

Fan Efficiency Regulation Update for ASHRAE TC 5.1

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Greenheck Fan

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Department of Energy (DOE)

Commercial & Industrial Fans & Blower (CIFB)

Rule Making Update



DOE CIFB Status / Timing



- **Term Sheet – September 2015**
 - “Letter of Intent” for Rule
- **Proposed Rule (NOPR) – Q1 2016***
 - Test Standard NOPR
 - Regulatory NOPR
- **Final Rule – January 2017***
 - 1st Potential for Compliance
 - Estimate Products on the Market by 2018
- **Mandatory Compliance – January 2022***
 - 5 Years after Final Rule*

**Anticipated Date*

DOE CIFB Term Sheet



- 32 Recommendations
 - Submitted to Appliance Standards & Rulemaking Federal Advisory Committee (ASRAC)
- DOE ASRAC 25 WG Members
 - 1 DOE
 - 7 AMCA
 - 8 AHRI
 - 4 Energy Advocates
 - 3 AMCA/AHRI
 - 1 Consultant
 - 1 Motor/Drive Supplier
- Term Sheet “Consensus” (*after 16 Meetings*)
 - 23 “For” / 2 “Against”
 - Consensus on 28 of 32 Recommendations



DOE CIFB Term Sheet



- Fan Categories “In” & “Out”
- Scope
- Metric
- Test
- Certification/Labeling

- ❖ **KEY Items NOT covered:**
- Efficiency Levels
 - Replacement Fans(rec. #28)

CIFB Fan Term Sheet

Categories/Equipment Classes “In”

- “Stand Alone Fans”:
 - Axial Cylindrical Housed
 - Panel
 - Centrifugal Housed & Unhoused (excluding inline & radial)
 - Inline & Mixed Flow
 - Radial Housed (shrouded impeller)
 - Power Roof Ventilators



Ref. Recommendation #1, 30

CIFB Fan Term Sheet

Categories “In”

- “Embedded” Fans in:
 - Equipment not Regulated by the DOE
 - Equipment Regulated by the DOE where the regulation does not capture the fan energy.
 - » Fan will be tested outside of equipment (stand alone)
 - » Fan will be tested as a defined “testable configuration”.

Ref. Recommendation #4 & 8

CIFB Fan Term Sheet

Categories “Out”

- Radial Housed Unshrouded
 - Diameter < 30” / Blade Width < 3”
- Safety
- Circulating
- Induced Flow
- Jet
- Cross Flow



Ref. Recommendation #2

CIFB Fan Term Sheet

Categories “Out”

- **Supply & Condenser Fans** in DOE Regulated Equipment where the Regulation captures the energy of these fans
- **Fans “Embedded” in:**
 - DOE Regulated Central AC & Heat Pumps
 - DOE Regulated Commercial AC & Heat Pumps
 - DOE Regulated Consumer Furnaces
 - Transport Refrigeration
 - Vacuums
 - Heat Rejection Equipment (per Cooling Tower Institute)
 - Air Curtains



okokchina.com

Ref. Recommendation #2 & 3

CIFB Fan Term Sheet

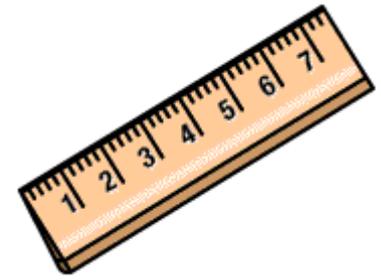
“Scope”

- Fans offered for sale at Operating Points where:
 - Fan shaft power is greater than or equal to 1 BHP
 - Fan air power is less than or equal to 150 HP (approx. 200 shaft BHP)

Ref. Recommendation #5

CIFB Fan Term Sheet

“Metric”



