M I N U T E S

DRAFT

TECHNICAL COMMITTEE 5.1

2024 Winter Meeting

January 22nd, 2024

Note: These draft minutes have not been approved and not the official, approved record until approved by the Technical Committee.

Fans

ASHRAE Technical Committee 5.1

DRAFT

TC/TG/MTG/TRG MINUTES COVER SHEET

TC/TG/MTG/TRG No. TC 5.1 January 22, 2024

TC/TG/MTG/TRG TITLE Fans

DATE OF MEETING January 22nd, 2024 LOCATION Chicago, IL

Attendees				
Name	**Affiliation**	**Status**	**YEA**	**Int'l**
Brooks, Joe	AMCA International	CM	No	No
Chinoda, Z. Patrick	Revcor	CM	No	No
Dommu, Jeremy	US DOE	Guest	No	No
Dubensky, Harold	JCI	Voting, Chair	No	No
Johar, Chaitanga	AAON	Voting	Yes	No
Kuntz, Ken	Greenheck	CM	No	No
Gebke, Kevin	DuctSox Zoo Fans	Sec., Voting	No	No
Ganesh, Rad	Twin City Fan	Voting	No	No
Albers, Tim	Nidec	Guest	No	No
Kohil-Bhargava, Shruti	AMCA	Guest	No	No
Vake, Brett	Twin City Fan	Guest	No	No
Lauda, Dale	AMCA	Guest	No	No
Johnson, Zac	AMCA International	Guest	Yes	No
Settergren, Matt	Twin City Fan	Guest	No	No
Yong Kong, Ng	NYKK Engineering	Guest	No	No
Saenz-Acosta, Karina	AAON	Guest	No	No
Meredith, Dustin	Trane	CM	No	No
Miller, Jane	Clarage	CM	Yes	No
Moshina, Nazme	2050 Partners	Guest	No	No
Nowak, David	AMCA International	PCM	Yes	No
Osborn, Kim	Nortek Air Solutions	Voting	No	No
Sanchez, Geep	TYLin	CM	No	No
Ramos, Juke	DuctSox Corp Zoo Fans	PCM	Yes	No
Riggotz, Hannah	Guidehouse	Guest	No	No
Langford, Joe	American Coolair	Guest	No	No

Attendees - Continued				
Name	**Affiliation**	**Status**	**YEA**	**Int'l**
Stauter, Rich	Carrier	Voting, Prog. Chair	No	No
Reynolds, Brian	Trane	Voting	No	No
Mahesh, Uma	Maico Gulf	Guest	No	No
Stoker, Katlyn	BAF	PCM	Yes	No
Eldridge, Jay	Daikin Applied	Voting	No	No
Arnold, Richard Ben	Halton	PCM	No	No
Taber, Christian	BAF	Guest	No	No
Feuser, Michael	Woods	CM	Yes	No
McLernon, David	Daiken Applied	Guest	No	No
Cope, Eliza	Guidehouse	Guest	No	No
Bissler, Robert	Morrison Products	PCM	Yes	No
Fetting, Nathan	Greenheck	CM	No	No
VanderKooy, Mark	Greenheck	Voting	Yes	No
Desai, Ashish	Metal Industries	CM	No	No
Sharma, Abhishek	Regal Rexnord	PCM	Yes	No
Wagner, Greg	Morrison Products	Voting	No	No
Kauffmann, Matt	Daikin Applied	CM	No	No
Wang, Zhiping	Morrison Products	CM		
Wang, Gang	University of Miami	Voting	No	No
Simonson, Brian	Daikin Applied	Guest	No	No
Aramthanapon, Kristen	NEEA	Guest	No	No
Yeh, Jamie	AHRI	Voting	Yes	No

CM: Corresponding Member; PCM: Provisional Corresponding Member; MNQ: Member Non-Quorum.

DISTRIBUTION: ***All Members of TC plus the following:***	
TAC Section Head:	SH5@ashrae.net
All Committee Liaisons, such as Research, Standards, Handbook, Staff, etc.	See ASHRAE email alias list for needed addresses.
Mike Vaughn, Manager Of Research & Technical Services	MORTS@ashrae.net

Note: These draft minutes have not been approved and are not the official, approved record until approved by the TC.

ASHRAE TC 5.1 Fans

Minutes of the In Person Meeting in Chicago, IL

Monday January 22nd, 2024

1. Call to Order at 4:45 pm ET

Meeting was called to order at 4:45 pm ET.

2. Roll Call

TC 5.1 voting members:
Harold Dubensky – Chair
Mark VanderKooy – Vice Chair
Kevin Gebke - Secretary
Dr. Rich Stauter – Program S/C Chair
Jamie Yeh – Research S/C Chair
Dr. Rad Ganesh
Chaitanya Johar
Nazme Mohsina
Kim Osborn
Brian Reynolds
Dr. Gang Wang
Jay Eldridge
Greg Wagner

Non-Voting S/C Chairs and Officers:
Joseph Brooks – Standards S/C Chair
Z. Patrick Chinoda – Handbook S/C Chair
Brandon Diaz - Webmaster

Voting members NOT present:
None Eic Tinglof

13 out of 13 total voting members were present. Six members are required for a quorum as two voting members are MNQ. A quorum was established. All attendees were asked to report their attendance using the in-person sign-in sheet.

3. Adoption of Agenda

The draft agenda was posted to the TC 5.1 Basecamp prior to the meeting.

The agenda was adopted by consensus.

4. Approval of the Previous Meeting Minutes

The last meeting of this committee was held on June 25th, 2023 in Tampa as an in-person meeting. Draft meeting minutes were posted on TC 5.1 basecamp.

Motion 1: To approve the minutes from the June 25th, 2024 meeting.

Moved: Mark VanderKooy
Second: Greg Wagner

Motion passed.

