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Small Duct High Velocity

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Pre-Rulemaking Workshop
Rosenfeld Hearing Room
July 18, 2017

Background

- Residential HVAC systems have been the target of efficiency measures
- Effort to achieve close to their rated efficiency
- Overcome field installation variables that impact capacity and efficiency

Background

2005 Title 24 compliant HVAC system*:

Mandatory	Prescriptive
Minimum efficiency	Duct insulation
Minimum duct insulation	Refrigerant charge or TXV
	Maximum duct leakage (<6% total)

*Newly constructed or complete replacement (system and ductwork)

Background

2008 Title 24 compliant HVAC system*:

Mandatory	Prescriptive
Minimum efficiency	Duct insulation
Minimum duct insulation	Refrigerant charge
	Maximum duct leakage (<6% total)
	Minimum airflow per nominal ton (350 CFM)
	Maximum fan watts (0.58 W/CFM)

*Newly constructed or complete replacement (system and ductwork)

Background

2013 Title 24 compliant HVAC system*:

Mandatory	Prescriptive
Minimum efficiency	Duct insulation
Minimum duct insulation	Refrigerant charge
Maximum duct leakage (<6% total)	
Minimum filtration	
Minimum condensing unit clearance	
Minimum airflow per nominal ton (350 CFM)	
Maximum fan watts (0.58 W/CFM)	

*Newly constructed or complete replacement (system and ductwork)

Background

2016 Title 24 compliant HVAC system*:

Mandatory	Prescriptive
Minimum efficiency	Duct insulation
Minimum duct insulation	Refrigerant charge
Maximum duct leakage (<5% total)	
Minimum filtration	
Liquid line filter drier	
Minimum condensing unit clearance	
Minimum airflow per nominal ton (350 CFM)	
Maximum fan watts (0.58 W/CFM)	

*Newly constructed or complete replacement (system and ductwork)

Background

2008 Building Energy Efficiency Standards

Introduced airflow and fan watts as a prescriptive measure

§151(c)7B – Required airflow greater than 350 CFM/ton of nominal cooling capacity and fan watt draw less than 0.58 W/CFM

The analysis that was conducted during the 2008 update did not include small duct, high velocity (SDHV) systems

Background

42 U.S.C. 6295 – Energy Conservation Standards

(i) Small duct, high velocity system – A heating and cooling product that contains a blower and indoor coil combination that –

I. Is designed for and produces at least 1.2 inches of external static pressure when operated at the certified air volume rate of 220-350 CFM per rated ton of cooling; and

II. When applied in the field, uses velocity room outlets generally greater than 1,000 fpm that have less than 6.0 square inches of free area.

Background

§430.32(c)(3)
(3) Central air conditioners and central air conditioning heat pumps manufactured on or after January 1, 2015, shall have a Seasonal Energy Efficiency Ratio and Heating Seasonal Performance Factor not less than:

Product Class	Seasonal Energy Efficiency Ratio (SEER)	Heating Seasonal Performance Factor (HSPF)
I. Split-system air conditioner…….	13	
II. Split-system heat pumps…….	14	8.2
III. Single-package air conditioner……..	14	
IV. Single-package heat pumps……..	14	8.0
V. Small-duct, high-velocity systems……	**12**	**7.2**
VI. (A)Space-constrained products-air conditioners	12	
VI. (B)Space-constrained products-heat pumps	12	7.4

Compliance with Current Code

Mandatory	Prescriptive
Minimum efficiency	Duct insulation
Minimum duct insulation	Refrigerant charge
Maximum duct leakage (<5% total)	
Minimum filtration	
Liquid line filter drier	
Minimum condensing unit clearance	
Minimum airflow per nominal ton (350 CFM)	
Maximum fan watts (0.58 W/CFM)	
*Newly constructed or complete replacement (system and ductwork)	

Compliance with Current Code

EXCEPTION 1 to Section 150.0(m)13B: Standard ducted systems without zoning dampers may comply by meeting the applicable requirements in Table 150.0-B or 150.0-C as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Sections RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section 150.0(m)12C for the system air filter device(s) shall conform to the requirements given in Tables 150.0-B and 150.0-C.

Table 150.0-B: Return Duct Sizing for Single Return Duct Systems

Return duct length shall not exceed 30 feet and shall contain no more than 180 degrees of bend. If the total bending exceeds 90 degrees, one bend shall be a metal elbow.

Return grille devices shall be labeled in accordance with the requirements in Section 150.0(m)12A to disclose the grille's design airflow rate and a maximum allowable clean-filter pressure drop of 12.5 Pa (0.05 inches water) for the air filter media as rated in accordance with AHRI Standard 680 for the design airflow rate for the return grille.