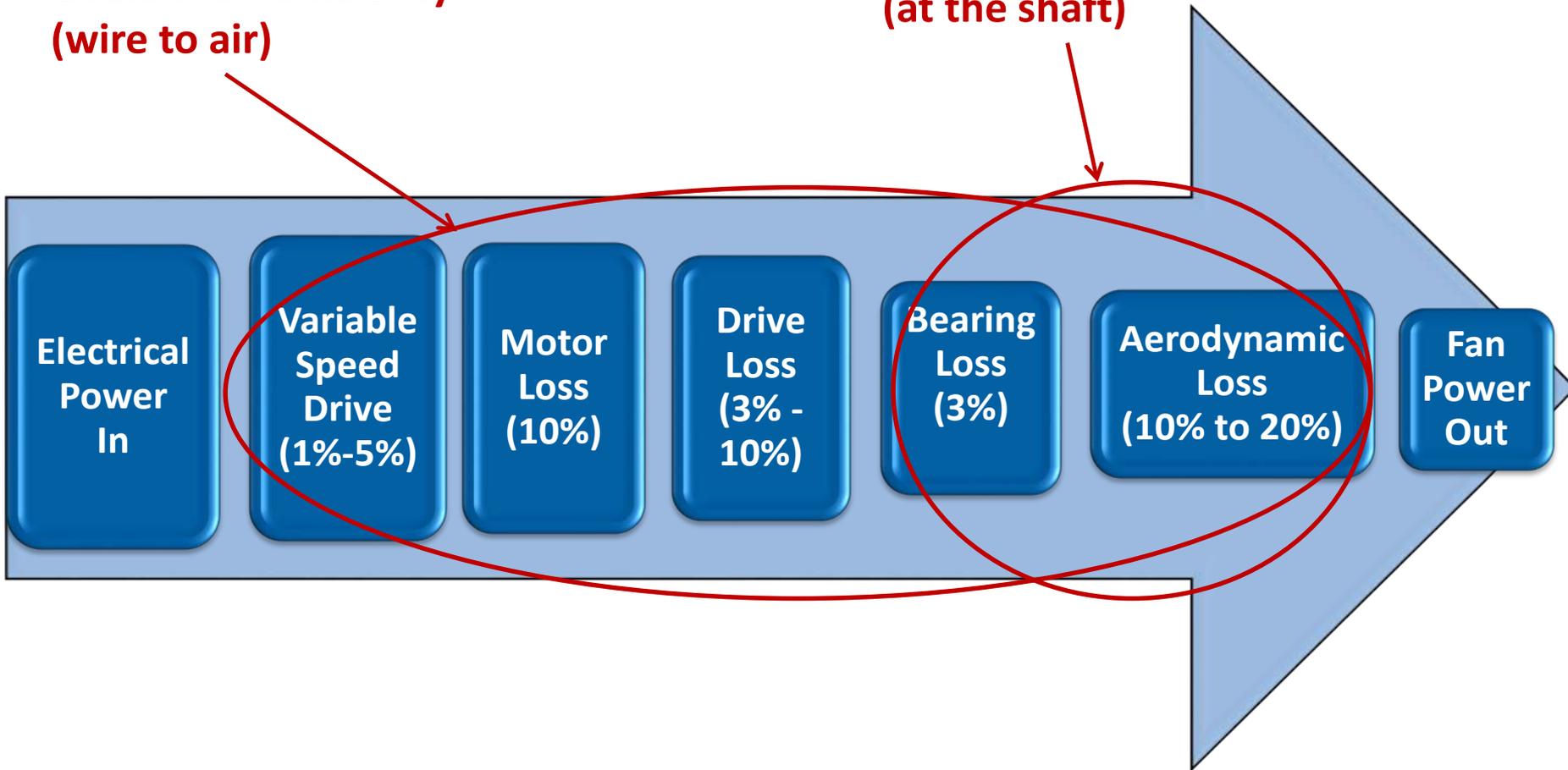
- Fan Electrical (input) Power (FEP)
 - Wire-to-Air (including motor & VSD when supplied by manufacturer)
 - Specific to Operating Point
 - Airflow and Pressure define Maximum Allowable Power – $FEP_{(std)}$
 - Results in a Range of Airflow and Pressure that can be offered for sale
- Fan Efficiency Index (FEI)
 - $FEP_{(std)} / FEP_{(actual)}$
 - $FEI \geq 1$
 - $(FEI - 1) = \% \text{ savings relative to DOE minimum requirement}$

