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 5.2 DATE June 27, 2017

TC/TG/TRG TITLE Duct Design

DATE OF MEETING June 27, 2017 LOCATION Long Beach, CA

MEMBERS PRESENT	TERM TO	MEMBERS ABSENT	YEA	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Bob Reid, Chair	6/30/17	P	N	Ken Peet, Section 5 Head
Tim Eorgan, Vice Chair	6/30/18	P	N	David John, Research Liaison
	6/30/18	Scott Hobbs, Sec.	N	John Constantinide, Webmaster, CM
Herman Behls	6/30/17	P	N	Larry Smith, CM
Kevin Gebke	6/30/17	P	N	Charlie Culp, CM
Vikram Murthy *	6/30/17	P	N	Ralph Koerber, CM
Craig Wray	6/30/17	P	N	Jeff Boldt, CM
	6/30/18	Johnny Andersson *	N	Bruce Meyer, CM
Pat Brooks	6/30/19	P	N	Robert Hassler, CM
David Dias	6/30/19	P	N	Wes Davis, CM
John Hamilton	6/30/19	P	N	Perry Philp, CM
Cindy Bittel	6/30/20	P	Y	Marcus Bianchi, CM
	6/30/20	Bill Smith	N	Mark Smith, CM
Neal Walsh	6/30/20	P	N	Ralph Koerber, CM
				Chris Van Rite, CM
				Gavin Hunter, PCM
				Allison Bailes, G
				David Aquilina, G
				Shawn Ohara, G

*** Member Non-Quorum**
CM = Corresponding Member
PCM = Provisional Corresponding Member
G = Guest

DISTRIBUTION

All Members of TC plus the following:	
TAC Section Head	Ken Peet
TAC Chair	Michael Bilderbeck
2017 Handbook Liaison (Fundamentals)	Larry Akers
2020 Handbook Liaison (Systems & Equipment)	Florentino Rodriguez
Research Liaison	David John
Standards Liaison	Dr. Arsen Melikov
ALI/PDC	James Bochat
Chapter Tech Transfer	James Arnold
Staff Liaison	Mike Vaughn

ASHRAE

1791 Tullie Circle, N.E.
Atlanta, GA 30329

ASHRAE Annual Conference, Long Beach, CA

TC 5.2 Duct Design

Tuesday, June 27, 2017
Time: 3:30-6:00 PM

Location: Long Beach Convention Center
Seaside 4B

1) **Call to order:**
2) **ASHRAE Code of Ethics Commitment (Bob Reid)**
"In this and all other ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, integrity and respect for others, and we shall avoid all real or perceived conflicts of interest. (See full Code of Ethics: https://www.ashrae.org/about-ashrae/ashrae-code-of-ethics*.)"*
3) **Introductions and Attendance**
   a) Introduction of people present
   b) Quorum determination
      i) Quorum reached: 10 of 13 members present during Executive Session
      ii) Quorum reached: 9 of 13 members present outside of Executive Session
   c) Corrections/additions and Approve agenda
      i) Agenda: Wray moved, Gebke seconded, passes 9-0-0-4 CNV as amended.
4) **Las Vegas (January 2017) Meeting Minutes**.
   a) Minutes from the Las Vegas meeting were approved by electronic ballot May 30, 2017 10-0-0-5 CV.
5) **Special Announcements**
   a) ASHRAE Vision - ASHRAE will be the global leader, the foremost source of technical and educational information, and the primary provider of opportunity for professional growth in the arts and sciences of heating, ventilating, air conditioning and refrigerating.
   b) Thank you letters to your employer --- all committee members who have served ASHRAE during the 2016-2017 society year only will receive an e-mail early in the month of July containing information on how to submit a request for the ASHRAE President to send a thank you letter to their employer.

6) **Section Head Report**

   a) Section Head 5.0 Highlights --- *The section 5.0 chairman's breakfast was be held on Sunday, June 25, 2017.* **ATTACHMENT A**

      i) Addressed CEC items and having an updated website.

      ii) Many thanks for his term of service as Section Head.

   b) Please update your on-line ASHRAE bio

6) **TC 5.2 Items (Bob Reid)**

   a) Acknowledge our PCMs --- mentorship

      i) Mufeed Alshakhori, Akshay Bhargava, Eugene Fairs, Timothy Gordon, Sreenidhi Krishnamoorthy

      ii) PCMs who want a member should ask the TC Chair for one.

      iii) Vikram Murthy will be Akshay Bhargava's mentor.

   b) Historian (Bob Reid)

      i) Starting for Society Year 2017-2018

   c) Contractor involvement

      i) Encourage contractors to take part in the TC

   d) Education internal to the TC

      i) Possible future sessions -- suggestions welcome

         (1) Chris Van Rite had suggestions for future suggestions relating to insulation products, including a bubble-based insulation.

      ii) Future roundtables

         (1) A program on insulation will be put together for Chicago

   e) Honors and Awards (Steve Idem)

      i) Herman Behls is being nominated for Holliday and Hightower Awards.

7) **Subcommittee Reports**

Sub-committee meeting
Monday – June 26, 2017 8:00 – 12:00 PM
Location: Long Beach Convention Center
Room: Seaside Ballroom A

Subcommittee Meetings – ATTACHMENT B

   a) Handbook

      i) 2020 Handbook: HVAC Systems & Equipment (Duct Construction chapter) --- David Dias, Ralph Koerber, Bob Reid

      ii) 2021 Handbook: Fundamentals (Duct Design chapter) --- Vikram Murthy, Wes Davis, John Constantinide

      iii) Authoring Portal is now used by TCs for Handbook updates.

   b) Membership (Cindy Bittel)

      i) New provisional corresponding members added during 2016-2017 society year:

         (1) Mufeed Alshakhori --- Fresno, CA

         (2) Timothy Gordon --- Merrifield, VA

         (3) Akshay Bhargava --- Indianapolis, IN

         (4) Gavin Hunter --- Atlanta, GA

         (5) Zay Zay --- ThinGunGyun, Myanmar

      ii) Voting members rolling off: Bob Reid, Herman Behls, Kevin

Gebke, Vikram Murthy, Craig Wray, Bill Stout (resigned)
iii) New voting members on July 1, 2017: Ralph Koerber, John Constantinide, Wes Davis, John Gierzak, Chris Van Rite
iv) New officers for 2017-2018 society year: Tim Eorgan (Chair), Scott Hobbs (Vice Chair), John Constantinide (Secretary), Cindy Bittel (Webmaster)
v) Moving from PCM to Corresponding Member: Gavin Hunter, Perry Philp
vi) New Membership Chair: Akshay Bhargava (PCM, YEA)
(1) Being Central Indiana Chapter MP Chair, he will help bring resources to expand TC.
(2) Contact Akshay to get a mentor or be a Voting Member.
vii) John Constantinide e-mailed the TC the "Introduction to TCs" presentation that can be presented to chapters.

c) Programs (Steve Idem)
i) See CEC handout – **ATTACHMENT C**
ii) Potential 2018 Houston presentations for White Paper generation
(1) Discussion of programs
(2) Bob Reid will be a part of a program from the Seismic TC (Wind Effects of Rooftop Units, Piping, and Ducts) in Earth, Wind, and Fire track
(a) **Motion for TC Co-sponsorship of session: Dias moved, Wray seconded, Roll Call Vote 9-0-0-4 CNV**
iii) **Motion: TC 5.2 Co-sponsoring Optimization of HVAC&R Systems track**
(1) **Wray moved, Dias seconded, Roll Call Vote 9-0-0-4 CNV**
(2) Discussion: TC members agree that track needs clarification of building type, intent, inclusion of residential, and parameters of track.

d) Duct Design Guide (Pat Brooks)
i) ASHRAE has set up an FTP site for the Duct Design Guide
Site address: http://files.ashrae.org/
Username: tc5.2ddg
Password: DDG@dmin1
ii) Chapter 6 in progress
iii) Chapter 9 --- Air Dispersion Systems --- See **ATTACHMENT D**
(1) Motion: Remove noted Chapter 9 from DDG (with included friendly amendments): Wray moved, Dias seconded, Passed with Roll Call Vote 9-0-0-4 CNV
(a) Friendly amendment by Reid accepted by Wray: Reference to prospective guide based on Chapter 9 will be inserted in the DDG
(b) Friendly amendment by Gebke accepted by Wray: Intent to make Chapter 9 its own guide
(c) Discussion
(i) Wray: Chapter is too long, addresses items not addressed elsewhere in DDG, and can be its own guide. DDG can refer to the new guide that will come from Chapter 9, and removing this item can get this draft published.
(ii) Gebke: Chapter 9 complements what is in DDG and does not distract from scope.
(iii) Smith: Editing will reduce page count.

(iv) Reid: Chapter 9 is relevant, but a briefer version of the chapter can be provided as a separate document.
(v) Vikram: Chapter 9 still has popular forms of ductwork, although it is not characteristic of what is in DDG.

e) Duct fitting database (DFDB) (Herman Behls and Pat Brooks)
   i) Comments from Reid/Eorgan on meetings received from Steve Comstock on DFDB app
   ii) Publications and Education Council would like to keep the app as a way for people to use that would lead to purchase of the full database
   iii) Brooks: 3 current versions exist: App, Online, and Desktop. Move is to keep App and phase out Desktop version to promote Online version.

f) Code Interaction (Ralph Koerber)
   i) "5 Questions for CIS (Code Interaction Subcommittee)" from John Hamilton - See **ATTACHMENT E**
   ii) Motion to approve 5 Questions for CIS: moved by Hamilton, seconded by Dias, Passed with Roll Call Vote 7-0-2-4 CNV
      (1) Discussion: 4 questions related to air connectors and 1 related to duct material asked to NFPA, IMC, and UMC.
   iii) At next meeting in Chicago, Koerber will present bends at air terminals to TC.

g) ASHRAE Learning Institute (ALI) (Pat Brooks)

h) Webmaster (John Constantinide)
   i) TC5.2 Website: https:/TC0502.ashraetcs.org/
   ii) New Incoming Webmaster: Cindy Bittel
   iii) Use of Basecamp: John proposed using it. The TC generally agreed to start using it. Cindy and John will put together a tutorial and set it up with Society.

i) Liaison Reports
   i) 90.1 (Mark Smith)
      (1) At 90.1 Meeting with TCs, the following discussions were addressed.
         (a) Definition for "buried duct work"
         (b) IAPMO Codes with Duct Changes
         (c) 2013 to 2016 changes discussed.
      (2) 90.1 Language Task Group – Bob Reid will have first conference call next week to start and include Jeff Boldt in communication.
   ii) SSPC 189.1 (Scott Hobbs)

j) Research (Behls/Brooks)
   i) 1180-RP <u>Duct Design Guide</u> --- after default of original contractor, this project is being completed by TC 5.2.
   ii) TRP-1764 Determine the Absolute Roughness for Phenolic Duct Board and Loss Coefficient for Rectangular Radius Elbow
      (1) **<u>EXECUTIVE SESSION</u>**: Discussion was conducted on voting members leading to **approval with vote of 10-0-0-2 CNV**.
   iii) WS-xxxx Reducing Barriers to Achieving Low Leakage Air Handling Systems (Wray) --- See **ATTACHMENT F**

k) Standards
   i) SPC 120-2016R "Method of Test to Determine Flow Resistance of HVAC Ducts and Fittings" (Kevin Gebke). – Published this year. No action needed.
   ii) Standard 126-2016 "Method of Testing HVAC Air Ducts" --- (Kevin Gebke). Published

last year. No action needed.

iii) Standard 215P (Craig Wray) – Met yesterday afternoon. Voted for public review. Wray will work with ASHRAE Staff on the review.

l) Flexible Duct Subcommittee (Ralph Koerber) – Proposal to strike residential exception. For now, residential exception will remain until further changes are made in the code development process.

8) Deadlines

7/7/2017	Conference Papers Due	2018 Winter Conference (Chicago)	Conference Papers
8/1/2017	Proposals Due	2018 Winter Conference (Chicago)	Seminar, Forums, Debates & Panels
8/26/2017	Approved & Posted	2017 Annual Conference (Long Beach)	TC5.2 Minutes
8/28/2017	Abstracts Due	2018 Annual Conference (Houston)	TC Papers or Sessions
12/8/2017	Conference Papers Due	2018 Annual Conference (Houston)	Conference Papers
1/8/2018	Presentations Due Online	2018 Winter Conference (Chicago)	Chicago Presentations
2/9/2018	Proposals Due	2018 Annual Conference (Houston)	Seminar, Forums, Debates & Panels
6/1/2018	Presentations Due Online	2018 Annual Conference (Houston)	Houston Presentations

9) Old Business

a) Duct Design software programs

b) TC5.2 Long Range Objectives --- See **ATTACHMENT G**

a) Motion to adopt Long Range Objectives: Wray moved, Hamilton seconded, Passed with Roll Call 9-0-0-4 CNV

10) New Business

a) CIS looked for new members. Submissions were needed to be submitted by January 8, 2017. Recommendations should have come from the TC Chair.

a) Bob Reid appoints Hamilton as CIS Liaison of STD-C.

b) Chris Van Rite serves on UMC Board for IAPMO.

11) Action Items

TC 5.2 (Duct Design) Action Items			
Number	**Description**	**Assigned to**	**Status**
1	**Add new fittings to DFDB as determined by plasma machines and/or catalogs**	**Larry Smith, Herman Behls**	No action recommended. Closed.
2	**RTAR covering cost to seal ductwork**	**Neal Walsh, Pat Brooks**	**Active**
3	**Remove TC5.2's FAQ's from ASHRAE system**	**Bob Reid**	Letter sent to ASHRAE staff. Closed.

12) Adjournment

Wray moved, Hamilton seconds, no objections. Adjourned 6:07 PM.

Upcoming Meetings:

2018 ASHRAE Winter Conference --- Chicago, IL January 20-24, 2018

2018 ASHRAE Annual Conference --- Houston, TX June 23-27, 2018

2019 ASHRAE Winter Conference --- Atlanta, GA January 12-16, 2019

2019 ASHRAE Annual Conference --- Kansas City, MO June 22-26, 2019

ATTACHMENT A

AGENDA
SECTION TC/TG/TRG CHAIR'S BREAKFAST MEETING
2017 Annual Meeting
Long Beach, CA

Sunday, June 25th
6:30 A.M. – 8:00 A.M. PDT
Renaissance Hotel – ALL Section meetings located on either 1st, 2nd, or 3rd floor as noted below.

Section 1, Bixby 1 Room – 2nd Floor
Section 2, Bixby 2 Room – 2nd Floor
Section 3, Dawson Room – 3rd Floor
Section 4, Broadlind 1 Room – 2nd Floor
Section 5, Pike 3 Room – 1st Floor
Section 6, Bixby 3 Room – 2nd Floor
Section 7, Broadlind 2 Room - 2nd Floor
Section 8, Pike 2 Room – 1st Floor
Section 9, Pike 1 Room – 1st Floor
Section 10, Nieto Room - 2nd Floor
MTG Section, Tichenor Room – 2nd Floor

Note: The agenda and times estimated are for guidance only and should be modified to be sure the most important information is discussed and that there is adequate time to discuss things important to the committee chairs. Note that the time estimates shown allow for other important business to be conducted within the time frame allotted.

a.1. Introduction of TC/TG/TRG/MTG Chairs, Vice Chairs, and guests (5 minutes).

a.2. Review and approval of agenda (2 minutes). (note that you might want to solicit additions and corrections at the time the draft agenda is sent to the TC Chairs – it is almost impossible to do anything in only 2 minutes)

a.3. Summarize discussion from last meeting and status of actions assigned, if any (5 minutes).

a.4. Liaisons from other committees should each be given a chance to speak and distribute information pertinent to the section from their committee. An effort should be made to accommodate their schedules without major disruption of the Section meeting (15 Minutes).
- a.4.1. Research Administration
- a.4.2. Conference and Exposition Committee (CEC)
- a.4.3. Handbook
- a.4.4. Other Standing Committees

a.5. Discuss the MBOs set for the year and how the section can work together to address them (10 minutes).

a.6. Review summary report for the Section prepared from the TC/TG activity database and TAC (15 minutes).
- a.6.1. Section activities and trends will be discussed relating to membership, research, programs, publications and new communication tools and services.
- a.6.2. Do TCs prefer to go back to a paper activity form instead of MS-Excel form used now?

a.7. Identify shared opportunities and challenges for section (10 minutes).

a.8. Announcements and Reminders for TC/TG/TRG & MTG Chairs (Handout)

a.9. Adjourn.

Announcements and Reminders for TC/TG/TRG & MTG Chairs
LONG BEACH 2017

A. NEW!

1. **Discuss and confirm that TGs, TRGs, and MTGs in section will continue in 17-18 Society Year or disband**
   TBD

2. **17-18 Rosters Access & Distribution -** Remember, the current 2016-2017 roster for your TC, TG or MTG is in effect until after the June meeting this year – through Friday, June 30th.

   TC, TG and MTG chairs will soon receive a PDF & MS-Excel file of their new 2017-2018 roster from their Section Head or staff for distribution to the committee. In addition, each member can view all of the rosters of their committees on the ASHRAE Website once the new Society year goes into effect. Go to www.ashrae.org http://www.ashrae.org , click on the "Membership & Conferences" tab in the header, click on "My Membership" text in the left sidebar, and log in (if you have not logged in lately, you might need to set up a new username and password). Click on the "Update Your Bio / View or Edit Tour Profile" link. Now, you should see your current "bio info". Click on "Committees" on the left sidebar; all of the committees you are a member of will appear. Click on the "blue" roster text at the left hand side of a committee to reveal the roster with linked contact information. Make sure everyone on your committee also knows how to access the roster once the new Society year begins.

   The Provisional Corresponding Member (PCM) position is a relatively new position on TC/TG/TRG rosters. This position allows potential new members to be added by staff to the committee roster any time a request for membership is made by an individual. The position has a 2-year term on the committee. Staff will notify the chair and reissue a new roster to the committee chair any time a provisional member is added. The TC/TG/TRG chair has the option each year during the regular roster update process to convert provisional CMs that have been active participants on the committee the past year into regular CMs or voting members or drop them. If no action is taken, they will time expire from the roster and be removed by staff.

3. **Let's Celebrate ASHRAE's Technical Excellence Historically!**
   ASHRAE is highly regarded for its technological advances. Consider that these advances evolved from the efforts of our predecessors and you, and the current members of ASHRAE's Technical Committees in advancing HVAC&R technology are building on a deep foundation. So, what is the historical foundation of your Technical Committee specialty? ASHRAE will be celebrating its 125th anniversary in a couple years. The Historical Committee has a project to publish articles in the ASHRAE Journal and organize paper presentations celebrating our technical heritage for the anniversary. We plan to emphasize technical advances after 1920. Can you help with an article or a

paper or can your TC organize and sponsor a program session for the 2019-2020 meetings?

Here is a list of topics that TC members have already suggested.

- Development of open communication protocols such as BACNET.
- Modern improvements in psychrometrics (Goff & Gratch).
- History and effect of the Environmental movement on our technology. How technology and equipment has improved the indoor environment.
- The refrigerant revolution
- Solving the problems of “sick buildings.”
- The re-discovery of past technology and its application today (such as district energy, hydrocarbon refrigerants, off peak energy storage, “total energy” systems, etc.)
- History of the application of electronics to HVAC&R technology.
- ASHRAE’s long history in applying innovative technology.
- History and importance of frozen food technology.

All of these topics and others you may think of need to be written up and/or presented by someone.

How about YOU?

The 125th anniversary will be celebrated at the 2020 winter and Annual meetings. The Historical Committee has been charged with the responsibility of organizing Society and industry history projects for the 125th. If you would like to submit an article or a paper or organize a program session, contact Emily Sigman, Historical Committee Staff Liaison at esigman@ashrae.org.

There is a deadline – please submit abstracts or outlines before **September 30, 2017**.

4. **Oversight of TC websites with regard to *Technical Bulletins* (White Papers) and alignment with Society positions, policy, or opinions**
TCs are allowed to develop Technical Bulletins - A Technical Bulletin does not result from a technical meeting and is a brief 1-2 page statement on a special interest HVAC&R topic that has been developed by either a technical or grassroots committee of ASHRAE. After the TC approves the Technical Bulletin, TAC is responsible for coordinating a peer review by a minimum of three persons with expertise in the field of the bulletin before it can be posted. In addition, ASHRAE’s policy for websites states the following: **“4 (3) f. Statements and presentations may not appear on web sites that state, purport, or imply that they present ASHRAE positions, policy, or opinions.”**

5. **Additional TC E-mail Position Aliases Now Available**
New position e-mail alias addresses have now been created for each of the remaining mandatory positions of the Technical Committee management team (Secretary,

Standards Sub. Chair, Program Sub. Chair, Handbook Sub. Chair, and Webmaster). The 16-17 E-mail Alias list with these new position aliases is posted on the ASHRAE website www.ashrae.org/TCs under the heading *Procedures, Forms & Information for TCs/TGs/MTGs and TRGs*. The new 17-18 E-mail Alias list will be posted in the same location shortly after the Long Beach meeting.

6. **New Restructured TC MOP (Manual of Procedures) issued**
   TAC has restructured the TC MOP so that it is easier to navigate and find information. The new TC MOP can be found on the ASHRAE website www.ashrae.org/TCs under the heading *Procedures, Forms & Information for TCs/TGs/MTGs and TRGs*.

7. **Distribution of TC minutes changed in TC MOP**
   The TC MOP and *TC/TG/MTG/TRG Minutes Cover Sheet* form have both been updated and you are no longer required to send the TAC chair a copy of your minutes after each meeting. The new minutes cover sheet can be found on the ASHRAE website www.ashrae.org/TCs under the headings *Procedures, Forms & Information for TCs/TGs/MTGs and TRGs – Routine Forms for TC/TG/MTGs/TRGs*.

8. **How to Import Your TC Roster Information into MS-Outlook**
   Detailed instructions on how to import your TC roster information into MS-Outlook has been created and an e-mail announcement will be issued to all TC chairs, vice chairs, and secretaries once these instructions and the restructured TC MOP are posted to the TC page of the website (www.ashrae.org/TCs)

9. **Updated TAC Presentation Template Available for TC members to use with local Chapter**
   TAC recently updated the standard presentation and presentation notes that TC members can use, without a lot of effort, to explain what TCs do for the Society and how that work benefits members in your local ASHRAE Chapter. You should also know that use of this presentation at a chapter meeting in SY 17-18 will earn a chapter 50 (100 points maximum) PAOE points. Additional PAOE points are also possible in SY 17-18 for a presentation(s) on the work of one specific TC.

   The new presentation and presentation notes files are posted now at the following link www.ashrae.org/tcs under the heading *General TC Information* at the top of the page in case you prefer to direct others to these files posted online. The presentation material is now also available in both English and Spanish.

10. **Basecamp Information from ECC**
    More and more TCs and standing committees are making use of ASHRAE's subscription to Basecamp3 to better organize, store, and distribute online committee files that are needed for their meetings through a dedicated committee Basecamp site. If you would like to learn more about Basecamp and how to request a site for your particular committee, please go to the Electronic Communications Committee (ECC) web page:

(https://www.ashrae.org/society-groups/committees/electronic-communications-committee) and scroll down to the section titled *Guidance for Basecamp 3*

B. AT THIS MEETING

1. On-Site Training Options

i. **TC/TG/TRG Chair's Training Workshop Reminder**
Sunday June 25th, 9:45-10:45 AM in Room #101A, 1st Floor, in the Long Beach Convention Center. The training will start with a brief presentation on how to run Effective Meetings and then highlight some of the online resources that are available through the TAC training portal for additional training and information on a variety of topics. The training session will also have a Q&A session so that you can also get answers to your specific questions.

ii. **RAC's Research Subcommittee Chair's Breakfast**
Monday, June 26th, 6:30 AM – 9:30 AM in Regency room, 4th Floor, Hyatt Regency Hotel. Please encourage your Research Subcommittee Chair or another representative from the TC to attend this meeting so that your RAC Research Liaison (RL) can get an update on the TC's research activities and so that your RL can help resolve issues & questions that TC may have concerning their research program. The training portion of this meeting will focus on changes to the *Research Manual*.

iii. **TC Program Subcommittee Chair Training in Long Beach**
Tuesday, 6/27, 11:15 AM – Noon, Room #202C, 2nd Level, in the Long Beach Convention Center. *Don't complain about the meeting program and your TC's submissions if you have not been to training*.

A few things you might learn in training are as follows:

- Incomplete program submissions is the biggest reason for rejection now. All information is needed up front for CEC selection process.
- A packaged session on a similar topic is the best way to greatly improve your chances for acceptance.
- There is no difference in how CEC handles 60 and 90 minute program slots. 60 minute slots are just as good as 90 minute slots if complete.

2. Location of Section Head Mailboxes & Free Wi-Fi Access at this Society meeting

Mailboxes are located just outside ASHRAE Headquarters Office (Seaview Ballroom B & C – Lower Level (1st floor) – Hyatt Regency Hotel).

Also, Internet access and computers for e-mail are available in the Cyber Café located in the registration area during operating hours. Please be considerate to others and limit your usage to five minutes.

Wireless internet will be available in all meeting rooms at the Hyatt, Renaissance, and Long Beach Convention Center. ASHRAE will be working with the internet provider to manage the bandwidth so that member expectations of accessibility and speed are fulfilled. We would like to request that everyone limit their usage to functions that do not use excessive bandwidth. Applications such as Facebook, YouTube, streaming video, etc. use excessive bandwidth.

Hyatt & Renaissance Wi-Fi Access: **PSAV_High_Speed** is the network, **ashrae2017** is password (case sensitive).

Long Beach Convention Center Wi-Fi Access: **ashrae2017** is the network, **longbeach** is password (case sensitive).

3. **RPM (Remote Participation Meetings) being held in Long Beach**
   The 12th RPM (Remote Participation Meeting) Capable Society Meeting, which allows some TC members to participate in the TC meeting from a remote location electronically, will occur in Long Beach and the following fifteen TCs have agreed to participate in this effort: TC 1.6, TC 1.10, TC 1.12, TC 2.1,TG2(HVAC), TC 5.8, TC 5.11, TC 6.9, TC 7.3, TC 7.9, TC 8.3, TC 9.2, TC 9.4, TC 10.3, and TC 10.6 – This represents a 25% increase over the number of TC's hosting RPM meetings in Las Vegas. A total of 43 RPM meetings will be hosted in Long Beach when you include project committee and other committee meetings. For comparison, a total of 38 RPM meetings were hosted in St. Louis last year at this time.
   The chairs of those TCs participating should provide to their Section Head feedback on their RPM meeting experience before TAC meets on Wednesday morning, 6/28.

4. **Name Badges**
   As offered in the past, members of TCs who are not registered for the Conference and plan to only attend TC meetings may receive a free, plain white name badge. The purpose of these badges is for TC members not registered for the Conference to be able to identify one another in meetings.

   To receive your badge, please go to the ASHRAE Registration desk located in room 104 at the Long Beach Convention Center and look for the sign for "TC Badges." Please identify yourself as someone only attending committee meetings, not registered for the Conference, who would like a white name badge. An ASHRAE staff person will create a badge for you that includes your name, company name and city, state and country (if outside the U.S.). The badge will not have a QR code and will not allow you into the Technical Program.

   However, if you'd like to register for the entire Conference you can do so in advance or onsite. We realize your time is limited, one-day registrations ($270 for Members) are available as well as one-session registrations ($70). If you wish to register for one day of the Technical Program you or one session, you can do so at the ASHRAE Registration desk. The One-Day option gives you access to the Virtual Conference which is viewable on-demand for 18 months. Questions? Contact meetings@ashrae.org.

5. **Retiring TC/TG/TRG/MTG Chair Certificates**
TC chairs that are completing their terms as chair at this Society meeting will be presented with a certificate of appreciation. Please coordinate with your Section Head as to when and where at the meeting you would like to be presented with the certificate (Section meeting or TC meeting).

C. UPCOMING DEADLINES

1. **TC Activity Forms for the Long Beach Meeting are due to Your Section Head <u>before Wednesday, 6/28/17</u>**
TC/TG/TRG Activity Feedback Form (Excel) can downloaded from the Technical Committee webpage under the "TC Forms and Documents" page - https://www.ashrae.org/standards-research--technology/technical-committees/tc-forms-and-documents. Section heads can also provide an electronic copy of the form if requested.

2. **Thank You Letters to Employers**
ASHRAE President – Tim Wentz– has offered to send letters to the employers of TC volunteers this year thanking them for supporting their employee's service on an ASHRAE TC during Society year 2016-2017. If requested by the volunteer, the letter will be sent to his/her employer by the end of July or early August and the volunteer will receive a copy.

   Please let your committee members know that they will be receiving an email about employer thank you letters in early July with details on how to request a thank you letter.

3. **Seminar and Forum proposals for Chicago are due by Tuesday, August 1st, 2017.**
Please visit the following site to submit your proposal:
https://ashraem.confex.com/ashraem/w18/cfp.cgi

   For more information, go to: www.ashrae.org/chicago

4. **2017-2018 Hightower Award & Service to ASHRAE Research Award Nominations by Friday, September 1st**
Nominations for the 2017-2018 *George B. Hightower Technical Achievement Award* are due to you Section Head by September 1, 2017. The award recognizes outstanding technical leadership and contributions on a TC/TG/TRG during the past four years, excluding research and standards activities. Please go to the Technical Committee page of the ASHRAE website at the following link under the "Procedures, Forms…" heading: http://www.ashrae.org/tcs

   Nominations for the 2017-2018 *Service to ASHRAE Research Award* for TC volunteer efforts in research are due to RAC research liaison by September 1, 2017. Please go to the Research page of the ASHRAE website at the following link under the "Research Grants and Awards" heading: http://www.ashrae.org/research

5. **2018 RPM (Remote Participation Meetings) Request for Chicago Meeting**

   ASHRAE has streamlined the process for requesting RPM meetings moving forward, which will allow us to confirm meeting information earlier in advance of the actual meeting dates.
   The updated procedures are as follows:
   - ALL committees that want to be considered for an RPM capable meeting in Chicago next January must turn in an *ASHRAE Meeting Room Request Form* for Chicago to the ASHRAE Meetings section.
   - The request should include the reasons why you are requesting RPM meeting capability.
   - RPM meeting requests for the upcoming Chicago Winter meeting should be submitted by **Monday, October 2nd or sooner.**
   - Confirmation emails (verifying the requests) will be sent out in November 2017
   - Requests received after the above date may not be accommodated due to high and growing demand for this service.

