

Fans, Ducts and Air Handling Systems: Design, Performance and Commissioning Issues

Diffusers and Grilles



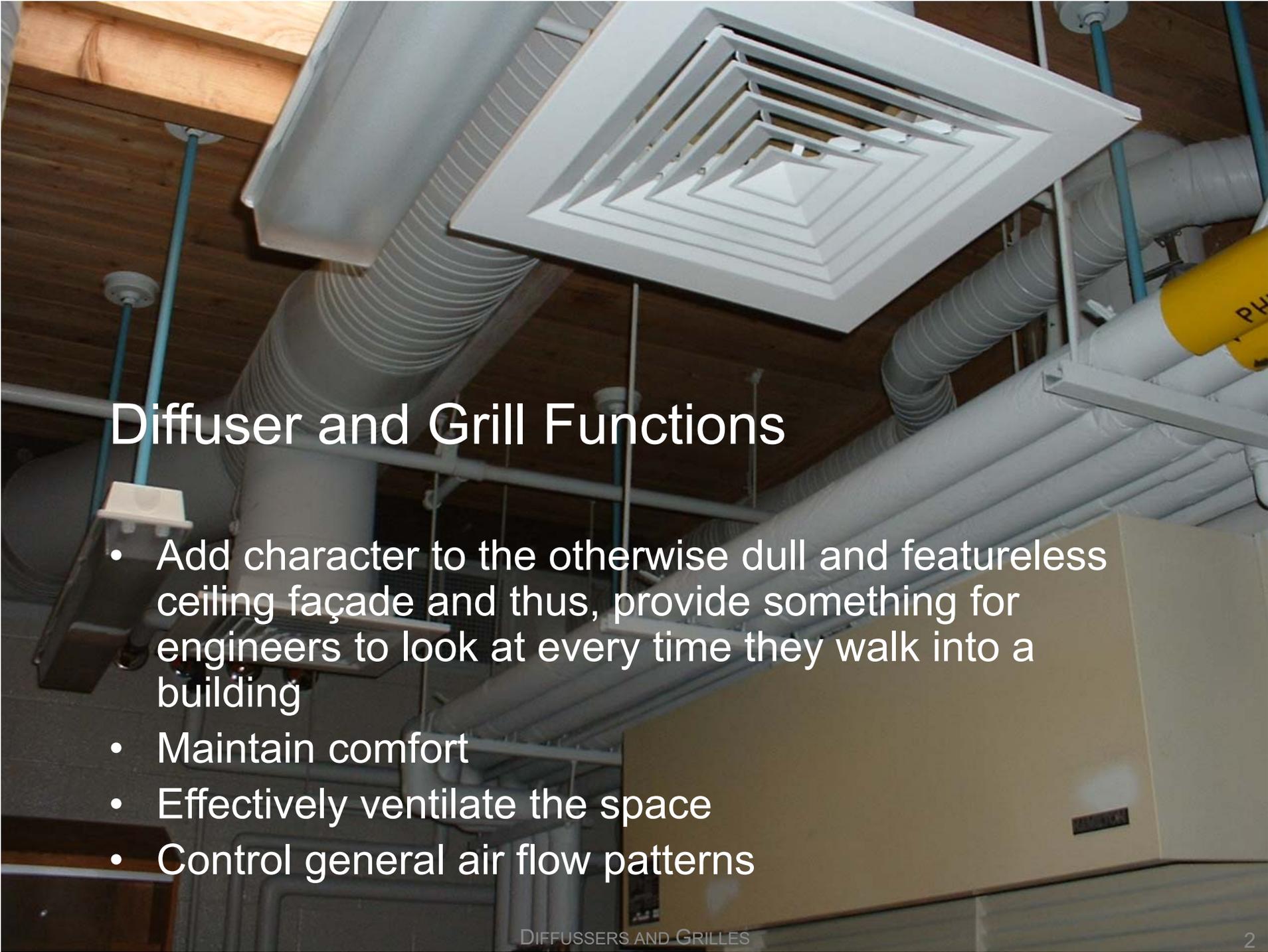
Instructor:

David Sellers

Senior Engineer

Facility Dynamics Engineering

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Diffuser and Grill Functions

- Add character to the otherwise dull and featureless ceiling façade and thus, provide something for engineers to look at every time they walk into a building
- Maintain comfort
- Effectively ventilate the space
- Control general air flow patterns

