

**AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS, INC.
1791 Tullie Circle, N.E./Atlanta, GA 30329
404-636-8400**

TC/TG/MTG/TRG MINUTES COVER SHEET

(Minutes of all Meetings are to be distributed to all persons listed below within 60 days following the meeting.)

TC/TG/MTG/TRG No. TC 5.1 DATE 19 Feb 2016

TC/TG/MTG/TRG TITLE Fans

DATE OF MEETING 25 Jan 2016 LOCATION Orlando

MEMBERS PRESENT	YEAR APPTD	MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT
Patrick Chinoda	2014	Craig Wray	2014	Asesh Raychaudhuri (2012)
Franco Cincotti	2014			Mike Brendel (2012)
John Murphy	2012			John Cermak (2014)
Harold Dubensky	2014			Chuck Coward 2014)
Armin Hauer	2015			David Rasmussen (2012)
Tim Kuski	2014			Eric Tngloff (2014)
Greg Wagner	2012			

DISTRIBUTION

All Members of TC/TG/MTG/TRG plus the following:

TAC Section Head:	<u>Ken Peet</u>
TAC Chair:	<u>Thomas Lawrence</u>
All Committee Liaisons As Shown On TC/TG/MTG/TRG Rosters:	Annette Dwyer (HB systems & Equip) James Arnold, PE (CTTC) David John, PE (Research) Arsen K Melikov, PhD (Standards)
Manager Of Standards Manager Of Research & Technical Services	Stephanie Reiniche Mike Vaughn

EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE

Additional Attendance

Joseph Brooks -- Secretary
Brent Fullerton – Webmaster
Brian Reynolds – Research S/C chair
Zhiping Wang – Handbook S/C Chair
Mark Bublitz
David Carroll
Mike Checovich
Mark DeRoo
Jay Eldridge
Michael Feuser
Jay Fizer
Rad Ganesh
Larry Hopkins
Sanaee Iyama
Sam Jasinski
Igor Maerski
Tim Mathson
Greg Meeuwsen
Jane Miller
Arash Moharreri
Tadahino Nakagawa
Chris Papidimos
Robert Pope
James Sweeney
Jeremy Tait
Bob Valbracht
Curt Wenger
Steve Wise
Roman Wowk
Lauren Zelinski

**ASHRAE TC 5.1 Meeting
Monday, 25 Jan 2016**

Orlando Hilton, Orlando, FL

Room: Lake Nona B

Minutes

1. Call to Order – 4:15 pm

The Chair, Patrick Chinoda, called the meeting to order at 4:21 pm.

2. Roll Call

The following TC 5.1 voting members were present:

Patrick Chinoda – Chair
Franco Cincotti – Vice Chair
John Murphy – Standard S/C Chair
Harold Dubensky
Armin Hauer
Tim Kuski
Greg Wagner
Craig Wray

A quorum was present. The following voting members were unable to attend:

Asesh Raychaudhuri – Program S/C Chair
Mike Brendel
John Cermak
Chuck Coward
David Rasmussen
Eric Tingloff

3. Adoption of Agenda

Agenda was adopted by consensus.

4. Approval of the Minutes

Motion TC5.1-01-2016

Moved by: John Murphy
Seconded: Franco Cincotti

“Move to approve the minutes of the last meeting of this TC held on 29 June 2015 in Atlanta, GA.”

Passed unanimously

5. Items of business

5.1 TC 5.0 Section Head/Liaison Reports

Ken Peet was introduced to the TC. He reported that ASHRAE had revamped all TC website templates and noted the CEC initiative to make it easier to have a program approved.

5.2 Chairman's report

The chair, Patrick Chinoda, after welcoming visitors and guests, reported on the discussion made during the Sunday morning Section meeting:

- No nominations were submitted for ASHRAE Research Award this year
- Steve Duda of TC 4.3 & 9.1 won the High Tower award this year.
- Update on the website is complete and it is now very user friendly
- CEC and TAC are looking for member feedback on ASHRAE's Technical Program submission process
- Please update your membership roster BIO by making sure your employment discipline is added
- The professional Development Committee (PDC) is seeking ideas for new ASHRAE Learning Institute courses
- RAC will be prioritizing for bid accepted research topics that support the reduction of energy consumption for HVAC&R, water heating, and lighting in existing homes.

5.3 DOE Fan Regulation Status

The DOE ASRAC WG term sheet was reviewed yesterday at a hot topic meeting. At this meeting the TC discussed when embedded fans would be in the scope of the DOE regulation. The question of how fan arrays would be regulated was asked. It was thought that the ASRAC WG term sheet did not specifically address fan arrays.

5.4 Old business

There was no other old business brought to the floor.

6. Subcommittee reports

6.1 Standards subcommittee – John Murphy

6.1.1 ASHRAE Standard 87.3-2001 (RA 2010)

It was determined that this standard was withdrawn (It will not be included in future agendas).

6.1.2 ASHRAE Standard 149-2013

The committee was directed to make a recommendation to the Standing Reaffirmation Subcommittee (SRS) on whether this standard should be reaffirmed, revised or withdrawn. It was thought that TC 5.6 was the cognizant TC and they should be making recommendation.

Motion TC5.1 02-2016

Moved by: John Murphy
Seconded: Craig Wray

“Move that TC 5.1 recommend to TC 5.6 and SRS that this standard [ASHRAE 149] be withdrawn”

Passed unanimously, 8-0-0 (w/chair voting)

6.1.3 ASHRAE 68/AMCA 330

After discussion, the status of this standard was unclear. Joe B. will look up in minutes and report on the actions taken on this standard in the past. Patrick Chinoda will contact SRS and ask what can be done with this standard.

