

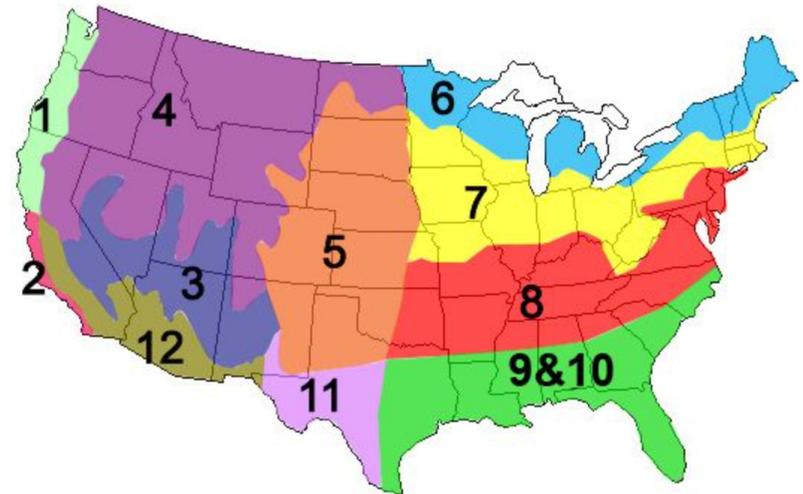
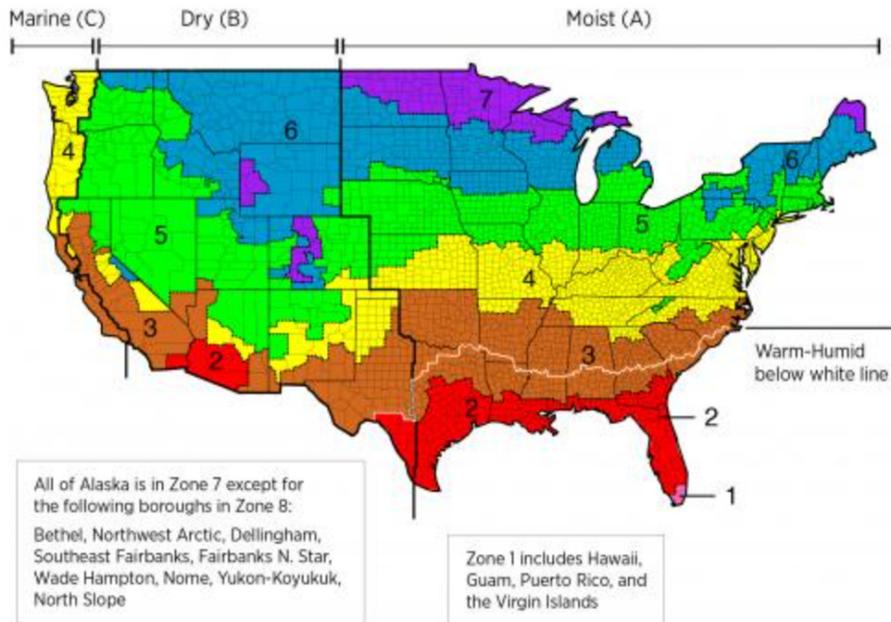
# Dehumidification & Ventilation

David Treleven

Ultra-Aire

2/27/19

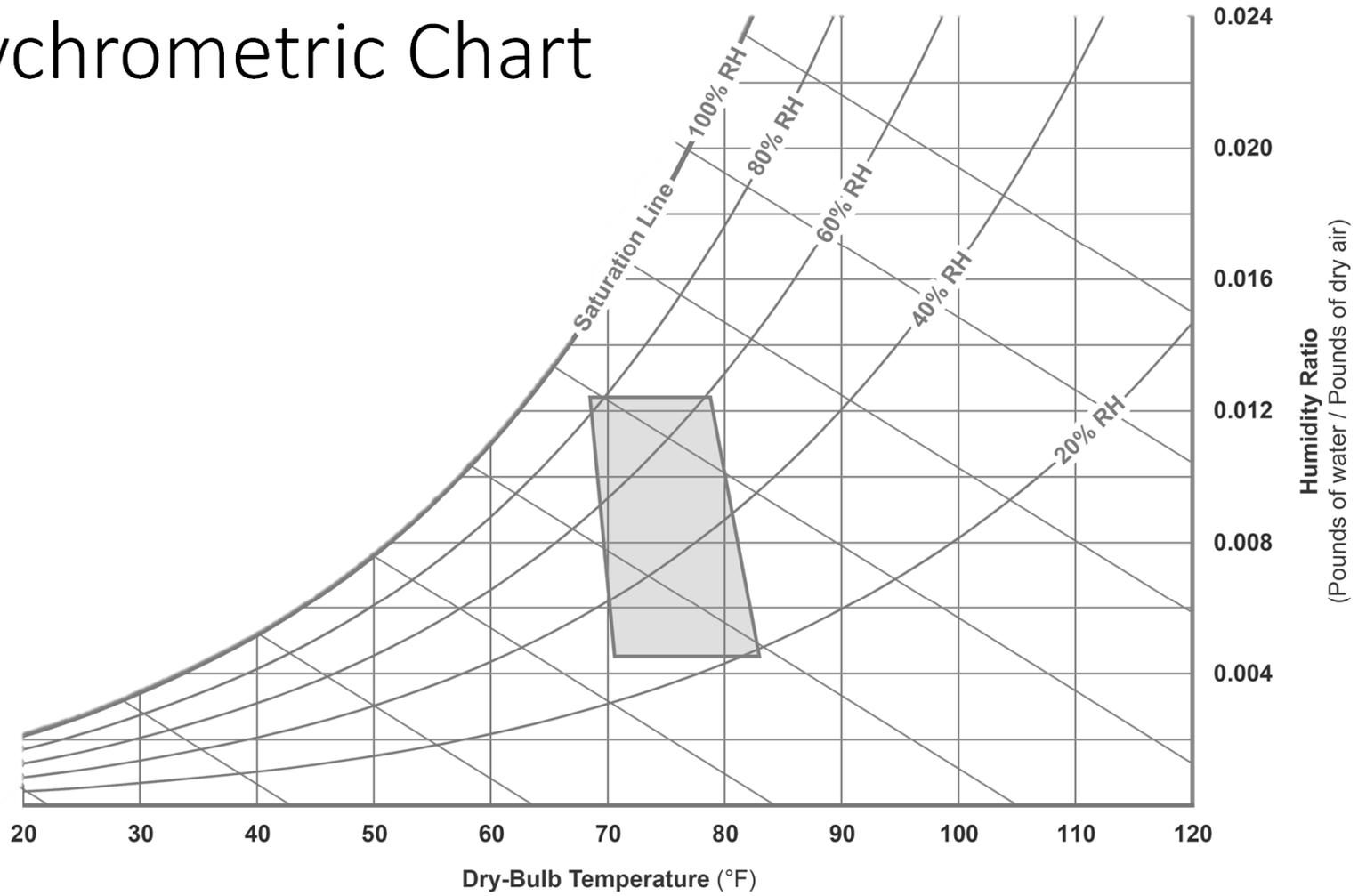
# Green Grass Climates



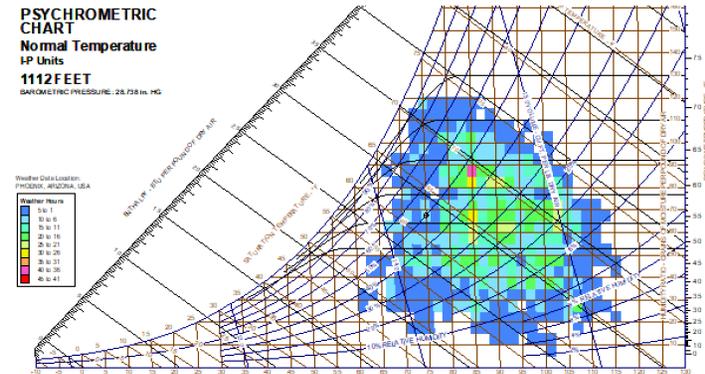
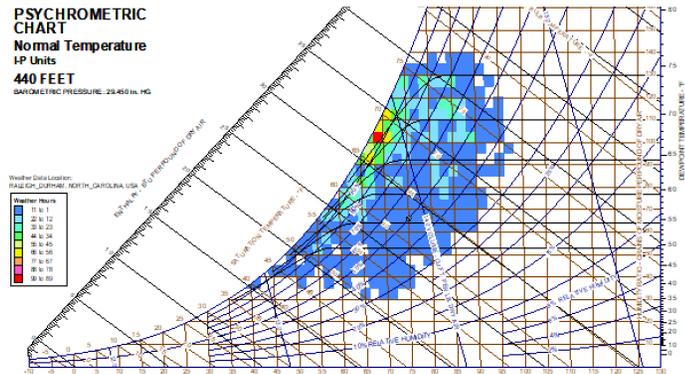
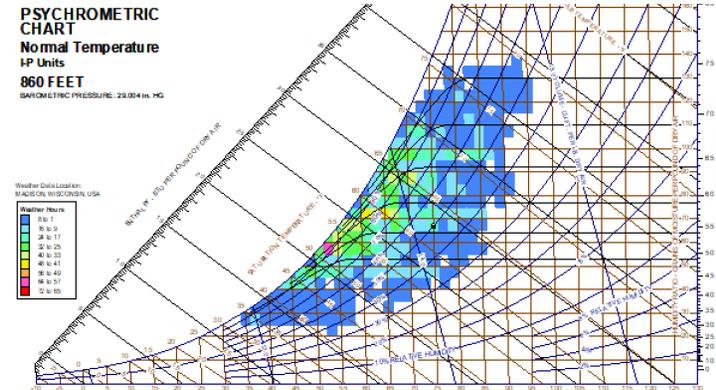
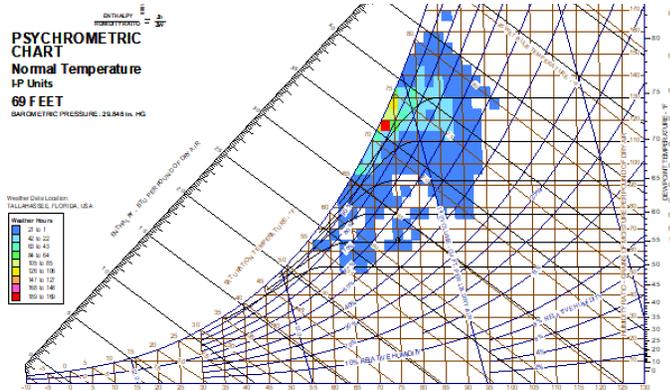
# Green Grass Climates



