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

404-636-8400

TC MINUTES COVER SHEET

TC/TG/TRG NO TC 5. DATE February 10, 2011

TC/TG/TRG TITLE Duct Design

DATE OF MEETING February 1, 2011 LOCATION Las Vegas, Nevada

MEMBERS PRESENT	TERM TO	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Kevin Gebke	6/30/09	Bass Abushakra	6/30/12	Ken Chappell (ARCOM -MasterSpec)
Herman Behls	6/30/12	Johnny Andersson	6/30/13	Peyton Collier (SMACNA)
Pat Brooks	6/30/13	Bill Elosh	6/30/12	Wes Davis (CM)
Richard Evans	6/30/13	Mark Terzigni	6/30/13	John Gierzak (Metal Industries}
John Hamilton	6/30/13			Robert Hassler
Steve Idem	6/30/11			Mark Hooks (Suretape Technologies)
Bob Reid	6/30/14			Eli Howard (CM)
Chris Van Rite	6/30/13			Ralph Koerber (CM)
				Ed Koop (Ruskin)
				Gowri Krishnan (PNNL)
				Bruce Meyer (CM)
				Gary Miller (PCM)
				Vikram Murthy (Urivae Environment Systems)- (PCM)
				Tom Ponder (CM)
				Larry Smith (Lindab) (CM)
				Mark Smith (Ductmate)
				Robert VanBecelaere
				Craig Wray (CM)

DISTRIBUTION

All Members of TC plus the following:	
TAC Section Head	Giustino Mastro
TAC Chair	Chuck Wilkins
2012 Handbook Liaison	Cindy Callaway
2013 Handbook Liaison	James Aswegan
RAC Liaison	Piotr Domanski
Standards Liaison	Gowri Krishnan
Special Pubs	Stanley Mumma
ALI/PDC	Florentino Mendez
Manager of Research & Technical Services	Mike Vaughn

ASHRAE Winter Meeting, Las Vegas, NV
TC 5.2, Duct Design

Meeting Minutes

Tuesday, February 1, 2011

Las Vegas Convention Center
Room: N232
Time: 3:30 – 6:30 pm

2010 – 2011 Roster:

a. **Voting Members (12):** Kevin Gebke, Bass Abushakra, Johnny Andersson (non-quorum), Herman Behls, Patrick Brooks, William Elosh, Richard Evans, John Hamilton (non-quorum), Steve Idem, Bob Reid, Mark Terzigni, Chris Van Rite

b. **Corresponding Members (CM):** Marcus Bianchi, Charles Culp, Wesley Davis, Eli Howard, Ralph Koerber, Bruce Meyer, Vernon Peppers, Tom Ponder, Michael Resetar, Donald Seibert, Larry Smith, Bill Stout, Craig Wray

c. **Provisional Members (PCM):** Gary Miller, Vikram Murthy

1. **Call to Order –** Kevin Gebke called the meeting to order at 3:35 pm.

2. **Introduction/Attendance**
   - See Cover Sheet for attendees.

3. **Albuquerque (June 2010) Meeting Minutes**
   - Albuquerque meeting minutes approved by electronic ballot 8-0-1 (12); CNV. Meeting minutes are posted on the TC Web site (http://tc5.2.ashraetcs.org/meetings.html).

4. **Section Head Report (Gus Mastro- Section Head, Kevin Gebke TC 5.2 Chair)**
   a. Make sure you have a passport if you plan to go to the annual meeting in Montreal.
   b. A new ASHRAE technical committee type under TAC entitled Multidisciplinary Task Group (MTG) has been created as follows to address emerging technical topics and goals of the Society that are broader in scope or can be handled by a single TC. Multidisciplinary Task Group (MTG): a committee of technical experts appointed by TAC when the Society has determined a need for activity in a field of interest that encompasses the expertise of TCs from two or more sections and/or from non-TC groups such as SSPCs or outside organizations. Each TC and non-TC group whose field of interest falls within the MTG defined scope, or is added after the MTG starts, shall have a voting representative on the MTG. The functions of an MTG may include Handbook, Program, Publications, Research, and Standards as required by their specific charge, but the customary function of the MTG will be to coordinate those activities within the TCs and non-TC groups represented on the MTG
   c. There are four types of sessions at ASHRAE: technical, conference, seminar and forum. The conference session require a paper but just one blind review. Technical session review papers are still rigorously reviewed.
   d. The TC/TG/TRG Manual of Procedures (MOP) has been revised to clarify the positions of "Voting Member" and "International Member". Voting Member is now "Member-Quorum" in the MOP and International Member is now "Non-Quorum Member" – In addition, Non-Quorum members no longer need to reside outside the U.S. and Canada

in order to qualify for this designation on the roster and can be assigned to up to two members on the roster that have trouble attending meetings on a regular basis for other reasons (medical, recent job change, etc.) – The current rosters and the update workbooks for the 2010-2011 rosters still need to be revised to reflect this new terminology.