Ref. Recommendation #6, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21

“Elements” of Fan Efficiency

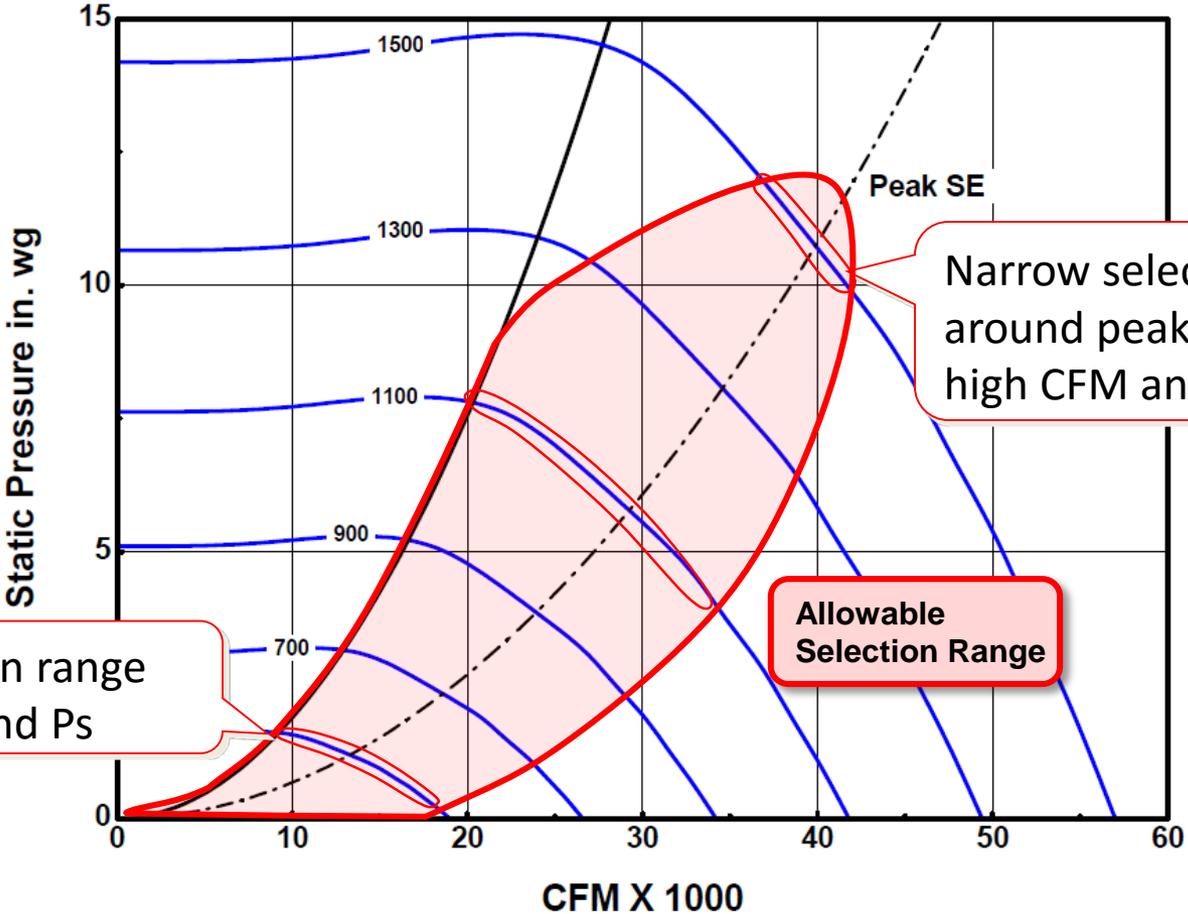
Overall Fan Efficiency
(wire to air)

Fan Efficiency
(at the shaft)



Compliant Fan Selections

FEI "Bubble"