6.1.4 ASHRAE 51/AMCA 210

Tim Mathson, chair of the joint ASHRAE/AMCA revision committee, reported that the AMCA member vote resulted in two Yes votes with comments and one No vote. The next actions required were discussed.

6.2 Handbook subcommittee – Zhiping Wang

See attachment

6.3 Research subcommittee – Brian Reynolds

See attachment.

6.4. Program subcommittee – Asesh Raychaudhuri

Asesh could not attend (due to storm on East coast). He reported via e-mail. He will submit one seminar for the St. Louis meeting (a seminar by Mike, Tim, and Craig). Seminar submissions are due on 8 Feb 2016 for St. Louis meeting. He asked for additional ideas. None brought forward.

Other avenues to provide knowledge on how to select a fan was discussed. John M. volunteered to put together a fan selection syllabus (including complete selection process) for TC 5.1 review in St. Louis. It was thought an ASHRAE course may be a way to get this done.

7. Website Report – Harold Dubensky

The TC 5.1 website was updated and no comments received on it.

Website is up to date with meeting minutes. It also has an area for presentations. Analytics will be reported upon at next meeting.

8. New Business

Six voting members are due to roll off on July 1, 2016. The chair identified replacements.

9. Time and Place of Next Meeting

10. Adjournment

The meeting adjourned at approx. 6:30 pm.

Attachments:

- 1) Handbook Subcommittee Report
- 2) Research Subcommittee Report
- 3) Tim Mathson's presentation from Sunday on the ASRAC WG, term sheet,
- 4) ASHRAE 68/AMCA 330 Recent History

Minutes recorded by:

Joseph A. Brooks
ASHRAE TC 5.1
Secretary

TC 5.1 Handbook Subcommittee Notes (01/25/2016)

Zhiping Wang

- 2016 version is not finalized yet. We are still waiting for the proof read version to come out. I was told by the staff that it will come out after this meeting. Armin, Mike and myself will review the chapter once available.

List of Topics for Fan Chapter Revision – 2020 Version

- **Fan Efficiency – New section to define and discuss total efficiency vs. static efficiency**
 - Examples of proper fan selection to save energy
 - Fan Selection (Total pressure based vs. Static pressure based)**Actions:** Subcom. decided to wait for next revision cycle or when we have proper information. Wait after DOE publishes the new fan regulation?
- **Fan Drive System – Direct Drive vs. Belt Drive, VFD, VSD, etc.**
Actions: 05/23/14 - Greg, Chuck, and Zhiping will draft up the content. Craig suggested Chpt.18 (9th ed.) of Fan Engineering covers information about motors and drives. AMCA 203 also has good information. AMCA 207 maybe, too. **01/25/15 – For next revision cycle.**
- **Fan Part Load?**
Actions: 05/23/14 – Good topic but Committee decided to put it on the parking lots for now. Maybe for next revision cycle after we collect enough information.
- **Airflow measurement by means of instrumented fan inlet rings (Armin Hauer)**
Actions: 01/25/15 – Armin will re-submit the content after AMCA publishes the Publication 600-06. So this is going to be pushed back for next revision cycle.
- **Fan Stall (Greg Sanchez wrote some content during our last revision cycle and will investigate further)?**
Actions: 05/23/14 - Greg will send out information before the Seattle meeting for the committee members to review.
06/29/14 - Greg Sanchez will have the information ready by mid. July.
01/25/15 – No content yet. Will push back for next revision cycle.
- **Fan Noise (Greg S., predicting fan noise – AMCA 301, or aerodynamic noise?)**
Actions: 05/23/14 - Good topic. Committed decided to put it on the parking lots for now. Maybe for next revision cycle. Reference Bill Cory's book and the Fan Engineering.

- **Fan Law Applications and System Curves** – Craig Wray already sent the revised content last year. Need to review the content.
- **Handbook Online** - Some ideas came out from our last HB meeting.
 - 3D models of different types of fans and interactive performance curves within Table 1;
 - Interactive curves to demonstrate the fan laws;
 - Interactive contents to show the stall/surge;
- **Outside Reviewers** – Let me know if you know somebody who could be a potential reviewer for us.
- **ASHRAE Terminology** – We will dedicate some time to review those terms associated with fans.

TC 5.1 (Fans) Research Committee Meeting January 25, 2016 (Orlando)

Research Chair breakfast notes

RAC reviewed 9 RTAR's in Atlanta

- 5 accepted with comments, 4 rejected

4 work statements were considered

- 1 accepted, 1 conditionally accepted, 1 returned, and 1 incomplete

No research awards were made in Orlando (no nominations were received). TC's are encouraged to nominate.

TC 5.1 Research Subcommittee meeting summary (1-24-16)

- TC 5.1 currently has no active research projects and no work statements at this time.
- There is one RTAR in process and another proposed RTAR that has two co-authors.

1. RTAR 1769 - Experimental Evaluation of (the Part Load) Efficiency of V-Belt Drives used on Fans – (authors Tim Mathson and Craig Wray)

- RAC negative vote in Atlanta
- Craig talked to Mike Vaughn. Agreement to re-submit & address RAC concerns.
- We are already using the new RTAR form so that is OK
- Explain why research is needed and what information does not currently exist.
- Consider including a cover letter since the first submission was rejected. Explain the reasons for re-submitting.
- Needed by AMCA 207 (especially part load).
- Tim Mathson attended the January 22 meeting of the AHRI Central Station Air Handler Engineering Committee. AHRI has a long range plan to move AHU performance ratings from shaft power (BHP) to electrical power input (kW). This RTAR is of interest.
- Have AHRI review the RTAR and they will consider co-sponsorship.