e. The current roster with contact information for the committees to which you are a member can be accessed at www.ashrae.org by logging into the" Members' Only" section. Once you log-in, go to update your bio and select the option "My Committees."

5. Subcommittee Reports

a. Handbook (Bob Reid, Chair)

- Duct Construction, Chapter 18, 2008 Systems and Equipment Handbook (2012 Handbook)

  (1) Chapter due date is 5/2/2011.

  (2) This chapter was emailed previous to the meeting and hard copies were available at this meeting. The revised chapter includes (1) approved text missed by the 2008 Handbook editor, (2) update of references, and (3) all comments received to date. Comments received were from Kevin Gebke and Bob Reid. Kevin Gebke updated significantly the "Air Dispersion Systems" section, and Bob Reid revised a sentence related to negative pressure flat oval duct. The "Leakage" section is being handled separately by the TC's Leakage Subcommittee.

  The Residential section duct gauge was discussed in detail. Considerable discussion was center around how to reconcile the difference in metal thickness between ICC's 2006 and 2009 International Residential Codes. Chris Van Rite is to investigate adding the IAPMO Uniform Mechanical Code.

  (3) Duct Construction chapter comments are to be sent to Bob Reid.

  (4) The Duct Construction chapter will be sent out for email ballot by the end of February for approval by voting members.

  (5) The Duct Construction chapter will be sent out for email ballot by the end if February to active (attended one of the last two meetings) Corresponding Members for comments.

  (6) Each substantive comment will be circulated to all members for discussion.

- Duct Design, Chapter 21, 2009 Fundamental (2013 Handbook)

  (1) Chapter due date is 6/7/2012.

  (2) Fitting loss coefficient tables will be removed from the chapter and just the ASHRAE Duct Fitting Database will be referenced. This was approved at the Louisville meeting (June 2009, Article 4.a5).

  (3) Pat Brooks suggested that the T-Method be removed as being impractical to use since a successful duct design program has never been written.

- The ASHRAE Handbook ONLINE has challenged TCs to develop and submit at least one electronic feature for their chapters.

b. Membership (Kevin Gebke, Chair)

b1. The following changes were submitted to TAC, and will be effective if approved after the June meeting in Montreal.

- Mark Terzigni will become TC 5.2 Chair
- Larry Smith will become TC 5.2 Vice-Chair and a voting member.
- Bob Reid will be the TC 5.2 Secretary
- Kevin Gebke and Steve Idem will roll off as voting members and will continue as corresponding members.
- John Hamilton will be changed from a non-quorum voting member to a voting member (quorum).
- Rich Evans will become a non-quorum voting member. The committee is allowed two non-quorum voting members. The other one is Johnny Andersson. These are voting members who will not count against the quorum if they are unable to attend the annual or winter meetings.
- Kevin Gebke will become the Handbook Chair and remain the Membership Chair.
- Tom Ponder will remain the Standards Chair.
- Steve Idem will remain the Program Chair and the Honors and Awards Chair.
- Herman Behls will remain the Research Chair.
- Mark Terzigni will continue as the webmaster. Everyone agreed he was doing an excellent job.
- Vernon Peppers requested to be a 2011-2012 voting member.
- Gary Miller added as a corresponding member.

b2. See the TC 5.2 Web Site (http://tc5.2.ashraetcs.org/meetings.html) for the official 2010-2011 roster, and when finalized the 2011-2012 roster.

c. Programs (Steve Idem, Chair)

c1. Montreal (25 – 29 June, 2011): Theme is "Net Zero buildings"

- The proposed seminar: "Is Ductwork Leakage Field Testing Needed?" was not accepted for the Las Vegas meeting. No reason was given. The seminar will be resubmitted for the Chicago meeting.
- We will not have a program at the Montreal meeting.

c2. Chicago (January 21-25, 2012): Theme is "Impact of HVACR on our Daily Lives"