Wide selection range
at low CFM and Ps

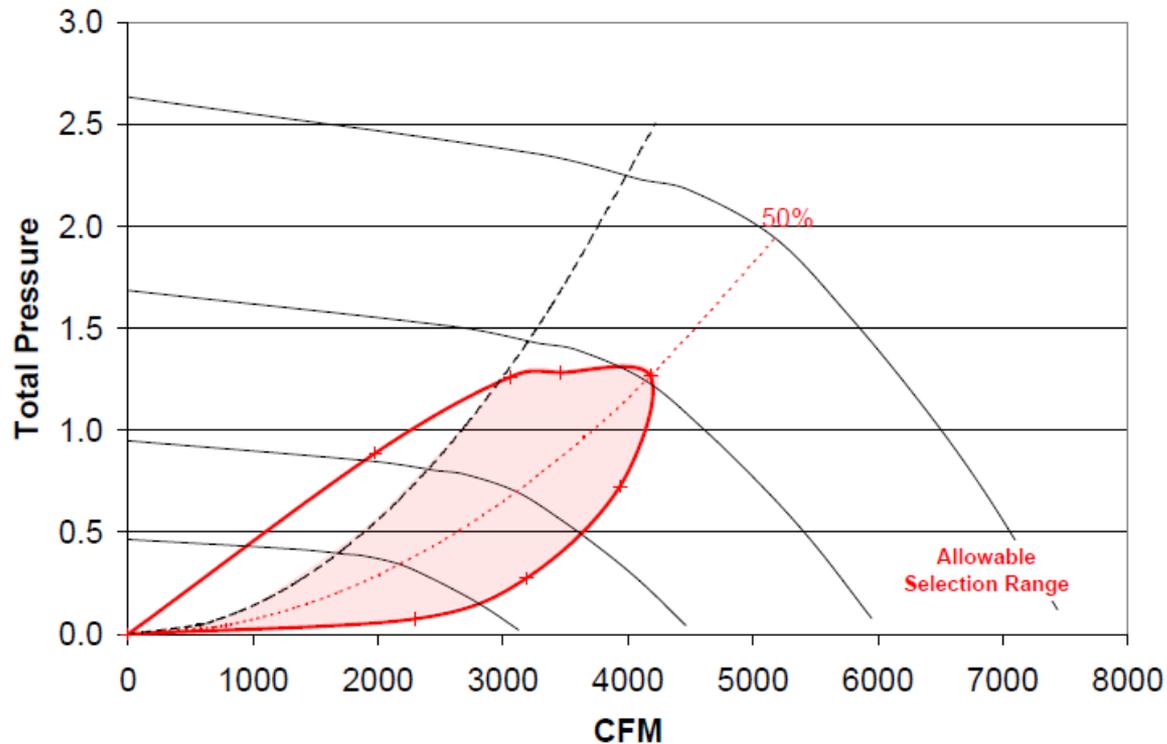
Narrow selection range
around peak efficiency at
high CFM and Ps

