Theoretical Discussion: Impacts of Air flow on AC Performance

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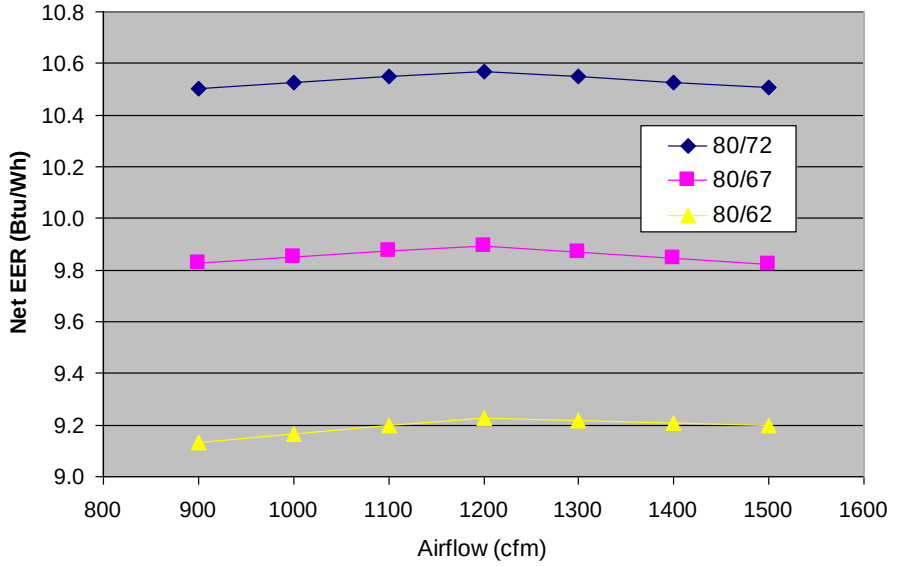
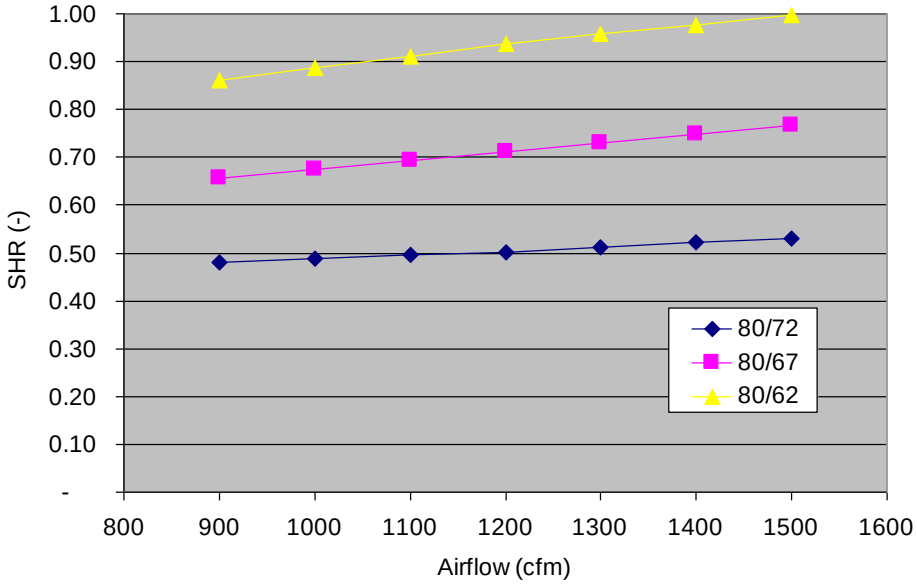
Overview

- Use Manufacturer's "Catalog" Data to Show Impact of Airflow on Performance
  - efficiency & capacity
- Use Public Domain Steady-State Refrigeration Model to Evaluate Flow Impacts

Catalog Data for 3-ton RTU

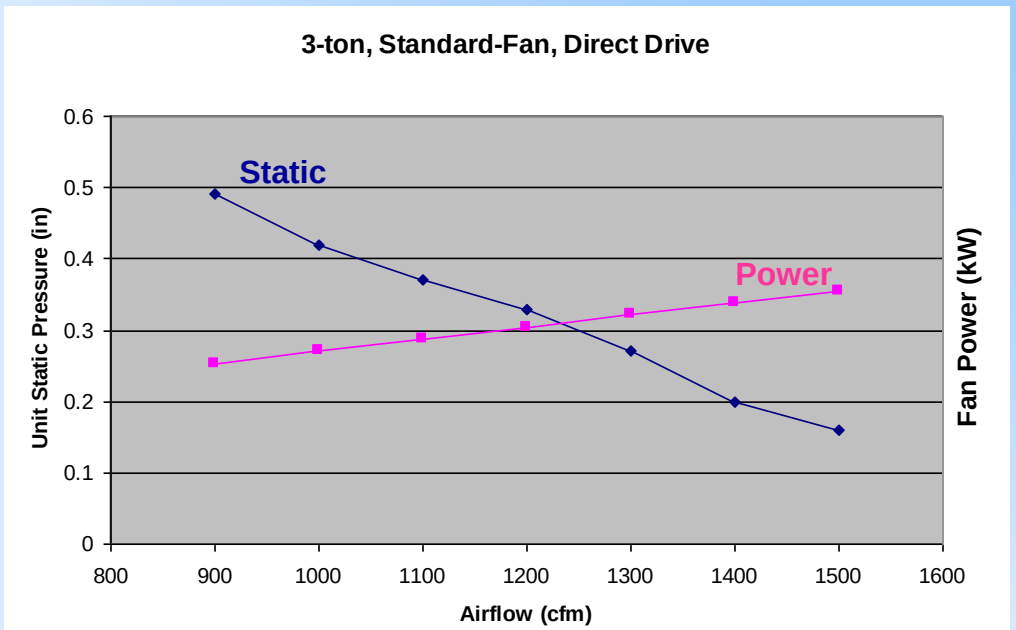
- Combined "Gross" Coil Performance Data with Fan Curves
  - 300 to 500 cfm/ton
- Shows Combined Impact of Flow:
  - comp efficiency increases with flow
  - fan power increases with flow

