AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC

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

404-636-8400

TC/TG/TRG MINUTES COVER SHEET

TC/TG/TRG NO: TC 2.6 DATE: June 27, 2011

TC/TG/TRG TITLE: Sound and Vibration Control

DATE OF MEETING: June 27, 2011 LOCATION: Montreal, QB

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	MEMBERS ABSENT
VOTING		CORRESPONDING		CORRESPONDING
Francis Babineau		Zvirimumwoyo Chinoda		Tim Simcoe
E Curtis Eichelberger		Charles Culp		Thomas Sobieski
John Gierzak		John Dunlap		John Sofra
Robert Hassler		Ronald Eligator		William Stewart
Siu-Kit Lau		William Fleming		Jeff Traylor
Dustin Meredith		Michael Froehlich		Vijay Tripathi
Patrick Oliver		Kevin Gaghan		Terence Tyson
Kim Osborn		Jason George		Michael Vaughn
Douglas Reynolds		Brian Guenther		Jonathan Weinstein
Kenneth Roy		Arthur Hallstrom		
Robert Simmons		Joseph Horesco		EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
		Jean-Gabriel Joannette		
CORRESPONDING		Reginald Keith		Tim Simcoe
Daniel Abbate		Manoj Khati		Thomas Sobieski
David Carroll		Howard Kingsbury		John Sofra
Radha Ganesh		Marvin Kloostra		William Stewart
Lewis Goodfriend		Glenn Kowald		Jeff Traylor
James Kline		Dan LaForgia		Vijay Tripathi
Patrick Marks		Heng-Yi Lai		Terence Tyson
Charles Mattocks		Brian Landsberger		Michael Vaughn
Karl Peterman		Joshua Leasure		Jonathan Weinstein
Lauren Ronsse		H Leventhall		
Lily Wang		William McCoy		
Zhiping Wang		Duane McLennan		
Steven Wise		Alexander Michaud		Distribution
		Erik Miller-Klein		All Members of the TC/TG/TRG
		Andrew Mitchell		TAC Section Head: Thomas Sobieski
MEMBERS ABSENT		Emanuel Mouratidis		TAC Chair: Charles Culp
VOTING		Ralph Muehleisen		All Committee Liasions: Jean-Gabriel
Robert Lilkendey		Jose Nepomuceno		Joannette, William McCoy, John Nix, William
Jerry Lilly		John Nix		Fleming, Jeff Traylor, Hoy Bohanon
Matthew Murello		Thomas Paige		
Chris Papadimos		John Pappas		
Richard Peppin		James Pooler		Manager of Standards: Stephanie Reiniche
Matthew Stead		Raj Prime		
Jason Swan		Stephanie Reiniche		Manager of Research & Technical Services:
Randal Zimmerman		Michael Resetar		Mike Vaughn
		William Rockwood		
CORRESPONDING		Eric Rosenberg		
Charles Arnold		Erica Ryherd		
Mark Bastasch		Benjamin Sachwald		
Hoy Bohanon		Mark Schaffer		
Norman Broner		Michael Schwob		
Todd Busch		Ken Shook		

ASHRAE TC 2.6 Sound and Vibration Control
Main Committee Meeting Minutes
Monday, June 27th, 2011, Montreal, QB

Attendence List

Voting Members:

Francis Babineau	Johns Manville	francis.babineau@jm.com
E Curtis Eichelberger	Johnson Controls	curtis.eichelberger@jci.com
John Gierzak	Oriflow	john@oriflow.com
Robert Hassler	McGill AirFlow LLC	rhassler@mcgillairflow.com
Siu-Kit Lau	University of Nebraska-Lincoln	slau3@unl.edu
Dustin Meredith	Trane	dmeredith@trane.com
Patrick Oliver	EH Price Ltd.	patricko@price-hvac.com
Kim Osborn		kosborn@governair.com
Douglas Reynolds	Univ Of Nevada Las Vegas	reynolds@nscee.edu
Kenneth Roy	Armstrong World Industries	kproy@armstrong.com
Robert Simmons	Amber/Booth A VMC Group Company	res@seismic-source.com

Corresponding Members:

Daniel Abbate	AHRI	dabbate@ahrinet.org
David Carroll	Morrison Products Inc	dcarroll@morrisonproducts.com
Radha Ganesh	Twin City Fan Companies	rganesh@tcf.com
Lewis Goodfriend	Lewis S Goodfriend & Assoc's	LGoodfriend@LSGA.com
James Kline	Intertek	jim.kline@intertek.com
Patrick Marks	Johnson Controls	patrick.c.marks@jci.com
Charles Mattocks	Aaon	hunterm@aaon.com
Karl Peterman	Vibro-Acoustics	kpeterman@vibro-acoustics.com
Lauren Ronsse	Const. Engineering Research Lab	lronsse@unomaha.edu
Lily Wang	University Of Nebraska	lwang4@unl.edu
Zhiping Wang	Morrison Products Inc	zpwang@morrisonproducts.com
Steven Wise	Wise Associates	stevewise@att.net

Visitors:

Michael Brendel	Lau Industries	mbrendel@laufan.com
Joseph Brooks	AMCA International Inc.	jbrooks@amca.org
Glenn Brower	Knauf Insulation	glenn.brower@knaufinsulation.com
Franco Cincotti	Comefri USA	fcincotti@comefriusa.com
Sami Elkhazin	Vibro-Acoustics	selkhazin@vibro-acoustics.com
Jeff Gribble	Carrier Corporation	jeffrey.gribble@carrier.utc.com
Larry Hopkins	Huntair Inc.	lhopkins@huntair.com
Amir Jokar	Exponent	ajokar@exponent.com
Joshua Kading	Texas A&M University	joshuakading@tees.famus.edu
Michael Keating	Kinetics Noise Control	michaelsonkeating@gmail.com
Greg Meeuwsen	Trane	gmeeuwsen@trane.com
Andrew Moore	Mitsubishi Electric	amoore@hvac.mea.com
John Murphy	Jogram	jogram@bright.net
Daniel Rau	Ruskin Company	drau@ruskin.com
Brian Reynolds	Trane	breynoldds@trane.com
Greg Wagner	Morrison Products Inc	gwagner@morrisonproducts.com
Jack Wang	Trane	jjwang@trane.com
Josiah Wiley	Ruskin Company	jwiley@ruskin.com

ASHRAE TC 2.6 Sound and Vibration Control
Main Committee Meeting Minutes
Monday, June 27th, 2011, Montreal, QB

1. **Call to order (Wang)**
   - Call to order by Lily – 2:17 PM
   - Read scope of TC 2.6
   - Additions and/or modifications to the agenda
2. **Introduction of those present (All)**
3. **Confirmation of current voting members (Oliver)**
   - 11 voting members present – constitutes a quorum
4. **Review and approval of the minutes (Wang)**
   - **Motion** by Doug, seconded by Ken: Approve the Las Vegas minutes
     - Passed unanimously
5. **Secretary's report (Rockwood/Meredith)**
   - Please provide all subcommittee reports by Monday, July 11th.
6. **TC Chair's meeting report (Wang)**
   - ASHRAE is looking to create MTG's – Multidisciplinary Task Groups. Will be similar to a TC but more interdisciplinary. Building modeling is an example. None of interest to TC 2.6 at this time.
   - The CEC – Conference & Exposition Committee – is considering ways to improve speaker quality. Based on speaker ratings, there have been enough complaints on speakers, slides, etc… to warrant a better approach. One example is speaker training. Suggestions welcome.
7. **Chair's announcements and correspondence (Wang)**
   - Warren Blazier's passing: Lily donated to ASHRAE research in his name to honor his memory. Recommend others do the same.
   - Vote on ASHRAE TC 2.6 sponsorship of NAE/TQA (National Academy of Engineering/Technology for a Quieter America) meeting:
     - We voted to endorse after confirming there were no issues with society. There will be an upcoming meeting on how to move forward.
8. **Subcommittee reports**

8.1. Research subcommittee (Eichelberger)

- Curt thanked Mark for handling the research subcommittee responsibilities in Las Vegas.

8.1.1. Research Chair's meeting report

- New liaison: William McCoy. Curt will send email out with his contact information. Can send to generic email address for now.
- Please copy Curt on all research correspondence.

8.1.2. Ongoing research projects

8.1.2.1. RP-1322 Performance, Perception and Criteria with PI Wang/UNL (Schaffer)

- Lily will finish minor corrections by July 11th. Will get ballot out soon.

8.1.2.2. RP-1408 Attenuation of Lined Ducts with PI Reynolds/UNLV (Lilly)

- There have been a few delays concerning the technical details of the test facility. Most have been resolved at this point. Preliminary test data presented at the meeting.
- Issue: core test plan won't start until late Summer. How much time is reasonable? Consensus is January 2013 would be reasonable.
- Motion by Curt, Karl seconded: Approve a no-cost extension to the project.
  - Yea: 8
  - Nea: 0
  - Abstain: 1 (chair not voting)
- Note: a contract extension was approved a year ago to add sound intensity.
  - Added to facilitate another project on numerical methods (in an effort to validate some numerical models; WS-1529).
  - Has been in the pipeline to be bid for quite some time.
  - This may get approved in the Fall. If not, this will be in the pipeline for next year.

8.1.3. Work Statements/RTAR's/URP's

8.1.3.1. TRP-1529 Numerical Modeling of Lined Ducts (Marks)

8.1.3.2. RTAR-1560 Installed Performance of Vibration Isolators (Simmons)

- Dropped due to inactivity. TC voted to re-submit in Las Vegas. Robert & Karl will do one more edit and submit for a letter vote ASAP. This will perhaps be ready in a week or so.

8.1.3.3. RTAR-XXXX Effect of HVAC Noise in Hospitals (Babineau/Roy)

- Trying to get joint efforts from TC 2.1 & 9.6. Feedback: need to focus and ensure it addresses holes in the FGI guidelines. TC 2.1 (Ken) wants to broaden beyond just HVAC noise.

8.1.4. Topics for future research

8.1.4.1. #1 - Room effect (Keith/Roy/Reynolds)

- Many feel the information is already available – just need to combine.
- Ken: would be a good topic for a conference paper (perhaps Dallas).

8.1.4.2. #2 - Tones (Wang/Marks/Lilly)

- Lily, Pat, & Jerry are willing to write an RTAR. If anyone else is interested, please let the others know.
- A method for measuring tone prominence will be included.

8.1.4.3. #3 - Noise Generation in Ducts and Duct Accessories (Muehleisen/Reynolds)

- The data in the handbook is over 40 years old and the origin is questionable.

8.1.4.4. Others:

- RP 1420 (TC 5.1) is of interest to this TC.

8.2. Programs Subcommittee (Papadimos)

8.2.1. Programs Chair's meeting report

- No attendance.

8.2.2. Programs this meeting

8.2.2.1. Seminar #37: “Energy Efficiency and Performance of Multiple Plenum Fans in Arrays” (Raychaudhuri)

- This forum is scheduled for Tuesday morning.
- Sponsored by TC 5.1, co-sponsored by TC 2.6.

8.2.2.2. Forum #9: “Incorporating Acoustics into BIM” (Peterman/Mitchell)

- This forum is scheduled for Wednesday morning.
- BIM is considered a hot topic.

8.2.3. Potential programs for upcoming meetings:

- Chicago 2012:
  - Note: The theme of the Chicago meeting is “HVAC&R in our Daily Lives”.
  - Seminar: “Aerodynamic Noise” (Schaffer)
  - Seminar: “Green Building Acoustics” (Muehleisen)
    - Instead of a paper, we will switch to a seminar.
  - Seminar: “Vibration-Induced Noise and Mechanical Equipment Vibration Isolation and Balance” (Marks)
  - Forum/Seminar: “Update to Acoustic Guidelines in 2011 ASHRAE Applications Handbook” (Peterman)
    - Placed in four separate tracks.
- San Antonio 2012:
  - Note: San Antonio will no longer have themes but there will still be tracks.
  - Conference papers session (Marks)
    - Deadline in September.
    - Pat will work with Chris.

8.3. Publications Subcommittee (Wise)

8.3.1. Handbook chapters

8.3.1.1. 2011 HVAC Applications Handbook (Wise/Peppin)

- Revised several sections: Criteria, etc…
- We missed a few errors. A total of 50 errors were identified in the proof stage; all but 7 got fixed. All 7 errors that got through are considered small. Steve will send a list of what those errors were.
- We weren’t able to get to 7 or 8 topics that need to be changed this go around. Will try to cover in the next revision (2015). A call for volunteers was issued.

8.3.1.2. 2013 Fundamentals Handbook (Weinstein/Wise)

- In Chicago, we will have a vote on whether to approve as is. The last edition was almost perfect and we have yet to receive any comments. Please get any comments in before Chicago.