Allowable
Selection Range



Allowable Fan Selections

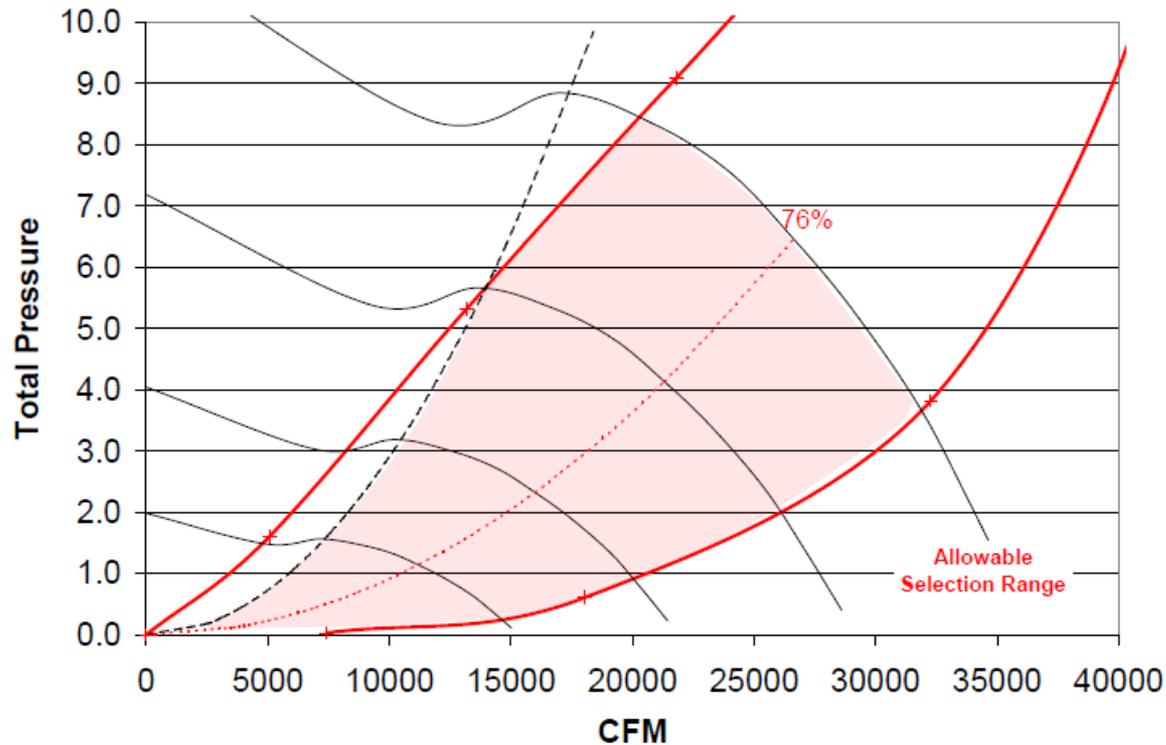
Example: Inefficient Fan



**Square
Inline Fan**

Allowable Fan Selections

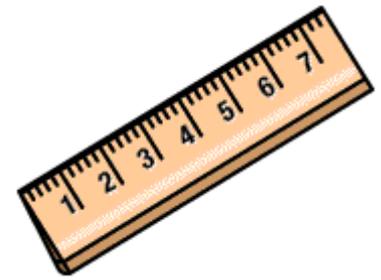
Example: Efficient Fan



**Mixed Flow
Inline Fan**

CIFB Term Sheet

“Metric”



Compliance Metric: Fan Electrical Power at Design Point \leq FEP_{STD}

$$FEP_{STD,i} = \frac{(Q_i + Q_0)(P_i + P_0)}{6346 * \eta_{target}}$$

$FEP_{STD,i}$ = maximum fan input power at operating point i

Q_i = flow (cfm) at operating point i

P_i = total pressure for ducted fans, static pressure for non-ducted fans (in. wg.) at operating point i

