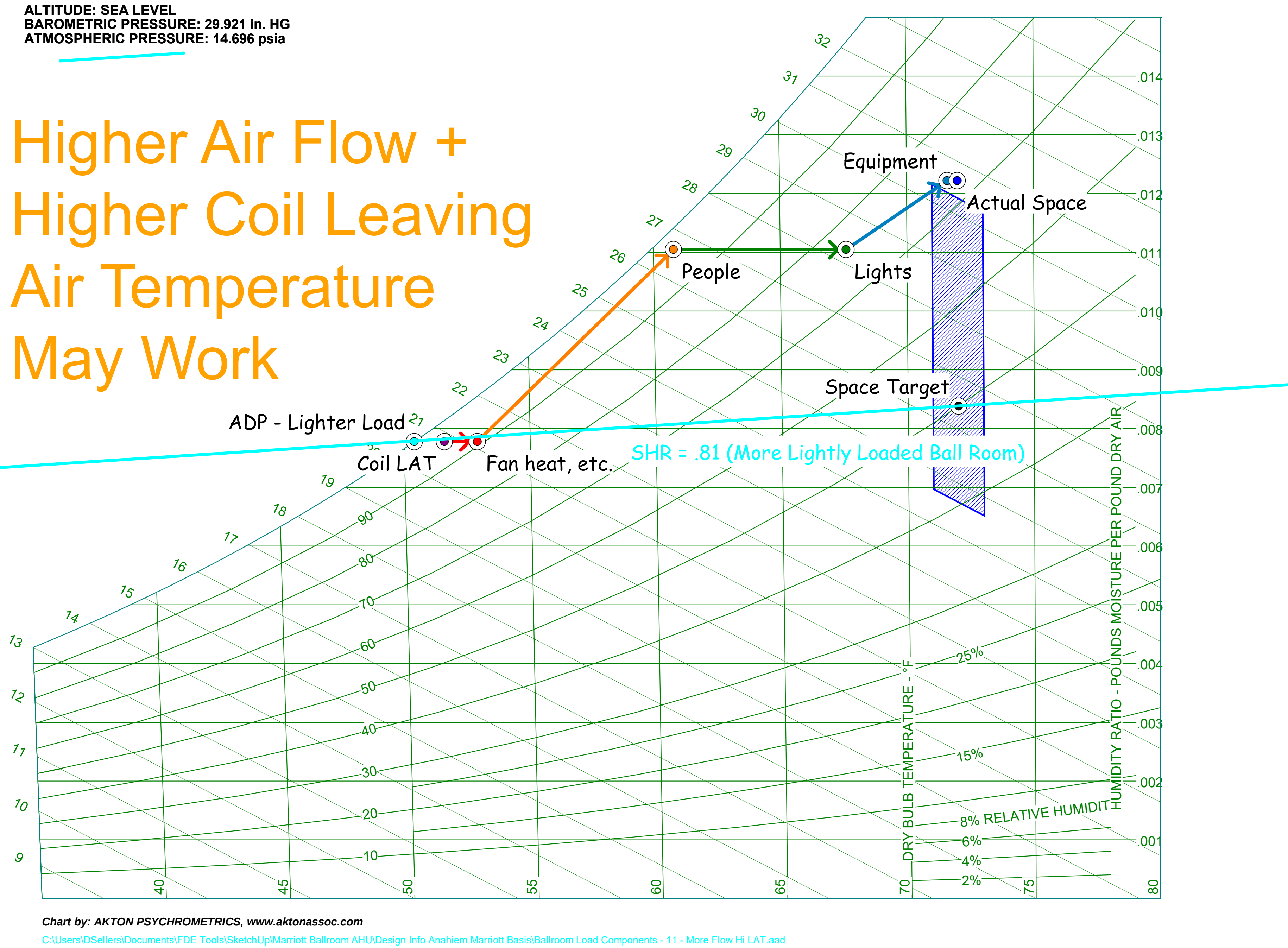
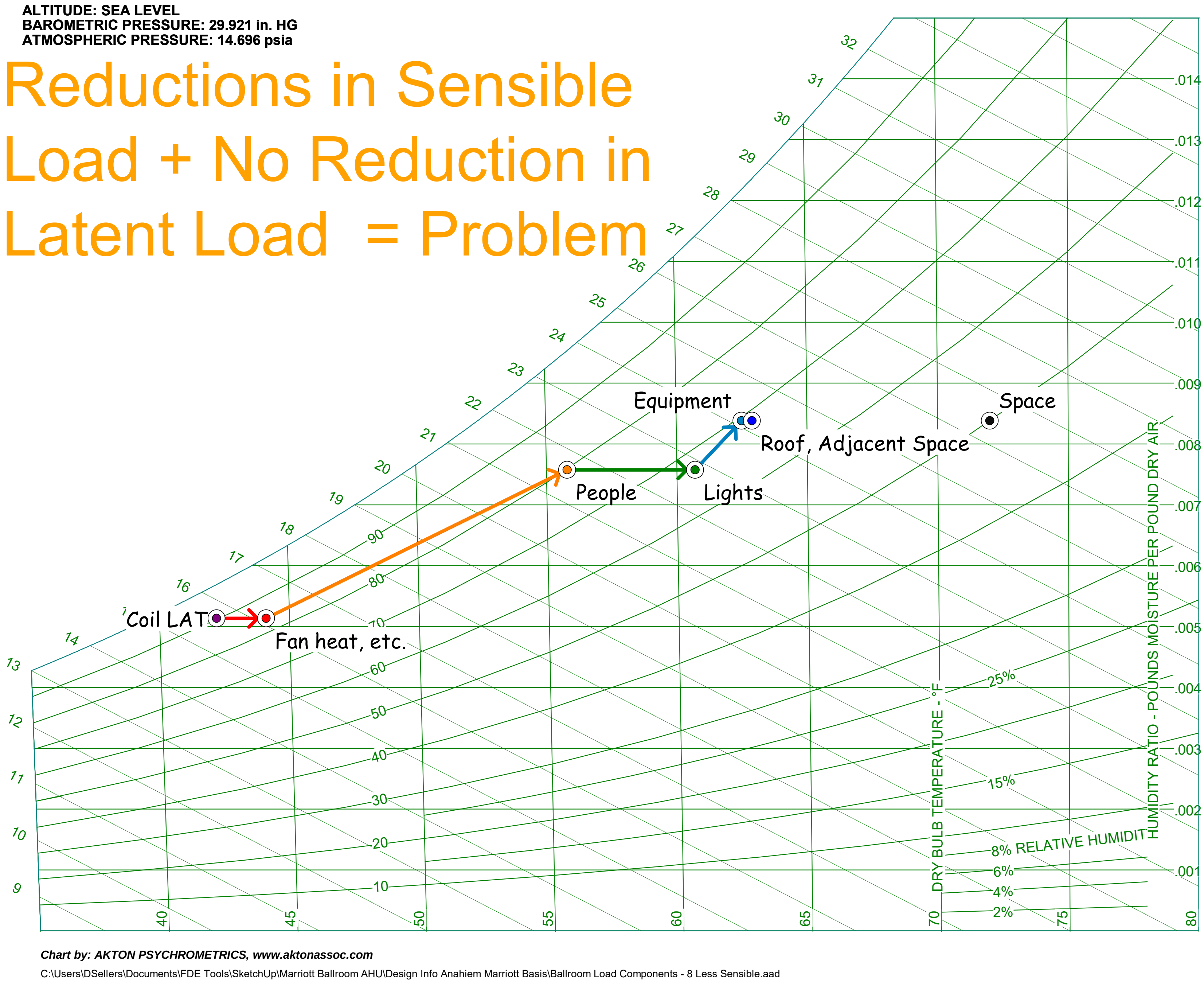