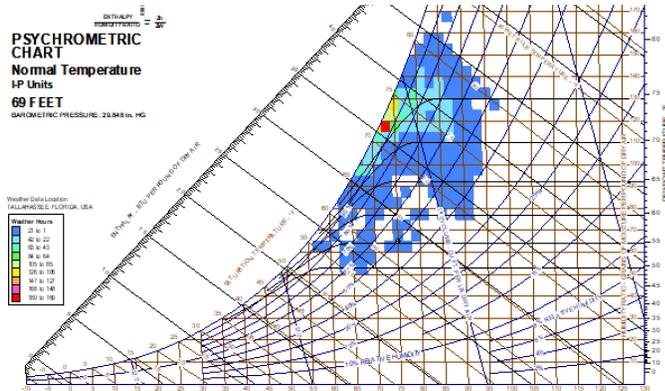
# Psychrometric Chart



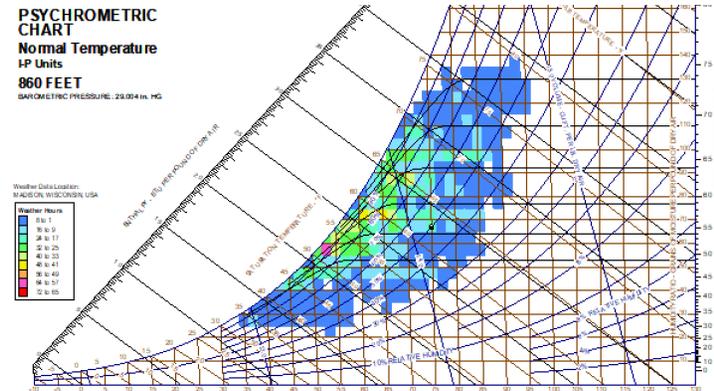
# Green Grass Climate Outside Air



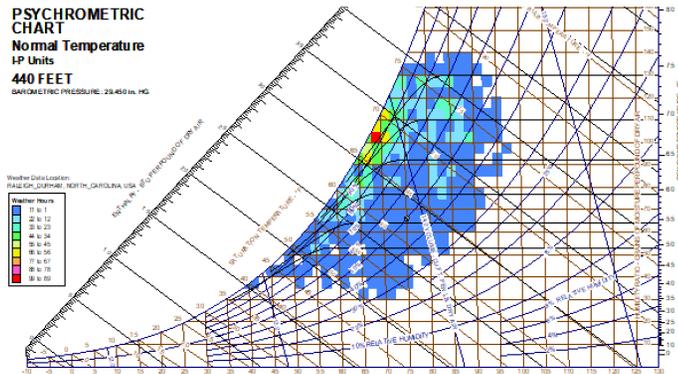
# Green Grass Climate Outside Air



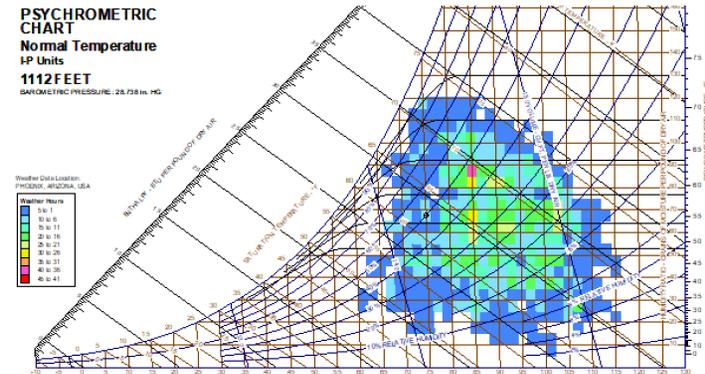
Miami, FL



Madison, WI



Raleigh, NC



Phoenix, AZ

# Green Grass Climate Outside Air

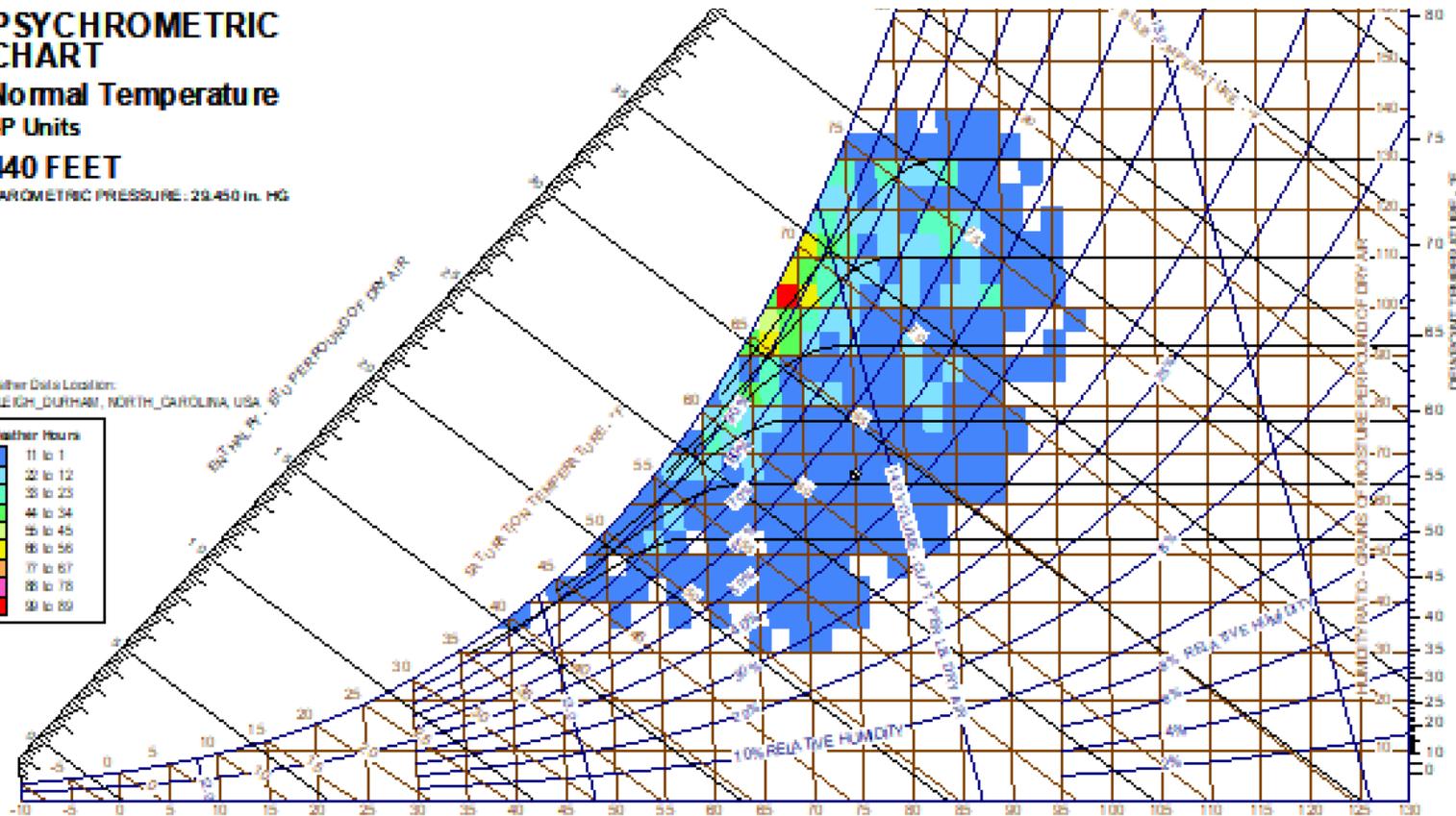
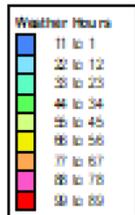
## PSYCHROMETRIC CHART