2. Proposed RTAR - "Inlet and Outlet Air and Sound system effects on multiple plenum fans (parallel arrangement)"

- Authors – Dustin Meredith & Patrick Chinoda
- Scope was reduced & modified from an earlier RTAR that Patrick authored.
- Steve Idem (TTU) can provide review comments
- Extension of RP 1420 (single DDP system effects)

RAC dates

- RAC meets 3 times per year to review RTAR's (May 15, August 15, and December 15)
- There is also a spring conference call meeting around March 15. RTAR's are typically not reviewed at the spring meeting but a special request can be made for a review. Mike Vaughn said we could do that for RTAR 1769 if the re-write is ready.
- RTAR 1769 re-write would be needed by mid-February to allow time for liaison review, TC letter ballot. Then RAC would like to have it two weeks before they

Attachment 2, Research Subcommittee Report

meet. Can we do that or just try for the regularly scheduled May 15 RAC review?

Tim and Craig will attempt to re-write the RTAR in time for the spring RAC meeting.

- Very important to have no negative votes or letter ballot abstentions.
- Our liaison (David John) is our voice at the RAC meeting so it is important for him to understand what the RTAR is about.
- For the new RTAR, Dustin and Patrick will work toward May 15 RAC review.

Other research topics list

- The list was distributed prior to the Orlando meeting
- The list was reviewed at the 1-24 Research sub-committees meeting.
- There are not any actionable items from the list at this time (no champions or authors).
- One possible topic was added to the list - EC motor fans. Fan/motor/drive systems. How does air & sound compare with traditional fan with induction motor & inverter? Good MTG issue. (Rad)
- Also some good discussion about improving the design of flow settling means utilized in multi-nozzle chamber performance testing defined in AMCA standard 210/ASHRAE standard 51.

Is there no other fans research needed by ASHRAE? Send suggestions to Brian Reynolds (breynolds@trane.com)

Sunday presentation
on the ASRAC WG, Term Sheet

Fan Efficiency Regulation Update for ASHRAE TC 5.1

Tim Mathson

Greenheck Fan

January 24, 2016

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

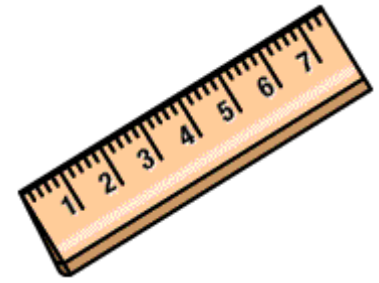
“Scope”

- 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”