Grilles

A frame enclosing a set of either vertical or horizontal vanes

Diffusers

Generate a radial or directional discharge pattern

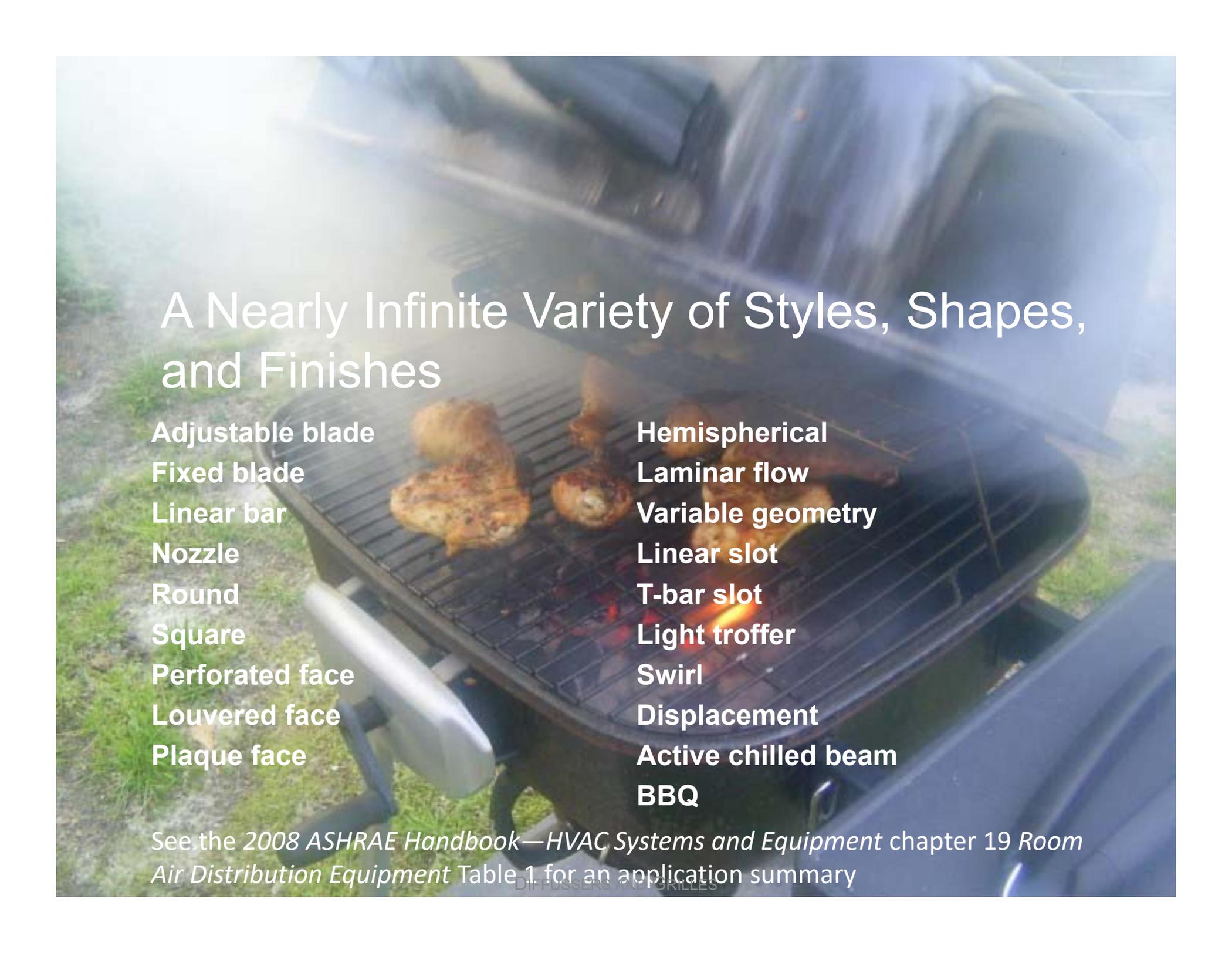


A Nearly Infinite Variety of Styles, Shapes, and Finishes

- Adjustable blade
- Fixed blade
- Linear bar
- Nozzle
- Round
- Square
- Perforated face
- Louvered face
- Plaque face

Hemispherical
Laminar flow
Variable geometry
Linear slot
T-bar slot
Light troffer
Swirl
Displacement
Active chilled beam

See the *2008 ASHRAE Handbook—HVAC Systems and Equipment* chapter 19 *Room Air Distribution Equipment* Table 1. for an application summary