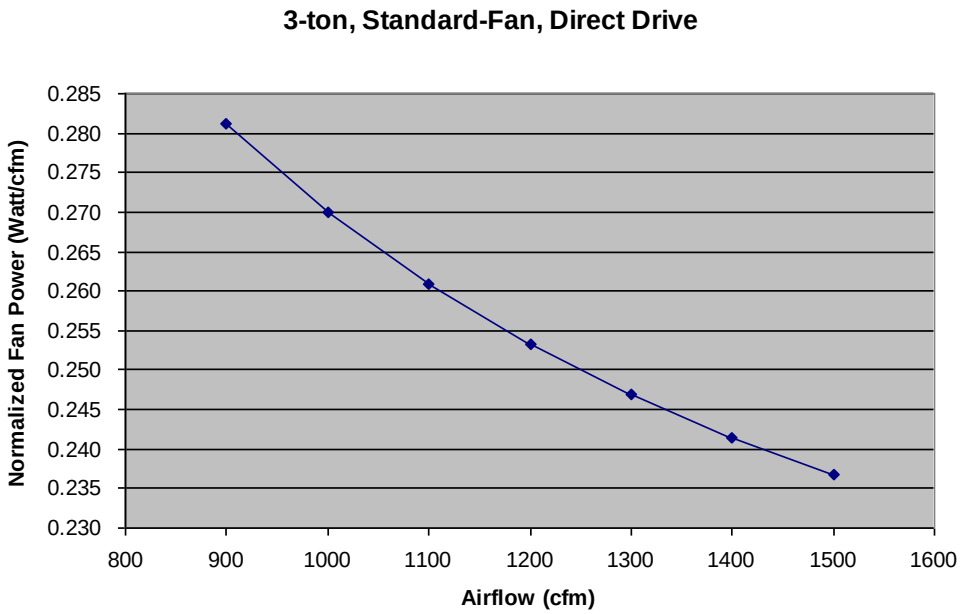




Fan Performance Impacts EER Trends

- Unit Static Ranges from 0.16 to 0.49 in
- RTU similar to Residential
  - direct drive, FC fan
  - DX coil & furnace section
- 0.24-0.28 W/cfm