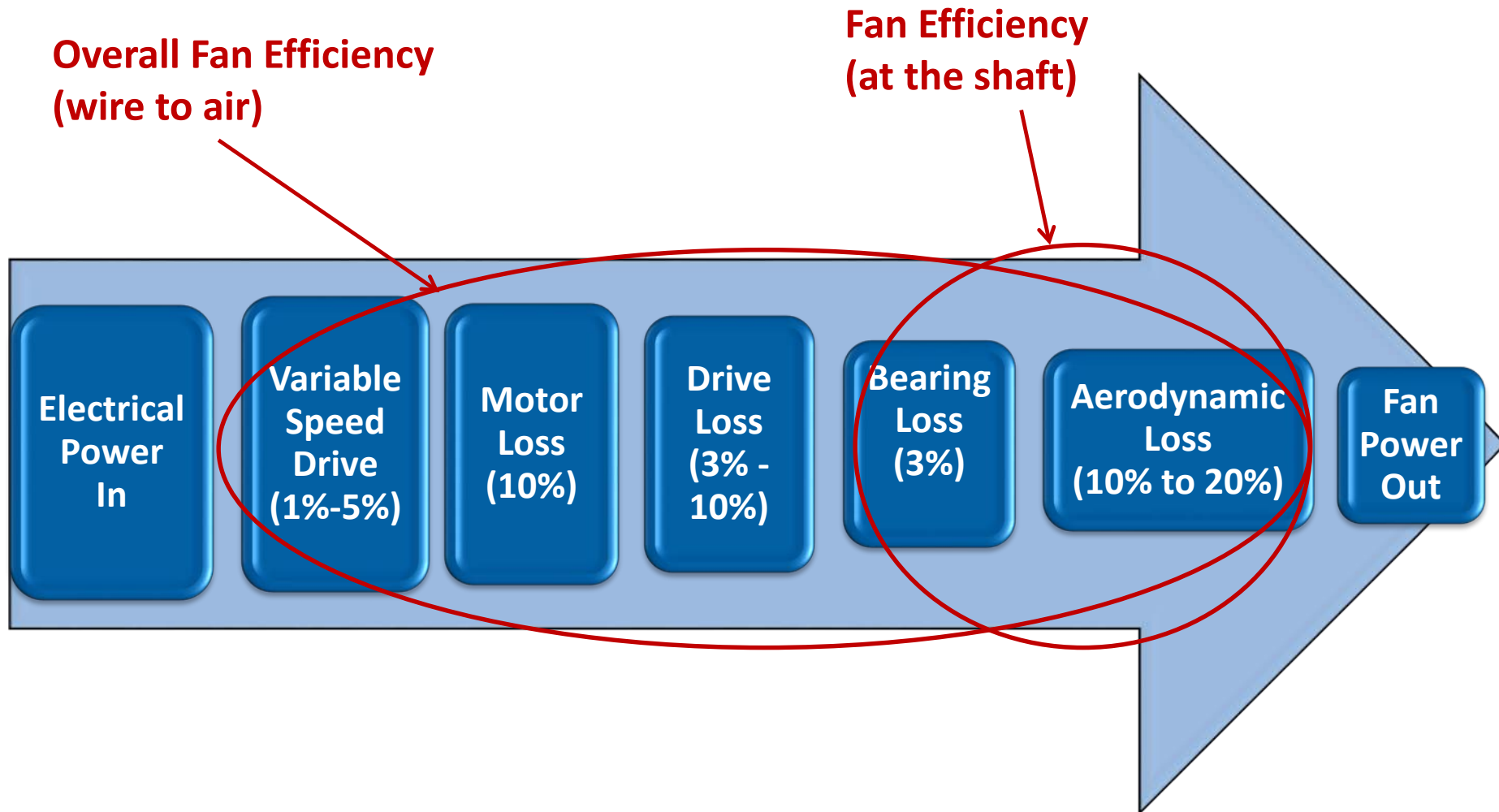


- Fan Electrical (input) Power (FEP)
 - Wire-to-Air (including motor & VSD when supplied by manufacturer)
 - Specific to Operating Point
 - Airflow and Pressure define Maximum Allowable Power – $FEP_{(std)}$
 - Results in a Range of Airflow and Pressure that can be offered for sale
- Fan Efficiency Index (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