Normal Temperature  
IP Units

440 FEET

BAROMETRIC PRESSURE: 29.450 in. HG

Weather Data Location:  
RALEIGH\_DURHAM, NORTH CAROLINA, USA



# Green Grass Climate Outside Air

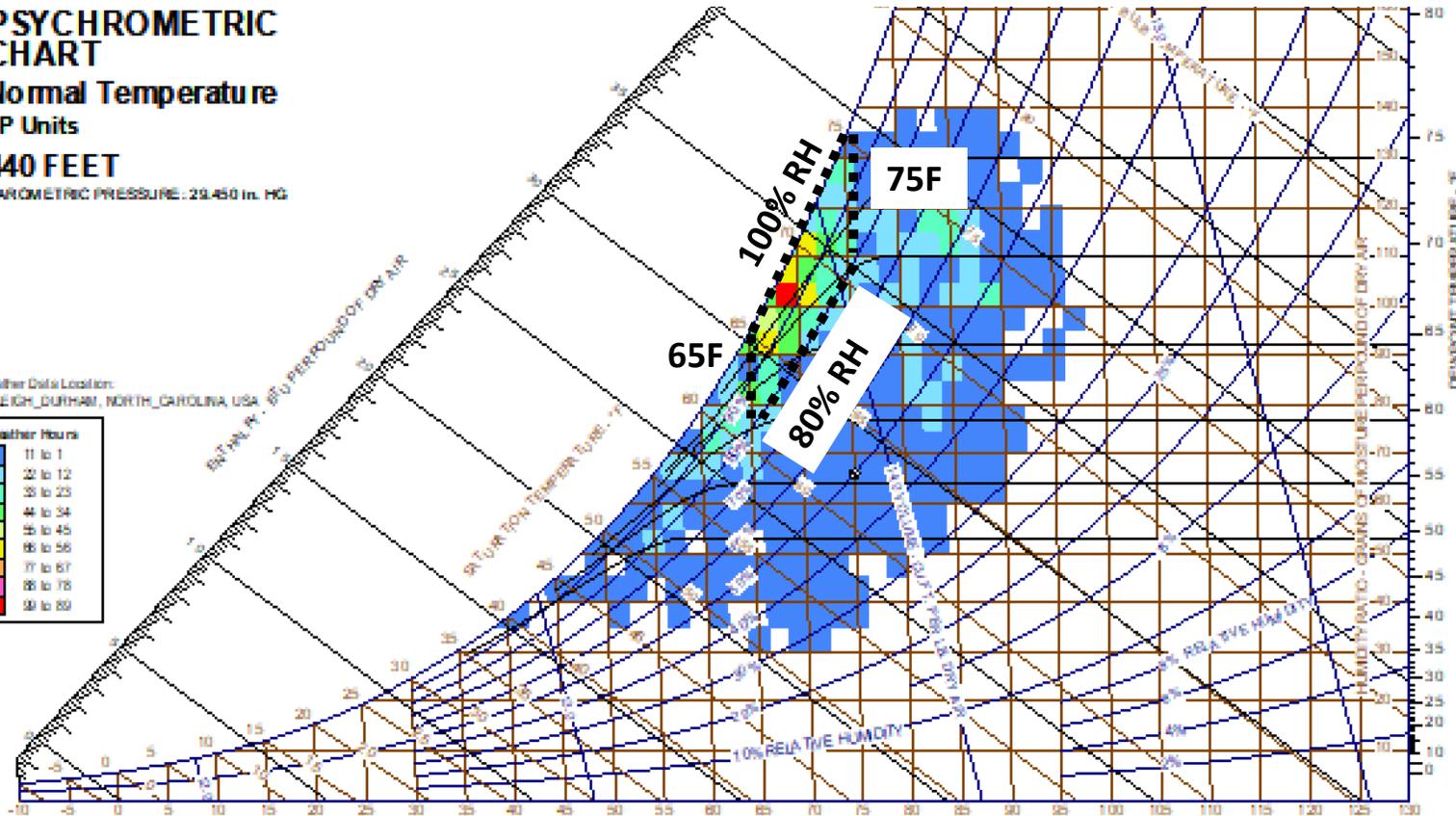
## PSYCHROMETRIC CHART

Normal Temperature  
IP Units

440 FEET

BAROMETRIC PRESSURE: 29.450 in. HG

Weather Data Location:  
RALEIGH\_DURHAM, NORTH CAROLINA, USA



# Green Grass Climate Outside Air

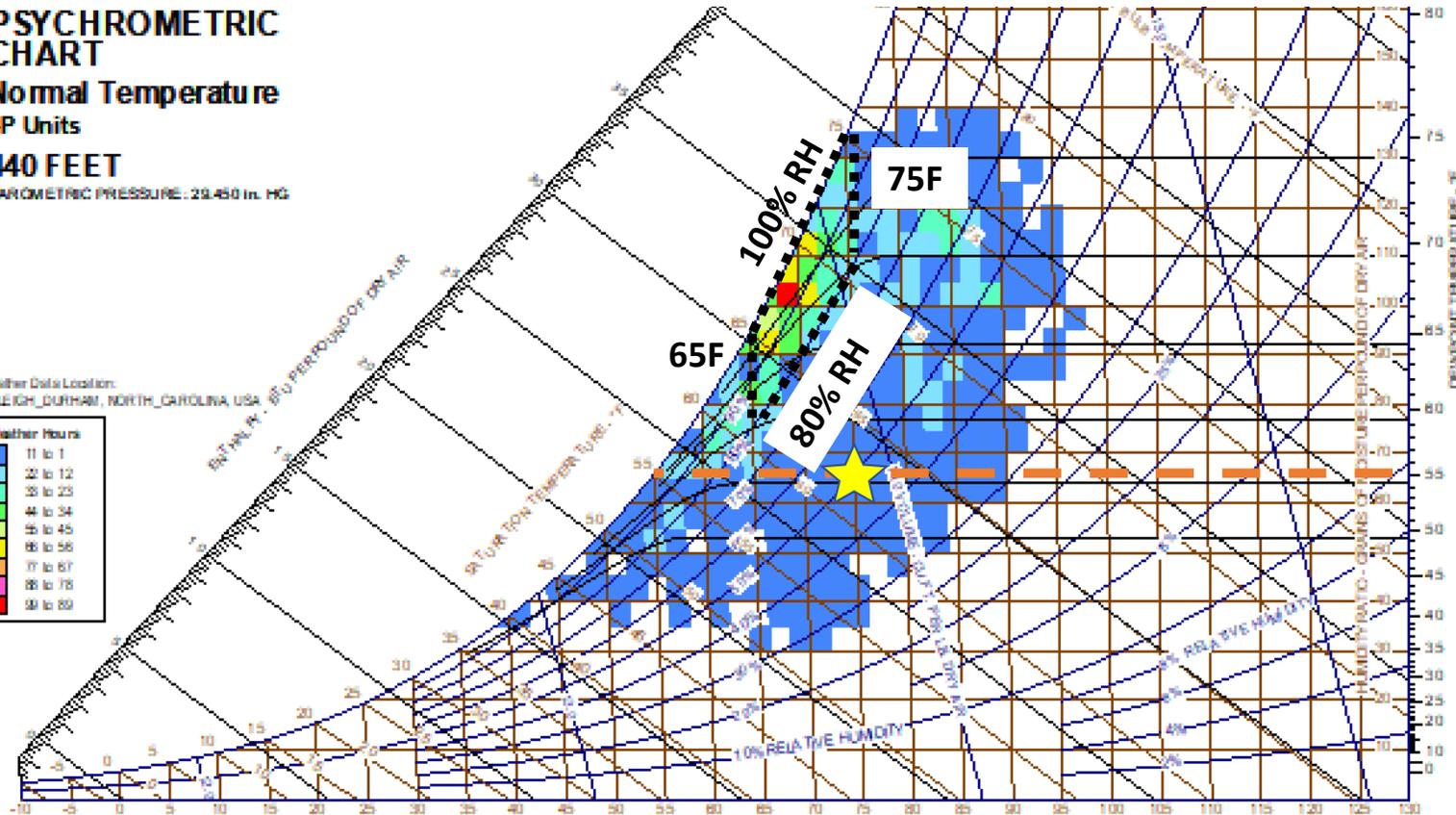
## PSYCHROMETRIC CHART

Normal Temperature  
IP Units

440 FEET

BAROMETRIC PRESSURE: 29.450 in. HG

Weather Data Location:  
RALEIGH\_DURHAM, NORTH CAROLINA, USA



# Green Grass Climate OA

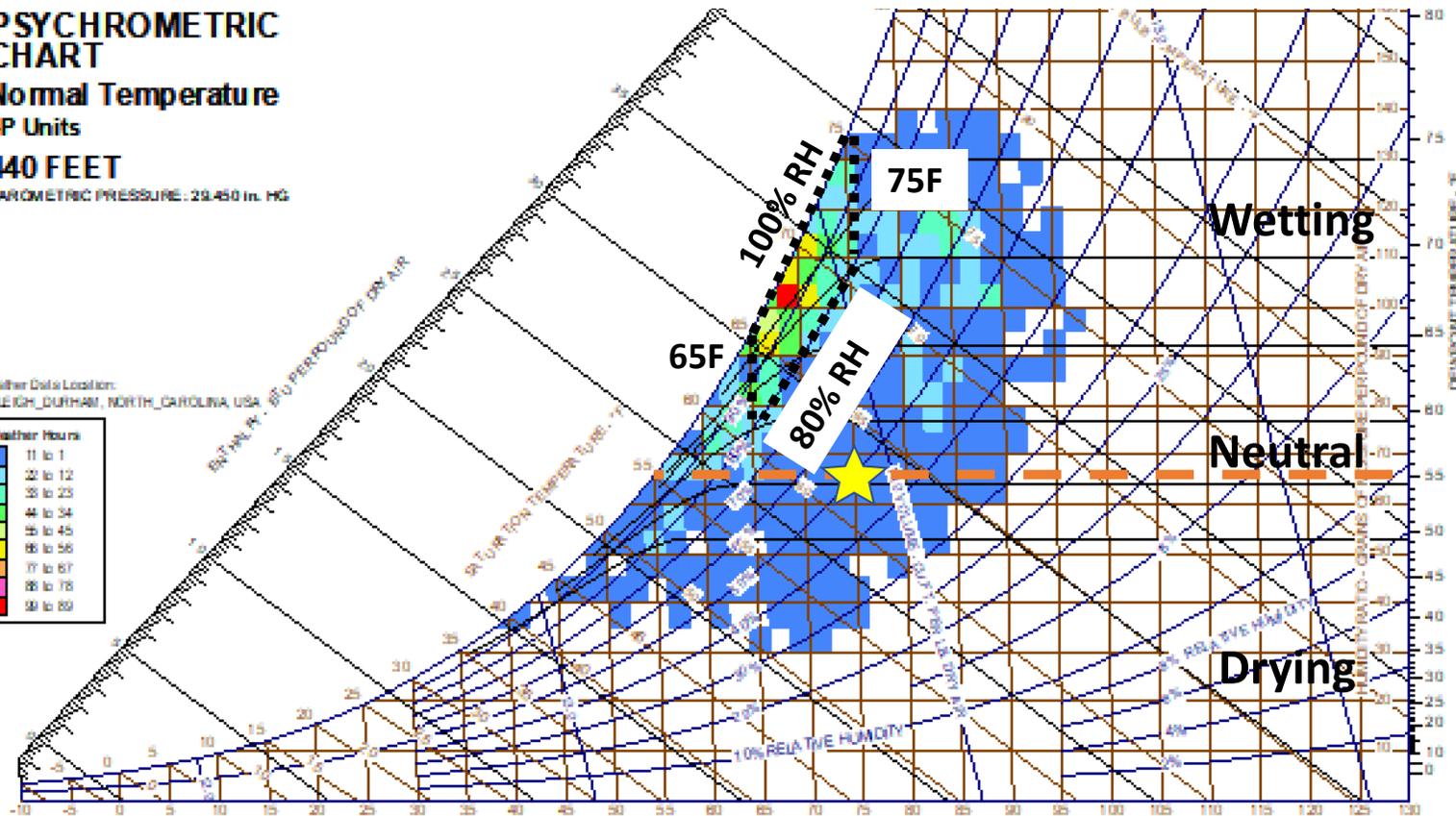
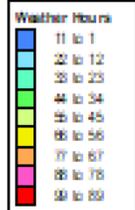
## PSYCHROMETRIC CHART

Normal Temperature  
IP Units

440 FEET

BAROMETRIC PRESSURE: 29.450 in. HG

Weather Data Location:  
RALEIGH\_DURHAM, NORTH\_CAROLINA, USA



# Ventilation Load

<b>Conditions</b>	<b>85F/60%</b>		<b>76F/95%</b>	
	Vent Rate	50CFM	100CFM	50CFM
Sensible	540 btuh	1080 btuh	54 btuh	108 btuh
Latent	1563 btuh	3128 btuh	2261 btuh	4523 btuh
Total	2103 btuh	4208 btuh	2315 btuh	4631 btuh

\* Interior Conditions 75F 50%RH

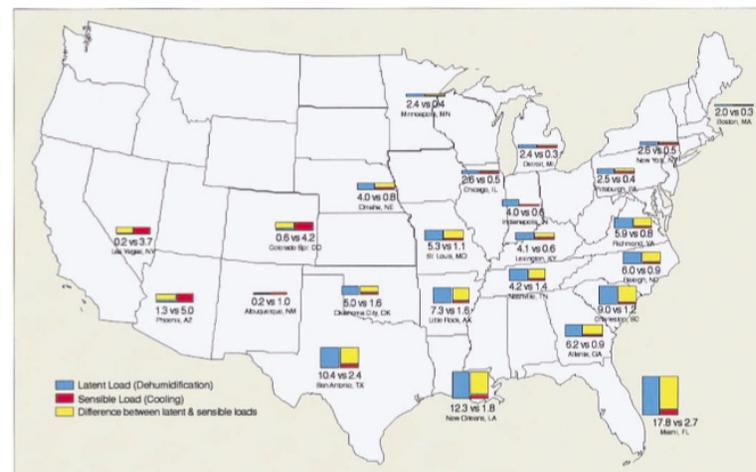
The following article was published in ASHRAE Journal, November 1997. © Copyright 1997 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. It is presented for educational purposes only. This article may not be copied and/or distributed electronically or in paper form without permission of ASHRAE.

# Dehumidification and Cooling Loads From Ventilation Air

By **Lewis G. Harriman III**  
Member ASHRAE

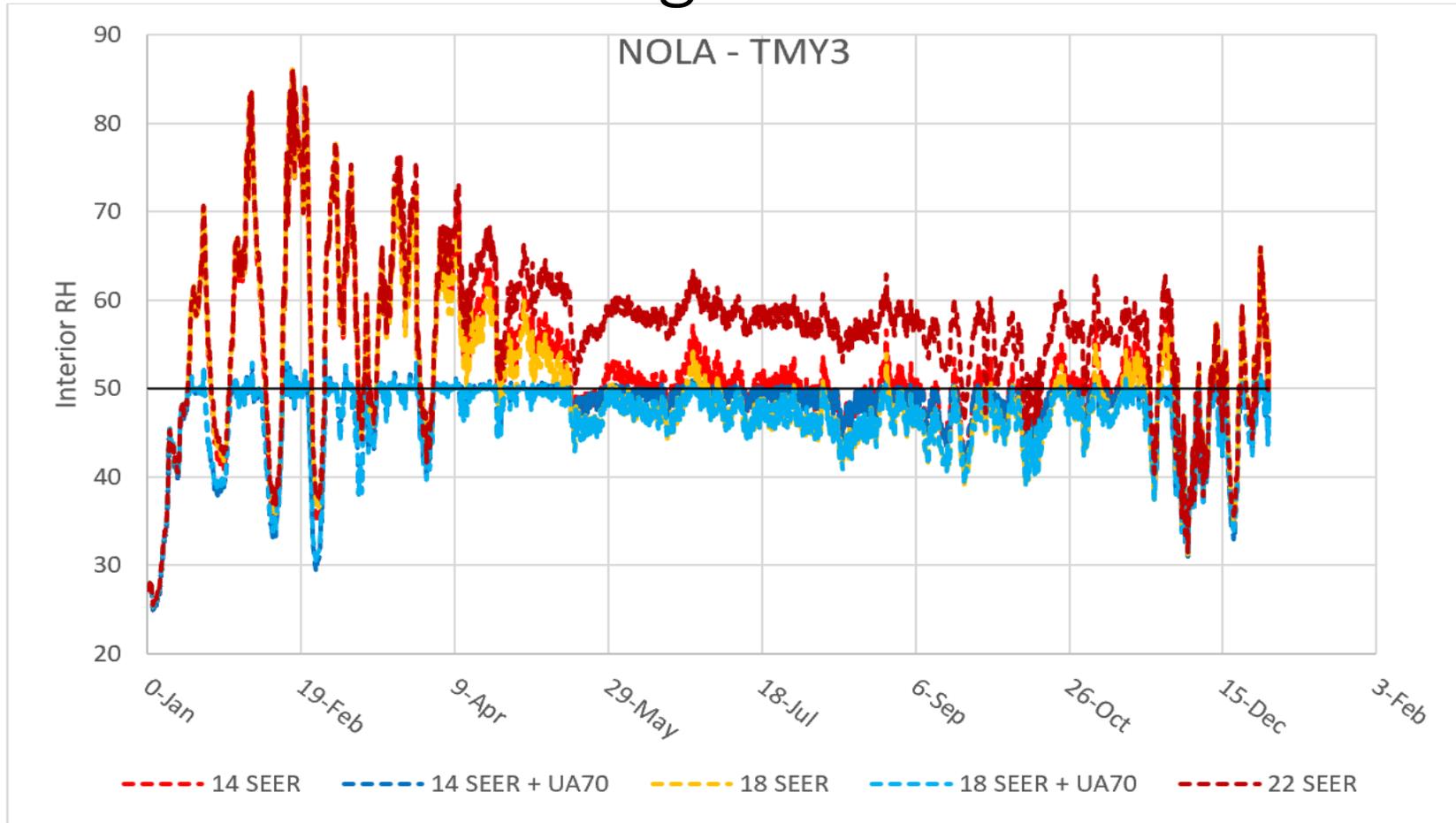
**Dean Plager**  
and **Douglas Kosar**  
Member ASHRAE

