1791 Tullie Circle, N.E./Atlanta, GA 30329
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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. 5.1 DATE 2/23/2017

TC/TG/MTG/TRG TITLE Fans

DATE OF MEETING 1/30/2017 LOCATION Las Vegas, NV

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Franco Cincotti	2016	Brian Reynolds	2016	Asesh Raychaudhuri
Armin Hauer	2016	John Cermak	2014	Dan Manole
Joseph Brooks	2016	Chuck Coward	2014	Kim Osborn
Zhiping Wang	2016	Jay Fizer	2016	Brent Fullerton
Harold Dubensky	2015			Ken Peet
Jay Eldridge	2016			Rad Ganesh
Michael Feuser	2016			Asesh Rachaudhuri
Tim Kuski	2014			Mike Brendel
Eric Tingloff	2014			Paul Lin
				Charles Seyfert
				Bob Valbracht

DISTRIBUTION: ***All Members of TC/TG/MTG/TRG plus the following:***	
TAC Section Head: Kenneth Peet	SH5@ashrae.net
All Committee Liaisons As Shown On TC/TG/MTG/TRG Rosters (Research, Standards, ALI, etc.)	David John davidjohntarpon@gmail.com Dr. Melikov,PhD akm@byg.dtu.dk James Bochat jim.bochat@cxconcepts.com James Arnold jarnold@live.com Folorentino Roson Rodriquez f.roson@supsercontrols.com.ar
Mike Vaughn, Manager Of Research & Technical Services	MORTS@ashrae.net

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

ADDITIONAL ATTENDANCE (Continued)

Chandra Gollapudi
Peter Bushnell
Jaime Yeh
Greg Meeuwsen
Ken Kuntz
Walter Mecozzi
Sanaee Iyama
Lauren Zelinski
Adam Sterne
Lee Buddrus
Rich Stauter
Greg Wagner
Tim Mathson
Mac Mezachi
Mike Wolf
Gus Faris

ASHRAE TC 5.1 Meeting
Monday, 30 Jan 2017
Caesers Palace **Room Forum 7**
Las Vegas, NV

Minutes

1. Call to Order – 4:23 pm

The Chair, Franco Cincotti, called the meeting to order at approx. 4:15 pm.

2. Roll Call

The following are TC 5.1 voting members were present:

Franco Cincotti –Chair
Armin Hauer – Vice Chair
Joseph Brooks – Secretary
Zhiping Wang – Handbook S/C Chair
Harold Dubensky – Webmaster
Jay Eldridge
Michael Feuser
Tim Kuski
Eric Tingloff

Non-Voting S/C Chairs:

Asesh Raychaudhuri – Program S/C Chair

The following voting members could not attend:

Brian Reynolds
John Cermak
Chuck Coward
Jay Fizer

A quorum was present.

3. Adoption of Agenda

The agenda was adopted by consensus

4. Approval of the Minutes

The last two meeting of this committee were held on 27 June, 2016 in St. Louis, MO and 25 Jan 2016 in Orlando, FL.

Motion: TC 5.1 – 2-17 – 01 Moved by: Armin Hauer
Seconded: Zhiping Wang

"To approve the minutes of this TC from 27 June 2016 and 25 Jan 2016 as distributed."

Passed unanimously

5. Items of business

5.1 ASHRAE Code of Ethics
TC members were asked to review the ASHRAE code of ethics found at http://www.ashrae.org/codeofethics .

5.2 TC 5.0 Section Head/Liaison Reports
The TAC Section Head, Ken Pete, highlighted items discussed at the section head meeting of chairs. He noted that the TAC suggests and promotes the use of electronic meetings outside of the annual and winter meetings, especially for sub-committee meetings.

5.3 Chairman's report

The chair reported on the news from the Section Head meeting with the chairs. Highlights are:

- There were 81 conference papers, 30 technical papers, 76 seminars, 7 workshops and 3 forums and 3 panels at this meeting.
- Described the technology portal.
- TAC is soliciting reviewers.

5.4 DOE Fan Regulation Status
It was reported that no progress has been made. However, the DoE did release a third notice of data availability (NODA). An attendee did report that the DoE did not see a consensus on default issues.

5.5 Old business
No additional old business was brought to the floor.

6. Subcommittee reports

6.1 Standards subcommittee – John Murphy

6.1.1 ASHRAE 51/AMCA 210
ASHRAE 51 was reported as being completed. The major changes were discussed at the previous day's hot topics session.