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BBQ

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General Approaches

Fully mixed

Little or no thermal stratification within the occupied zone

Overhead air systems are an example

Fully stratified

Little or no mixing within the occupied zone

Displacement ventilation is an example

Partially mixed

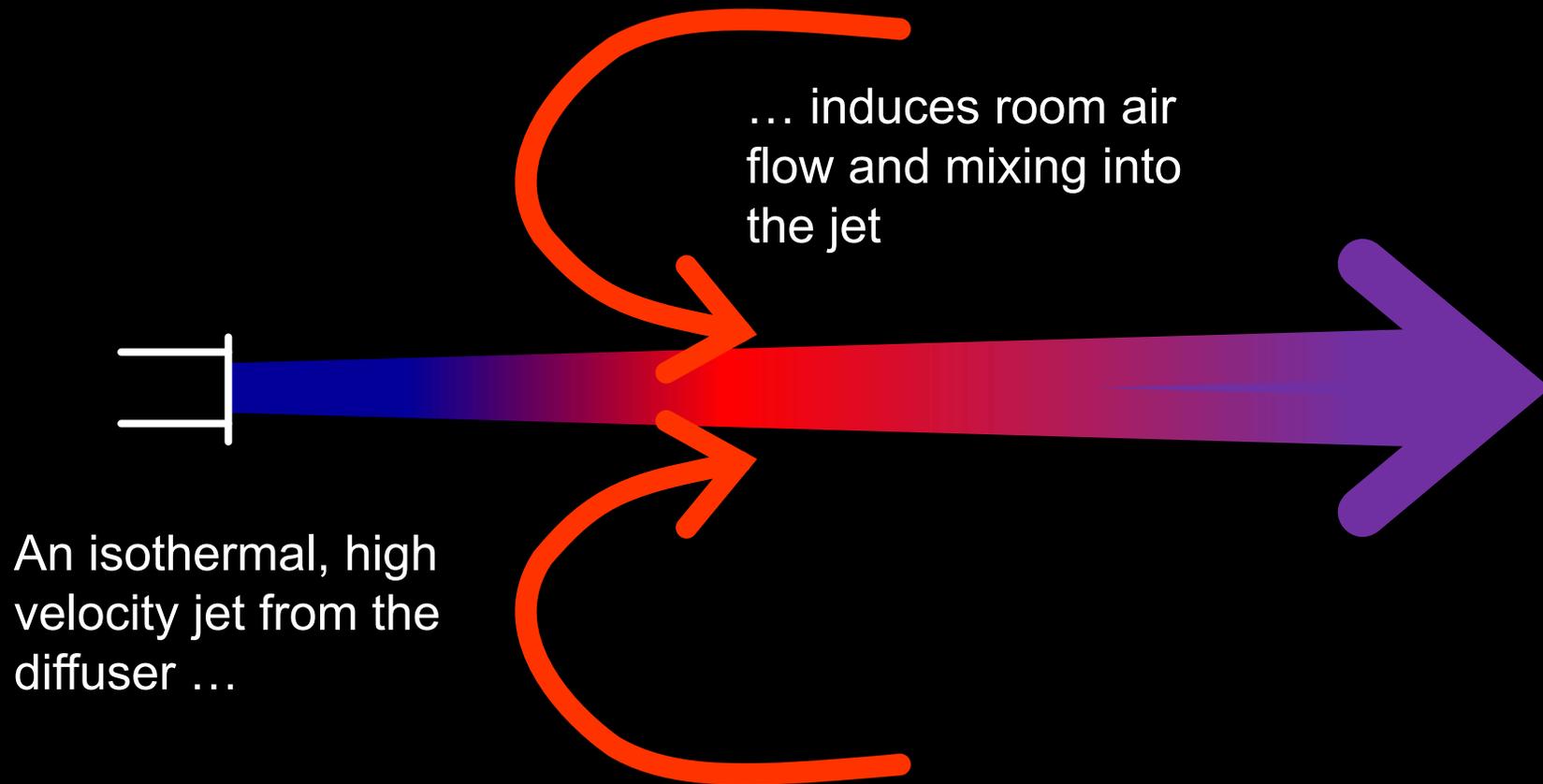
Limited mixing within the occupied zone

Underfloor air distribution is an example

Task

Condition a focused area

Induction is a Key Concept for Any System that Targets Mixing



Sizing/Selection is Critical to Comfort

- Distributing **hot air** is different from distributing **cold air**
- Velocities need to be at 40-50 fpm or less in the occupied zone
- Throw needs to cover the area but not hit anything
- VAV diffusers need to perform at both the maximum and minimum flow rates
 - Failing to consider minimum flows = poor induction = dumping
 - Failing to consider maximum flows = noise

Selection Criteria

- Location (ceiling, sidewall, floor, etc.)
 - Often architecturally driven
- Overcome stratification and flows created by the loads in the space
- Acceptable sound levels
 - Not a noise source vs. white noise
- Maximum comfort

You can please some of the people some of the time ...

Selection Criteria

Selection based on noise criteria

- Distance related
- Impacted by louver settings and balancing damper settings and location
- Often architecturally driven

Selection based on throw patterns

- Jet “attaches” to the ceiling
- Can fall away at about 100 fpm terminal velocity

Selection based on comfort criteria

- Air Diffusion Performance Index
- Likely to become the preferred method in an ASHRAE 62 update

An Important Consideration

Parameters we often vary in buildings and HVAC systems can have a significant impact on the performance of a diffuser

- Temperature difference between the supply and zone impacts the shape of the primary and secondary jets and the room air flow patterns
- Velocity has a similar impact to temperature and also impacts how the jet interacts with nearby surfaces
- Obstructions and variations in surfaces can impact the jet and the airflow patterns it generates

ALTITUDE: 1112 FEET
BAROMETRIC PRESSURE: 28.738 in. HG
ATMOSPHERIC PRESSURE: 14.115 psia

ASHRAE Comfort Zones

ASHRAE Standard 55

ASHRAE Handbook of Fundamentals 2007, Chapter 9

80% of sedentary or slightly active persons find the environment thermally acceptable

... which means 20% find it unacceptable

Depends on the level of clothing

- Summer expectations might be different from winter
- Units of “clo” used to define the effect
 - a winter business suit has about 1 clo of insulation
 - a short-sleeved shirt and trousers has about 0.5 clo

Airspeeds below 40 fpm

Chart by: AKTON PSYCHROMETRICS, www.aktonassoc.com

ENTHALPY - BTU PER POUND OF DRY AIR

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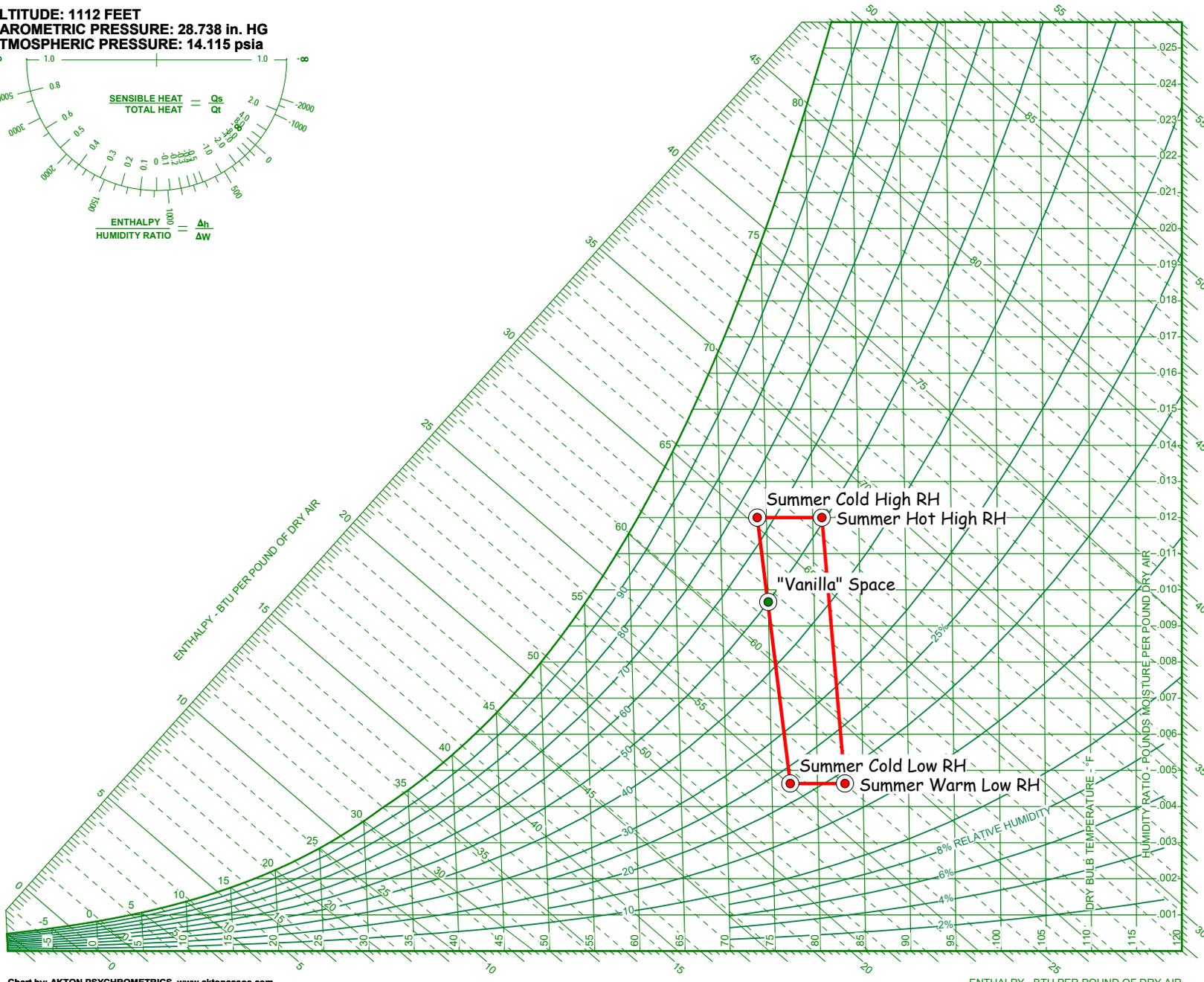
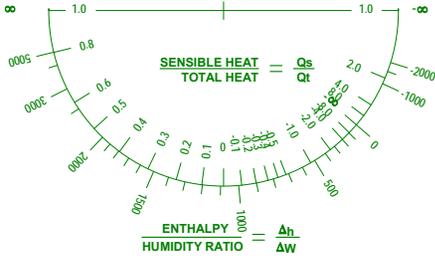