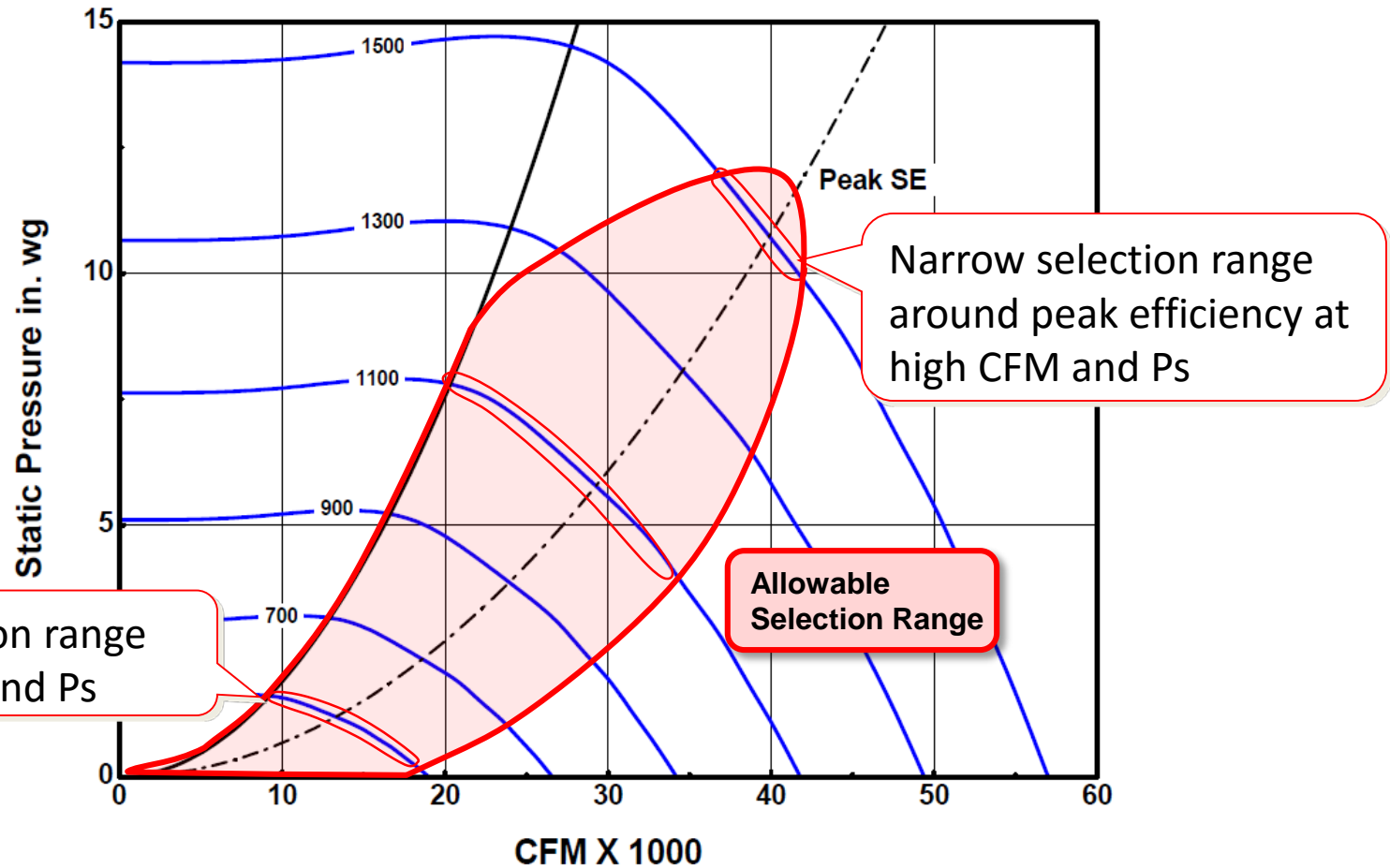


“Elements” of Fan Efficiency



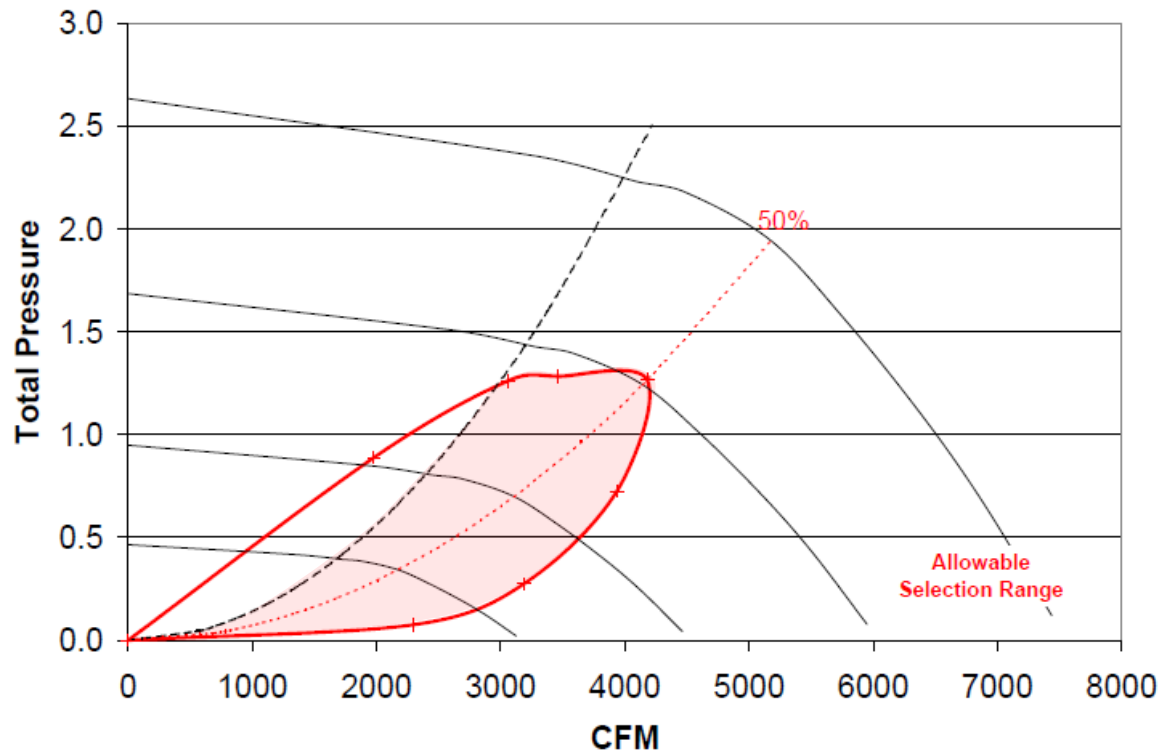
Compliant Fan Selections

FEI “Bubble”