D. REMINDERS

1. **Useful TC/TG/TRG/MTG Chair Information and forms on ASHRAE website**
   Information for TC/TG/TRG and MTG chairs can be found on the Technical Committee page of the ASHRAE website at the following link: http://www.ashrae.org/tcs

2. **Request for each TC to briefly review ASHRAE Code of Ethics at start of meeting**
   See the following link for the latest version of the ASHRAE Code of Ethics: https://www.ashrae.org/about-ashrae/

3. **Make a Special Effort to welcome new Members, and Visitors to TC meeting**
   Potential new members for your committee have been encouraged to drop-by your meeting. As a result, please make a special effort to recognize and warmly welcome all visitors to your meeting – A TC can never have too many willing and able volunteers.

4. **Option for TC Subcommittee Meetings via Conference Calls and Web Meetings**
   More and more TCs are taking advantage of a new Society service that allows TCs to hold subcommittee meetings by phone and/or web. Many TCs are finding this to be a more efficient way for them to conduct subcommittee business and it also allows TC members that can't travel to meetings on a regular basis a way to still contribute to the TC. Such a change can also eliminate potential conflicts with the TC's program sessions at Society meetings. Please pass your conference call/web meeting/webinar requests on to the Manager of Research and Technical Services, Mike Vaughn, at mvaughn@ashrae.org or MORTS@ashrae.net

5. **Is Your Committee Website up to Date?**
If not, please ask your webmaster to at least post the latest minutes and the Long Beach meeting times and agenda. If your website has been neglected, add an action item for this meeting to appoint a responsible member of the TC/TG/TRG who will bring it back to life. The new TC website template has greatly simplified the duties of the TC webmaster and this form of communication is critical to the efficient operation of your committee, and for attracting new members.

The recent conversion to a new TC website platform highlighted a couple areas where a refresher of the ASHRAE rules on website maintenance is warranted. First be aware that ASHRAE Products (i.e., handbook chapters, journal articles, final reports from research projects, etc.) cannot be published on your TC's website. It is very appropriate to post the title and scope of the product and then link the reader to the ASHRAE bookstore or other location on the ASHRAE site where the product may be purchased. Any possible exceptions to this rule must be sent through Steve Comstock for review and approval (scomstock@ashrae.org). The second issue involves timely posting of the draft minutes. Draft minutes (and final, approved minutes from the prior meeting) should be posted to your website (or otherwise distributed to the members) within 60 days after the meeting. Please ensure that your secretary and webmaster are aware of this deadline. To assist your secretary in understanding the procedures for taking and reporting minutes, a video has been developed and posted on the Technical Committees' Training page (https://www.ashrae.org/standards-research--technology/technical-committees/tc-training-and-presentations). On the same page, a video has also been posted for use by webmasters to learn about the procedures and schedule to maintain the new websites.

6. **TC 2017-2018 Master Calendar – Now Available through Google -** The Technical Committee Master Calendar is now available through Google. In order to access this calendar you need to have a Google account.

Once you log into your Google account, follow the instructions below:

To add a friend's calendar, just follow these steps:
- At the bottom of the calendar list on the left, click Add and select Add a friend's calendar.
- Enter the appropriate email address (techservices1791@gmail.com) in the field provided, then click Add.

This calendar is public and will appear under 'Other Calendars' in the left column.

To set up Google Calendar Sync to your Outlook:
- Make sure you're using a supported operating system and Outlook version.
- Download Google Calendar Sync (version 0.9.3.6) at
- http://dl.google.com/googlecalendarsync/GoogleCalendarSync_Installer.exe
- Once a dialog box appears, click Save File. The downloaded file should open automatically. If it doesn't, manually open it from your browser's download window.

- Click OK to confirm that you're aware this is an executable file.
- Read through the Google Calendar Sync Terms of Service, and click I Agree.
- Follow through the Installation Options and click Install to finish the set-up process.

Once Google Calendar Sync is installed on your computer, the Google Calendar Sync Settings window will appear:

In the Settings window, enter your email address and password and select the Sync Option you prefer. Read about each Sync Option.

You'll also be able to set the time interval for syncing to occur. Please keep in mind that 10 minutes is the minimum time interval allowed.

After the initial set-up, you can access the Google Calendar Sync Settings window again by double-clicking the calendar icon in your Windows System Tray.

E. RECENT ANNOUNCEMENT

1. RAC Prioritizing Research Topics Related to the Residential Sector

Continuing in 2017-2018, RAC will be prioritizing for bid accepted research topics that support Goal #3 below from the Research Strategic Plan.

Goal #3: To reduce significantly the energy consumption for HVAC&R, water heating and lighting in existing homes.

2. CEC's Standing Request for Future Society Meeting Program Track Suggestions

The Conferences and Expositions Committee (CEC) oversees ASHRAE's annual and winter conferences and other specialty conferences and expositions globally. The CEC continually works to improve the conference experience for all attendees. To help keep a "pulse" on the technical issues facing professionals in the HVAC&R marketplace, and to create meetings that reach all of ASHRAE's constituencies, the CEC seeks ideas for tracks for the Atlanta 2019 winter meeting and annual and winter conferences beyond as well as topics for specialty conferences from TC members.

Please submit your suggestions to ASHRAE Staff member Tony Giometti (Giometti@ashrae.org). You can also add your track suggestion in the "Comment" section of the TC Activity form for the Long Beach meeting.

3. CEC Always Seeks TC Volunteers willing to Support Content Development and Quality Control for Society Technical Program at Society Meetings

Provide to your Section Head after each Society meeting a list of qualified volunteers from your TC that are potential Technical Session chairs and reviewers of session papers that are related to TC's scope for use by the Conferences & Expositions Committee (CEC) in developing technical content for future technical programs**.**

4. **The Professional Development Committee (PDC) is seeking ideas for new ASHRAE Learning Institute (ALI) courses**.

   The Professional Development Committee (PDC) is actively seeking ideas for new ASHRAE Learning Institute (ALI) courses. We need practical courses of broad interest to be presented as face-to-face seminars or short courses, instructor-led online courses and self-paced courses. Examples include courses with a focus on new technologies that need to be shared, fundamentals for engineers new to the discipline, standard applications that need explanation, and courses based on new design guides. Does your TC have a potential course idea?

   Contact Karen Murray (ASHRAE staff) kmurray@ashre.org or James Bochat (2016-17 PDC chair) PDCchair@ashrae.net with your course ideas.

F. CURRENT & UPCOMING ASHRAE CONFERENCE PROGRAMS

1. **Long Beach Annual Conference - June 24 – June 28, 2017**
   Conference Website: http://ashraem.confex.com/ashraem/s17/cfp.cgi
   Conference Program Chair: Ann Peratt Email: ann.peratt@gmail.com

   Program Focus at Long Beach Annual Conference

   i. Track 1: Fundamentals and Applications
   ii. Track 2: HVAC&R Systems and Equipment
   iii. Track 3: Refrigeration
   iv. Track 4: Building Life Safety Systems
   v. Track 5: Controls: Smart Building Systems and the Security Concerns as Technology Emerges
   vi. Track 6: Commissioning: Optimizing New and Existing Buildings and their Operation
   vii. Track 7: Net Zero Energy Buildings: The International Race to 2030
   viii. Track 8: Residential Buildings: Standards and Guidelines and Codes
   ix. Track 9: Research Summit

2. **Chicago Winter Conference – Jan. 20 – Jan. 24, 2018**
   Seminar and Forum proposals for Chicago are due by **Tuesday, August 1, 2017**.
   Conference Website: https://ashraem.confex.com/ashraem/w18/cfp.cgi
   Conference Program Chair: Michael Collarin Email: Michael.Collarin@parsons.com

   Program Focus at Chicago Winter Conference

   i. Track 1: Systems and Equipment

ii. Track 2: Fundamentals and Applications

iii. Track 3: Standards, Guidelines and Codes

iv. Track 4: Earth, Wind & Fire NEW!

v. Track 5: Transportation IAQ and Air Conditioning NEW!

vi. Track 6: Tall Buildings

vii. Track 7: Modeling Throughout the Building Life Cycle NEW!

viii. Track 8: Heat Exchange Equipment

ix. Track 9: Refrigerant Mini Track @ Expo*

x. Track 10: Residential Mini Track @ Expo*

3. Houston Annual Conference - June 23 – June 27, 2018
Seminar and Forum proposals for Houston are due by **Friday, February 9th, 2018**.
Conference Website: https://www.ashrae.org/membership--conferences/conferences/2018-ashrae-annual-conference/call-for-papers
Conference Program Chair: Cindy Moreno Email: cindym@tmmechanical.com

Program Focus at Houston Annual Conference

i. Track 1: HVAC&R Systems and Equipment

ii. Track 2: Fundamentals & Applications

iii. Track 3: District Energy and Cogeneration Plants NEW!

iv. Track 4: Safeguarding our HVAC&R System NEW!

v. Track 5: Residential: Modern Buildings in Hot & Humid Climates

vi. Track 6: Professional Skills

vii. Track 7: Research Summit

viii. Track 8: HVAC&R Control Freaks NEW!

ix. Track 9: HVAC&R Analytics NEW!

G. OTHER UPCOMING WORKSHOPS, CONFERENCES AND EVENTS

1. 2017

i. **Building Simulation 2017** – Aug. 7 – Aug. 9, 2017 – San Francisco, CA USA – Contact: http://www.buildingsimulation2017.org/

ii. **ISHPC2017** – Aug. 7 – Aug. 10, 2017 – Tokyo, JAPAN – Contact: http://biz.knt.co.jp/tour/2017/ISHPC2017/congress.html

iii. **ASHRAE Building Performance Analysis Conference** – September 27-29, 2017 – Atlanta GA, USA – Contact: https://ashraem.confex.com/ashraem/bpa17/cfp.cgi

iv. **2nd ASHRAE Developing Economies Conference** – Nov. 10-11, 2017, Delhi, INDIA – Contact: https://ashraem.confex.com/ashraem/de17/cfp.cgi

TC/TG/TRG Activity Feedback Form

Please provide feedback on your TC/TG/TRG activities and return this form by Tuesday night 9:00 pm to your Section Head by email or drop off a printed copy in the Section Head's mailbox folder outside the ASHRAE Headquarters Room.
Include activities performed since the last TC meeting (e.g. any letter ballots, submissions to RAC, award nominations, etc.)

PLEASE DO NOT LEAVE NUMERIC CELLS EMPTY. ENTER 0 IN CELLS IF THERE IS NO COUNT.

TC#		Committee Name:	EXAMPLE ONLY - See your SECTION HEAD for your TC's Customized FORM
		Chair:	

Meeting was Held (City)		(Day)		(Date)	

Membership	Quorum Established (Yes/No)		
	Number Present	Remote Participants	Total on Committee Roster
Voting Members (excluding Non-Quorum Members)	0	0	0
Non-Quorum Members	0	0	0
Corresponding Members	0	0	0
Provisional Members	0	0	0
Visitors/Guests	0	0	n/a
All members/guests who are **ALSO** YEA members	0	0	0

Handbook Responsibilities		Standards Responsibilities	
Total Number of Chapters	0	Total Number of Standards	0
# Chapters voted out this meeting	0	# Standards recommended	0

Special Publications (last six months)	0	Title:	

Program Activities (For This Meeting)

Total # of Forums			Total # of Seminars			Total # of Paper Sessions			Other Presentations		
Submitted*	Sponsor	Co-sponsor	Submitted*	Sponsor	Co-Sponsor	Submitted*	Sponsor	Co-Sponsor	TC Research Results	Other Papers**	
0	0	0	0	0	0	0	0	0	0	0	0

Current Research Activities (active)		TC Management	
# of new/revised RTARs submitted	0	Minutes completed on time?	
# of other active RTARs	0	Agenda distributed on time?	
# of Work Statements submitted	0	Did Chair attend training?	
# of other active Work Statements	0	Did Vice Chair attend?	
# of active TRPs	0	Did Program Chair attend training?	
# of active RPs	0	Did Handbook Chair attend training?	
Problems getting RTAR/WS approved?		Did Research Chair attend breakfast?	

Other Technical Activities		Award Nominations (last six months)	
# FAQs updated this meeting		# of Distinguished Service Nominations	
# New members added to roster		# of Exceptional Service Nominations	
		# of Other Nominations: Hightower, Research, Fellow,etc	
		Specify Award :	

Any Concerns or requests for the Technical Activities Committee? (Please type in Space Below)

PLEASE DO NOT LEAVE CELLS EMPTY. ENTER 0 IN CELLS IF THERE IS NO COUNT.

YES/NO Questions can be answered using drop box selection or by typing in answer.

CITY Please enter city only without the state.

MEMBERSHIP SECTION

members/guests who are also YEA members:

Enter total number of YEA members here. Be sure that they were also included in the appropriate categories above, too.

Example: There are 18 people in the room: 6 voting members and 12 guests. Of these, one of the six voting is a YEA member and two of the guests are YEA members. Thus the count is

Voting	6
Guests	12
YEA	3

HANDBOOK SECTION

Chapters voted out this meeting

Count all handbook chapters (reviewed, revised, or developed) that were approved by the TC through a vote for submission to the handbook committee at this meeting

STANDARDS SECTION

Standards recommended

Count all standards which the TC developed a recommendation for at this meeting. (I.e. reaffirm, revise, or)

PROGRAM SECTION

"Submitted" program sessions.

Count only sessions which <u>your committee initiated</u> and submitted <u>for</u> this meeting.

"Co-sponsored" program sessions

Count sessions <u>initiated by other committees</u> and accepted for presentation which you cosponsored.

"Sponsored" program sessions.

Count all sessions initiated by your committee and <u>accepted for presentation</u>, including those which you invited others to co-sponosr.

ATTACHMENT B

TC 5.2 Subcommittee Minutes

Attendance

Name	Affiliation	E-mail Address	Status/ Position	Phone Number	YEA?
Timothy D. Eorgan	Hardcast	tim.eorgan@hardcast.com	V	877-457-1389	N
John Constantinide	Alpha MRC Architects Engineers	john.constantinide@alphamrc.com	CM	321-449-9455	Y
Bob Reid	Spiral Pipe of Texas	bobtheductman@gmail.com	Chair	713-724-0031	N
Dave Dias	Sheet Metal Workers #104	DaveD@smw104.org	V	707-227-0239	N
Mark Smith	Ductmate Industries	msmith@greenseamind.com	CM	724-258-0500	N
Robert Hassler	Kinetics Noise Control	RHassler@Kineticsnoise.com	CM	614-648-2920	N
Charlie Haack	NAIMA	chaack@naima.org	G	814-777-7397	N
Bob Persechini	RDK Engineers	RPersechini@RDKEngineers.com	CM	857-221-5501	N
Cindy Bittel	DMI Companies	bitelcindy@gmail.com	V	267-243-1034	Y
Larry Smith	Linux Industries	LarryS@Li-HVAC.com	CM	757-672-2968	N
Craig Wray	Retired	pharmeng@pacbell.net	V	204-254-7766	N
Ralph Koerber	Atco Rubber Products	rkoerber@atcoflex.com	CM	814-966-2100	N
Perry Philp		perry@flexmastercompany.com	CM	905-841-2000	N
Akshay Bhargava	TRCWW	abhargava@trcww.com	PCM	321-609-1179	Y
Sreenidhi Krishnamcorthy	UC David	skrishnamoorthy@ucdavis.edu	G	513-739-2778	N
Steve Idem	Tennessee Technological University	sidem@tntech.edu	CM	931-372-3607	N
Tim Gordon	USACE	Timothy.d.gordon@usace.army.mil	PCM	703-352-9570	N
John Hamilton		jhamilton@tabbcertified.org	V	571-722-5893	N
Herman Behls	Retired	hfbehls@gmail.com	V	847-870-1204	N
Kevin Gebke	Ductsox	kgebke@ductsox.com	V	563-588-5350	N
Marcus Bianchi	Owens Corning	marcus.bianchi@owenscorning.com	CM	720-258-6822	N
Mikael Salonvagra	Owens Corning	mikael.salonvagra@owenscorning.com	G	706-360-8006	N
Gus Faris		gfaris@nailor.com	CM	281-590-1172	N
Patrick Brooks	Eastern Sheet Metal	pbrooks@easternsheetmetal.com	V	513-878-3683	N
Alexander Zhivov	USACE	Alexander.M.Zhivov@usace.army.mil	CM	217-417-6928	N

1. Duct Design Guide
    a. Sections are being completed.
    b. Herman Behls interfacing with Pat Brooks on study and incorporating into the DDG.
    c. Study is being discussed for inclusion in the DDG.

d. Herman Behls to follow up on completing study for inclusion in the DDG.
e. Analysis is complete and has first draft on study by Steve Idem.
f. Looking to create a seminar about DDG and working with the Program Subcommittee to submit to CEC for a Society seminar session.
    i. John Reinz will talk about fundamentals, Herman Behls will talk about design methods, and Patrick Brooks will talk about the database.
g. Bob inquired about making this a white paper from a study to be able to post on the website.
h. Herman Behls asking someone to take a look at the Elite software
    i. Larry Smith to follow up with Bill … about testing the program.
i. Herman will put together the organization of the air dispersion chapter and will reach out to Jim McGill
j. Everyone will be e-mailed a draft of DDG chapter 9 for review prior to the full committee meeting.
k. Will put

2. Standard Liaising
    a. 90.1
        i. Mark Smith will be sent as the TC 5.2 liaison will be sent to a 90.1 meeting to interact with the TCs.
            1. **Action Item:** Mark Smith will ask the chair if he could be a consultant to 90.1 representing the interests of TC 5.2.
        ii. Bob will distribute past 90.1 versions pertaining to duct design and construction to provide context for understanding what 90.1 has in its current version.
        iii. Changes:
            1. All ducts to be tested for 4 cfm/100 s.f. of duct.
            2. 3-in. limitation present.
            3. Ducts to be tested are those in excess of 3-in. water gauge, ducts with 25% leakage, and 100% of all ducts outside of building envelope.
            4. Ductwork leakage language removed from current 90.1 version.
                a. TC is asked if we want to revert to reinsert removed language, provide new language, or wait until Std 215 is published.
                b. Recommended to present best case that involved engineering calculations, can be done in the field, and is manageable in cost
                c. Jeff Boldt was leading the duct leaking working group for 90.1 but covered more leakage items than ducts (e.g. doors, etc.) and supports for ducts. Mark will ask to be a part of the working group.
                d. Previous language puts responsibility on contractor to seal ducts and test for leakage as noted in 90.1-2013, Sec. 6.4.2.2.2.
                e. Decision: Previous language will be advocated to be brought back.
        iv. **Action Item**: Bob Reid forms an Ad-Hoc Committee to address draft language that will provide new language for duct leakage language: Tim Eorgan (ex-officio), Dave Dias, Bob Reid (volunteered as Chair), Mark Smith, Tim Gordon, John Constantinide, Perry Philp
            1. Bob will arrange a conference call and will start work on draft language.
    b. 189.1, IGCC
        i. David will be sent as the TC 5.2 liaison for 189.1 interaction.

3. VAV Design Guide is finished except for final edits. Gus is working on getting it voted out from TC 5.3 on Tuesday.
    a. Design guides get their own web page once published. Could Jeff Boldt write language for the page until TC 5.2 agrees on language to put on the page?
4. Per the TC Chair Breakfast on Sunday morning, TCs are allowed to develop Technical Bulletins (White Papers).
    a. Process: A member can produce a white paper, which needs to be previewed and gets brought to the TC 5.2 for vote. Once approved, it can be posted to the website for access.
    b. White Papers must adhere to ASHRAE's non-commercialism policy.
    c. The process gets information to the public without the research process and does not require funding allocations.
    d. Possibility of having an off-site field trip to a test site researching duct performance instead of subcommittee meeting to look at white paper production on items.
    e. White Papers may lead to research projects.
    f. Bob Reid will pursue a white paper for duct leakage and transverse usage.
5. Future research projects and work statement proposals
    a. WS on Phenolic Duct will be voted on in Executive Session tomorrow.
    b. TC 2.4 asked to vote on approving RTAR #1626 Energy Implications of Air Filtration in Commercial Buildings
        i. TC 5.2 should consider being a co-sponsor.
        ii. Craig Wray expressed that TC 5.2 would be interest in understanding the research on system impacts.
        iii. **Action Item**: Bob Reid will reach out to TC 2.4 Chair Carolyn Kerr regarding co-sponsorship.
    c. Larry Smith will work with TC 5.3 to write a WS on diffusers.
    d. Proposed research project on Reducing Barriers to Achieving Low-Leakage Air-Handling Systems from Craig Wray with MTG.EEB as co-sponsor.
        i. Herman Behls and Criag Wray assessed whether to pursue this or not 4 years ago and is now being brought back.
        ii. RP 308 was the last project addressing duct leakage, so more duct leakage research is needed.
        iii. AMCA 511 Method of Testing Transfers and Duct Connections test standard is now published for 5 years. It was intended for manufacturers of proprietary duct connections but lacks data for expectations of common construction.
        iv. IAW AMCA 511, have an RP that addresses data for expectations of common construction types.
        v. DOE rejected the proposed research project, but other funders, like AHRTI, can fund this research.
    e. Pat Brooks inquired about a project assessing the cost of duct sealing (e.g. using mastic, fittings, flanges/gasketed flanges).
        i. Per Mark Smith, contractors do not record costs of duct sealing, since it is seen as a commodity.
        ii. Manufacturers have done studies but uses different units or conditions for tests.
        iii. Study commissioned by Lindlab and published by TUV: Hofmeister, Peter. *Advisory Opinion regarding the comparative test and evaluation of the overall installation costs of various installed air systems under consideration of the*

functional requirements and seal in accordance with EN 12237 and EN 1507. TUV Rhineland Industrie Service GmbH, TUV order no. 9986501. 2008.

iv. Craig Wray notes that the ultimate goal is building good systems. Testing should verify that the system is built well.

v. General industrial objections noted question the effectiveness of duct sealing in relation to overall lost energy and, as a result, ongoing cost if the leaking duct is releasing conditioned air. Question is if the conditioned air is leaking in the "right place" instead of as designed.

vi. **Action Item**: Pat Brooks will create an RTAR addressing the cost of duct sealing to reduce duct leakage to a certain level. Boundaries of proposed project need to be defined.

vii. Peer Review of Air Duct Council Committee by TC 5.2 of a white paper.

1. Research looked at comparing expected results in controlled conditions, not in-field conditions.
2. Ralph Koerber will look to TC members individually for guidance.

f. Pat Brooks working with SPIDA to obtain more technical information. SPIDA is seeking ASHRAE for sponsorship and co-funding from SPIDA to address friction loss in round duct and duct liner.

6. TC 9.1 looking for a definition of buried duct underground.
   a. ORNL did research on that
7. 90.1 is being rejected by IAPMO for having duct and duct leakage standard that is not as stringent as IAPMO standards.
8. TC 5.2 Long Range Plan Objectives: John Constantinide noted that the objectives need to be voted on by the full TC for them to be in effect and dissolve the Ad-Hoc Strategy & Planning Committee.

Adjourned at 11:51 am.

ATTACHMENT C

Conferences and Expositions Committee Information Items for Technical Committees
2017 Annual Conference, Long Beach, California

This "handout" includes recent updates and upcoming deadlines in the preparation of the technical program for the Winter, Annual and specialty conferences. It is being provided in advance of the conference for your information so that it does not have to be presented during the onsite TC section breakfasts. CEC will provide a short update at the TC breakfasts and answer any questions. *Jon Cohen, 2016-2017 CEC Chair, jonc@chemtreat.com*

1. **2018 Annual Conference Research Summit Call for Papers**
The 2018 Annual Conference in Houston, TX features a call for papers for the Research Summit track. Please consider submitting papers or groups of papers as entire sessions from your TC for the conference. Abstracts are due August 28, 2017 and is fast approaching. This is an excellent opportunity for TC's to highlight current research and case studies at the Annual Conference next year! If you have any questions, please contact Dr. Melanie Derby, the Research Summit Track Chair at derbym@ksu.edu.

2. **Student Authors Recognized at Las Vegas, Long Beach, and Beyond**
Starting at the 2017 Winter Conference, CEC began recognizing student papers. Certificates were awarded to students at their assigned conference paper session. There were "Best Paper" and "Honorable Mention" certificates presented to graduate candidates and PhD candidates.
For the 2017 Annual Conference, one Best Paper and one Honorable Mention will be presented to undergraduate/graduate students and PhD candidates.

3. **Invited Speakers**
CEC has developed a policy to allow for invited speakers to have their speaker fee waved. The proposed invited speakers shall be submitted with the respective program submission, and will be reviewed concurrent to the submission review process. The CEC Chair, Vice Chair, and Conference Program Chair will review submissions and will accept up to five invited speakers, per Annual and Winter meeting, considering the strength of the proposal. The speaker must meet the following criteria to be considered: a.) Subject matter expert, b.) Not an ASHRAE member, c.) Will provide information that is useful to the ASHRAE membership.

4. **Program statistics for Long Beach; for a total of 107 available slots:**

Conferences Papers
- 151 conference paper abstracts submitted, 129 approved
- 71 conference papers presented
- 20 Conference Paper Sessions

Technical Papers
- 27 Technical papers received
- 19 Technical papers presented
- 6 Technical Paper Sessions

Seminars
- 121 submitted
- 61 presented

Workshops
- 13 submitted
- 9 presented

Forums
- 11 submitted
- 4 presented

Debates
- 4 submitted
- 3 presented

Panels
- 5 submitted
- 2 presented

5. **2018 ASHRAE Winter Conference in Chicago, IL:** http://www.ashrae.org/chicago
    a. Conference Papers are due July 7
    b. Seminar, Forum, Debate, Panel and Workshop proposals are due August 1
    c. Program notifications go out September 6
    d. Web site opens for presentation uploads on December 1
    e. All presentations due online January 8, 2018
        - ***Track 1: Systems and Equipment***
          Track Chair: Carrie Ann Crawford Email: crawford.ashrae@gmail.com
        - ***Track 2: Fundamentals and Applications***
          Track Chair: Kevin Marple Email: kmarple@benzco.com
        - ***Track 3: Standards, Guidelines and Codes***
          Track Chair: Corey Metzger Email: corey.metzger@resource.com
        - ***Track 4: Earth, Wind and Fire***
          Track Chair: Ashish Rakheja Email: ashish.rakheja@aeonconsultants.in
        - ***Track 5: Transportation IAQ and Air Conditioning***
          Track Chair: Dimitris Charalambopoulos Email: dimitris@ashrae.gr
        - ***Track 6: Tall Buildings***
          Track Chair: Leticia Neves Email: leneves@gmail.com
        - ***Track 7: Modeling Throughout the Building Lifecycle***
          Track Chair: Joseph Firrantello Email: j.firrantello@gmail.com
        - ***Track 8: Heat Exchange Equipment***
          Track Chair: Vikrant Aute Email: vikrant@umd.edu
        - ***Track 9: Refrigerant Mini Track @ Expo***
          Track Chair: Gary C. Debes Email: gcdebes@verizon.net
        - ***Track 8: Heat Exchange Equipment***
          Track Chair: Gary C. Debes Email: gcdebes@verizon.net

6. **2018 ASHRAE Annual Conference in Houston, TX:** http://www.ashrae.org/houston
    a. Conference Paper Abstracts due Monday, August 28, 2017
    b. Conference Papers due Friday, December 8, 2017
    c. Seminar, Forum, Panel, Debate and Workshop proposals are due Friday, February 9, 2018
    d. Web site opens for presentation uploads Monday, April 30, 2018
    e. All presentations due online Friday, June 1, 2018
        - ***Track 1: HVAC&R Systems and Equipment:***
          Track Chair: Frank Schambach Email: frankschambach@mindspring.com
        - ***Track 2: Fundamentals and Applications:***
          Track Chair: Dennis Alejandro Email: denzjac@yahoo.com
        - ***Track 3: District Energy and Cogeneration Plants:***
          Track Chair: Kimberly Pierson Email: kdpwildcat@gmail.com
        - ***Track 4: Safeguarding your HVAC&R System:***
          Track Chair: Rich Rose Email: richr@mticontrols.com

- ***Track 5: Residential – Modern buildings in Hot and Humid Climates*****:**
  Track Chair: Dimitris Charalambopolous Email: dimitris@ashrae.gr
- ***Track 6: Commissioning– Optimizing New & Existing Buildings and their Operation:***
  Track Chair: Kevin Marple Email: kmarple@benzco.com
- ***Track 7: Research Summit:***
  Track Chair: Melanie Derby Email: derbym@ksu.edu
- ***Track 8: HVAC&R Control Freaks:***
  Track Chair: Gary Debes Email: gcdebes@verizon.net
- **Track 9: HVAC&R Analytics (Mini-Track)**
  Track Chair: Vikrant Aute Email: Vikrant@umd.edu

7. Potential Sources Bias Disclosure

Speakers will be asked to fill out a potential sources bias disclosure document that will note affiliations/ involvement with any organizations with financial or commercial interest in the subject matter to be discussed, in accordance with the ASHRAE Code of Ethics.