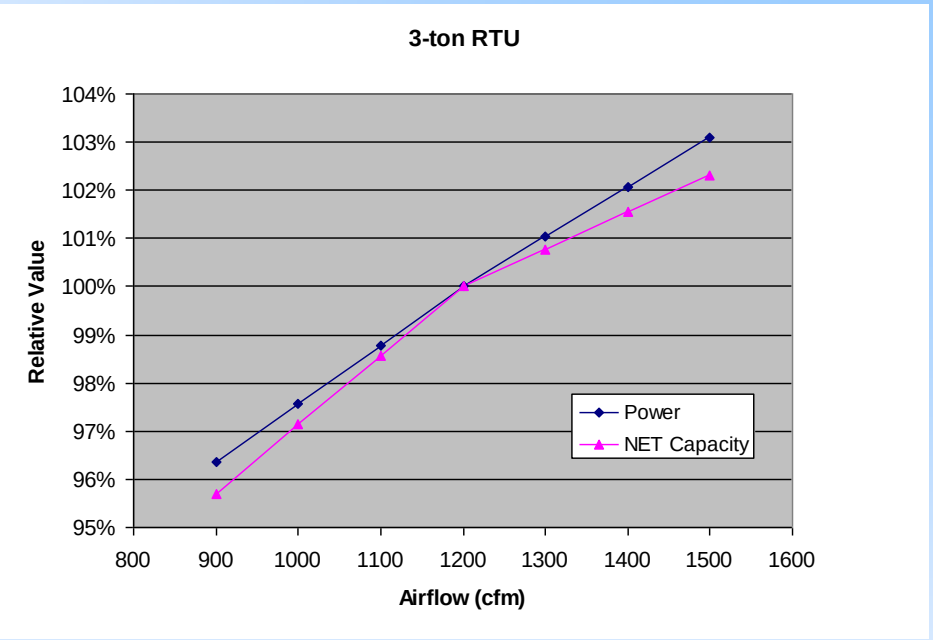


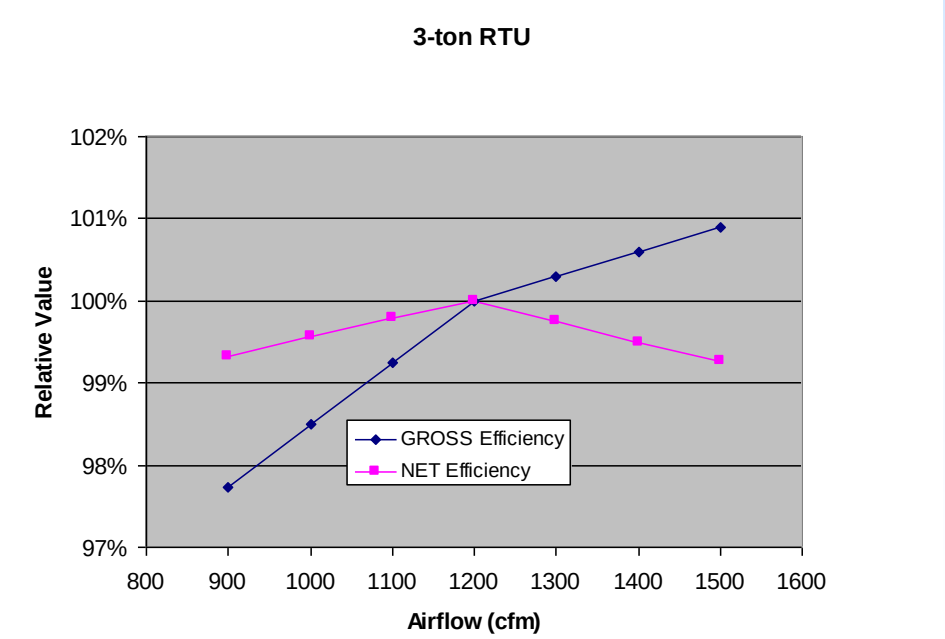


Impact of Flow at Nominal Conditions

80/67F, 95F

- NET Capacity and Power change by ±2-3%
- NET EER changes by less than 1%

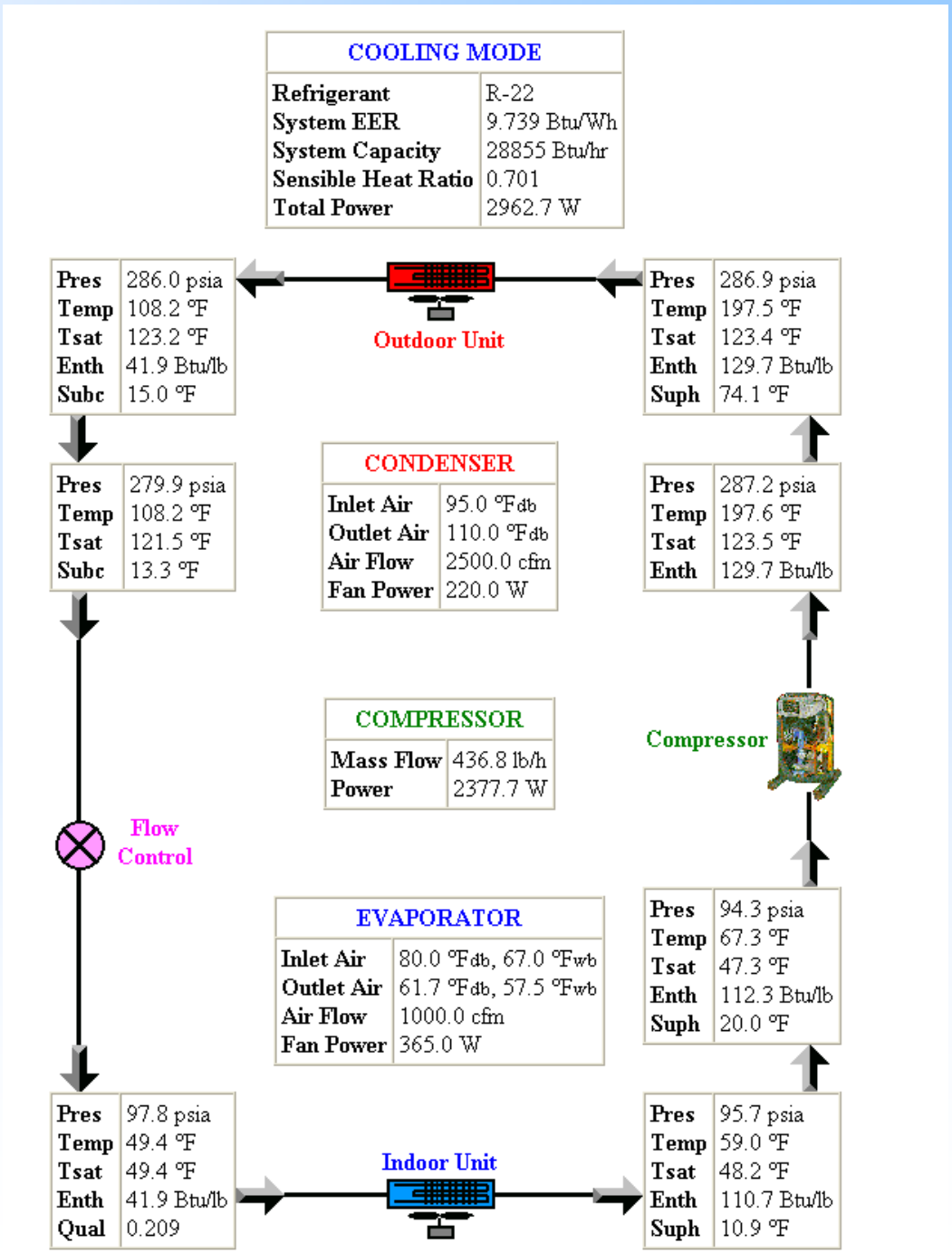




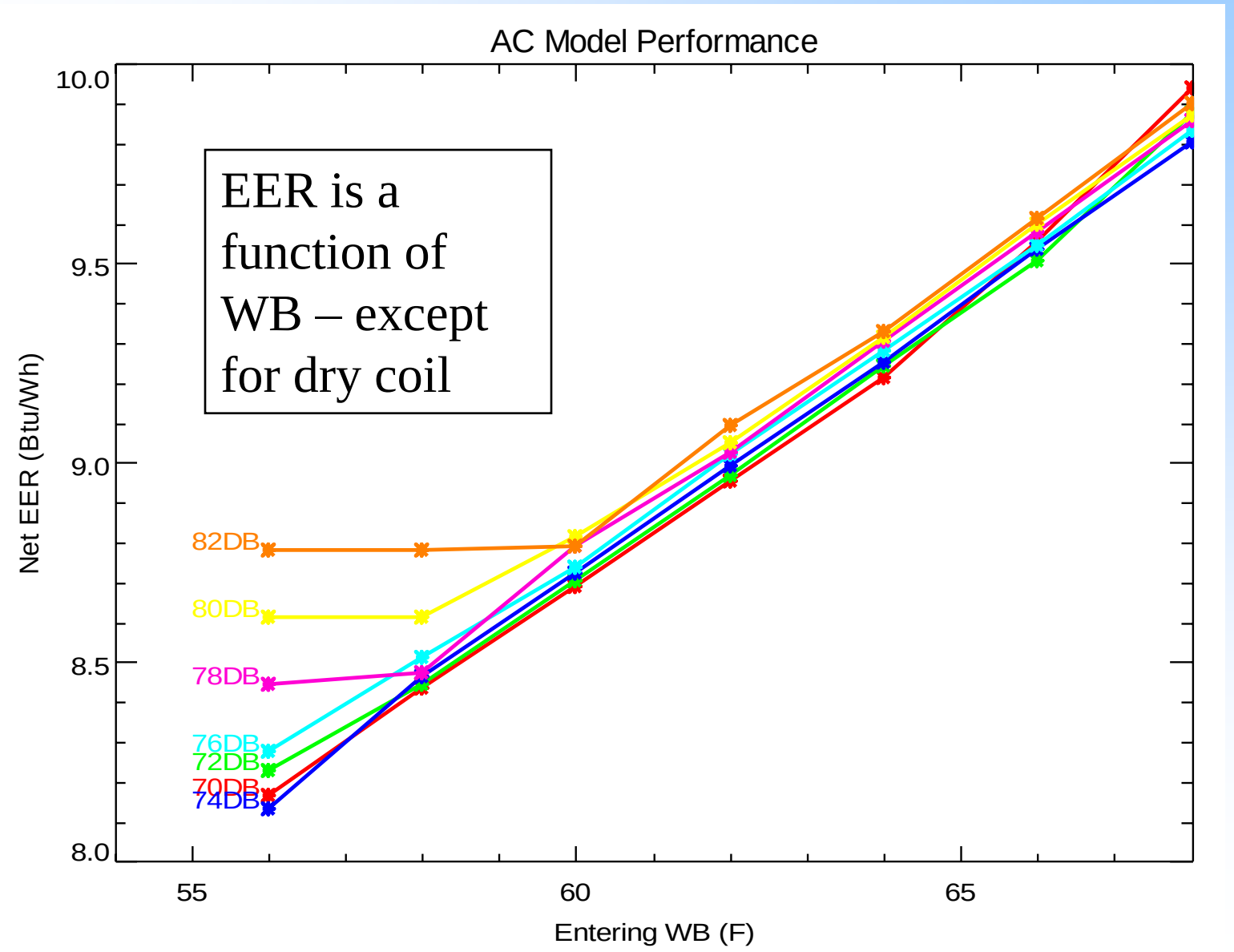
Use AC Model to Evaluate Trends

- Public-Domain Refrigeration System Model
  - 20+ years of history
  - validated by ASHRAE 859-RP, others
  - web-interface, parametric run mode
- Default Model Inputs
  - 2.5 ton, reciprocating compressor,
  - R22, 400 cfm/ton
  - supply fan: 0.365 W/cfm (constant value)