6.1.2 ASHRAE 149-2013
A justification for the recommendation to withdraw ASHRAE 149 was developed. It is:

The TC 5.1 believes that ASHRAE 149 be withdrawn because it has no reported use. In addition, after its approval, AMCA International developed a certification based on this standard and no entity showed any interest in it. It is believed that its non-usage does not warrant the resources needed to revise it.

Attachment 6.2

Motion: TC 5.1 – 2017 – 02 Moved by: Armin Hauer
Seconded: Michael Feuser

"To recommend withdrawal [of ASHRAE 149] based on this justification."

Passed unanimously

6.2 Handbook subcommittee – Zhiping Wang

Zhiping – reported on the next revision requirements. His report is attached.

6.3 Research subcommittee – Brian Reynolds

The research subcommittee chair was not present. The TC chair reported on the research breakfast meeting. Highlights of the Research Subcommittee were discussed and highlights of discussion are:

A. Work Statement (WS) 1769, Experimental Evaluation of the Efficiency of Belt Drives for Fans:
It was agreed to proceed with the following plan of action:

- Send to TC 5.1 members after the meeting, for a two week review of the work statement and request any comments (comments to include proposed wording changes).
- Forward the WS to RAC liaison for his comments, due end of February.
- WS authors Tim Mathson and Craig Wray will review comments and work with RAC liaison to resolve comments.
- Forward to TC for vote. Any comments from the TC should be brought up during the initial two week review period prior to the vote.

B. Cosponsoring of RTAR "Characterizing the Performance of Entrained Flow Stacks"**:** TC 9.10 (Laboratory Systems) is the lead TC. They are interested in having TC 5.1 review the RTAR and possibly be a co-sponsor. Brent Fullerton volunteered to be a liaison with TC 9.10 regarding this RTAR.

Motion: TC 5.1 – 2017 – 03 Moved by: Eric Tingloff
Seconded: Michael Feuser

"That TC 5.1 agrees to co-sponsor the TC 9.10 research project entitled, 'Characterizing the Performance of Entrained Flow Stacks.'"

Passed: 7- Yes, 0-No, 1- Abstain
(Chair did not vote)

C. RTAR "Inlet and Outlet System Effects on Multiple Plenum Fans in a Parallel Arrangement (Fan Arrays) for Air and Sound Performance"**:** The RTAR was reviewed at the research subcommittee meeting and is attached.

Attachment 6.2

Motion: TC 5.1 – 2017 – 04 Moved by: Armin Hauer
Seconded: Michael Feuser

"To approve the RTAR for "Inlet and Outlet System Effects on Multiple Plenum Fans in Parallel Arrangement (Fan Arrays) for Air and Sound Performance."

Passed unanimously (chair not voting)

D. TC 2.4 (Particulate Air Contaminants and Particulate Contaminant Removal Equipment) asked if TC 5.1 is willing to help with the revision of the RTAR titled Energy Implications of Air Filtration in Commercial Buildings, and co-sponsor it. A copy of the RTAR will be distributed to the TC.

6.4. Program subcommittee – Asesh Raychaudhuri
The subcommittee chair, Asesh, announced he would be resigning from the position of program subcommittee chair.

Motion: TC 5.1 – 2017 – 05 Moved by: Joe Brooks
Seconded: Zhiping Wang

"That this committee appoint Rad Ganesh as the TC 5.1 Program S/C chair effective 31 January."

Passed unanimously

Asesh will work with Rad for the June submittal.

For June meeting it was suggested that Tim Mathson and Armin Hauer present a seminar and FEI and applications. Authors will submit and Rad will be the program chair.

A fan fundamental seminar was suggested for the Chicago meeting

7. Website Report – Harold Dubensky

Statistic for web visits to the TC 5.1 website were presented. Presenters from today's seminar were asked to send their slides to webmaster. They will then be placed on the TC 5.1 website.

8. New Business

8.1 Recommendations to ASHRAE 90.1 Mech. SubCommittee (MSC)
ASHRAE Standard 90.1 currently regulates fan efficiency using Fan Efficiency Grades (FEGs). This efficiency metric is not being considered by the current US Dept. of Energy (DoE) Commercial/Industrial Fan & Blower (CIFB) rulemaking efforts and may not be allowed for use in the US if (or when) the DOE regulation is enacted. The MSC has indicated that any changes to 90.1 should be initiated by this

committee. It has been suggested that TC 5.1 should organize a Working Group to address this issue and work with MSC.

Motion: TC 5.1 – 2017 – 06 Moved by: Harold Dubensky
Seconded: Joe Brooks

"To form a working group to investigate the metric for fans in ASHRAE 90.1."