8. TC Opportunities:

a. TC members who want to submit a program should consult the Track Chair for assistance in preparing a good abstract, learning objectives, and Q&A to help assure complete submission.
b. TCs and Sections are welcome to suggest new presentation formats (like how the Workshop was born). Best way to present material to benefit attendee is a goal.
c. TCs and Sections are encouraged to work with a track chair to put together a series of sessions that can be used as a mini-track.
d. Putting together an entire track of programs in cooperation with other TCs is also encouraged; keeping in mind that track subjects are typically determined 14-15 months prior to a conference.
e. CEC welcomes suggestions for tracks! We value your input. TAC/CEC agreed that the Comment Section on the activity form is the location for the TC to provide this information.

9. Speaker Ratings

About 11 speakers from Las Vegas had speaker ratings below 3.5 out of 5.0. These speakers were sent letters indicating that if they receive two additional low ratings they will be required to provide proof that they have received speaker training before they will be permitted to speak again.

10. Presentations

CEC has had an ongoing issue with presentations not being uploaded for commercialism review before the conference. This is problematic because it requires a “fire drill” for CEC on Saturday and Sunday to process commercial reviews for these presentations before they can be uploaded to the system. For clarification, presentation requirements include:

a. Uploads need to be substantially complete; including the AIA Disclaimer and Learning Objectives. Blank slides and place holders do not constitute a substantially complete presentation.
b. Recent Presentation Upload History
    i. For Long Beach, 41 presentations had not been uploaded by the June 12 deadline.
        1. 6 presentations were still not uploaded as of 6/21/2017.
        2. 4 of those 6 were TC sponsored.
    ii. For Las Vegas, 48 presentations were not uploaded by the final due date.
    iii. For St. Louis, 11 presentations were not uploaded by the start of the conference. 9 of these programs were sponsored by TCs

CEC needs to hold speakers accountable for making deadlines. Starting with the 2017 Winter Meeting in Las Vegas, CEC started enforcing a 3 strike policy for speakers who do not up load their presentation by the published deadline. If a speaker receives 3 strikes they will not be able to present for the following year (two conferences).

11. CEC Announces a Call for Reviewers and Paper Session Chairs

ASHRAE has a number of conferences coming up that include papers, and CEC seeks your help in reviewing them. Additionally opportunities to chair a paper session are available. Specifically, there is an immediate need for reviewers and session chairs for the 2018 Winter Conference and various specialty conferences.

Please submit your interest in reviewing a paper or chairing a paper session using the online form: http://web.ashrae.org/cec_request/. Please contact Tiffany Cox, ASHRAE Assistant Manager, Conference Programs, at tcox@ashrae.org for more information.

12. Specialty Conferences

ASHRAE's topical conferences are focused on a particular aspect of the industry and bring together professionals for networking and professional development. Two specialty conferences are available for the remainder of 2017.

2017 ASHRAE Building Performance Analysis Conference
http://www.ashrae.org/BuildPerform2017
September 27-29, 2017, Atlanta, Georgia

The conference program is set and includes the third annual ASHRAE LowDown Showdown modeling competition.

ASHRAE Second Developing Economies Conference ashrae.org/Developing2017
November 10 – 11, 2017, Delhi, India

A call for presenters is currently open through July 7. Apply through the conference Web site.

13. Program Types

Technical Paper Session:
These sessions present papers on current applications or procedures, as well as papers resulting from research on fundamental concepts and basic theory. Papers presented in these session have successfully completed a rigorous peer review. Forms for written comment are available at each session, and sent to respective authors for reply and publication in ASHRAE transactions, if received by a certain date.

Conference Paper Session:
These sessions present papers on current applications or procedures, as well as papers reporting on research in process. These papers differ from technical papers in that they are shorter are length and undergo a much less stringent peer review.

Seminar:
These sessions feature presentations on subjects of current interest. There are not papers attached to seminars.

Workshop:
These sessions enable technical committees and other ASHRAE committees to provide a series of short presentations on a topic requiring specific expertise. These short presentations are provided with an increased emphasis on audience participation and training in a specific set of skills. There are not papers attached to workshops.

Forum:
The sessions are "off-the-record" discussed held to promote a free exchange of ideas. Reporting of forums in limited to allow individuals to speak confidentially without concern of criticism. There are not papers attached to forums.

Panel Discussion:
Panel discussions can feature a broad range of subjects and explore different perspectives on industry related topics. This session format includes a panel of 3-4 speakers each addressing a facet of the session topic, followed by an interactive discussion lead by the session chair. Panel Discussions may be 60 minutes or 90 minutes in length and will be posted online in the Virtual Conference.

Debate:
Debates highlight hot-button issues commonly faced by our membership. Industry experts, either on teams or as individuals, argue opposing sides of an issue, concluding with position summaries and audience feedback. Debate sessions may be 60 minutes or 90 minutes in length and will be posted online in the Virtual Conference.

ATTACHMENT D

Revision 16 revised after manufacturers' review
Kevin Gebke
June 26, 2015

Chapter 9
AIR DISPERSION SYSTEM DESIGN

OVERVIEW

The design methodologies promoted in this chapter cover specifically Textile Air Dispersion (TAD) systems. TAD systems are low pressure extended plenum systems where tubing is pressurized and air is distributed along a path of least resistance. Suggestions are provided for (1) supporting and installing TAD systems, and (2) material selection. Design details and examples are provided. Consult with the manufacturer and their specific product data and performance information when designing and specifying TAD systems. The design principles of this chapter can also be applied to air dispersion systems constructed out of metal.

AIR DISPERSION SYSTEM SUPPLY AIR OUTLET STYLES

There are a variety of supply air outlet styles available**:** porous fabric weave used as an outlet, microperforations, linear vents, orifices and nozzles. Many of these air outlet styles can be used together to achieve specific results.

Porous Fabric Weave

Air is delivered through the weave of the fabric. This can result in air velocities of less than 30 fpm (0.15 m/s) at the material surface. Having the ability to achieve such a low face velocity allows this to be the preferred dispersion style where displacement ventilation is needed. This dispersion style is ideal for food-processing, clean rooms, and laboratory environments where elimination of drafts and uniform air distribution is required. Cool air drops to the floor and then spreads across the lower level of the space. Porous fabric ducts can be used in combination with most linear vents and orifice applications. Generally lower air throw distance than linear vents.

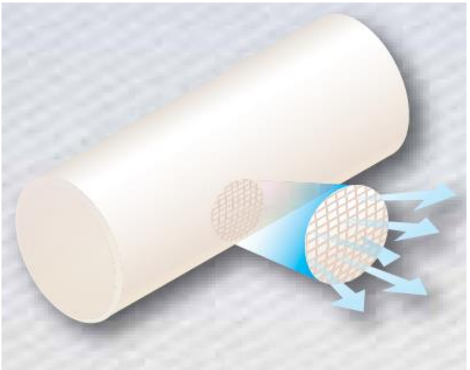


Figure 9-1a Porous Fabric Weave

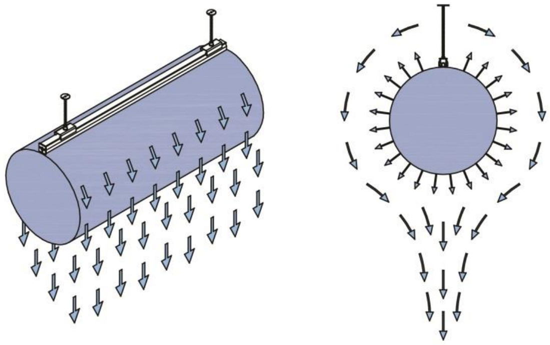


Figure 9-1a Porous Fabric Weave Used as an Outlet

Microperforation Outlets

Air is delivered through laser cut microperforations generally smaller than .4mm. As with porous fabric, air velocities of less than 30 fpm (0.15 m/s) can be realized 2 feet from the duct. Microperforations offer low velocity distribution in the occupied zone without forcing the majority of the air through the weave of the material. Further, the Microperforations can be uniformly located 360° or within a specific area or side of the air dispersion device allowing designers to disperse air exactly where it is needed. This method can be used for displacement ventilation and isothermal/makeup air but is limited for heating applications (when using directed microperforations for heating consult with manufacturer for throw data). This dispersion style is also ideal for food-processing, clean rooms, and laboratory environments where elimination of drafts and lower velocity air is required. Cool air can be more evenly distributed in the space using directed microperforations rather than dropping or "dumping" due to buoyancy, directly below the diffuser. Microperforations can be used in combination with most other flow models to modify throw and velocity to meet design requirements.

Figure 9-1b Microperforations Used as an Outlet

Linear Vent Outlet

Air is delivered through a linear vent outlet which generally consists of many small outlets in a linear pattern. This provides uniform airflow with throw suitable for commercial and retail spaces, schools and theaters. Generally medium air throw distance can be achieved.

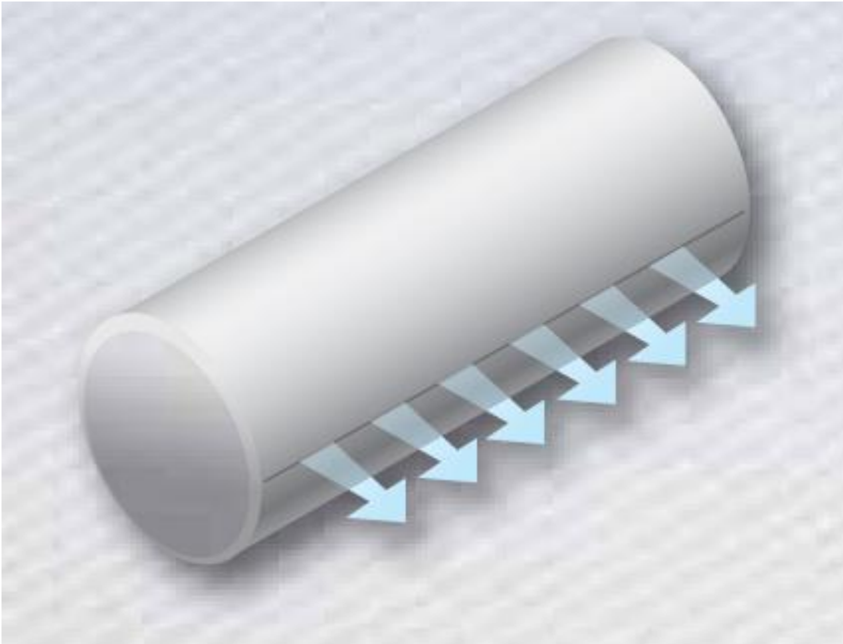


Figure 9-2 Fabric with a Linear Vent Outlet

Orifice and Nozzle Outlets
Air is delivered through orifices or venturi shaped nozzles providing jet-type air distribution for applications such as gymnasiums, pools and manufacturing facilities. Generally higher air throw distance than other air outlet styles. Nozzles can direct air perpendicularly away from the surface of the duct. Adjustable nozzles allow for changing the direction and/or flow rate and throw. Nozzles generally have the least entrainment of longer throw outlets. Manufacturers have many specific options for this style of air outlet and the manufacturers data must be consulted.

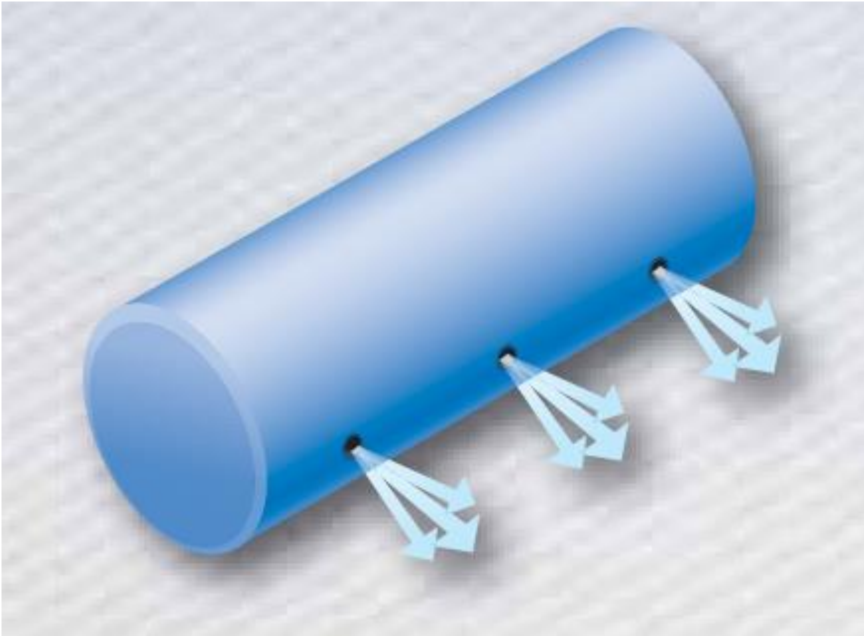


Figure 9-3a Fabric with Orifice Outlets

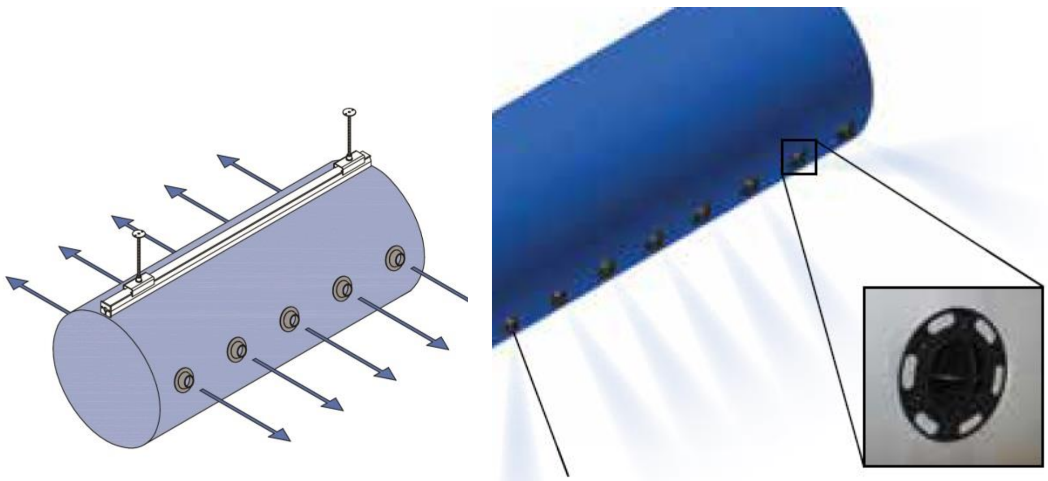
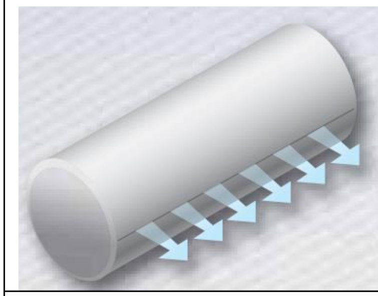
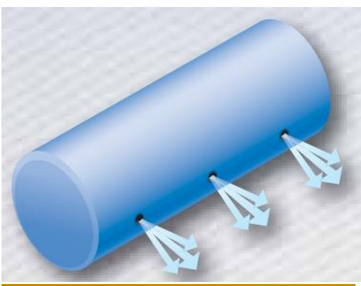
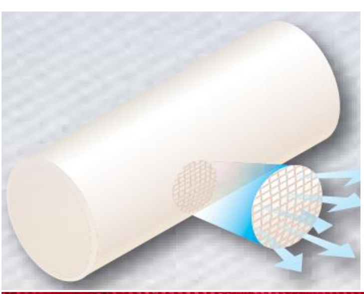


Figure 9-3b Fabric with Nozzle Outlets

Applications

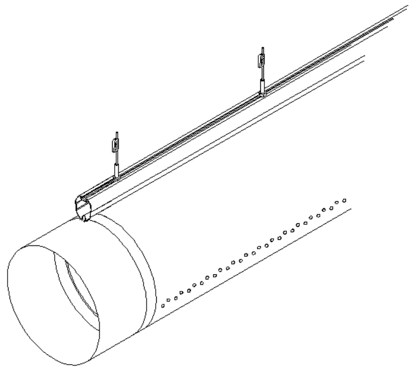
Table 9-1 is a guide for where to apply linear vent outlets, orifice and nozzle outlets, and porous fabrics. Air dispersion systems are used in systems under positive pressures, and should not pass through or penetrate fire-resistant rated construction.

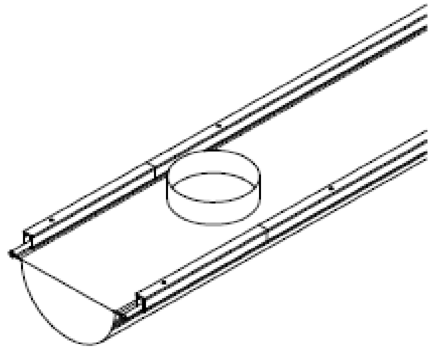
Table 9-1. Typical Fabric Air Dispersion System Applications

Air Distribution System	Characteristics	Applications
Linear Vents 	• Style 1: Series of small holes arranged in a linear pattern. • Style 2: Woven mesh strip continuous length of duct. • Similar to linear slot diffusers	• Commercial & Retail • Schools/Classrooms • Tents • Retail Outlets • Performance Arts/Theaters • Museums
Orifices and Nozzles  	• Fabric with cut orifices or venturi shaped outlets • Similar to jet diffusers • Nozzles offer longer throw than orifices • Air from nozzle is thrown perpendicular from diffuser	• Warehouses • Light & Heavy Manufacturing • Theaters • Pools • Sporting Complexes • Gymnasiums • Educational Facilities • Tents • Animal Housing • Prisons • Retail Sales Spaces • Precision Machining/ Aerospace Industry.
Porous Fabrics and Microperforation  	• Low velocity dispersion method • Porous material: typical range of 2 to 165 cfm/ft^2 at 0.5 in. water (10.2 to 838 L/s per m^2 at 125 Pa) • Similar to perforated metal displacement diffusers • Microperforations are 0.4mm diameter or less	• Refrigerated or cooled processing areas for: food preparation areas, slaughter houses, and carcass cooling rooms. • Precision Measurement Labs • Optical Labs • Biological Labs • Labs with Fume Hoods • Sound Labs

AIR DISPERSION SYSTEM SHAPES

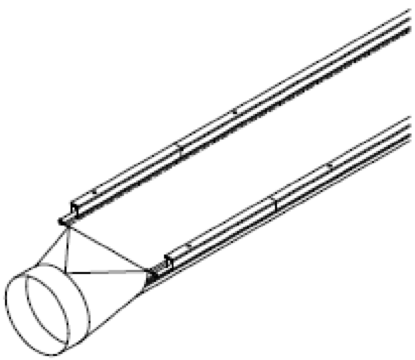
Three shapes are commonly available, cylindrical, half circle (D-shape), and the quarter circle as illustrated by Figure 9-4. Cylindrical systems are typical for open ceiling spaces and are mounted using a tension cable or suspended aluminum track suspension system. The half circle can be installed against a ceiling or wall. Manufacturers also have many custom shapes that can be used to solve installation challenges.





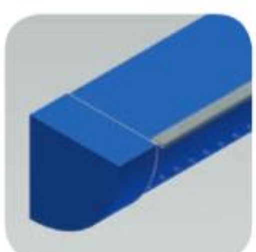
Top Inlet, Center

(a) Cylindrical, End Inlet



End Inlet

(b) Half Circle, Surface Mount



(c) Quarter Circle, Corner Mount

Figure 9-4 Air Dispersion System Shapes

DESIGN

For the purpose of analysis a new section is created whenever there is a change in airflow, size, shape or static pressure due to a flow control device. Each length of porous fabric duct, fabric duct with a linear vent, and fabric duct with orifices is considered a section.

To design multi-section fabric air dispersion systems, use the constant friction spreadsheet (Appendix E) in conjunction with the design tools on the CD. The design of fabric air dispersion systems is an iterative solution because the following parameters affect each other**:** layout of system, length of porous duct, length of linear vents, number of orifices, vent size, orifice diameter and throw.

Material Selection

Air dispersion system ducts, classified by Underwriters Laboratories as an air distribution device, should have a Class 1 rating per UL 723. The maximum flame spread/smoke developed index is currently 25/50. Additional important properties in selecting a material for air dispersion systems are durability and aesthetics. Durability includes not only the environment, but the design. Supports and static pressure must hold fabric air dispersion system materials in tension to prevent fabric wear and tear. The maximum velocity in a system should not exceed the manufacturer's rated velocity due to excessive air velocities causingfabrics to fail prematurely. The International Mechanical Code (ICC 2013) requires that air dispersion systems be listed and labeled in compliance to UL 2518. Enforce the listing and labeling of products installed to UL 2518. UL 2518 states that materials for air dispersion systems shall not break away, crack, peal, flake off, or show evidence of delamination at a velocity two and one-half times the manufacturer's rated velocity.

The use of a slightly permeable material allows dispersion of air below dew point without the risk of condensation forming on the fabric air dispersion system. The duct is pressurized and air is forced through the surface of the material forming an insulating barrier of cooler air around the duct, preventing warm moist air from contacting the cold surface of the air dispersion system and, thus, preventing water droplets from forming on the surface. The permeated air is often induced by outlets on the system and entrained into the supply air exiting the outlets.

Nonpermeable materials can be used where ever the risk of condensation is low and applied similar to uninsulated single wall metal ducts. Often used in dryer climates or for lengthy systems.

Polyester is typically the preferred material for fabric air dispersion systems because it has very low hydroscopic properties, is a synthetic material that is not a food source for organisms, and is easy to launder. Several manufacturers offer materials with complimenting properties, such as antimicrobial treatment (to prevent microbial growth), anti-static for use around sensitive electronics and in explosion proof facilities, and fabrics that do not "shed" filament particles for use in cleanrooms and critical laboratories.

Some examples of air dispersion system materials are as follows. Products coated are non-permeable; products not coated are permeable.

1. 6.8 to 3.2 oz/yd^2 (231 to 109 g/m^2) antimicrobial treated woven polyester.
2. 8.2 to 3.1 oz/yd^2 (278 to105 g/m^2) woven polyester and coated.
3. 6.2 oz/yd^2 (210 g/m^2) woven non-shedding polyester.
4. 2.9 oz/yd^2 (98 g/m^2) anti-static polyester.
5. 5.5 oz/yd^2 (187 g/m^2) woven polyethylene and coated.
6. AND many others

Suspension Systems

Textile air dispersion system manufacturers offer many different types of suspension systems to address the many types of applications where they are used. Typically the types of suspension systems are

1. Clips sewn to the top of the air dispersion system and clipped onto a tensioned horizontal cable.
2. Sliders or continuous keder cord sewn to the top of the air dispersion system and slid into a metal track (the track could be mounted directly to the ceiling or suspended a distance below it).
3. Sliders or continuous keder cord sewn to the top corners of a half circle air dispersion system and slid into a metal track (the track could be mounted directly to the ceiling or suspended a distance below it).
4. Direct suspension from an internal frame system

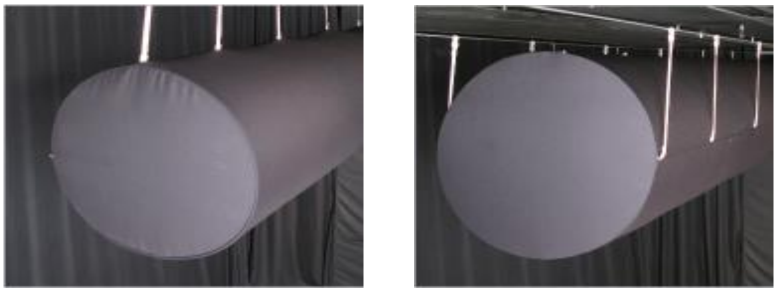


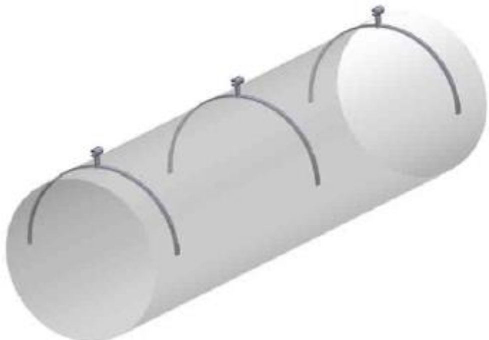
Figure 9.5: Single and Dual Cable system
Courtesy: KE Fibertec NA

Figure 9.6: Single and Dual Rail system
Courtesy: KE Fibertec NA

Figure 9.7: Dual Rail system to support half circle or quarter circle fabric ducts
Courtesy: KE Fibertec NA

Hold-open and Fabric Retension Systems

Textile air dispersion systems can also be held open (restricting their potential to collapse onto themselves when the HVAC unit is not providing airflow) with rings, hoops, and arcs.



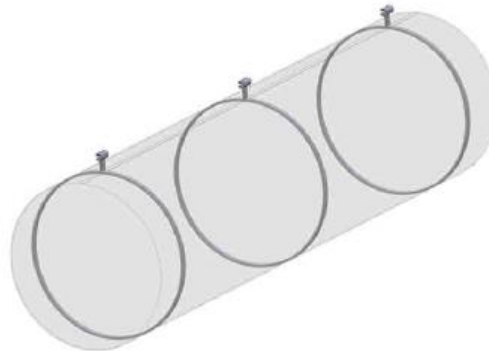


Figure 9-X Inflated internal arc   Figure 9-X Hoop system

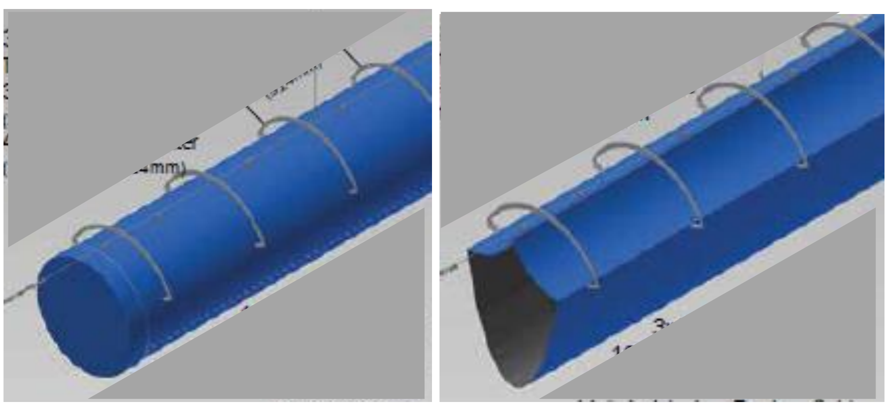


Figure 9-X Inflated and deflated external hanger system

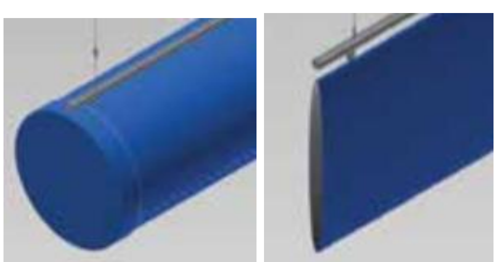


Figure 9-X Inflated and deflated 1-row system

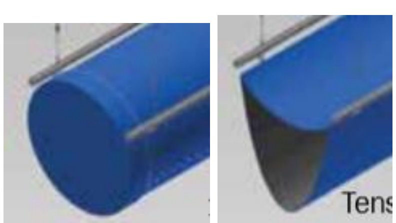


Figure 9-X Inflated and deflated 2-row system

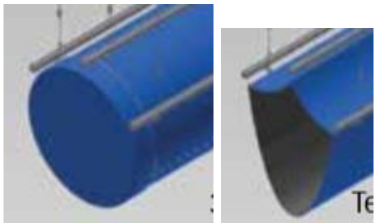
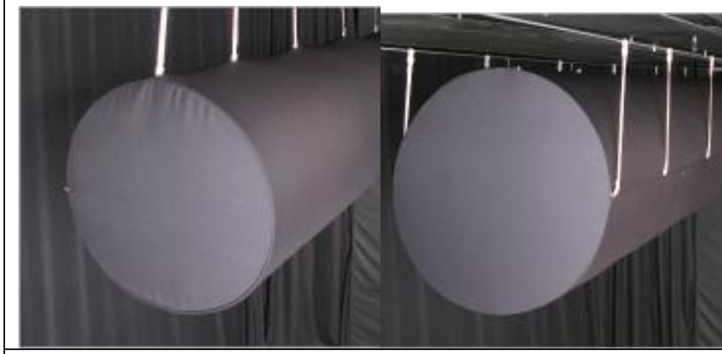
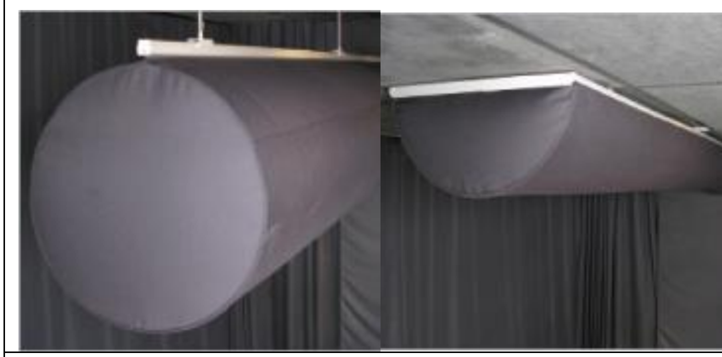
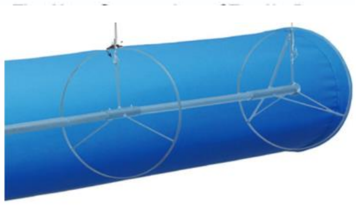


Figure 9-X Inflated and deflated 3-row system

Fabric Tension system (see Figure 9-5). Fabric tensioning systems hold the fabric in place whether or not the system is pressurized. These fabric tensioning systems increase the longevity of the fabric by reducing the movement of the fabric. Some hold the fabric in such a way that air velocities within the product can be increased to a higher maximum (which results in smaller diameter sizes) without the concern of the fabric wall being unstable and fluttering, which would cause premature failure.