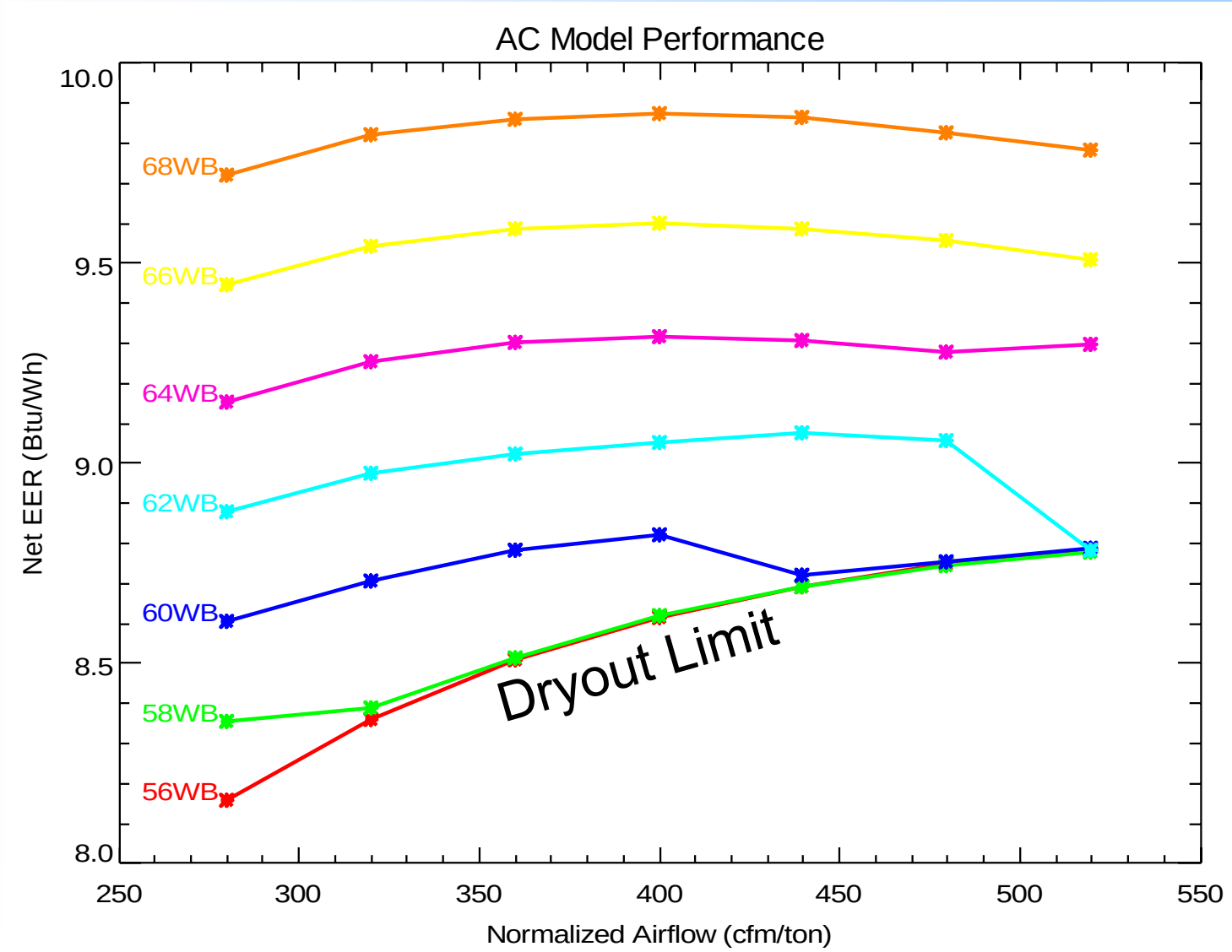
Refrigeration Model Output



Almost No DB Impact



Impact of Entering WB



What Are Typical Entering Conditions?