8.3.2. Other Publications

- Transferred some traditional Publications subcommittee items to the new Standards subcommittee.
- The SI edition of “A Practical Guide to Noise and Vibration Control for HVAC Systems” by Mark Shaffer (blue cover) is now in the bookstore.

8.3.3. Web page (Schwob)

- The new web page is up and running. Discussed updates.
- There were some concerns raised about the Contact page. Any contact should go directly to the TC chair.
- Curt will get a list of past projects to add.
- Need to update the main ASHRAE website link.
- Need to add an FAQ page.

8.4. Standards Subcommittee (Ronsse)

- Subcommittee met yesterday. Goal for the subcommittee: consistency among standards.
- Currently in the process of designating liaisons for all of the standards that involve acoustics.
- Liaisons can send their individual reports to Lauren or Dustin.

8.4.1. SPC 79 – Method of Testing for Fan-Coil Units (Oliver)

- Met Saturday. Spent time discussing the fan coil MOT and how to incorporate sound.

8.4.2. SPC 130 – Methods of Testing Air Terminal Units (Oliver)

- Met last night; a brief meeting. Incorporate end reflection in the MOT.

8.4.3. SPC 189.1 – Standard for the Design of High-Performance Green Buildings (Ronsse)

- Published and on continuous maintenance.
- Have designated reviewers from TC 2.6; issued a call for others.
- Minimal information on acoustics in the current edition – would like to expand.
- Will submit to the TC for comments and then a vote. Will try to incorporate any comments in the next version.

8.4.4. SPC 189.2 – Design, Construction and Operation of Sustainable High Performance Healthcare Facilities (Babineau)

- Met this morning.
- Draft standard out for public review.
- Many comments (for example: is the standard really needed?).
- Call for anyone that works on healthcare to help out.

8.4.5. SPC 197 – Method of Test for Passive Vibration Isolators (Peterman)

- Will meet after this meeting.
- A draft has been created based on an ISO standard.

8.4.6. SPC 200 – Method of Test for Chilled Beams (Zimmerman)

- Met this morning. No update.

8.4.7. SGPC ASHRAE Guideline 10 – Interactions Affecting the Achievement of Acceptable Indoor Environments (Wang)

- Met yesterday.
- Now a published document (19 years of work).
- There will be a section on interactions between acoustics and thermal lighting issues.
- Lily will roll on as a voting member.

8.4.8. Performance Measurement Protocol (PMP) Best Practices document (Eichelberger)

- SPC 123.

- A document, not a standard. Follow-on to the PMP document available in the bookstore.
- Goal is to condense the PMP document. Can be used by owner, commissioning firms, and others.
- Trying to get this in a continuous improvement process. Benchmarking, quantifying savings, etc…
- A 60% draft is available on the website (technology tab); available for public comment. Deadline is the 30th. Curt will make for sure your comments make it in the next draft so don't worry about the deadline. We want to make for sure the acoustics stay in the document.

8.4.9. Proposed Position Document on "Environmental Health in Green Building Programs" (Roy/Muehleisen)

- No update. Discussion about ASHRAE putting out a position paper.

8.4.10. Updates from Other Standards Organizations

8.4.10.1. AHRI (Abbate)

- 1 standard since Las Vegas: AHRI-1120 (transport); now an ANSI standard.
- 2 others close: AHRI-260 (air-handling equipment), AHRI-1280 (water cooling equipment) – end of the year. September is the goal for AHRI-260; end of year is the goal for AHRI-1280. Both are free downloads
- 2 revised: AHRI-370 (large equipment) & AHRI-530 (compressors). AHRI-370 is on the website, AHRI-530 will be on the website in the next week or so.

8.4.10.2. AMCA (Brooks)

- AMCA-301 is in process.
- AMCA-330/ASHRAE 68 is in process.
- AMCA-210/ASHRAE-51 is entering a review stage. A committee is being formed now.
- A fan array committee has been formed. Larry Hopkins is chair. The committee met for the first time last week.
- Patrick: Revised version of ASTM-477 round robin in process.

8.4.10.3. ANSI (Ronsse)

- Would someone that's more active in ANSI like to take this from Lauren?
- A list of standards will be included in the subcommittee report.
  - ANSI working Group on Sound Measurement in Rooms (Lilly)
    - No update.

8.4.10.4. ASTM (Peppin)

- ASTM E477 (Patrick)
  - Currently being revised. End of this year, early next year is the goal.
- ASTM E33 (Paige)
  - No report.

8.4.10.5. ISO (Reynolds)

- ISO TC205 (Roy)

- New standards for building environment design.
- WG 6 includes acoustics.
- Not much international participation. Ken trying to form a joint working group. Will work through ISO not ASHRAE.
- In Europe, a country pays for folks to attend. Won't be meeting at ASHRAE, will meet at ISO.

8.5. Standing Subcommittees

8.5.1. Sound Criteria (Wang)

- Met yesterday.
- Reviewed the scope. Two main goals: measurement protocol and benchmarks for the HVAC industry.
- Reviewed the HVAC Applications handbook. Discussed what to do for the next round. Discussed tones at length. The subcommittee will work on the tones RTAR.
- Discussed other organizations – make for sure we are participating.

8.5.1.1. International Green Construction Code update

- The current acoustics section is lacking - consortium trying to improve. The subcommittee voted earlier for this to be a part of the consortium. Will meeting again later this Summer.

8.5.2. Vibration Isolation (Simmons)

8.5.2.1. Reviewed the revised RTAR: MOT for performance. See research committee notes for more detail.

8.5.2.2. A few mistakes were found in the handbook. Nothing new at this time.

8.6. Operations Subcommittee (Oliver)

8.6.1. Bylaws

- The TC has bylaws on the website.

8.6.2. Honors and awards

- We need to consider members of our committee.
- Hightower Award:
  - For activity on a TC excluding research and standards.
  - The chair needs to nominate. Let Patrick know if you have someone in mind.
  - Due in September.
- Distinguished Service Award:
  - No limit to the number of people.
  - Based on a point system: 15 points in a minimum of three categories (TC, speaker, etc…).
  - Can self-nominate.
  - Due in May of each year.
- Fellowship Award:
  - Lost a number of members this year. The Executive Subcommittee discussed forwarding a few names.
  - Please let the leadership know of others.

- Due December 1st.

8.6.3. Long-range planning

- There is no standing committee for long-range planning; it is handled via the main and Executive subcommittee meetings.
- If you have any comments, please let us know.

8.6.4. Membership (Oliver)

- The roster has been submitted. A few glitches – some did not get accepted.
- See the Membership subcommittee minutes for details on who has rolled off or rolled on.

8.6.5. Liaisons (Oliver)

8.6.5.1. ASHRAE TC 2.1 Physiology and the Human Environment (Wang)

- Not much on sound; mostly thermal comfort.
- Main meeting is tomorrow.
- Lily plans to get more active.

8.6.5.2. ASHRAE TC 2.7 Seismic and Wind Restraint Design (Meissel)

- Main meeting is tomorrow.
- ASHRAE seismic restraint guidelines document being updated; there have been many code changes of late.
- TC 2.7 will co-sponsor the MOT RTAR.
- The 2010-2015 strategic research plan addresses seismic restraint. The MOT addresses both.
- Note that the name of the committee has changed to "Seismic and Wind Resistant Design".

8.6.5.3. ASHRAE TC 5.1 Fan Design and Application (Osborne/Brooks)

- The TC is actively pursuing the concept of FEG – Fan Efficiency Grades - for ASHRAE Standard 90.1. The mechanical subcommittee of 90.1 approached TC 5.1 for acceptable minimum fan efficiencies. A new AMCA standard has been published: AMCA 205. AMCA now has a certification program for FEG.
- The first test for RP 1420 is complete. The RP is a joint project with TC 2.6. Two TC 2.6 members are on the subcommittee.
- A paper detailing the results of RP-1272 - inlet effects on FC fans – is being presented on Wednesday. The paper could not be placed in a transaction section so it is in a separate section with non-related issues. Mark Stevens will present.

8.6.5.4. ASHRAE TC 5.2 Duct Design (*)

- No report.

8.6.5.5. ASHRAE TC 5.3 Room Air Distribution (Oliver/Zimmerman)

- Main meeting is tomorrow afternoon.
- Completed the research project on diffuser performance. Final report has been submitted. The PMS is expected to accept.
- SPC 130 has been re-opened to address sound issues.

8.6.5.6. ASHRAE TC 6.10 Fuels and Combustion (Herrin)

- David Herrin has a research project on combustion noise generation.
- Nothing else to report.

8.6.5.7. ASA (Wang)

- Lily was not able to attend the Seattle meeting.
- Upcoming meeting: November in San Diego.
- The international meeting will be in Hong Kong next May (first time in Asia).

8.6.5.8. VISCMA (Peterman)

- Met on Saturday.
- There are a number of good whitepapers on the website.
- Will be modifying/updating the FEMA manual for seismic restraints.

8.6.5.9. Others (CTI, INCE, NCAC, etc…)

- Noting else.

9. New business/Old business

- No report.

9.1. Hot Topics at this meeting (Wang)

- None at this meeting.

9.2. Hot Topics for next meeting (Oliver)

- Insertion Loss of Vibration Isolators? (Lilly)
  - Patrick to coordinate with Jerry. If others interested, let us know.

10. Next meeting date and location: Chicago, IL; January 21-25, 2012

11. Adjournment

- **Motion** by Doug, seconded by Lily.
- Meeting adjourned at 4:00 PM.

Attachment 1:

Membership – Patrick Oliver

ASHRAE Summer Meeting – Montreal, June 2011

Membership Chair's Executive Subcommittee Report
Patrick Oliver, Vice Chair, ASHRAE TC 2.6

Current Roster for 2010-2011

16 Voting Members (8 manufacturers, 6 consultants, 2 academic) – 2 vacant seats
2 International Members (2 consultants) – no vacant seats
50 Corresponding Members

The Current Roster of Voting Members for Montreal meeting is:

Mr Francis J Babineau, Jr
Mr Warren E Blazier, Jr
Mr E Curtis Eichelberger, Jr
Mr John B Gierzak, PE
Mr Robert E Hassler, PE
Mr Robert M Lilkendey
Mr Neil A Moiseev
Mr Matthew T Murello, PE
Mr Patrick J Oliver
Mr Thomas S Paige, P.Eng.
Mr Chris A Papadimos
Mr Richard J Peppin
Mr Karl L Peterman
Dr Douglas D Reynolds, PhD
Dr Kenneth P Roy, Phd
Mr Robert E Simmons, PE
Dr Lily M Wang, PhD
Mr Randal S Zimmerman

There were 12 new corresponding member applicants:

Mr Daniel Abbate
Mr Todd Busch
Dan LaForgia
Mr Michael Keating
David Carroll
Mr Jason George
Dr Brian J Landsberger
Mr Joshua Leasure
Mr Andrew Mitchell
Mr Benjamin Harold Sachwald

Mr Tim Simcoe
Mr Vijay K Tripathi

The following 2 corresponding members were deleted from the roster:

Eric Rosenberg, Emanuel Mouratidis

Proposed Rollover Roster for 2010-2011

18 Voting Members – no vacant seats
2 International Members – no vacant seats
57 Corresponding Members
Chair – Patrick Oliver
Vice-Chair – John Gierzak
Secretary – Dustin Meredith

The 2011-2012 Roster of Voting Members will be (Effective July 1, 2011):

Mr Francis J Babineau, Jr
Mr E Curtis Eichelberger, Jr
Mr John B Gierzak, PE
Mr Robert E Hassler, PE
Mr Robert M Lilkendey
Mr Matthew T Murello, PE
Mr Patrick J Oliver
Mr Chris A Papadimos
Mr Richard J Peppin
Dr Douglas D Reynolds, PhD
Dr Kenneth P Roy, Phd
Mr Robert E Simmons, PE
Mr Randal S Zimmerman
Mr Kevin P Gaghan
Dr Siu-Kit Lau, PhD
Mr Jerry Lilly
Mr Dustin Eric Jason Meredith, PE
Mr Kim G Osborn

Attachment 2:

Research Subcommittee – Curt Eichelberger

ASHRAE TC2.6 Research Subcommittee Report, 06/27/2011, Montreal, QC.

Curt Eichelberger (curtis.eichelberger@jci.com)

Highlights of Research Chair's meeting:

After this meeting, we will have a new Research Liaison, William McCoy (RL2@ashrae.net). Reminder that our Research Liaison, should review all RTARs and WS. Please copy Curt Eichelberger (curtis.eichelberger@jci.com) on all correspondence with the Research Liaison.

Ongoing Research Projects:

RP-1322 Productivity and perception based evaluation of indoor noise criteria, Mark Schaffer, chair. Lily Wang, University of Nebraska, principle investigator. Project report was submitted for PMS review. Four changes were requested and PI will complete these changes by July 11. TC letter ballot will be conducted shortly thereafter for report approval.