Q_0 = flow constant of 250 cfm

P_0 = pressure constant of 0.4 inches water gauge

η_{target} = target static and total efficiency levels to be set by DOE

Ref. Recommendation #18, 19, 20, 21

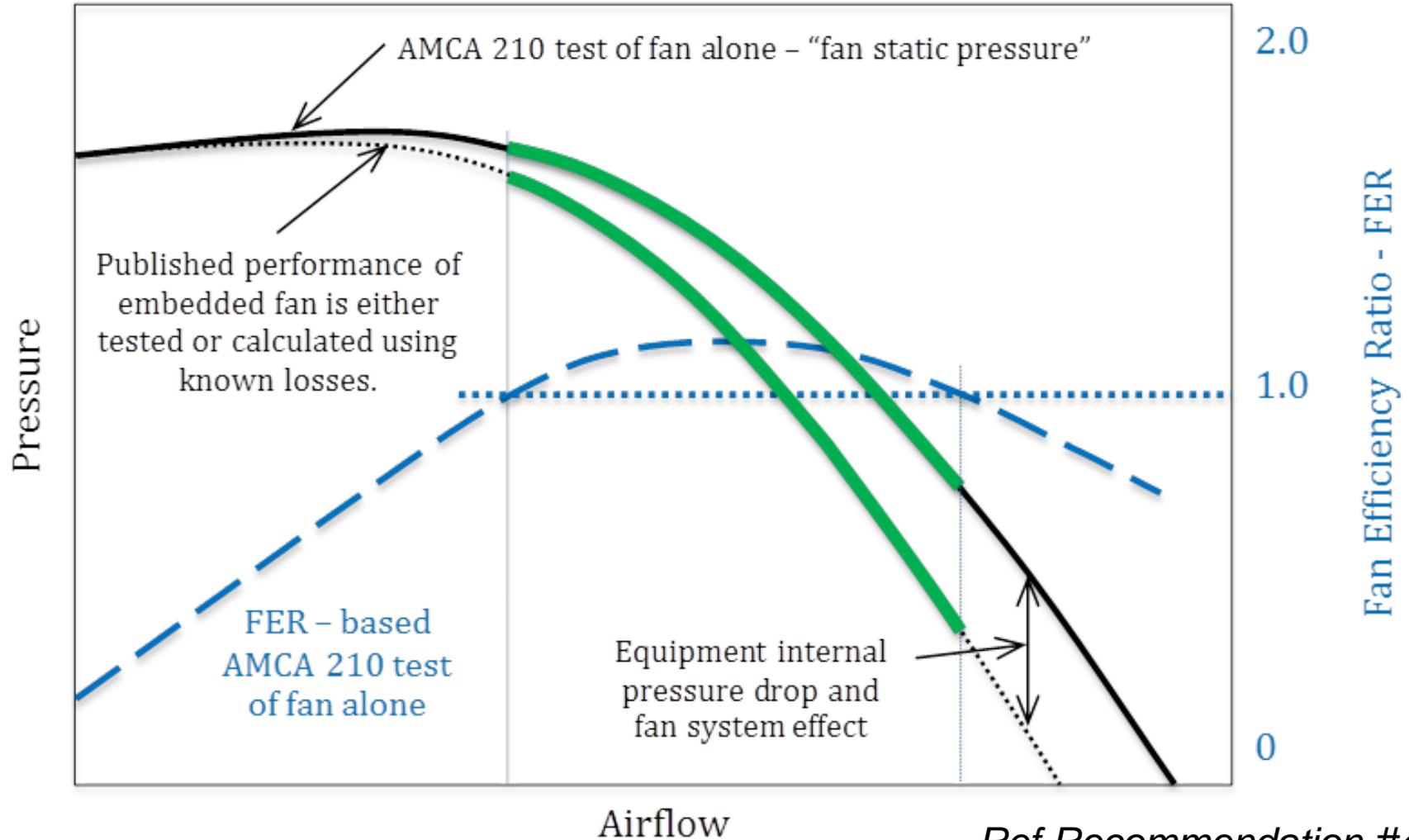
CIFB Fan Term Sheet “Test”



- DOE Regulation based on:
 - AMCA Standard 210 (stand alone / non-embedded fans)
- Includes “default” losses for:
 - Drives, Motors, VSDs
- Allows Alternative Efficiency Determination Method
 - AEDM

Ref. Recommendation #7, 8, 9, 17, 22, 23, 24, 25, 29

Embedded Fan Testing

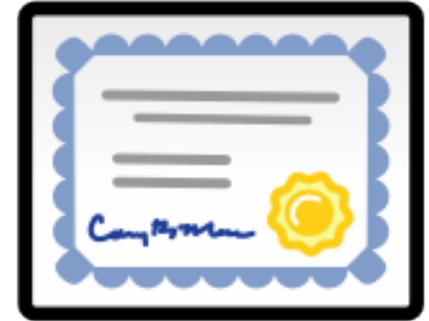


Ref Recommendation #4, 8

CIFB Fan Term Sheet

“Certification/Labeling*”