Figure 9-5 Direct suspension from a Fabric Tensioning System

Table 9.2 Typical suspension methods

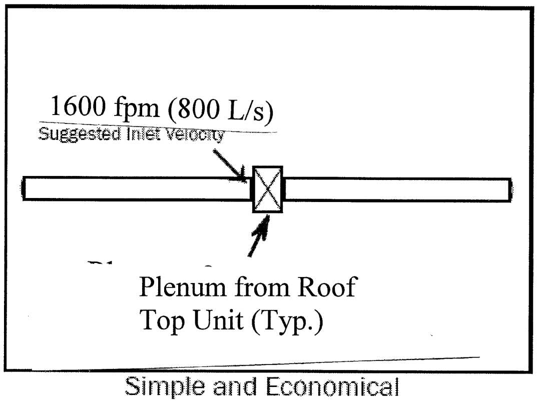
Suspension method	**Characteristics**
Cable (Single or Dual) 	- Simple and fast installation. - System walls collapse when air is off. - Fabric is intermitently supported with webbing straps. - Well suited for mounting in light-construction buildings - Popping can occur if AHU is not equiped with soft-start, but popping can be reduced with multiple rows of support
Track (Single or Dual) 	- Fabric is continuously supported along the entire length - System can be slid into the track from one end - Popping can occur if AHU is not equiped with soft-start, but popping can be reduced with multiple rows of support.
Arc / Internal ring system (Hold open system) 	- Hold-open systems can be combined with Track or Cable suspension - System is partially held open when air is off - Reduced "popping" at start up - Rings and arc must be removed before washing
Fabric Tension System  	- The system appears the same, whether the HVAC unit is on or off - Fabric walls of the system are tensioned - Tensioned fabric moves less and reduces breakdown

Layout

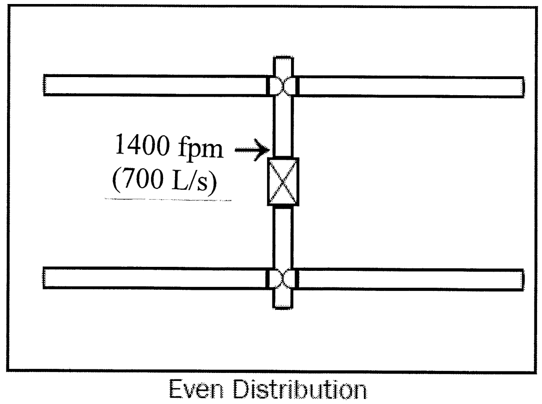
A fabric air dispersion system performs as both a duct and a diffuser. There could be several solutions to any given application as shown by Figure 9-6. Keep the layout as simple as possible, preferably straight runs. Because porous fabric duct, linear vents and orifices outlets can be integrated into all sections, system design may vary significantly while providing adequate air dispersion. Figure 9-6 shows the recommended inlet velocity to fabric air dispersion ducts.

Metal ductwork prior to the fabric inlet should have the same air velocity as the fabric duct and when possible it is recommended to use 3x diameter of straight metal duct, 1.5x diameter radius elbows and turning vanes in sheet metal transitions prior to fabric. High velocity (+1600fpm) and turbulent conditions immediately prior to the system can cause excessive fabric movement and premature wear.

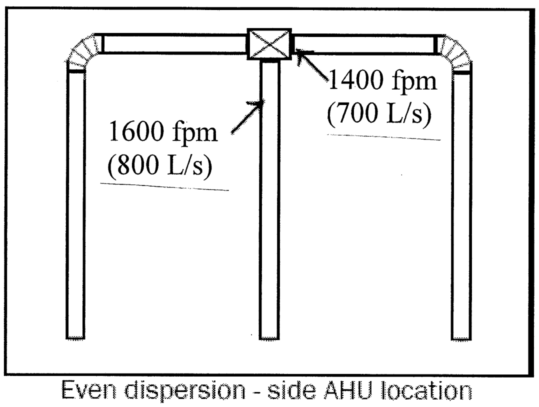
There is little need to reduce diameters because air dispersion systems are essentially extended plenums that have the capability to maintain static pressure due to continuously occurring static regain. Custom fittings should be coordinated with the manufacturer. It is recommended that end caps be one diameter from a wall to maintain clearance for systems that have movement and ease of installation.



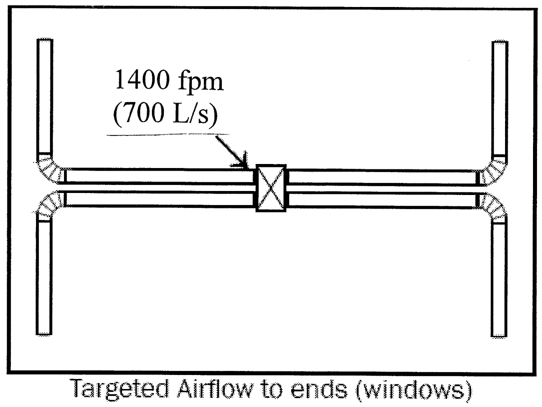
(a) System 1 (8.13m/s)



(b) System 2 (7.11m/s)



(c) System 3 (8.13 and 7.11 m/s)



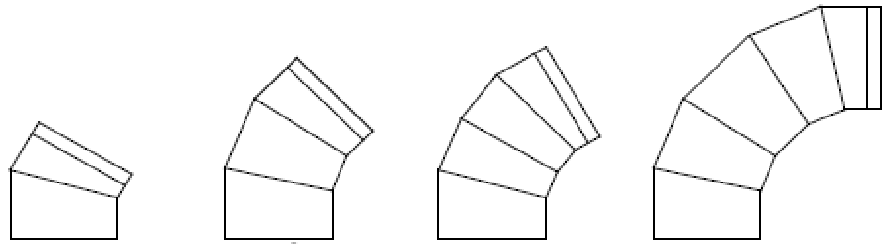
(d) System 4 (7.11m/s)

Figure 9-6 Typical Air Dispersion System Layouts

Fittings

Straight duct lengths and fittings are connected together using a circumference zipper. The zipper is affixed with its start/stop typically located at the top-center and includes a circumferential fabric overlap to conceal the zipper. Typical lengths of zippered sections are sized so that laundering and installation is easily accomplished. Longer sections are broken into multiple lengths.

Elbows. The typical centerline radius of an elbow is figured by multiplying the cross-sectional diameter by 1.5. For example, a 24" diameter air dispersion system elbow would have a centerline radius of 36". The number of gores depends on the angle of the turn as illustrated by Figure 9-7. Figure 9-8 shows a surface mount D-shape elbow and tee.



(a) 30° **(b) 45° CD3-14** **(c) 60° CD3-13** **(d) 90° CD3-9**

Figure 9-7 Elbows, Fabric

(a) Elbow

(b) Tee

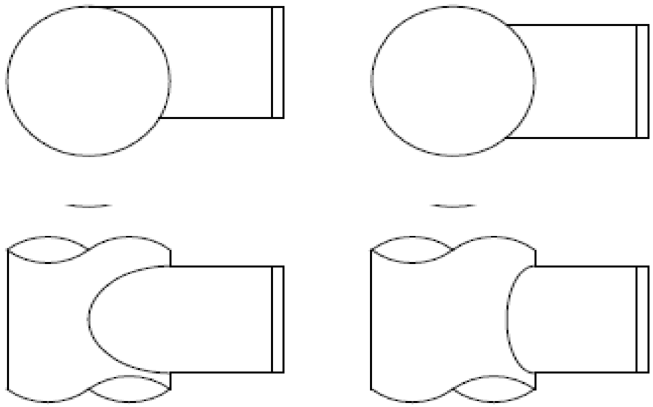
Figure 9-8 Surface Mount D-Shape Fittings

Transitions. Reducing transitions are available in concentric, top flat, or bottom flat configurations (Figure 9-9). Transition length varies from 12 to 36 in. (300 to 900 mm) and is based on the change in diameter such that the total angle does not exceed 20-degrees.

(a) Concentric SD4-1 **(b) Top Flat** **(c) Bottom Flat)**

Figure 9-9 Transitions, Fabric

Tees. Tees are saddle type and the branch requires a zipper for attachment. Typical tee arrangement is shown by Figure 9-10. It is recommended that tees be located at least 1.5 times the outlet diameter from end caps (see Figure 9-11).



(a) Top Aligned **(b) Center Aligned**
SD5-9

Figure 9-10 Tees, Fabric

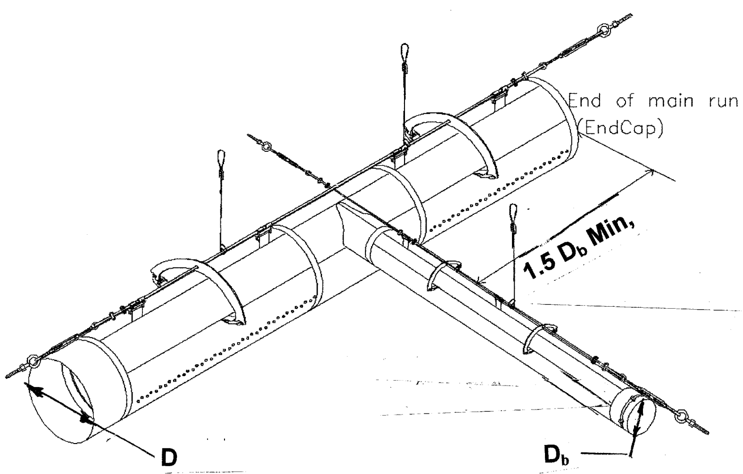


Figure 9-11 Relationship of End Caps to Tees

Cross, Capped. See Figure 9-12 for the capped cross, which is SD5-20 in the DFDB.

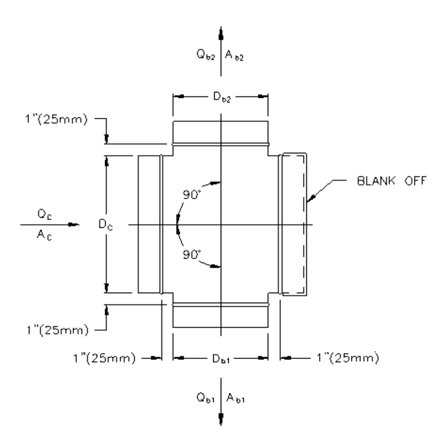
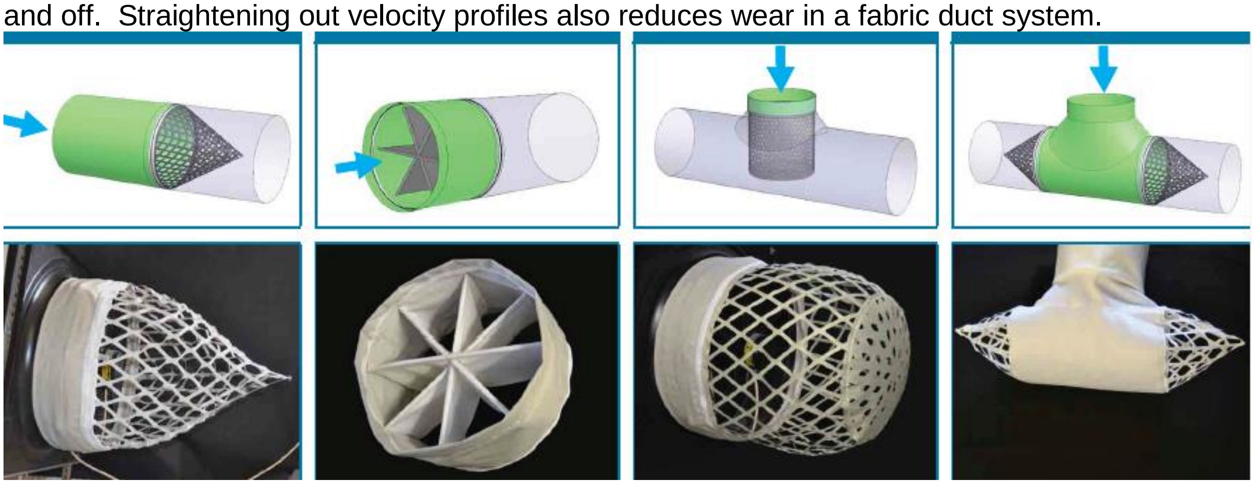


Figure 9-12 Capped Cross, Fabric (SD5-20)

Dampers and Static Regain Devices.

These fittings are used to address multiple objectives. The fittings offer engineered resistance to balance airflow in multiple runs and branches, reduce turbulence, reduce inflation pop, reduce noise, reduce movement from abrupt start-ups and balance static regain (see Example A9-1, Appendix 9-1). Locate flow devices at (1) inlet collars, (2) one-third point of a straight section, and (3) after take-offs and elbows. A flow device at the inlet collar reduces fluttering due to turbulent airflow as it enters the air dispersion system. At the first zipper the flow device reduces the force of initial inflation and reduces "pop"; a fabric tensioning system can go one step further and eliminate any movement, deflation, or noise due to the HVAC system cycling on and off. Straightening out velocity profiles also reduces wear in a fabric duct system.



Another example of these devices consists of a mesh cone with an adjustable orifice in the center (Figure 9-13). The flow device offers variable resistance (Figure 9-14)

Figure 9-13 Fabric Adjustable Flow Device

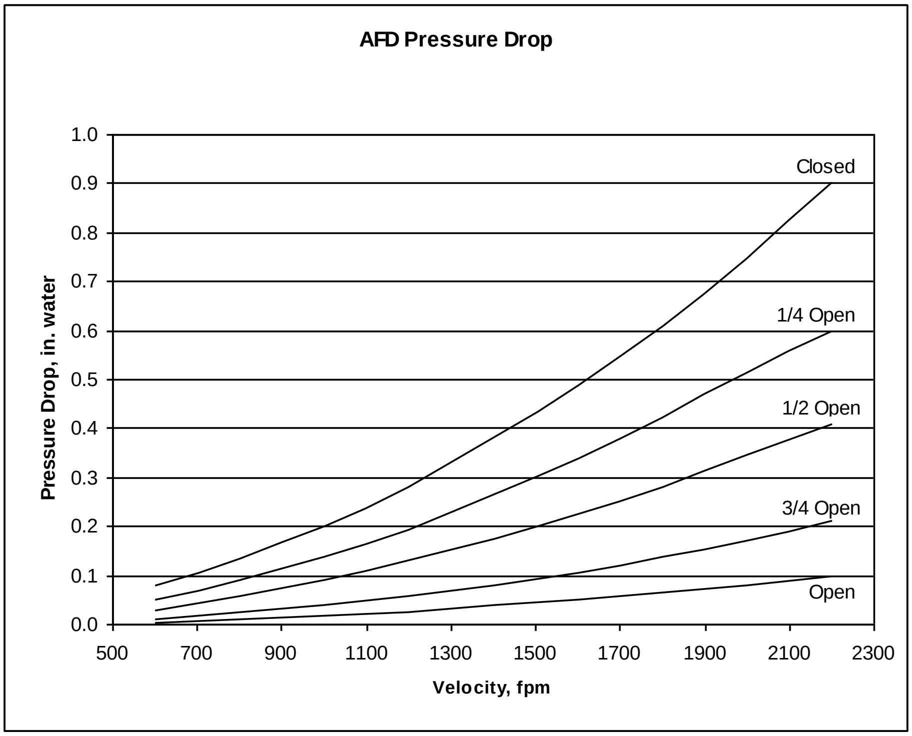


Figure 9-14(I-P) Pressure Drop Chart at Various Settings of an Adjustable

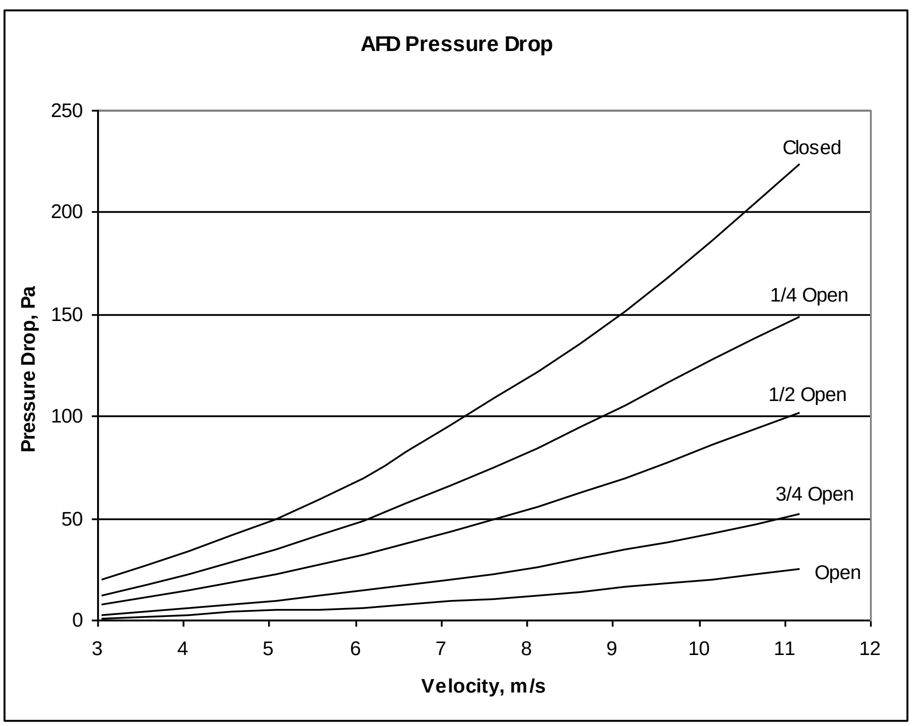
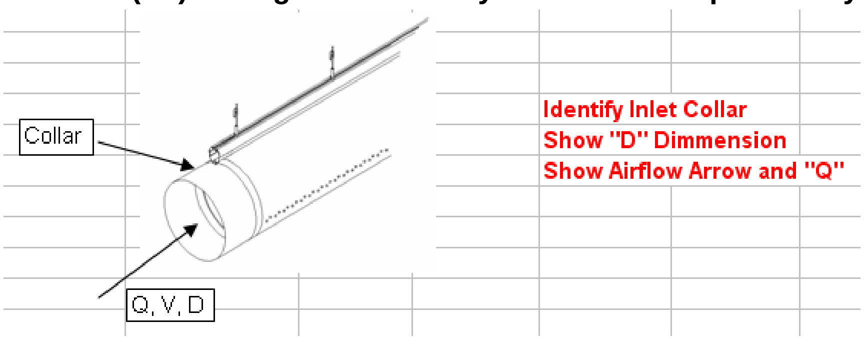


Figure 9-14(SI) AFD Pressure Drop

Sizing

Cylindrical Air Dispersion Systems. Use Table 9-2 to size cylindrical air dispersion systems. The recommended design velocity is 1600 fpm (8.1 m/s) for a system without fittings, and 1400 fpm (7.1 m/s) for a system with fittings. Use lower velocity [1000 to 1200 fpm (5.1 to 6.1 m/s)] for noise sensitive areas. If the diameter is too large, design the system for multiple runs.

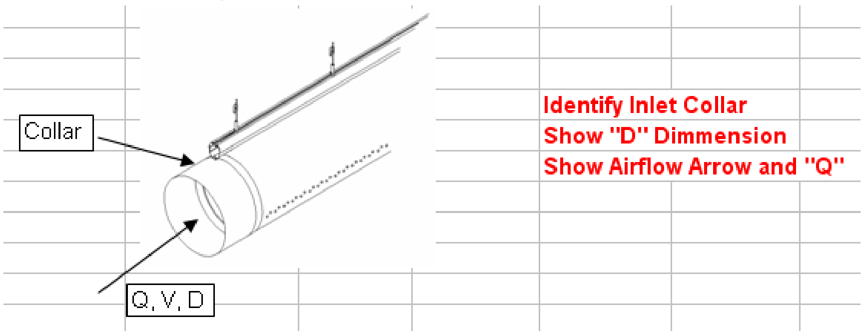
Table 9-2(I-P). Sizing Criteria for Cylindrical Air Dispersion Systems



Fabric Diameter (D), in.	Inlet Airflow (Q), cfm			
	Inlet Velocity (V), fpm			
	1000	1200	1400	1600
	Lower Inlet Velocities Reduce Stress and Noise		Maximum: Inlet with Fittings	Maximum: Straight Run
8	349	419	489	559
10	545	654	764	873
12	785	942	1100	1257
14	1069	1283	1497	1710
16	1396	1676	1955	2234
18	1767	2121	2474	2827
20	2182	2618	3054	3491
22	2640	3168	3696	4224
24	3142	3770	4398	5027
26	3687	4424	5162	5899
28	4276	5131	5986	6842
30	4909	5890	6872	7854
32	5585	6702	7819	8936
34	6305	7566	8827	10088
36	7069	8482	9896	11310
38	7876	9451	11026	12601
40	8727	10472	12217	13963
42	9621	11545	13470	15394
44	10559	12671	14783	16895
46	11541	13849	16157	18466
48	12566	15080	17593	20106
50	13635	16362	19090	21817

52	14748	17698	20647	23597
54	15904	19085	22266	25447
56	17104	20525	23946	27367
58	18348	22017	25687	29356
60	19635	23562	27489	31416
62	20966	25159	29352	33545
64	22340	26808	31276	35744
66	23758	28510	33262	38013
68	25220	30264	35308	40352
70	26725	32070	37415	42761
72	28274	33929	39584	45239

Table 9-2(SI). Sizing Criteria for Cylindrical Air Dispersion Systems



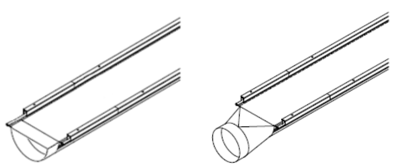
Fabric Diameter (D), mm	**Inlet Airflow (Q), L/s**			
	Inlet Velocity (V), m/s			
	5.1	6.1	7.1	8.1
	Lower Inlet Velocities Reduce Stress and Noise		Maximum: Inlet with Fittings	Maximum: Straight Run
200	160	192	223	254
250	250	299	349	398
300	360	431	502	573
350	491	587	683	779
400	641	767	892	1018
450	811	970	1129	1288
500	1001	1198	1394	1590
550	1212	1449	1687	1924
600	1442	1725	2007	2290
650	1692	2024	2356	2688
700	1963	2348	2732	3117
750	2253	2695	3137	3578
800	2564	3066	3569	4072
850	2894	3461	4029	4596
900	3244	3881	4517	5153
950	3615	4324	5033	5741
1000	4006	4791	5576	6362
1050	4416	5282	6148	7014

1100	4847	5797	6747	7698
1150	5297	6336	7375	8413
1200	5768	6899	8030	9161
1250	6259	7486	8713	9940
1300	6769	8097	9424	10751
1350	7300	8731	10163	11594
1400	7851	9390	10930	12469
1450	8422	10073	11724	13376
1500	9012	10780	12547	14314
1550	9623	11510	13397	15284
1600	10254	12265	14275	16286
1650	10905	13043	15182	17320
1700	11576	13846	16116	18385
1750	12267	14672	17078	19483
1800	12978	15523	18067	20612

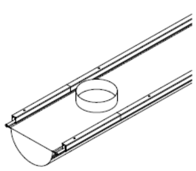
Half Circle (D-Shape) Air Dispersion Systems.

(1) Determine the D-shape duct configuration as noted below. Refer to the table noted for the fabric duct and supply duct sizes. For any supply air split use the EXCEL Program on the CD to size the system.

a. End supply (Table 9-3).

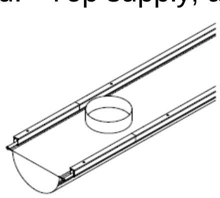


b. Top supply, equal split (Table 9-4a/EXCEL Program).



c. Top supply, from the end (Table 9-4b/EXCEL Program).

d. Top supply, any split (Table 9-4c/EXCEL Program).

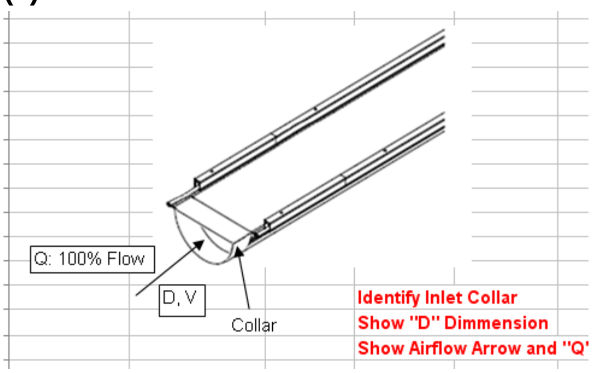


(2) D-shape air dispersion systems should be sized so that the fabric duct velocity does not exceed the rigid supply duct velocity. This is the design basis for the tables and the EXCEL Program. The maximum velocity for a straight run is 1000 fpm (5.1 m/s). For a system with a fitting the recommended velocity is 800 fpm (4.1 m/s). A lower inlet velocity to the fabric duct reduces stress and noise.

(3) Use the EXCEL program to design top inlet D-Shape systems. Flow can be any split including flow from the end. The D-Shape diameters (D) and the duct diameters (D_c) in the program are good for a split to 38%/62%. For a greater split the inlet duct diameter (D_c) needs to be reduced so the branch duct velocity does not exceed the design inlet duct velocity (800 or 1000 fpm (4.1 or 5.1 m/s)].

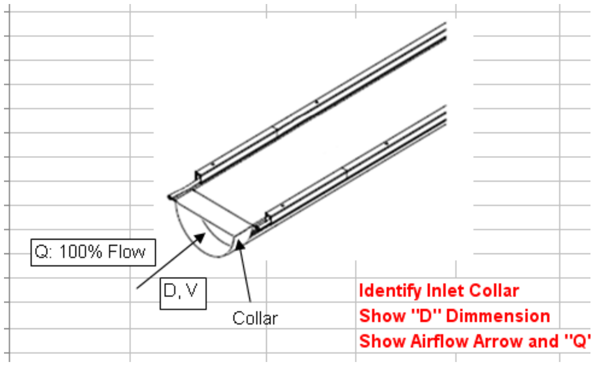
Table 9-3(I-P). Sizing "D-Shape," End Supply, Air Dispersion Systems

(a)



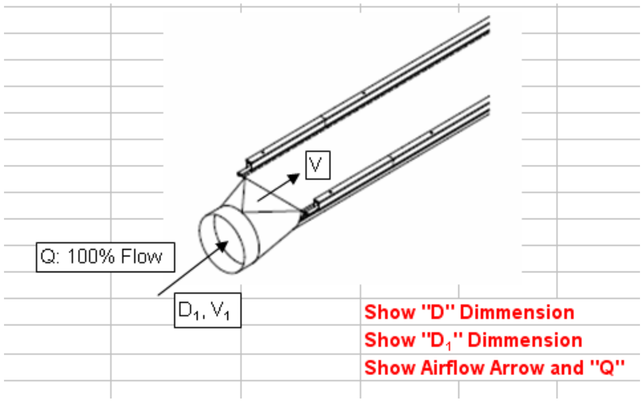
D-Shape Diameter (D), in.	**Inlet Airflow (Q), cfm**			
	Inlet Fabric (Collar) Velocity (V), fpm			
	1000	**1200**	**1400**	**1600**
	Lower Inlet Velocities Reduce Stress and Noise		Maximum: Inlet with Fittings	Maximum: Straight Run
10	273	327	382	436
12	393	471	550	628
14	535	641	748	855
16	698	838	977	1117
18	884	1060	1237	1414
20	1091	1309	1527	1745
22	1320	1584	1848	2112
24	1571	1885	2199	2513
26	1844	2212	2581	2950
28	2138	2566	2993	3421
30	2454	2945	3436	3927
32	2793	3351	3910	4468
34	3153	3783	4414	5044
36	3534	4241	4948	5655
38	3938	4725	5513	6301
40	4363	5236	6109	6981

Table 9-3(SI). Sizing "D-Shape," End Supply, Air Dispersion Systems (a)



D-Shape Diameter (D), mm	Inlet Airflow (Q), L/s			
	Inlet Fabric (Collar) Velocity (V), m/s			
	5.1	6.1	7.1	8.1
	Lower Inlet Velocities Reduce Stress and Noise		Maximum: Inlet with Fittings	Maximum: Straight Run
250	125	150	174	199
300	180	216	251	286
350	245	293	342	390
400	320	383	446	509
450	406	485	565	644
500	501	599	697	795
550	606	725	843	962
600	721	862	1004	1145
650	846	1012	1178	1344
700	981	1174	1366	1559
750	1127	1347	1568	1789
800	1282	1533	1784	2036
850	1447	1731	2014	2298
900	1622	1940	2258	2576
950	1807	2162	2516	2871
1000	2003	2395	2788	3181

(b: I-P)



D-Shape Diameter (D), in.	Inlet Diameter (D_1), in.	Inlet Airflow (Q), cfm Inlet Fabric Velocity (V), fpm				Duct Velocity (V_1), fpm			
		1000	1200	1400	1600	Fabric Velocity (V) =1000 fpm	Fabric Velocity (V) =1200 fpm	Fabric Velocity (V) =1400 fpm	Fabric Velocity (V) =1600 fpm
		Lower Inlet Velocities Reduce Stress and Noise		Maximum: Inlet with Fittings	Maximum: Straight Run				
10	8	273	327	382	436	781	938	1094	1250
12	10	393	471	550	628	720	864	1008	1152
14	10	535	641	748	855	980	1176	1372	1568
16	12	698	838	977	1117	889	1067	1244	1422
18	14	884	1060	1237	1414	827	992	1157	1322
20	14	1091	1309	1527	1745	1020	1224	1429	1633
22	16	1320	1584	1848	2112	945	1134	1323	1513
24	18	1571	1885	2199	2513	889	1067	1244	1422
26	18	1844	2212	2581	2950	1043	1252	1460	1669
28	20	2138	2566	2993	3421	980	1176	1372	1568
30	22	2454	2945	3436	3927	930	1116	1302	1488
32	24	2793	3351	3910	4468	889	1067	1244	1422
34	24	3153	3783	4414	5044	1003	1204	1405	1606
36	26	3534	4241	4948	5655	959	1150	1342	1534
38	28	3938	4725	5513	6301	921	1105	1289	1473
40	28	4363	5236	6109	6981	1020	1224	1429	1633