Allowable Fan Selections

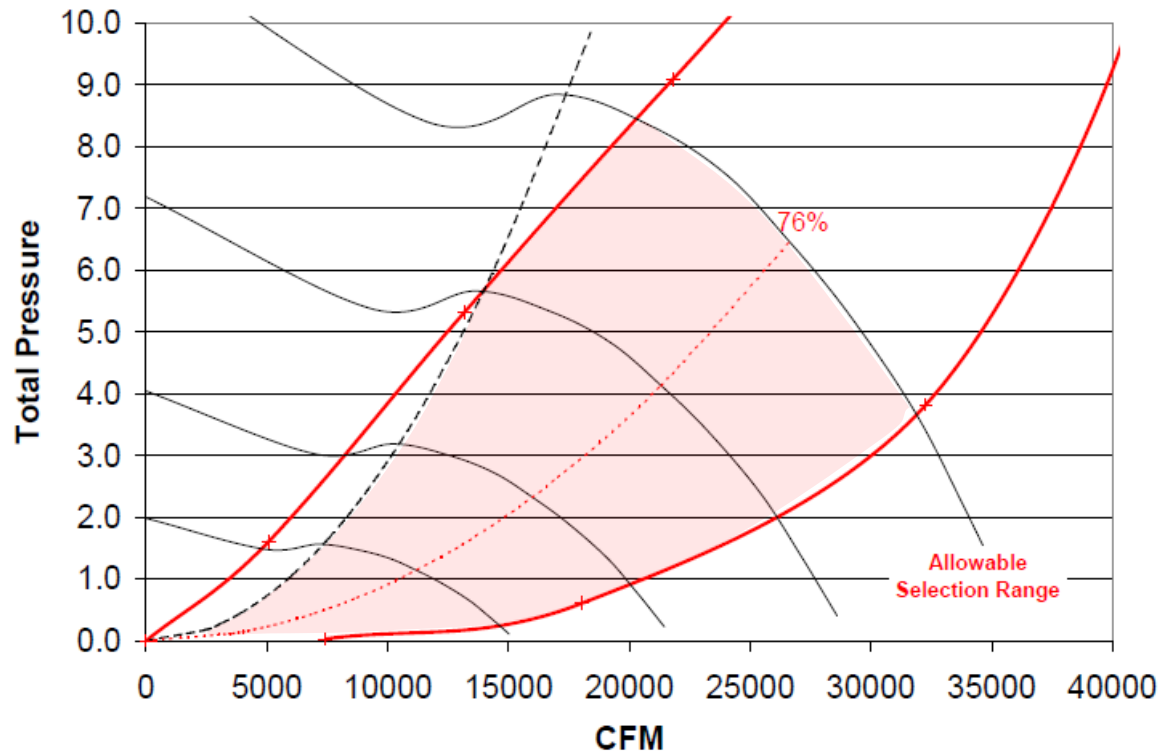
Example: Inefficient Fan



**Square
Inline Fan**

Allowable Fan Selections

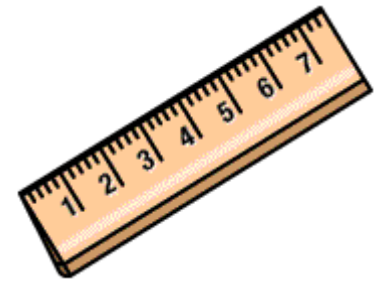
Example: Efficient Fan



**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

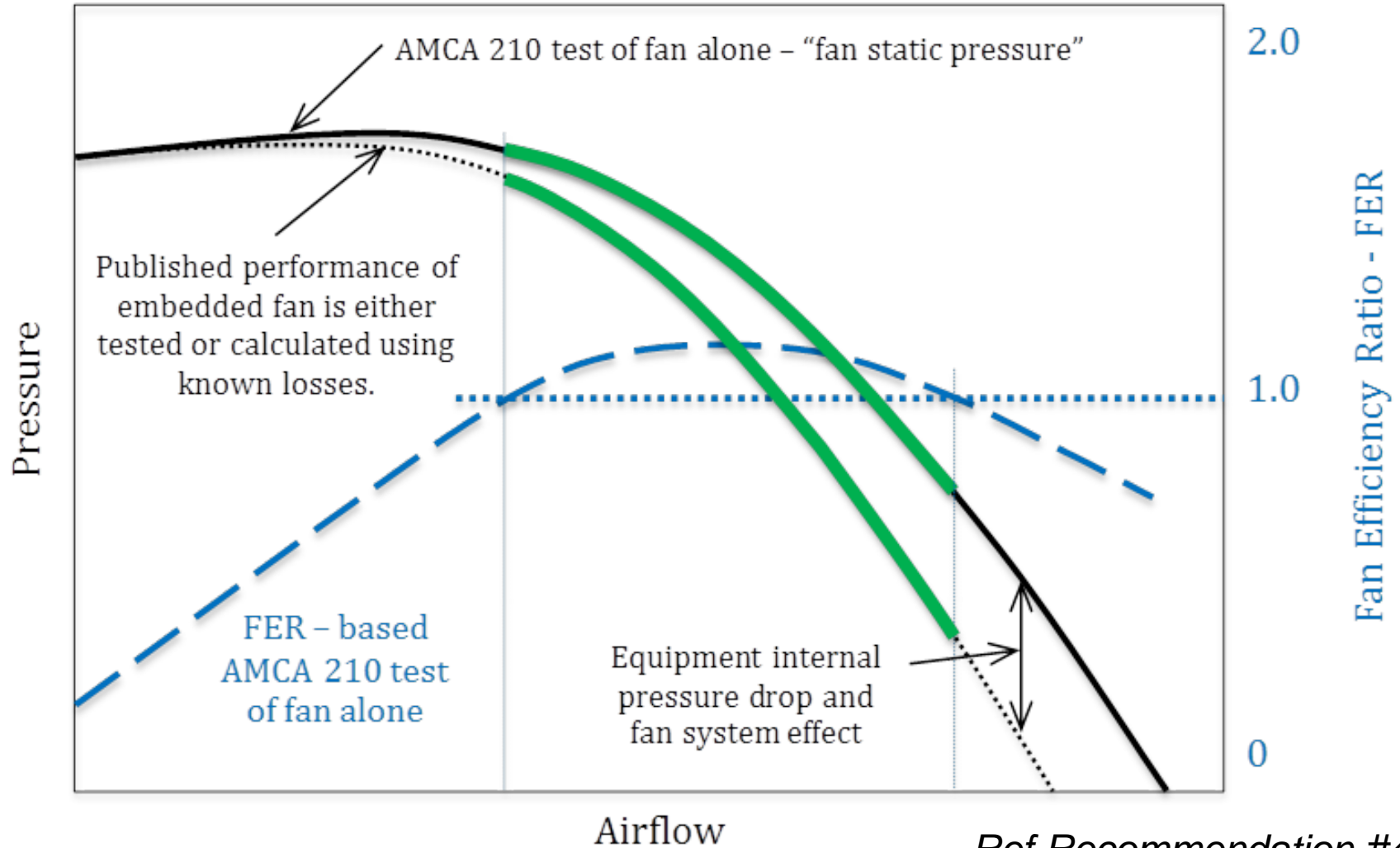
“Test”



- 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*”

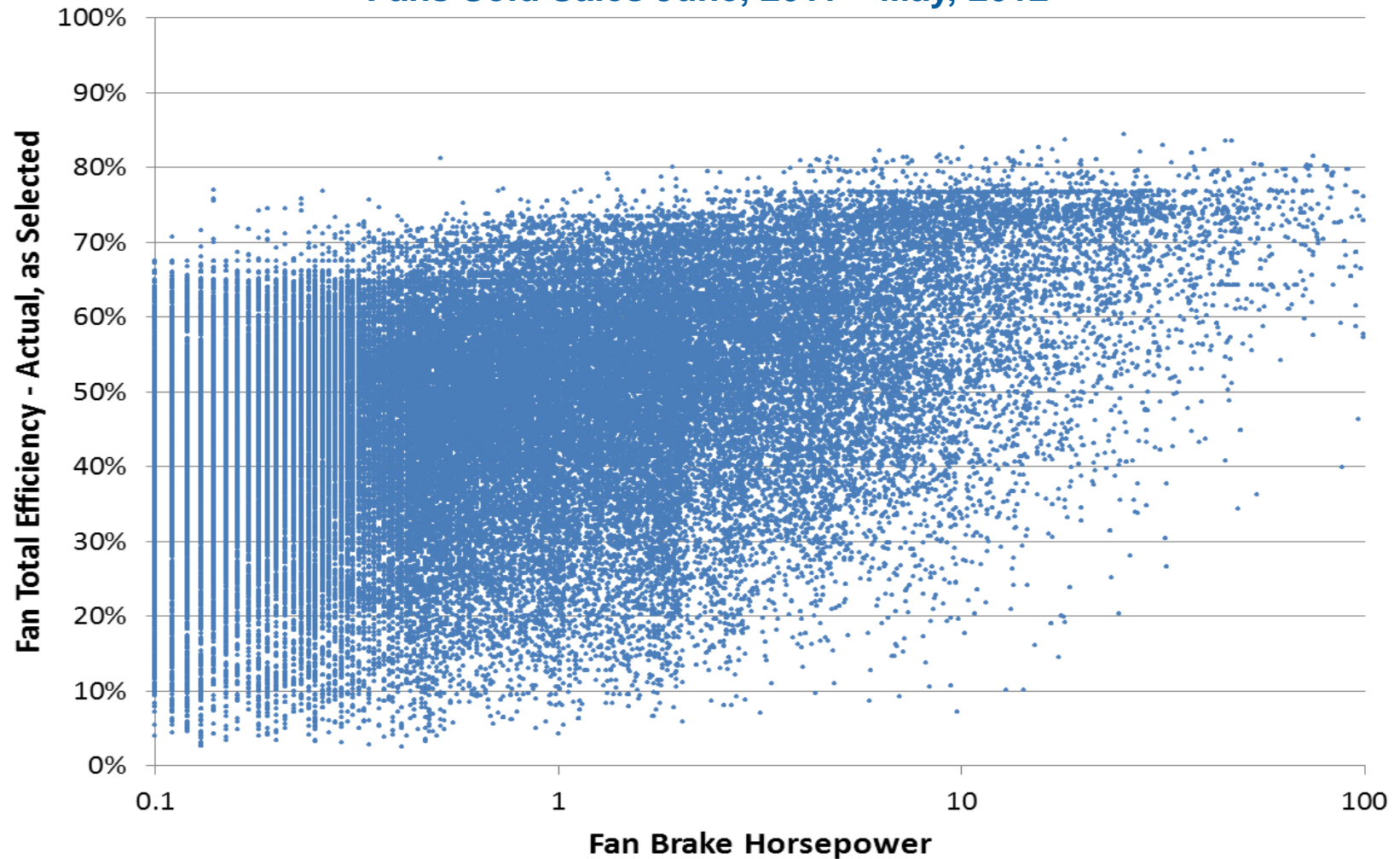
- Certification:
 - Submit Selection Software (like AMCA eCAT)
 - Submit Operating Range (equation or tabular)
 - Submit Literature
 - Info will be in “Public Domain”
 - Working to utilize AMCA CRP
- Labeling (design point dependent)
 - Model
 - Serial #, Date
 - Design Airflow, Pressure, FEI
 - Max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



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

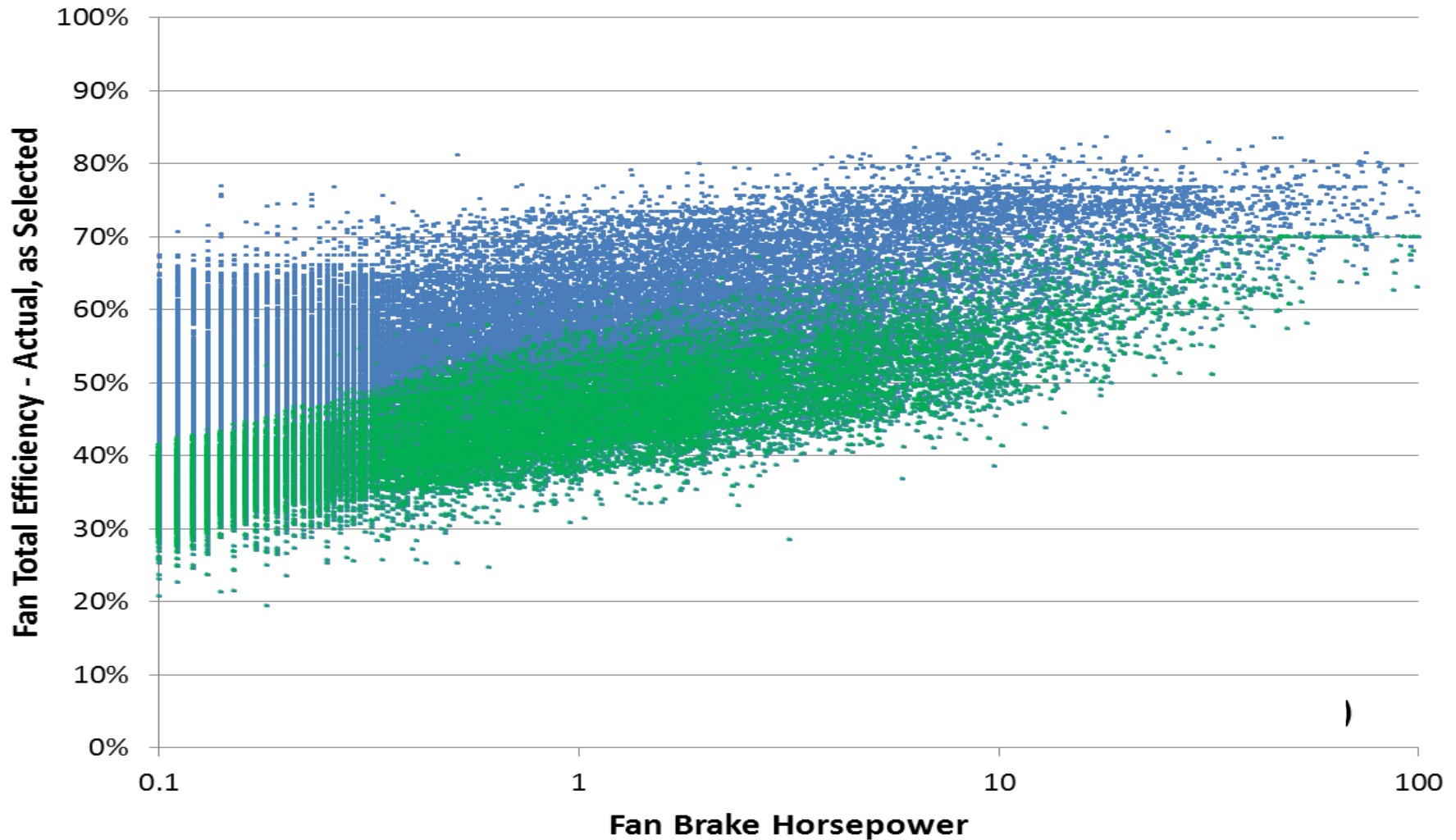
Total Annual Sales

Fans Sold Sales June, 2011 – May, 2012



Impact of Selection-Based Efficiency Limits

Fans Sold June, 2011 – May, 2012



Future

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

Questions / Comments

DOE CIFB Rule



ASHRAE 68/AMCA 330, Laboratory Method of Testing To Determine the Sound Power In A Duct

The following are excerpts or summaries derived from minutes of ASHRAE TC 5.1 meetings. Meetings are designated by an "S" for the summer annual meeting and with a "W" for the winter meeting and the last two digits of the year held.

S-04

"The standard reaffirmation must be coordinated with TC 2.6. John Murphy will contact representatives of TC 2.6 and determine the status of the reaffirmation.

"Since it is now possible once again to obtain a sampling tube from B&K, there is no longer a need to revise the standard to provide the user with detailed information regarding how to build a sampling tube. As a result, the ASHRAE standard for In-duct testing is considered equivalent to the ISO Standard. The committee recommended that in the future, ASHRAE adopt the ISO In-duct standard instead of maintaining a separate standard."

W-05

"The Standards Subcommittee Chairman of TC 2.6 will make a motion at their committee meeting to eliminate ASHRAE Standard 68. The reason for the motion is that there is limited use of the standard in the US.

"John Murphy expressed interest in recommending to the ASHRAE Standards Committee to retain the standard. Keeping the standard provides the US the ability to control the requirements of testing noise via the in-duct method and not be subject to the requirements of the international ISO standard 5136.

"John Cermak agreed with the motion proposed by TC 2.6 and mentioned that there are means available to have an impact on the requirements of the ISO standard. Further, he made a motion to have TC 5.1 recommend to the ASHRAE Standards Committee to eliminate the standard. Joe Brooks seconded the motion. The motion was passed by a vote of 6 to 5."
Nothing reported in minutes

S-05

"John Hogan, ASHRAE Standards Committee Chairman, joined TC 5.1 during the discussion of SPC 68-86R.

"The TC 2.6 committee voted to give up ownership of the standard at the Orlando meeting, it did not vote to withdraw the standard. ASHRAE headquarters has not reassigned the standard to any other technical committee (TC).

"Gary Kile made a motion that TC 5.1 become the cognizant committee for SPC 68-86R. Asesh Raychaudhuri seconded the motion. The motion passed by a vote of 9 to 1.

"John Cermak made a motion to withdraw the standard SPC 68-86R. Walt Ziemann seconded the motion. The motion passed 9 to 1.

W-06

"It was noted that at the Denver meeting a motion was made that TC 5.1 become the cognizant committee for SPC 68-86R. In addition, another motion was made to withdraw the standard. Both motions were passed by

Attachment 4, ASHRAE 68/AMCA 330 History

the committee.

“At this time it is not known if ASHRAE has approved the withdrawal of the standard.”

S-06

It was reported that ASHRAE requested AMCA to take the lead of the 68/330 standard. AMCA agreed and indicated that it will adopt ISO 5136

W-07

Nothing reported

S-07

Nothing reported in minutes

W-08

Cannot locate minutes, if anyone has a copy, please forward copy to me.

S-08

Nothing reported in minutes

W-09

“John Cermak moved and Franco Cincotti seconded to adopt ISO 5136 as this standard. Approved 8, 0, 0 (Chairman not voting).”

S-09

[Minutes duplicated from W-09]

W-10

Reported that AMCA intends to initiate adoption procedures to identically adopt ISO 5136 for ASHRAE 68/AMCA 330.

S-10

TC5.1 approved Tim Mathson as chair of joint ASHRAE/AMCA Committee to oversee the identical adoption of ISO 5136 in place of ASHRAE 68/AMCA 330.

W-11

It was reported that the identical adoption of ISO 5136 was underway and may be completed by the June meeting.

S-11

Reported that the 68/330 committee is being formed

W12

Reported that the ASHRAE 68/AMCA 330 committee was approved by ASHRAE and the identical adoption of ISO 5136 would be underway shortly.

S12

Tim Mathson, chair of 68/330 committee reported the committee is considering withdrawal or identical adoption

W13

Reported that AMCA will ballot its members to add ISO 5136 to AMCA 111 (AMCA's Lab Accreditation Program), then 68/330 would be withdrawn.

S-13

The chair of the joint standard review committee reported that AMCA International is adding ISO 5136 to its list of acceptable standards for certification. When complete action will be taken from AMCA International to withdraw this standard.

W-14

It was reported that 68/330 was still in committee and the committee may recommend withdrawal

S-14

It was reported that AMCA has withdrawn AMCA 68/330.

W-15

It was reported that AMCA has withdrawn AMCA 68/330 and that AMCA may pursue identical adoption of ISO 5136

S-15

No report given in minutes.