5. ASHRAE Code of Ethics

In this and all other ASHRAE meetings, the ASHRAE Code of Conduct requires us to act with honesty, fairness, courtesy, competence, integrity, and respect for others, and that "we shall avoid all real or perceived conflicts of interest whenever possible". (See full Code of Ethics: https://www.ashrae.org/about/governance/code-of-ethics.)

6. Chair's Report – Harold Dubensky

6.1.1.Announcements and Highlights from Section 5 Breakfast Meeting

7. TC Membership/Roster Report Harold Dubensky

7.1. Membership: 120 - Total Members Erc Tinglof
7.1.1.14 - Voting Members – All but ~~Eric Langton~~ present
7.1.2.3 - Non-voting Subcommittee Chairs
7.1.3.68 - Corresponding Members iv. 30 - Provisional Corresponding Member
v. 5 - Liaisons
7.2. July 1, 2024: updates to voting members and/or subcommittee chairs.
7.3. ASHRAE requirement for TC Balance - See update FG MOP on basecamp.
7.4. If Interest in becoming a voting member. Submit your request to the TC Chair
7.5. Provisional Corresponding Members are dropped after 2 years.
7.5.1.The TC chair will change you to a Corresponding Members

8. Liaison/Section Head Reports

8.1. Any TC liaisons or section heads present are given an opportunity to report on their activities.

9. Fan Regulatory Activities

9.1. Presentation by Michael Ivanovich

9.1.1. Please see attached slides

9.1.2. Please see additional info through this link:

- https://content.govdelivery.com/accounts/USEERE/bulletins/386510e

10. Subcommittee Reports

10.1. **Website Report Brandon Diaz**

10.1.1. Please see attached slides

10.2. **Standards Subcommittee Joe Brooks**

10.2.1. The only standard from TC 5.1 is ASHRAE 51 which is a joint standard with AMCA 210. The AMCA 210/ASHRAE 51 Review Committee is meeting on Jan. 22,2024. Shruit Kohli-Bhargava is the AMCA staff liaison. AMCA has the lead on the project.

10.2.2. Other standards of Interest:

- See the Excel spreadsheet in the TC 5.1 Basecamp for current standards of interest and those under review or new standards of interest.

10.3. **Handbook Subcommittee Patrick Chinoda**

10.3.1. The chapter rewrite/updates were successfully submitted and are being worked. No outstanding items at this point. We are waiting for the draft so we can start proof reading.

10.3.2. The following people are part of the proof reading/review WG: Patrick Chinoda, Zhiping Wang, Abhishek Sharma, and Nathan Fetting

10.3.3. Forward looking for the next review cycle:

- Jayme Yeh volunteered to be our liaison for the TC 1.6 to help harmonize Fan Terms with our TC
- Add belt drive research project results into the Handbook as reference
- Greg Sanchez said he has something he would like to be considered for the next cycle as well.

10.3.4. There were no FAQ submitted into the TC website

10.4. **Program Subcommittee Rich Stauter**

10.4.1. At the Summer 2023 meeting in Tampa, the Fluids Committee sponsored a seminar presentation where the results of the Fluids Committee Research Project RP-1769 "V-Belt Drive Efficiency". This was co-sponsored by the Motors Committee, TC1.11. The results of the research project were presented in two parts by the researchers on the project: David Nowak and Tim Matthson (ret) of AMCA. Complementing the V-Belt drive presentations, the seminar featured a third presentation by Gang Wang of Miami University who presented a primer on Variable Frequency Motor Drives.

10.4.2. A panel discussion was proposed for the 2024 Winter Meeting in Chicago on the impacts of the proposed California and US DOE fan efficiency regulations. However, this proposal was not accepted for the Winter Meeting; nevertheless, the proposal is being reworked and submitted to the 2024 Summer Meeting in Indianapolis. Michael Ivanovich, Director of Global Affairs for AMCA will be the moderator, with panelists Mark VanderKooy of Greenheck, Christian Taber of Big Ass Fans, Laura Petrillo-Groh of AHRI, and John Bade of Partners 2050 (California). This is really a star-studded cast - my thanks goes to Michael Ivanovich for his assistance in arranging this.

10.4.3. We invite any interested Fans Committee members to be on the program subcommittee and help arrange interesting and relevant topics for presentation. Suggested topics for future ASHRAE conferences include a seminar on the use of CFD for fan design and fan application. This might include presentations on the state of the art, novel applications, or possibly even the use of artificial intelligence with CFD. We are always open to suggestions. It should be noted that it is easy to think of interesting and relevant topics to suggest - it is quite another matter to identify a person willing to prepare and do a presentation.

10.4.4.

10.5. **Research Subcommittee Jaime Yeh**

10.5.1. Updates from Research subcommittee chair breakfast:

- Budget and schedules are back to normal.
- No more backlog of approved WS waiting to go for bid.
- Need to ensure RTARs and WSs are aligned with ASHRAE's Strategic Plan.

- Research Manual will be updated to provide more budget cost estimating guidelines. Still encouraging co-funding and want TC to be involved in looking for cosponsors.

10.5.2. Current & Future Work:

- RP-1769 (Belt Drive Efficiency) – Report is complete and published. Technical Paper pending review. Working through final steps to close out project.
- TC 5.1 is Cosponsor of active project RP-1835: Characterizing the Performance of Induced Flow Stacks, the main sponsoring committee is 9.10 Laboratory Systems. Tim is on the PMS and gave an update at the subcommittee meeting.
  - Goal of project is to verify plume rise calculations and investigate effect of the fan.
  - Site chosen; concrete poured but no electrical yet. Test fans delivery expected December or January.
  - Plan to begin measurements in spring, continuing through summer months.
  - TC members have concerns about use of drone for measurements. Will be compared with a fixed probe to test for interference of the propellers.

- We have a few volunteers to work on a proposal related to the use of CFD in fan design and performance prediction, and potentially a tie into system interactions. Will start developing that proposal between now and the annual conference.
- Plan to maintain a list of potential research topics on Basecamp. All TC members are encouraged to share any ideas for future projects.