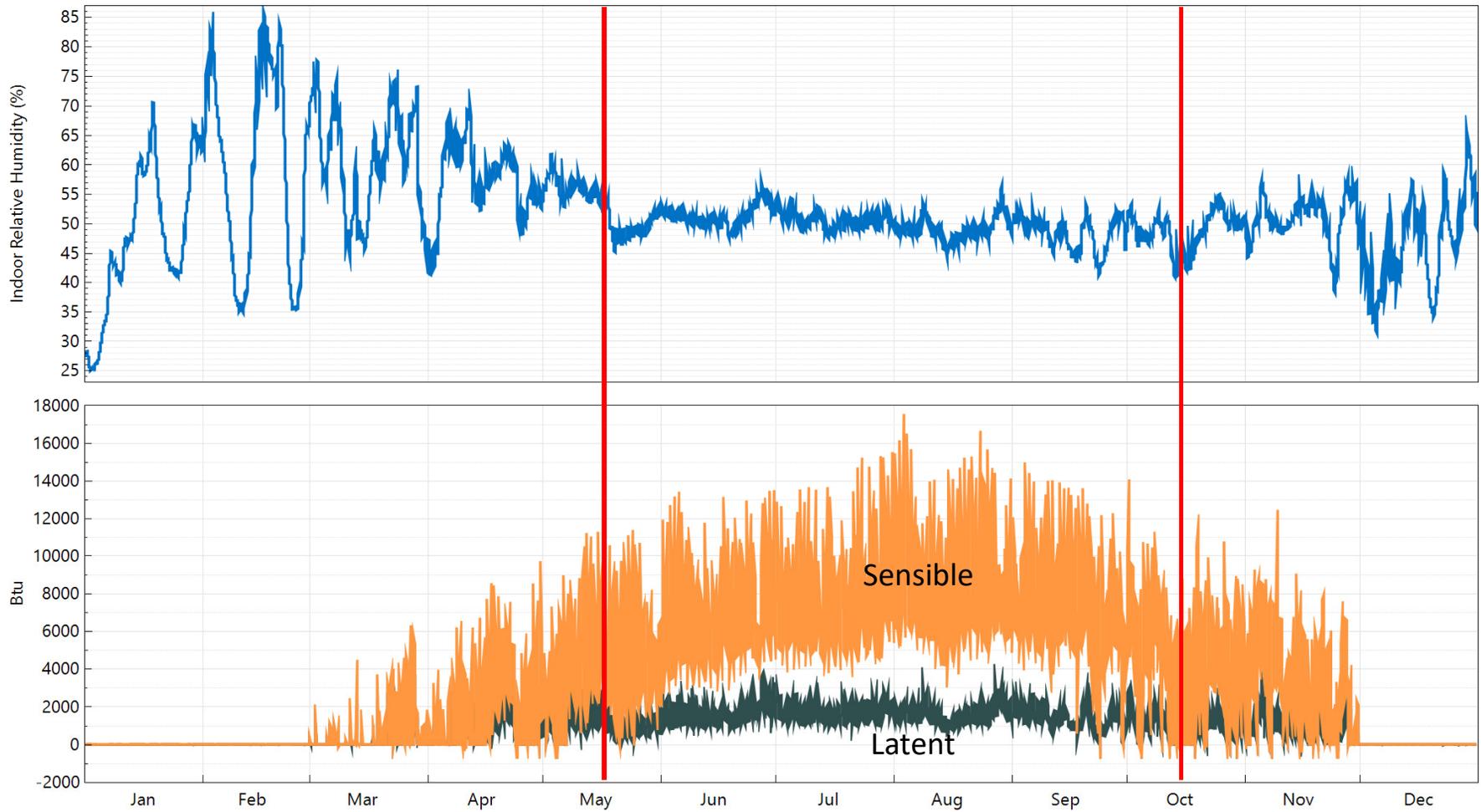
**N**inety-five years since Willis Carrier began the modern era of air conditioning by dehumidifying a printing plant, our industry is becoming more concerned with the importance of controlling humidity in buildings. In part, this concern stems from indoor air quality problems associated with excess moisture in air-conditioning systems. But more universally, the need for ventilation air has forced HVAC equipment (originally optimized for high efficiency in removing sensible heat loads) to remove high moisture loads.<sup>1</sup>



**Fig. 1: Map of Ventilation Load Indexes (VLI) for selected locations.**

# Interior RH Modelling





# Variable Capacity Equipment

- Higher AVG Supply Air Temp (~60F – typical 55F)
- Less latent capacity when turned down
  - SHR 0.65
  - 3000 btuh Total ~2000 btuh Sensible & 1000 btuh Latent



# Variable Capacity Equipment

- Higher AVG Supply Air Temp (~60F – typical 55F)
- Less latent capacity when turned down
  - SHR 0.65
  - 3000 btuh Total ~2000 btuh Sensible & 1000 btuh Latent

Outside Air

<b>Conditions</b>	<b>76F/95%</b>	
Vent Rate	50CFM	100CFM
Sensible	54 <u>btuh</u>	108 <u>btuh</u>
Latent	2261 <u>btuh</u>	4523 <u>btuh</u>
Total	2315 <u>btuh</u>	4631 <u>btuh</u>

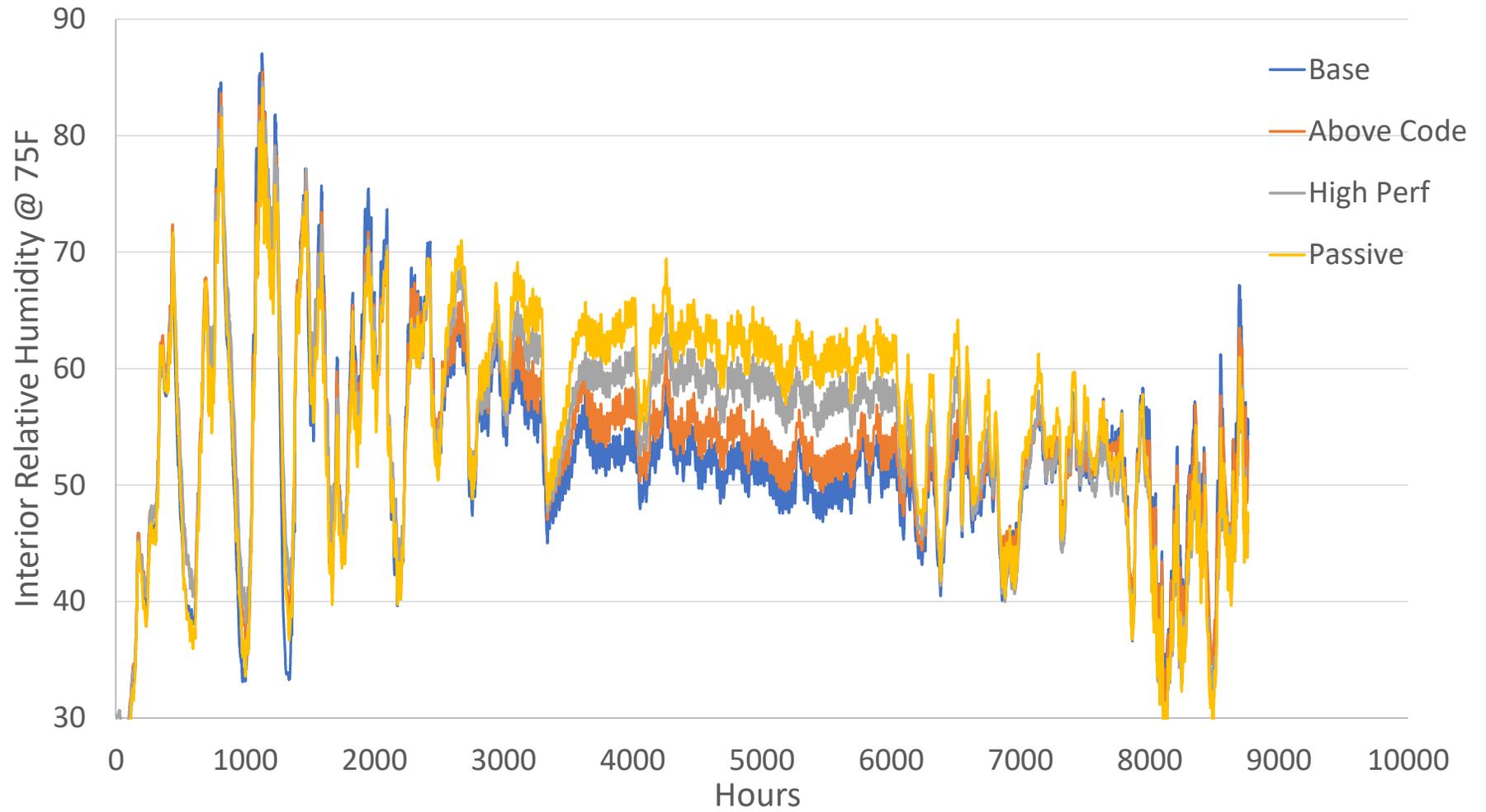
# Increased Insulation/Air-Tightness



# Low-Sensible Load Houses

	Sensible Cooling Load	Latent Cooling Load
Continuous Insulation		
Air Tight Construction		
Optimized Windows/Shading		
Mechanical Ventilation		
Ducts in Conditioned Space		