Passed unanimously (chair not voting)

Discussion: Should FEG be part of the WG statement of work? Another question – who should appoint the members.

The following attendees desired consideration to be part of WG: TC 5.3 (Gus Faris), Dan Manole, Harold Dubensky, Bob Valbracht, Kim Osborn, Greg Wagner, Chandra Gollapudi, Peter Bushnell, Tim Mathson, and Franco Cincotti.

9. Time and Place of Next Meeting

The next meeting of TC 5.1 will be held in conjunction with the ASHRAE Annual Meeting on 26 June 2017 in Long Beach, CA.

10. Adjournment

The meeting adjourned at 6:41 pm.

Minutes recorded by
Joseph Brooks, PE

Attachments: 6.2 – Handbook subcommittee report
6.3C – Draft RTAR

Attachment 6.2

TC 5.1 Handbook Subcommittee Notes (01/29/2017)

By Zhiping Wang

- The revised and TC approved Fan chapter for the 2020 ASHRAE Handbook will be due around May 2019.
- ASHRAE is promoting the use of the ASHRAE Authoring Portal (authoring.ashrae.org) which is a new, officially approved collaborative authoring tool for developing Handbook content. We will give it a try in this revision cycle, and a PowerPoint presentation about the Portal will be sent out to the members before our next meeting.
- Two outside reviewers' comments and suggestions about our chapter were received and will be reviewed and discussed in our next meeting.
- The ASHRAE Terminology issue was brought up and discussed with the staff. According to the staff, in order to change the content, we have to work through our handbook liaison. Don't know how easy or how hard this is going to be.
- As always, we are open for ideas, suggestions, and Handbook Online stuff.

List of Potential Topics for 2020 Version of the Fan Chapter

- **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: Wait after DOE publishes the new regulation on fans?
- **Fan Drive System – Direct Drive vs. Belt Drive, VFD, VSD, etc.**
  Actions: 05/23/14 – Greg S., 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.
- **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: 03/21/16 – Armin submitted the material after AMCA published the Publication 600-06. We now need to create the right content/format for the chapter.
- **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;

Attachment 6.2

- Interactive curves to demonstrate the fan laws;
- Interactive contents to show the stall/surge;

Attachment 6.3C

Research Topic Acceptance Request Cover Sheet

Date: 20 June 2016

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(Please Check to Insure the Following Information is in the RTAR)

A. Title	☑
B Executive Summary	☑
C. Background	☑
D. Research Need	☑
E. Project Objectives	☑
F. Expected Approach	☑
G. Relevance and Benefits to ASHRAE	☑
H. Anticipated Funding Level and Duration	☑
I. References	☑

Title:

Inlet and Outlet System Effects on Multiple Plenum Fans in a Parallel Arrangement (Fan Arrays) for Air and Sound Performance

RTAR # XXXX
(To be assigned by MORTS)

Results of this Project will affect the following Handbook Chapters, Special Publications, etc.:

Systems & Equipment S21, ASHRAE Standard 51/AMCA 210, 201

Research Classification:

Basic/Applied Research	☑
Advanced Concepts	☑
Technology Transfer	

Responsible Committee: TC 5.1 "Fans"

Date of Vote:

For		
Against	*	
Abstaining	*	
Absent or not returning Ballot	*	
Total Voting Members		

RTAR Authors

Lead: Dustin Meredith

Others: Z. Patrick Chinoda

Co-sponsoring TC/TG/MTG/SSPCs (give vote and date)

TC 2.6 "Sound and Vibration"
TC 5.2 "Duct Design"

Expected Work Statement Authors

Lead: Dustin Meredith

Others: Patrick Chinoda

Potential Co-funders (organization, contact person information):

AMCA International
AHRI

	Yes	No
Has an electronic copy been furnished to the MORTS?		
Has the Research Liaison reviewed the RTAR?		

* Reasons for negative vote(s) and abstentions

Attachment 6.2

Attachment 6.3B

RTAR # XXXX

Title:

Inlet and Outlet System Effects on Multiple Plenum Fans (Fan Arrays) in a Parallel Arrangement for Air and Sound Performance

Executive Summary

Describe in summary form the proposed research topic, including what is proposed, why this research is important, how it will be conducted, and why ASHRAE should fund it (50 words maximum)

The results of this research project will help to optimize building energy use and IEQ through an improved understating of multiple plenum fans (fan arrays) in a parallel arrangement. The project will test a variety of configurations to develop system effect factors and offer guidance on such configurations.