(1) Proposed Seminar: "Is Ductwork Leakage Field Testing Needed?" Four presentations are:

i. "Testing for Duct Leakage" by Gaylon Richardson
ii. "Energy Impacts of Air-Handling System in Large Commercial Buildings: Measurement and Simulation" by Craig Wray
iii. "The Need for Ductwork Leakage Tests" by Mark Terzigni
iv. "Duct Leakage: Measured Magnitude and Calculated Impacts" by Mark Modera

(2) Technical Paper: "Measurements of Flat Oval Diverging Flow Fitting (Tees & Laterals) Loss Coefficients (1488-RP)" by D. Gibbs and S. Idem. ASHRAE Transactions, 2011, In Press

(3) Technical Paper: "Laboratory Testing of Converging Flow Flat Oval Tees and Laterals to Determine Loss Coefficients (1488-RP)" by D. Kulkarni and S. Idem. ASHRAE Research, 2011, In Press

(4) Technical Paper: "Laboratory Testing of Saddle Tap Tees to Determine Loss Coefficients" by A. Nalla and S. Idem. ASHRAE Transactions, 2011, Under Review.

c3. San Antonio (June 23-28, 2012): Conference Papers: CFD Shootout Contest Results (1493-RP) – One or more papers will be submitted by each of the three contest winners and presented in a Technical Session, pending the completion of the review process.

d. Special Publications

d1. **ASHRAE Duct Fitting Database (DFDB)** – Herman Behls, Administrator; Pat Brooks, Associate Administrator; John Downey, Programmer

- Version 5.00.10 issued 4/1/10.
  a. Need to resolve converging flow interpolation issues. Symmetrical fittings are not giving the same results for the same conditions on both branches. Pat Brooks will send Steve Idem the data to see if he can develop power equations for the data.
  b. An application has been written for the I-Pad, I-Pod and I-Phone to run the ASHRAE Duct Fitting Database program. Cost is $19.99.
- Next Update:
  a. Licensing agreement to be revised (Network).
  b. Add flat oval converging and diverging junctions.
  c. Update drawings to match input and output.

d2. **Duct Design Guide** – Pat Brooks, Chair

- See Exhibit 1 for the table of contents and the status of each chapter.
- Brooks create a website to upload and download chapter revisions since Google Groups can no longer be used. Any member that wants to review chapters or add content can e-mail Pat and he will send the link.
- The committee plans to have substantial completion by the Montreal Meeting.
- It was suggested to remove the section on codes and standards. The committee is considering this request.

e. Research (Herman Behls, Chair)

e1. 1333-RP: HVAC Duct Pressure Loss Measurements

- Project Director: Dr. Charles Culp
- PMS: Behls (Chair), Evans, Idem, Ponder
- Technical Papers: Three Transactions papers published.
- Final Report: To be completed by end of March.

e2. 1488-RP: Laboratory Testing of Flat Oval Tees and Laterals to Determine Loss Coefficients

- Principal Investigator: Dr. Steve Idem
- PMS: Behls (Chair), Brooks, Evans, Reid
- Two technical papers have been approved for publication. Publication will take place after the 1493-RP CFD Shootout submittals are received.
- Final report approved 10-0-1 (12) by email ballot.
- Project is complete.

e3. 1493-RFP: CFD Shootout Contest – Prediction of Duct Fitting Losses

- Cost: $85,000
- PMS: Steve Idem (Chair), Bass Abushakra, Yan Chen (TC 4.10), Vernon Peppers, and the following two contractors:

  Dr. John Zhai
  University of Colorado at Boulder
  UCB 428, ECOT 441
  Boulder, CO 80309
  Phone: 303-492-4699
  E-mail: john.zhai@colorado.edu

  Dr. Ahmad Sleiti
  University of North Carolina Charlotte
  College of Engineering, Smith 206
  Charlotte, NC 28223
  Phone: 704-687-2931
  E-mail: asleiti@uncc.edu

- Drs. Zhai and Sleiti reported that 28 letters of intent have been received. Of these Zhai and Sleiti expect to receive at least 15 CFD submittals,

e4. 1606-RFP: Laboratory Testing of Flat Oval Transitions to Determine Loss Coefficients

- PMS: Behls (Chair), Brooks, Evans, Reid
- Status: Approved by RAC. The RFP (Request for Proposals) will be sent out by ASHRAE staff this spring.