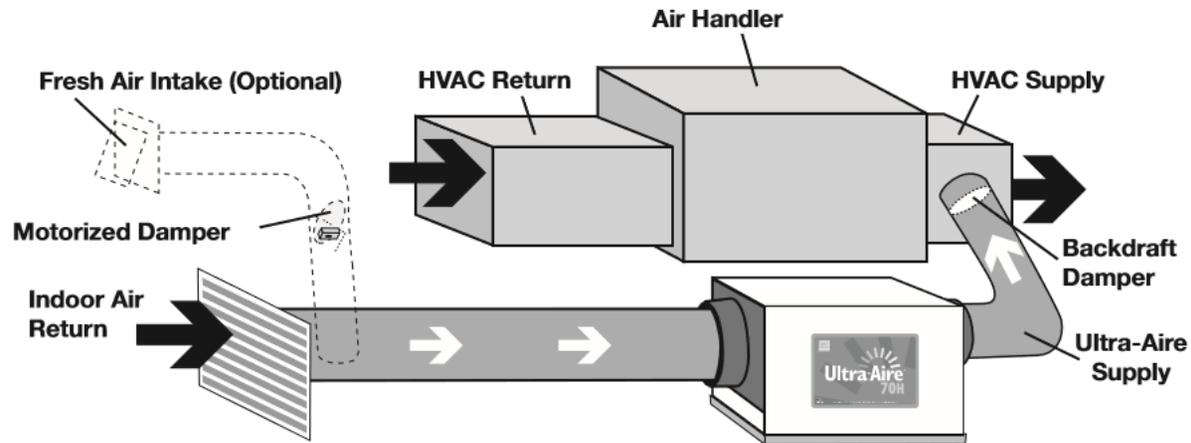
# NOLA



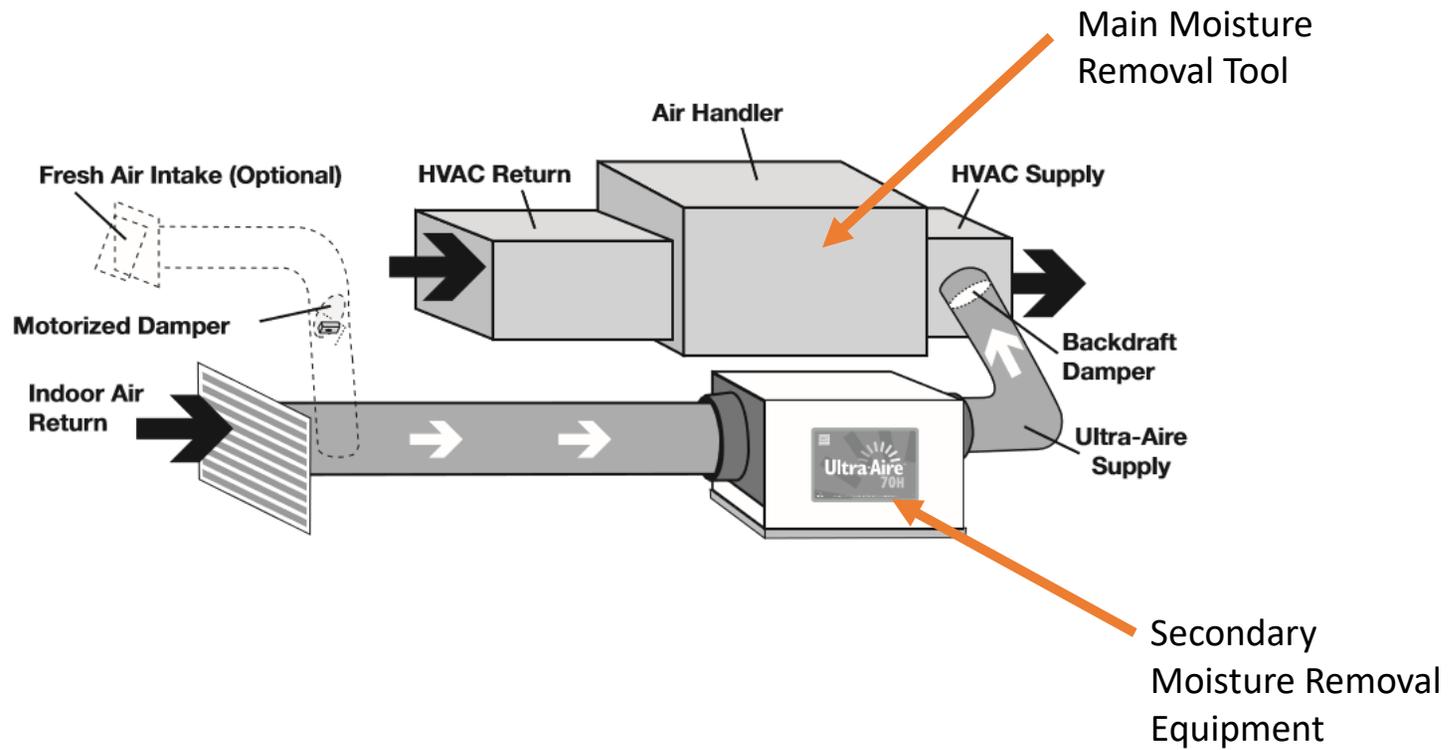
# Ventilating/Whole Home Dehumidifiers



# Ventilating Dehumidifier – Supply Ventilation



# Ventilating Dehumidifier



# Dehumidifier Performance

## Important Dehumidifier Information:

- Dehumidifiers are rated @ 80F/60%RH – 0.0 IWG (AHAM)
  - New 2019 DOE – 73F/60%RH – 0.2 IWG
- Pint ~ 1000 Btu/h
- Heat generated – 3.46 Btu/h per Watt & 1000 Btu/h per pint of water removed



@ 75F/50%RH – 0.2 IWG  
Latent – 1700 Btu/h  
Sensible added - 3500 Btu/h

# Dehumidifier Performance

**Performance  
Summary:**

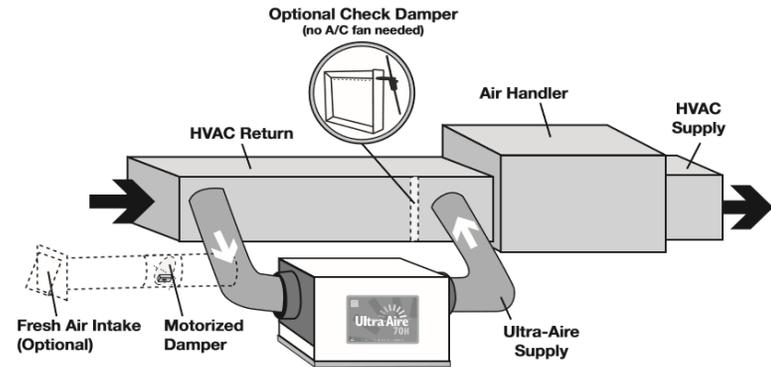
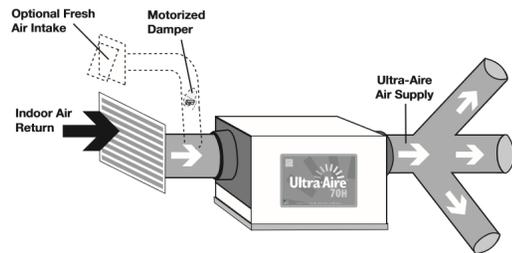
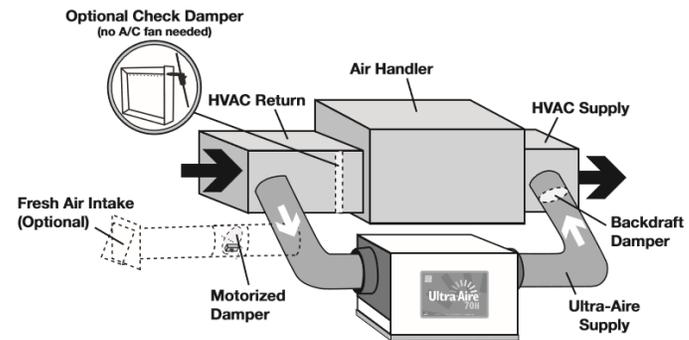
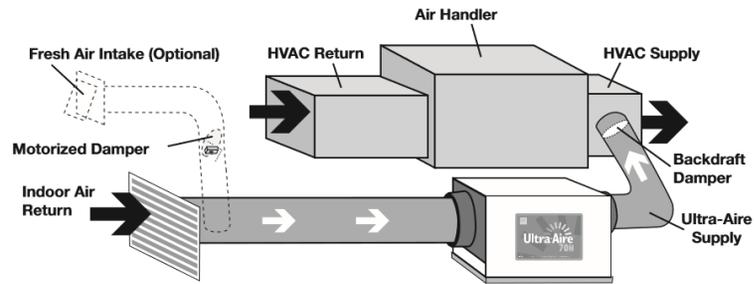
			Static Pressure				
			0"	0.2"	0.4"	0.6"	0.8"
TEMP	RH	PPD					
60	40%	13.8					
60	50%	38.5					
60	60%	64.2					
65	40%	43.3					
65	50%	64.3					
65	60%	86.6					
70	40%	52.2					
70	50%	76.2					
70	60%	96.2					
80	40%	69.8					
80	50%	98.9					
80	60%	125.2					

# Dehumidifier Performance

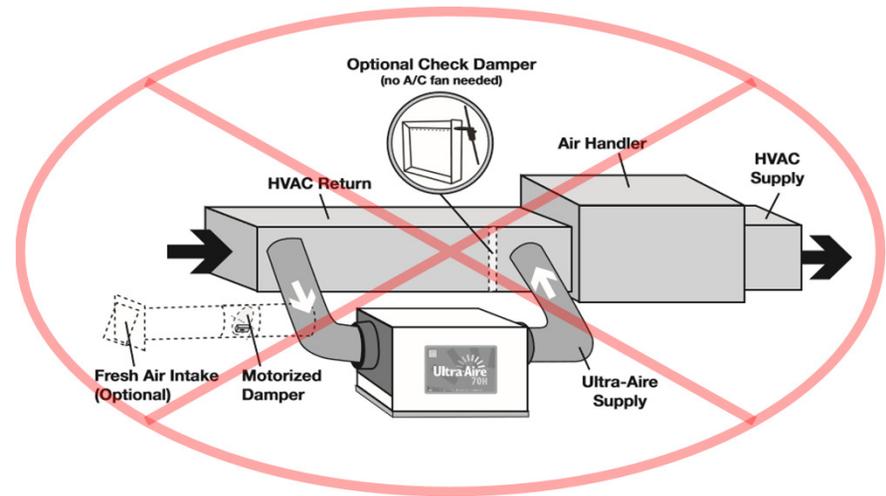
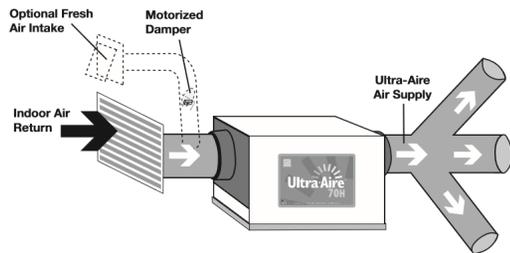
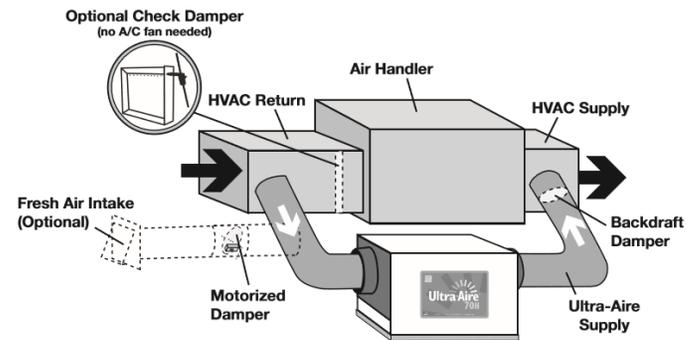
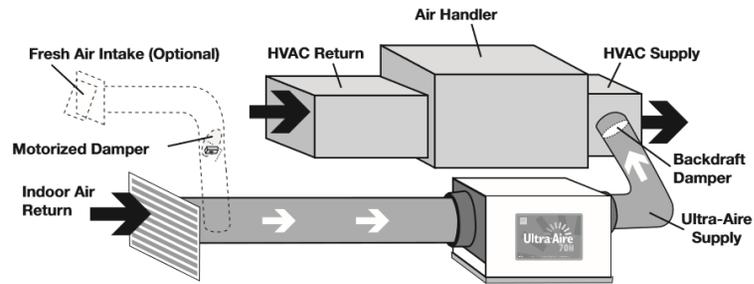
Performance  
Summary:

			Static Pressure				
			0"	0.2"	0.4"	0.6"	0.8"
TEMP	RH	PPD					
60	40%	13.8					
60	50%	38.5					
60	60%	64.2					
65	40%	43.3					
65	50%	64.3					
65	60%	86.6					
70	40%	52.2					
70	50%	76.2					
70	60%	96.2					
80	40%	69.8					
80	50%	98.9					
80	60%	125.2					

# Whole Home Dehumidifier Installation



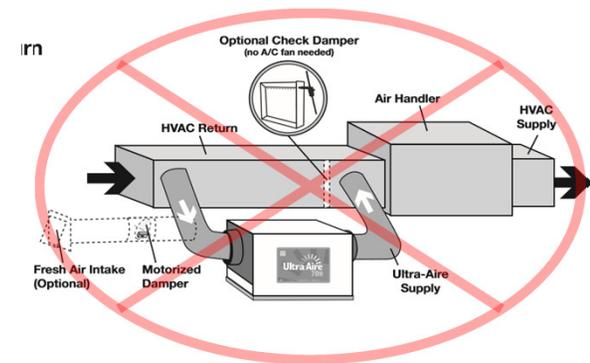
# Whole Home Dehumidifier Installation



# FSEC – June 2018 – FSEC-CR-2028-18

DHU ducted from/to central return had the highest daily energy use and resulted in two primary causes of latent performance degradation.