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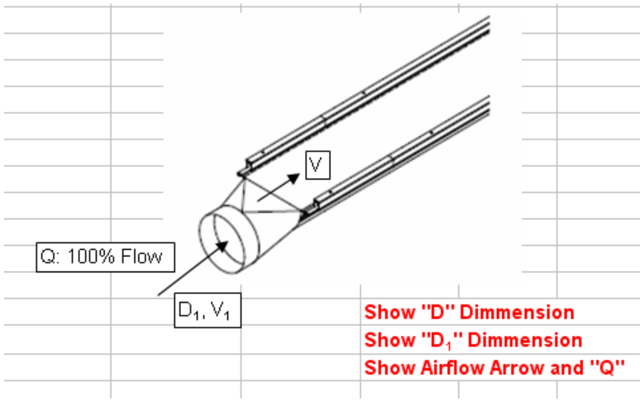
(b: SI)



D-Shape Diameter (D), mm	Inlet Diameter (D_1), mm	Inlet Airflow (Q), L/s — Inlet Fabric Velocity (V), m/s: 5.1	6.1	7.1	8.1	Duct Velocity (V_1), m/s			
		Lower Inlet Velocities Reduce Stress and Noise		Maximum: Inlet with Fittings	Maximum: Straight Run	Fabric Velocity (V) =5.1 m/s	Fabric Velocity (V) =6.1 m/s	Fabric Velocity (V) =7.1 m/s	Fabric Velocity (V) =8.1 m/s
250	200	125	150	174	199	4.0	4.8	5.5	6.3
300	250	180	216	251	286	3.7	4.4	5.1	5.8
350	250	245	293	342	390	5.0	6.0	7.0	7.9
400	300	320	383	446	509	4.5	5.4	6.3	7.2
450	350	406	485	565	644	4.2	5.0	5.9	6.7
500	350	501	599	697	795	5.2	6.2	7.2	8.3
550	400	606	725	843	962	4.8	5.8	6.7	7.7
600	450	721	862	1004	1145	4.5	5.4	6.3	7.2
650	450	846	1012	1178	1344	5.3	6.4	7.4	8.5
700	500	981	1174	1366	1559	5.0	6.0	7.0	7.9
750	550	1127	1347	1568	1789	4.7	5.7	6.6	7.5
800	600	1282	1533	1784	2036	4.5	5.4	6.3	7.2
850	600	1447	1731	2014	2298	5.1	6.1	7.1	8.1
900	650	1622	1940	2258	2576	4.9	5.8	6.8	7.8
950	700	1807	2162	2516	2871	4.7	5.6	6.5	7.5
1000	700	2003	2395	2788	3181	5.2	6.2	7.2	8.3

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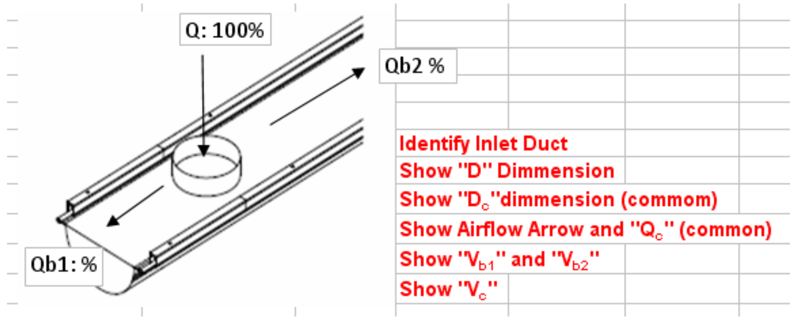
Table 9-4(I-P). Sizing “D-Shape,” Top Supply, Air Dispersion Systems

(a) Top Center, Equal Flow ($Q_{b1} = Q_{b2}$):



Q_{b1}	50% (INPUT)
Q_{b2}	50%

D-Shape Diameter (D), in.	Duct Diameter[1] (D_c), in.	Inlet Airflow (Q_c), cfm / Duct Velocity (V_c), fpm		Inlet Branch Airflow, cfm				Inlet Branch Velocity, fpm			
				Q_{b1}		Q_{b2}		V_{b1}		V_{b2}	
		800	1000	V_c =800 fpm	V_c =1000 fpm	V_c =800 fpm	V_c =1000 fpm	V_c =800 fpm	V_c =1000 fpm	V_c =800 fpm	V_c =1000 fpm
10	6	157	196	79	98	79	98	288	360	288	360
12	8	279	349	140	175	140	175	356	444	356	444
14	10	436	545	218	273	218	273	408	510	408	510
16	12	628	785	314	393	314	393	450	563	450	563
18	14	855	1069	428	535	428	535	484	605	484	605
20	16	1117	1396	559	698	559	698	512	640	512	640
22	18	1414	1767	707	884	707	884	536	669	536	669
24	20	1745	2182	873	1091	873	1091	556	694	556	694
26	22	2112	2640	1056	1320	1056	1320	573	716	573	716
28	24	2513	3142	1257	1571	1257	1571	588	735	588	735
30	26	2950	3687	1475	1844	1475	1844	601	751	601	751
32	28	3421	4276	1710	2138	1710	2138	613	766	613	766

34	30	3927	4909	1963	2454	1963	2454	623	779	623	779
36	32	4468	5585	2234	2793	2234	2793	632	790	632	790
38	34	5044	6305	2522	3153	2522	3153	640	801	640	801
40	36	5655	7069	2827	3534	2827	3534	648	810	648	810

[1]Duct diameter D_c is 4 in. less D-shape diameter D unless downsized.

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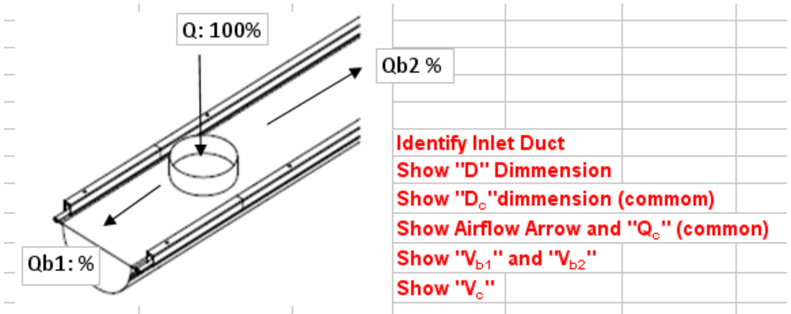
Table 9-4(SI). Sizing "D-Shape," Top Supply, Air Dispersion Systems
(a) Top Center, Equal Flow ($Q_{b1} = Q_{b2}$):



Q_{b1}	50% (INPUT)
Q_{b2}	50%

D-Shape Diameter (D), mm	Duct Diameter[1] (D_c), mm	Inlet Airflow (Q_c), L/s / Duct Velocity (V_c), m/s		Inlet Branch Airflow, L/s				Inlet Branch Velocity, m/s			
				Q_{b1}		Q_{b2}		V_{b1}		V_{b2}	
		4.1	5.1	V_c =4.1 m/s	V_c =5.1 m/s	V_c =4.1 m/s	V_c =5.1 m/s	V_c =4.1 m/s	V_c =5.1 m/s	V_c =4.1 m/s	V_c =5.1 m/s
250	150	72	90	36	45	36	45	1.5	1.8	1.5	1.8
300	200	129	160	64	80	64	80	1.8	2.3	1.8	2.3
350	250	201	250	101	125	101	125	2.1	2.6	2.1	2.6
400	300	290	360	145	180	145	180	2.3	2.9	2.3	2.9
450	350	394	491	197	245	197	245	2.5	3.1	2.5	3.1
500	400	515	641	258	320	258	320	2.6	3.3	2.6	3.3
550	450	652	811	326	406	326	406	2.7	3.4	2.7	3.4
600	500	805	1001	403	501	403	501	2.8	3.5	2.8	3.5
650	550	974	1212	487	606	487	606	2.9	3.7	2.9	3.7
700	600	1159	1442	580	721	580	721	3.0	3.7	3.0	3.7
750	650	1361	1692	680	846	680	846	3.1	3.8	3.1	3.8
800	700	1578	1963	789	981	789	981	3.1	3.9	3.1	3.9

850	750	1811	2253	906	1127	906	1127	3.2	4.0	3.2	4.0
900	800	2061	2564	1030	1282	1030	1282	3.2	4.0	3.2	4.0
950	850	2327	2894	1163	1447	1163	1447	3.3	4.1	3.3	4.1
1000	900	2608	3244	1304	1622	1304	1622	3.3	4.1	3.3	4.1

[1]Duct diameter D_c is 100 mm less D-shape diameter D unless downsized.

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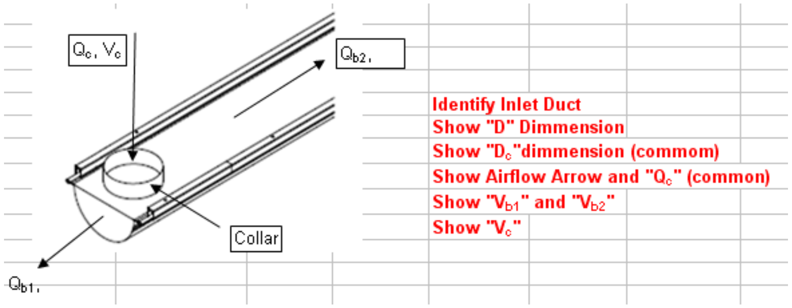
(b: I-P) End Supply



Q_{b1}	**0% (INPUT)**
Q_{b2}	**100%**

D-Shape Diameter (D), in.	Duct Diameter[1] (D_c), in.	Inlet Airflow (Q_c), cfm / Duct Velocity (V_c), fpm		Inlet Branch Airflow, cfm				Inlet Branch Velocity, fpm			
				Q_{b1}		Q_{b2}		V_{b1}		V_{b2}	
		800	1000	V_c =800 fpm	V_c =1000 fpm	V_c =800 fpm	V_c =1000 fpm	V_c =800 fpm	V_c =1000 fpm	V_c =800 fpm	V_c =1000 fpm
10	6	157	196	0	0	157	196	0	0	576	720
12	8	279	349	0	0	279	349	0	0	711	889
14	10	436	545	0	0	279	349	0	0	816	1020
16	**10[2]**	436	545	0	0	436	545	0	0	**625[3]**	**781[4]**
18	**12[2]**	628	785	0	0	628	785	0	0	**711[3]**	**889[4]**
20	**14[2]**	855	1069	0	0	855	1069	0	0	**784[3]**	**980[4]**
22	**16[2]**	1117	1396	0	0	855	1069	0	0	**846[3]**	**1058[4]**
24	**16[2]**	1117	1396	0	0	1117	1396	0	0	**711[3]**	**889[4]**
26	**18[2]**	1414	1767	0	0	1414	1767	0	0	**767[3]**	**959[4]**
28	**18[2]**	1414	1767	0	0	1414	1767	0	0	**661[3]**	**827[4]**
30	**20[2]**	1745	2182	0	0	1745	2182	0	0	**711[3]**	**889[4]**
32	**22[2]**	2112	2640	0	0	2112	2640	0	0	**756[3]**	**945[4]**
34	**24[2]**	2513	3142	0	0	2513	3142	0	0	**797[3]**	**997[4]**

36	**24**[2]	2513	3142	0	0	2513	3142	0	0	**711**[3]	**889**[4]
38	**26**[2]	2950	3687	0	0	2950	3687	0	0	**749**[3]	**936**[4]
40	**28**[2]	3421	4276	0	0	3421	4276	0	0	**784**[3]	**980**[4]

[1]Duct diameter Dc is 4 in. less D-shape diameter D unless downsized.
[2]Duct diameter downsized to maintain maximum design branch velocity.
[3]Maximum branch design duct velocity (800 fpm).
[4]Maximum branch design duct velocity (1000 fpm).

Revision 16 revised after manufacturers' review
Kevin Gebke
June 26, 2015

(b: SI) End Supply

Insert Drawing

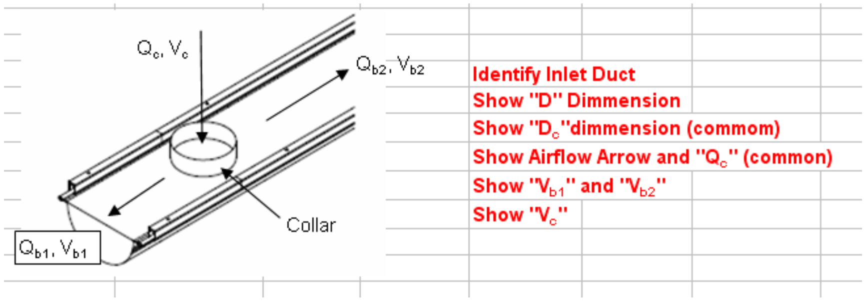
Q_{b1}	0% (INPUT)
Q_{b2}	100%

D-Shape Diameter (D), mm	Duct Diameter[1] (D_c), mm	Inlet Airflow (Q_c), L/s		Inlet Branch Airflow, L/s				Inlet Branch Velocity, fpm			
		Duct Velocity (V_c), m/s		Q_{b1}		Q_{b2}		V_{b1}		V_{b2}	
		4.1	5.1	V_c =4.1 m/s	V_c =5.1 m/s	V_c =4.1 m/s	V_c =5.1 m/s	V_c =4.1 m/s	V_c =5.1 m/s	V_c =4.1 m/s	V_c =5.1 m/s
250	150	72	90	0	0	72	90	0.0	0.0	3.0	3.7
300	200	129	160	0	0	129	160	0.0	0.0	3.6	4.5
350	**200**[2]	129	160	0	0	129	160	0.0	0.0	**2.7**[3]	**3.3**[4]
400	**250**[2]	201	250	0	0	201	250	0.0	0.0	**3.2**[3]	**4.0**[4]
450	**300**[2]	290	360	0	0	290	360	0.0	0.0	**3.6**[3]	**4.5**[4]
500	**350**[2]	394	491	0	0	394	491	0.0	0.0	**4.0**[3]	**5.0**[4]
550	**350**[2]	394	491	0	0	394	491	0.0	0.0	**3.3**[3]	**4.1**[4]
600	**400**[2]	515	641	0	0	515	641	0.0	0.0	**3.6**[3]	**4.5**[4]
650	**450**[2]	652	811	0	0	652	811	0.0	0.0	**3.9**[3]	**4.9**[4]
700	**450**[2]	652	811	0	0	652	811	0.0	0.0	**3.4**[3]	**4.2**[4]
750	**500**[2]	805	1001	0	0	805	1001	0.0	0.0	**3.6**[3]	**4.5**[4]
800	**550**[2]	974	1212	0	0	974	1212	0.0	0.0	**3.9**[3]	**4.8**[4]
850	**600**[2]	1159	1442	0	0	1159	1442	0.0	0.0	**4.1**[3]	**5.1**[4]
900	**600**[2]	1159	1442	0	0	1159	1442	0.0	0.0	**3.6**[3]	**4.5**[4]
950	**650**[2]	1361	1692	0	0	1361	1692	0.0	0.0	**3.8**[3]	**4.8**[4]
1000	**700**[2]	1578	1963	0	0	1578	1963	0.0	0.0	**4.0**[3]	**5.0**[4]

[1]Duct diameter D_c is 100 mm less D-shape diameter D unless downsized.
[2]Duct diameter downsized to maintain maximum design branch velocity.
[3]Maximum branch design duct velocity (4.1 m/s).
[4]Maximum branch design duct velocity (5.1 m/s).

Revision 16 revised after manufacturers' review
Kevin Gebke
June 26, 2015

(c: I-P) Top Supply, Any Split Ratio



Q_{b1}	**38% (INPUT)**
Q_{b2}	**62%**

For splits greater than 38%/62% change D_c until V_{b2} is less than V_c (800/1000 fpm).

D-Shape Diameter (D), in.	Duct Diameter[1] (D_c), in.	Inlet Airflow (Q_c), cfm / Duct Velocity (V_c), fpm		Inlet Branch Airflow, cfm				Inlet Branch Velocity, fpm			
				Q_{b1}		Q_{b2}		V_{b1}		V_{b2}	
		800	1000	V_c =800 fpm	V_c =1000 fpm	V_c =800 fpm	V_c =1000 fpm	V_c =800 fpm	V_c =1000 fpm	V_c =800 fpm	V_c =1000 fpm
10	6	157	196	60	75	97	122	219	274	357	446
12	8	279	349	106	133	173	216	270	338	441	551
14	10	436	545	166	207	271	338	310	388	506	633
16	12	628	785	239	298	390	487	342	428	558	698
18	14	855	1069	325	406	530	663	368	460	600	750
20	16	1117	1396	424	531	693	866	389	486	635	794
22	18	1414	1767	537	672	877	1096	407	509	664	830
24	20	1745	2182	663	829	1082	1353	422	528	689	861
26	22	2112	2640	803	1003	1309	1637	435	544	710	888
28	24	2513	3142	955	1194	1558	1948	447	558	729	911
30	26	2950	3687	1121	1401	1829	2286	457	571	745	931
32	28	3421	4276	1300	1625	2121	2651	466	582	760	949

34	30	3927	4909	1492	1865	2435	3043	473	592	772	965
36	32	4468	5585	1698	2122	2770	3463	480	600	784	980
38	34	5044	6305	1917	2396	3127	3909	487	608	794	993
40	36	5655	7069	2149	2686	3506	4383	492	616	804	1004

[1]Duct diameter D_c is 4 in. less D-shape diameter D unless downsized.

Revision 16 revised after manufacturers' review
Kevin Gebke
June 26, 2015

(c: SI) Top Supply, Any Split Ratio

Insert Drawing

Q_{b1}	38% (INPUT)
Q_{b2}	62%

For splits greater than 38%/62% change D_c until V_{b2} is less than V_c (4.1/5.1 m/s).

D-Shape Diameter (D), mm	Duct Diameter[1] (D_c), mm	Inlet Airflow (Q_c), L/s		Inlet Branch Airflow, L/s				Inlet Branch Velocity, m/s			
		Duct Velocity (V_c), m/s		Q_{b1}		Q_{b2}		V_{b1}		V_{b2}	
		4.1	5.1	V_c =4.1 m/s	V_c =5.1 m/s	V_c =4.1 m/s	V_c =5.1 m/s	V_c =4.1 m/s	V_c =5.1 m/s	V_c =4.1 m/s	V_c =5.1 m/s
250	150	72	90	28	34	45	56	1.1	1.4	1.8	2.3
300	200	129	160	49	61	80	99	1.4	1.7	2.3	2.8
350	250	201	250	76	95	125	155	1.6	2.0	2.6	3.2
400	300	290	360	110	137	180	224	1.8	2.2	2.9	3.6
450	350	394	491	150	186	245	304	1.9	2.3	3.1	3.8
500	400	515	641	196	244	319	397	2.0	2.5	3.3	4.0
550	450	652	811	248	308	404	503	2.1	2.6	3.4	4.2
600	500	805	1001	306	381	499	621	2.2	2.7	3.5	4.4
650	550	974	1212	370	460	604	751	2.2	2.8	3.6	4.5
700	600	1159	1442	441	548	719	894	2.3	2.8	3.7	4.6
750	650	1361	1692	517	643	844	1049	2.3	2.9	3.8	4.8
800	700	1578	1963	600	746	978	1217	2.4	3.0	3.9	4.8
850	750	1811	2253	688	856	1123	1397	2.4	3.0	4.0	4.9
900	800	2061	2564	783	974	1278	1589	2.5	3.1	4.0	5.0
950	850	2327	2894	884	1100	1442	1794	2.5	3.1	4.1	5.1
1000	900	2608	3244	991	1233	1617	2012	2.5	3.1	4.1	5.1

[1]Duct diameter D_c is 100 mm less D-shape diameter D unless downsized.

Quarter Circle Air Dispersion Systems. Consult manufacturer.

Outlet Types

Air outlets can be porous duct materials, linear vents, orifices, or a combination of material porosity and vents/orifices.

Design Procedure

An EXCEL spreadsheet is provided (see attached CD) to aid in the design of Air Diffusion Systems.

To design air dispersion systems follow the steps below.

Step 1. Layout the system. Keep as simple as possible.

Step 2. Knowing the system airflow requirement determine the fabric duct size using Table 9-2, 9-3 or 9-4.

Step 3. Assuming an ISP (Inlet Static Pressure) to each section of the air dispersion system calculate the average static pressure in each section by Equation 9-1. Use the ASHRAE Duct Fitting Database (DFDB) to calculate Δp_{tx}. Equation 9-1 is an empirical equation based on experience gained by air dispersion system designers. Leverette et al. (2013) state that this equation is approximately correct. For an example problem by Leverette refer to Appendix 9-1. Most often the ISP to the air dispersion system is approximately 0.5 in. water (125 Pa).

$$p_{sx,avg} = p_{sx} + 0.65\left(p_{vx} - \Delta p_{tx}\right) \quad (9\text{-}1)$$

where

$p_{sx,avg}$ = average static pressure within section x, in. water (Pa)
p_{sx} = inlet static pressure (ISP) to section x, in. water (Pa)
p_{vx} = inlet velocity pressure to section x, in. water (Pa)
Δp_{tx} = total pressure loss of section x, in. water (Pa)

The component of total pressure drop (Δp_{tx}) of a fabric duct that is dispersing air equally along its length can be estimated using the ASHRAE Duct Fitting Database (DFDB: Fitting CD11-1) and 35% of the duct length, where 35% is an estimate because the effect of air dispersion along its length is not known. The absolute roughness supported (internal skeleton frame) and unsupported fabric duct is 0.0056 ft (1.69 mm) and 0.0004 ft (0.11 mm) respectively (Kulkarni et al. 2012). These values by Kulkarni are based on a 14.5 in. (368 mm) non-porous polyester fabric duct with an acrylic/urethane coating. Use these values until additional data becomes available.

Step 4: The airflow through porous material of length "L" is calculated by Equation 9-2.

$$Q_{material} = \overline{P}\left[\pi\left(\frac{D}{K_1}\right)L\right]\left[\frac{p_{sx,avg}}{K_2}\right] \quad (9\text{-}2)$$

where

$Q_{material}$ = airflow diffused through porous material, cfm (L/s)

D	=	system duct diameter, in. (mm)
$\overline{P}$	=	material porosity, cfm per ft^2 at 0.5 in. water (L/s per m^2 at 125 Pa)
L	=	length of system duct, ft (m)
$p_{sx,avg}$	=	average static pressure within section x, in. water (Pa)
K_1	=	12 (1000)
K_2	=	0.5 (125)

Figure 9-15(I-P) Fabric Porosity

Figure 9-15(SI) Fabric Porosity

Step 5. Calculate the airflow required though the fabric duct outlets (vents or orifices) by Equation 9-3.

$$Q_{outlet} = Q_{system} - Q_{material} \quad (9\text{-}3)$$

where

Q_{outlet}	=	total outlet airflow, cfm (L/s)
Q_{system}	=	system airflow, cfm (L/s)
$Q_{material}$	=	airflow through material, cfm (L/s)

Step 6. Determine the length of vent or number of orifices, orientation of outlets (Figure 9-16), and throw. Typically there is a 4 foot (1.2 m) void (no outlets) near the inlet or after any fitting within a system to reduce wear. This is manufacture dependant. Consider the following when selecting the orientation of air outlets.

- 11&1, 10&2 and 3&9 o'clock (Figure 9-16a)**:** Primarily chosen for cooling or ventilating, these locations direct the exiting air upward and/or outward from the air dispersion system. Throw should reach the exterior walls or fill the gaps between parallel air dispersion ducts.
- 4&8, 5&7 and 6 o'clock (Figure 9-16a)**:** Primarily chosen for applications with heating, but can also be used for cooling or ventilating, these location direct the exiting air downward and/or outward from the air dispersion system. Throw requirements can be critical in these locations because the air is directed towards the occupied space.

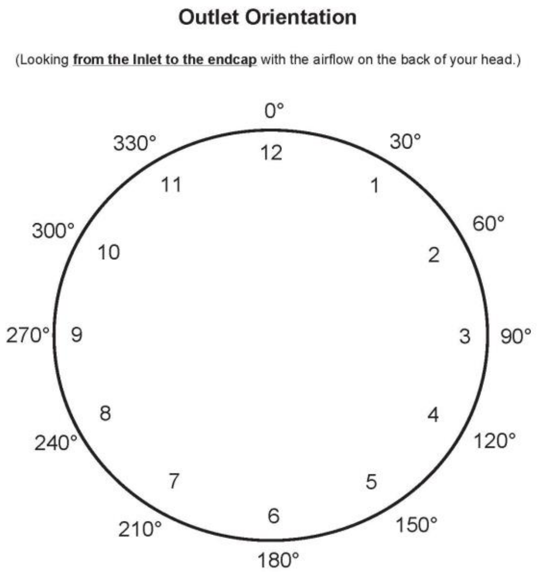
Determine throw. Throw is calculated by Equation 9-4.

$$T = K_5 \left(H - K_T\right) \quad (9\text{-}4)$$

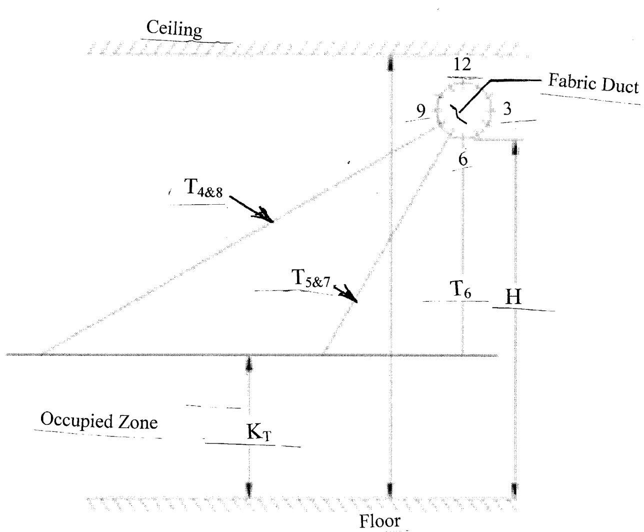
where

T	=	required throw, ft (m)
H	=	distance between bottom of duct and the floor, ft (m)
K_T	=	6 (1.8)
K_5	=	2.0 for 4&8 o'clock 1.15 for 5&7 o'clock

1.0 for 6 o'clock



(a) Throw Orientations



(b) Throw Length

Figure 9-16 Throw: Directional Airflow/Distance

Step 7a. For linear vent outlets select the vent size using manufacturer's data. Table 9-5 is an example of manufacturer's data. Terminal Velocity is the maximum airstream velocity at end of throw.

Table 9-5(I-P). Manufacturer's Data for Linear Vent Outlets

Vent Size	Static Pressure	Airflow (cfm/ft)	Distance (ft) to Terminal Velocity (fpm)

	(in. water)		150	100	50
5	0.25	3.5	4	5	9
	0.50	5.0	5	8	12
	0.75	6.1	6	9	15
	1.00	7.1	7	11	17
10	0.25	7.1	6	9	15
	0.50	10.0	9	13	21
	0.75	12.2	11	16	26
	1.00	14.1	12	19	30
15	0.25	10.6	8	12	18
	0.50	15.0	11	16	26
	0.75	18.4	13	20	32
	1.00	21.2	15	23	37
20	0.25	14.1	9	14	22
	0.50	20.0	13	20	31
	0.75	24.5	16	24	38
	1.00	28.3	18	28	44
30	0.25	21.2	12	18	29
	0.50	30.0	17	26	41
	0.75	36.7	21	31	50
	1.00	42.4	24	36	58
40	0.25	28.3	15	22	36
	0.50	40.0	21	31	50
	0.75	49.0	26	39	62
	1.00	56.6	30	45	71
50	0.25	35.4	18	26	42
	0.50	50.0	24	33	60
	0.75	61.2	30	46	73
	1.00	70.7	35	53	84
60	0.25	42.4	19	28	45
	0.50	60.0	26	39	63
	0.75	73.5	32	48	77
	1.00	84.9	37	56	89

Courtesy: DuctSox Corp.

Table 9-5(SI). Manufacturer's Data for Linear Vent Outlets

Vent Size	Static Pressure (Pa)	Airflow (L/s per m)	Distance (m) to Terminal Velocity (m/s)		
			0.75	0.50	0.25
7.8	62	5.4	1.2	1.5	2.7
	125	7.7	1.5	2.4	3.7
	187	9.4	1.8	2.7	4.6
	250	11.0	2.1	3.4	5.2
15.5	62	11.0	1.8	2.7	4.6
	125	15.5	2.7	4.0	6.4
	187	18.9	3.4	4.9	7.9
	250	21.8	3.7	5.8	9.1
23.3	62	16.4	2.4	3.7	5.5
	125	23.2	3.4	4.9	7.9
	187	28.5	4.0	6.1	9.8
	250	32.8	4.6	7.0	11.3
31.0	62	21.8	2.7	4.3	6.7
	125	31.0	4.0	6.1	9.4
	187	37.9	4.9	7.3	11.6
	250	43.8	5.5	8.5	13.4
46.7	62	32.8	3.7	5.5	8.8
	125	46.4	5.2	7.9	12.5
	187	56.8	6.4	9.4	15.2
	250	65.6	7.3	11.0	17.7
61.7	62	43.8	4.6	6.7	11.0
	125	61.9	6.4	9.4	15.2
	187	75.9	7.9	11.9	18.9
	250	87.6	9.1	13.7	21.6
77.5	62	54.8	5.5	7.9	12.8
	125	77.4	7.3	10.1	18.3
	187	94.8	9.1	14.0	22.3
	250	109.5	10.7	16.2	25.6
92.9	62	65.6	5.8	8.5	13.7
	125	92.9	7.9	11.9	19.2
	187	113.8	9.8	14.6	23.5
	250	131.4	11.3	17.1	27.1

Courtesy: DuctSox Corp.