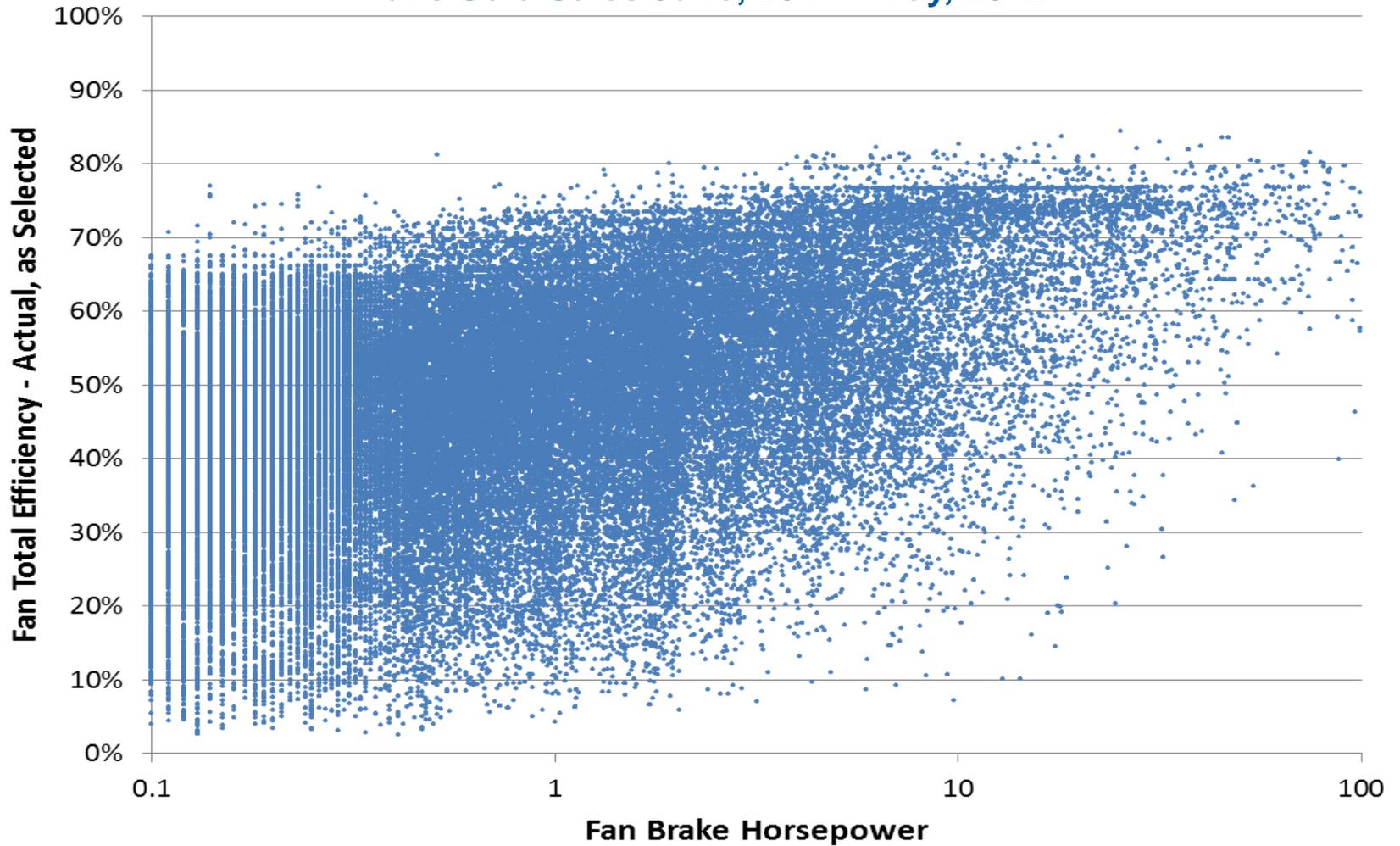
- Certification:
 - Submit Selection Software (like AMCA eCAT)
 - Submit Operating Range (equation or tabular)
 - Submit Literature
 - Info will be in “Public Domain”
 - Working to utilize AMCA CRP
- Labeling (design point dependent)
 - Model
 - Serial #, Date
 - Design Airflow, Pressure, FEI
 - Max RPM
 - Link to DOE website