Nominal: 80F & 51% RH → 67F WB

Typical: 75F & 55% RH → 64F WB

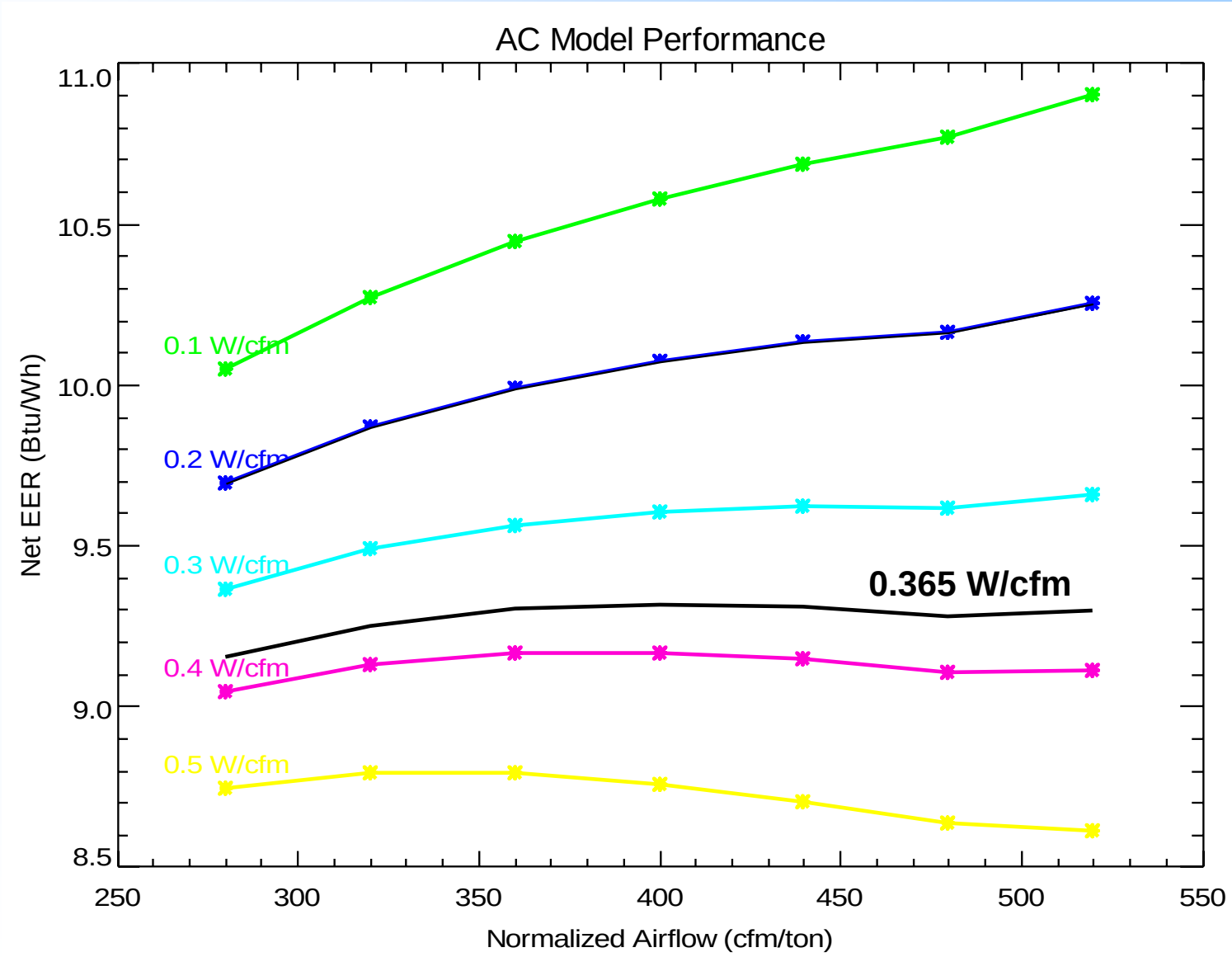
Mild: 80F & 35% RH → 62F WB

…BUT so is…

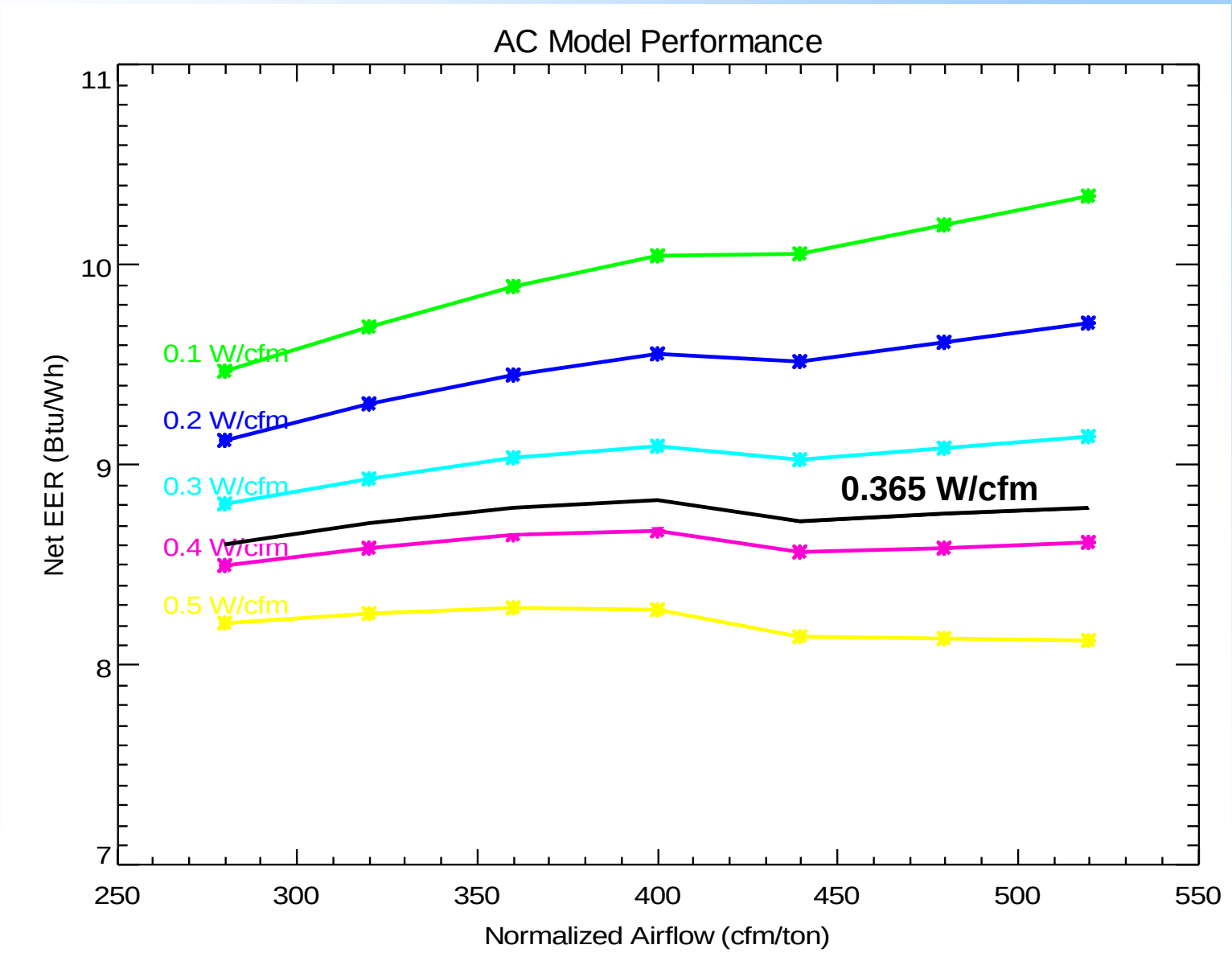
75F & 48% RH