- DHU air degraded central latent cooling performance during simultaneous operations of both AC and DHU appliances. Temporary steady-state testing, with both the central cooling system and DHU operating at the same time, found that the central cooling latent performance was decreased by 28% compared to when no DH was operating at the same time.
- DHU air re-evaporated water off of warm central coil when AC was cycled off. Temporary steady-state testing just after the central system cycled off, with the DHU operating 28 continuous minutes after, measured a total 1.5 lbs of water re-evaporated off of the central cooling coil (rate of 3.2 lb/h back into condition space).
- During one 15 minute period observation of uninterrupted monitoring, the moisture pulled out of the room air by the DHU was at about the same rate that was being re-evaporated off of the central cooling coil while the AC was cycled off. In this instance the DHU coil rate of latent removal was -1.8 lb/h and the latent heat due to evaporation from the central cooling coil was +1.9 lb/h into the space while the DH was operating steady and the central cooling system had remained naturally cycled off 1.25 hours prior during very low cooling load period in the early morning.



# 100% Outside Air?

OA Conditions	85F/60%/DP 70
Vent Rate	150CFM

Interior Conditions 75F/50%/DP 55F

150 CFM OA



50 CFM OA  
100 CFM IA



# 100% Outside Air?

OA Conditions	85F/60%/DP 70
Vent Rate	150CFM

Interior Conditions 75F/50%/DP 55F

150 CFM OA



85F/60%

50 CFM OA  
100 CFM IA



78F/56%

LAT ~ 122F/14%/DP 60F

LAT ~ 105F/16%/DP 50F

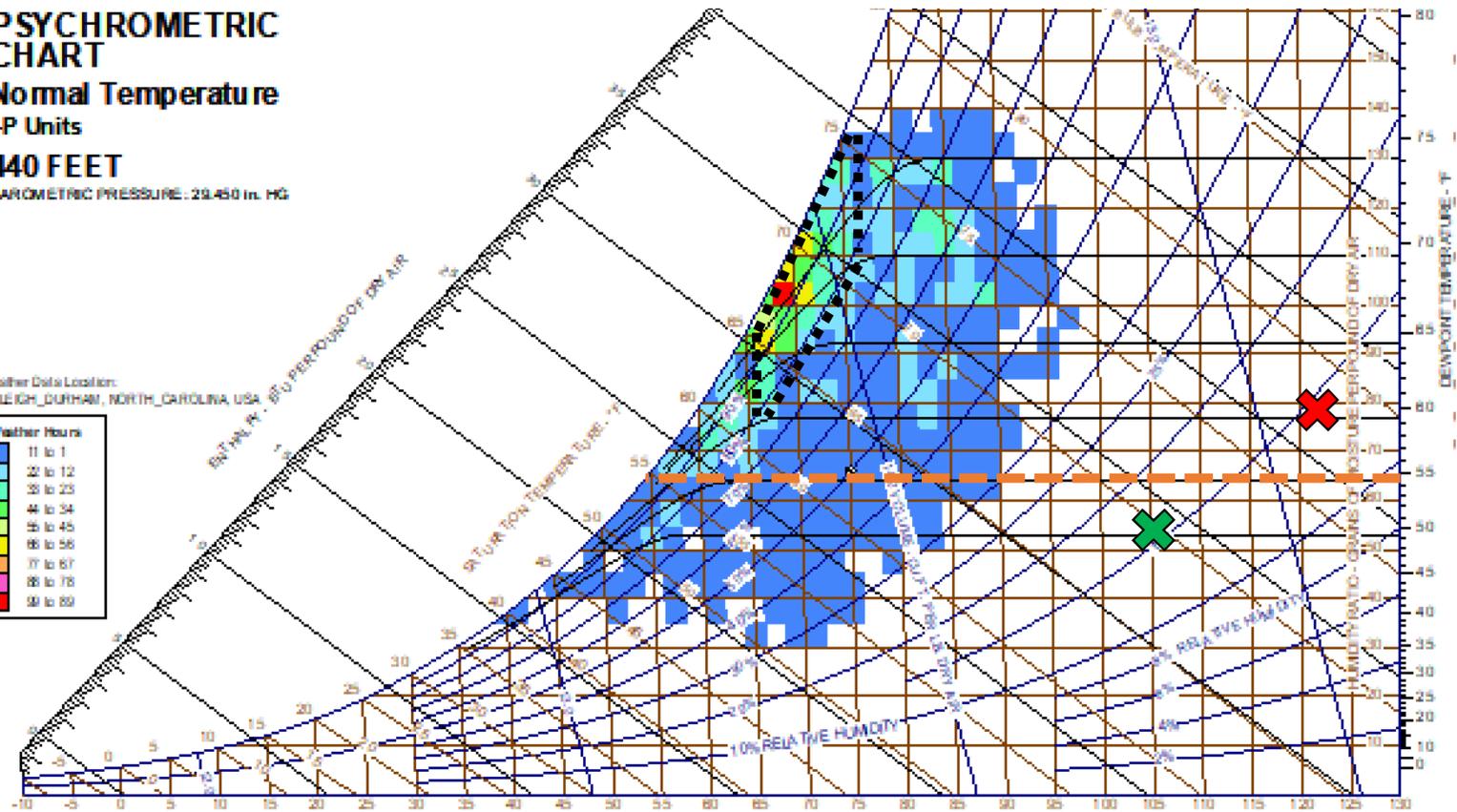
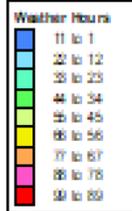
# PSYCHROMETRIC CHART

Normal Temperature  
IP Units

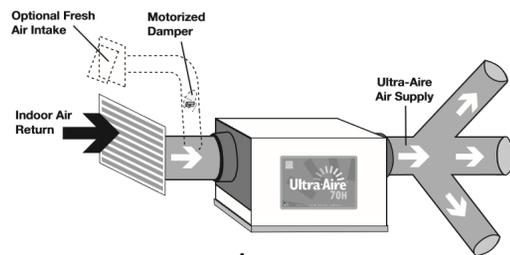
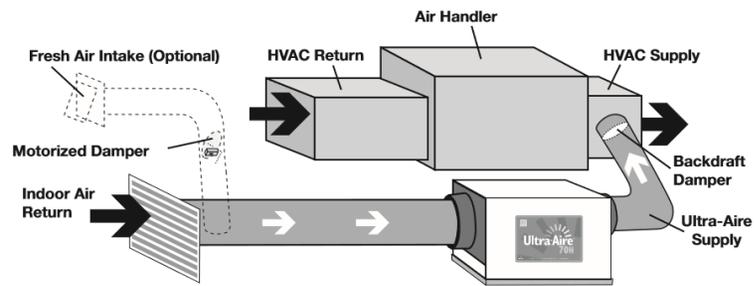
440 FEET

BAROMETRIC PRESSURE : 29.450 in. HG

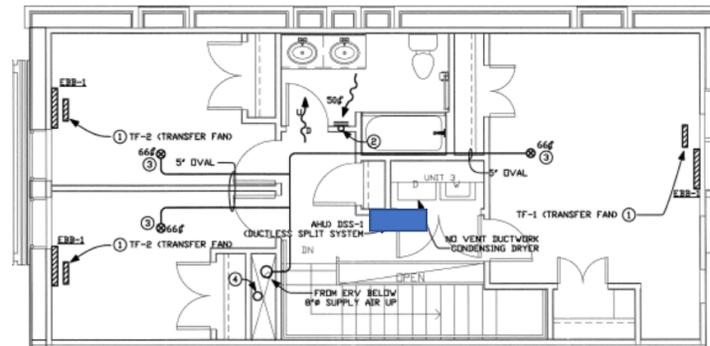
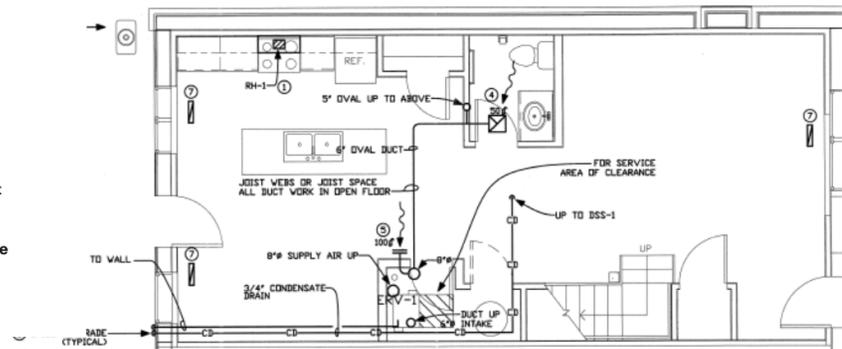
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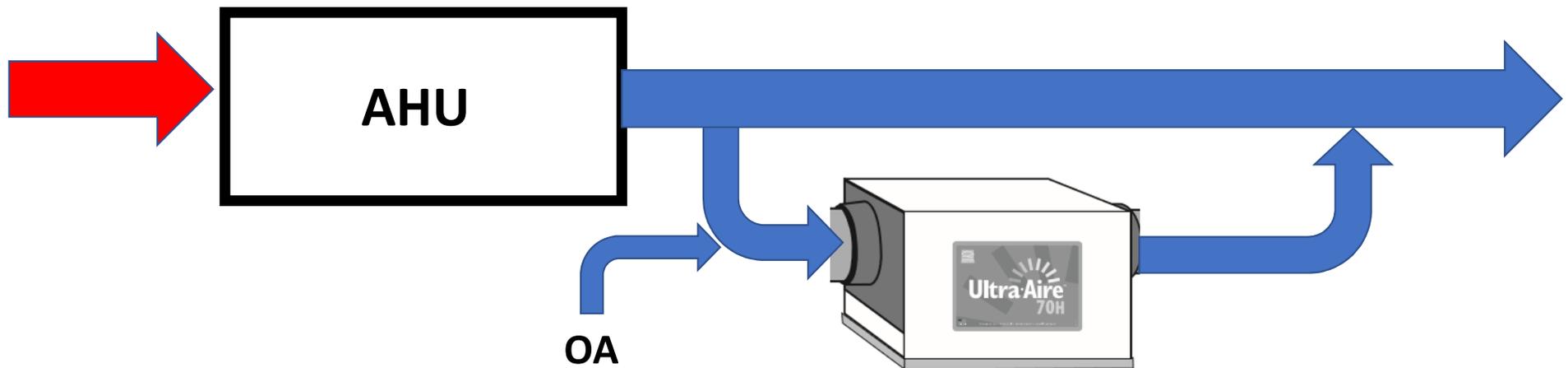
# Whole Home Dehumidifier Installation



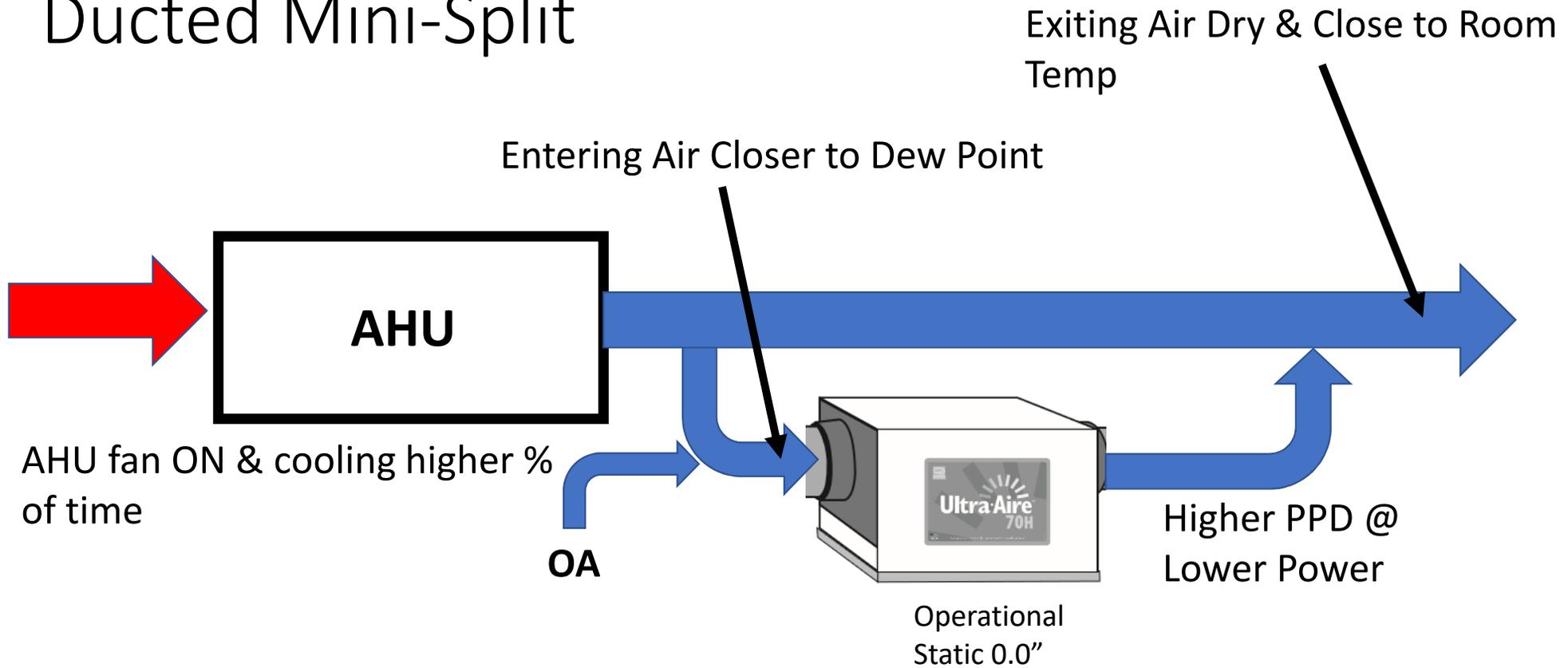
@ 75F/50%RH – 0.2 IWG  
 Latent – 1700 Btu/h  
 Sensible added - 3500 Btu/h