Step 7b. For orifice outlets select the orifice diameter using manufacturer's data. Table 9-6 is an example of manufacturer's data. Terminal Velocity is the maximum airstream velocity at end of throw.

Table 9-6(I-P). Orifice Characteristics

Orifice Diameter (in.)	Static Pressure (in. water)	Airflow (cfm each)	Distance (ft) to Terminal Velocity (fpm)		
			150	100	50
1/16 *(13 pcs holes per LF)	0.25	2.8/ft	N/A	N/A	4
	0.50	4.1/ft	N/A	1	9
	0.75	5.0/ft	N/A	3	13
	1.00	5.9/ft	1	4	19
	1.25	6.4/ft	2	5	24
1/2	0.25	1.6	3	4	8
	0.50	2.3	4	6	11
	0.75	2.8	5	7	14
	1.00	3.3	5	8	16
	1.25	3.7	6	9	18
1	0.25	6.6	5	8	16
	0.50	9.3	8	11	23
	0.75	11.4	9	14	28
	1.00	13.1	11	16	32
	1.25	14.7	12	18	36
2	0.25	26	11	16	32
	0.50	37	15	23	45
	0.75	45	19	28	56
	1.00	52	21	32	64
	1.25	59	24	36	72
2.5	0.25	41	13	20	40
	0.50	58	19	28	57
	0.75	71	23	35	69
	1.00	82	27	40	80
	1.25	92	30	45	90
3	0.25	59	16	24	48
	0.50	84	23	34	68
	0.75	102	28	42	83
	1.00	118	32	48	96
	1.25	132	36	54	108
4	0.25	105	21	32	64
	0.50	148	30	45	91
	0.75	182	37	56	111
	1.00	210	43	64	128
	1.25	235	48	72	144
5	0.25	164	27	40	80
	0.50	232	38	57	113
	0.75	284	46	69	139
	1.00	328	53	80	160
	1.25	367	60	90	179

Table 9-6(SI). Orifice Characteristics

Orifice Diameter (mm)	Static Pressure (Pa)	Airflow (L/s each)	Distance (m) to Terminal Velocity (m/s)		
			0.75	0.50	0.25
Ø4 *(42 holes per linear metre)	62	a. / m	N/A	N/A	1.3
	125	6.4 / m	N/A	0.4	2.7
	187	7.8 /m	N/A	0.8	4.0
	250	9.2 / m	0.3	1.2	5.8
	312	10.0 / m	0.5	1.6	7.3
13	62	0.77	0.9	1.2	2.4
	125	1.09	1.2	1.8	3.4
	187	1.34	1.5	2.1	4.3
	250	1.54	1.5	2.4	4.9
	312	1.73	1.8	2.7	5.5
25	62	3.1	1.5	2.4	4.9
	125	4.4	2.4	3.4	7.0
	187	5.4	2.7	4.3	8.5
	250	6.2	3.4	4.9	9.8
	312	6.9	3.7	5.5	11.0
50	62	12.4	3.4	4.9	9.8
	125	17.5	4.6	7.0	13.7
	187	21.5	5.8	8.5	17.1
	250	24.8	6.4	9.8	19.5
	312	27.7	7.3	11.0	21.9
63	62	19.4	4.0	6.1	12.2
	125	27.4	5.8	8.5	17.4
	187	33.5	7.0	10.7	21.0
	250	38.7	8.2	12.2	24.4
	312	43.3	9.1	13.7	27.4
75	62	27.9	4.9	7.3	14.6
	125	39.4	7.0	10.4	20.7
	187	48.3	8.5	12.8	25.3
	250	55.7	9.8	14.6	29.3
	312	62.3	11.0	16.5	32.9
100	62	49.5	6.4	9.8	19.5
	125	70.1	9.1	13.7	27.7
	187	85.8	11.3	17.1	33.8
	250	99.1	13.1	19.5	39.0
	312	110.8	14.6	21.9	43.9
125	62	77	8.2	12.2	24.4
	125	109	11.6	17.4	34.4
	187	134	14.0	21.0	42.4
	250	155	16.2	24.4	48.8
	312	173	18.3	27.4	54.6

Table 9-6(I-P). Manufacturer's Data for Nozzles

Nozzle Size	Static Pressure (in. water)	Airflow (cfm/ft)	Distance (ft) to Terminal Velocity (fpm)		
			150	100	50
½"	0.25	2.3	4	7	13
	0.50	3.2	6	9	18
	0.75	4.0	8	11	22
	1.00	4.4	9	13	26
¾"	0.25	4.7	5	8	16
	0.50	6.6	8	11	20
	0.75	8.1	10	14	27
	1.00	8.9	11	16	31
1"	0.25	8.7	9	12	26
	0.50	12.2	12	18	35
	0.75	15.0	15	22	43
	1.00	17.4	17	25	50
2"	0.25	34.7	18	27	53
	0.50	48.9	25	37	74
	0.75	60.0	31	46	N/A
	1.00	70.1	35	53	N/A
2½"	0.25	56.6	19	29	58
	0.50	84.1	28	41	82
	0.75	105.5	34	51	N/A
	1.00	123.5	39	58	N/A

Courtesy: KE Fibertec NA

Table 9-6(SI). Manufacturer's Data for Nozzles

Nozzle Size	Static Pressure (Pa)	Airflow (L/s)	Distance (m) to Terminal Velocity (m/s)		
			0.75	0.50	0.25
Ø12 mm	62	1.1	1.3	2.0	4.1
	125	1.5	1.9	2.8	5.6
	187	1.9	2.3	3.4	6.8
	250	2.1	2.7	4.0	8.0
Ø18 mm	62	2.2	1.6	2.4	4.8
	125	3.1	2.3	3.5	6.2
	187	3.8	2.9	4.3	8.1
	250	4.2	3.3	4.9	9.6
Ø24 mm	62	4.1	2.6	3.8	7.8
	125	5.8	3.7	5.5	10.8
	187	7.1	4.5	6.7	13.1
	250	8.2	5.2	7.7	15.3
Ø 48 mm	62	16.4	5.4	8.1	16.3
	125	23.1	7.6	11.4	22.5
	187	28.3	9.3	13.9	N/A
	250	33.1	10.8	16.2	N/A
Ø60 mm	62	26.7	5.9	8.9	17.7
	125	39.7	8.4	12.6	25.1

	187	49.8	10.3	15.5	N/A
	250	58.3	11.9	17.8	N/A

Courtesy: KE Fibertec NA

Examples that follow are on the CD

Example Designs

Example 9-1. The fabric air dispersion (FAD) system is a 45 ft (13.7 m) porous [2 cfm/ ft^2 (10.2 L/s per m^2)] cylindrical fabric duct with 41 ft (12.5 m) of linear vent at 4 and 8 o'clock (Figure 9-17). Fabric duct <u>does have an internal skeleton frame</u>. The total flow is 1900 cfm (900 L/s) at a density of 0.075 lbs/ft^3 (1.204 kg/m^3). The bottom of the fabric duct is 21 ft (6.4 m) from the floor. The room is occupied (limit terminal velocity to 50 fpm (0.25 m/s).

Solution.

Step 1. Layout the system.

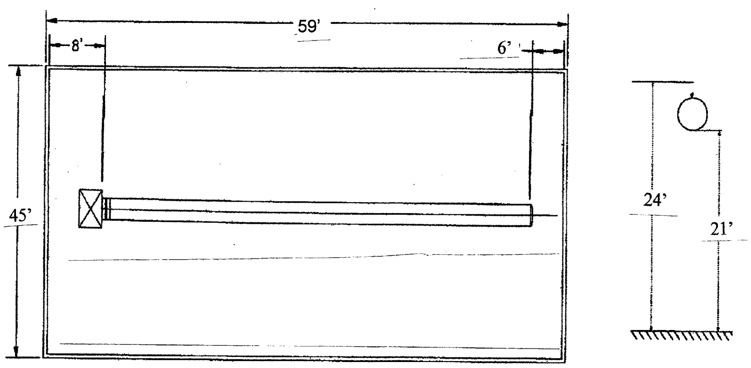


Figure 9-17(I-P) System Layout for Example 9-1

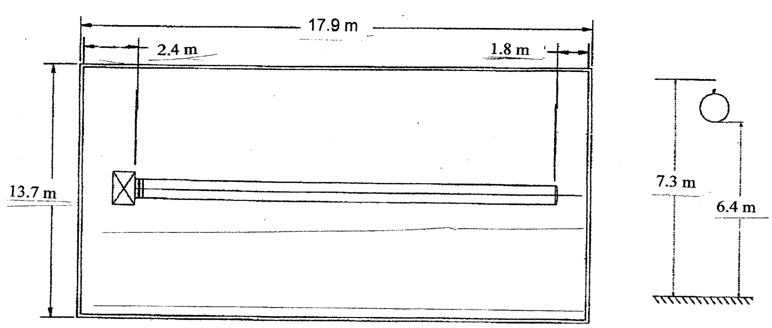


Figure 9-17(SI) System Layout for Example 9-1

Step 2. From Table 9-2 the fabric duct diameter for 1900 cfm (900 L/s) is 16 in. (400 mm). Inlet velocity is 1361 fpm (7.2 m/s).

Step 3. Assume 3/8 in. water (93 Pa) inlet static pressure (ISP) using Table 9-5 as a guide, and calculate the average duct static pressure ($p_{s,avg}$) using Equation 9-1, where Δp_{t1} is from Figure A9-2.1. The average static pressure is 0.44 in. water (109 Pa), calculated as follows.

I-P: $$p_{s1,avg} = p_{s1} + 0.66\left(p_{v1} - \Delta p_{t1}\right) = 0.375 + 0.65\left(0.12 - 0.02\right) = 0.44 \text{ in. water}$$

SI: $$p_{s1,avg} = p_{s1} + 0.66\left(p_{v1} - \Delta p_{t1}\right) = 93 + 0.65\left(31 - 7\right) = 109 \text{ Pa}$$

Step 4. The airflow through the fabric duct calculated by Equation 9-2 is 329 cfm (152 L/s), calculated as follows

$$\text{IP}: \quad Q_{\text{material}} = \overline{P}\left[\pi\left(\frac{D}{12}\right)L\right]\left(\frac{p_{s1,avg}}{0.5}\right) = 2\left[\pi\left(\frac{16}{12}\right)45\right]\left[\frac{0.44}{0.5}\right] = 329 \text{ cfm}$$

$$\text{SI}: \quad Q_{\text{material}} = \overline{P}\left[\pi\left(\frac{D}{1000}\right)L\right]\left(\frac{p_{s1,avg}}{125}\right) = 10.2\left[\pi\left(\frac{400}{1000}\right)13.7\right]\left[\frac{109}{125}\right] = 152 \text{ L/s}$$

Step 5. The airflow through the linear vent outlet, calculated by Equation 9-3, is 1571 cfm (748 L/s), calculated as follows.

I-P: $Q_{\text{outlet}} = Q_{\text{system}} - Q_{\text{material}} = 1900 - 329 = 1571 \text{ cfm}$

SI: $Q_{\text{outlet}} = Q_{\text{system}} - Q_{\text{material}} = 900 - 152 = 748 \text{ L/s}$

Step 6. The total length of linear vent is 82 ft (25.0 m). For the room aspect ratio and configuration the best orientation of the linear vents for cooling air is 4 and 8 o'clock with a terminal velocity not exceeding 50 fpm (0.25 m/s) for occupant comfort. Throw calculated using Equation 9-4 is 30 ft (9.2 m), calculated as follows.

I-P: $T_{4\&8} = 2(H-6) = 2(21-6) = 30 \text{ ft}$

SI: $T_{4\&8} = 2(H-1.8) = 2(6.4-1.8) = 9.2 \text{ m}$

Step 7. The airflow per unit length of vent is 19 [1570/ (41*2)] cfm/ft of vent [29.9 (747/ (12.5*2))] L/s per m of vent]. From manufacturer's data (Table 9-5) the linear vent is size 20 (19 cfm/ft at 0.44 in. water) [31 (30 L/s per m at 109 Pa)]. By interpolation the throw is approximately 28 ft (30 ft max.) at 0.44 in. water [8.7 m (9.2 m max.) at 109 Pa] static pressure. If the solution does not yield a reasonable throw repeat steps 3, 4, 5 and 7.

Inlet Static Pressure (ISP) to the FAD system is 0.375 in. water (93 Pa).

Example 9-2. The system is a 42 ft (12.8 m) non-porous cylindrical fabric duct with 38 ft (11.6 m) allocated for orifices at 4 and 8 o'clock. The total flow is 400 cfm (190 L/s) at 0.075 lbs/ft^3 (1.204 kg/m^3). Fabric duct <u>has an internal skeleton frame</u>. The bottom of the fabric duct is 21 ft (6.4 m) from the floor. The room is occupied [limit terminal velocity to 50 fpm (0.25 m/s)]. For the system layout refer to Figure 9-18.

Solution.

Step 1. Layout the system.

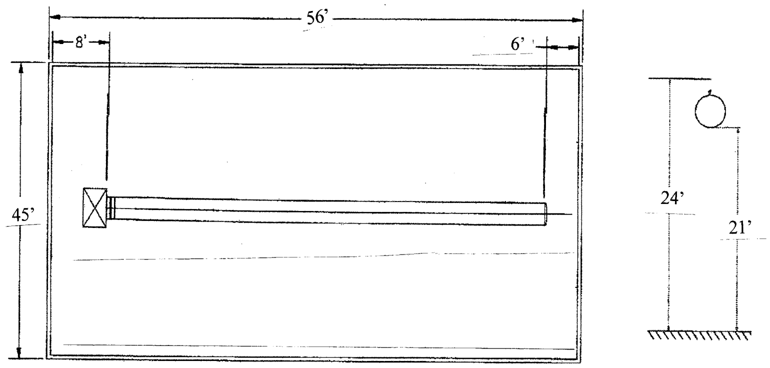


Figure 9-18(I-P) System Layout for Example 9-2

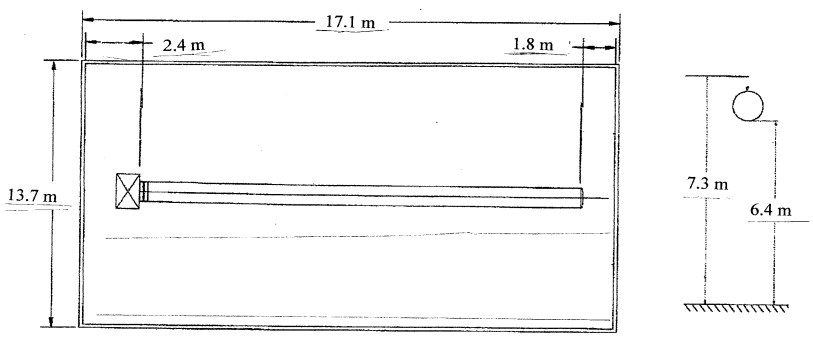


Figure 9-18(SI) System Layout for Example 9-2

Step 2. From Table 9-2 the fabric duct diameter is 8 in. (200 mm). Inlet velocity is 1146 fpm (6.0 m/s).

Step 3. Assume ¾ in. water (188 Pa) inlet static pressure (ISP) using Table 9-6 as a guide, and then calculate the average duct static pressure ($p_{s,avg}$) using Equation 9-1. The average static pressure is 0.76 in. water (191 Pa), calculated as follows.

I-P: $p_{s,avg} = p_{s1} + 0.66\left(p_{v1} - \Delta p_{t1}\right) = 0.75 + 0.65\left(0.08 - 0.07\right) = 0.76 \text{ in. water}$

SI: $p_{s,avg} = p_{s1} + 0.66\left(p_{v1} - \Delta p_{t1}\right) = 188 + 0.65\left(22 - 18\right) = 191 \text{ Pa}$

Step 4. Not applicable.

Step 5. The airflow through the orifice outlets calculated by Equation 9-3 is 400 cfm (190 L/s), calculated as follows.

I-P: $Q_{outlet} = Q_{system} - Q_{material} = 400 - 0 = 400 \text{ cfm}$

SI: $Q_{outlet} = Q_{system} - Q_{material} = 190 - 0 = 190 \text{ L/s}$

Step 6. The total length allocated for orifices is 76 ft (23.2 m). For the room aspect ratio and configuration the best orientation of the orifices for cooling air is 4 and 8 o'clock with a terminal velocity not exceeding 50 fpm (0.25 m/s) for occupant comfort. Throw calculated using Equation 9-4 is 30 ft (9.2 m), calculated as follows.

I-P: $\mathrm{T} = 2\left(\mathrm{H} - 6\right) = 2\left(21 - 6\right) = 30\,\mathrm{ft}$

SI: $\mathrm{T} = 2\left(\mathrm{H} - 1.8\right) = 2\left(6.4 - 1.8\right) = 9.2\,\mathrm{m}$

Step 7. Juggle the number of orifices (airflow per orifice), throw and ISP to reach a solution. Assume eighteen (18) orifices are located on each row at 4 and 8 o'clock resulting in 11 cfm (5.3 L/s) per orifice. From manufacturer's data (Table 9-6) the orifice is 1.0 in. diameter (≈11 cfm/ft at 0.76 in. water) [25 mm diameter (≈5.3 L/s per m at 191 Pa)]. By interpolation the throw is approximately 28 ft [30 ft max.) at 0.76 in. water [8.5 m (9.2 max.) at 191 Pa] static pressure. If the solution does not yield a reasonable throw repeat steps 3, 5 and 7.

Inlet Static Pressure (ISP) to the FAD system is 0.75 in. water (188 Pa).

Example 9-3. Design Section 1 and 2 as shown by the layout illustrated by Figure 9-19. Section 3 is a mirror image of 2. Sections 4, 5 and 6 are a mirror image of 1, 2 and 3. The airflow in Sections 1 and 4 are 1100 cfm (520 L/s) and Sections 2, 3, 5 and 6 is 500 cfm (236 L/s). The fabric duct in Sections 2, 3, 5 and 6 has a porosity of 2 cfm/ft^2 (10.2 L/s per m^2), and two rows of vents. Fabric ducts have an internal skeleton frame. The duct lengths of Sections 1 and 4 are 25 ft (7.6 m) and Sections 2, 3, 5 and 6 are 32 ft (9.8 m). The bottom of the fabric duct is 21 ft (6.4 m) from the floor. The room is occupied [limit terminal velocity to 50 fpm (0.25 m/s)].

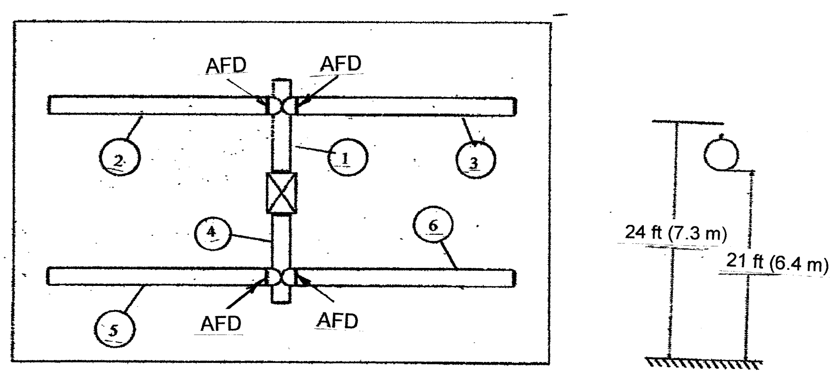


Figure 9-19 System Layout for Example 9-3

Solution. From Table 9-2 the fabric duct diameter for Sections 1 and 4 is 12 in. (300 mm), and Sections 2, 3, 5 and 6 are 8 in. (200 mm). Refer to the CD (Example 9-3) for the design of Section 2. Assume ISP is 0.75 in. water (187 Pa) at the entrance to Section 2. The vent in Section 2 is 6.1 cfm/ft (9.4 L/s per m) and the average static pressure in Section 2 is 0.78 in. water (195 Pa). The total vent length is 48 ft (14.6 m) with 24 ft (7.3 m) spaced intermittently at 5&7 o'clock. From manufacturer's data (Table 9-5) the linear vent size is 5 (6.1 cfm/ft at 0.78 in. water) [7.8 (9.4 L/s per m at 196 Pa)]. By interpolation the throw is approximately 15 ft (17 ft max.) at 0.78 in. water [4.6 m (5.3 m) at 196 Pa]. If the solution does not yield a reasonable throw repeat from Step 3. The total pressure required at the plenum (entering Section 1) is 1.48 in. water (379 Pa) (see Spreadsheet, Figure A9-2.4).

OPERATION

Filtration

Filtration before it gets into the air distribution system is essential. An efficient filtration system means less cleaning, resulting in a longer product life. Higher filtration (MERV 5) is recommended for low velocity outlets (porous fabric and microperforations). Fabric air distribution systems are washable.

Pressure Required for Inflation
For proper inflation the static pressure at the inlet to a fabric air distribution system should exceed 1.3 times the inlet velocity pressure.

Example 9-4. What is the minimum static pressure at a point entering a fabric air distribution system with an inlet velocity of 1800 fpm (9.1 m/s)? Assume standard air.

Solution. Inlet velocity pressure is 0.20 in. water (50 Pa); therefore the minimum static pressure should exceed 0.26 in. water (65 Pa), calculated as follows: (1.3) (0.20) = 0.26 in. water [(1.3) (50) = 65 Pa].

Fan Operation
Extreme cycling may cause premature failure of the system due to inflation impact stress, especially if a "popping" sound is evident. In different environments some may find this distraction. It is recommended that a fabric air distribution system be continuously operated to avoid inflation and deflation of the system or specify a suspension system that tensions the fabric.

Frequency Drive/Soft Start Mechanisms
It is recommended that a frequency drive or soft start motor controller be used to ramp up the speed of fabric air dispersion system fans. This will greatly reduce the initial surge of airflow that causes stress on fabric air distribution systems. Motorized damper

For larger systems a two speed fan or a staging fan can be considered. Either option will keep the fabric air distribution system inflated when the system is not operating. When the main fan kicks in, the system is already partially inflated. This option virtually eliminates any concern of an inflation pop.

TERMINOLOGY

Air Dispersion Systems. Any HVAC system designed to simultaneously convey and diffuse air into a room/space/area. Systems operate under positive pressure and are commonly constructed of, but not limited to, fabric or plastic film.

Terminal Velocity. Maximum velocity of air from an outlet at end of throw.

Throw. Horizontal or vertical axial distance an airstream travels after leaving an air outlet before maximum stream velocity is reduced to a specified terminal velocity [e.g. 50, 100 or 150 fpm (0.25, 0.50 or 0.75 m/s)].

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Leverette, J., K. Gebke and S. Idem. 2014. Pressure and Velocity Variations in a Fabric Air Dispersion System. HVAC&R Research, 20:8, 862-874. http://dx.doi.org/10.1080/10789669.2014.957592.

Kulkarni. D, A.N. Nalla, S. Idem, and K. Gebke. 2012. Laboratory testing of a fabric air dispersion system. ASHRAE Transactions, Vol. 118, Part 2.

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APPENDIX 9 1

Example A9-1.1

Figure A9-1.1 is the total and static pressures plotted incrementally for the following FAD system design. The duct is fabric, porous with a linear vent consisting of 5/16 in. holes arrayed in a triangular grid pattern along the longitudinal surface of the fabric duct. There were two rows of linear vents on either side of the duct. The top linear vent row dispersed the air approximately 14° downward relative to the horizontal centerline, while the other row was oriented approximately 52° downward relative to the horizontal centerline. The porosity of the fabric duct is 3.457 cfm at 1 in. water (1.63 L/s at 250 Pa).

Inlet Airflow: 1600 cfm (755 L/s)
Diameter: 12 in. (300 mm)
Length: 44 ft (13.4 m)
Inlet Static Pressure: 0.36 in. water (90 Pa)
Inlet Velocity: 2037 fpm (10.3 m/s)
Ambient Temperature: 70°F (21.1°C)

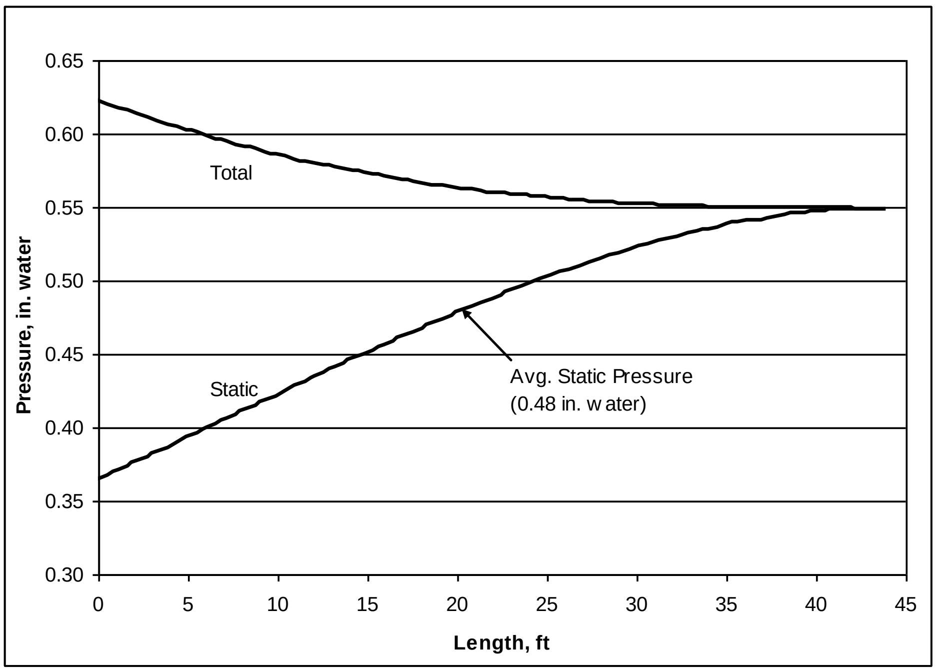

Figure A9-1.1(I-P) Example A9-1.1 Grade Line

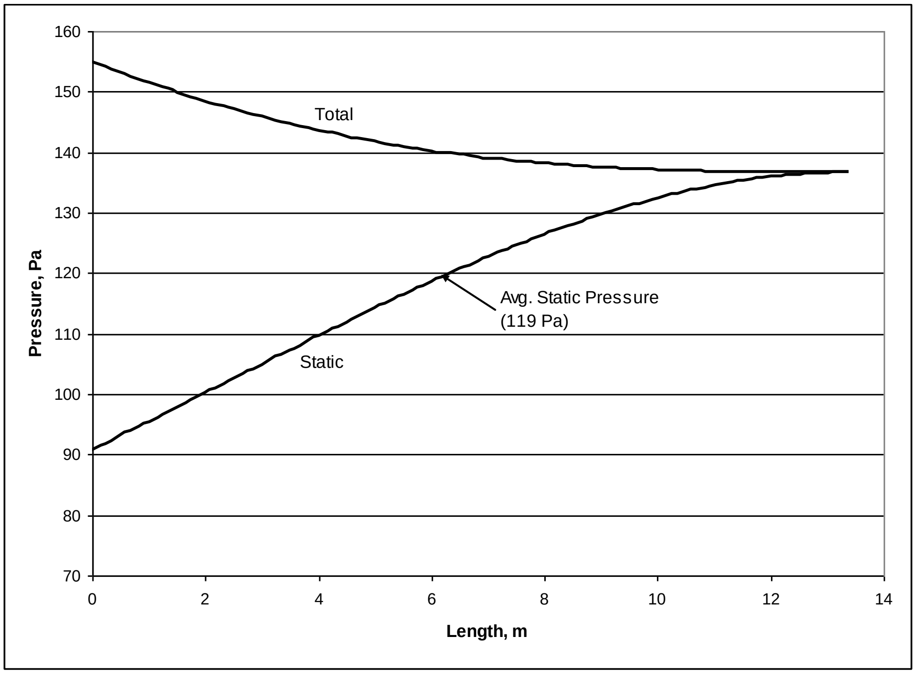

Figure A9-1.1(SI) Example A9-1.1 Grade Line

The purpose of the AFD is to adjust the static pressure and lessen the static pressure difference due to regain as illustrated by Figure A9-1.2. Inserting an AFD at 14 ft (4.3 m) and adjusting its resistance to 0.09 in. water (22 Pa) results in approximately the same static pressure at the inlet to FAD system and immediately downstream of the AFD. Uneven static pressures result in uneven airflow to the space. Without an AFD the airflow can commonly vary from 10 to 20% from inlet to endcap in a straight system. With the AFD the range of airflow is typically 3 to 6%.