e5. 1591-RTAR: Laboratory Testing of Flex Duct to Determine Resistance to Flow

- PMS: Behls, Abushakra, Brooks, Van Rite
- Status: RAC returned RTAR with comments 7/17/09. “Return” means topic is probably acceptable for ASHRAE research, but RTAR is not quite ready.
- RTAR withdrawn because Dr. Culp extrapolated the 4, 18 and 20 inch flexible duct sizes as reported in the 1333-RP Final Report.

e6. RTAR - Tees with Balancing Dampers

- Proposer: John Hamilton
- PMS: Hamilton, Behls, Gebke, Terzigni
- RTAR was discussed at the Albuquerque meeting, but never submitted to RAC.
- At this meeting the topic was discussed and the RTAR revised (Exhibit 2). The consensus of attendees was to proceed with a Work Statement (WS). Behls and Hamilton to prepare WS.

e7. RTAR - Vane Rectangular Elbows

- Proposer: John Hamilton
- At Albuquerque the vote to reject the RTAR was 5-0-2. John Hamilton was not present at the TC 5.2 meeting. The discussion center on locating the turning vanes tight to the heel (not the location of the first vane at the throat).
- Hamilton discussed with the research subcommittee at the Sunday meeting and the members present discovered they had misunderstood the intent. Hamilton stated that with poor placement of vanes in the throat of the elbow, the lowest vane (at the throat) may not see and turn air (Exhibit 3), allowing it

to converge with air flowing around the vanes, thus creating turbulence and a higher pressure loss

- The member present at the TC meeting agreed that a Work Statement should be prepared for approval. The scope is to evaluate vane placement for the following ASHRAE Duct Fitting Database fittings.
  (1) CR3-14: Double-Thickness Vanes, 1 1/2 in, vane spacing
  (2) CR3-15: Double-Thickness Vanes, 2 1/8 in, vane spacing
  (3) CR3-14: Double-Thickness Vanes, 3 1/4 in, vane spacing
  (4) CR3-9: Single-Thickness Vanes, 1 1/2 in, vane spacing
  (5) CR3-12: Single-Thickness Vanes, 3 1/4 in, vane spacing
- Duct velocity shall be 2000 to 2500 fpm.

e8. WS – Terminal Unit and Access Door Leakage

- The need for a Work Statement (WS) to determine the leakage of terminal unit and access doors was discussed to support our activities with Standard 90.1's Mechanical Working Group. Members present recommend the TC proceed to write a WS.
- The purpose is (1) to determine if the Terminal Unit leakage values proposed for Standard 90.1 are realistic, and (2) have a basis for access door allowable leakage.
- Terminal Units and access doors leakage will be determined in compliance with ASHRAE Standards 130 and 126,

6. Standards (Tom Ponder, Chair)

a. ANSI/ASHRAE Standard 120-2008 (Method of Testing to Determine Flow Resistance of HVAC Ducts and Fittings) is in its 3rd year of a 5-year review cycle. Tom Ponder distributed to the past-chair (Herman Behls) the notification notice package that includes (1) staff review, and (2) the Periodic Maintenance Recommendation form so that he can determine if Standard 120 can be reaffirmed or needs the formation of a project committee to revise Standard 120. According to staff's report Standard 120 needs to be revised. TC 5.2 needs to approve the formation of a project committee to revise Standard 120.

b. ANSI/ASHRAE/SMACNA Standard 126-2008 (Method of Testing HVAC Air Ducts) is in its 3rd year of a 5-year review cycle. Tom Ponder distributed to the past-chair (Richard Evans) the notification notice package that includes (1) staff review, and (2) the Periodic Maintenance Recommendation form so that he can determine if Standard 126 can be reaffirmed or needs the formation of a project committee to revise Standard 126. According to staff's report Standard 126 needs to be revised. TC 5.2 needs to approve the formation of a project committee to revise Standard 126.

c. ANSI/ASHRAE/IESNA Standard 90.1-2010 (Energy Standard for Buildings Except Low-Rise Residential Buildings)

- Duct and plenum leakage section (6.4.4.2) of Standard 90.1 requires that ductwork and all plenums with pressure class ratings be constructed to Seal Class A, where Seal Class A is defined as follows: "A ductwork sealing category that requires sealing all transverse joints, longitudinal seams, and duct wall penetrations. Duct wall penetrations are openings made by pipes, holes, conduit, tie rods, or wires. Longitudinal seams are joints orientated in the direction of air flow. Transverse joints are connections of two duct sections orientated perpendicular to flow."