Reductions in Sensible Load + No Reduction in Latent Load = Problem



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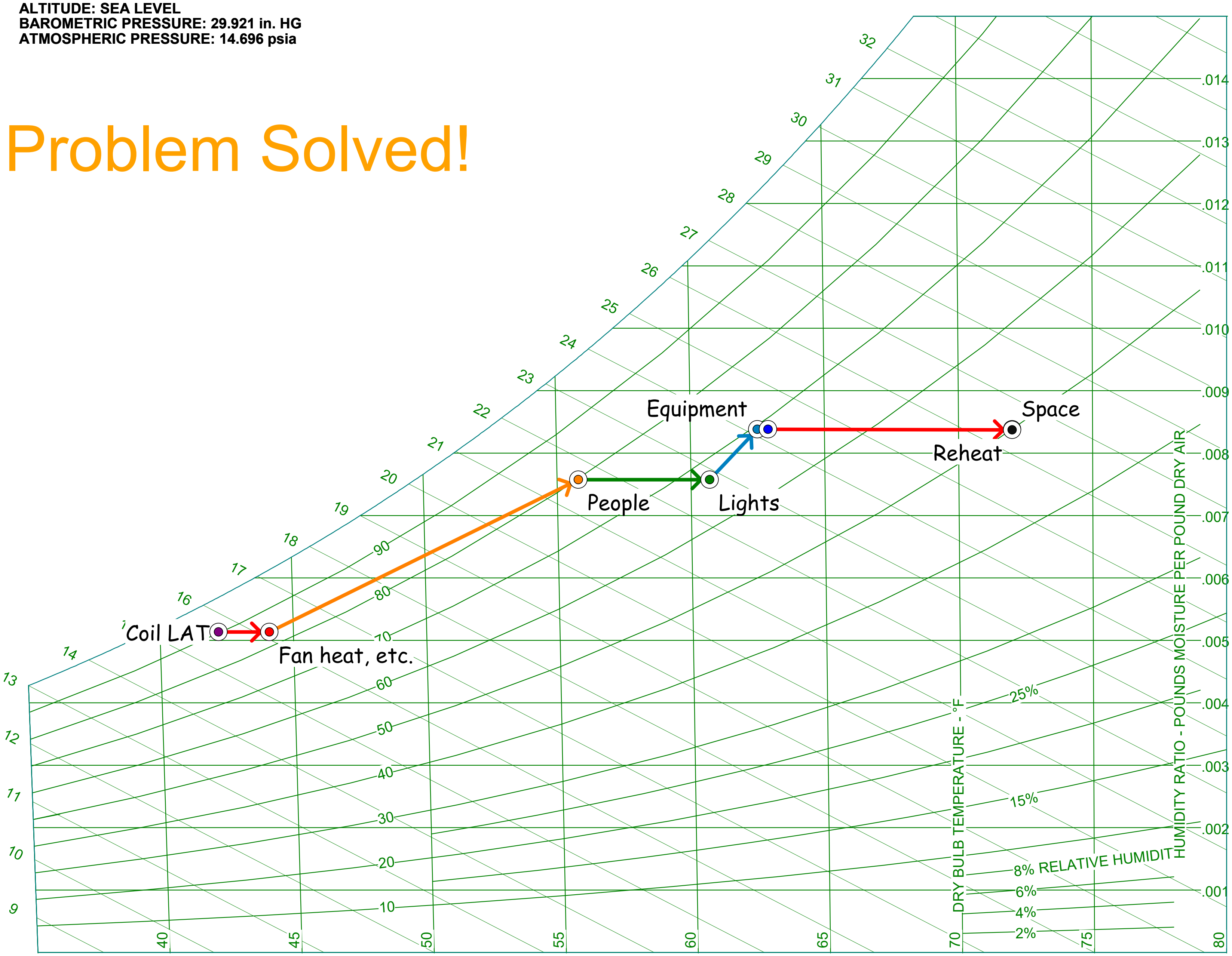
Problem Solved!