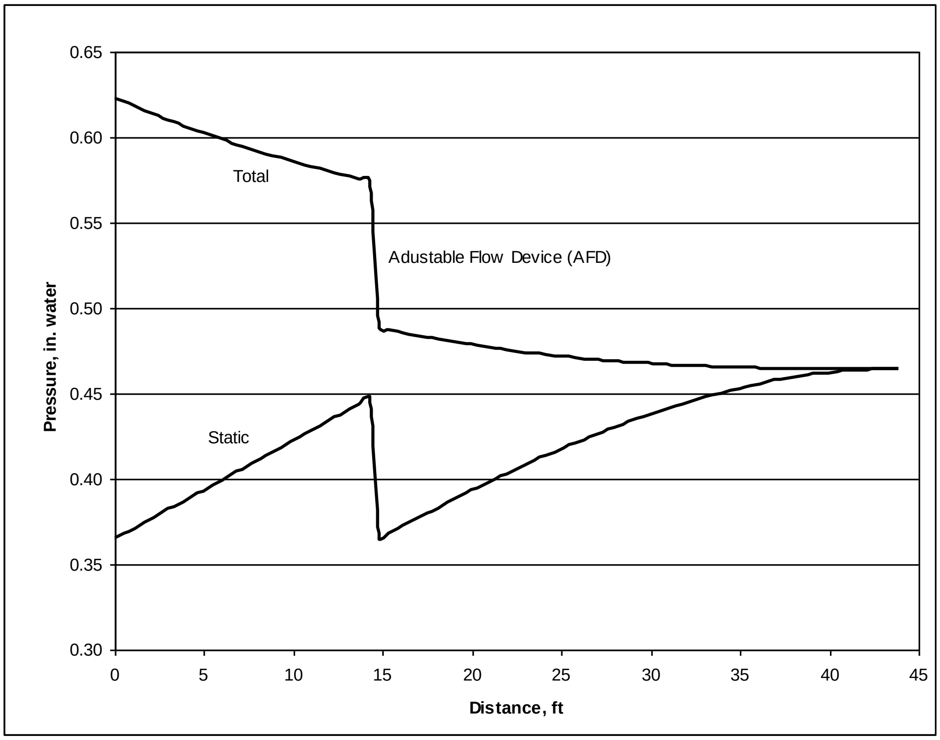

Figure A9-1.2(I-P) Example A9-1.1 Grade Line with an AFD

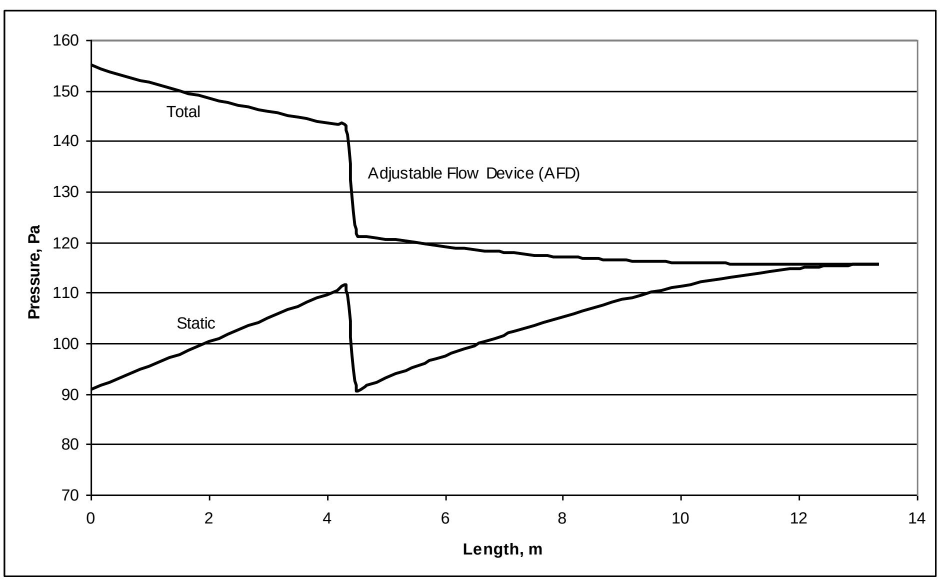

Figure A9-1.2(SI) Example A9-1 Grade Line with an AFD

APPENDIX 9-2

Example A9-2.1

Figure A9-2.1 is showing the Basic Sound Power Level for different type of Air Dispersion Systems. The Sound Power level is noise generated primarily from air movement inside the fabric duct and/or from the fabric outlets (different type of outlet like porous fabrics, orifices, linear vent and nozzles has different noise characteristics). The total pressure (Static pressure + Dynamic pressure) is a good and simplified way to make a basis calculation. To convert the Sound Power Level to an exact Sound Pressure level in a room information about geometry and dimensions of the room must be available as well as the surface characteristics. The location and number of fabric ducts and finally the distance from the fabric duct to the recipient. It is recommended to contact the fabric duct manufacturer to get exact data to perform a Sound Pressure Level calculation.

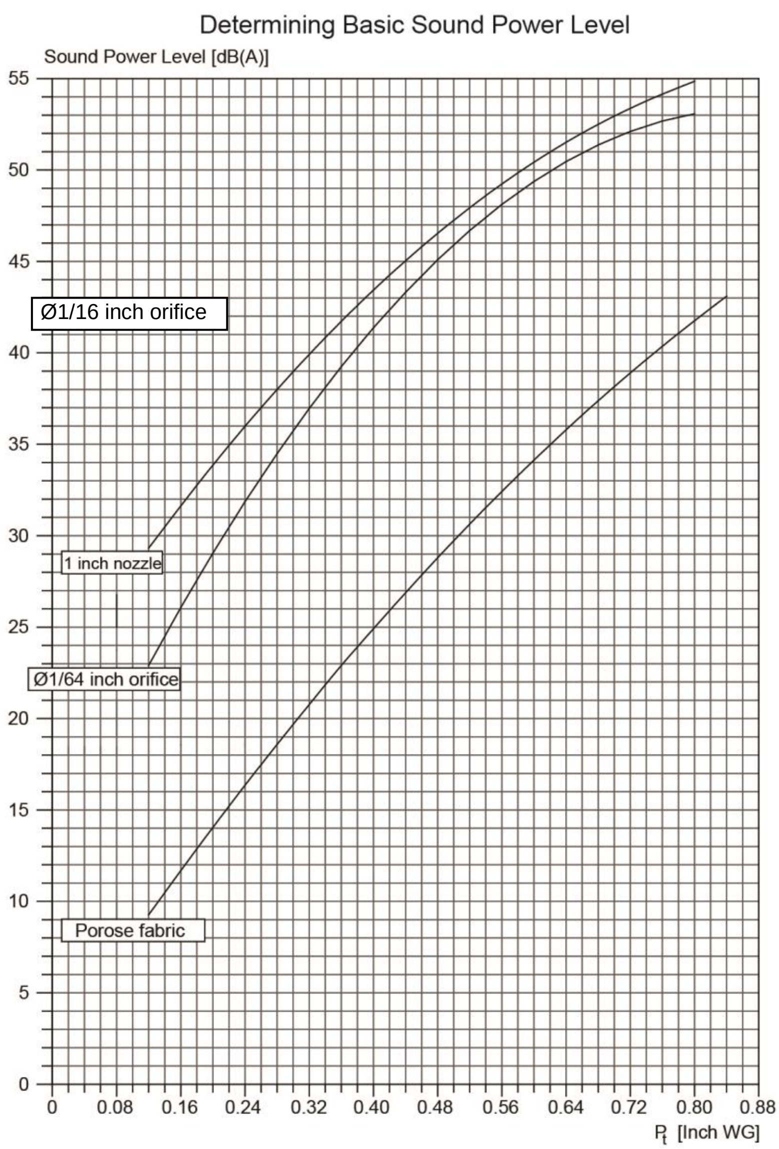

Figure A9-2.1(IP) Example Of Basic Sound Levels for different type of Fabric ducts
Courtesy: KE Fibertec NA

CORRECTION FOR SOUND POWER LEVELS

1” Nozzle (ø24mm) – Correction of dB(A) dependent on fabric duct length and number of nozzles

Nozzles	Duct length [ft]									
d	8	16	24	32	40	48	56	64	72	80
2	-13.0	-10.0	-8.2	-7.0	-6.0	-5.2	-4.6	-4.0	-3.5	-3.0
4	-10.0	-7.0	-5.2	-4.0	-3.0	-2.2	-1.5	-1.0	-0.5	+0.0
6	-8.2	-5.2	-3.5	-2.2	-1.2	-0.5	+0.2	+0.8	+1.3	+1.8
8	-7.0	-4.0	-2.2	-1.0	+0.0	+0.8	+1.5	+2.0	+2.6	+3.0
10	-6.0	-3.0	-1.2	+0.0	+1.0	+1.8	+2.4	+3.0	+3.5	+4.0
12	-5.2	-2.2	-0.5	+0.8	+1.8	+2.6	+3.2	+3.8	+4.3	+4.8
14	-4.6	-1.5	+0.2	+1.5	+2.4	+3.2	+3.9	+4.5	+5.0	+5.4
16	-4.0	-1.0	+0.8	+2.0	+3.0	+3.8	+4.5	+5.1	+5.6	+6.0
18	-3.5	-0.5	+1.3	+2.6	+3.5	+4.3	+5.0	+5.6	+6.1	+6.5
20	-3.0	+0.0	+1.8	+3.0	+4.0	+4.8	+5.4	+6.0	+6.5	+7.0
22	-2.6	+0.4	+2.2	+3.4	+4.4	+5.2	+5.9	+6.4	+6.9	+7.4
24	-2.2	+0.8	+2.6	+3.8	+4.8	+5.6	+6.2	+6.8	+7.3	+7.8
26	-1.9	+1.1	+2.9	+4.1	+5.1	+5.9	+6.6	+7.2	+7.7	+8.1
28	-1.5	+1.5	+3.2	+4.5	+5.4	+6.2	+6.9	+7.5	+8.0	+8.5
30	-1.2	+1.8	+3.5	+4.8	+5.7	+6.5	+7.2	+7.8	+8.3	+8.8
32	-1.0	+2.0	+3.8	+5.1	+6.0	+6.8	+7.5	+8.1	+8.6	+9.0
34	-0.7	+2.3	+4.1	+5.3	+6.3	+7.1	+7.7	+8.3	+8.8	+9.3
36	-0.5	+2.6	+4.3	+5.6	+6.5	+7.3	+8.0	+8.6	+9.1	+9.5
38	-0.2	+2.8	+4.5	+5.8	+6.8	+7.6	+8.2	+8.8	+9.3	+9.8
40	+0.0	+3.0	+4.8	+6.0	+7.0	+7.8	+8.5	+9.0	+9.5	+10.0

Porous Fabric dependent on fabric duct length (dB(A))

	Duct length [ft]									
	8	16	24	32	40	48	56	64	72	80
Corr.	-3.0	+0.0	+1.8	+3.0	+4.0	+4.8	+5.5	+6.0	+6.5	+7.0

1/16” (ø4 mm) holes. 42 pcs per linear metre (13 pcs LF). Number of rows and duct length

Rows	Duct length [ft]									
r	8	16	24	32	40	48	56	64	72	80
2	-7.0	-4.0	-2.2	-1.0	+0.0	+0.8	+1.5	+2.0	+2.6	+3.0
4	-4.0	-1.0	+0.8	+2.0	+3.0	+3.8	+4.5	+5.1	+5.6	+6.0
6	-2.2	+0.8	+2.6	+3.8	+4.8	+5.6	+6.2	+6.8	+7.3	+7.8
8	-1.0	+2.0	+3.8	+5.1	+6.0	+6.8	+7.5	+8.1	+8.6	+9.0
10	+0.0	+3.0	+4.8	+6.0	+7.0	+7.8	+8.5	+9.0	+9.5	+10.0
12	+0.8	+3.8	+5.6	+6.8	+7.8	+8.6	+9.2	+9.8	+10.3	+10.8
14	+1.5	+4.5	+6.2	+7.5	+8.5	+9.2	+9.9	+10.5	+11.0	+11.5
16	+2.0	+5.1	+6.8	+8.1	+9.0	+9.8	+10.5	+11.1	+11.6	+12.0
18	+2.6	+5.6	+7.3	+8.6	+9.5	+10.3	+11.0	+11.6	+12.1	+12.6
20	+3.0	+6.0	+7.8	+9.0	+10.0	+10.8	+11.5	+12.0	+12.6	+13.0

Figure A9-2.2(IP) Correction factors for different duct lengths and number of outlets
Courtesy: KE Fibertec NA

Sound calculation example

A standard Porous Fabric duct with a length of 48 foot and with a design pressure of P_t = 0.47 inch WG. The Basic Sound Power Level = 28 dB(A). Figure A9-2.1.

The corrected Sound Power Level (1 duct) is: +4.8 dB(A). Figure A9-2-2. =>
28 dB(A) + 4.8 dB(A) = **32.2 dB(A).**

To determine the resulting Sound Pressure Level the room attenuation must be known.

APPENDIX 9 3

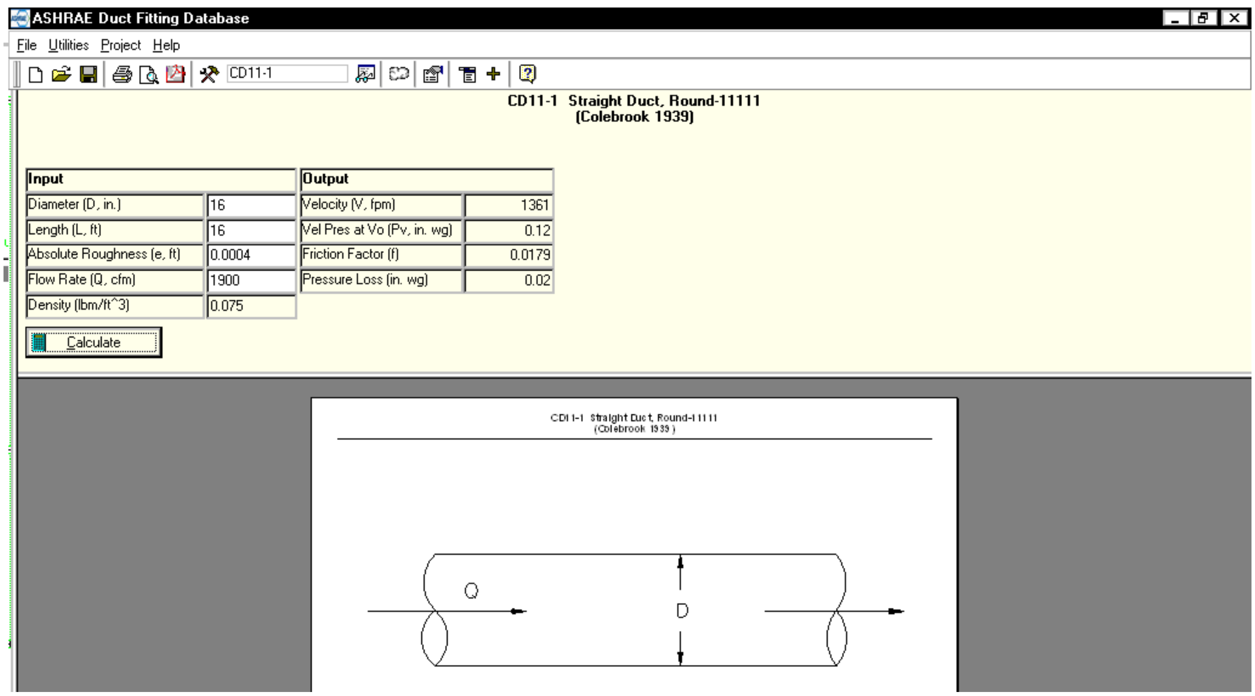

Figure A9-3.1(I-P) DFDB (CD11-1) Output for Example 9-1
Note: Length (L) is calculated as follows: (45 * 0.35 = 16 ft. See Design Procedure, Step 2.

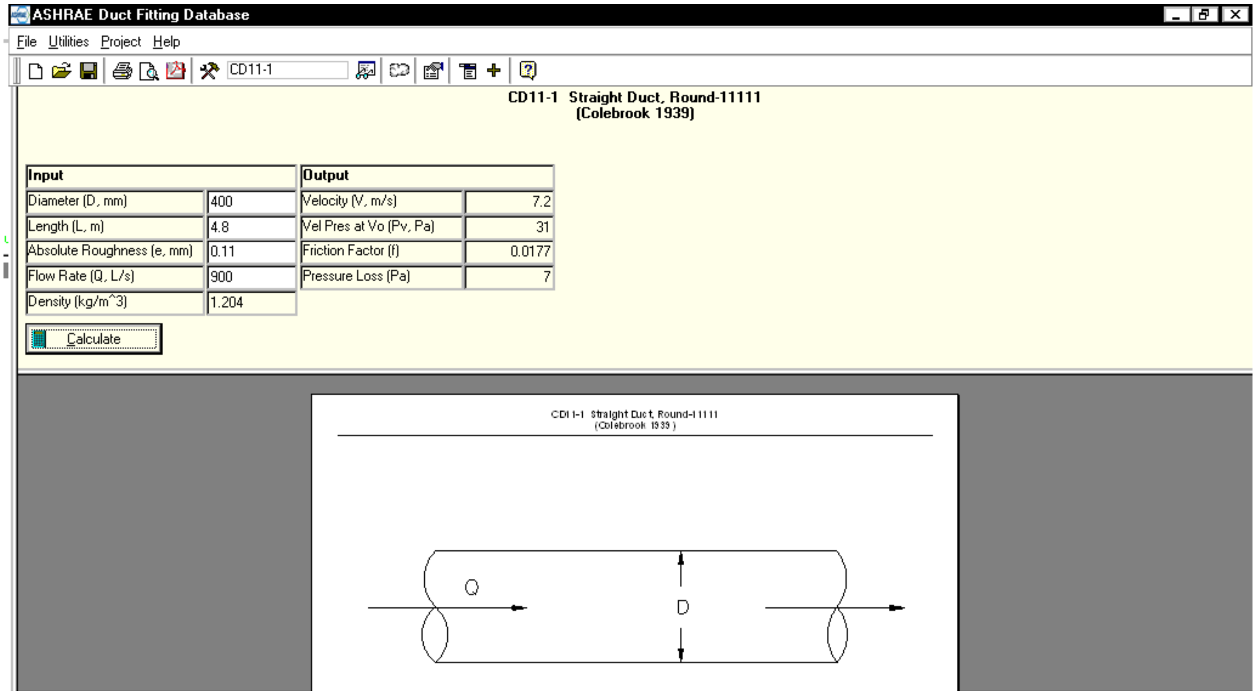

Figure A9-3.1(SI) DFDB (CD11-1) Output for Example 9-1

Note: Length (L) is calculated as follows: (13.7 * 0.35 = 4.8 m. See <u>Design Procedure, Step 2</u>.

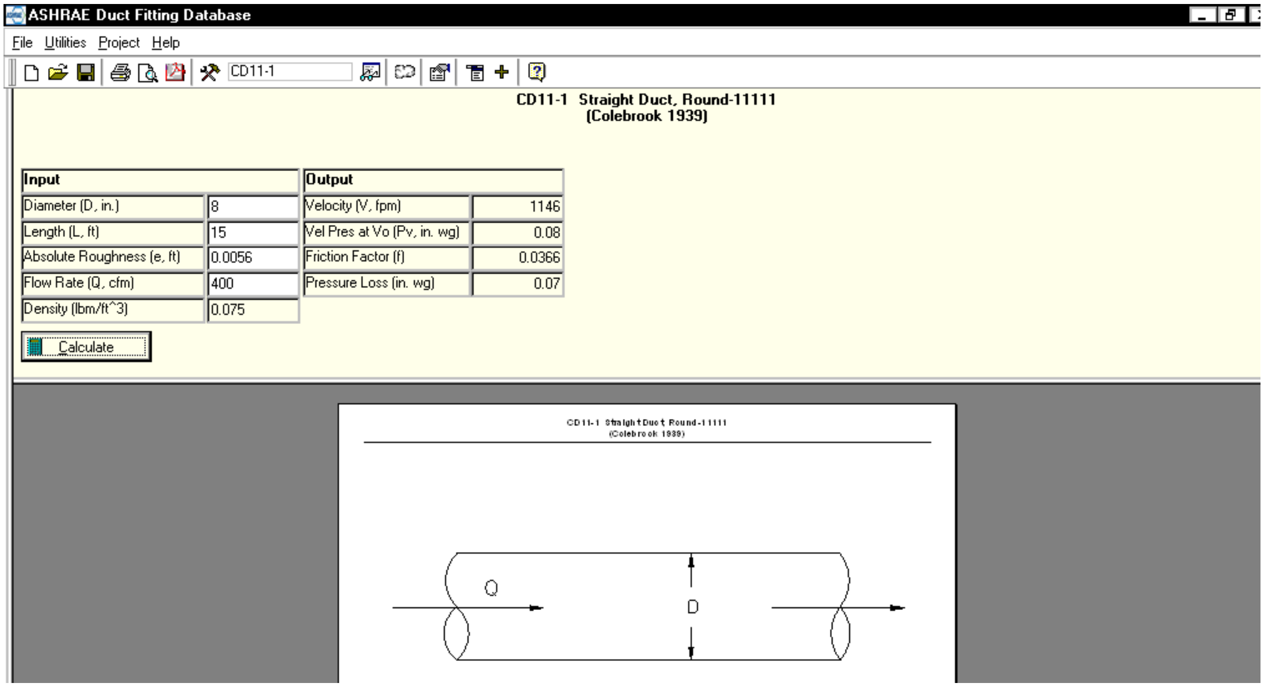

Figure A9-3.2(I-P) DFDB (CD11-1) Output for Example 9-2

Note: Length (L) is calculated as follows: (42 * 0.35 = 15 ft. See Design Procedure, Step 2.

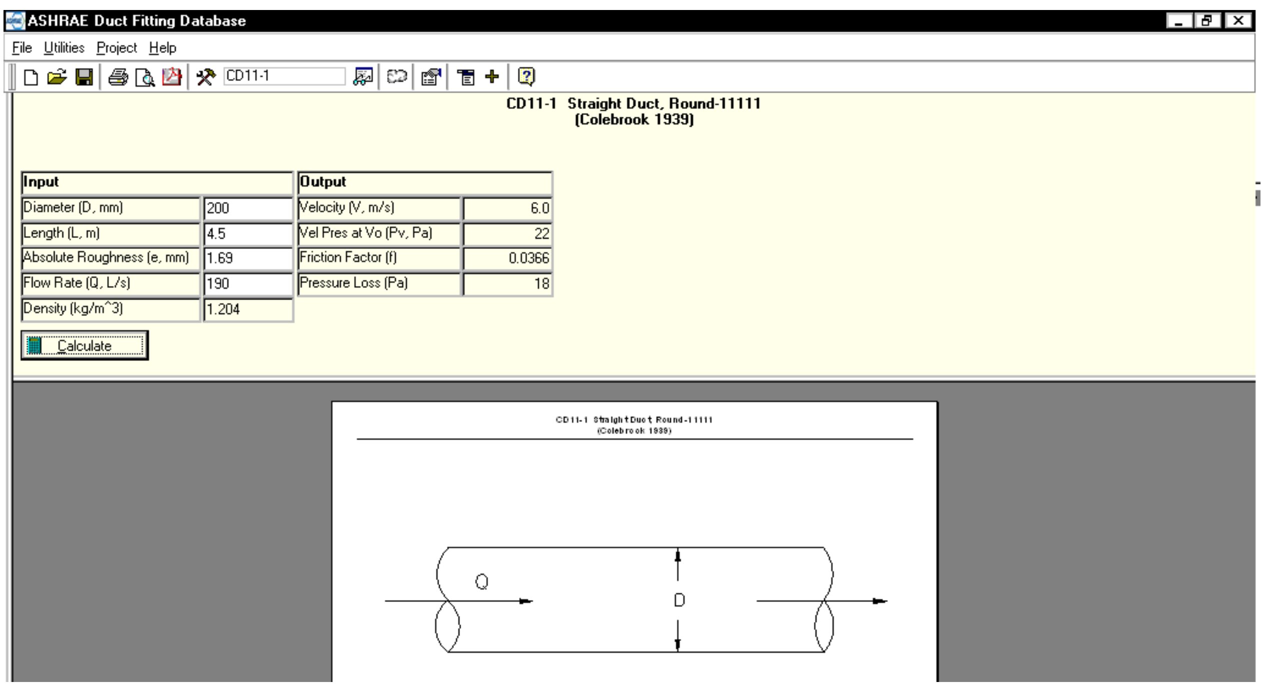

Figure A9-3.2(SI) DFDB Output (CD11-1) for Example 9-2

Note: Length (L) is calculated as follows: (12.8* 0.35 = 4.5 m. See Design Procedure, Step 2.

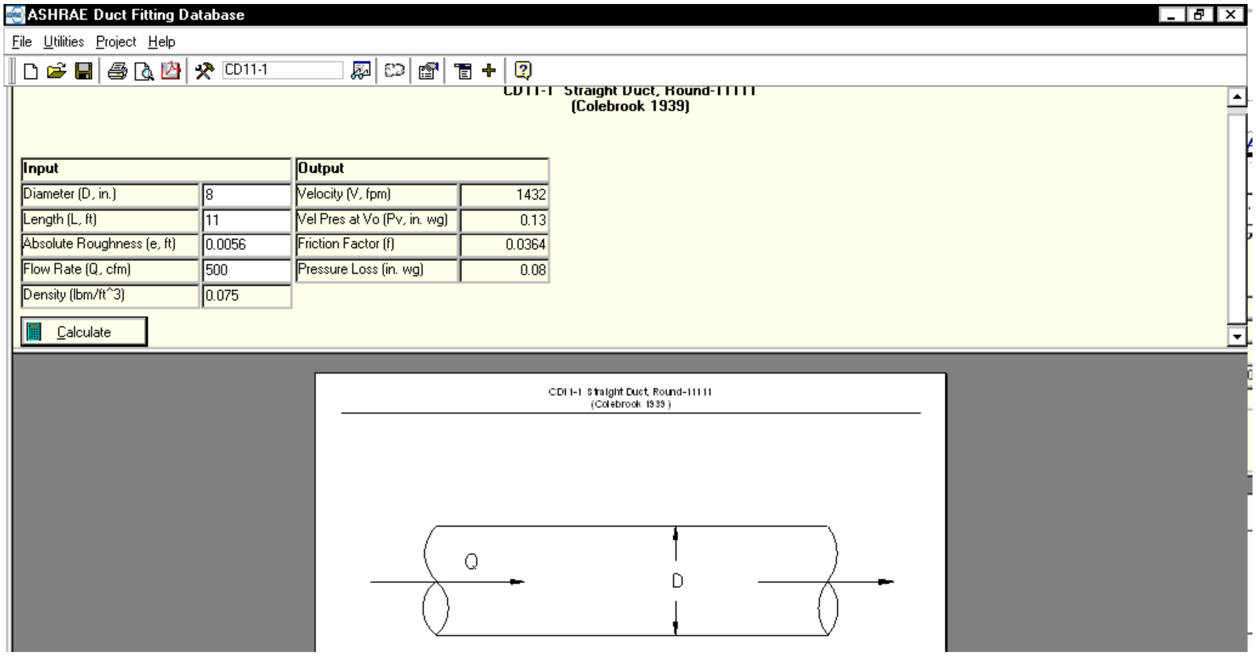

Figure A9-3.3(I-P) DFDB Output (CD11-1) for Example 9-3, Section 2

Note: Length (L) is calculated as follows: (32 * 0.35 = 11 ft. See Design Procedure, Step 2.