- An addendum is being proposed (Exhibit 4) covering the allowable leakage for single duct and dual duct terminal boxes.

d. SMACNA HVAC Air Duct Leakage Test Manual

- SMACNA's updated "HVAC Air Duct Leakage Test Manual" has not been published and is in the ANSI review stage as of this meeting.

7. Duct System Leakage Subcommittee (Herman Behls, Chair)

a. Refer to Exhibit 5 for the purpose and scope of the committee. To date activities of this committee were involvement with the 90.1 Mechanical Working Group. Primary activities to date were (1) an update of Standard 90.1-2010 that requires sealing all ductwork, and (2) the Terminal Unit Addendum to be acted upon by the 90.1 committee this spring for public review (Exhibit 4).

b. The 90.1 working group needs to resolve the public review comment by Eli Howard (accepted no change so as not to hold up publication of 90.1-2010) that relates to duct tape (UL 181). Suggested changes should be sent to Jeff Boldt (boldtjg@kjww.com).

c. Attached is a literature search (Exhibit 6) of related materials.

8. Website (Mark Terzigni, Webmaster)

- See TC 5.2 Website (http://tc5.2.ashraetcs.org/meetings.html). The website has the 2010-2011 and roster and all TC meeting minutes. The 2011-2012 roster will be posted as soon as it is finalized. Please submit any changes to the webmaster.
- ASHRAE is now recommending Google sites to transfer large files. Members can still download data, but cannot upload new data. Webmaster to investigate its use.

9. **Awards (Steve Idem)**

- The Service to ASHRAE Research award went to Steve Taylor, TCs 4.3 and 1.4.

  Steve is being honored for the extensive contributions that he has made to the ASHRAE research program for multiple TCs and the Society in general. Specifically, Steve served as a member of the Society's Research Advisory Panel for the 2010-15 plan, authored nine work statements, served on five Proposal Evaluation Subcommittees (chaired three), served on 10 project monitoring subcommittees (chaired three), and served as the research subcommittee chair for TCs 1.4 and 4.3.

- The Hightower award went to Gary Phetteplace, TCs 6.2 and 6.8.

  Dr. Phetteplace is being honored by TC 6.8 for recently chairing an ad hoc committee to help resolve a difference of opinion in content to the geothermal chapter of the Applications Handbook for 2011. Gary supported TC 6.2 by completing a major restructure and edit of chapter 11 of the 2008 Systems & Equipment handbook. He was also named as a significant contributor to the 1996-2008 editions of the HVAC Systems Handbook. He is a great example of a TC member going the extra mile by attending numerous district energy conferences in order to stay current and brief the TC and by attending all TC 6.2 subcommittee meetings.

10. Deadlines: No new deadlines.

11. Unfinished Business: No unfinished business to discuss**.**

12. New Business: No new business discussed.

13. Informational Item: ASHRAE's Board of Directors approved 2/3/2011 cosponsoring BSR/SMACNA 021-201x, HVAC Total System Air Leakage Manual, with SMACNA being the lead organization.

BACKGROUND: This proposed SMACNA standard was announced in the September 4, 2010 ANSI Standards Action. After the project initiation notification system announcement was made in the ANSI Standards Action ASHRAE sent a duplication/conflict of interest letter to SMACNA. ASHRAE staff and SMACNA staff had a conference call to discuss the issues. Subsequently, ASHRAE President-Elect Ron Jarnagin met with SMACNA staff and leadership in October. The parties discussed cosponsoring. SMACNA's Executive Committee and Board of Directors have approved this co-sponsorship. SMACNA's procedures will be followed and ASHRAE will have representation on the development committee (which is outside of SMACNA's normal procedures). It is not anticipated that there will be any fiscal impact from this arrangement beyond normal publishing costs. This will be determined when the sponsorship and publication agreement are sent by SMACNA. This standard contains HVAC air distribution leakage classification methodology, test procedures, quantification and requirements for total HVAC air-distribution system air leakage performance in commercial building applications. This proposed standard will establish air leakage performance for the total HVAC system. The Title, Purpose and Scope are included below for informational purposes.

TITLE: HVAC Total System Air Leakage Manual

PURPOSE/SCOPE: This Standard will contain HVAC air distribution system leakage classification methodology, test procedures, quantification and requirements for total HVAC air distribution system air leakage performance for commercial building applications.