Dry Climate: 75F & 35% RH → 58F WB

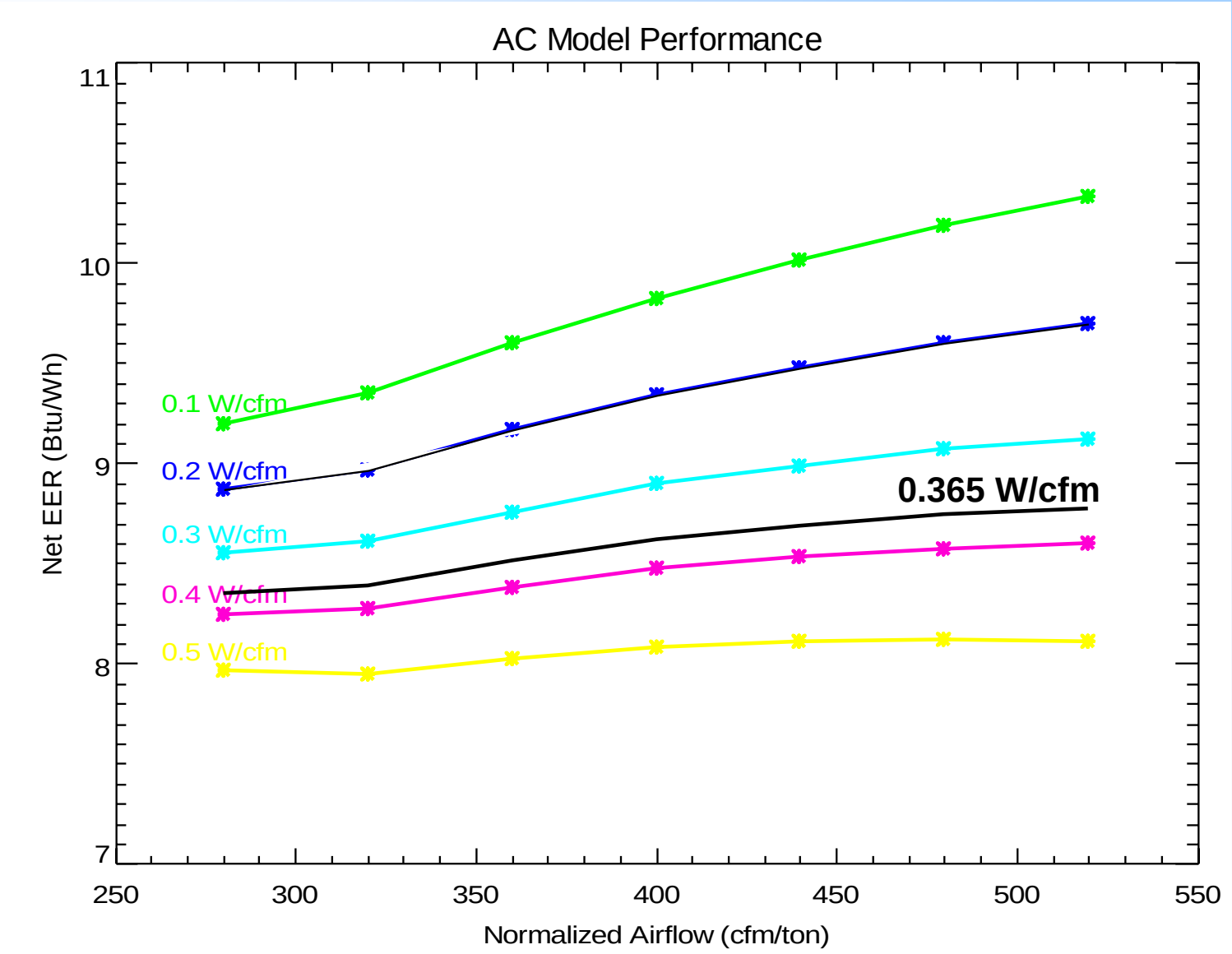
Impact of Fan Power (at 64F WB)



Impact of Fan Power (at 60F WB)



Impact of Fan Power (at 58F WB)



What Fan Power is Typical?