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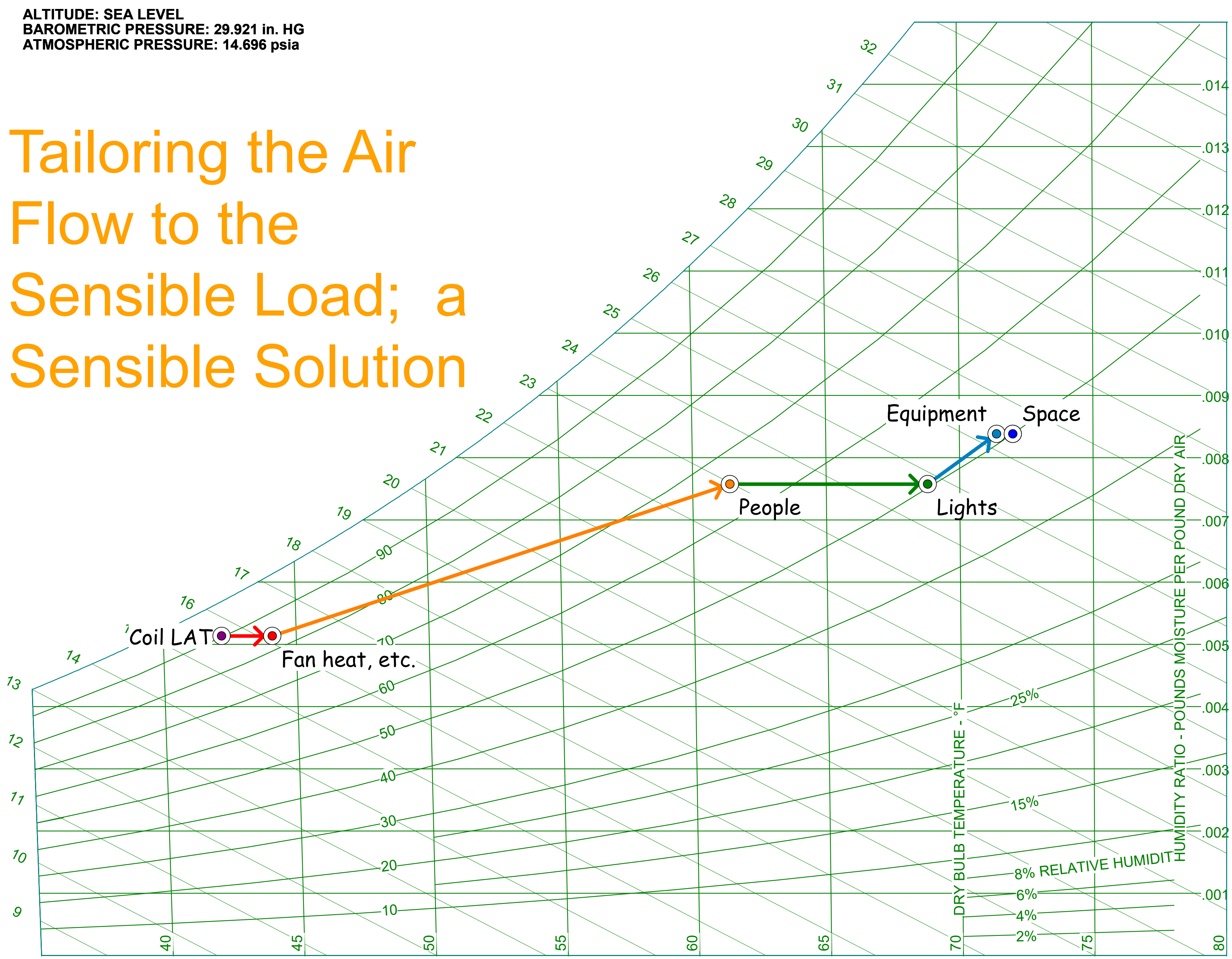
Tailoring the Air Flow to the Sensible Load; a Sensible Solution



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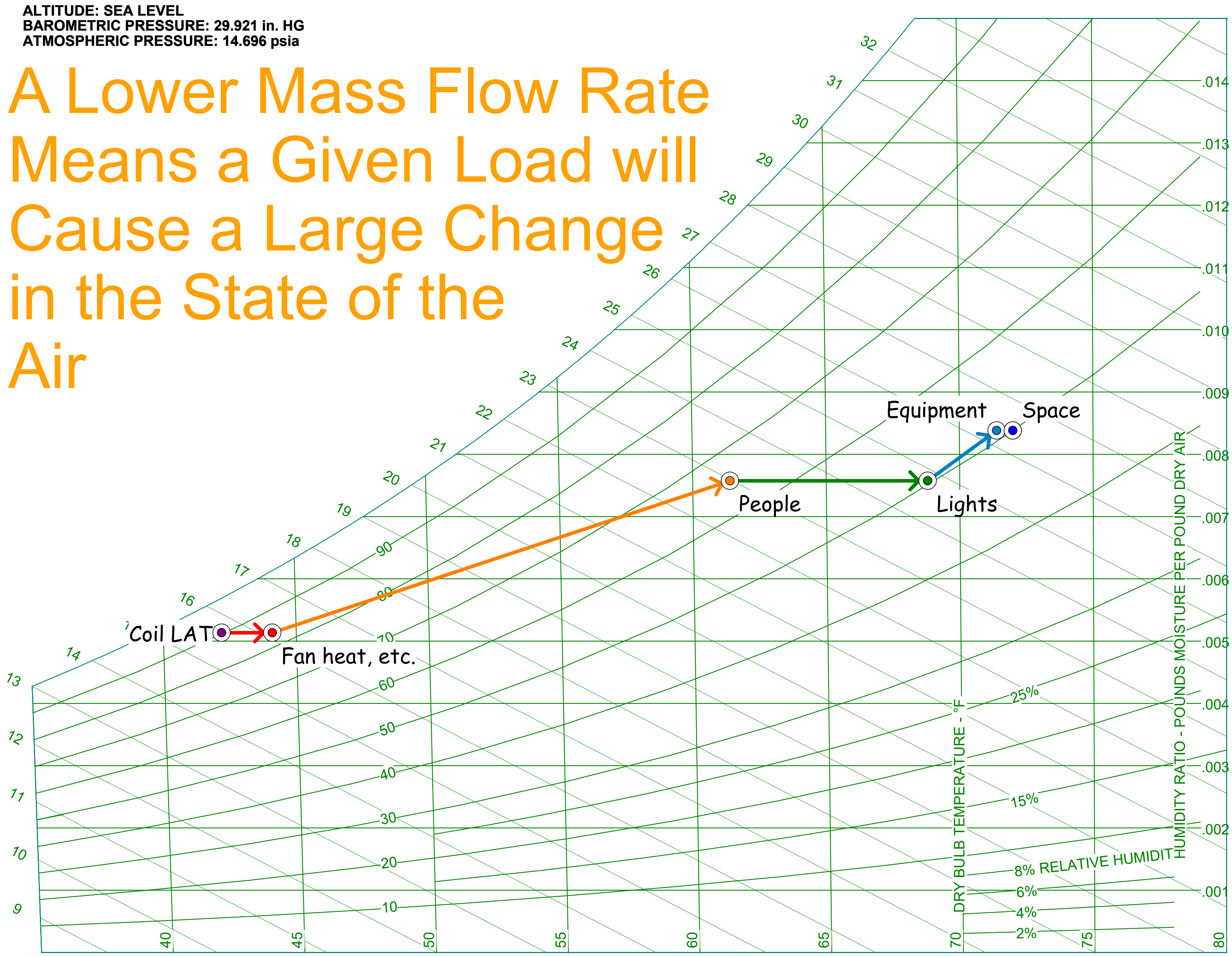
A Lower Mass Flow Rate Means a Given Load will Cause a Large Change in the State of the Air



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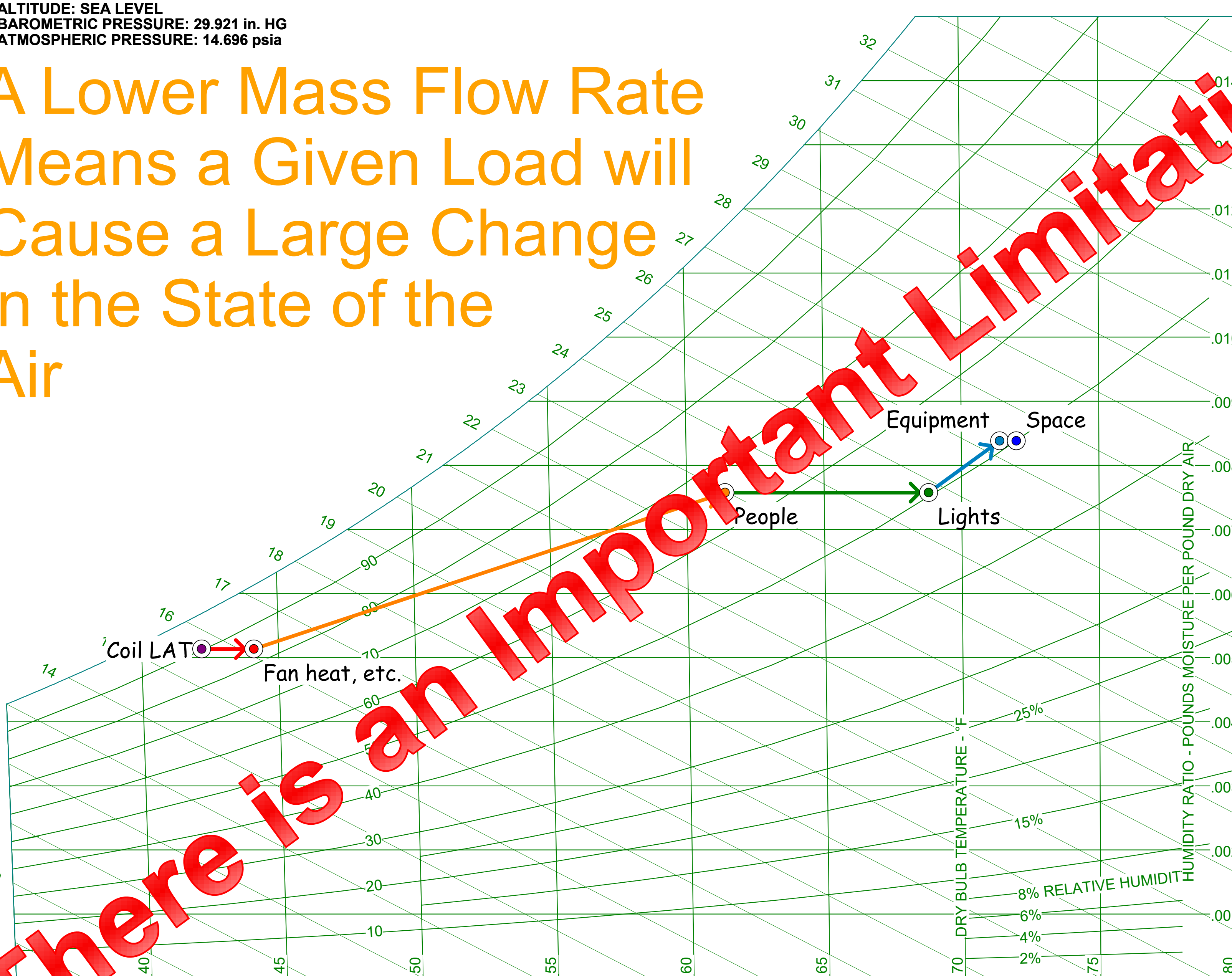

There is an Important Limitation

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