14. Adjournment

- Meeting adjourned 5:30 PM by voice vote unanimously.

Exhibit 1
Duct Design Manual
Table of Contents & Assignments (Rev. 12)

Chapter	Title	Rev	Sub-Sections	Primary Responsibility	Draft Received	Reviewed by PJB	Reviewed by HFB	Reviewed by PJB	To Reviewers
	Table of Contents	11		Editor					
	Foreword			ASHRAE Editor/All					
	Acknowledgements								
1	Introduction	1		Rich Evans	Yes (June 09)	Yes	Yes (Feb 11)		1/26/10 1/11 (Rev. 1)
2	HVAC/Duct System Design Process	5		Rich Evans	Yes (June 09)	Yes	Yes (Feb 11)		1/26/10 1/11 (Rev. 5)
3	Room Air Distribution	0		Herman Behls	Yes (Feb 11)				1/11 (Rev. 0)
4	Equipment Room Location & Duct Layout	5		Rich Evans	Yes (June 09)	Yes			1/26/10 1/11 (Rev. 5)
5	Fundamentals and Design Tools	9		Herman Behls	Yes (9/9/09)	Yes (11/1/09)	Yes (1/19/10)	Yes (1/20/10)	1/26/10 1/11 (Rev.9)
6	Duct Design Methods	7	Text	Herman Behls	Yes (9/9/09)				1/11 (Rev. 7)
		6	Equal Friction Text & Example	Herman Behls	Yes (9/9/09)	Yes (1/2/10)			1/26/10 1/11 (Rev.6)
		5	Static Regain Text & Example	Herman Behls	Yes (9/9/09)	Yes (1/2/10)			1/11 (Rev. 5)
7	Duct Design	2		Herman Behls	Yes (Feb 11)				1/11 (Rev. 2)
8	Industrial Local Exhaust Systems	14	Text	Pat Brooks	Yes (7/27/09)		Yes (5/4/10)	Yes (5/23/10 (Note 1)	1/11 (Rev. 14)

Chapter	Title	Rev	Sub-Sections	Primary Responsibility	Draft Received	Reviewed by PJB	Reviewed by HFB	Reviewed by PJB	To Reviewers
		Included above	Example Design	Pat Brooks	Yes (7/27/09)		Yes (5/4/10)	Yes (5/23/10)	1/11 (Rev.14)
9	Air Dispersion Systems	1		Kevin Gebke	Yes (9/18/09) (HFB met with Kevin 4/28/10)				1/11 Rev. 1)
10	Residential Systems 1. Rigid Duct Systems 2. Flexible Duct Systems	0 (PDF)		Wes Davis	Yes (9/2/09)				1/11 (Rev.0)
				Herman Behls					
11	Duct System Acoustics	7		Pat Brooks	Yes		Yes (12/29/09)	Yes (1/3/10)	1/26/10 1/11 (Rev. 7)
12	Specialty Topics	2	1. Leakage 2. Materials 3. Fans	1. Herman Behls 2. Bob Reid 3. Herman Behls					1/11 (Rev. 1)
13	Commissioning	0	1. Pre-Design Phase 2. Design Phase 3. Construction Phase 4. Occupancy & Operation Phase	Herman Behls					1/11 (Rev.0)
14	Duct System Controls								

Chapter	Title	Rev	Sub-Sections	Primary Responsibility	Draft Received	Reviewed by PJB	Reviewed by HFB	Reviewed by PJB	To Reviewers
	(VAV. Laboratory)								
	Index			Editor, All					
	Each Chapter has Nomenclature								
	Each Chapter has References								

Committee:

Pat Brooks, Chair
Herman Behls
Wes Davis
Richard Evans
Kevin Gebke
Bob Reid

Reviewers:

Bass Abushakra
Payton Collie
Charles Culp
Mark Terzigni
Chris Van Rite
Jeff Boldt
Craig Wray

Notes:

1. Dr. Gerhard Knutson explained the basis for acfm in the ACGIH Industrial Ventilation Manual (particle control vs. particle collection).

Exhibit 2

Title: HVAC Supply Tees with Balancing Dampers

State-of-the-Art (Background):
(1) The ASHRAE' electronic *Duct Fitting Database* (DFDB) was developed in 1989 and supported by ASHRAE research where necessary to increase the population of common air duct fittings.
(2) Takeoffs with balancing damper are not in the DFDB, but are manufactured and marketed by wholesalers and fabricated by sheet metal contractors. This fitting should be in the DFDB.