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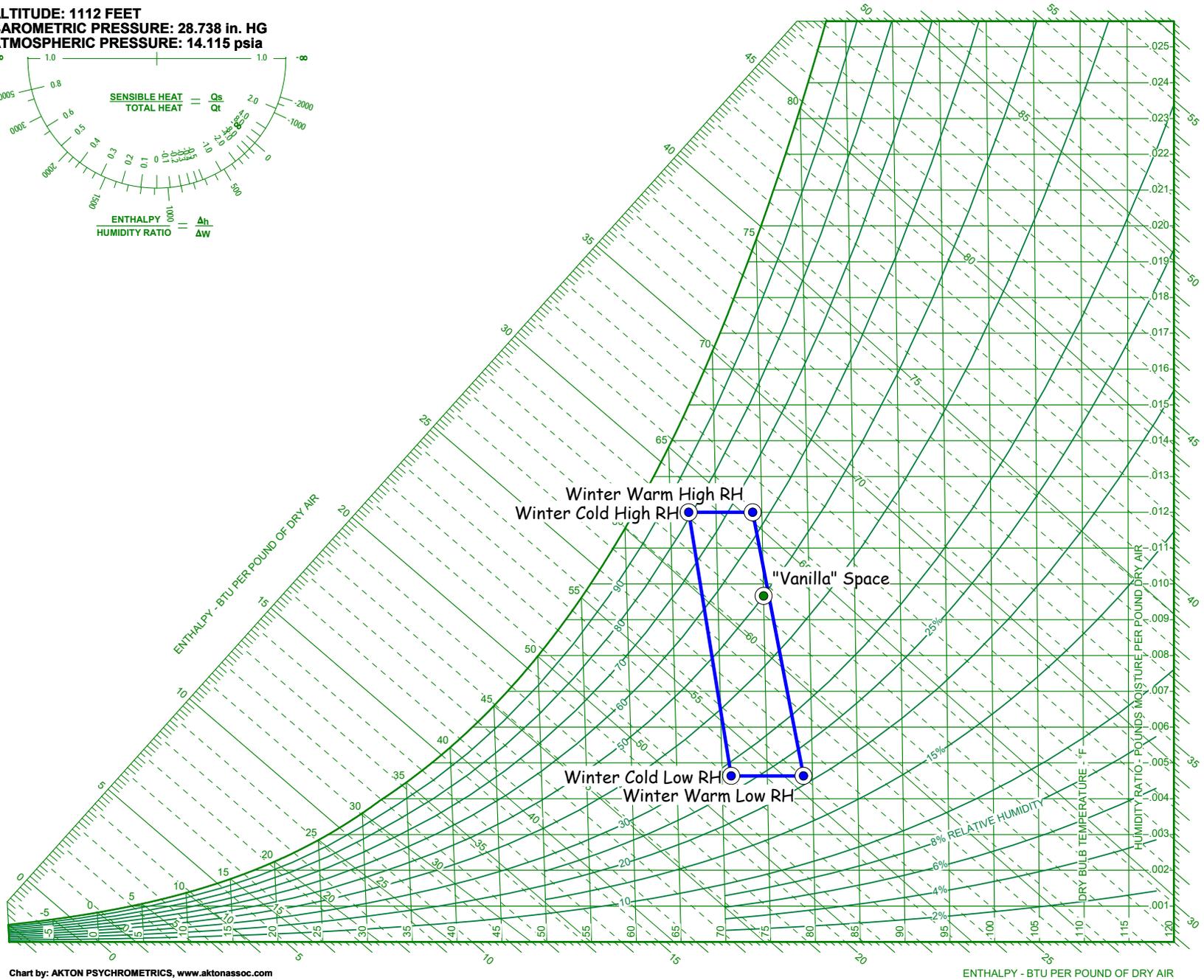
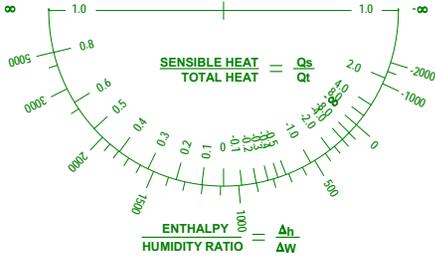


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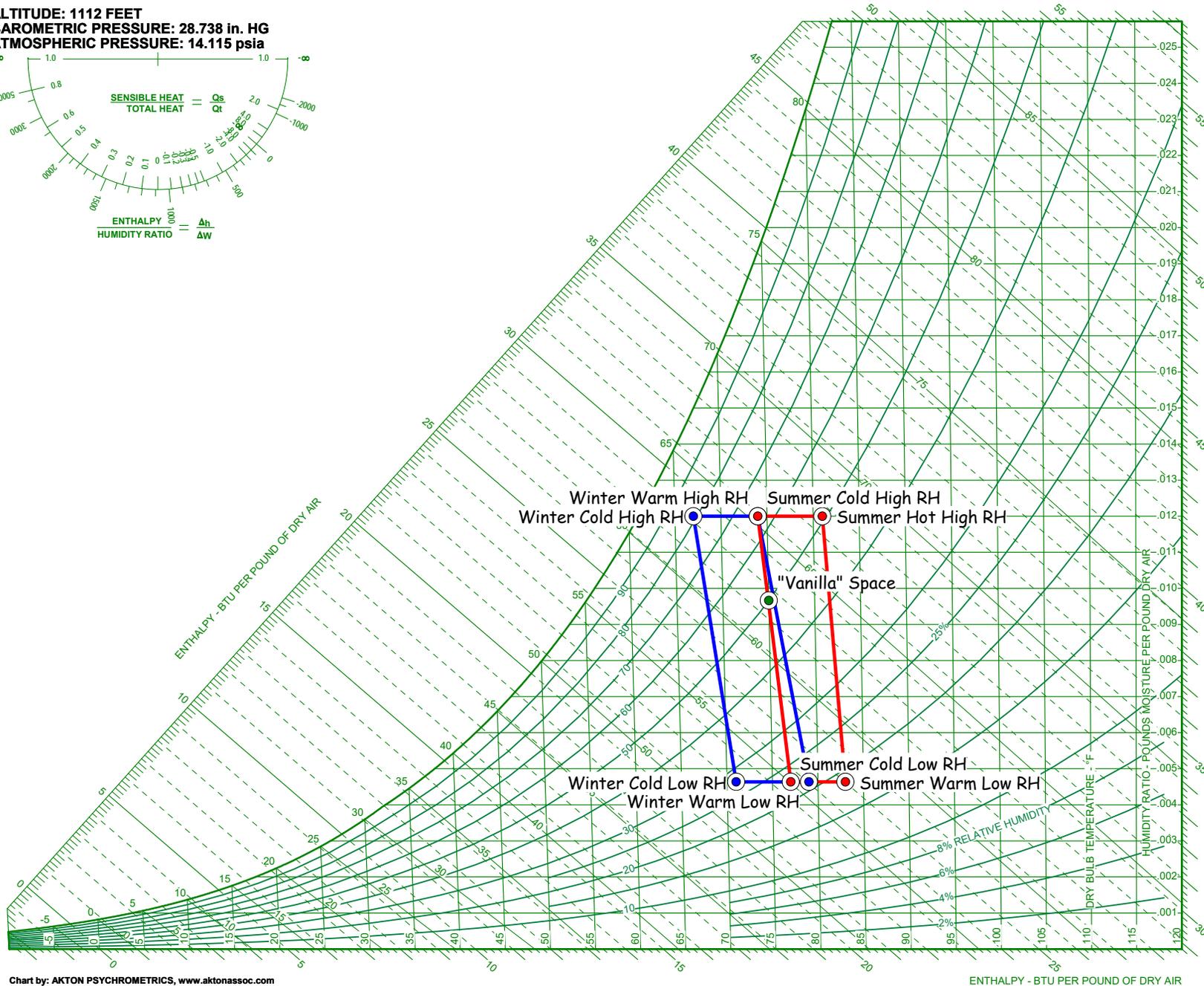
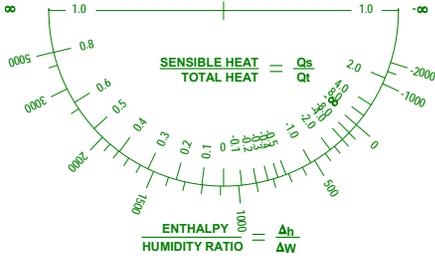
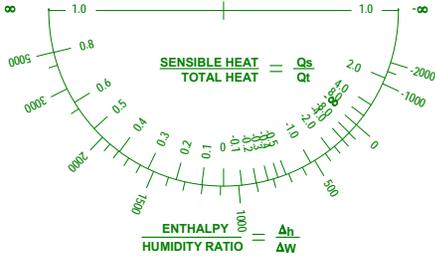


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Profile Presentation Control

Page Setup Chart Settings Chart Lines Point/Process Lines
 Comfort Zones Paper-Chart Colors Data Processing Zones

Show Summer Comfort Zone

Minimum Dewpoint Temp.	36.0 °F
Maximum DP Dry-Bulb	81.0 °F
Minimum DP Dry-Bulb	74.0 °F
Maximum Wet-Bulb Temp.	68.0 °F
Maximum WB Dry-Bulb	79.0 °F
Minimum WB Dry-Bulb	73.0 °F

Load Summer Zone Defaults

Pen Color Pen Weight 10 Fill Color

Show Winter Comfort Zone

Minimum Dewpoint Temp.	36.0 °F
Maximum DP Dry-Bulb	76.0 °F
Minimum DP Dry-Bulb	69.0 °F
Maximum Wet-Bulb Temp.	64.0 °F
Maximum WB Dry-Bulb	74.0 °F
Minimum WB Dry-Bulb	68.0 °F

Load Winter Zone Defaults

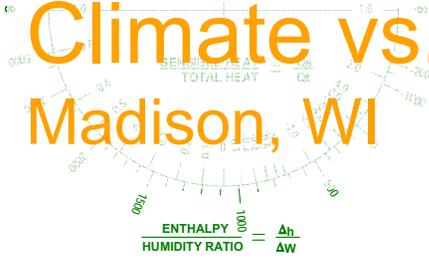
Pen Color Pen Weight 10 Fill Color



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ALTITUDE: 860 FEET
 BAROMETRIC PRESSURE: 29.004 in. HG
 ATMOSPHERIC PRESSURE: 14.245 psia

Climate vs. Comfort Madison, WI



Weather Hours

189 to 169
168 to 148
147 to 127
126 to 106
105 to 85
84 to 64
63 to 43
42 to 22
21 to 1

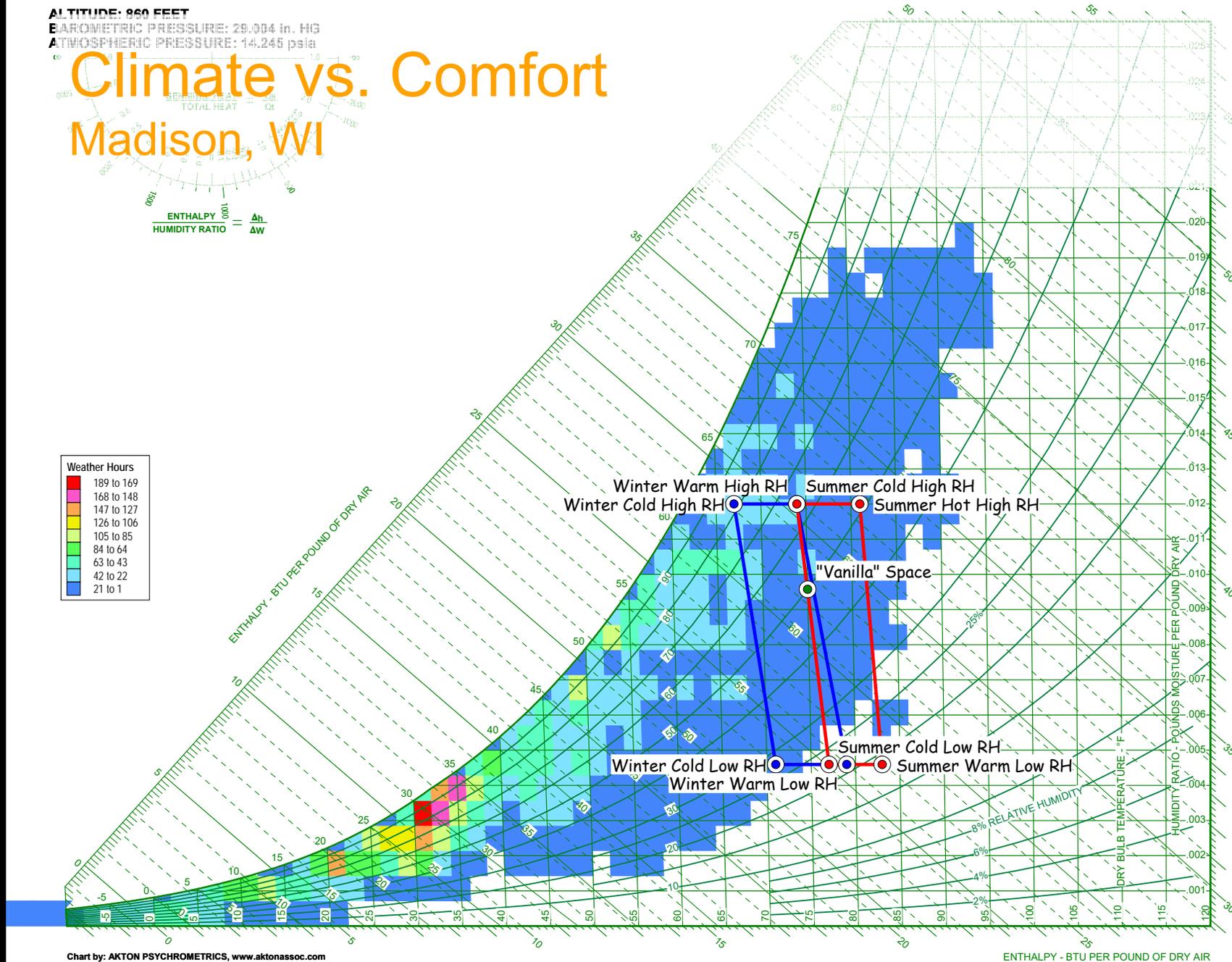
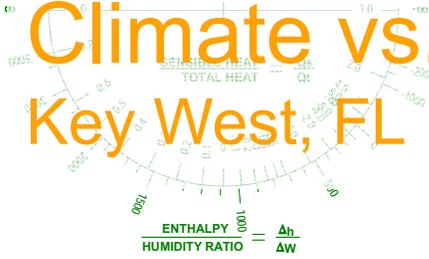


Chart by: AKTON PSYCHROMETRICS, www.aktonassoc.com

ALTIMITUDE: 3 FEET
 BAROMETRIC PRESSURE: 29.918 in. HG
 ATMOSPHERIC PRESSURE: 14.694 psia

Climate vs. Comfort

Key West, FL



Weather Hours	
Red	279 to 249
Pink	248 to 218
Orange	217 to 187
Yellow	186 to 156
Light Green	155 to 125
Green	124 to 94
Cyan	93 to 63
Blue	62 to 32
Dark Blue	31 to 1

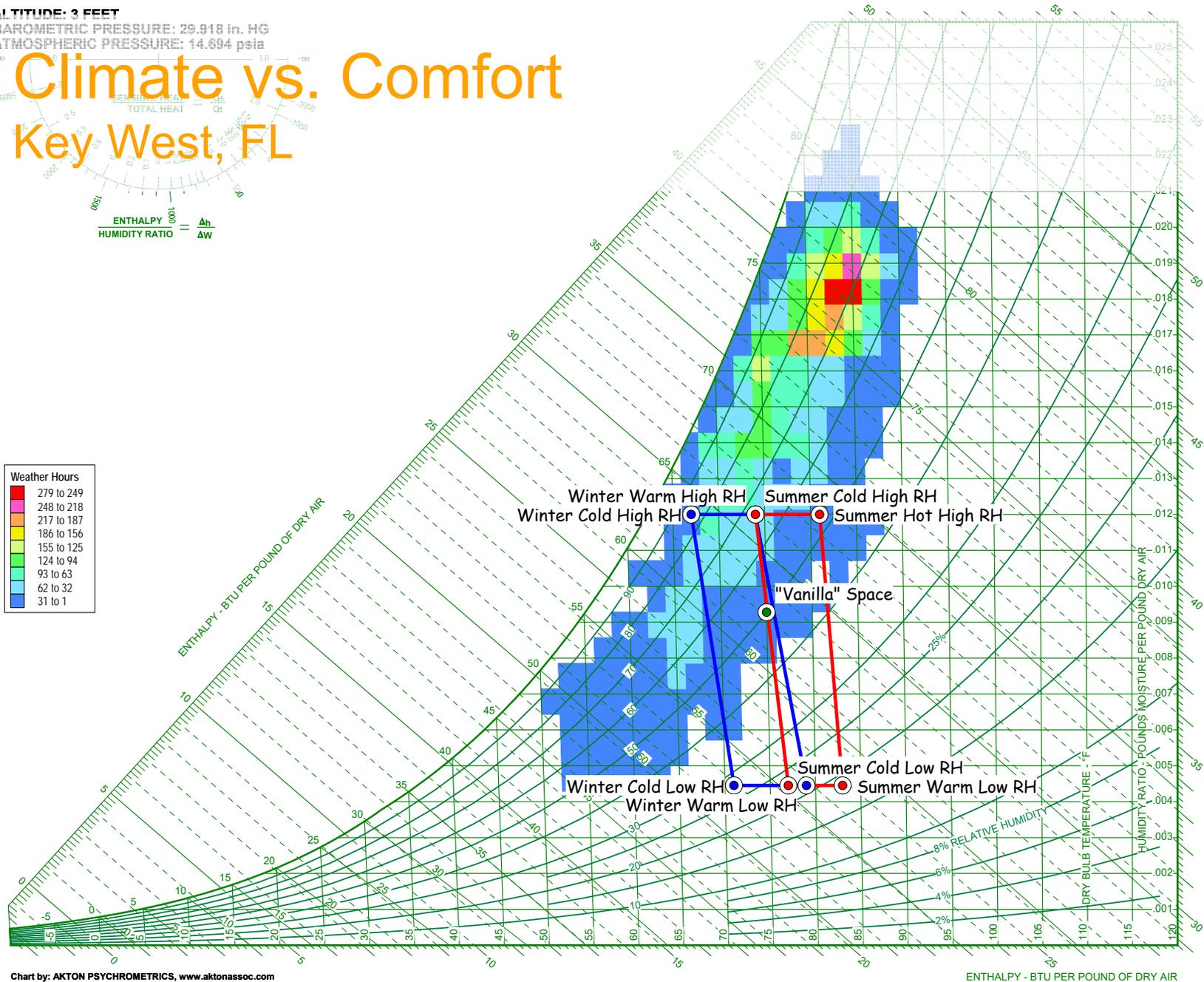


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Climate vs. Comfort

Phoenix, AZ

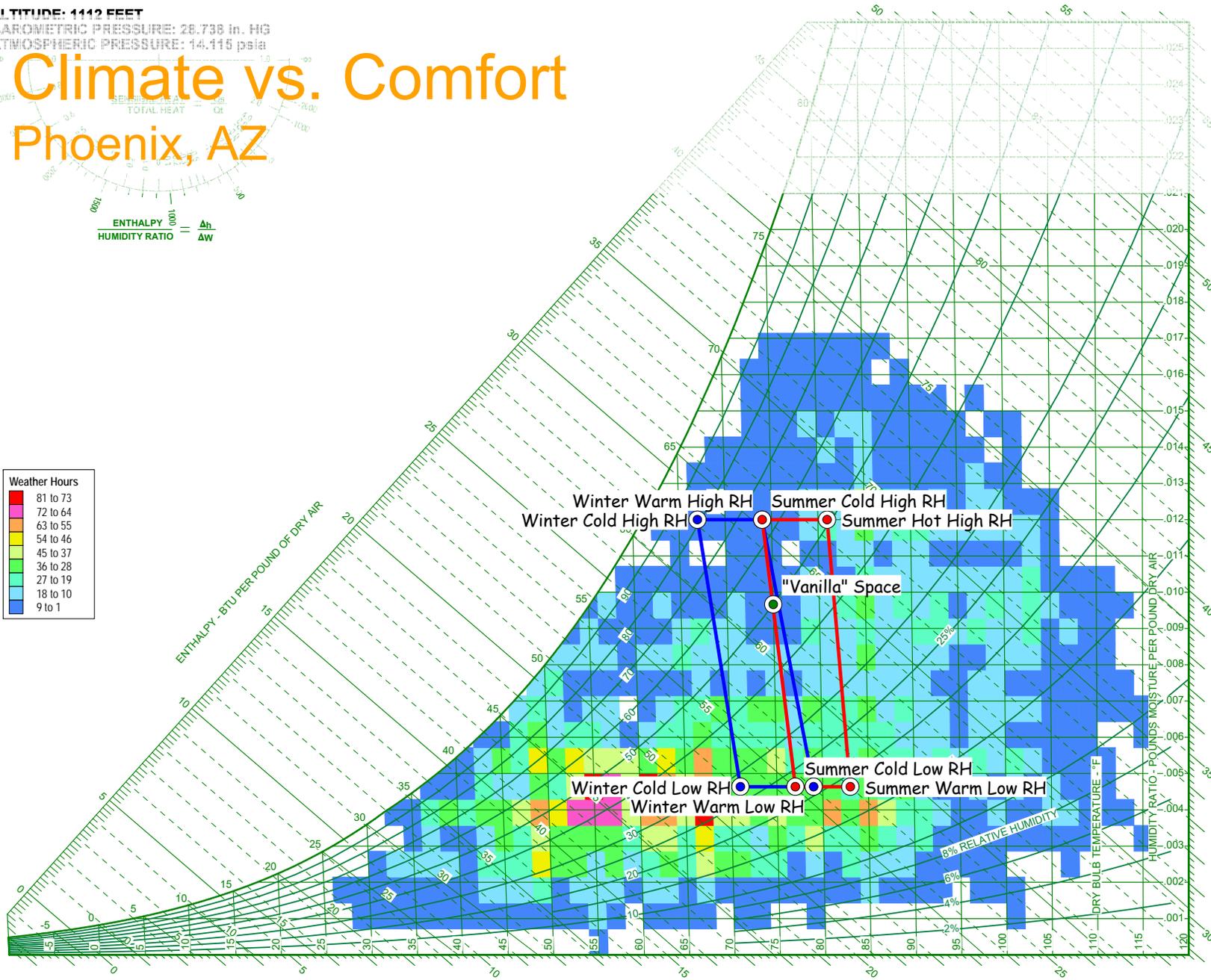
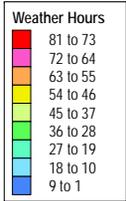
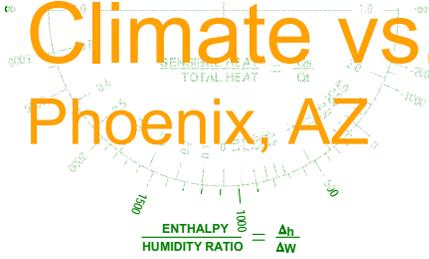
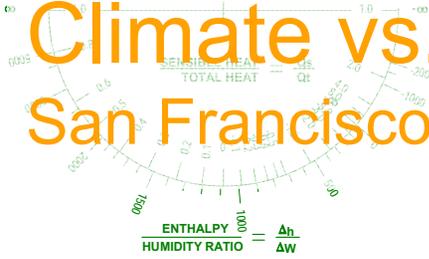


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ALTIMITUDE: 16 FEET
 BAROMETRIC PRESSURE: 29.904 in. HG
 ATMOSPHERIC PRESSURE: 14.687 psia

Climate vs. Comfort San Francisco, CA



Weather Hours

360 to 321
320 to 281
280 to 241
240 to 201
200 to 161
160 to 121
120 to 81
80 to 41
40 to 1

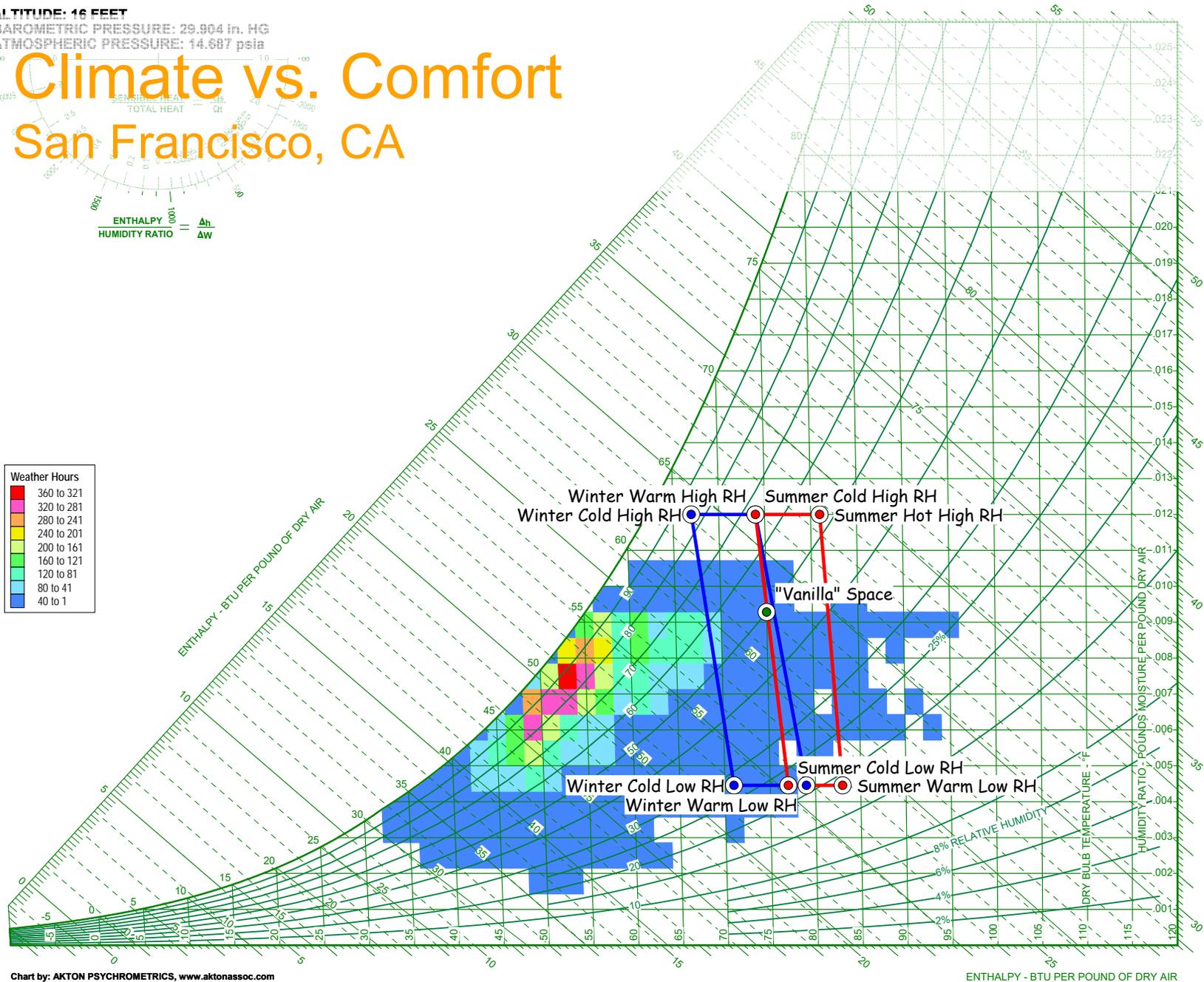


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