RP-1408 The effect of lining length on the insertion loss of acoustical duct liner. Jerry Lilly PMS chair. Doug Reynolds, UNLV, principle investigator. The objective of this research is to show how the sound attenuation of lined ducts depends on duct length. The facility supply and return ducts were lined to eliminate low frequency breakout noise. One more test is needed with a modified plug to confirm the dynamic capability of the test facility in the 63 Hz octave band. The PMS will then review to determine if the rest results are acceptable. Goal is to start testing this summer. The PI will need a no-cost extension to the end of January 2013.

RP-1408 Extension. An extension to the 1408 Work Statement was approved. The purpose is to collect vibration and sound intensity test data on a small subset of duct configurations. This test data will then be used to enhance the analytical models of breakout noise that we anticipate developing in RP-1529.

Work Statements:

RP-1529 Full frequency numerical modeling of sound transmission and radiation in lined ducts – This project will develop and validate full-frequency numerical modeling techniques for sound transmission through, and radiation from, HVAC ductwork. Pat Marks will serve as the PES Chair. Project is ready for bid, possibly in the Fall of 2011.

RTARs:

Effect of HVAC noise in hospitals – Ken Roy and J.R. Babineau prepared a draft RTAR and this was forwarded to TC members for review 6/20/2010. This is a potential joint project with TC2.1 (Physiology & Human Environment) and TC9.6 (Health Care Facilities). The next step, Ken Roy, is to revise based on comments received during the research subcommittee meeting, confirm support from TC2.1, TC9.6 and other outside organizations.

RTAR-1560 Installed performance of vibration isolators – RTAR was dropped off the list due to inactivity. TC voted to resubmit in Las Vegas meeting. Vibration subcommittee worked on new version of the RTAR. Robert Simmons and Karl Peterman agreed to do another edit and to submit to TC to accept via a letter ballot.

Topics discussed and prioritized by (# votes) for future research:

#1 Tones (Champions L. Wang, P. Marks, J. Lilly) Investigate the effects of tonal HVAC noise on humans. Expand the scope to measurement techniques beyond tone prominence-ratios.

2 Noise generation in ducts and duct accessories – (Champions: Ralph Muehleisen and Doug Reynolds). Purpose is to quantify noise generation in ducts and fittings for various duct layouts. Existing data is over 40 years old.

3 Room Effect/ Single Pass through Ceiling System. (Champions R. Keith, K. Roy and D. Reynolds) Objective would be to review the room effect calculations that exist in the Application Handbook. Bill Rockwood suggested that much of this work could be performed with predictive models. D. Reynolds suggests that this data already exists on various sizes and types of rooms. Review of available data. K. Roy suggested that R. Keith and existing data be reviewed and make recommendation forward. May be a good topic for conference papers at Dallas, meeting.

Attachment 3:

Programs Subcommittee – Lily Wang for Chris Papadimos

THIS MEETING – MONTREAL - JUNE 25-29, 2011

- Theme: Sustainability knows no borders

- The technical program is organized under the following tracks (pending):

  Track 1 Refrigeration
  Track 2 HVAC Systems
  Track 3 HVAC Fundamentals and Applications
  Track 4 Net Zero Energy Buildings
  Track 5 Professional Skills
  Track 6 Engineering Tools
  Track 7 Commissioning
  Track 8 Alternative Technologies

- Programs (submitted/accepted/presented):

Type	Subject	Chair	Accepted?
Seminar	Acoustic Criteria for Design, Diagnostics and Commissioning	Mark Schaffer	N
Seminar	Vibration-Induced Noise and Mechanical Equipment Vibration Isolation and Balance	Pat Marks	N
Seminar TC 2.6/5.1/5.9	Multiple Plenum Fans in Arrays	Asesh Raychaudhuri	Y
Forum	Building Information Modeling (BIM) – how to integrate acoustics	Andrew Mitchell	Y

NEXT MEETING – CHICAGO – JANUARY 21-25, 2011

- Theme: The Impact of HVAC&R on Our Daily Lives

- Submission deadlines:

  Conference Paper Submissions: April 18, 2011 (Abstract), July 8, 2011 (Paper)
  Forum (1 moderator - 60 min, no presentations) – Aug 12, 2011
  Seminar (1-2 presentations - 60min; 3-4 presentations - 90 min) – Aug 12, 2011

  ACTION ITEM: Check with ASHRAE on status of Conference Paper Session submitted by Patrick Marks

- The link to upload program submissions is on www.ashrae.org/chicago

- The technical program is organized under the following tracks (pending):

  Track 1 Energy Efficiency – New Technologies and Applications
  Track 2 Integrated Design
  Track 3 Specialized Applications – Healthcare, Laboratories, and Data Centers
  Track 4 Energy Modeling Applications
  Track 5 Installation, Operation & Maintenance of HVAC Systems
  Track 6 High Performance Buildings
  Track 7 HVAC&R Systems and Equipment
  Track 8 Professional Skills
  Track 9 HVAC&R Fundamentals and Applications
  Track 10 Refrigeration

- Programs to submit:

Type	Subject	Chair	TRACK
Seminar	Aerodynamics noise (GRD, Terminal Units, +)	Mark Schaffer	7
Seminar?	Green Building Acoustics	Ralph Muehleisen	6
Forum/Seminar	Acoustic Criteria for Design, Diagnostics and Commissioning	Karl Peterman	9
Seminar	Vibration-Induced Noise and Mechanical Equipment Vibration Isolation and Balance	Pat Marks (speakers were Sheeren and Bender-retiring, though)	5

NOTES:

Seminar submissions should include six (6) Learning Objectives and ten (10) Questions/Answers for the session. In addition, a short biography for each speaker will be required so that the program can be submitted to USGBC for LEED-AP credits. The biography should include information about current position, educational background and relevant experience.

The track chairs will be using the following criteria to evaluate the program submissions:

- Relevance to track theme (addresses the abstract appropriately)
- Hot Topic (timely, topic of pressing interest to engineers/industry)
- Strength of session proposal and completeness (well written, comprehensive abstracts for both the overall session and for presentations, including Learning Objectives and Q&A's)
- Market-based session (such as case studies, or application-oriented topic, or "how-to apply" or "how-to use" sessions, etc.)

UPCOMING MEETINGS

- Annual Meeting 2012 San Antonio - June 23 to 28, 2012
  - Theme: No More Themes!
  - Deadline for Conference Paper Submission: September 26, 2011
  - The link for conf paper submissions: www.ashrae.org/sanantonio
- The technical program is organized under the following tracks (pending):

Track 1 HVAC&R System & Equipment
Track 2 HVAC&R Fundamentals and Applications
Track 3 Integrated Energy Systems
Track 4 Building Modeling Applications
Track 5 Refrigeration Applications
Track 6 Indoor Environmental Applications
Track 7 Integrated Building Controls

- Details to follow in upcoming meetings
- Programs to consider:

Type	Subject	Chair	
Seminar			
Forum			
Conf Papers?	Numerical Techniques in Noise and Vibration Simulation for HVAC&R Systems	Pat Marks	
Tech Papers			

PROGRAM TOPICS "IN THE HOPPER"

- Miscellaneous program topics – listed in order of priority by vote in Las Vegas and as tentatively assigned for upcoming conferences.

Votes	Subject	Leader
-	~~Air handlers with fan arrays (Montreal 2011 Seminar)~~	~~Asesh Raychaudhuri~~
21	Acoustic criteria (Chicago 2012 Seminar) ... couple with the ANSI Standard on Measurement Procedures?	Karl Peterman
~~19~~	~~BIM and acoustics (hot topic or forum – Montreal 2011)~~	~~Karl Peterman~~
17	Aerodynamic Noise (Chicago 2012 Seminar)	Mark Schaffer
16	Green Building Acoustics – (Chicago 2012 Seminar) ... IGCC, PMP, ...	Ralph Muehleisen
11	Vibration-Induced Noise - Case Studies (Chicago 2012 Seminar)	Patrick Marks
6	Mechanical Equipment Vibration Isolation and Balance	Jerry Lilly
8	Duct Breakout and Flanking Paths Noise	Doug Reynolds
6	Forum on next generation handbook	Bill Rockwood
6	Forum/Seminar on Equipment Sound Standards	Chris Papadimos
4	Outdoor Noise / Liabilities from Outdoor Noise	Matt Murillo
3	Fan Selection for Acoustics	Mark Schaffer
1	Tunnel Ventilation	
0	Variable Capacity Compressors	
0	Exhaust Fan Noise	
0	Standard method of test for vibration isolators	
	RTU Noise	Sami Elkhazin

- Please contact Chris Papadimos with ideas and suggestions for additional topics.
  - Email: chris@papadimosgroup.com
  - Tel 415 456 0170 x202

DISCUSSION ON USING SPEAKER RATINGS

- The ASHRAE Conference and Expositions Committee (CEC) is working on ways to improve the quality of the technical program, and they would like suggestions from TCs on what parameters should be used by end users to rate and evaluate program sessions at the meeting.
- 15% of speakers typically get a rating of 3.5 or lower (out of 5) on the current scoring system.
- Perhaps these persons would be asked to participate in some training on how to give better presentations, after getting 'low' ratings two or three times?
- Comments from TC 2.6 members:
    - Good idea to instruct bad speakers
    - This is a volunteer organization, though ... this could turn people away from participating as speakers at the conference
        - Do we have a dearth of presenters?
    - Maybe not a bad thing because (1) you get rid of bad speakers or (2) these speakers actually improve
    - Would have to instruct audience members how to use rating scales
    - What about grad students? Or persons who use English as a Second Language?
    - Apply after speaking twice?
    - TC chair should really be the one pushing improvement of speakers, based on feedback from the program surveys
    - ASHRAE staff member (Don Reem) could perhaps help with providing continuing education on how to make successful presentations
    - It would be good for ASHRAE to offer these sessions (leadership skills, presentation skills) on some regular basis (alternate, every other meeting)?
    - Another idea is to require that speakers have to read through 'How to Make Good Presentations' prior to submitting presentation
    - Or require that slides have to meet FORMAT reviews, in addition to commercialism... so ASHRAE would provide templates
        - Font size
        - Number of figures
        - Over-animation

- Minutes submitted by L. Wang

Attachment 4:

Publications Subcommittee – Steve Wise

Subject: TC2.6 Publications Subcommittee Minutes from Montreal, June 2011

TC Website

Mike Schwob has launched our new site: http://ashrae-tc26.org, intended to include the basic attributes of our former location while adding some new features. We had a spirited discussion in Montreal about how to handle things such as outside inquiries, FAQ, links to Research reports, etc. See Mike's separate report for more info.

Miscellaneous publications available via ASHRAE

Mark Schaffer mentioned that his book, *A practical guide to noise and vibration control for HVAC systems*, 2nd ed, will is now available in SI units as well as the original IP version, through the ASHRAE bookstore.

It was agreed in Las Vegas that we should endeavor to keep in contact with ASHRAE for an opportunity to make revisions to the acoustical section of the "Pocket Guide" as desired in the future. Though we have not made progress on that to date, we are still interested in any ideas that TC members might suggest.

Fundamentals Handbook, 2013 revision

Dan LaForgia attended our meeting on Jon Weinstein's behalf. To this point, we have no suggestions for any changes to the last update in 2009. At the 2012 ASHRAE Winter Meeting in Chicago, we will vote to either leave it unchanged, or agree to specific revisions that surface between now and then. If anyone notices an incorrect item between now and then, please contact Dan or Jon.

Applications Handbook, 2011 revision

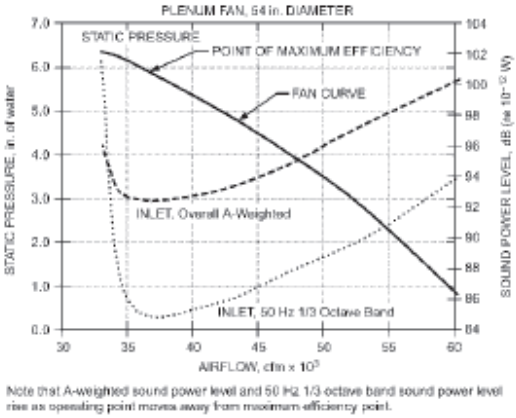
Our latest rev edition hit the streets in May. For the most part, it was as we intended, with some meaningful changes in a few section. However, we did find some errors that were not picked up by ASHRAE after our review of the galley proofs.

Attached are excerpts from a Word.doc markup copy (both SI and IP units). We are showing the items that need to be addressed either in official errata, or in the next 2015 edition.