Justification and Value to ASHRAE: Subject fitting is a popular fitting that is not in the DFDB. Fitting is needed by duct design engineers so that they have available a complete population of common duct fittings. This will allow consulting engineers to properly estimate the resistance of HVAC air systems and select properly sized fans.

Objectives:
(1) To determine the optimum orientation (parallel or perpendicular to flow) for one arrangement (round main to round branch.).
(2) To determine the optimum location of the branch damper for four arrangements: rectangular main to round branch, and round main to round branch, each with a 45º entry tee and a straight-body tee.
(3) To determine the loss coefficients of open balancing dampers for the sizes listed under scope. Orientation and location shall be that determined previously.

Application of Results: Tees with balancing dampers will be added to the DFDB.

Procedures: Test shall be conducted in compliance with ASHRAE Standard 120-2008.

Scope: Main and branch duct sizes to be evaluated are

Sizes:

Main (Round and Rectangular): Sized at 2000 to 2500 fpm
Branch: (round): 4, 8, 12, 16, and 20 in,

Exhibit 3

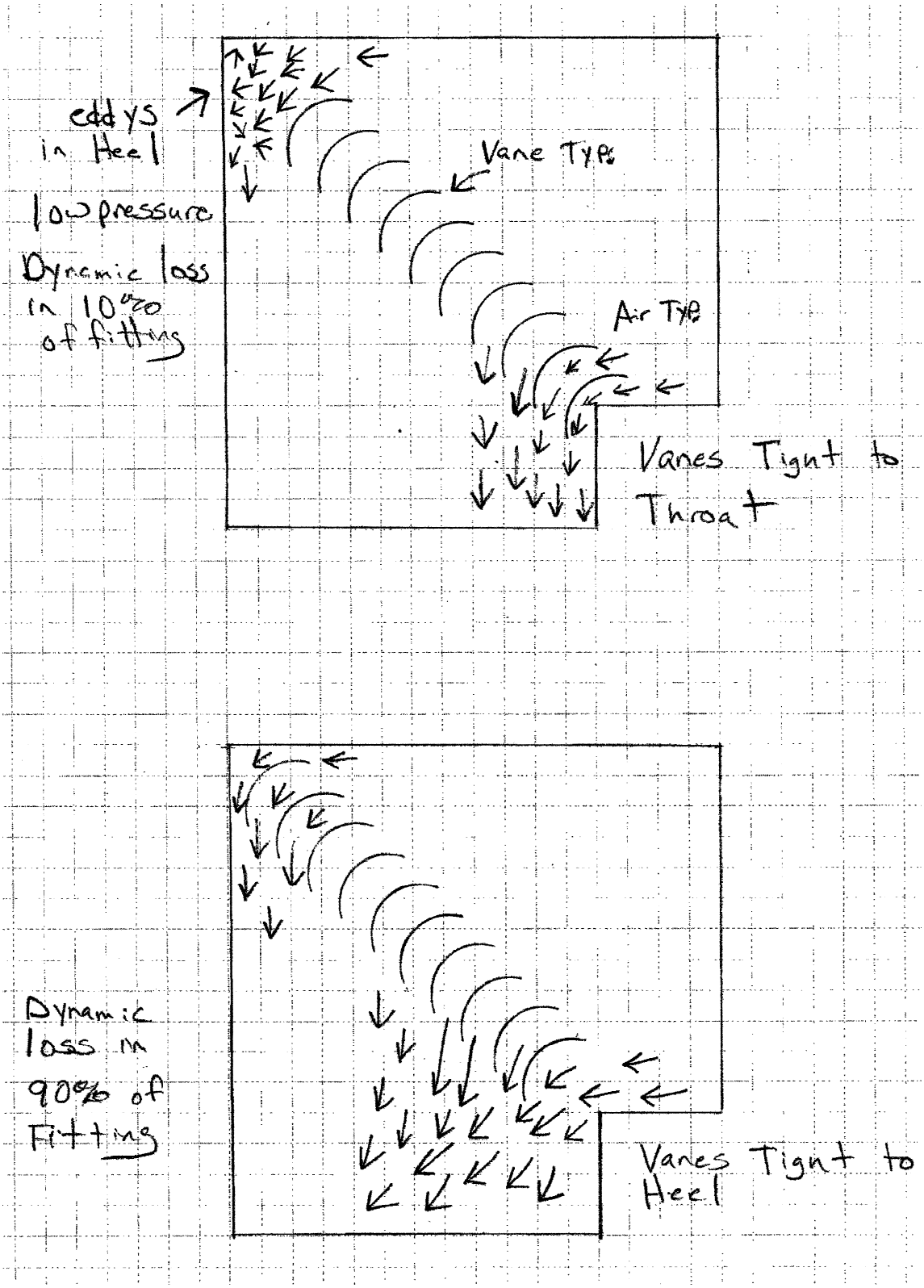
eddys in Heel
low pressure
Dynamic loss in 10% of fitting
Vane Type
Air Type
Vanes Tight to Throat
Dynamic loss in 90% of Fitting
Vanes Tight to Heel

Exhibit 4

Addendum [] to 90.1-2010

Revise the Standard as follows (S-I and I-P units)

6.4.4.2 ~~Ductwork and Plenum Leakage~~ Air Distribution System Leakage

6.4.4.2.3 VAV Box Leakage. Air leakage for VAV boxes shall be determined in accordance with ASHRAE Standard 130. Each manufacturer shall list leakage for their terminal units and include that leakage in their AHRI certification. Air leakage for single-duct, non-fan-powered VAV boxes shall not exceed the values in table 6.4.4.2A. Air leakage for dual-duct VAV shall not exceed the values in table 6.4.4.2B.

TABLE 6.4.4.2A - SINGLE DUCT VAV BOXES, NOT INCLUDING FAN-POWERED BOXES
DAMPER LEAKAGE TESTED AT 1" DIFFERENTIAL PRESSURE
CASING AND DOWNSTREAM APPURTENANCES LEAKAGE TESTED AT 0.5" DIFFERENTIAL PRESSURE

DAMPER SIZE	AHRI NOMINAL RATING (CFM)	DAMPER MAXIMUM LEAKAGE (CFM)	CASING MAXIMUM LEAKAGE (CFM)	1-ROW WATER COIL MAXIMUM LEAKAGE (CFM)	WATER COIL MAXIMUM LEAKAGE PER ADDITIONAL ROW (CFM)	ELECTRIC HEATER MAXIMUM LEAKAGE (CFM)	MULTIPLE OUTLET PLENUM MAXIMUM LEAKAGE (CFM)
4"	150	8	4	2	2	6	4
5"	250	8	4	2	2	6	4
6"	400	8	4	2	2	6	4
7"	550	14	7	3	2	8	6
8"	700	14	7	3	2	8	6
9"	900	22	11	4	6	10	8
10"	1100	22	11	4	6	10	8
12"	1600	32	16	8	12	10	8
14"	2100	42	21	10	15	12	12
16"	2800	56	28	12	18	12	15
16" X 24"	5350	107	53	15	21	15	26

TABLE 6.4.4.2B - DUAL DUCT VAV BOXES, NOT INCLUDING FAN-POWERED BOXES DAMPER LEAKAGE TESTED AT 6" DIFFERENTIAL PRESSURE CASING AND DOWNSTREAM APPURTENANCES LEAKAGE TESTED AT 1" DIFFERENTIAL PRESSURE			
DAMPER SIZE	AHRI NOMINAL RATING (CFM)	DAMPER MAXIMUM LEAKAGE (CFM)	CASING MAXIMUM LEAKAGE (CFM)
4"	150	12	6
5"	250	12	6
6"	400	12	6
7"	550	21	11
8"	700	21	11
9"	900	33	17
10"	1100	33	17
12"	1600	48	24
14"	2100	63	32
16"	2800	84	42

12. Normative References

ASHRAE Standard 130-2008 Methods of Testing Air Terminal Units

Exhibit 5

TITLE: HVAC Air System Leakage

PURPOSE:

(1) To establish best-practice guidance and acceptance criteria related to air-handling system sealing and leakage testing for inclusion in ASHRAE documents.
(2) To encourage enhanced HVAC system performance.

SCOPE:

(1) Conduct a search for literature related to air-handling system leakage and prepare an annotated summary to document the findings.
(2) Develop Air-Handling System Leakage sections for the following ASHRAE Handbooks:
    a. 2012 HVAC Systems and Equipment, Duct Construction chapter
    b. 2013 Fundamentals, Duct Design chapter
(3) Develop an Air-Handling System Leakage Technical Bulletin.
    Identify knowledge gaps that require further research.

Exhibit 6

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