**Likely to Change
Ref. Recommendation #26, 27, 31, 32*

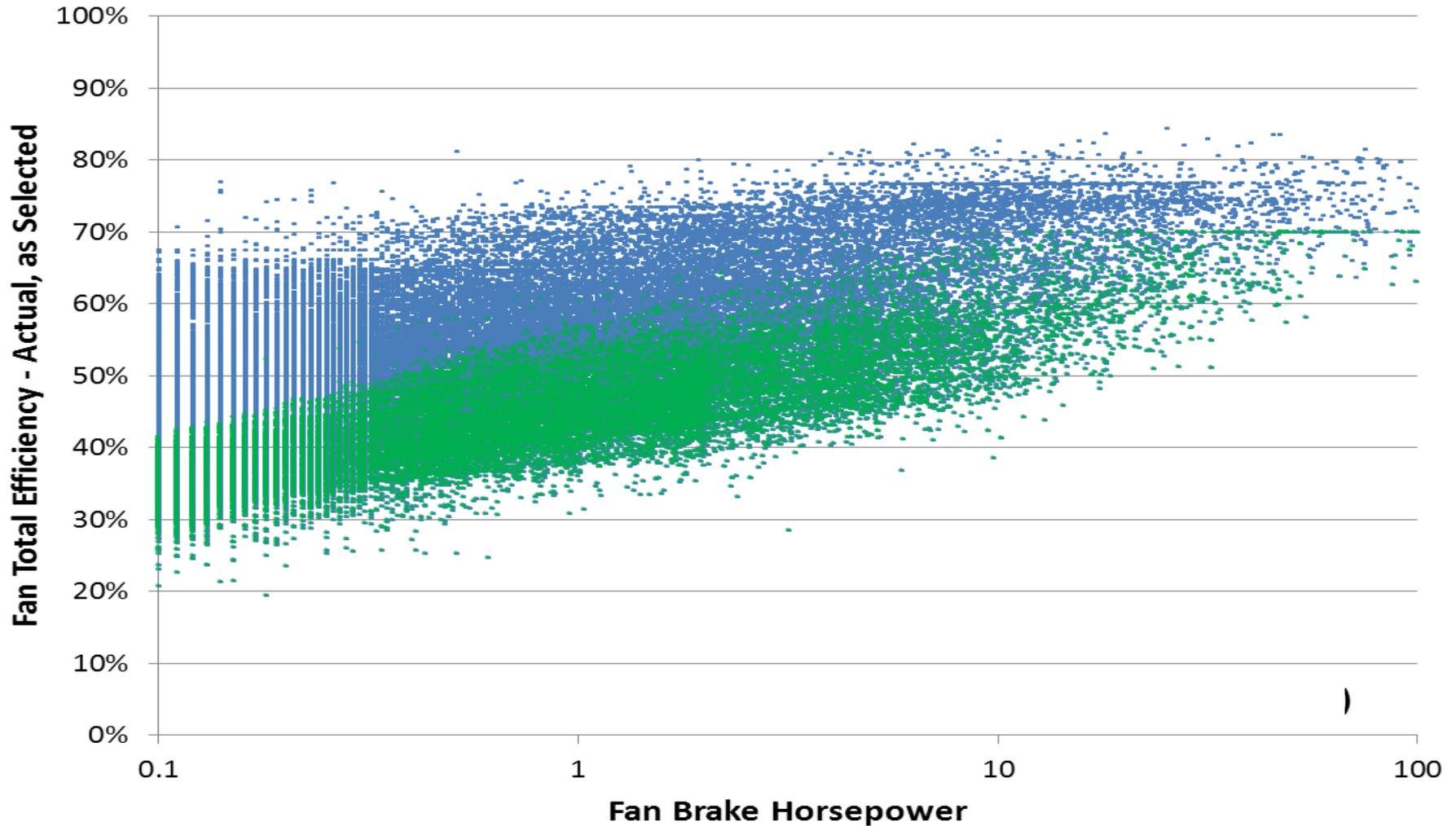
Total Annual Sales

Fans Sold Sales June, 2011 – May, 2012



Impact of Selection-Based Efficiency Limits

Fans Sold June, 2011 – May, 2012



Future

- ASHRAE 90.1
 - FEI ≥ 1.0 at design airflow and pressure
- ASHRAE 189.1
 - FEI ≥ 1.1 at design airflow and pressure
- Utility Rebates
 - FEI ≥ 1.2 triggers \$X per motor hp rebates

Questions / Comments

DOE CIBF Rule