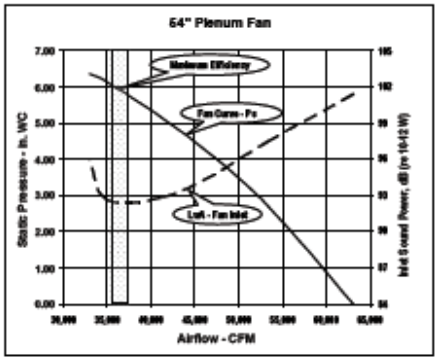
Problems with 2011 Applications Handbook

1. Page 48.9 This figure was a carryover from previous editions. The 50Hz plot has no meaning with regard to what is found in the accompanying text, so we had submitted a new curve that did not have it. Unfortunately, it did not get picked up by ASHRAE.

Fig. 8 Test Data for Plenum Fan, Comparing Operating Point (Static Pressure and Airflow), A-Weighted Sound Power Level



As in 2011 Handbook



As we had proposed

2. p.48.19 – Under Eq (7)

"For frequencies that correspond to plane wave propagation in the duct (below the cutoff frequency), the following relationship applies, with a lower frequency limit of 50 Hz:

$TL = A_f S + W_e + OAE$ ($TL = 10.76A_f S + W_e + OAE$) (7)

where

A_f = surface area coefficient, dB/ft² (m²) (see Table 13 for small and large plenum size ranges)

W_e = wall effect, dB (see Table 13 for common HVAC plenum wall types)

The maximum TL predicted by Equation (7) should be limited to 20 dB at $f < f_{co}$."

need to add:

OAE = Offset Angle Effect

and delete "The maximum TL predicted by Equation (7) should be limited to 20 dB at *f<fc.*"

3. p48.29 Table 30 – the 4th line under "Spiral Wound Ducts" was to be deleted, but ASHRAE missed it.

Table 30 Experimentally Measured TL_{out} Versus Frequency for Round Ducts

			Octave Midband Frequency, Hz						
Diameter, in. (mm)	Length, ft (m)	Gage	63	125	250	500	1000	2000	4000
Long Seam Ducts									
8 (200)	15 (4.6)	26	>45	(53)	55	52	44	35	34
14 (350)	15 (4.6)	24	>50	60	54	36	34	31	25
22 (560)	15 (4.6)	22	>47	53	37	33	33	27	25
32 (810)	15 (4.6)	22	(51)	46	26	26	24	22	38
Spiral Wound Ducts									
12 (300)	12 (3.6)	26*	52	51	53	51	50	46	36
24 (610)	24 (7.3)	24	51	53	51	44	36	26	29
	24 (7.3)	24*	51	51	54	44	39	33	47
	10 (3)	16	>48	53	36	32	32	28	41
36 (915)	24 (7.3)	20	51	51	52	46	36	32	55

*Ducts internally lined with 1 in. (25 mm) thick 1.5 pcf (24 kg/m³) fiberglass with 24 ga perforated sheet metal inner liner.

4. . p48.30 Example 6, note between two tabulations, should be Equations (21) to (23) (IP only)

Example 6. Repeat Example 5 using 24 in. (610 mm) diameter spiral round duct, 24 ga, 25 ft (7.6 m) long with 1 in. (25 mm) thick acoustical duct lining.

Solution: Using Equations (13) and (23),

	Octave Midband Frequency, Hz						
	63	125	250	500	1000	2000	4000
$L_{w(in)}$	90	85	80	75	70	65	60
$-TL_{out}$ (Table 30)	–51	–51	–54	–44	–39	–33	–47
10 log (S/A)	17	17	17	17	17	17	17
$L_{w(out)}$	56	51	43	48	48	49	30
$-10 \log(\pi rL) + 10$ [$-10 \log(\pi rL)$]	–16	–16	–16	–16	–16	–16	–16
L_p, dB	40	35	27	32	32	33	14

Using Equations (21) to (23) yields

	Octave Midband Frequency, Hz						
	63	125	250	500	1000	2000	4000
$L_{w(in)}$	90	85	80	75	70	65	60
$-TL_{out}$ (Table 30)	–51	–51	–54	–44	–39	–33	–47
α, dB/ ft (m) (Table 20)	0.7 (0.23)	0.5 (0.82)	0.57 (1.87)	1.28 (4.2)	1.71 (5.61)	1.24 (4.07)	0.85 (2.79)
γ	0.98	0.94	0.88	0.74	0.67	0.75	0.82
L^*, ft (m)	21 (6.2)	13 (4.0)	7.3 (2.2)	3.4 (1.0)	2.5 (0.8)	3.5 (1.1)	5.1 (1.5)
10 log (S^*/A)	16	14	12	8.3	7.1	8.5	10
$L_{w(out)}$	55	48	38	39	38	40	23
$-10 \log(\pi rL) + 10$ [$-10 \log(\pi rL)$]	–16	–16	–16	–16	–16	–16	–16
L_p, dB	39	32	22	24	22	25	7

5. p48.45 Table 47, under "Reciprocating Machines and Chillers", line for "screw", isolator type should be 4, not 1. Missed by ASHRAE.

Table 47 Selection Guide for Vibration Isolation

			Equipment Location (Note 1)												
						Floor Span									
			Slab on Grade			Up to 6 m			6 to 9 m			9 to 12 m			
Equipment Type	Shaft Power kW and Other	RPM	Base Type	Isolator Type	Min. Defl., mm	Base Type	Isolator Type	Min. Defl., mm	Base Type	Isolator Type	Min. Defl., mm	Base Type	Isolator Type	Min. Defl., mm	Reference Notes
Refrigeration Machines and Chillers															
Reciprocating	All	All	A	2	6.4	A	4	19	A	4	38	A	4	64	2,3,12
Centrifugal, scroll	All	All	A	1	6.4	A	4	19	A	4	38	A	4	38	2,3,4,8, 12
Screw	All	All	A	1	25	A	4	38	A	4	64	A	4	64	2,3,4,12
Absorption	All	All	A	1	6.4	A	4	19	A	4	38	A	4	38	
Air-cooled recip., scroll	All	All	A	1	6.4	A	4	38	A	4	38	A	4	64	2,4,5,12
Air-cooled screw	All	All	A	4	25	A	4	38	B	4	64	B	4	64	2,4,5,8,12
Air Compressors and Vacuum Pumps															

Should be 4

6. p. 48.45, In the Vibration Isolator Selection Guide, we need to add "water-cooled for clarity. There was also a typo in the SI table with regard to Packaged AH sizes. And in several items where we had indicated ranges of sizes, it was pointed out by an independent reviewer that there were some gaps. Robert Simmons and Karl Peterman looking into proposed changes.

Table 47 Selection Guide for Vibration Isolation

			Equipment Location (Note 1)												
						Floor Span									
			Slab on Grade			Up to 20 ft			20 to 30 ft			30 to 40 ft			
Equipment Type	Horsepower and Other	RPM	Base Type	Isolator Type	Min. Defl., in.	Base Type	Isolator Type	Min. Defl., in.	Base Type	Isolator Type	Min. Defl., in.	Base Type	Isolator Type	Min. Defl., in.	Reference Notes
Refrigeration Machines and Chillers															
Water-cooled Reciprocating	All	All	A	2	0.25	A	4	0.75	A	4	1.50	A	4	2.50	2,3,12
Water-cooled Centrifugal or scroll	All	All	A	1	0.25	A	4	0.75	A	4	1.50	A	4	1.50	2,3,4,8, 12
Water-cooledScrew	All	All	A	1	1.00	A	4	1.5	A	4	2.50	A	4	2.50	2,3,4,12
Absorption	All	All	A	1	0.25	A	4	0.75	A	4	1.50	A	4	1.50	
Air-cooled recip. or scroll	All	All	A	1	0.25	A	4	1.50	A	4	1.50	A	4	2.50	2,4,5,12
Air-cooled screw	All	All	A	4	1.00	A	4	1.50	B	4	2.50	B	4	2.50	2,4,5,8,12
Air Compressors and Vacuum Pumps															
Tank-mounted horiz.	≤10	All	A	3	0.75	A	3	0.75	A	3	1.50	A	3	1.50	3,15
	≥15	All	C	3	0.75	C	3	0.75	C	3	1.50	C	3	1.50	3,15
Tank-mounted vert.	All	All	C	3	0.75	C	3	0.75	C	3	1.50	C	3	1.50	3,15
Base-mounted	All	All	C	3	0.75	C	3	0.75	C	3	1.50	C	3	1.50	3,14,15
Large reciprocating	All	All	C	3	0.75	C	3	0.75	C	3	1.50	C	3	1.50	3,14,15
Pumps															
Close-coupled	≤7.5	All	B	2	0.25	C	3	0.75	C	3	0.75	C	3	0.75	16
	≥10	All	C	3	0.75	C	3	0.75	C	3	1.50	C	3	1.50	16
Inline	5 to 25	All	A	3	0.75	A	3	1.50	A	3	1.50	A	3	1.50	
	≥30	All	A	3	1.50	A	3	1.50	A	3	1.50	A	3	2.50	
End suction and double-suction/split case	≤40	All	C	3	0.75	C	3	0.75	C	3	1.50	C	3	1.50	16
	50 to 125	All	C	3	0.75	C	3	0.75	C	3	1.50	C	3	2.50	10,16
	≥150	All	C	3	0.75	C	3	1.50	C	3	2.50	C	3	3.50	10,16
Packaged pump systems	All	All	A	3	0.75	A	3	0.75	A	3	1.50	C	3	2.50	
Cooling Towers	All	Up to 300	A	1	0.25	A	4	3.50	A	4	3.50	A	4	3.50	5,8,18
		301 to 500	A	1	0.25	A	4	0.75	A	4	0.75	A	4	0.75	5,18
		501 and up	A	1	0.25	A	4	1.50	A	4	1.50	A	4	1.50	5,18
Boilers															
Fire-tube	All	All	A	1	0.25	B	4	0.75	B	4	1.50	B	4	2.50	4
Water-tube, copper fin	All	All	A	1	0.12	A	1	0.12	A	1	0.12	B	4	0.25	
Axial Fans, Plenum Fans, Cabinet Fans, Fan Sections, Centrifugal Inline Fans															
Up to 22 in. diameter	All	All	A	2	0.25	A	3	0.75	A	3	0.75	C	3	0.75	4,9,8
24 in. diameter and up	≤2 in. SP	Up to 300	B	3	2.50	C	3	3.50	C	3	3.50	C	3	3.50	9,8
		301 to 500	B	3	0.75	B	3	1.50	C	3	2.50	C	3	2.50	9,8
		501 and up	B	3	0.75	B	3	1.50	B	3	1.50	B	3	1.50	9,8
	≥2.1 in. SP	Up to 300	C	3	2.50	C	3	3.50	C	3	3.50	C	3	3.50	3,8,9
		301 to 500	C	3	1.50	C	3	1.50	C	3	2.50	C	3	2.50	3,8,9
		501 and up	C	3	0.75	C	3	1.50	C	3	1.50	C	3	2.50	3,8,9
Centrifugal Fans															
Up to 22 in. diameter	All	All	B	2	0.25	B	3	0.75	B	3	0.75	B	3	1.50	9,19
24 in. diameter and up	≤40	Up to 300	B	3	2.50	B	3	3.50	B	3	3.50	B	3	3.50	8,19
		301 to 500	B	3	1.50	B	3	1.50	B	3	2.50	B	3	2.50	8,19
		501 and up	B	3	0.75	B	3	0.75	B	3	0.75	B	3	1.50	8,19
	≥50	Up to 300	C	3	2.50	C	3	3.50	C	3	3.50	C	3	3.50	2,3,8,9,19
		301 to 500	C	3	1.50	C	3	1.50	C	3	2.50	C	3	2.50	2,3,8,9,19

Comment [S1]: Added "water-cooled" here to address reader concerns.

Comment [S2]: 2007 had Type 1 here, and we had proposed Type 4 for 2011. But ASHRAE didn't catch it, and it is still 1. Do we want to change it to 4, as I have now indicated?

Comment [S3]: What about sizes between 10 and 15? Do we open up the ranges and still have just 2 lines, or do we add a 3rd line, to fill the gap?

Comment [S4]: Also a gap in this range.

Comment [S5]: And a gap in this range.

Comment [S6]: And gaps in these ranges.

Comment [S7]: And a gap in this range.