System Nominal Cooling Capacity (Ton)*	**Minimum Return Duct Diameter (inch)**	**Minimum Total Return Filter Grille Gross Area (inch2)**
1.5	16	500
2.0	18	600
2.5	20	800

***Not applicable to systems with nominal cooling capacity greater than 2.5 tons or less than 1.5 ton

Proposal

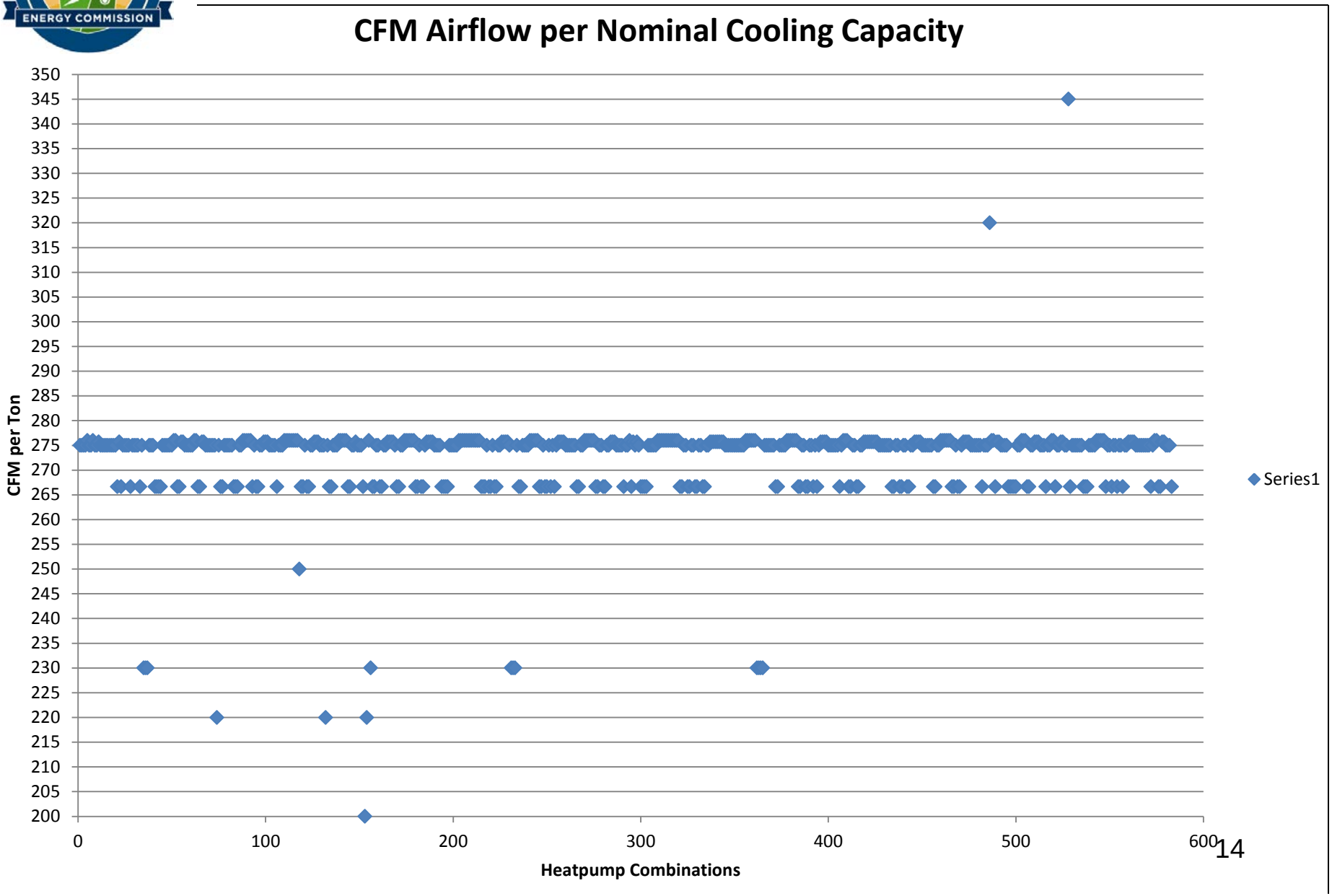
AHRI Directory –

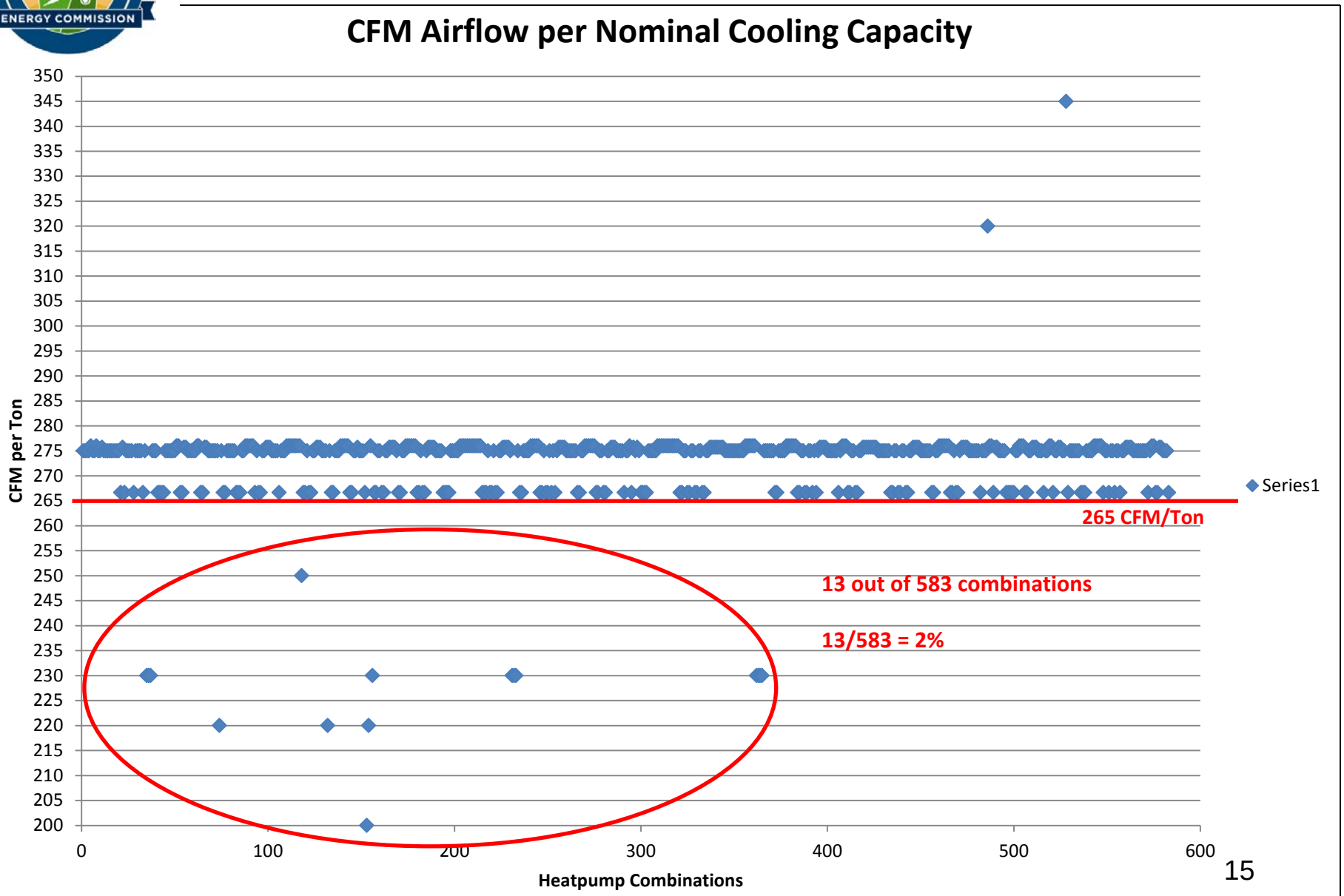
583 certified combinations of SDHV heat pumps

Using nominal condenser capacity and rated indoor air handler airflow

New target CFM/ton = 265

New target W/CFM = 0.54


CFM Airflow per Nominal Cooling Capacity
CFM per Ton
350
345
340
335
330
325
320
315
310
305
300
295
290
285
280
275
270
265
260
255
250
245
240
235
230
225
220
215
210
205
200
0
100
200
300
400
500
600
Heatpump Combinations
Series1


CFM Airflow per Nominal Cooling Capacity
CFM per Ton
Heatpump Combinations
Series1
265 CFM/Ton
13 out of 583 combinations
13/583 = 2%
350
345
340
335
330
325
320
315
310
305
300
295
290
285
280
275
270
265
260
255
250
245
240
235
230
225
220
215
210
205
200
0
100
200
300
400
500
600

Fan Watt Draw

All rated combinations incorporate an ECM fan

Assumptions:

Q = 1 CFM

η_m *Motor* = 0.72

η_f *Blower Wheel* = 0.45

P_t = 1.5 in w.c.

$$W = \frac{Q(P_t)}{8.51(\eta_m)(\eta_f)}$$

$$W = \frac{1 \text{ CFM } (1.5 \text{ in w.c.})}{8.51 * 0.72 * 0.45} = 0.54 \text{ W}$$

Proposed Code Language

13. Duct System Sizing and Air Filter Grille Sizing. Space conditioning systems that utilize forced air ducts to supply cooling to an occupiable space shall:

[…]

D. **Small Duct, High Velocity Central Forced Air Systems**. Demonstrate, in every control mode, airflow greater than or equal to 265 CFM per ton of nominal cooling capacity through the return grilles, and an air-handling unit fan efficacy less than or equal to 0.54 W/CFM as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.

Questions?

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Comments Due by August 1, 2017
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