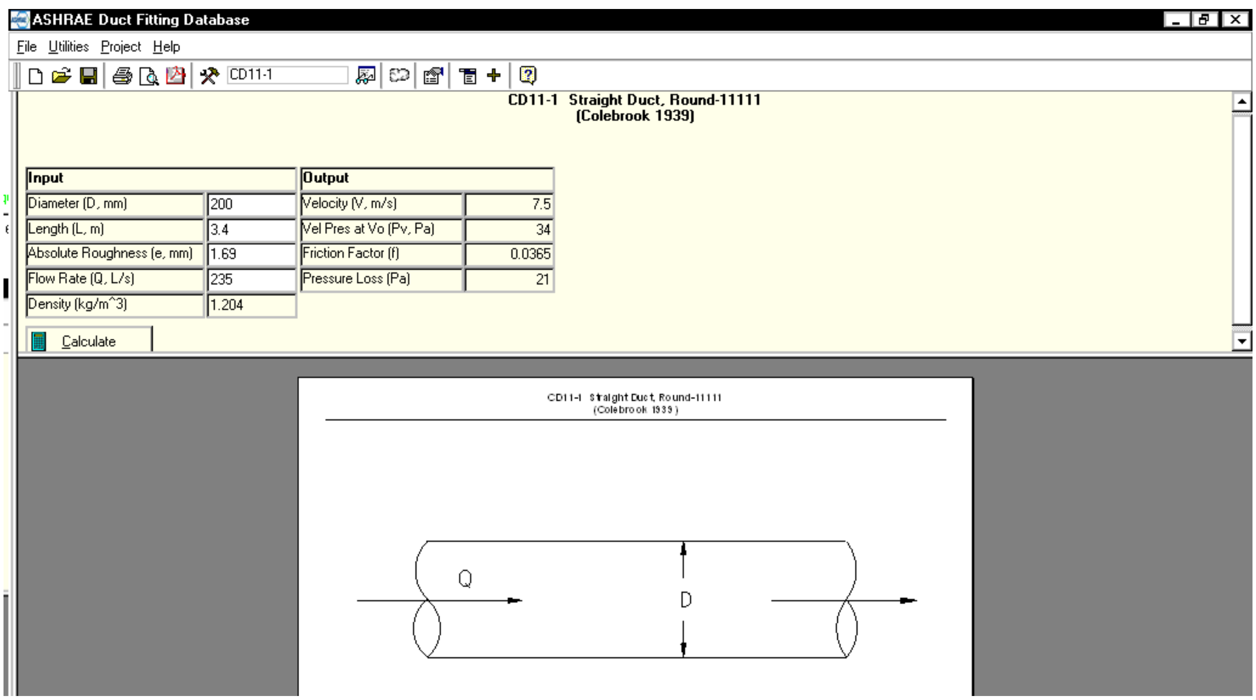

Figure A9-3.3(SI) DFDB (CD11-1) Output for Example 9-3, Section 2

Note: Length (L) is calculated as follows: (9.8 * 0.35 = 3.4 m. See Design Procedure, Step 2

Elevation, ft	**0**
Ambient Density, lb_m/ft^3	**0.075**
Absolute Roughness (ε), ft	**0.0056**

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Section				**Fitting**	**ASHRAE Fitting Code**	**Air Quantity (cfm)**	**Equivalent Round, D_e (in.)**	**Duct Size (in.) D (W x H or A x a)**	**Velocity (fpm)**	**Duct Length (ft)**	**Velocity Pressure; p_v (In. water)**	**Loss Coefficient, C**	**Δp_t (In. water)**
				Source									
				Drawings	**DFDB**	**Drawings**	**Friction Chart**	**Table 9-2**	**DFDB**	**Drawings**	**DFDB**	**DFDB**	**∑**
1				Duct, Fabric	CD11-1 (See Fig. A9-2.5)	1000		12	1273	25			0.08
											0.10		0.0
Section Total ……													0.08
2				Cross, Capped	SD5-20 (See Fig. A9-2.6)	500		8	1432			3.7	
				Adjustable Flow Device (AFD) – Open (Fig. 9-14)									0.04
				ISP_2 = 0.75 in. water ($TP_2=ISP_2+p_{v2}$ =0.75+0.13=0.88)									0.88
											0.13	3.7	0.48
Section Total ……													1.40

Path Total Pressure Loss:

Terminal	**Path**	**Path Total Pressure Losses (in. water)**	**Path Total Pressure (in. water)**	**Unbalance (in. water)**
Linear Vent Terminal	1, 2	0.08+1.40	1.48	NA

Revision 16 revised after manufacturers' review
Kevin Gebke
June 26, 2015

Figure A9-2.4(I-P) Output for Example 9-3

Elevation, m	**0**	
Ambient Density, kg/m^3	**1.204**	
Absolute Roughness (ε), mm	**1.69**	

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Section				**Fitting**	**ASHRAE Fitting Code**	**Air Quantity (L/s)**	**Equivalent Round, D_e (mm)**	**Duct Size (mm)** **D** **(W x H or A x a)**	**Velocity (m/s)**	**Duct Length (m)**	**Velocity Pressure; p_v (Pa)**	**Loss Coefficient, C**	**Δp_t (Pa)**
				Source									
				Drawings	**DFDB**	**Drawings**	**Friction Chart**	**Table 9-2**	**DFDB**	**Drawings**	**DFDB**	**DFDB**	**∑**
1				Duct, Fabric	CD11-1 (See Fig. A9-2.5)	472		300	6.7	7.6			22
											27		0
Section Total ……													22
2				Cross, Capped	SD5-20 (See Fig. A9-2.6)	236		200	7.5			3.7	
				Adjustable Flow Device (AFD) – Open (Fig. 9-14)									10
				ISP_2 = 187 Pa ($TP_2=ISP_2+p_{v2}$ =187+34=221)									221
											34	3.7	126
Section Total ……													357

Path Total Pressure Loss:

Terminal	**Path**	**Path Total Pressure Losses (Pa)**	**Path Total Pressure (Pa)**	**Unbalance (Pa)**
Linear Vent Terminal	1, 2	22+357	379	NA

Figure A9-3.4(SI) Output for Example 9-3

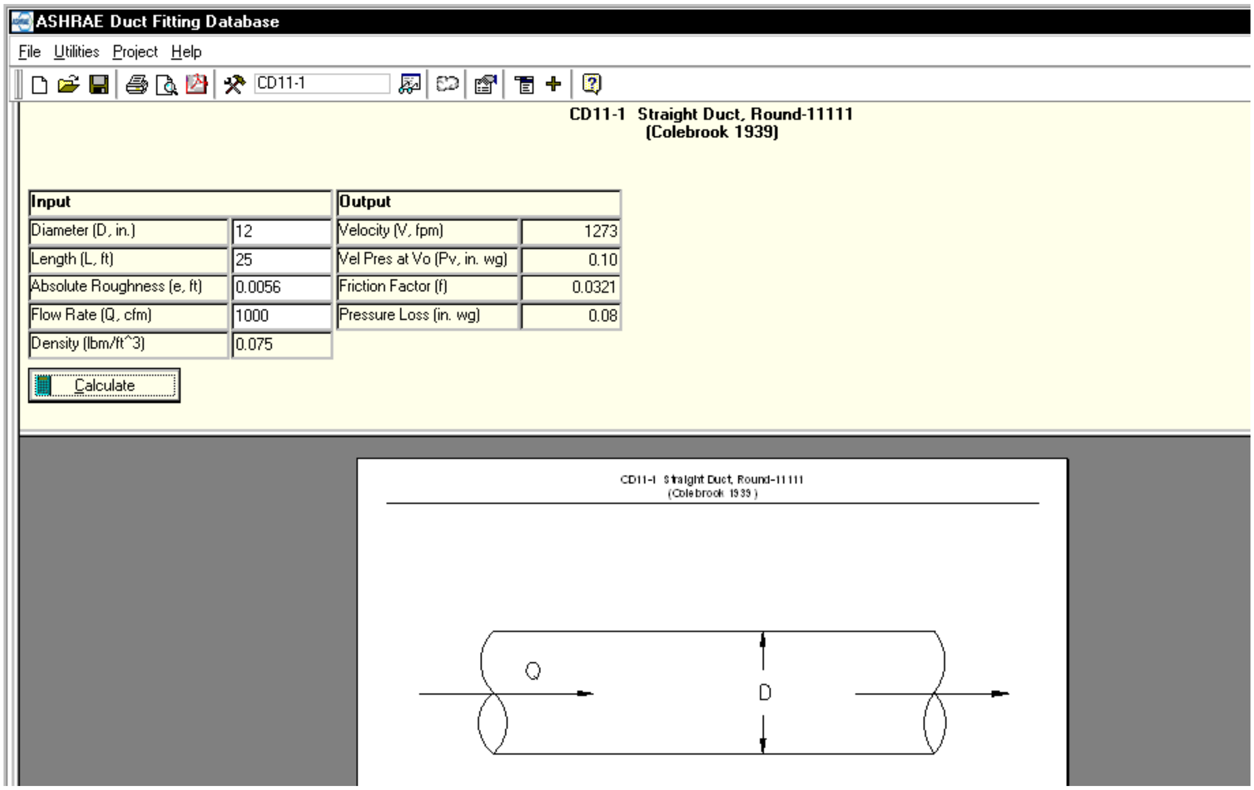

Figure A9-3.5(I-P) DFDB (CD11-1) Output for Example 9-3, Section 1

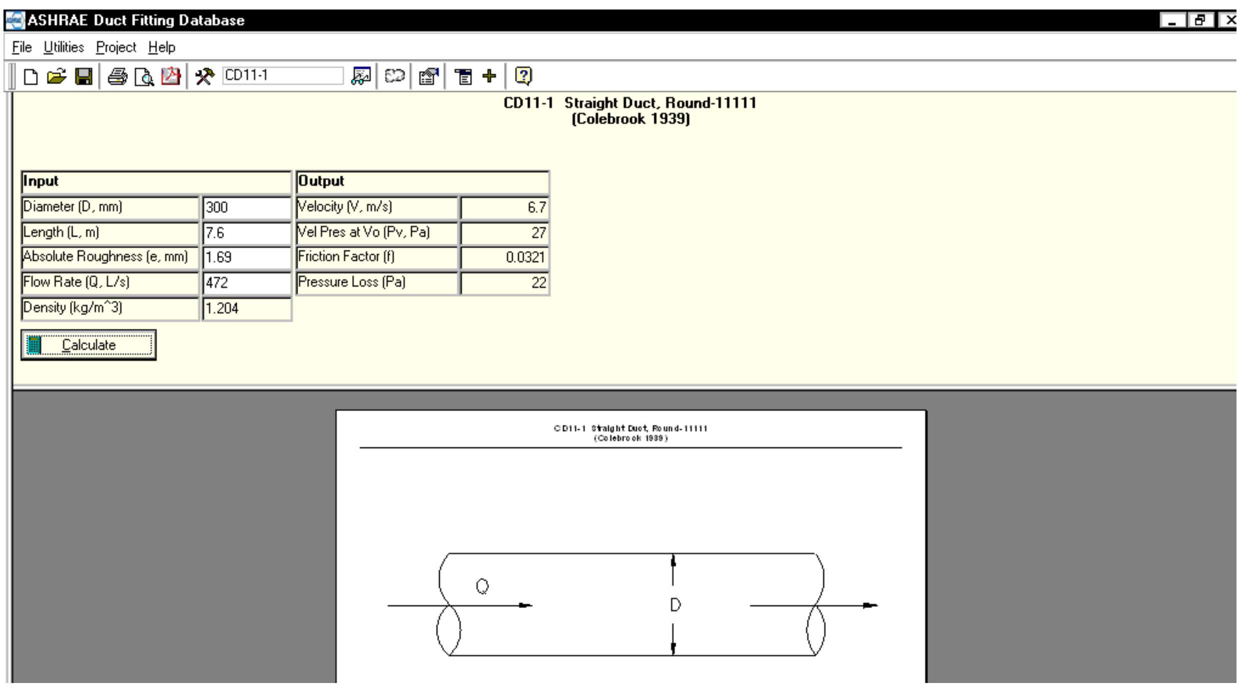

Figure A9-3.5(SI) DFDB (CD11-1) Output for Example 9-3, Section 1

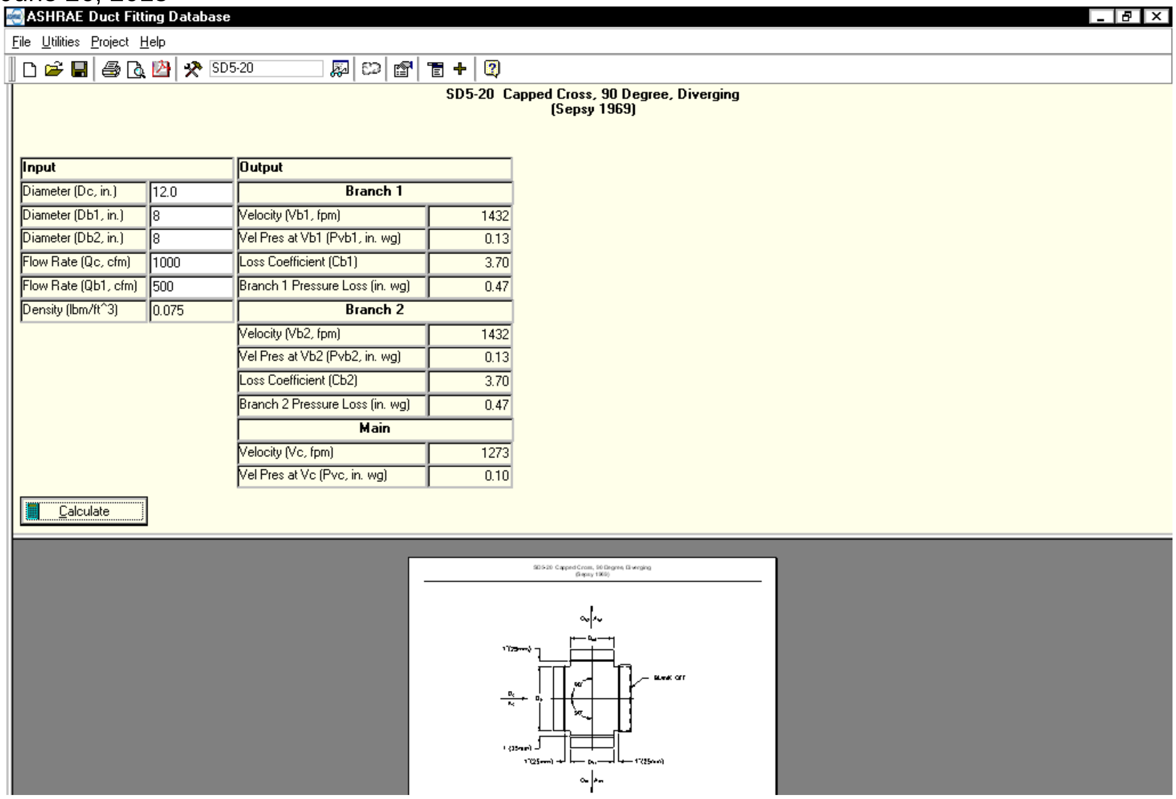

Figure A9-3.6(I-P) DFDB (SD5-20) Output for Example 9-3, Section 2

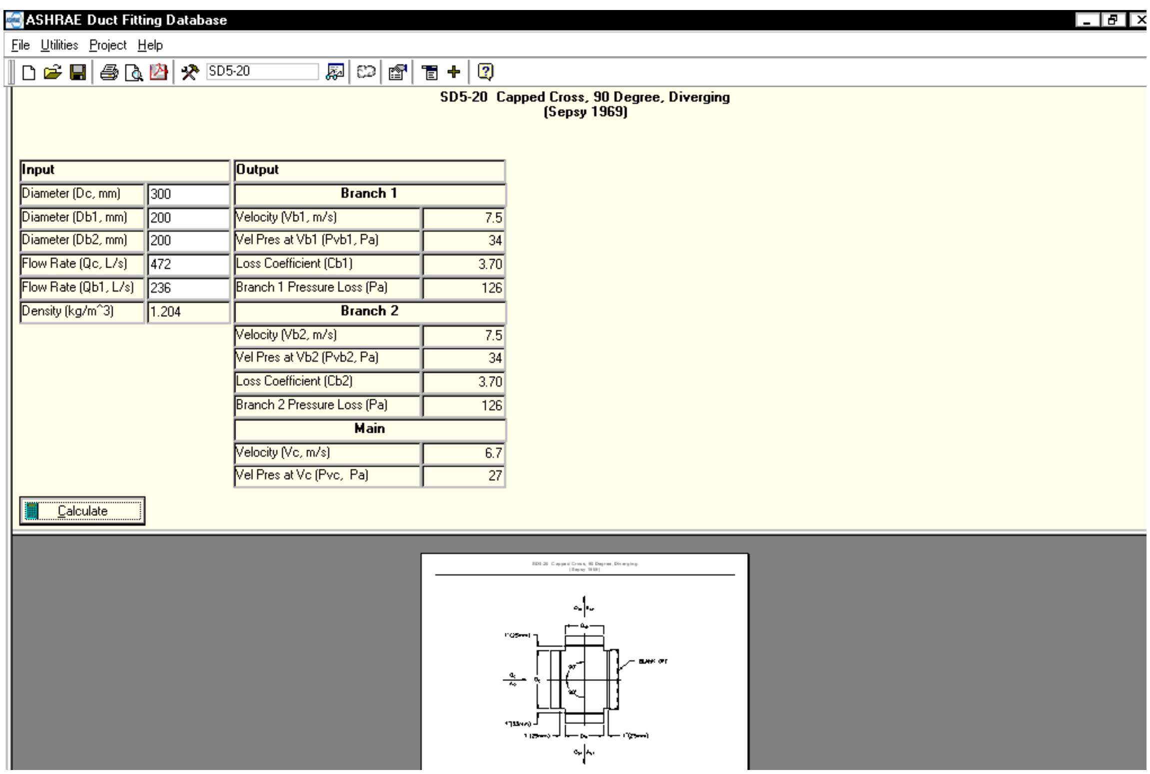

Figure A9-3.6(SI) DFDB (SD5-20) Output for Example 9-3, Section 2

ATTACHMENT E

TC 5.2 Questions for NFPA, IMC, and the UMC on the use of air connectors. TC 5.2 is requesting ASHRAE CIS to ask the following 5 questions, 4 related to air connector, 1 related to gypsum ducts.

Question #1: Can an air connector be used as part of HVAC duct system that passes through a rated firewall?

Example: 20' of metal duct connects to 10' of air connector that connects to a metal sleeve that passes through the firewall, which extends 2" out both sides of the firewall allowing the air connector to attach to 4 feet of air connectors on the other side of the sleeve. The air connector is not going through the firewall it is used before and after the firewall and attached to metal, which is passing through the firewall.

Question #2: Can air connector be used as a section of the duct system that penetrates a fire rated assembly?

Example: 20' of metal duct connects to 10' of air connector that connects to a metal sleeve that passes through the fire rated assembly, which extends 2" out of both sides of the fire rated assembly so the air connector is not passing through the fire rated assembly.

Question #3: Can an air connector be used as any part or section of duct system that terminates though a floor?

Example: 20' of metal duct connects to 10' of air connector in a basement that connects to a 6" metal fitting (floor boot) that passes through the floor terminates just above the floor.

Question #4: Can air connectors be used in a return air duct run inside a mechanical room which serves floors above or outside of the mechanical room, or ducts that pass through a fire rated assembly?

Example 30' metal return air duct, 3 feet of air connector attached to metal duct that is connected to the inlet of the HVAC fan.

Question #5: When gypsum wall board is used as a duct do all tapes and mastics used for sealing the gypsum duct need to be UL 181 approved?

Background information:

The following questions were previously asked of NFPA, and the NFPA answers are attached.

Dear Mr. Hamilton,

You've asked the following questions related to NFPA 90A and I have inserted my response below each:

Question #1: Can air connector be used in any section of duct system that passes through a rated fire wall?

Response #1: No, per 4.3.2.1.4 of NFPA 90A

Question #2: Can air connector be used in a section of duct system that penetrate a fire rated assembly?

Response #2: No, per 4.3.2.1.4 of NFPA 90A

Question #3: Can air connector be used in a an part or section of duct system that passes through a floor?

Response #3: No, per 4.3.2.1.4 of NFPA 90A

As an air connector is not rated, it will quickly fail under fire/heat conditions and allow smoke/flame to pass freely from one side of the particular assembly to the other therefore defeating the purpose of the particular rated assembly.

ATTACHMENT F

Potential TC 5.2 Research Project (Cosponsor with MTG.EAS)

Project title: Reducing Barriers to Achieving Low-Leakage Air-Handling Systems

Abstract

HVAC system air leakage due to deficient component designs and installation practices can be substantial in commercial buildings and is a major reason why some air-handling systems perform poorly. New requirements for low leakage systems are emerging now, but industry requests indicate that there are still needs for a consolidated source of certified component leakage data, cost-effective leakage targets, ways to meet these targets, and related field test methods to move forward with making these requirements standard practice. This project will develop a public leakage database that consolidates available manufacturer test data, develop related leakage targets, identify and assess methods of modifying components to meet targets, develop field leakage verification test methods, and disseminate this information to industry in a new ASHRAE component leakage guide, in updates to related chapters of the ASHRAE Handbooks, and in ASHRAE 90.1 code change draft proposals that address component and whole-system leakage.

Impact

HVAC systems, especially those in large commercial buildings, have numerous field-assembled joints between duct sections as well as numerous connections to duct-mounted equipment and accessories (e.g., terminal boxes, fire dampers, access doors). In aggregate, these joints and connections create substantial opportunities for air leakage and related thermal losses (e.g., leakage can be 25% or more of the fan flow in some cases). Tight systems should and can be at least a factor of five tighter. Historically, leakage sealing and testing has focused on new construction, and usually only address the "main" ducts (i.e., the high-pressure/medium-pressure sections upstream of terminal boxes). In doing so, these efforts have ignored sections that operate at lower pressures, such as ones downstream of these boxes, as well as the equipment and accessories located throughout the system. They have also ignored the considerable opportunity to reduce leakage in existing systems.

The 2012 and 2013 ASHRAE Handbook chapters on duct construction and duct design, respectively, now recommend that whole-system air leakage be addressed. Also, codes such as the Green Uniform Mechanical Code now require all ducts to be tested and the governing body (IAPMO) is considering requiring system testing prior to issuance of a certificate of occupancy. To support these changes, as requested by industry, more leakage data are needed to define cost-effective system and component leakage targets, equipment and accessory improvements to meet these targets need to be identified and assessed, and field diagnostic procedures for measurement and verification of these measures need to be standardized. This project will address these needs, as described further in the "Technical Approach" section.

The target market for the proposed work is new and existing small and large commercial buildings. Stakeholders include DOE's Commercial Building Energy Alliance (CBEA) partners, HVAC designers, energy service companies (ESCOs), equipment manufacturers, mechanical contractors, commissioning agents, code officials, and related industry organizations. By providing needed information to industry, this effort will enable it to identify and focus on key components where leaks are largest and most cost effective to reduce. As stricter code requirements emerge and industry develops expertise in applying new leakage reduction measures, we anticipate that low leakage systems will become normal practice in new construction and this in turn will encourage retrofit tightening of systems. This project will provide data, guidance, and a compelling value proposition that will help the industry achieve low-leakage systems. Metrics for project success are: a) inclusion of project results in a new ASHRAE guide, in industry handbooks, and in related energy and test standards; and b) ultimately, all systems constructed or retrofit meet low-leakage targets by 2030.

Based on DOE's Building Technology Office prioritization tool, the largest impacts associated with reducing system leakage are including new building "duct" sealing in codes and sealing "ducts" in existing large buildings. Costs of conserved energy (CCEs) are 10.78 and 4.16 $/MMBtu and annual economic potentials by 2030 are 0.16 and 0.27 Quads, respectively, or 0.43 Quads in total. Given that half the system leakage might be from equipment and accessories as opposed to just from ductwork joints, the marginal cost of using tighter equipment and accessories to reduce system leakage is likely small in a competitive market, such that the actual CCEs might be half of those calculated by the tool, and the ratios of economic potential to CCE might be double what the tool indicates. Results of the proposed project will allow one to better estimate and disaggregate these metrics for specific measures.

Technical Approach

The proposed effort will develop a public leakage database for equipment and accessories based on existing AHRI 880 and AMCA 511 test data from manufacturers. This database will provide a central data repository for designers and others to use as a reference when specifying components. Using these data, the contractor will develop cost-effective component leakage targets and identify equipment and accessory modifications needed to achieve low-leakage air handling systems. Next, the contractor will develop field diagnostic procedures for measurement and verification of these measures. Finally, the contractor will disseminate the leakage data, targets, economic analyses, and test procedures. The following provides further information about each task in the proposed project, including deliverables and milestone dates.

Task 1. Develop a reference database of equipment and accessory leakage measured by manufacturers. These data are needed by designers to calculate system leakage impacts, specify airtight components, and for contractors to adjust sectional leakage test data to separate out component leaks (i.e., so they know where to fix problems if a system does not pass a leakage test). The contractor will work with industry associations (e.g., AHRI, AMCA, ASHRAE, SMACNA) to identify a host for such a database. The contractor will also work with industry standards committees to propose new tests where needed to address gaps in the available data. Start: October 2013; End: February 2014.

Task 2. Using the data from Task 1, the contractor will develop cost-effective component leakage targets and identify component improvements needed to meet these targets. Possible improvements include better sealing of terminal box seams (and backdraft dampers when present), enclosing reheat coil end tubes on boxes, and adding low-friction expansion-tolerant shaft seals for dampers. The contractor will form a technical advisory group comprised of manufacturers (e.g., Price Industries, Krueger, Nailor, Ruskin, Titus) and other stakeholders to guide the development of these targets and implement where possible related improvements in their product lines. Particular parameters of interest will be to show the changes in system leakage corresponding to each component and to quantify the costs and savings of specifying and delivering tight systems. Start: January 2014; End: June 2014.

Task 3. Various standards already address some component leakage tests in laboratory settings, but none yet provide procedures for field verification of provided data. The contractor will develop and pilot test cost-effective field methods of test that provide sufficient accuracy to determine whether components meet specifications both in the case of new systems and after retrofit in the case of existing systems. Start: March 2014; End: August 2014.

Task 4. Results will be disseminated in a new ASHRAE component leakage guide, in updates to related chapters of the ASHRAE Handbooks, and in ASHRAE 90.1 code change draft proposals that address component and whole-system leakage. A summary report and briefing materials will also be prepared for ASHRAE dissemination. Start: July 2014; End: September 2014.

Qualifications, Experience, and Capabilities

The contractor must demonstrate an understanding of: building air-handling system technology, design, installation, and operation; the extent of related deficiencies; associated system retrofit technologies (e.g., leakage sealing); benefits and risks related to improvements; and related standards and ASHRAE handbook information. Experience related to non-residential air-handling system diagnostics, performance modeling, and uncertainty analyses is also required. Confirmed access to laboratory facilities and field test sites along with associated research-grade airflow and pressure measurement instrumentation will be necessary.

Cost Effectiveness

This is a one-year project that can be completed for $150K of ASHRAE funds.

The economic potential by 2030 for energy savings across the commercial building sector is about 0.43 Quads annually (or about $4 Billion, based on the 2030 ratio of commercial primary energy use to associated expenditures reported in DOE’s 2010 Buildings Energy Data Book, which is about $9.3 Billion per Quad in 2009 dollars). The “bang for the buck” therefore is a ratio of about 27,000:1 for each dollar of ASHRAE funding.

Introduction

Technical Committee (TC) 5.2 convened a Strategy and Planning Ad-Hoc Subcommittee to look for long-range plan objectives --- the direction TC 5.2 should focus in both research and effort. With representation from throughout the TC, both from different parts of the HVAC&R industry and inclusion of Young Engineers in ASHRAE (YEAs), objectives were discussed and approved by the Ad-hoc Subcommittee members to advance to the TC at large.

The intent of these objectives are two-fold:

1. Provide a focus on what TC 5.2 should do in the coming three years to sustain its membership and stay relevant with the HVAC&R industry; and
2. Facilitate the formation of working groups, whether in the form of TC ad-hoc subcommittees or as a subgroup of TC standing subcommittees, which will focus on the completion of their assigned objectives.

Participants of the Ad-Hoc Subcommittee were John Constantinide, appointed as Chair, Bob Reid, Tim Eorgan, Pat Brooks, Larry Smith, Herman Behls, and Cindy Bittel. The Subcommittee approved this Long Range Plan to be brought to the TC's subcommittee meeting session at the 2017 ASHRAE Winter Conference in Las Vegas for additional feedback prior to presentation at the TC Full Committee meeting.

Upon the adoption of these LRP objectives by the TC, the Strategy and Planning Ad-hoc Subcommittee will consider its objective complete and dissolve.

Objectives

The objectives include notes on who are willing to be lead points of contacts (POCs) for each objective's working group, who are initially willing to participate in each working group, and initial means of completing these objectives. These notes are evolving constantly based on additional meetings within the respective working groups. <u>Only the objectives will be considered final.</u>

The four objectives are as follows.

Objective 1: TC 5.2 will reach out to the following market segments for additional engagement and representation:

- **a. Practicing Engineers and Commissioning Agents;**
- **b. Code Authorities/Authorities Having Jurisdiction;**
- **c. Building Owners and Managers via BOMA, IFMA, USGBC;**
- **d. SMACNA; and**
- e. **General Contractors and Mechanical Contractors, including Testing and Balancing Contractors, through organizations such as ACCA and SPYDA.**

Notes on the Objective:

1. Identified volunteers on the teleconferences willing to be Lead POCs or take part in the working group, are John Constantinide and Tim Eorgan.
2. The Membership & YEA Subcommittee may be a standing subcommittee that is delegated this objective, with Cindy Bittel acting as Lead POC for the objective.

3. Completion of this objective will be a committee-wide effort, requiring the use of members' contacts to promote TC participation and contribution. Therefore, this objective's working group is anticipated to be large.
4. Some ways that this objective may be completed are as follows:
    a. The working group can come up with a plan to effectively engage the identified stakeholders, whether through seminars at the noted organizations' conferences and functions, presentations to ASHRAE Chapters, and outreach at Chapters' Regional Conferences.
    b. YEAs are an ideal demographic to attract to this committee. Cindy Bittel has made initial efforts to attract this demographic through the Membership & YEA Subcommittee.

Objective 2: Duct Design Guide:

- **a. Complete and publish the Duct Design Guide.**
- **b. Develop and promote educational and training material based on the Duct Design Guide for the practicing engineer, through the ASHRAE Learning Institute (ALI), and with engineering students at the college level.**

Notes on this Objective:

1. Identified volunteers on the teleconferences willing to be lead POCs or take part in the working group are Larry Smith, Pat Brooks, and Herman Behls.
2. Encourage TC members to apply for the Distinguished Lecturers (DL) program.
    a. Herman Behls recommended having a primary DL apply for the program, with understudies learning from the DL and then applying to become DLs.
        i. Pat Brooks was highly recommended as a first DL, who will be interested later and will receive assistance from Herman Behls, with interested understudies including Cindy Bittel, Scott Hobbs, and John Hamilton. Steve Idem was suggested as a DL because of his work in research.
        ii. The deadline is December 1, and the application would be approved for the following Society Year. As a result, the soonest that a DL would be approved would be for Society Year 2018-2019.
    b. John can help with those applying and will communicate with the Chapter Technology Transfer (CTT) DL Subcommittee to address questions by TCs.
    c. Craig Wray brought up the need for a list of topics, both based on the Duct Design Guide and other publications from the TC that people can offer to choose for a DL.
    d. From the meeting feedback, John Constantinide identified the following suggested DL topics:
        i. Chapters from the Duct Design Guide, once published;
        ii. The Handbook chapter that TC 5.2 is responsible for updating;
        iii. Design Considerations for Duct Design; and
        iv. Proper Application of the Duct Fitting Database.
3. The Duct Design Guide will include Fundamentals (e.g. equations) and acoustics for teaching at the collegiate level.

Objective 3: Present seminars and publish papers in response to publication and research based off of SPC 215 Method of Test to Determine Leakage of Operating HVAC Air-Distribution Systems.

Notes on this Objective:

1. Identified volunteers on the teleconferences willing to be lead POCs or take part in the working group are Larry Smith, with Bob Reid assisting.
2. TC members may become DLs and present on the standard and results of the research from the SPC.

Objective 4: Develop a long-range and maintenance plans for the Duct Fitting Database, including incorporation of research.

Notes on this Objective:

1. Identified volunteers on the teleconferences willing to be lead POCs or take part in the working group are Pat Brooks and Larry Smith.
2. As mentioned, TC members may become DLs and present on proper application of the Duct Fitting Database.

Requested Action

The TC is requested to vote on the objectives of this Long-Range Plan. If approved, the Ad-Hoc Subcommittee will dissolve, and the TC Chair is responsible for ensuring that the objectives are pursued and completed, whether by creating ad-hoc working groups and appointing points of contact for each group, refer the objectives to standing subcommittees, create ad-hoc subcommittees as needed to complete the objectives, or a combination of the mentioned suggestions.

If the four objectives are adopted by the TC, the Long-Range Plan will be in effect as of the date of adoption. Although the notes may be changed, the objectives will be recommended for review or maintenance no more than three years of the date of adoption.