		501 and up	C	3	1.00	C	3	1.50	C	3	1.50	C	3	2.50	2,3,8,9,19
Propeller Fans															
Wall-mounted	All	All	A	1	0.25	A	1	0.25	A	1	0.25	A	1	0.25	
Roof-mounted	All	All	A	1	0.25	A	1	0.25	B	4	1.50	D	4	1.50	
Heat Pumps, Fan-Coils, Computer Room Units	All	All	A	3	0.75	A	3	0.75	A	3	0.75	A/D	3	1.50	
Condensing Units	All	All	A	1	0.25	A	4	0.75	A	4	1.50	A/D	4	1.50	
Packaged AH, AC, H, and V Units															
All	≤10	All	A	3	0.75	A	3	0.75	A	3	0.75	A	3	0.75	19
	≤15,≤4 in. SP	Up to 300	A	3	0.75	A	3	3.50	A	3	3.50	C	3	3.50	2,4,8,19
		301 to 500	A	3	0.75	A	3	2.50	A	3	2.50	A	3	2.50	4,19
		501 and up	A	3	0.75	A	3	1.50	A	3	1.50	A	3	1.50	4,19
	>15,>4 in. SP	Up to 300	B	3	0.75	C	3	3.50	C	3	3.50	C	3	3.50	2,3,4,8,9
		301 to 500	B	3	0.75	C	3	1.50	C	3	2.50	C	3	2.50	2,3,4,9
		501 and up	B	3	0.75	C	3	1.50	C	3	1.50	C	3	2.50	2,3,4,9
Packaged Rooftop Equipment	All	All	A/D	1	0.25	D	3	0.75			See Reference Note 17				5,6,8,17
Ducted Rotating Equipment															
Small fans, fan-powered boxes	≤600 cfm		A	3	0.50	A	3	0.50	A	3	0.50	A	3	0.50	7
	≥601 cfm		A	3	0.75	A	3	0.75	A	3	0.75	A	3	0.75	7
Engine-Driven Generators	All	All	A	3	0.75	C	3	1.50	C	3	2.50	C	3	3.50	2,3,4
Piping and Ducts (See sections on Isolating Vibration and Noise in Piping Systems and Isolating Duct Vibration for isolator selection.)															

Base Types:
A. No base, isolators attached directly to equipment (Note 28)
B. Structural steel rails or base (Notes 29 and 30)
C. Concrete inertia base (Note 31)
D. Curb-mounted base (Note 32)

Isolator Types:
1. Pad, rubber, or glass fiber (Notes 20 and 21)
2. Rubber floor isolator or hanger (Notes 20 and 25)
3. Spring floor isolator or hanger (Notes 22, 23, and 26)
4. Restrained spring isolator (Notes 22 and 24)
5. Thrust restraint (Note 27)
6. Air spring (Note 25)

Table 47 Selection Guide for Vibration Isolation

			Equipment Location (Note 1)												
						Floor Span									
			Slab on Grade			Up to 6 m			6 to 9 m			9 to 12 m			
Equipment Type	Shaft Power kW and Other	RPM	Base Type	Isolator Type	Min. Defl., mm	Base Type	Isolator Type	Min. Defl., mm	Base Type	Isolator Type	Min. Defl., mm	Base Type	Isolator Type	Min. Defl., mm	Reference Notes
Refrigeration Machines and Chillers															
Water-cooled Reciprocating	All	All	A	2	6.4	A	4	19	A	4	38	A	4	64	2,3,12
Water-cooled Centrifugal or scroll	All	All	A	1	6.4	A	4	19	A	4	38	A	4	38	2,3,4,8, 12
Water-cooled Screw	All	All	A	4	25	A	4	38	A	4	64	A	4	64	2,3,4,12
Absorption	All	All	A	1	6.4	A	4	19	A	4	38	A	4	38	
Air-cooled recip or scroll	All	All	A	1	6.4	A	4	38	A	4	38	A	4	64	2,4,5,12
Air-cooled screw	All	All	A	4	25	A	4	38	B	4	64	B	4	64	2,4,5,8,12
Air Compressors and Vacuum Pumps															
Tank-mounted horiz.	≤7.5	All	A	3	19	A	3	19	A	3	38	A	3	38	3,15
	≥11	All	C	3	19	C	3	19	C	3	38	C	3	38	3,15
Tank-mounted vert.	All	All	C	3	19	C	3	19	C	3	38	C	3	38	3,15
Base-mounted	All	All	C	3	19	C	3	19	C	3	38	C	3	38	3,14,15
Large reciprocating	All	All	C	3	19	C	3	19	C	3	38	C	3	38	3,14,15
Pumps															
Close-coupled	≤5.6	All	B	1	6.4	C	3	19	C	3	19	C	3	19	16
	≥7.5	All	C	3	19	C	3	19	C	3	38	C	3	38	16
Large inline	3.7 to 19	All	A	3	19	A	3	38	A	3	38	A	3	38	
	≥22	All	A	3	38	A	3	38	A	3	38	A	3	64	
End suction and split case	≤30	All	C	3	19	C	3	19	C	3	38	C	3	38	16
	37 to 93	All	C	3	19	C	3	19	C	3	38	C	3	64	10,16

Comment [S8]: Do we change this to Type 4?

Comment [S9]: A gap in this range.

Comment [S10]: A gap in this range.

Comment [S11]: A gap in this range.

	≥110	All	C	3	19	C	3	38	C	3	64	C	3	89	10,16
Packaged pump systems	All	All	A	3	19	A	3	19	A	3	38	C	3	64	
Cooling Towers	All	Up to 300	A	1	6.4	A	4	89	A	4	89	A	4	89	5,8,18
		301 to 500	A	1	6.4	A	4	64	A	4	64	A	4	64	5,18
		501 and up	A	1	6.4	A	4	19	A	4	19	A	4	38	5,18
Boilers:															
Fire-tube	All	All	A	1	6.4	B	4	19	B	4	38	B	4	64	4
Water-tube, copper fin	All	All	A	1	3	A	1	3	A	1	3	B	4	6.4	
Axial Fans, Plenum Fans, Cabinet Fans, Fan Sections, Centrifugal Inline Fans:															
Up to 560 mm diameter	All	All	A	2	6.4	A	3	19	A	3	19	C	3	19	4,9
610 mm diameter and up	≤500 Pa SP	Up to 300	B	3	64	C	3	89	C	3	89	C	3	89	9,8
		300 to 500	B	3	19	B	3	38	C	3	64	C	3	64	9,8
		501 and up	B	3	19	B	3	38	B	3	38	B	3	38	9,8
	≥501 Pa SP	Up to 300	C	3	64	C	3	89	C	3	89	C	3	89	3,8,9
		300 to 500	C	3	38	C	3	38	C	3	64	C	3	64	3,8,9
		501 and up	C	3	19	C	3	38	C	3	38	C	3	64	3,8,9
Centrifugal Fans:															
Up to 560 mm diameter	All	All	B	2	6.4	B	3	19	B	3	19	B	3	38	9,19
610 mm diameter and up	≤30	Up to 300	B	3	64	B	3	89	B	3	89	B	3	89	8,19
		300 to 500	B	3	38	B	3	38	B	3	64	B	3	64	8,19
		501 and up	B	3	19	B	3	19	B	3	19	B	3	38	8,19
	≥37	Up to 300	C	3	64	C	3	89	C	3	89	C	3	89	2,3,8,9,19
		300 to 500	C	3	38	C	3	38	C	3	64	C	3	64	2,3,8,9,19
		501 and up	C	3	25.4	C	3	38	C	3	38	C	3	64	2,3,8,9,19
Propeller Fans:															
Wall-mounted	All	All	A	1	6.4	A	1	6.4	A	1	6.4	A	1	6.4	
Roof-mounted	All	All	A	1	6.4	A	1	6.4	B	4	38	D	4	38	
Heat Pumps, Fan-Coils, Computer Room Units:	All	All	A	3	19	A	3	19	A	3	19	A/D	3	38	
Condensing Units:	All	All	A	1	6.4	A	4	19	A	4	38	A/D	4	38	
Packaged AH, AC, H and V Units:															
All	7.5	All	A	3	19	A	3	19	A	3	19	A	3	19	19
	≤11kW	Up to 300	A	3	19	A	3	89	A	3	89	C	3	89	2,4,8,19
	≤1kPa SP	301 to 500	A	3	19	A	3	64	A	3	64	A	3	64	4,19
		501 and up	A	3	19	A	3	38	A	3	38	A	3	38	4,19
	>11kW	Up to 300	B	3	19	C	3	89	C	3	89	C	3	89	2,3,4,8,9
	≥1kPa SP	301 to 500	B	3	19	C	3	38	C	3	64	C	3	64	2,3,4,9
		501 and up	B	3	19	C	3	38	C	3	38	C	3	64	2,3,4,9
Packaged Rooftop Equipment	All	All	A/D	1	6.4	D	3	19			See Reference Note 17				5,6,8,17
Ducted Rotating Equipment:															
Small fans, fan-powered boxes	≤300 L/s	All	A	3	12.7	A	3	12.7	A	3	12.7	A	3	12.7	7
	>301 L/s	All	A	3	19	A	3	19	A	3	19	A	3	19	7
Engine-Driven Generators:	All	All	A	3	19	C	3	38	C	3	64	C	3	89	2,3,4
Piping and Ducts (See sections on Isolating Vibration and Noise in Piping Systems and Isolating Duct Vibration for isolator selection.)															

Base Types:
A. No base, isolators attached directly to equipment (Note 28)
B. Structural steel rails or base (Notes 29 and 30)
C. Concrete inertia base (Note 30)
D. Curb-mounted base (Note 31)

Isolator Types:
1. Pad, rubber, or glass fiber (Notes 20 and 21)
2. Rubber floor isolator or hanger (Notes 20 and 25)
3. Spring floor isolator or hanger (Notes 22, 23, and 26)
4. Restrained spring isolator (Notes 22 and 24)
5. Thrust restraint (Note 27)
6. Air spring (Note 25)

Comment [S12]: Gaps in these ranges.

Comment [S13]: A gap in this range.

Comment [S14]: We had corrected this in our submittal to ASHRAE, but they had it goofed in their final edit.

7. p.48.49 under "suspended piping", last paragraph, need to insert "within 50 ft of noise-sensitive areas...."

Suspended Piping. Isolation hangers described in Note 26 of Table 47 should be used for all piping in equipment rooms and up to 50 ft (15 m) from vibration-isolated equipment and PRV stations. To avoid reducing the effectiveness of equipment isolators, at least the first three hangers from the equipment should provide the same deflection as the equipment isolators, with a maximum limitation of 2 in. (50 mm) deflection; the remaining hangers should be spring or combination spring and rubber with 0.75 in. (20 mm) deflection.

The first two hangers adjacent to the equipment should be the positioning or precompressed type, to prevent load transfer to equipment flanges when the piping system is filled. The positioning hanger aids in installing large pipe, and many engineers specify this type for all isolated pipe hangers for piping 8 in. (200 mm) and larger.

Piping over 2 in. (50 mm) in diameter that is suspended below or within 50 ft (15 m) of noise-sensitive areas should be hung with isolation hangers. Hangers adjacent to noise-sensitive areas should be the spring and rubber combination type 3.

ITEMS FOR FUTURE REVIEW:

1. p. 48.23 Duct Silencers. Karl Peterman, Dan LaForgia, and Jerry Lilly are reviewing this for possible changes.

2. p. 48.18 Plenums.

   Several continuing frustrations here:

   1) we know ASHRAE is tight on page space, which is why we have to compress our chapter, and this item seems to command more space than it deserves in the big picture (2.5 out of 54.5 pages);
   2) the methodology is complicated enough that it is unlikely to have many general HVAC engineers ever looking at it, and
   3) there are "mysterious" effects, like the Offset Angle at 45°, when f>fc, gives a TL of 19 dB at 250 Hz and 5 dB at 315 Hz.
   4) we did not clearly define the ATL that is used above the cutoff frequency, or how we got the values in the example tabulation. And why do we call it transmission loss, when in practice if we are evaluating a silencer vs. plenum options, the silencer data is insertion loss.

3. Page 48,21+ "Duct Attenuation". It will be great when we get new duct attenuation data. Might not make it for the 2015 edition either. In the meantime, can we reach consensus on how to best handle the fact that lined rectangular ducts don't show 63 Hz data?

This does factor into calculations, and people will indeed make their own assumptions if we don't direct them. Can we do it?

4. Page 48,38, item 5, reference to Ceiling Attenuation Table 43.

How best to note that this data includes room effect (note to this table, and elsewhere)?

We need better data, but in the absence of that, how do we best answer:

a) what effect does ceiling cavity volume have?

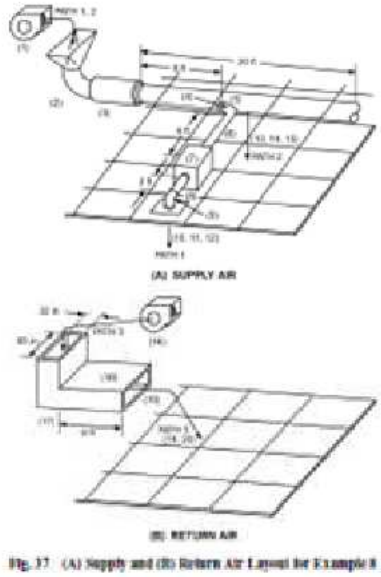
b) b) what is value for line source vs point source?