Attachment 6.3B

Background

Provide the state of the art with key references (at the end of this document) substantiating it (300 words maximum)

Multiple plenum fans in parallel are a trending design practice in both duct systems and air-handling units. They help to maximize efficiency, offer redundancy, are easy to maintain, and offer much-needed flexibility. 2-fan, 3-fan, 4-fan, and 6-fan arrangements are very common with even higher quantities being widespread.

Parallel fans are somewhat addressed in AMCA Publication 201, *Fan Engineering*, and even the ASHRAE handbook chapter on fans. However, industry information on multiple plenum fans is limited to airflow performance (not sound) and only address housed (not plenum), 2-fan arrangements.

There are no governing guidelines to help fan and system designers design a more efficient system both in terms of air and sound performance.

This is an extension of RP 1420 which addressed single plenum fans only.

Attachment 6.3B

Research Need

Use the state of the art described above as a basis to specify the need for the proposed effort (250 words maximum)

System effect factors need to be developed for those systems that deviate from established guidelines.

There has been no in-depth, published study to understand system effects surrounding multiple, plenum arrangements. A few manufacturers have performed in-house testing and have presented the results of such testing to industry committees (namely, a disbanded AMCA committee). Note that there were a few issues with the in-house testing, including the need for a test rig that minimizes any impact structural resonance may have on sound performance.

Even at a stable operating point, total airflow is not the sum of the individual fans. Significant deviations from predictions based on industry literature have been witnessed—both airflow and sound. If not designed correctly, the correction for a deviation in expected airflow can have a significant effect on fan energy consumption and space sound levels.

This project will establish system effect factors and guidelines for system designers and equipment manufacturers.

Investigate conditions that may result in ~~fan~~ paralle~~ing~~ fan instability.

Attachment 6.3B

Project Objectives

Based on the identified research need(s), specify the objectives of the solicited effort that will address all or part of these needs (150 words maximum)

The objectives of this project will be to:

- Investigate both contained and uncontained parallel plenum fan
- Address both the fan inlet and outlet for each factor listed below
- For any factor not addressed in prior research, establish a single fan baseline
- Develop system effect factors for air and sound performance through laboratory testing
- Provide spacing guidelines
    - Push the limits, don't use conventional rules-of-thumb (e.g., 0.5D)
    - ~~Consider~~ Include mismatched walls
- ~~Consider~~ Include rotation direction in the study

Expected Approach

Describe in a manner that may be used for assessment of project viability, cost, and duration, the approach that is expected to achieve the proposed objectives (200 words maximum).

Check all that apply: Lab testing☑, Computations☐, Surveys☐, Field tests☐, Analyses and modeling☑, Validation efforts☐, Other ☐ (specify)

Conventional laboratory testing using an air test chamber ~~wind tunnel~~ and a reverberation room. ~~At a minimum, a 2-fan, 3-fan, & 4-fan system should be tested with additional configurations (6-fan, etc.) being ideal.~~ The following configurations shall be tested (wxh): single-fan not addressed in prior research project, 2-fan (2x1), 3-fan (3x1), 4-fan (2x2), & 6-fan (3x2). For each configuration, on both the inlet and the outlet, test a number of wall spacings (reference RP 1420 for an example; plus the addition of mismatched walls). Test at least one configuration to determine if rotation direction is a factor. If so, add this variable as well.

Attachment 6.3B

Relevance and Benefits to ASHRAE

Describe why this effort is of specific interest to ASHRAE, its impact, and how it will benefit ASHRAE and the society. How does it align with ASHRAE Strategic Plans and Initiatives? How does it advance the state of the art in this area in general? Are there other stakeholders that should be approached to obtain relevant information or co-funding? (350 words maximum)

Multiple, parallel plenum fans help to maximize efficiency, offer redundancy, are easy to maintain, and offer much-needed flexibility; by minimizing direction of airflow distance in particular. Energy use and IEQ can be optimized if good application guidelines are developed.

Engineers, system designers, and many equipment manufactures rely on unproven theories when it comes to parallel plenum fan system design. Thus, many members in the ASHRAE community will benefit from the results of this research. ASHRAE will offer leadership and guidance to system designers if such guidelines are established. ASHRAE will be viewed and remain in the forefront of energy conservation endeavors through cutting edge research.

AMCA International, AHRI, and the DOE would all be logical stakeholders.

Anticipated Funding Level and Duration

Funding Amount Range: $120K

Duration in Months: 18

Attachment 6.3B

References

List the key references cited in this RTAR

- AMCA Publication 201 Fans and Systems
- *Fan Engineering* Howden Buffalo Inc.
- ASHRAE Standard 51 Laboratory Methods of Testing Fans for Rating
- ASHRAE Handbook chapter on fans