# Whole Home Dehumidifier Installation w/ Ducted Mini-Split



# Whole Home Dehumidifier Installation w/ Ducted Mini-Split



# ERVs in Humid Climates

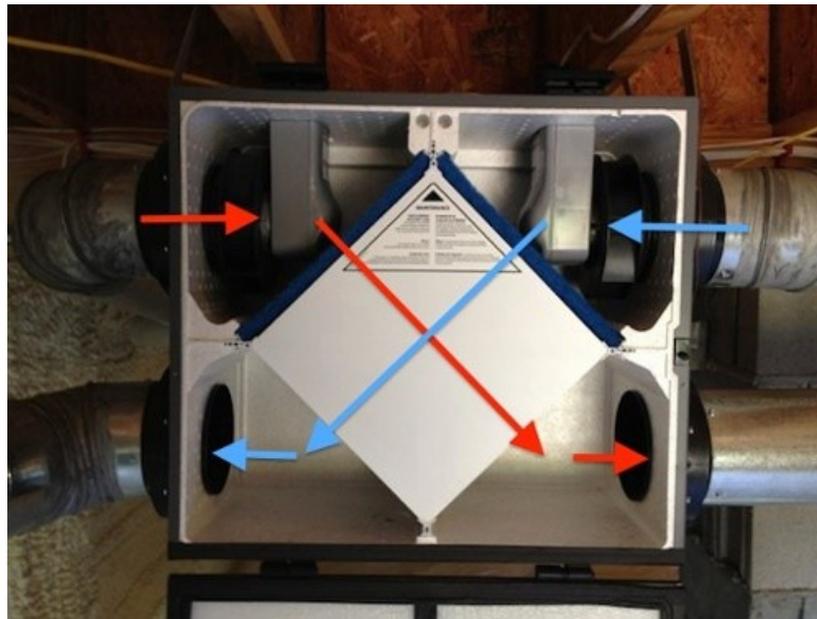
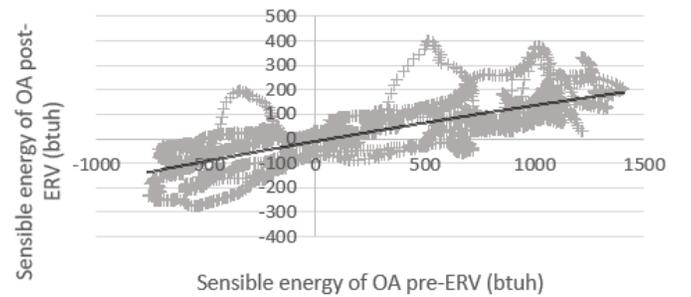
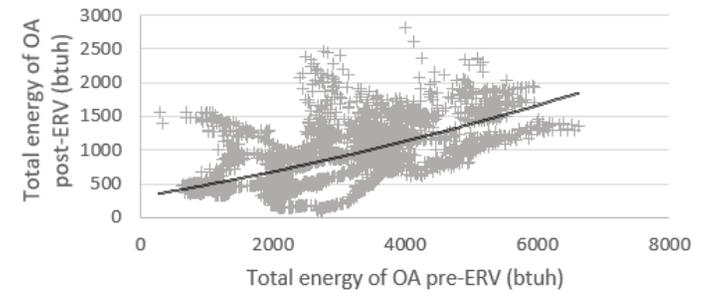
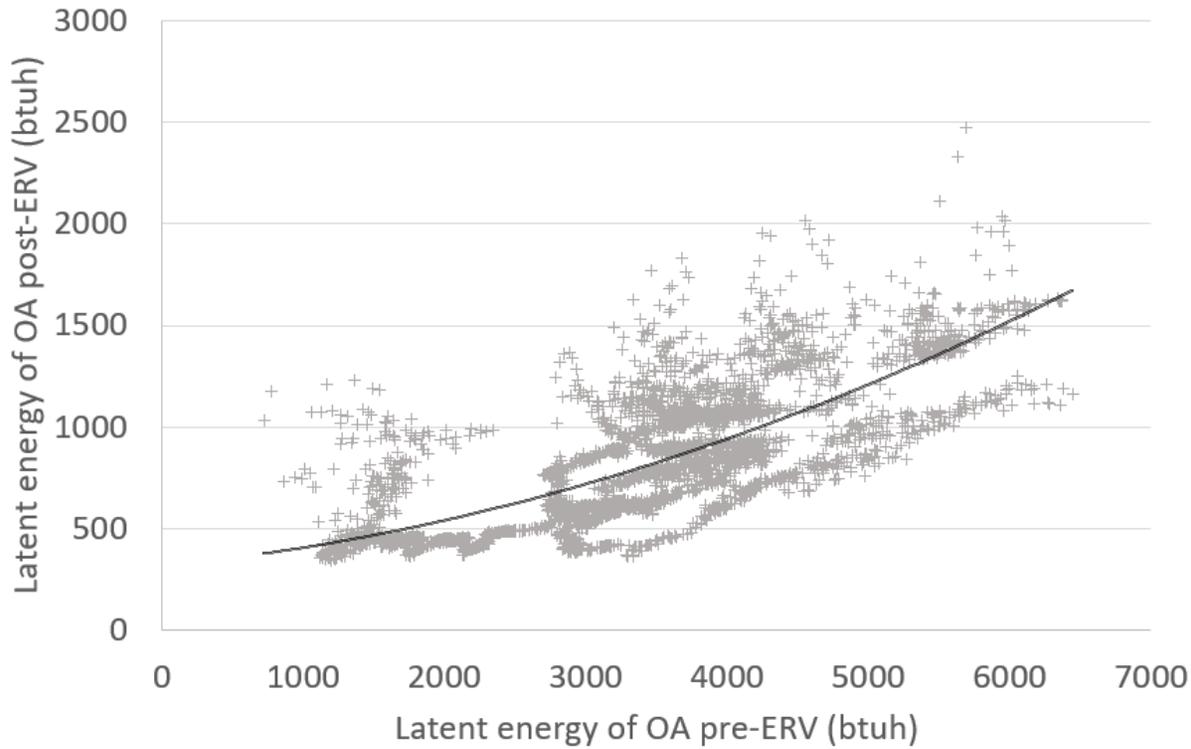
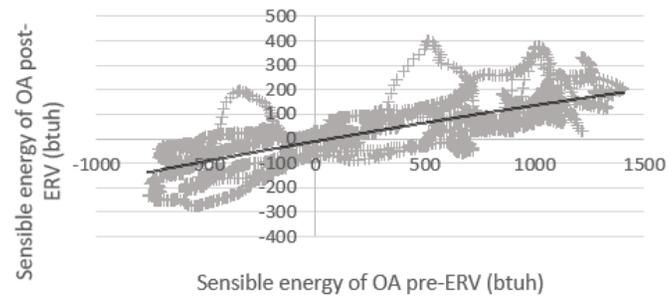
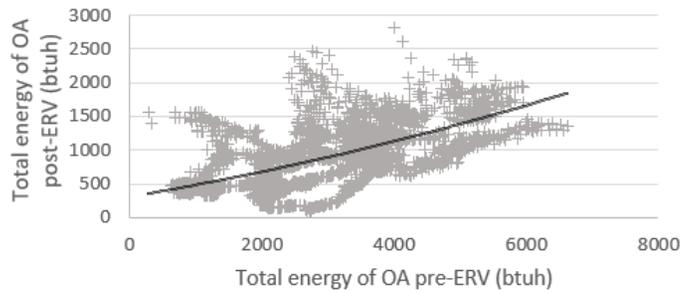
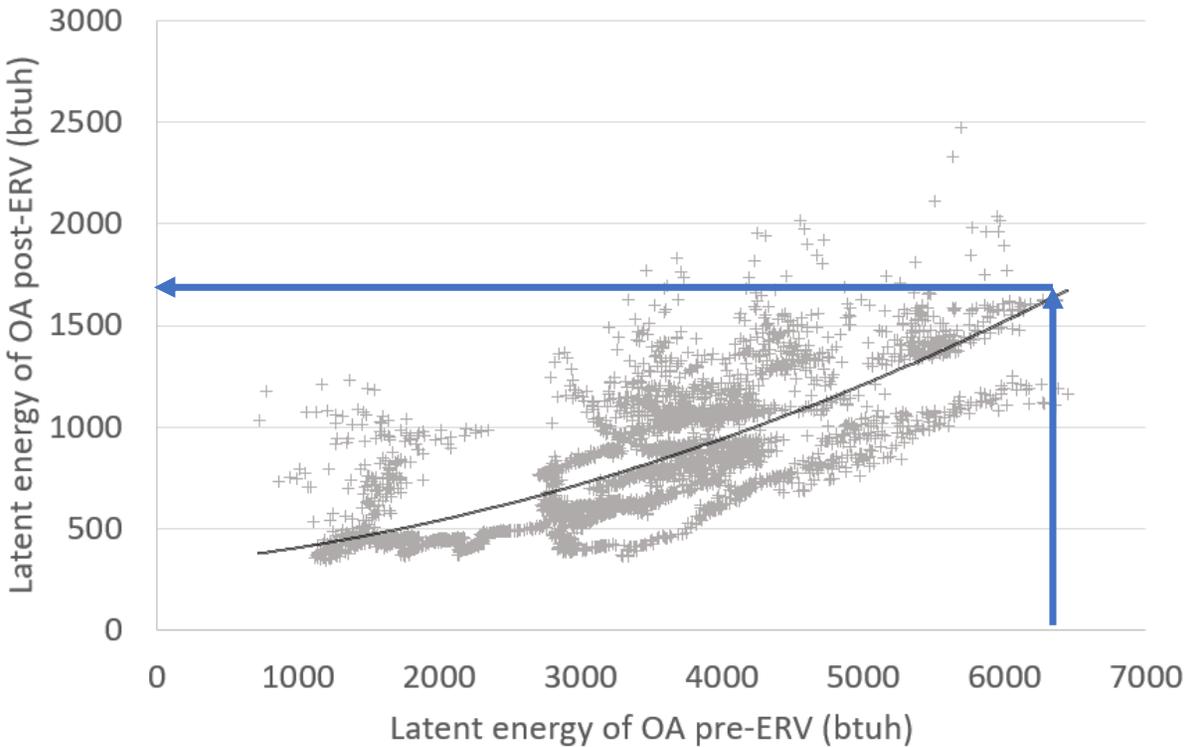