5. Page 48.40, Table 44 – and related Fig 37 which identifies paths of propagation. We need to decide if this should be devoted to just the example problem or to all possible paths. We are currently leaning toward the latter. Either way, we must clearly establish guidelines/procedures for using the room effect for different duct location / ceiling data.

Specifically, 1) If a duct as a linear source does that affect the attenuation? 2) Do we have a correct general statement, in the right place, about the ramifications of a duct being against the roof slab in a tight ceiling space? 3) do we address the missing 63 Hz lined duct attenuation data sufficiently here?

Table 44 Path Element Sound Calculation Reference

ID	Description	Data Source Reference
01	Supply air fan, 7000 cfm, 2.5 in. of water	Manufacturer's data
02	22 in. dia., 90° rad. unlined elbow	Attenuation: Table 23
03	22 × 44 in. long sound attenuator	Manufacturer's data
04	22 in. dia., 8 ft long unlined duct	Attenuation: Table 27
05.2	16 in. dia. branch, 22 in. dia. main, branch path	Attenuation: Table 27
05.1	16 in. dia. branch, 22 in. dia. main, main path	Attenuation: Table 27
06	16 in. dia., 6 ft long unlined duct	Attenuation: Table 16
07	VAV terminal	Manufacturer's data
08	16 in. dia., 2 ft long unlined duct	Attenuation: Table 16
09	16 in. dia., 90° rad. unlined elbow	Attenuation: Table 23
10	16 in. dia. diffuser, end reflection	Attenuation: Table 28
11	15 × 15 in. rectangular diffuser	Manufacturer's data
13	22 in. dia., 20 ft long, 24 ga. duct breakout	Attenuation: Equation (20), Table 30
14	2 × 4 ft × 5/8 in. lay-in ceiling	Attenuation: Table 32
15	ASHRAE room correction: line source	Equation (30)
16	Return air fan, 7000 cfm, 2.5 in. of water	Manufacturer's data
17	36 × 72 in., 90° mitered unlined elbow	Attenuation: Tables 22 and 24
18	36 × 72 in., 8 ft long lined duct	Attenuation: Table 30; assume 1 dB at 63 Hz
19	36 × 72 in. end reflection loss	Attenuation: Table 27, $D = 45.9$ in.



(A) SUPPLY AIR

(B) RETURN AIR

Fig. 37 (A) Supply and (B) Return Air Layout for Example 8

Attachment 5:

Webmaster Report – Michael Schwob

Webmaster Report – Michael Schwob

The new web page is up and running. The URL is http://ashrae-tc26.org.

The old website was removed by the Region 7 webmaster. I saved the contents of the old website.

Most of the content from the old website has been migrated to the new website. Pages for past programs are still being created.

The new member roster must be added to the site.

Future website projects currently being considered:

1. The addition of a FAQ page regarding the TC, Noise and Vibration.
2. The addition of a private online forum for TC member discussion and notification.

Attachment 6:

Standards Subcommittee – Lauren Ronsse

ASHRAE TC 2.6 Standards Subcommittee Meeting Minutes

4:00 – 4:30 PM, Sunday, June 26, 2011

Peribonka (Convention Level), Fairmont, Montreal, QB

Submitted by: Lauren Ronsse

1. Meeting called to order
2. Discussion Points
    a. Subcommittee Goal: Develop sound & vibration control content for new ASHRAE standards consistent with existing ASHRAE documents
        i. ASHRAE Handbook (2011 Applications Handbook) and Performance Measurement Protocol (PMP) document
        ii. Designate liaisons to SPCs and WGs to accomplish this goal
    b. ASHRAE Standard 189.1: Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings (Ronsse)
        i. Update from Chair of IEQ WG 8 (Persily)
        ii. TC 2.6 Designated Reviewers: Kevin Gaghan, Jerry Lilly, Stuart McGregor, Erik Miller-Klein, Karl Peterman, Ken Roy
            1. NOTE: Others may join if desired. Send email to Lauren Ronsse (ronsse.lauren@gmail.com) if interested.
            2. Reviewers provided comments to IEQ WG 8 on two acoustics proposals (Peterman)
        iii. Developing proposed sound & vibration control content for standard
            1. Exterior to Interior Sound Isolation (Miller-Klein)
            2. Interior Sound Isolation (Lilly)
            3. Interior Background Sound Control (Peterman / Gaghan)
            4. Interior Room Acoustics and Reverberation Control (Roy)
        iv. Tentative Timeline
            1. Submit to TC 2.6 for comments by August 30, 2011

a. Draft will also be submitted to A. Persily for informal feedback. Persily will provide feedback on wording and what items to submit as separate proposals.
2. Submit to TC 2.6 for vote by September 30, 2011
3. Submit to IEQ WG by October 15, 2011

v. Anyone may sign-up for the Standard 189.1 listserve to get updates

c. ASHRAE Standard 189.2: Design, Construction and Operation of Sustainable High Performance Health Care Facilities (Babineau)
   i. This standard is currently under development. The standard will be similar to Standard 189.1, but will specifically target issues related to health care. The first draft should be out for public review next year.
   ii. The TC 2.6 Standard 189.1 subcommittee will submit any acoustics issues specific to health care for inclusion in Standard 189.2. This should be completed within one year. **Additional volunteers welcome to assist with this effort.**

3. Active Committees: TC 2.6 liaisons provided brief reports during TC 2.6 main meeting.
   a. SPC 79: Method of Testing for Fan-Coil Units (Patrick Oliver)
   b. SPC 130: Method of Testing for Rating Ducted Air Terminal Units (Patrick Oliver)
      i. Incorporating end reflection into method of test
   c. SPC 189.1: Design for High Performance Green Buildings (Lauren Ronsse)
   d. SPC 197: Method of Test for Passive Vibration Isolators (Karl Peterman)
      i. Developing method of test for vibration isolators, particularly above 100 Hz based on ISO Standard
   e. SPC 200: Method of Test for Chilled Beams (Randy Zimmerman)
   f. Performance Measurement Protocol (PMP) Best Practices document (Curt Eichelberger)

i. This document is intended to target building owners. The final document should be published by the end of the year.
ii. 60% draft is currently up for review

4. ASHRAE documents referencing sound & vibration control
    a. ANSI/ASHRAE. 2010. Ventilation for acceptable indoor air quality. *Standard* 62.1-2010.
    b. ANSI/ASHRAE. 2010. Ventilation and acceptable indoor air quality in low-rise residential buildings. *Standard* 62.2-2010.
    c. ANSI/ASHRAE. 1997. Laboratory method of testing to determine the sound power in a duct. *Standard* 68-1997.
    d. ANSI/ASHRAE. 2006. Method of testing for rating the performance of air outlets and inlets. *Standard* 70-2006.
    e. ANSI/ASHRAE. 2008. Method of testing for rating ducted air terminal units. *Standard* 130-2008. (Oliver)
    f. ANSI/ASHRAE. 2008. Method of test of seismic restraint devices for HVAC&R Equipment. *Standard* 171-2008.
    g. ANSI/ASHRAE. 2009. Standard for the design of high-performance green buildings except low-rise residential buildings. *Standard* 189.1-2009.
    h. ASHRAE. Interactions affecting the achievement of acceptable indoor environments. *Guideline* 10P. (Wang)
5. Meeting adjourned.

Attachment 7:

Liaisons – Lauren Ronsse

ANSI Liaison Report to ASHRAE TC 2.6

Date: June 27, 2011
Submitted by: Lauren Ronsse

Active Working Groups (Select)

S1/WG01 Standard Microphones and their Calibration
Active
(Parallel to IEC/TC29/WG5 and IEC.TC 28/WG 8) – Revision of S1.10-1966(R 1986) Method for the Calibration of
Microphones and S1.12-1967 (W 2001) Specification for Laboratory Standard Microphones
Chair, S1/WG01 V. Nedzelnitsky

S1/WG04 Measurement of Sound Pressure Levels in Air
Active
To revise the current Annex A: Identification and evaluation of prominent discrete tones (Character of the sound) to bring it into consistency with the more up-to-date prominent tone procedures recently published in ECMA-74.
Chair, S1/WG04 VACANT
Vice-Chair, S1/WG04 E. Dunens

S2/WG06 Vibration and Shock Actuators
Active
This WG will monitor workings of ISO TC 108 SC 6, develop standards that relate to vibration generating systems including: electrodynamic, electropneumatic, mechanical generating systems (exciters), shock generating machines, and standards that provide guidance for use and selection of these systems.
Chair, S2/WG06 G.B. Booth

S2/WG07 Acquisition of Mechanical Vibration and Shock Measurement Data
Active
Development of standards for the acquisition of data related to mechanical vibration and shock measurements.
Chair, S2/WG07 B.E. Douglas

S2/WG10 Measurement and Evaluation of Machinery for Acceptance and Condition
Active
The development of standards and standardized terminology for the measurement, analysis, and evaluation of machinery for the purposes of acceptance and condition assessment. This measurement, analysis, and evaluation activity generally applies to the mechanical vibration, balance, structural integrity, and the electrical, thermal and tribology-related properties of machinery. The standardization includes the measurement instrumentation, evaluation procedures, and acceptance criteria related to the balancing, condition monitoring, acceptance testing, diagnostics, life usage, fault analysis, and prognosis of machinery.
Chair, S 2/WG10 R.L. Eshleman

S2/WG39 Human Exposure to Mechanical Vibration and Shock
Active
Standardization in the field of shock, vibration and related biodynamic environments with regard to health, safety, performance and comfort criteria and guidelines regarding the effects of occupational and non-occupational exposures on the human population (environments of primary interest are: vibration, rotational oscillations, shock and impact transmitted to the whole-body or parts thereof). Preparation of standard terminology and characterization of the biodynamic properties of humans with and without support and restraint devices by means of biodynamic models or analogues is also included as a basis for the description of the physical, behavioral and physiological effects of the mechanical environments under consideration.
Chair, S2/WG39 D.D. Reynolds

S12/WG03 Measurement of Noise from Information Technology and Telecommunications Equipment
Active
(parallel to ISO/TC 43/ SC1/WG23) - Development of procedures for measurement and evaluation of noise emitted from
Information Technology and Telecommunications Equipment and their component noise sources.
Chair, S12/WG03 K.X.C. Man

S12/WG15 Measurement and Evaluation of Outdoor Community Noise
Active
To produce a series of Standards for outdoor environmental noise that deal with: (1) definitions and nomenclature, (2)
measurements including both short-term measurements and long-term monitoring, etc., (3) modeling of environmental
noise, (4) quantitative evaluation of the effects of environmental noise such as annoyance, complaints, sleep disturbance,
disturbance by noise-induced vibration and rattles, and (5) compatible land use planning with respect to noise.
Chair, S12/WG15 P.D. Schomer

S12/WG44 Speech Privacy
Active
To develop standards and guidelines for the design and evaluation of speech privacy in health care facilities.
Chair, S12/WG44 G.C. Tocci
Vice-Chair, S12/WG44 D.M. Sykes

S12/WG51 Procedure for Measuring the Ambient Noise Level in a Room
Active
Develop a new standard that will specify how to conduct ambient noise measurements in a room, including: instrumentation
requirements, microphone placement, duration of each measurement, identification of specific noise sources (e.g., HVAC,
lighting, electrical, exterior traffic and aircraft), and data reduction and analysis.
Chair, S12/WG51 J.G. Lilly

S12/L5 ASTM E-33 on Environmental Acoustics
Active
The development of standards on the characteristics and performance of materials, products, systems, and services relating to the acoustical environment and the promotion of related knowledge (to include the activities of ASTM E33.06 on Building Acoustics, parallel to ISO/TC 43/SC2 and ASTM E33.09 on Community Noise).
Chair, S12/L5 K.P. Roy

S12/L8 ASME PTC 36 Measurement of Industrial Sound
Active
The object of PTC 36 is to describe procedures for measuring and reporting airborne sound emission from stationary sound sources and equipment, or from facilities composed of multiple stationary sound sources. The scope includes procedures to determine compliance with specified acoustical criteria in a variety of acoustical environments, including outdoor settings influenced by ambient sound. Generally, sound pressure levels and/or sound power levels in prescribed frequency bands are used to quantify the sound emission of industrial equipment and facilities. Sound pressure level measurements or sound intensity measurements may be used to calculate sound power level.
Chair, S12/L8 R.A. Putnam

Current ANSI Standards (Select)