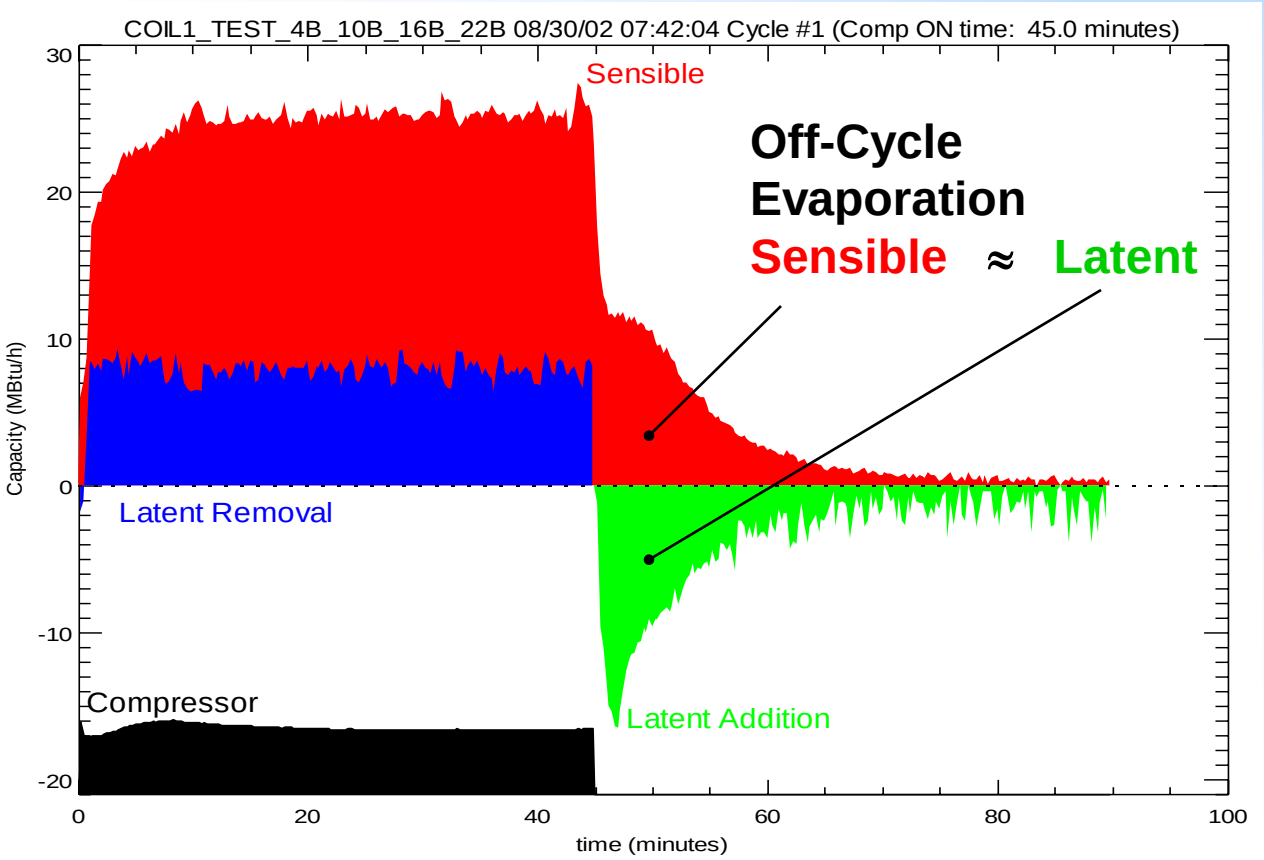
- Same 3-ton RTU offers High Static Option with Belt Driven Fan
  - Fan speed set to provide flow & static
- Fan Power Can Change by Factor of 5 Across the Range: 0.2 to 1.0 Watt/cfm

Riding Fan Curve

	Normalized Fan Power (Watts/cfm)									
	Unit Static (in)									
cfm/ton	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
300	0.20	0.28	0.38	0.48	0.54	0.63	0.69	0.75	0.80	0.86
333	0.22	0.30	0.38	0.49	0.55	0.63	0.69	0.75	0.80	0.85
367	0.24	0.32	0.36	0.50	0.55	0.61	0.66	0.72	0.77	0.82
400	0.27	0.34	0.41	0.53	0.56	0.61	0.67	0.73	0.78	0.83
433	0.29	0.37	0.46	0.54	0.58	0.64	0.71	0.76	0.82	0.87
467	0.32	0.41	0.48	0.55	0.60	0.66	0.73	0.79	0.84	0.90
500	0.35	0.44	0.51	0.57	0.63	0.70	0.76	0.83	0.89	0.95

What if I Don't Need the Latent Capacity in My Dry Climate?

- Don't Worry Your Not Getting Much….



EER ~ Sensible EER

Summary

- Airflow has Very Little Impact on EER near Nominal Conditions
  - but more impact at dry coil conditions
- The Variation of EER with Airflow Depends on Fan Power
- Best Airflow Rate Depends on Climate and Equipment Characteristics