Photo Credit: Energy Vanguard

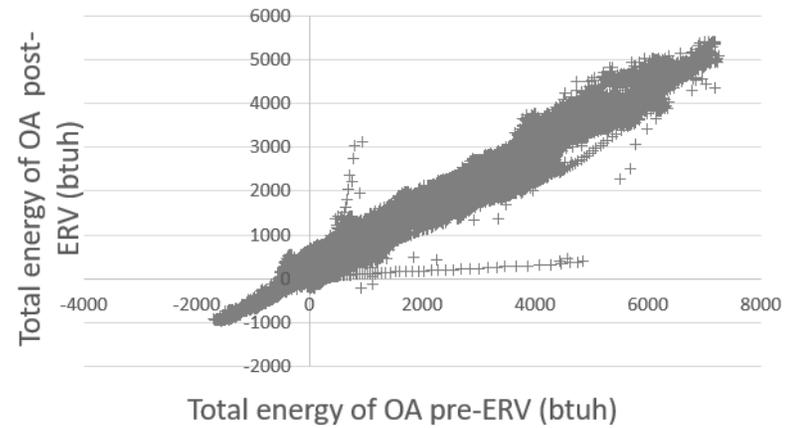
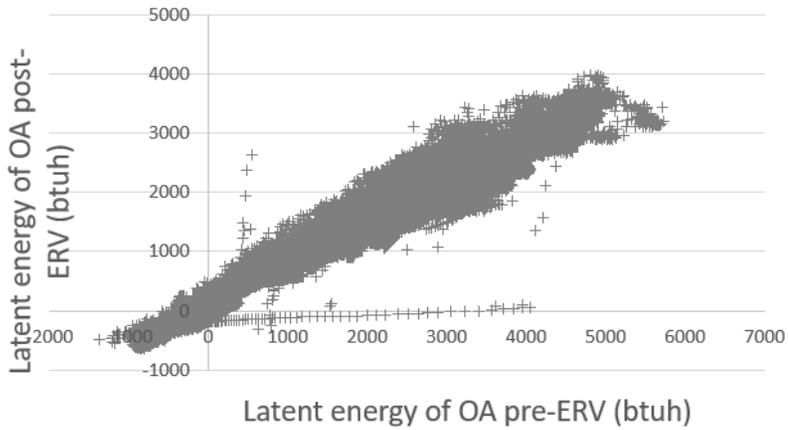
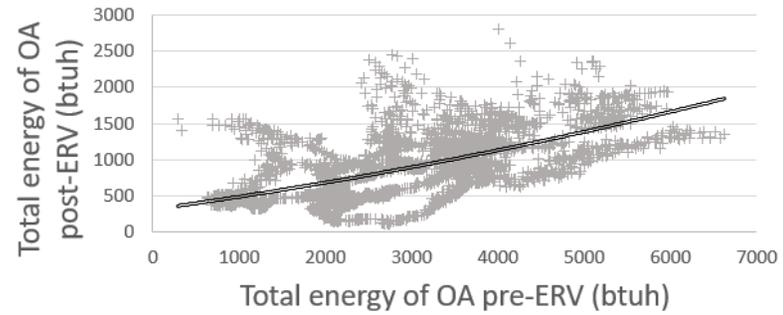
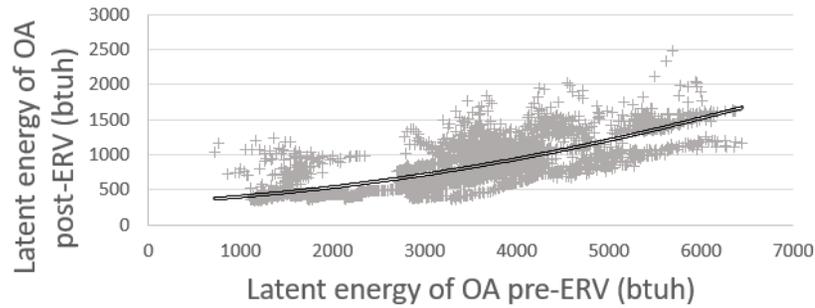
# ERV Ventilation Load



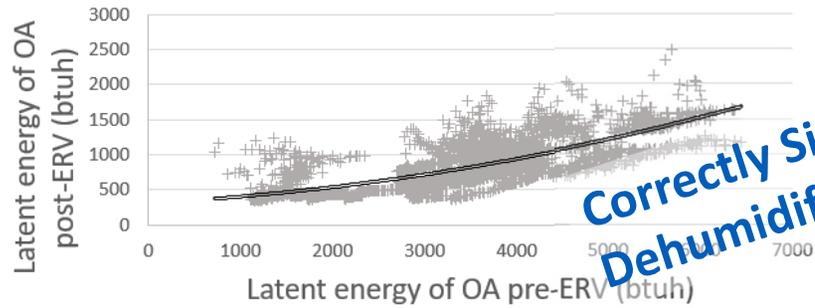
# ERV Ventilation Load



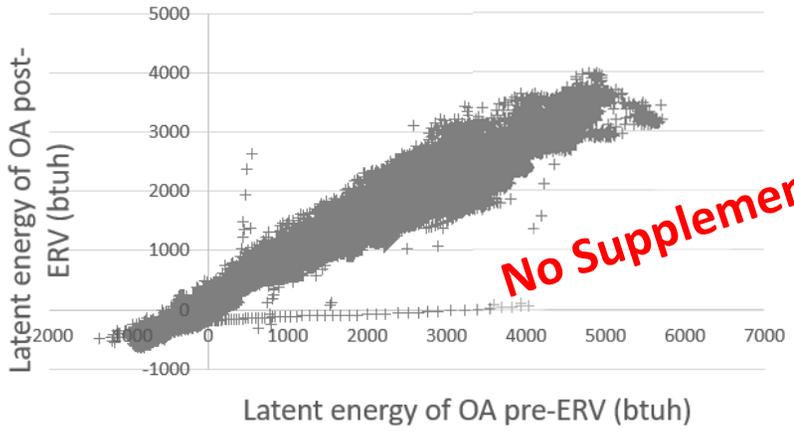
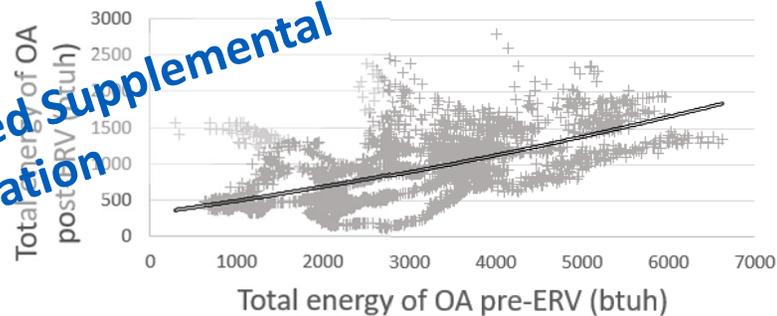
# ERV Ventilation Load



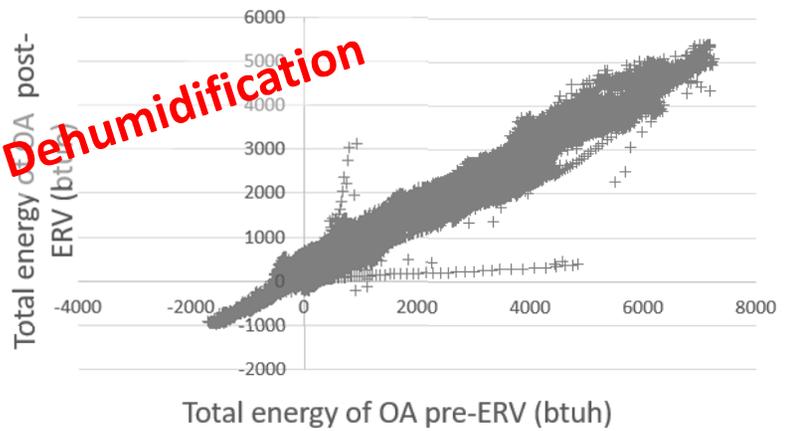
# ERV Ventilation Load



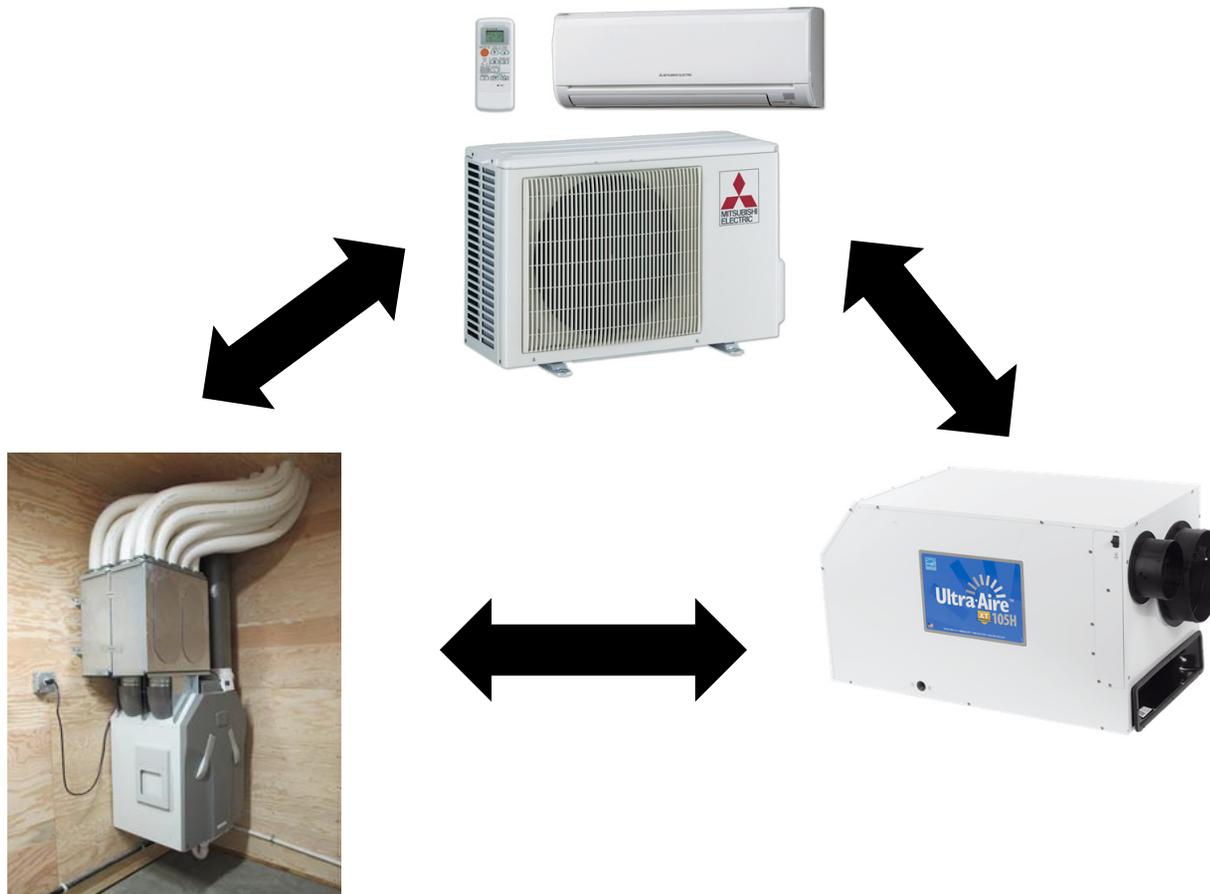
**Correctly Sized Supplemental Dehumidification**



**No Supplemental Dehumidification**



# Mechanical Systems



# Green Grass Climate Ventilation Systems

- Typically OA is wet and near room temperature
- Need extra horsepower to deal with load from ventilation system
  - Independent of temperature
- Minimize potential for comfort issues and negative system interactions
  - Correct application
- Monitor & make adjustments



# My challenge to you....

- Put Health/Safety/Durability over Energy Efficiency
- Practice true systems thinking – Envelope/Mechanicals
- Determine the moisture load being brought in by ventilation system and ensure adequate latent capacity (95% of the year) – do not be afraid of dehumidification
- Educate Educate Educate

David Treleven

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