- **ANSI S1.13-2005 (R 2010)** American National Standard Measurement of Sound Pressure Levels in Air.
- **ANSI/ASA S1.18-2010** American National Standard Method for Determining the Acoustic Impedance of Ground Surfaces. *(Revision of ANSI S1.18-1999).*
- **ANSI S2.8-2007** American National Standard Technical Information Used for Resilient Mounting Applications.
- **ANSI S2.71-1983 (R 2006)** American National Standard Guide to the Evaluation of Human Exposure to Vibration in Buildings (*Reaffirmation and redesignation of ANSI S3.29-1983*).
- **ANSI S12.1-1983 (R 2006)** American National Standard Guidelines for the Preparation of Standard Procedures to Determine the Noise Emission from Sources.
- **ANSI/ASA S12.2-2008** American National Standard Criteria for Evaluating Room Noise.
- **ANSI S12.3-1985 (R 2006)** American National Standard Statistical Methods for Determining and Verifying Stated Noise Emission Values of Machinery and Equipment.
- **ANSI S12.7-1986 (R 2006)** American National Standard Methods for Measurements of Impulse Noise.
- **ANSI/ASA S12.8-1998 (R 2008)** American National Standard Methods for Determining the Insertion Loss of Outdoor Noise Barriers.
- **ANSI S12.9/Part 1-1988 (R 2003)** American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 1.
- **ANSI/ASA S12.10-2010/Part 1** American National Standard Acoustics - Measurement of Airborne Noise Emitted by Information Technology and Telecommunications Equipment - Part 1: Determination of Sound Power Level and Emission Sound Pressure Level
- **ANSI/ASA S12.11/Part 1-2003 (R 2008) / ISO 10302:1996 (MOD)** American National Standard Acoustics – Measurement of noise and vibration of small air-moving devices – Part 1: Airborne noise emission. (Modified Nationally Adopted International Standard*).*
- **ANSI/ASA S12.11/Part 2 – 2003 (R 2008)** American National Standard Acoustics – Measurement of Noise and Vibration of Small Air-Moving Devices – Part 2: Structure-Borne Vibration.
- **ANSI/ASA S12.16-1992 (R 2007)** American National Standard Guidelines for the Specification of Noise of New Machinery.
- **ANSI S12.23-1989 (R 2006)** American National Standard Method for the Designation of Sound Power Emitted by Machinery and Equipment.
- **ANSI/ASA S12.60/1-2010** American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1: Permanent Schools.
- **ANSI/ASA S12.60/2-2009** American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 2: Relocatable Classroom Factors.
- **ANSI S12.65-2006** American National Standard for Rating Noise with Respect to Speech Interference.

Attachment 8:

Criteria Subcommittee – Lily Wang

Members present: S. Campbell, N. Campbell-Kyureghyan, C. Eichelberger, S. Elkhazin, M. Fly, E. Garces, J. Gierzak, L. Goodfriend, R. Hassler, M. Keating, J. Kline, D. Laforgia, S. Lau, P. Marks, H. Mattoclas, G. Meeuwsen, A. Mitchell, P. Oliver, K. Osborn, K. Peterman, D. Reynolds, L. Ronsse, K. Roy, J. Wang, L. Wang, S. Wise

SCOPE OF COMMITTEE

- The members present discussed the scope/purpose of this committee. The following statement was found to be acceptable by the majority of those present:
  - "To define and promote **measurement protocols** and **benchmarks/guidelines/criteria** to evaluate building acoustics, as related to building mechanical systems"

- Other discussion focused on what are the guidelines for acceptability? Also who is the target market? Criteria are listed in ASHRAE Applications Chapter 48, but HVAC design engineers are generally just looking at tables, and the acoustical community uses it as a desk reference. Perhaps we should be aiming at specifiers or educators/textbook authors.

ACOUSTIC CRITERIA IN APPLICATIONS HANDBOOK

- A brief quiz was conducted to review the current material on acoustic criteria in 2011 ASHRAE Applications Handbook Ch. 48 on "Noise and Vibration Control"

Q1) Table 1 "Design Guidelines for HVAC-Related Background Sound in Rooms" lists which criteria methods?

Answer: NC/RC, dBA, dBC

Q2) Table 1 lists a single value … what does that value mean?

Answer: Not maximum, not ideal, but the "general limits of acceptability for typical building occupancies", the recommended goals… "each number rating typically represents a range of +/- 5 dB for the design target"

Other Feedback: Does this need more research here? In litigious society, a range may not be suitable ... but maybe not appropriate for ASHRAE to set legal absolutes

Q3) Which criteria rating methods are described in the text?

Answer: dBA/dBC, NC, RC Mark II (RC only briefly), NCB, RNC

Q4) What is provided in Table 4 “Comparison of Sound Rating Methods”

Answer: Overview, Considers Speech Interference Effects, Evaluates Sound Quality, Components Presently Rated by Each Method

Other Feedback: No mention of design versus diagnostics versus commissioning?

- The committee discussed the current material in the Handbook plus what is missing and/or what could be changed:
  - More differentiation between design versus diagnostics versus commissioning rating methods
  - Inclusion of RNC because ANSI S12.2-2008 includes it, but it really isn’t used
  - RC Mark II discussed much more prevalently than RC ... it’s not meant to be a design tool, though, and perhaps this needs to be clarified even more
  - NCB in chapter does not match what is in other published documents (ANSI S12.2-2008) ... but ‘new’ NCB requires low frequency data that is not currently available
  - Consider listing minimum sound levels? Also address speech privacy issues more directly
  - Mention of measurement protocols?

RESEARCH

- Tones continue to be a research topic of interest in the TC 2.06 Research Subcommittee... J. Wang stated that customers often complain about tones from equipment.

- Currently a number of methods exist to quantify tonality:
  - Prominence Ratio (PR) and Tone to Noise Ratio (TNR), both in ANSI S1.13-2005
  - Aures Tonalness Metric
  - Annex D of ISO Standard 1996-2 (2007): 1/3 octave band method
  - Appendix D of ANSI/AHRI Standard 1140 (2006) provides sound power level penalties in dB for tones in assorted 1/3 octave bands (source of data?)

- A subcommittee will work on developing an RTAR on Tones
  - ASHRAE Research Project RP 1322 only tested tones with PR 5 or 9 ... should next include tones with PR from 9 to 18, which are listed as the limits of acceptability in the current ANSI S1.13-2005 standard.
  - Perhaps consider looking at a simplified 1/3 octave band method as in Annex D of ISO Standard 1996-2 (2007); but such a method could miss the severity of a tone if its frequency is just between two 1/3 octave bands
  - C. Eichelberger urged the committee to keep it realistic, and to get input from equipment manufacturers of what is feasible. There’s always tones in the acoustic signature; it’s just how much those tones manage to get masked. Also pointed out

were more modern problems, especially electronic control motor (ECM), and switching frequencies on variable frequency drives (VFDs).
    - Maybe we should push towards using FFT analysis, though, because the availability of programs that can conduct FFT analysis (e.g. SLM's on smart phones) is certainly becoming more widespread.
    - Establish a closer connection to TC 2.01 for this research (e.g. to cosponsor)
    - Volunteers to draft include P. Marks, L. Wang, and possibly J. Lilly

OUTREACH TO STANDARDS/GUIDELINES

- The committee hopes to provide input on acoustical criteria to standards or guideline documents produced by ASHRAE or other groups, such as:
    - Proposed changes to the International Code Council's "Green Construction Code"
    - ASHRAE Performance Measurement Protocols (PMP) Best Practices Guide
    - ASHRAE Advanced Energy Design Guide for K-12 School Buildings

- One method is to assign a person as champion for each specific document, a person who maybe even participates on the standards committee/working group ... we will also coordinate with the TC 2.06 Standards Subcommittee.

SUMMARY OF ACTION ITEMS

ACTION ITEM	PERSON(S) RESPONSIBLE	PROPOSED DEADLINE
Update Handbook Chapter on Criteria • Design vs. diagnostics vs. commissioning • NCB to match ANSI S12.2-2008 • Include minimum sound levels; address speech privacy • Discussion of measurement protocols	Subcommittee to be assigned (possibly K. Peterman, R. Muehleisen, K. Roy, J. Lilly, C. Eichelberger)	For 2015 Applications Handbook
Develop RTAR on Tones	P. Marks, L. Wang, J. Lilly	December 1, 2011
Establish liaisons to appropriate standards/guidelines with acoustic criteria	L. Wang and L. Ronsse	Ongoing

Attachment 9:

Vibration Isolation
Subcommittee – Robert Simmons

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

1791 TULLIE CIRCLE, N.E.

ATLANTA, GA 30329

404-636-8400

TC2.6 VIBRATION ISOLATION SUBCOMMITTEE MEETING MINUTES

Monday, June. 27, 2011, 8-9:00am

Fontaine Salon E on Lower Level at Hilton

1. STANDARDS
SPC 197 – Method of Test (MOT) for Passive Vibration Isolators

- Karl Peterman/Robert Simmons - After much a few meetings discussing various options, it was felt that ISO 10846 was the closest cousin to what we are trying to accomplish. However, ISO 10846 was not written or tailored to the types of isolators or installations common to HVAC systems. As such some of it may be over kill and some parts unnecessary for our purpose. The committee determined that the standard scope would be essentially to provide a guide on the use if ISO 10846 (ISO 10846 "Lite"). First Draft was submitted by Bill Rockwood at the 6/2011 SPC 197 committee meeting. Review of the first draft was started and will be continued until the winter meeting.

5 RESEARCH
Research Topic Acceptance Request (RTAR)1560 – Acoustical Performance of Vibration Isolators

- The RTAR was returned with comments. At the last meeting in January 2011 the VI subcommittee discussed whether or not to continue pursuing this research project. It was a consensus of the committee that it was worthwhile research. In the meantime the RTAR had dropped off the ASHRAE "docket", and a new strategic research plan had been introduced, which changed the RTAR requirements. Robert Simmons re-wrote the RTAR to fit the new research strategic goals. The revised RTAR was reviewed by the VI subcommittee and discussed. The comments from the subcommittee review were to be incorporated into the revised RTAR by Robert. The VI subcommittee made a motion to the main TC2.6 meeting to approve the re-written and revised RTAR with comments from the VI subcommittee incorporated. The motion was approved. Attached is a copy of the RTAR. When re-submitted, the 1560# is dropped and a new one will be assigned.

6 PUBLICATIONS

Applications Chapter

There were a few changes that were missed in the final printing of the VI Table. Also a user of the chapter found an error. Steve Wise will send the errors that need to be reviewed and corrected by Robert and Karl. Steve to coordinate with publications.

7 Adjourn

Attachment 9a:

RTAR Form – Robert Simmons

Unique Tracking Number Assigned by MORTS _____ Formerly 1560 _____

RESEARCH TOPIC ACCEPTANCE REQUEST (RTAR) FORM

TC/TG: TC 2.6

Title:

Installed Performance of Vibration Isolators

Applicability to ASHRAE Research Strategic Plan:

The demand for high efficiency HVAC equipment has made the use of variable frequency drives and high speed equipment that create high frequency vibrations such as screw chillers more attractive. This equipment creates new technical challenges in the isolation of high-frequency noise and vibration from a building's structure. At the same time, building design specifications are increasingly emphasizing occupant comfort, and are employing more high tech equipment which require low vibration environments. Finally, new isolator technologies, some employing recycled materials for sustainability, are emerging. All of these factors present new challenges in HVAC &R system vibration isolation design. Addressing these will require greater understanding of the installed isolator performance across a broad range of vibration frequencies. Current building comfort and high tech needs for ~~high frequency~~vibration isolation require better understanding of dynamic characteristics of vibration isolators than presently exists. High frequency vibration poses a particular problem because even though current industry standard isolators should theoretically provide effective isolation, actual installed performance has proven to fall short. This project will provide the ASHRAE community with methods of testing isolator performance, and provide a basis for the development of advanced test standards~~metrics~~, which will be essential to adequately isolate HVAC&R systems to meet background sound and vibration criteria.

The project will address the following goals defined in ASHRAE's 11 goals of the updated ASHRAE Research Strategic Plan 2010-2015 (Navigation for a Sustainable Future):

GOAL 2: Progress toward Advanced Energy Design Guides (AEDG) and cost-effective net-zero-energy (NZE) buildings.

Objectives *... be economically practical....*

Technical Challenges: *Complexity and interaction among building subsystems represents an essential challenge...*

How this research will contribute to this goal:

As equipment and building methods incorporate AEDG, the nature and level of vibration that result will introduce new problems to meeting established noise criteria. Because there is limited understanding in reducing this vibration induced noise, the selected isolation system may be overdesigned and more costly than required. Noise creates tenant complaints, which creates costly bad will for owners which costs them time and money to fix. If implementing AEDG is perceived as too noisy and the cost to fix it is high, then a barrier to AEDG implementation exists. This research will provide needed data to enable lowest cost standard isolation products to be used. Thus avoiding a potential cost problem to AEDG.

Goal 4: Significantly advance our understanding of the impact of indoor environmental quality (IEQ) on work performance, health symptoms and perceived environmental quality in offices, providing a basis for improvements in ASHRAE standards, guidelines, HVAC&R designs and operation practices.