10.6. **Long Range Planning Subcommittee Harold Dubensky**

10.6.1. Harold is reviewing the long range document found on Basecamp

11. New Business / Old Business Harold Dubensky

12. Next meeting date and location - Indianapolis Annual 2024 Conference Harold Dubensky

13. Adjournment Harold Dubensky 5:49pm

Commercial Fans DOE Proposed Minimum Efficiency Standards

Laura Petrillo-Groh, AHRI
Michael Ivanovich, AMCA International

> Modified from SSPC 90.1 Mechanical Subcommittee presentation for TC 5.1
> Embedded Fans content reserved for future distribution and discussion

January 19, 2024

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DOE Commercial Fan Regulatory Activity

Test Procedure (10 CFR 431.174)

- Final rule published May 1, 2023 (Technical correction published August 8, 2023)
- General fans and blowers (GFBs) or fans and blowers other than air-circulating fans
  - Measure the fan electrical input power and
  - Determine the fan energy index (FEI)
  - Test method is generally ANSI/AMCA Standard 214-21
    - DOE omits some sections and has several unique requirements
    - These differences likely not important to practitioners
    - … but are important to manufacturers

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DOE Commercial Fan Regulatory Activity

Test Procedure (10 CFR 431.174)

- Air- circulating fans (ACFs)
  - Measure the fan airflow in cubic feet per minute per watt of electric power input
- Representations of energy use or energy efficiency must be based on testing in accordance with the test procedure final rule on October 30, 2023
  - Except for the 34 manufacturers granted extension until April 29, 2024

DOE Commercial Fan Regulatory Activity

Energy Conservation Standards (aka Efficiency Minimums)

- Proposal published in the *Federal Register* on January 19, 2024
  - DOE Fans Rulemaking Information: http://tinyurl.com/yckavb97
  - Comments due to DOE by March 19
    - Docket: EERE-2022-BT-STD-0002
    - Docket contains Technical Support Document and analytical spreadsheets
- DOE public meeting:
  - February 21, 10:00 a.m. to 4:00 p.m., in Washington, DC and via webinar
  - Click here to register for the webinar.
- Standards Rulemaking Timeline
  - Final Rule estimated in 2024
  - Compliance estimated in 2029 (5 years after final rule)
- Certification (CCMS filing) and (potential) labeling requirements reserved for future rulemaking completed before 2029

DOE Scope: Fan Sizes and Types

General fans and blowers (GFBs)

- Fan Size:
  - Fan shaft input power ≥ 1 HP
  - Fan air power ≤150 HP
- Metric: Fan Energy Index (FEI)
- Fan types included:
  - Radial housed fan
  - Centrifugal housed fan
  - Centrifugal inline fan
  - Centrifugal unhoused fan
  - Centrifugal power roof ventilator exhaust fan
  - Centrifugal power roof ventilator supply fan
  - Axial inline fan
  - Axial panel fan
  - Axial power roof ventilator fan

Circulating Fans that are Not Ceiling Fans

- Size: ≥ 125 W input power
- Metric: Efficacy – cfm/W

Housed Axial

Unhoused Axial

Housed centrifugal ACF are exempt from energy standard (carpet drying, for example)

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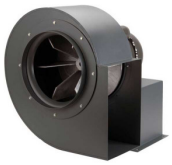
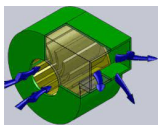
Centrifugal Fan Types

- Radial housed fan



- Centrifugal housed fan

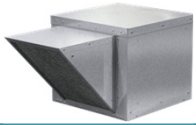


- Centrifugal inline fan

- Centrifugal unhoused fan

- Centrifugal power roof ventilator exhaust fan

- Centrifugal power roof ventilator supply fan



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Axial Fan Types

- Axial inline fan

- Axial panel fan

- Axial power roof ventilator fan

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Scope Exclusions

- GFBs are not:
  - (i) A radial housed unshrouded fan with blade diameter at tip less than 30 inches or a blade width of less than 3 inches;
  - (ii) A safety fan;
  - (iii) An induced flow fan;
  - (iv) A jet fan;
  - (v) A cross-flow fan;
  - (vi) A fan manufactured exclusively to be powered by internal combustion engines;
  - (vii) A fan that create a vacuum of 30 inches water gauge or greater;
  - (viii) A fan that is designed and marketed to operate at or above 482 degrees Fahrenheit (250 degrees Celsius); or

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Scope Exclusions - continued

- GFBs are not:
  (ix) A fan and blower embedded in the equipment listed below;
  - GFBs are not an embedded fan subject to the following exclusions:
    (i) The federal test procedure does not apply to fans embedded in:
    - (A) Single phase central air conditioners and heat pumps rated with a certified cooling capacity less than 65,000 Btu/h
    - (B) Three phase, air-cooled, small commercial packaged air-conditioning and heating equipment rated with a certified cooling capacity less than 65,000 Btu/h
    - (C) Transport refrigeration (*i.e.,* Trailer refrigeration, Self-powered truck refrigeration, Vehicle-powered truck refrigeration, Marine/Rail container refrigerant);
    - (D) Vacuum cleaners;
    - (E) Heat Rejection Equipment: Packaged evaporative open-circuit cooling towers; Evaporative field-erected open-circuit cooling towers; Packaged evaporative closed-circuit cooling towers; Evaporative field-erected closed-circuit cooling towers; Packaged evaporative condensers; Field-erected evaporative condensers; Packaged air-cooled (dry) coolers; Field-erected air-cooled (dry) cooler; Air-cooled steam condensers; Hybrid (water saving) versions of all of the previously listed equipment that contain both evaporative and air-cooled heat exchange sections;
    - (F) Air curtains; and
    - (G) Direct expansion-dedicated outdoor air system that are subject to any of DOE's test procedures

Scope Exclusions - continued

(ii) The federal test procedure does not apply to *supply or condenser fans* embedded in:

- (A) Air-cooled commercial package air conditioners and heat pumps (CUAC/CUHP) with a certified cooling capacity between 5.5 ton (65,000 Btu/h) and 63.5 ton (760,000 Btu/h)
- (B) Water-cooled and evaporatively-cooled commercial air conditioners that are subject to DOE's energy conservation standard
- (C) Water-source heat pumps that are subject to DOE's energy conservation standard
- (D) Single package vertical air conditioners and heat pumps
- (E) Packaged terminal air conditioners and heat pumps (PTAC/PTHP)
- (F) Computer room air conditioners that are subject to DOE's energy conservation standards; and
- (G) Variable refrigerant flow multi-split air conditioners and heat pumps (VRF)

Metrics/Efficiency Representations – GFBs

$FEI = FEP_b / FEP_i$

- **Fan Energy Index (FEI): the ratio of the electric input power of a reference fan to the electric input power of the actual fan**
  - Electrical input of the actual fan is calculated
    - per AMCA 208-18 in ASHRAE 90.1
    - per AMCA 214-21 in DOE TP
- **Fan Electrical Power (FEP)**
  - **FEP_b** is the baseline fan electrical input power, and
  - **FEP_i** is the fan's actual electrical input power
- **Efficiency Representations i**nclude:
  - Brake horsepower
  - Total efficiency
  - Static efficiency
  - Air flow
  - … essentially, any parameter that is measured or calculated for fan performance associated with the method of test
- At FEI = 1.00, the fan's electrical input power is equal to and meets the required baseline input power.
- If the FEI value of a fan in an application is 1.10, the fan is 10% more efficient than the baseline fan.

Referenced AMCA Standards

- ANSI/AMCA 208-18, *Calculating the Fan Energy Index (FEI)*
  - Developed following completion of DOE/Stakeholder public negotiations in 2015, resulting in a Term Sheet prior to postponement of the regulation between 2017-2020
- ANSI/AMCA 214-21, *Test Procedure for Calculating Fan Energy Index (FEI) for Commercial and Industrial Fans and Blowers*
  - Developed to make it easier for regulators to use FEI
  - References methods of test for fans amenable to FEI metric
    - ANSI/AMCA 210 and ISO 12759
  - Combines relevant sections of AMCA 208-18, AMCA 207-17, AMCA Publication 211
- ANSI/AMCA 210-16 (and ISO 5801) – longstanding test standards for most types of commercial and industrial fans

Fan-efficiency in Energy Codes

- Metric: Fan Energy Index (FEI) per ANSI/AMCA Standard 208-18, *Calculating the Fan Energy Index*
- Scope:
  - Standalone Fans ≥ 1 HP
  - Embedded Fans NOT in certified equipment (ASHRAE 90.1-2022 Section 6.5.3.1.3)
- Minimum Performance at the highest design airflow rate
  - Fans in VAV systems: FEI ≥ 0.95
  - All other covered fans: FEI ≥1.00
- Exemptions (there's a long list)
  - Generally regulated and certified embedded fans, safety fans, emergency operations

Fan-efficiency in Energy Codes

- FEI replaced Fan Efficiency Grade (FEG) in these editions:
  - 2019: ASHRAE 90.1
  - 2020: ASHRAE 189.1
  - 2021: IECC and IGCC
  - 2022: Title 24 (FEG was never in Title 24; 2022 was the first year for FEI)
- Third-party (certified) FEI ratings required in IECC and Title 24
- AMCA recommends specifying certified FEI ratings because of the complexity of the metric for manufacturers to accommodate variety of fan/motor/drive combinations, sizes, etc.
- To find AMCA-certified ratings, visit http://www.amca.org/FIND-FEI

DOE Proposed Standards for GFB

Equipment Class	Fan Energy Index (FEI)	
Axial Inline	1.18	*A if sold without a drive *A*B if sold with a drive A & B are adjustment parameters
Axial Panel	1.48	
Axial Power Roof Ventilator	0.85	
Centrifugal Housed	1.31	
Centrifugal Unhoused	1.35	
Centrifugal Inline	1.28	
Radial Housed	1.17	
Centrifugal Power Roof Ventilator - Exhaust	1.00	
Centrifugal Power Roof Ventilator - Supply	1.19	

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Observations regarding DOE's proposal

- FEI requirements based on fan type
- The levels are very high – well over 1.00 for most fan categories
- Filing and labeling requirements will be covered in future rulemaking
- "Whole fan curve" can be portrayed
- Non-compliant duty points would have to be noted by "grayed out" values, and identified with this disclaimer:

SALE AT THESE DUTY POINTS VIOLATES DEPARTMENT OF ENERGY REGULATIONS UNDER EPCA

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Your feedback is valuable!

- DOE proposal: http://tinyurl.com/yckavb97
- Submit written comments to DOE
  - Comments due to DOE by March 19
  - Docket number: EERE-2022-BT-STD-0002
  - Email: FansAndBlowers2022STD0002@ee.doe.gov
  - Include docket number EERE2022-BT-STD-0002 in the subject line of the message.
- Attend (and speak up) at the DOE public meeting:
  - February 21, 10:00 a.m. to 4:00 p.m., in-person in Washington, DC, and via webinar
  - Click here to register for the webinar.

Side Note: California Title 20 Fan Regulation Update

- California Title 20 regulation for "commercial and industrial fans and blowers" was finalized in Nov. 16, 2022
- California Title 20 has equivalence of FEI ≥ 1.00 for all covered fans and will remain in effect until the DOE energy standard goes into effect
- Title 20 exempts embedded fans and circulating fans; otherwise, scope is same as DOE regulation
- **WAS** scheduled to become effective on Nov. 16, 2023
  - Now undergoing a 45-day rulemaking to adopt the DOE test procedure
  - Rulemaking is "hoped" to be completed in March 2024
  - Has labeling and certification (compliance filing) requirements
- New deadline for compliance effectiveness is April 29, 2024
- Some fan manufacturers are already certified in MAEDbS CEC compliance database
- MAEDbS "quick search"
  - https://cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx

Embedded Fan Complexities

These slides are revisions to slides presented to ASHRAE 90.1 Mech. Subcommittee, and were developed by Eric Erdman, Greenheck. Corrections from the slides shown to the MSC are noted. An earlier version was provided to TC 5.1 but neither used during the meeting nor distributed.

AHU Product Example

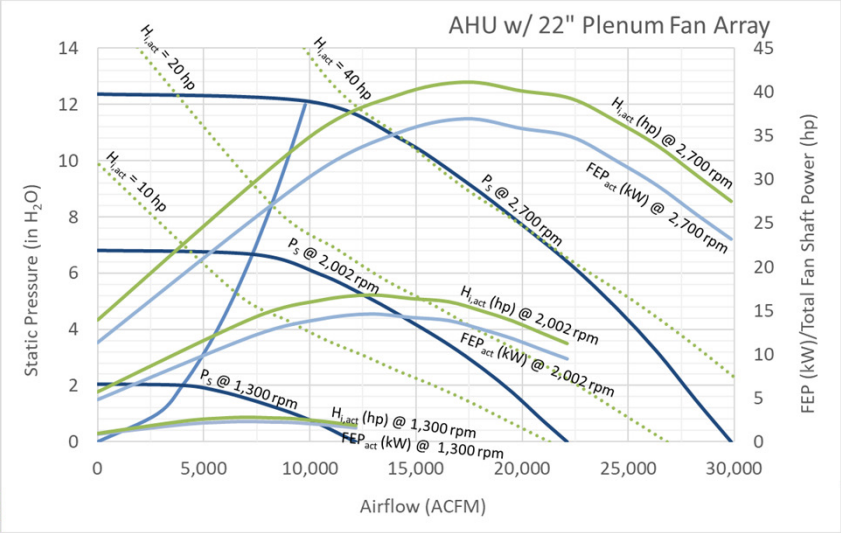
Application Requirements

- Unit features, “appurtenances”:
  - Combination MERV 8 & MERV 13 filters
  - Chilled water cooling
  - Hot water heating
  - Mixing box with control dampers
- Specified airflow requirements
  - 13,000 cfm
  - 2.6” of supply duct pressure
  - 1.5” of return duct pressure

AHU Supply Fan Offering

- Direct drive plenum fan array
  - 2 backward curved plenum fans
  - 10hp motors
  - Single 20 hp VFD
  - Uncontained fans
  - Near the top of fan efficiency fan offering

Central Station AHU Supply Fan Published Ratings (AHRI 430)

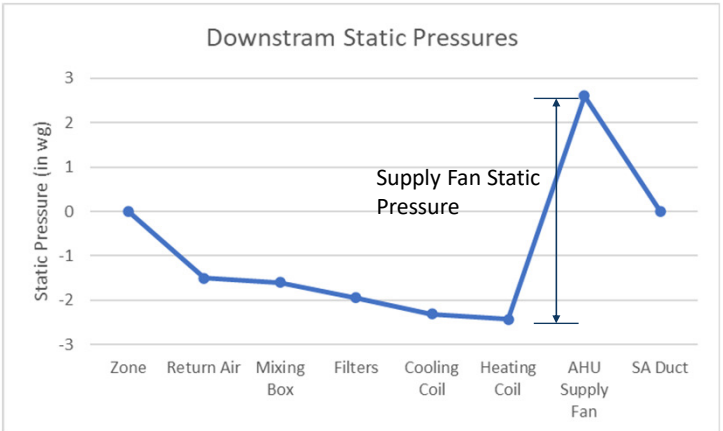


- Rated in accordance with AHRI Standard 430 (I-P)
  - "Fan in the box"
- FEP determined with electrical power measurement Wire-to-Air Method (5.1.1)
- Supply Fan w/o Appurtenances
- AHRI 430 Published Ratings:
  - Static Pressure, in H2O
  - Airflow Rate, ACFM
  - Fan Speed, rpm
  - FEP, kW.
  - Fan Shaft Power, hp. (if tested according to Sections 5.1.2 or 5.3.4.1)

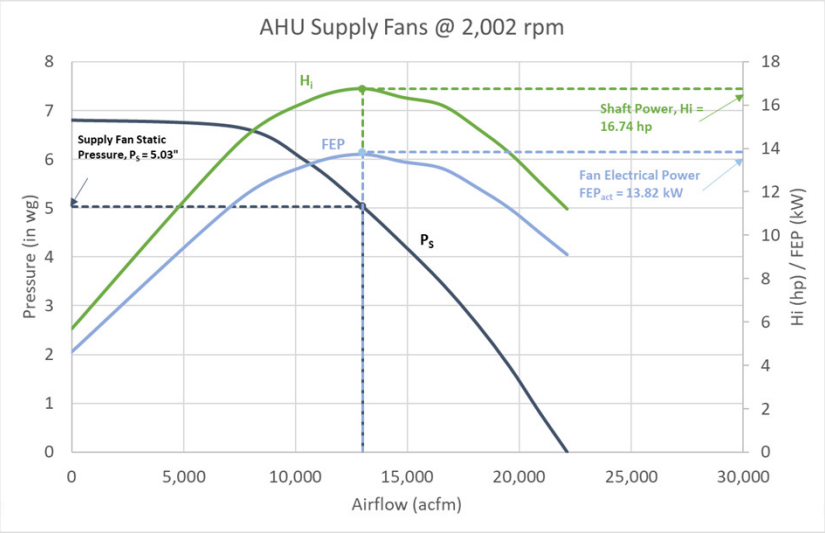
Static Pressure Requirement for AHU

1.60	in wg	Return Duct*
0.10	in wg	Mixing Box
0.34	in wg	Filters
0.37	in wg	Cooling Coil
0.12	in wg	Heating Coil
+ 2.60	in wg	Supply Duct*
5.03	in wg	AHU Supply Fan

* = Duct values specified by system designer



Product Example Performance Information



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FEI Representations

1. FEI for DOE regulation compliance considers only individual, stand-alone fan performance
2. FEI can optionally be shown for the equipment fan array, but testing must be done in accordance with DOE method of test
3. FEI for a fan array can be calculated in AMCA 208 Annex C with AMCA 214 updates

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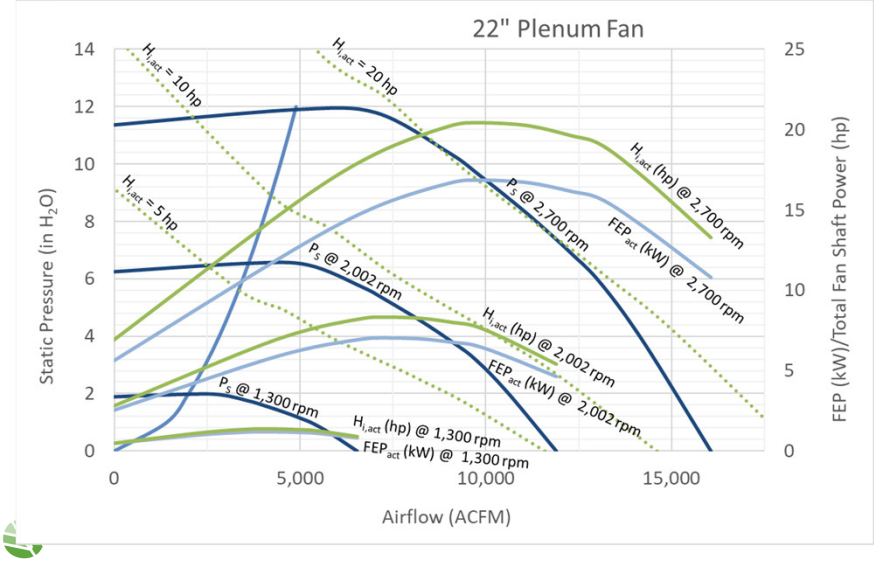
Stand Alone Fan Ratings



- Rated in accordance with AMCA Standard 211
- FEP calculated using AMCA 214 6.4.2.4
- **Tested with free inlet/discharge (no ducting)**

Note: Peak static efficiency is 73% for this fan.

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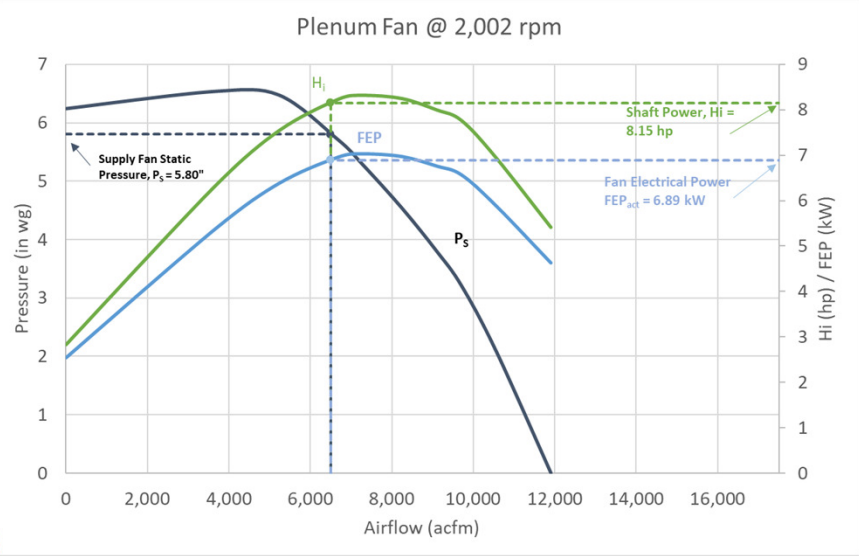
Stand Alone Fan Operating Point



- To find stand alone fan performance, keep same fan speed
- Use airflow per fan = 13,000/2 = 6,500 acfm
- Find resulting fan pressure = 5.80 in wg

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Example: FEI Calculation Comparison

	AHU	Fan-array	Fan-only
Parameter	**AHRI 430 Results**	**AMCA 208 Array**	**DOE Test Procedure**
Airflow (acfm)	13,000	13,000	6,500
Fan Speed (rpm)	2,002	2,002	2,002
Static Pressure (in wg)	5.03	5.80	5.80
Ducted	Yes	No	No
Pressure Basis	Total	Static	Static
Motor Size (hp)	10 (qty 2)	10 (qty 2)	10
VFD Size (hp)	20	20	10
Shaft Power (hp)	16.74	16.29	8.15
FEP actual (kW)	13.82	13.45	6.89
FEI	1.04	~~1.22~~ 1.34	~~1.24~~ 1.36

Original FEI numbers were inadvertently calculated with a total pressure baseline.

Evaluation must be matching airflow/speed

Main difference comes from housing impacts

Centrifugal unhoused fans tested without ducts

Note: Equipment uses single VFD.

Shaft power should line up closely in theory, but real-life test differences exist.

FEI or efficiency for equipment performance has little specifiable value. FEP_act is more important.

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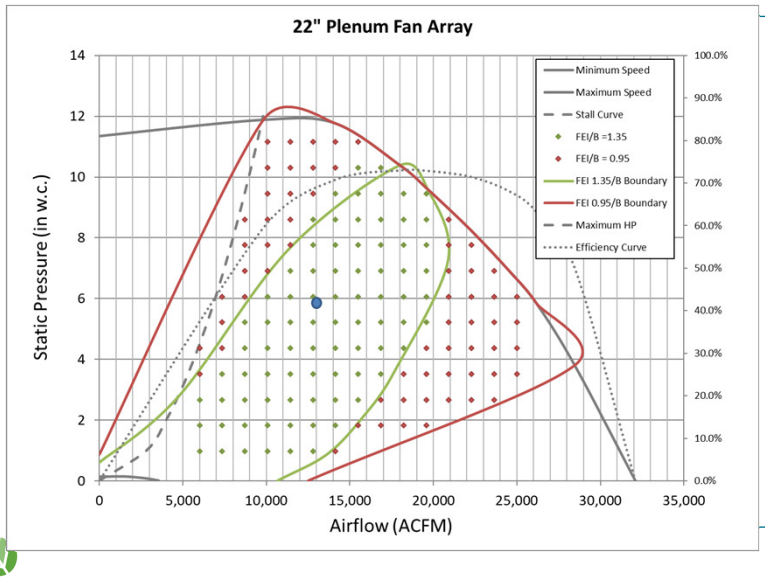
DOE NOPR Impact

FEI bubble grew slightly due to B factor calculation correction.



- Proposed FEI for unhoused centrifugal fans = 1.35*B
- B is a DOE credit for use of a VFD
- Would need larger diameter fan set to cover existing FEI 0.95 compliant range for ASHRAE 90.1
- Some loss of max allowable pressure,

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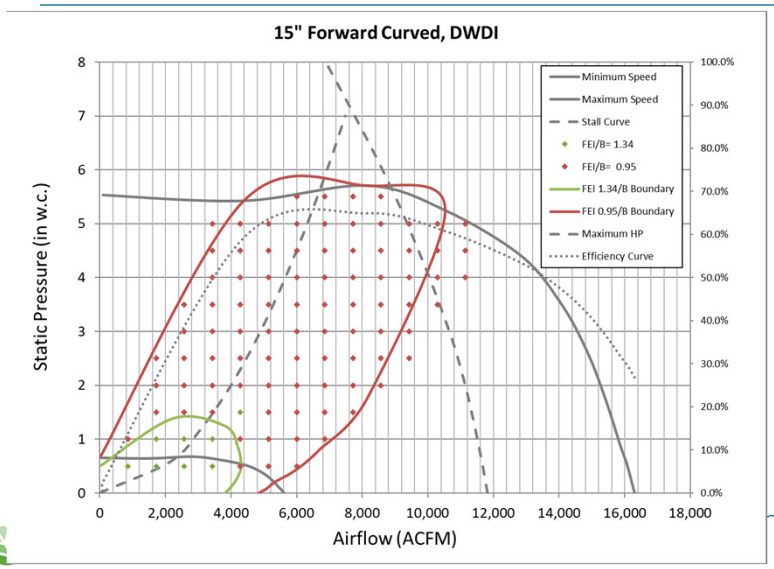
Forward Curved Fan Impact Analysis



- Proposed FEI for housed centrifugal fans = 1.34*B
- B is a DOE credit for use of a VFD
- New fan technology required or redesign of FC fan

FEI bubble grew slightly due to B factor calculation correction.

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Embedded Fan Summary and Discussion

- FEI is different in embedded and stand-alone configurations
  - DOE proposal permits showing efficiency ratings outside of regulated range.
    - What efficiency ratings can be published for AHUs?
    - If efficiency of finished good is lower will this create confusion for specifiers?
- Proposed FEI levels for forward curve and backward-curve plenum fans are very stringent
  - Manufacturers reviewing how many fan options are needed per AHU box to serve current market
  - High-pressure applications may be at risk

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Your feedback is valuable!

- DOE proposal: http://tinyurl.com/yckavb97
- Submit written comments to DOE
  - Comments due to DOE by March 19
    - Docket: EERE-2022-BT-STD-0002
      - Regulations.gov
      - FansAndBlowers2022STD0002@ee.doe.gov
        - Include docket number EERE2022-BT-STD-0002 in the subject line of the message.
- Attend (and speak up) at the DOE public meeting:
  - February 21, 10:00 a.m. to 4:00 p.m., in Washington, DC and via webinar
  - Click here to register for the webinar.

Embedded Fan Summary and Discussion

FEI is different in embedded and standalone configurations

- DOE proposal permits showing efficiency ratings outside of the regulated range.
  - What efficiency ratings can be published for AHUs?
  - If the efficiency of finished goods is lower, will this create confusion for specifiers?

Proposed FEI levels for forward curve and backward-curve plenum fans are **very stringent**

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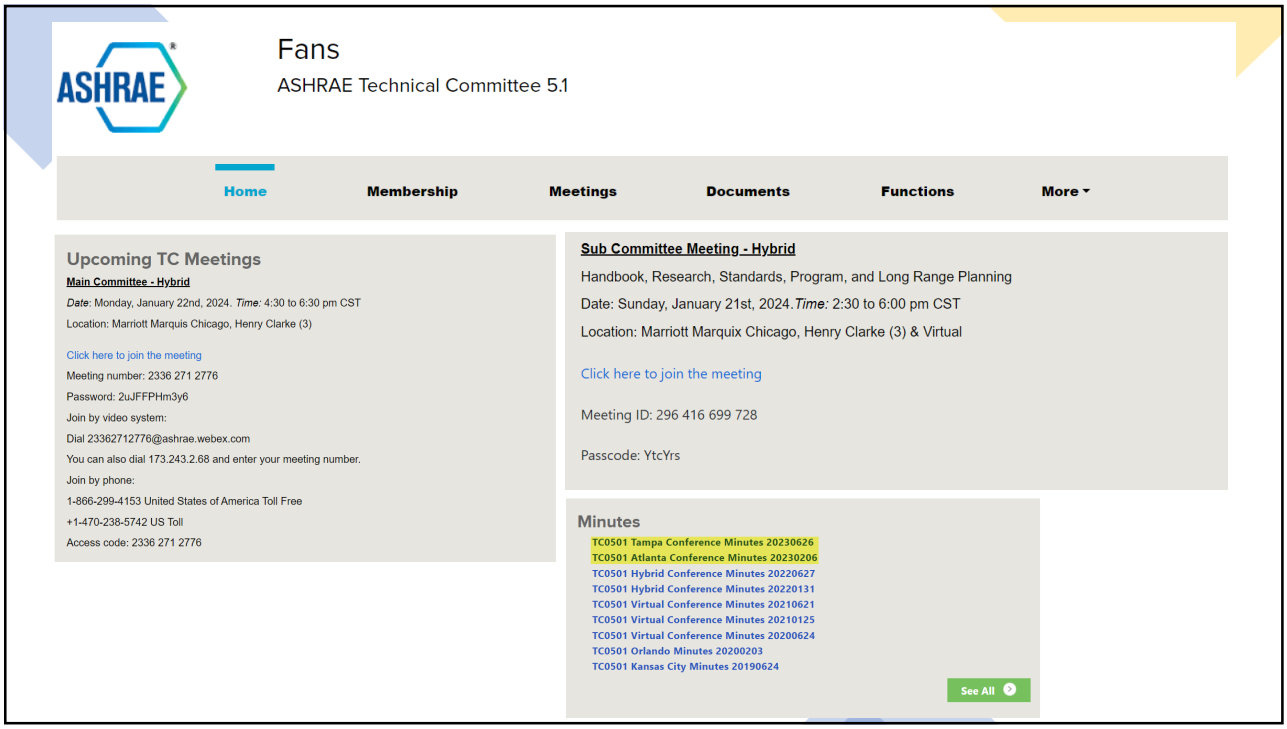
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Upcoming TC Meetings
Main Committee - Hybrid
Date: Monday, January 22nd, 2024. Time: 4:30 to 6:30 pm CST
Location: Marriott Marquis Chicago, Henry Clarke (3)
Click here to join the meeting
Meeting number: 2336 271 2776
Password: 2uJFFPHm3y6
Join by video system:
Dial 23362712776@ashrae.webex.com
You can also dial 173.243.2.68 and enter your meeting number.
Join by phone:
1-866-299-4153 United States of America Toll Free
+1-470-238-5742 US Toll
Access code: 2336 271 2776
Sub Committee Meeting - Hybrid
Handbook, Research, Standards, Program, and Long Range Planning
Date: Sunday, January 21st, 2024. Time: 2:30 to 6:00 pm CST
Location: Marriott Marquix Chicago, Henry Clarke (3) & Virtual
Click here to join the meeting
Meeting ID: 296 416 699 728
Passcode: YtcYrs
Minutes
TC0501 Tampa Conference Minutes 20230626
TC0501 Atlanta Conference Minutes 20230206
TC0501 Hybrid Conference Minutes 20220627
TC0501 Hybrid Conference Minutes 20220131
TC0501 Virtual Conference Minutes 20210621
TC0501 Virtual Conference Minutes 20210125
TC0501 Virtual Conference Minutes 20200624
TC0501 Orlando Minutes 20200203
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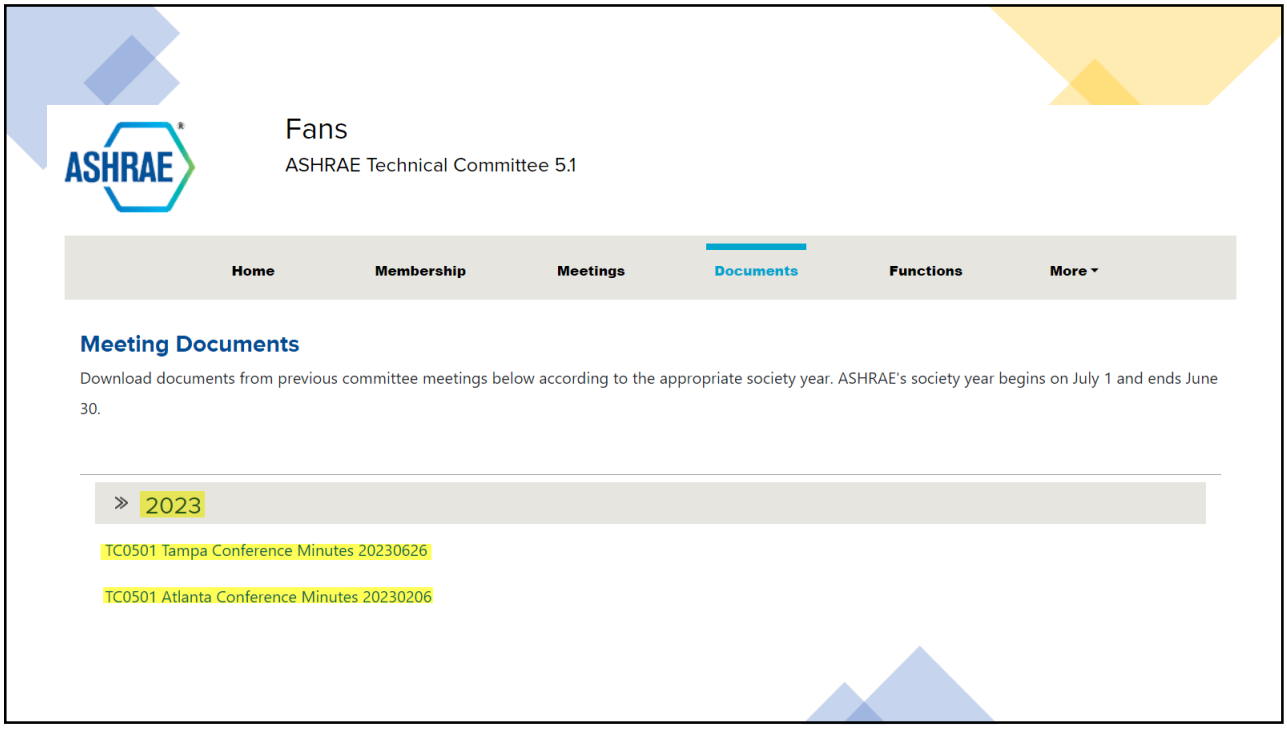
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Meeting Documents
Download documents from previous committee meetings below according to the appropriate society year. ASHRAE's society year begins on July 1 and ends June 30.
2023
TC0501 Tampa Conference Minutes 20230626
TC0501 Atlanta Conference Minutes 20230206

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