Objectives: *...2nd priority – desirable to address: Quantify the impact of particle and/or gas-phase air cleaning, noise levels and other IEQ conditions or control measures on*

- *high level cognitive, e.g., decision making, performance (highest priority);*
- *speed and accuracy of simulated office work tasks, e.g., proof reading, typing;*
- *perceived indoor environmental quality (PIEQ); and*
- *acute building-related health symptoms.*

Technical Challenges: *…. In most buildings, the major purpose of HVAC&R is to provide acceptable IEQ that maintains the comfort, satisfaction, health, productivity and promotes the education of the building's occupants ….dimensions of IEQ are… acoustic and vibration conditions …. Of these, ASHRAE has …* ***significant impact on acoustic and vibration conditions.***

How this research will contribute to this goal:

Recognizing vibration induced noise problems have an impact on perceived environmental quality, it is important to quantify the performance of isolation systems. This research will provide needed data to enable designers to select standard isolation systems with confidence to help meet IEQ goals.

Goal 7:Support development of tools, procedures and methods suitable for designing low-energy buildings.

Objectives: *…improve the capabilities of engineers to design low energy buildings, by increasing the usability, capability and accuracy of existing tools and developing new tools where needed.*

Technical Challenges: *Design engineers use a variety of tools…currently available tools often do not provide analysis for the innovative features that are utilized, nor do they support design except in an inefficient trial-and-error fashion.*

How this research will contribute to this goal:

One of the objectives will be to develop an equation tool to calculate isolator effectiveness associated with the testing that can be used by ASHRAE members. This would be a new tool that better evaluates varied types of isolators across a wide frequency rage.

Goal 9:Support the development of improved HVAC&R components ranging from residential through commercial to provide improved system efficiency, affordability, reliability and safety.

Objectives: *The improvement of HVAC&R components is a continuous, never ending process, with the current state-of-the-art…There will continue to be opportunities for component improvements…*

Technical Challenges: *Specific shortcomings that need to be addressed include the following:*

1) *There is a general lack of knowledge when it comes to seismic and wind restraints for HVAC&R equipment….*

How this research will contribute to this goal:

Seismic and wind restraint tend to "short out" classic spring isolators. Presently there is no way to quantify the resulting reduction in isolation performance. This research will help provide a means to evaluate alternative isolation materials that may provide improved vibration isolation, shock absorption, and damped displacement.

Goal 10: Significantly increase the understanding of energy efficiency, environmental quality and the design of buildings in engineering and architectural education.

Objectives: *…engineering and architectural education is where concepts and principles of building systems and design are taught …fostering successful… engineers and architects. However, the two disciplines seldom reach across departments, interact within the curriculum or collaborate on research projects*

…4) Train engineering and architecture faculty with the latest knowledge, resources and tools

Technical Challenges: *One difficulty in incorporating new ideas into engineering/architecture programs is lack of time…. Another obstacle to change is the "disconnect" between higher education and professional practice. Designers lack clear guidance on the direction of design decisions.*

How this research will contribute to this goal:

This research will attempt to capture some of the complex analysis done at the academic level and sift I down to a usable test method and equation that can be used by practicing engineers. Information from this research will be summarized and included in the Sound and Vibration Control Chapter 48 which is used in engineering education.

Research Classification:
Basic/Applied Research

TC/TG Priority:
(1)

TC Vote:
(For = 17, Against = 0, Abstentions = 0)

Reasons for Negative Votes and Abstentions:
N/A

Estimated Cost:
($150,000)

Estimated Duration:
(18 months)

RTAR Lead Author
Robert Simmons, VP Engineering
Petra Seismic Design
rsimmons@petraseismicdesign.com

Expected Work Statement Lead Author
Same.

Other Interested TC/TGs:
TC2.7 has reviewed and endorses approval of this RTAR. ~~The expected lead for this project is a voting member of TC2.7.~~

Possible Co-funding Organizations:
VISCMA (Vibration Isolator and Seismic Control Manufacturer's Association) will be solicited for co-funding during WS preparation.

Application of Results:
Results will significantly improve the Applications Handbook Chapter. 48, Sound & Vibration Control, sections on vibration isolation. For the first time ~~, information on the high frequency performance of isolators will be available to building designers~~ there will be a test method that designers can reference to confidently predict installed performance. In addition the test method would provide data that could be used to predict installed performance of emerging isolator materials (new elastomers, spring material, wire rope, air springs, etc). SPC 197 is currently developing a beta test method that will be ready by the time this research project is started. The research project will verify and/or revise the test method. This project is to research and verify the method of test. In particular, we need to investigate the affect that the test rig has on the accuracy and reliability of test results. Will the mass and stiffness of the specimen mounted on the isolators change the results? How much mass and stiffness will be needed in the support foundation to insure the results are not compromised. It is not currently known what minimum rig criteria and test method is required to provide reliable isolation characteristic testing that can be used by engineers, contractors or others in the construction industry.

State-of-the-Art (Background):
Vibration isolators are commonly used to prevent the transmission of equipment vibration into buildings. There are many types of isolators in use today (springs, elastomeric and fiberglass mounts, elastomeric and cork pads, wire rope, etc.) , but none of the commercially available products have been tested to determine their effectiveness over a wide range of frequencies. 'Classical' vibration isolation theory can only be used to estimate isolator performance in the low frequency region – at frequencies less five to ten times the fundamental resonance frequencies of the isolated equipment. It is well known that structural resonances both internal and external to the isolators themselves can significantly degrade their performance at high frequencies. However there is little understanding of how some frequencies, especially high frequencies, pass through standard isolators and into the structure. Performance issues have been identified when isolators have been installed following the current recommendations in the ASHRAE Handbook, Chapter 48. As an example, screw chillers mounted on spring isolators as recommended in the table 48~~7~~ experience serious vibration transmission through the isolators to the structure, resulting in objectionable noise. ~~These depend on the materials used in and the construction of the isolators.~~ Unfortunately, at present no test standard for measuring the ~~high frequency~~ dynamic properties of isolators exists. This is due to difficulties in measuring the key parameters for each translational and rotational degree of freedom involved. Further, the process of translating isolator dynamic characteristics, along with those of the structures to which they are attached, into an analytical model of high frequency isolation effectiveness requires complex analytical techniques with which the HVAC community has limited experience. In short there is no test standard available to the HVAC& R community that can be referenced to help a designer or user predict how affective an isolator will perform at high frequencies or how new type of isolator will perform over a broad range of frequencies. As a result designers/users often resort to more expensive isolation systems as a "catch all" without any means to predict the installed performance of standard isolators. Traditional

isolation methods that should theoretically work for equipment such as screw chillers and transformers (springs and rubber mounts) are not working in many cases. This has introduced a need to develop a test that can be used to predict if a particular isolator will provide the necessary isolation. There are also new elastomers and alternate materials available in the industry that do not necessarily fit the current simplified isolation calculation methods. So, a test method is needed to allow the industry to obtain better information regarding the isolator efficiency at all frequencies.

Advancement to the State-of-the-Art:

Because of the complex nature of how different test setups affect the results of isolator performance measurements, research is needed to determine the most appropriate test method. As an example, the effect that the test substructure has on the performance data is uncertain, and needs research to determine minimum criteria required for accurate testing. This research is not product testing. It is analysis of test methods and application to common building systems ~~to~~ so that a ~~common~~ standard method of test can be developed. Without research into test methods, there will be no way to verify if any product testing that may be done by a manufacturer is an accurate reflection of installed performance of an isolator, and there will be no consistency or confidence in any performance test data supplied by a manufacturer. This project will measure the a broad range of frequencies, including high frequency performance of various commonly used isolator types, as applied in several typical applications (see below). The results will quantify the effectiveness of vibration isolation test methods over a wide frequency range, and will highlight the implications of how the various isolator types are used. In the process, the limitations of 'classical' isolation theory will be clearly demonstrated. This is particularly important today because of the continued vibration problems reported for equipment such as screw chillers, vane-axial fans, VFD's and transformers. These devices generate high frequency tones which often generate unacceptable noise in occupied spaces due to inadequate vibration isolation. ~~Findings from this project will shed light on the potential benefits of alternative vibration isolators in troubleshooting applications.~~ In addition, key benchmark data will be obtained which could provide the basis for a potential follow-on project: to develop an isolator dynamic property measurement procedure, and analytical modeling techniques, for vibration transmission across a broad range of frequencies.

Justification and Value to ASHRAE:

Effective vibration isolation is an essential component of a growing class of high technology and increasingly flexible buildings structures. The present lack of information related to vibration isolation will become an increasingly significant impediment to effective building design. This project will provide valuable test data which will address that present and future need. The results will be incorporated in the ASHRAE Handbook Chapter 48 guidelines for selecting more cost effective vibration isolators.

Objective:

This project is for developing a test procedure. It is not meant to test specific products. We would have the successful bidder obtain generic isolators to use in researching the test method. It would be similar to the recent shaker table test sponsored by TC2.7 and co-funded by ASHRAE at MCEER(1323 RP). The isolators used for that project were generic, so that no particular manufacturer benefited unfairly. The proposed research project involves the measurement of vibration isolation effectiveness of various common isolator types in various configurations representative of a typical equipment installation. The contractor will fabricate a test system consisting of an upper structure (representing the HVAC equipment), isolators, and a support structure (representing the building floor). The assembly must be capable of varying the size and construction of the upper structure, the type and stiffness of the isolators, and the type and construction of the supporting structure. The size and weight of each type will be chosen to represent corresponding typical HVAC equipment. The types of isolators to be tested will be spring, elastomeric mount, combination spring and elastomeric mount, elastomeric pad, and wire rope. A full matrix of required test configurations will be developed as part of the Work Statement.

Both the Transmission Loss (the ratio of above mount to below mount vibration) and Insertion Loss (the ratio of hard-mounted to isolated vibration of the supporting structure) will be measured for each configuration. Data will be obtained across the frequency range from 10 to 2000 Hz. This will be accomplished by creating a special purpose test rig excited by two random vibration shakers. This capability exists in many mechanical engineering laboratories.

Key References:

ISO 10846-3:2002
Laboratory measurement of vibro-acoustic transfer properties of resilient elements – Part 3: Indirect method for determination of the dynamic stiffness of resilient supports for translatory motion.

ISO 10846-4:2003
Laboratory measurement of vibro-acoustic transfer properties of resilient elements – Part 4: Dynamic stiffness of elements other than resilient supports for translatory motion.

ISO 2017-1:2005
Mechanical vibration and shock – Resilient mounting systems – Part 1: Technical information to be exchanged for the application of isolation systems.

A Practical Guide to Noise and Vibration Control for HVAC Systems – Second Edition 2005 by Mark E. Schaffer

NOISE AND VIBRATION CONTROL – 1971, Edited by Leo L. Beranek

Attachment 9b:

RTAR 1560 Response to Comments – Robert Simmons

ASHRAE TC 2.06
Sound and Vibration Control
Vibration Isolation Subcommittee

January 16, 2012

Michael Vaughn, P.E.
Manager of Research and Technical Service
ASHRAE
1791 Tullie Circle, NE
Atlanta, GA 30329-2305

RE: RPS Review Comments for RTAR #1560, "Installed Performance of Vibration Isolators"

Dear Mr. Vaughn:

Per your request we have reviewed the comments returned by RPS and offer the following response and explanation.

1. The RTAR doesn't make clear why this is really research instead of product testing. Need clarification. This project is to research and verify the method of test. In particular, we need to investigate the affect that the test rig has on the accuracy and reliability of test results. Will the mass and stiffness of the specimen mounted on the isolators change the results? How much mass and stiffness will be needed in the support foundation to insure the results are not compromised. It is not currently known what minimum rig criteria and test method is required to provide reliable isolation characteristic testing that can be used by engineers, contractors or others in the construction industry.

2. Is high frequency transmission really so poorly understood? Yes. Traditional isolation methods that should theoretically work for equipment such as screw chillers and transformers (springs and rubber mounts) are not working in many cases. This has introduced a need to develop a test that can be used to predict if a particular isolator will provide the necessary isolation. There are also new elastomers and alternate materials available in the industry that do not necessarily fit the current simplified isolation calculation methods. So, a test method is needed to allow the industry to better information regarding the isolator efficiency at all frequencies.
3. How much of this is designing a test procedure vs. testing specific products? Do we need to develop a method of test before evaluating products? This project is for developing a procedure. It is not meant to test specific products. We would have the successful bidder obtain generic isolators to use in researching the test method. It would be similar to the recent shaker table test sponsored by TC2.7 and co-funded by ASHRAE at MCEER (1323-RP). The isolators used for that project were generic, so that no particular manufacturer benefited unfairly. SPC 197 is currently developing a beta test method that will be ready by the time this research project is started. The research project will verify and/or revise the test method.

We have incorporated the above into the revised RTAR. Please see highlighted in attached.

Yours very truly,

Robert E. Simmons, PE
TC2.6, Vibration Isolation Subcommittee Chair

Enclosure:
cc: