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:	January 23, 2012
TC/TG/TRG TITLE:	Sound and Vibration Control		
DATE OF MEETING:	January 23, 2012	LOCATION:	Chicago, IL

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
VOTING		CORRESPONDING		Christopher Ainley
Francis Babineau		Mark Bastasch		Mathew Blevins
E Curtis Eichelberger		Joseph Bridger		Mike Brendel
John Gierzak		Norman Broner		Joe Brooks
Robert Hassler		Todd Busch		Franco Cincotti
Siu-Kit Lau		John Dunlap		James Cottrell
Robert Lilkendey		Erroll Eaton		Nicole Cuff
Jerry Lilly		Ronald Eligator		Blake Erb
Dustin Meredith		Michael Froehlich		Dennis Flores
Patrick Oliver		Jason George		Andrew Hathaway
Kim Osborn		Lewis Goodfriend		Scott Hobbs
Chris Papadimos		Ali Kemal Guney		Larry Hopkins
Douglas Reynolds		Arthur Hallstrom		Chad Huggins
Kenneth Roy		Joseph Horesco		John Iacobellis
Robert Simmons		Reginald Keith		Joshua Kading
Jason Swan		Manoj Khati		Scott Kurszewski
Randal Zimmerman		James Kline		Tim Mathson
		Marvin Kloostra		Paul Meisel
CORRESPONDING		Glenn Kowald		Emanuel Mouratidis
Daniel Abbate		Dan LaForgia		John Murphy
David Carroll		Heng-Yi Lai		Ellen Peng
Zvirimumwoyo Chinoda		Brian Landsberger		Dan Rau
Mark Fly		Joshua Leasure		Brian Reynolds
Radha Ganesh		H Leventhall		Nate Sevener
Brian Guenther		Charles Mattocks		Luis Villeqas
Michael Keating		Duane McLennan		Gregory Wagner
Patrick Marks		Alexander Michaud		Don Warick, Jr.
Erik Miller-Klein		Andrew Mitchell		Kasey Worthington
Ralph Muehleisen		Jose Nepomuceno		
Karl Peterman		John Pappas		
Raj Prime		James Pooler		Distribution
Lauren Ronsse		Michael Resetar		All Members of the TC/TG/TRG
Mark Schaffer		William Rockwood		TAC Section Head: Thomas Sobieski
Michael Schwob		Erica Ryherd		TAC Chair: Charles Culp
Lily Wang		Benjamin Sachwald		All Committee Liasions: Jean-Gabriel
Zhiping Wang		Ken Shook		Joannette, William McCoy, John Nix, William
Jack Wang		Tim Simcoe		Fleming, Jeff Traylor, Hoy Bohanon
Steven Wise		John Sofra		
		Michael Spencer		
		William Stewart		Manager of Standards: Stephanie Reiniche
MEMBERS ABSENT		Nicholas Sylvestre-Williams		
VOTING		Vijay Tripathi		Manager of Research & Technical Services:
Kevin Gaghan		Terence Tyson		Michael Vaughn
Matthew Murello		Jonathan Weinstein		
Richard Peppin				
Matthew Stead				

ASHRAE TC 2.6 Sound and Vibration Control
Main Committee Meeting Minutes
Monday, January 23rd, 2012, Chicago IL

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	sklau@engineer.com
Robert Lilkendey	Siebein Associates Inc	rlilkendey@siebeinacoustic.com
Jerry Lilly	JGL Acoustics Inc	jerry@jglacoustics.com
Dustin Meredith	Trane	dmeredith@trane.com
Patrick Oliver	EH Price Ltd.	patricko@price-hvac.com
Kim Osborn	CES Group / Governair LLC	kosborn@governair.com
Chris Papadimos	Papadimos Group	cpapadimos@papadimosgroup.com
Douglas Reynolds	Univ Of Nevada Las Vegas	douglas.reynolds43@gmail.com
Kenneth Roy	Armstrong World Industries	kproy@armstrong.com
Robert Simmons	Petra Seismic Design	res@seismic-source.com
Jason Swan	Sandy Brown Associates	jasons@sandybrown.com
Randal Zimmerman	Titus	rzimmerman@titus-hvac.com

Corresponding Members:

Daniel Abbate	AHRI	dabbate@ahrinet.org
David Carroll	Morrison Products Inc	dcarroll@morrisonproducts.com
Zvirimumwoyo Chinoda	Hartzell Air Movement	pchinoda@hartzell.com
Mark Fly		mfly@cox.net
Radha Ganesh	Twin City Fan Companies	rganesh@tcf.com
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Patrick Marks	Johnson Controls	patrick.c.marks@jci.com
Erik Miller-Klein	SSA Acoustics, LLP	erik@ssaacoustics.com
Ralph Muehleisen	Argonne National Lab	rmuehleisen@anl.gov
Karl Peterman	Vibro-Acoustics	kpeterman@vibro-acoustics.com
Raj Prime	Mason Industries	rprime@mason-ind.com
Lauren Ronsse	US Army ERDC-CERL	ronsse.lauren@gmail.com
Mark Schaffer	Schaffer Acoustics Inc	mark@schaffer-acoustics.com
Michael Schwob	JBA Consulting Engineers	mschwob@jbace.com
Lily Wang	University Of Nebraska	lwang4@unl.edu
Zhiping Wang	Morrison Products Inc	zpwang@morrisonproducts.com
Jack Wang	Trane	jjwang@trane.com
Steven Wise	Wise Associates	stevewise@att.net

Visitors:

Christopher Ainley	University of Nebraska-Lincoln	cainley@unomaha.edu
Mathew Blevins	University of Nebraska-Lincoln	mattblvns@gmail.com
Mike Brendel	Lau	mbrendel@laufan.com
Joe Brooks	AMCA International, Inc.	jbrooks@amca.org
Franco Cincotti	Comefri USA	fcincotti@comefriusa.com
James Cottrell	University of Nebraska-Lincoln	jcottrell07@yahoo.com
Nicole Cuff	Acentech Inc	ncuff@acentech.com
Blake Erb	Venmar CES	berb@venmarces.com
Dennis Flores	McGill Airflow, LLC	dflores@mcgillairfow.com
Andrew Hathaway	University of Nebraska-Lincoln	ahathaway@unomaha.edu
Scott Hobbs	McGill Airflow, LLC	shobbs@mcgillairflow.com
Larry Hopkins	Huntair, Inc.	lhopkins@huntair.com
Chad Huggins	Krueger	chuggins@airsysco.com
John Iacobellis	Vibration Eliminator Co., Inc.	johniac@veco-ny.com
Joshua Kading	REEL	joshuakading@tees.tamus.edu
Scott Kurszewski	Greenheck Fan Corp.	scott.kurszewski@greenheck.com
Tim Mathson	Greenheck Fan Corp.	tim.mathson@greenheck.com
Paul Meisel	Kinetics Noise Control	pmeisel@kineticsnoise.com
Emanuel Mouratidis	VAW Systems	emouratidis@vawsystems.com
John Murphy	Jogram, Inc.	jogram@bright.net
Ellen Peng	University of Nebraska-Lincoln	zpeng@unomaha.edu
Dan Rau	Ruskin Company	drau@ruskin.com
Brian Reynolds	Trane	breynolds@trane.com
Nate Sevener	Soundscape Engineering, LLC	nsevener@soundscapeengineering.com
Luis Villeqas	Metal Industries, Inc.	lvilleqas@metalaire.com
Gregory Wagner	Morrison Products Inc	gwagner@morrisonproducts.com
Don Warick, Jr.	Vibration Eliminator Co., Inc.	donjr@veco-ny.com
Kasey Worthington	Aaon, Inc.	kaseyw@aaoninc.com

ASHRAE TC 2.6 Sound and Vibration Control
Main Committee Meeting Minutes
Monday, January 23rd, 2012, Chicago IL

1. **Call to order (Oliver)**
   - Call to order by Patrick – 2:16 PM.
   - Additions and/or modifications to the agenda.
2. **Introduction of those present (All)**
3. **Confirmation of current voting members (Gierzak)**
   - 16 voting members present – constitutes a quorum.
4. **Review and approval of the prior meeting's minutes (Oliver)**
   - **Motion** by Doug, seconded by Mark: Approve the Montreal minutes
     - Passed unanimously
5. **Secretary's report (Meredith)**
   - Please provide all subcommittee reports on or by Friday, February 3rd.
6. **TC Chair's meeting report (Oliver)**
   - ASHRAE has gone through a rebranding: "Shaping Tomorrow's Built Environment Today" with a new logo.
     - A logo usage document will be included in the email that everyone should have received over the weekend.
   - The Hightower award recipient was from TC 5.9.
   - A need has been identified for existing best practices concerning operation and maintenance.
     - Surveys are due by February 15th. If interested, contact Patrick.
     - Note that one cannot speak for a TC without a TC-approved position statement.
   - The upcoming AEDG for hospitals closed December 2nd.
   - Getting seminars approved is apparently a widespread concern. The abstract quality is a major factor – the abstract needs to be clear and how it benefits society should be highlighted. It's recommended that the track chair be engaged to ensure the program fits within the track.
     - Deadlines:
       - San Antonio – February
       - Dallas - August (abstracts due March 19th).
   - ASHRAE is providing a new conference call hosting service – great for subcommittee meetings.
7. **Chair's announcements and correspondence (Oliver)**
     - Included above.
8. **Subcommittee reports**
   - **8.1. Research subcommittee (Eichelberger)**
     - 8.1.1. Research Chair's meeting report
       - Submissions of RTAR's are low - there's a concern we will run out.
       - Bill McCoy is our new research liaison.
     - 8.1.2. Ongoing research projects
       - 8.1.2.1. <u>RP-1322 Performance, Perception and Criteria with PI Wang/UNL (Schaffer)</u>

- Finished changes to the final report and submitted the report to the PMS. The PMS will review and submit to the voting members via letter ballot.

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

- Very late in getting started.
- Based on 10-foot lengths only.
- PMS is satisfied with test apparatus qualification.
- 80% of the testing (straight duct) will be complete by December of this year.
- A contract extension has been proposed: include intensity tests to validate some analytical models. These test results will be used in TRP-1529.

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

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

- Ready to bid. An RFP will be issued in the Spring of this year.

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

- Originally dropped due to inactivity. Robert has prepared a new draft that was sent to the TC members.
- Will review and if there's agreement, will send again to the TC as a letter ballot before San Antonio.

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

- Actually a work statement.
- Returned with comments. Ken will try to keep it moving along.
- Trying to confirm support from TC 2.1 and TC 9.6.
- Should be ready in a couple of months.

8.1.4. Topics for future research

- Curst started off by creating a list of nine topics that keep recurring.

8.1.4.1. #1 - Room effect (Keith)

8.1.4.2. #2 - Tones (Wang)

- Will schedule a 2-hour hot topic meeting on this in San Antonio.
- Will try to scope an RTAR.
- Hunter Maddox to prepare a 15 minute presentation of where we are today with this topic.
- A blog will be created on the TC's website. Please give any tone-related information to our webmaster.

8.2. Programs Subcommittee (Papadimos)

8.2.1. Programs Chair's meeting report

8.2.1.1. Nothing additional to report.

8.2.2. Programs this meeting:

- Note that we additionally submitted a forum that didn't get accepted.

8.2.2.1. Seminar #25: "Vibration Induced Noise and Mechanical Equipment Vibration Isolation, Balance and Predictive Maintenance" (Marks)

- The seminar was held today.
- Two speakers: one from Kinetics and one from JCI.

- About 70-80 people in attendance.
- Seemed to go well.

8.2.2.2. Others of interest to our TC:

- Seminar #20: "Back to Basics: Selection of Proper Chiller Technology"
- Forum #1: "How to Specify Seismic Certification" (TC 2.7)
- Seminar #39: "Comparison of Laboratory and Field Performance Testing and Rating of Fans" (TC 5.1)
- Technical Paper Session #7: "Effect of Typical Inlet Conditions on Air Outlet Performance" (TC 5.3)
- Conference Paper Session #26: "Natural Ventilation Impacts and Applications in Large Buildings"

8.2.3.Potential programs for upcoming meetings:

- San Antonio, June 2012:
  - Forum or seminar – due February 13th
    - Need to include learning objectives.
    - Forum: one moderator, 60 minutes in length
    - Seminar: 30 minutes for 1-2 speakers, 90 minutes for 3-4 speakers.
  - Aerodynamic Noise Effects (Schaffer)
    - Inlet aerodynamic conditions that affect noise.
    - Diffusers, VAV's, Fans, AHU's.
  - Test methods for updated AHRI standards (Papadimos)
    - AHRI 260 – Curt
    - AHRI 880 – Patrick
  - Acoustic measurement procedures (Peterman)
    - Three speakers:
      - Uncertainty - Peppin
      - European - Swan
      - New criteria - Peterman/Marks
- Dallas, January 2013:
  - Conference paper abstracts and technical paper sessions due April 16th.
  - Forums/Seminars are due in July.
  - Conference Paper Session – Numerical Techniques for Noise & Vibration of HVACR systems (Marks):
    - Jack Wang from Trane.
    - Two papers from UK.
  - Seminar – Green Building Acoustics (Ralph/Wang)
- Denver, June 2013 & New York, January 2014
  - After San Antonio, ASHRAE will start charging reduced fees for chairs and a $100 fee for presenters.
  - Looking to cosponsor with other TC's.
  - If interested, contact Chris.

- Other Ideas: Duct Breakout, Vibration Isolators, Fans for Acoustic Performance, etc…

- Other conferences of note:
  - The ASHRAE High Performance Buildings conference will be held March 12-13 in San Diego.
    - Call for posters through February 3rd.
  - The ASHRAE Energy Modeling conference will be held October 1-3.
    - Call for presentations through February 15th.
  - The ASHRAE Cold Climate conference will be held November 12-14 in Calgary.

8.3. Publications Subcommittee (Wise)

8.3.1. Handbook chapters

- A new, electronic version of the handbook may be coming soon. Need to start thinking about how to handle.
- Need to have some comments added relative to energy efficiency.
- Chris, Mark, & Pat have formed a group to formulate a game plan to broaden the usage for our publications consistent with ASHRAE's rebranding.

8.3.1.1. 2011 HVAC Applications Handbook (Wise/Peppin):

- The isolation table and the silencer section need to be revised.
- **Motion** by Steve, seconded by Jason Swan: The volunteers for vibration and silencers are free to correct in the next two weeks.
  - Yea: 14, Nea: 0, Abstain: 1 (CNV – Chair not voting)
- Please see Steve if any other changes are desired.
- Other items tabled:
  - A plenum section, duct liner attenuation, and revised criteria.
  - Need to put research project results in the handbooks. For example: tones.

8.3.1.2. 2013 Fundamentals Handbook (Weinstein/Wise):

- Needs to be voted on soon. 2/3 of the voting members need to approve the changes.
- Until yesterday, the chapter was perfect. Some minor changes have come in since.
- Proposal to split the topics and have volunteers "own" certain sections. The voting members then approve the volunteer's work.
- By February, we would like to sign-off on the changes.
- **Motion** by Steve, seconded by Curt: Let five guys make the changes.
  - Yea: 13, Nea: 0, Abstain 1 (CNV - Chair not voting)

8.3.2. Other Publications

- No discussion at this meeting.

8.3.3. Web page (Schwob)

- The website has been revamped quite a bit. Michael has done an excellent job.
- A few new things will be added:

- A blog will be created to continue the tones discussion.
  - Mike will send an email when the blog page is setup. Will also post an email group that folks can sign-up for.
- The Montreal seminars will get posted.
  - If you haven't already, please send your presentations to Chris so they can be posted.
- Re-branded ASHRAE logos will be included.

8.4. Standards Subcommittee (Ronsse)

- Met yesterday.
- Goal: consistent content in all ASHRAE standards.
- The subcommittee is designating liaisons for each standard from TC 2.6.

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

- The standard is being revised.

8.4.2. SPC 130 – Method of Test for Rating Ducted Air Terminal Units (Zimmerman)

- Kick-off meeting held yesterday.
- Don't expect major changes.
- Update: include end reflection.
- Update: address more types of products (e.g., exhaust terminal units).
- The work has been divided; results should be available in San Antonio.

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

- Currently under continuous maintenance.
- Will circulate to the TC.

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

- Whether this standard should exist on its own is still up for debate.

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

- Based on an ISO standard that is more for automotive but still applicable.

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

- New standard for active chilled beams.
- The test procedures will be similar to a terminal unit and a diffuser.
- Standards 70 and 130 are the basis.
- A working document should be available in San Antonio with a public review in Dallas.
- The unit will not include water flow during sound testing.
- Up for debate: expose the entire unit or just the face of the unit?
  - Proposal: entire unit will be exposed to the reverberation room.

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

- On continuous maintenance.
- Interactions of thermal, IAQ, illumination and sound/vibration.
- Lily just rolled on as a voting member. Let Lilly know if you find anything.

8.4.8. SPC 132 - Performance Measurement Protocol (PMP) Best Practices document (Eichelberger)

- Goal is to simplify the document for building owners and operators.
- Methods for benchmarking and continuous improvement.
- Has been through two public reviews. Currently at the 90% point.
- Should get published mid-2012.

8.4.9. Updates from Other Standards Organizations

8.4.9.1. AHRI (Abbate)

- Three standards related to sound have been updated: AHRI-370 (large outdoor equipment), AHRI-260 (ducted equipment), AHRI-280 (reverberation room qualifications). All are available on the website.
  - AHRI-260: sound intensity was added.
  - AHRI-280: duct end correction was added.
- AHRI-530 (compressors) has become an ANSI standard.

8.4.9.2. AMCA (Brooks)

- Still working on a revision to 301; handling blade pass frequency in particular.
- Trying to make AMCA 330/ASHRAE 68 an ISO standard.
- ISO is revising the loudness standard; being removed from the ISO standard.
  - Note that this may affect the handbook.
- CRP Updates:
  - Waiting on revisions to the ASTM E477 standard.

8.4.9.3. ANSI (Ronsse)

- Is there anyone more active with ANSI that would like to take this liaison position?

8.4.9.3.1. Working Group on Sound Measurement in Rooms (Lilly)

- Started as an ASHRAE project. Transferred to ANSI S.12 WG 51. Currently have 14 members.
- Currently on draft #15. Responses have been difficult to come by.
- Anyone else interested? Let Jerry know.
- Note that this standard is not limited to HVAC noise. The standard addresses room sound measurement in general.

8.4.9.4. ASTM (Peppin)

- Jerry filled-in for Rich.
- Jerry is chair of 3308 (mechanical and electrical noise).
- Karl is chairing Performance of Acoustical Louvers.
- A standard for duct breakout is in the early stages.
- E3305 (Ken Roy):
  - Simplified acoustics; like the PMP document. Simple standards for green people.
  - Will be checking smartphone apps to see how well they work. How to take a number of measurements, etc…

8.4.9.4.1. ASTM E477 (Oliver)

- Going out for ballot.
- Trying to provide a method that will result in the same answer for everyone.

8.4.9.4.2. ASTM E33 (Lilly)

- No discussion.

8.4.9.5. ISO (Reynolds)

- Nothing to report.

8.4.9.5.1. ISO TC205 (Roy)

- Work has moved from ASHRAE to ISO.
- Next meeting in July (Pennsylvania).

8.5. Standing Subcommittees

8.5.1. Sound Criteria (Wang)

- Met yesterday.
- The Tones topic is top priority.
- Will draft an RTAR.
- In San Antonio, the Criteria subcommittee meeting will be replaced with a Tones hot topic.

8.5.2. Vibration Isolation (Simmons)

- Did not have an official meeting. Rolled the topic into the Research and Publications subcommittee meetings.
- In the Publications subcommittee meeting, a few errors were found.
- The HVAC Applications handbook table will be revised (see Publications notes).
- Re-wrote the RTAR to match the current agenda. Currently out for TC review.
  - Comments due by February 15th which will give us time to get this in at the next RAC meeting.

8.6. Operations Subcommittee (Gierzak)

8.6.1. Bylaws (Oliver)

- The bylaws are posted on our website.

8.6.2. Honors and awards (Wang)

- There are two awards we are considering:
  - Distinguished Service:
    - Nomination packets due May 1st.
    - Need a minimum of 15 points across three different categories.
    - Would like to nominate at least two each year.
    - You can nominate yourself. The TC doesn't always know how active you are outside of the TC.
  - ASHRAE Fellow:
    - The TC has some nomination ideas.
    - Anyone can nominate a fellow.

8.6.3. Long-range planning (Executive Committee)

- See Membership report below.

8.6.4. Membership (Gierzak)

- We have 18 voting members through San Antonio.
- 4 members will be rolling off after San Antonio.
- Have 3 volunteers; still have one open slot.
- John will be stepping down from vice chair.
- Dustin will move up to vice chair.
- Michael Schwob will move into Secretary.
- We have 58 or so corresponding members.

8.6.5. Liaisons (Gierzak)

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

- Main meeting is tomorrow.
- RTAR's include humidity and thermal comfort topics.

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

- Karl is now the chair.
- A new edition of the Practical Guide to Seismic Restraints is now available in the bookstore.
  - There is an entire chapter devoted to seismic certification.

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

- One active research project: RP 1420 – Installation Effects on Plenum Fans
- The TC 5.1 main meeting occurs immediately after this one.

8.6.5.4. ASHRAE TC 5.2 Duct Design (Gierzak)

- RP 1180 – duct design guide.
  - Meets at each ASHARE meeting.
  - If interested, please get involved.
- There was a seminar this morning on AHU leakage.

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

- Standard 79 is being revised.
- Chilled beams and terminal units are a part of the standard.

8.6.5.6. ASHRAE TC 6.10 Fuels and Combustion (Herrin)

- No report.

8.6.5.7. ASA (Wang)

- Meeting jointly with WESPAC in Hong Kong in May.
- The next meeting will be in Kansas City in October.
  - Lily is the technical program chair.

8.6.5.8. VISCMA (Peterman)

- Met on Saturday.
- FEMA 412 – Seismic Restraint for Mechanical Equipment.
  - VISCMA may take on the publishing.

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

- NCAC (Wang) is having a 50th anniversary meeting in Dallas.

- INCE (Wang) will have InterNoise 2012 in August in NYC.
  - Abstract deadline is February 15th.
- CIBSE (Swan)
  - Their guide uses NR.
- Fan 2012 in April in Paris
  - One track (of three) is on fan noise.

9. New business/Old business

- Nothing to report.

9.1. Hot Topics at this meeting (Oliver)

9.1.1. BIM Acoustics (Mitchell/Oliver)

- Follow-up to the forum hosted in Montreal.
- How to get something acoustically-useful out of BIM.
- Identified the need to lay the foundation/groundwork for proper definitions to be included in BIM models.
  - Andrew is championing the cause and will update the TC at future meetings.

9.2. Hot Topics for next meeting (Oliver)

- None identified at this time.

10. Next meeting date and location: San Antonio, TX; June 23-27, 2012

11. Adjournment

- **Motion** by Curt, seconded by John.
- Meeting adjourned at 3:52 PM.

Attachment 1:

Membership – Patrick Oliver

ASHRAE Winter Meeting 2012, Chicago, IL

TC 2.6 Membership Report

Status	Current	After June 2012
Voting	17	16
NQ Voting	2	1
Corresponding	58	64
Applied	6	

Current Voting Member Roster until June 30, 2012

Name	Employer	End Year	Position
John B Gierzak	Oriflow	06/30/2015	Vice Chair
Robert E Simmons	Petra Seismic Design	06/30/2013	VI Sub Chair
Dustin Meredith	Trane	06/30/2015	Secretary
Curt Eichelberger	Johnson Controls	06/30/2014	Research
Chris A Papadimos	Acoustics & Vibration	06/30/2012	Program
Jason D Swan	Sandy Brown Associates	06/30/2013	Member, NQ
Matthew J Stead	AECOM	06/30/2012	Member, NQ
Siu-Kit Lau	University of Nebraska-Lincoln	06/30/2015	Member
Jerry Lilly	JGL Acoustics Inc	06/30/2015	Member
Kim G Osborn		06/30/2015	Member
Randal S Zimmerman	Titus	06/30/2015	Member
Francis J Babineau	Johns Manville	06/30/2014	Member
Richard J Peppin	Scantek Inc Sound & Vibration	06/30/2014	Member
Robert E Hassler	McGill AirFlow LLC	06/30/2013	Member
Robert M Lilkendey	Siebein Associates Inc	06/30/2013	Member
Matthew T Murello	Lewis S Goodfriend & Associates	06/30/2012	Member
Kenneth P Roy	Armstrong World Industries	06/30/2012	Member
Douglas D Reynolds	Univ Of Nevada Las Vegas		Member
Patrick J Oliver	EH Price Ltd.	06/30/2013	Chair

Voting Members Rolling Off after June 30, 2012:

Name	Employer	End Year	Position
John B Gierzak	Oriflow	06/30/2015	Vice Chair
Matthew J Stead	AECOM	06/30/2012	Member, NQ
Matthew T Murello	Lewis S Goodfriend & Associates	06/30/2012	Member
Kenneth P Roy	Armstrong World Industries	06/30/2012	Member

New Voting members after June 30, 2012:

Name	Employer
John F Dunlap	Dunlap & Partners
Erik T Miller-Klein	SSA Acoustics, LLP
Terence M Tyson	Kirkegaard Associates

New Corresponding Members after June 30, 2012:

Name	Employer
Joseph Bridger	Stewart Acoustical Consultants
Nicholas Sylvestre-Williams	
Michael Spencer	JMS Acoustics LLC
Erroll Eaton	Johnson Controls Inc
Mark Fly	Aaon
Jack Wang	Trane

Current Corresponding Member Roster (Until June 30, 2012):

Name	Employer
Mr Charles G Arnold, PE	HDR
Mr Lewis S Goodfriend, P.E.	Lewis S Goodfriend & Assoc's
Mr Arthur D Hallstrom, PE BEMP	AD Hall
Mr Reginald H Keith	Hoover & Keith Inc
Mr Marvin L Kloostra	Titus Products
Mr John F Dunlap, PE	Dunlap & Partners
Dr Radha Krishna Ganesh	Twin City Fan Companies
Mr Vijay K Tripathi	
Mr Mark Elliot Schaffer	Schaffer Acoustics Inc
Mr Michael J Froehlich	Carrier Corporation
Mr Steven S Wise	Wise Associates
Mr Ronald Eligator	Acoustic Dimensions Inc
Mr John D Sofra	Kinetics Noise Control
Mr Brian F Guenther	Vibro-Acoustics
Dr Norman Broner	Sinclair Knight Merz
Mr Karl L Peterman	Vibro-Acoustics
Mr Michael A Schwob, PE	JBA Consulting Engineers
Mr William F Stewart	SSA Acoustics
Dr H Geoff Leventhall	Geoff Leventhall Acoustics
Mr William B Rockwood	The Trane Co
Mr Eric J Rosenberg	Grumman/Butkus Associates
Mr Terence M Tyson	Kirkegaard Associates
Mr Zvirimumwoyo P Chinoda	Hartzell Fan Inc
Prof Ralph Terry Muehleisen	Illinois Institute of Technology
Mr Patrick C Marks, PE	Johnson Controls
Dr Lily M Wang, PhD	University Of Nebraska

Dr Erica E Ryherd	Georgia Institute of Technology
Mr John Pappas	Giannis Pappas Mech Eng
Mr Jonathan Weinstein	Industrial Acoustics Co
Mr Glenn W Kowald	Lennox Industries
Mr Zhiping Wang	Morrison Products Inc
Mr Manoj K Khati	Kriger Ventilation Industries(India)Pvt Ltd
Mr David M Carroll	Morrison Products Inc
Mr Kevin P Gaghan	Gaghan Mechanical Inc
Mr Mark Bastasch	CH2M Hill
Mr Duane McLennan, CET	EH Price Ltd
Mr Joseph F Horesco	Acentech Inc
Dr Heng-Yi Lai	The Boeing Company
Mr Alexander P Michaud	Cerami & Associates
Mr James R Kline	Intertek
Dr Brian J Landsberger	Univ Of Nevada Las Vegas
Mr Raj Prime	Mason Industries
Mr Michael J Resetar	Armacell LLC
Mr Erik T Miller-Klein, PE	SSA Acoustics, LLP
Mr Ken Shook	
Lauren M Ronsse	
Mr Jose A Nepomuceno	
Mr Jason George, PE	Ruskin Company
James Pooler	
Mr Todd Busch	Todd Busch Consulting
Daniel William Abbate	AHRI
Mr Andrew Stephen Mitchell	Acoustic Dimensions Inc
Charles Hunter Mattocks, IV	Aaon
Mr Benjamin Harold Sachwald	AKRF, Inc.
Mr Michael Keating, PE	Kinetics Noise Control, Inc.
Joshua Leasure	JEAcoustics
Mr Tim Simcoe	Price Industries
Mr Dan N LaForgia	Industrial Acoustics

ASHRAE TC2.6 Research Subcommittee Report, 01/23/2012, Chicago, IL.

Curt Eichelberger (curtis.eichelberger@jci.com)

Attachment 2:

Research Subcommittee – Curt Eichelberger

Highlights of Research Chair's meeting:

The current number of RTARS is quite low – looking for new RTARs. Please note that there is a new RTAR coversheet, available on the ASHRAE web site. We have a new Research Liaison, William (Bill) 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 final report was changed, as requested by the PMS. Next step is for the PMS to review and recommend approval. The plan is to submit to the TC for approval via letter ballot.

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.

PMS has agreed that the facility is qualified and testing will start in 3-weeks. The critical path is to get the rectangular ducts for Price. PI expects to have 80% of the testing (straight ducts) completed by December. Payments have been withheld by ASHRAE on this project, until progress has been demonstrated. Mike Vaughn, ASHRAE Manager of Research & Technical Services, to negotiate a new payment schedule with UNLV.

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 Spring of 2012.

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. Robert Simmons prepared an initial draft and forwarded the TC members. Greg Meuseen, Pat Marks and Curt Eichelberger agreed to review and comment. Next step is to submit a letter ballot to the TC for approval.

Topics discussed and prioritized for future research:

The top topics discussed during the past seven research subcommittee meetings are listed below.

1. Review the room effect (include effect of single pass ceiling systems).
2. Tones.
3. Fluctuations
4. Silencer system effects
5. Piping noise for equipment
6. Effect of HVAC noise in hospitals
7. Fan elbow effect
8. BIM
9. Flow noise generation in ducts

We took a departure from the normal research subcommittee meeting procedure and focused only on the top topics. We discussed the following topics two:

Review the room effect. Discussion about equipment (ceiling mounted) vs. speech sources, ceiling system coverage, size, shape and finish of architectural spaces. Doug Reynolds agreed to post some existing research, UNLV thesis, on the TC2.6 web site. Looking for a champion to move this along.

Tones. The “working” objective is to develop a quantitative measure of tonal content. Next steps: we will schedule a 2-hour hot topics meeting in San Antonio to scope out such a project. Hunter Mattocks to prepare a 15-min kickoff presentation to summarize the research to date. All members are encouraged to post information in Blog for on the TC2.6 Web site, Mike Schwob, mschwob@jbace.com.

Attachment 3:

Programs Subcommittee – Chris Papadimos

ASHRAE Winter Meeting 2012
TC 2.6 - Programs Subcommittee Meeting Minutes

THIS MEETING – CHICAGO – JANUARY 21-25, 2012

- Theme: The Impact of HVAC&R on Our Daily Lives
- The technical program is organized under the following tracks:

  Energy Efficiency – New Technologies and Applications
  Energy Modeling Applications
  High Performance Buildings
  HVAC&R Fundamentals
  HVAC&R Systems and Equipment
  Installation, Operation & Maintenance of HVAC Systems
  Integrated Design
  Professional Skills
  Refrigeration
  Specialized Applications – Healthcare, Laboratories, and Data Centers

- Programs by TC 2.06:

Type	Subject	Chair	Status
Forum	New Acoustic Criteria for Design, Diagnostics and Commissioning	Karl Peterman	Not Accepted
Seminar 25	Vibration-Induced Noise and Mechanical Equipment Vibration Isolation, Balance and Predictive Maintenance	Pat Marks	Accepted (Mon 11am)

- Relevant Programs by other TC's:

Type	Subject	Time
Seminar 20	Back to Basics – Selection of Proper Chiller Technology (TC 8.02)	Mon 9:45am
Forum 1	How to Specify Seismic Certification (TC 2.07)	Mon 9:45am
Seminar 39	Comparison of Lab and Field Performance Testing and Ratings for Fans (TC 5.01)	Tue 1:30pm
Tech Paper Session 7	Effect of Typical Inlet Conditions on Air Outlet Performance (TC 5.03)	Tue 11:00am
Conf Paper Session 26	Natural Ventilation Impacts and Applications in Large Buildings (no TC sponsor)	Wed 8:00am

ASHRAE Winter Meeting 2012
TC 2.6 - Programs Subcommittee Meeting Minutes

NEXT MEETING – SAN ANTONIO – JUNE 23 to 27, 2012

- Hotel Venue: Grand Hyatt
- Submission deadlines:

  Conference/Technical Paper Submissions: too late, gone!
  Forum (1 moderator - 60 min, no presentations): Feb 13, 2012
  Seminar (1-2 presentations - 60min; 3-4 presentations - 90 min): Feb 13, 2012

- The link to upload program submissions is: www.ashrae.org/sanantonio
- The technical program is organized under the following tracks:
  - Track 1 - HVAC&R Systems & 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
- Programs to submit:

Type	Subject	Chair	TRACK
Seminar	Aerodynamics Noise – Diffusers, VAV Terminals, Fans, AHU's (Poots/Stevens/Oliver)	Mark Schaffer	1
Seminar	Test Methods – Recently released AHRI Standards 260/880 (Eichelberger/ Oliver)	Chris Papadimos	1
Seminar	Acoustic Criteria and Measurement Procedures (Peterman/Peppin/Swan)	Karl Peterman	6

NOTES:

Seminar submissions should include Learning Objectives and Questions/Answers for the session. In addition, a short biography for each speaker will be required that includes 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.)

ASHRAE Winter Meeting 2012
TC 2.6 - Programs Subcommittee Meeting Minutes

UPCOMING MEETINGS

Winter Meeting 2013: Dallas - January 26 to 30, 2013

- Submission deadlines:

  Conference Paper Abstracts: March 19, 2012
  Technical Papers: April 16, 2012
  Forum (1 moderator - 60 min, no presentations): early July 2012
  Seminar (1-2 presentations - 60min; 3-4 presentations - 90 min): early July 2012

- The link for conf paper submissions: www.ashrae.org/Dallas

- The technical program is organized under the following tracks:
  - Track 1 - HVAC&R Systems & Equipment
  - Track 2 - HVAC&R Fundamentals and Applications
  - Track 3 – Standards, Guidelines, and Codes
  - Track 4 – Energy Conservation
  - Track 5 - Refrigeration Applications
  - Track 6 – Large Building Design
  - Track 7 – Facility Management, Operations, Technology and Energy Improvements
  - Track 8 – Special Interest Track

- Programs to consider:

Type	Subject	Chair	Track
Seminar	Green Building Acoustics	Lily Wang	4
Seminar	TBD		
Forum	TBD		
Conf Papers	Numerical Techniques in Noise and Vibration Simulation for HVAC&R Systems	Pat Marks	1 or 4
Tech Papers	TBD		

Annual Meeting 2013: Denver – June 26 to 30, 2013

Winter Meeting 2014: New York – January 18 to 22, 2014

CONFERENCE REGISTRATION FEE UPDATE

Starting with Dallas for Winter 2013 Meeting:

- Speakers will start paying fee discounted by 75%
- Students and student branch advisors will start paying fee $25

- **PROGRAM TOPICS "IN THE HOPPER"**

- Miscellaneous program topics – listed in order of priority by vote in Montreal, June 2011as tentatively assigned for upcoming conferences.

Votes	Subject	Leader
-	Acoustic criteria including ANSI Standard on Measurement Procedures (Seminar – San Antonio)	Karl Peterman
-	Aerodynamic Noise (Seminar – San Antonio)	Mark Schaffer
-	Seminar on Equipment Sound Standards Test Methods – AHRI 260/880 (San Antonio Seminar)	Chris Papadimos
19	Duct Breakout and Flanking Paths Noise	Doug Reynolds
14	Green Building Acoustics – ... IGCC, PMP Best Practices, ... (Seminar - Dallas)	Lily Wang
13	Basics of Noise and Vibration Control	Chris Papadimos
10	Standard method of test for vibration isolators	Chris Papadimos
9	Fan Selection for Acoustics	Mark Schaffer
7	Outdoor Noise / Liabilities from Outdoor Noise	Matt Murillo
7	In-situ sound testing methods and challenges for different types of mechanical equipment	Chris Papadimos
1	RTU Noise	Sami Elkhazin
0	Forum on next generation handbook (hot topic)	Bill Rockwood
-	Balancing and alignment for mechanical equipment	Chris Papadimos

- Contact Chris Papadimos with ideas and suggestions for additional topics.
    - Email: chris@papadimosgroup.com
    - Tel 415 986 9100 x202

Attachment 4:

Publications Subcommittee – Steve Wise

To: Dustin Meredith
Date: January 23, 2012
From: Steve Wise
Subject: TC2.6 Publications Subcommittee Minutes from Chicago, Jan 2012

TC Website

Mike Schwob continues to do great work with the website: http://ashrae-tc26.org.

Two things that will be coming soon:

1. A blog/forum to allow dialogue on the pending RTAR for "tones". The idea is to have copies/links to related papers, and also allow viewer comments leading to shaping of the Work Statement that we (Research sub-comm) would like to resolve at the summer meeting in San Antonio.
2. Overdue copies of the Montreal seminar presentations.

Miscellaneous from ASHRAE:

Per new "branding" instructions from ASHRAE, we are trying to envision how our publications might evolve to appeal to a broader usage, eg: green buildings.

One proposal during our meeting was to have some kind of analysis (tabulation or other) that would link acoustical performance to component efficiency. For example, a fan selection must overcome the pressure loss of a duct silencer; as such, we could potentially rank noise control treatments with regard to their energy impact vs. acoustic performance.

Another progression might be to rework especially the applications chapter with an eye toward potential PDA applications. Sound meter app's, for example, already exist. What else can we foresee?

We have volunteers to start to rough-out a gameplan: Chris Papadimos, Mark Schaffer, Pat Marks.

Fundamentals Handbook, 2013 revision

We have a few minor changes with consensus from the meeting attendees. These will be fine-tuned by:
Jack Wang, Rob Lilkendy, Rich Peppin, Pat Marks, Mark Schaffer.
A draft of the proposed revisions is being circulated for final edit by the volunteers by Feb 3.

By a vote of 13 Yes, 1 Abstain, and 4 Absent, the TC approved the anticipated changes from the volunteers.

Applications Handbook, 2011 revision

Vibration Section: We have a series of small changes to various items on the master Table 47 showing recommended isolation types and specifications for a given piece of equipment and installation configuration.
Volunteers are: Robert Simmons, Jerry Lilly, Pat Marks, Chris Papadimos, Karl Peterman, Jack Wang, and Don Warick.
We need to accept/reject/modify Roberts proposed changes by Feb. 3.

Silencers: Dan LaForgia, Karl Peterman, and Patrick Oliver are discussing possible minor changes.
A draft is being circulated for consensus changes, to be finalized by Feb 3.

By a vote of 14 Yes, 1 Abstain, and 3 Absent, the TC approved the anticipated changes from the volunteers.

Other Handbook Issues: Potential changes, for which we are seeking volunteer driver's for any sections of interest in time for the 2015 next major rev:

Revamp *plenum section* (Karl P. and Emanual M.)
Duct liner attenuation (need RP 1408 data)
Criteria (will we have something new on tones).

Attachment 5:

Webmaster Report – Michael Schwob

Webmaster Report – Michael Schwob

Recent website activity:

1. An email "forum" has been setup to distribute email from the website contact page.
2. Most of our email was to request membership. A link was added to the website in the right column to the ASHRAE website page with instructions to become a TC member.
3. A FAQ page was setup with seed content to start the process of getting additional content from other TC members. We have not received additional content. I will push this forward again.
4. A page has been setup to share information and prepare the TC for a discussion on Tone Criteria at the next meeting. The page has not yet been included in the website navigation system and will be made public once information from Lily Wang is added. I anticipate that this will occur by February 10th. An announcement will be sent to TC members.
5. Changes and updates have been made based on feedback from the TC.

Near future website changes:

1. Update logo to comply with new ASHRAE logo requirements. The logo requirements require the use of a proprietary font. I am currently in dialogue with the ASHRAE Public Relations regarding this issue.
2. The current "Minutes" page which contains links to minutes from past meetings will be changed to a "Meetings" page with both the minutes and agendas from past meetings. The agendas that we have will be added, although we do not have many of the past meeting agendas. Future agendas will be added to this page.
3. Pages for the Montreal and Chicago programs will be added based on the Agendas for those meetings. We have not received files from the participants of the programs. The files were requested at the Chicago meeting.

Attachment 6:

Standards Subcommittee – Lauren Ronsse

ASHRAE TC 2.6 Standards Subcommittee Meeting Minutes

4:00 – 5:00 PM, Sunday, January 22, 2012

Montrose 4, Palmer House Hilton, Chicago

Meeting Attendees: L. Ronsse, P. Oliver, V. Clemente, J. Lilly, E. Lau, K. Peterman, L. Villeahs, R. Simmons, J. Paulauskis, R. Peppin, C. Eichelberger, J. Swan, M. Schaffer, D. Laforgia, L. Wang, R. Lilkendey, J. Wang, S. Wise, R. Hassler, P. Marks, C. Papadimos, M. Blevins, J. Cottrell, D. Meredith, E. Miller-Klein

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 Applications Handbook and Performance Measurement Protocol (PMP) document
        ii. Designate liaisons to SPCs and WGs to accomplish this goal
    b. Update on ASHRAE Standard 189.1: Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings (Ronsse)
        i. Currently under continuous maintenance
        ii. TC 2.6 Designated Reviewers: Joe Bridger, Kevin Gaghan, Jerry Lilly, Stuart McGregor, Erik Miller-Klein, Karl Peterman, Ken Roy
            1. J. Bridger is new subcommittee chair
        iii. Developing proposed sound & vibration control content in mandatory, enforceable language
            1. Exterior to Interior Sound Isolation (Miller-Klein)
            2. Interior Sound Isolation (Lilly)
            3. Interior Background Sound Control (Peterman)
            4. Interior Room Acoustics and Reverberation Control (Roy)

c. Update on Guideline 10P: Interactions affecting the achievement of acceptable indoor environments (Wang)
    i. Under continuous maintenance. Documents interactions between acoustics, thermal, and lighting issues.
    ii. Lily Wang is now a voting member of this committee

d. Volunteer for new ANSI liaison to TC 2.6? None present volunteered. If interested, please contact Lauren Ronsse at ronsse.lauren@gmail.com.

3. Active Committees
    a. SPC 79: Method of Test for Rating Fan Coil Units (Patrick Oliver)
    b. SPC 130: Method of Test for Rating Ducted Air Terminal Units (Randy Zimmerman)
        i. Updating method of test for terminal units to include end reflection
        ii. Updating standard to address more types of products…i.e. exhaust
    c. SPC 189.1: Design for High Performance Green Buildings (Joe Bridger)
    d. SPC 189.3: Design, Construction and Operation of Sustainable High Performance Health Care Facilities (JR Babineau)
        i. Nothing new to report. Still deliberating whether to include this as an appendix to Standard 189.1 or to create as a separate document.
    e. SPC 197: Method of Test for Passive Vibration Isolators (Karl Peterman)
    f. SPC 200: Method of Test for Chilled Beams (Randy Zimmerman)
    g. Best Practice for Evaluating and Improving the Performance of Commercial Buildings document (Curt Eichelberger)
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. (Bridger)
h. ASHRAE. Interactions affecting the achievement of acceptable indoor environments. *Guideline* 10P. (Wang)

5. AHU Sound Intensity Parking Lot Test Presentation (Mark Schaffer)
6. Meeting Adjourned

Attachment 7:

Liaisons – Lauren Ronsse

ANSI Liaison Report to ASHRAE TC 2.6

Date: January 23, 2012
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 2011)** 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 2011)** 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 (R 2011)** American National Standard for Rating Noise with Respect to Speech Interference.

TC 2.6 Criteria Subcommittee Meeting Minutes
Chicago: January 22, 2012
1-2 PM

Attachment 8:

Criteria Subcommittee – Lily Wang

Members present: C. Ainley, M. Blevins, F. Cincotti, V. Clemente, J. Cottrell, C. Eichelberger, M. Fly, R. Hassler, A. Hathaway, H. Hong, D. Laforgia, S. Lau, R. Lilkendey, J. Lilly, P. Marks, H. Mattocks, D. Meredith, E. Miller-Klein, A. Mitchell, R. Muehleisen, D. O'Brien, P. Oliver, K. Osborn, C. Papadimos, J. Paulaskis, E. Peng, R. Peppin, K. Peterman, B. Reynolds, D. Reynolds, L. Ronsse, K. Roy, M. Schaffer, M. Schwob, J. Swan, L. Villegas, J. Wang, L. Wang, S. Wise, K. Worthington

- Scope/purpose of this committee
  - At the last meeting, the scope of this committee was defined to be as follows:
    - "To define and promote measurement protocols and benchmarks/guidelines/criteria to evaluate **building acoustics, as related to building mechanical systems**"
  - Because ASHRAE as an organization is rebranding and considering the whole building environment, there was consensus that the scope of this committee could be redefined as follows:
    - "To define and promote measurement protocols and benchmarks/guidelines/criteria to evaluate **acoustic comfort in buildings**"
    - One further suggestion was to not specify 'acoustic comfort'; perhaps 'appropriate acoustics' or 'acoustic conditions' would be a better phrase.

- Current Applications Handbook
  - At the last meeting, the committee discussed what is missing and/or what could be changed for the 2015 Applications Handbook (shown in red below):
    - More differentiation between design versus diagnostics versus commissioning rating methods
      - Last Handbook version did include much more differentiation on this topic; perhaps could clarify even more, particularly with regards to RC (since NC and RC are the same column in the Table).
    - Inclusion of RNC because ANSI S12.2-2008 includes it, but it really isn't used
      - Keep the current presentation of RNC in the Handbook as it is.
    - 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' NC requires low frequency data that is not currently available
      - Refer to the new ANSI NC as NC-2008; mention in the same manner/depth as RNC.
    - Mention of measurement protocols?
    - Consider listing minimum sound levels?
      - No, let's not do this ... dangerous area to get into.
    - Also address speech privacy issues more directly?
      - Particularly now because of ASHRAE's rebranding about integrated building design, "Shaping Tomorrow's Built Environment Today"

- Addressing speech privacy includes dealing with sound isolation, reverberation, masking, ... does this mean that we have to start including room acoustics? Some would say yes.
- Maybe it is best if the Handbook simply acknowledges these issues and then points the reader to where to go look for more information on these topics.

- Research Ideas: Development of RTAR on Tones
  - Definition of the problem
    - Many customers complain about tones from building mechanical equipment
    - J. Wang commented that it would be helpful if ASHRAE had acceptable criteria to help others be mindful of tones ... a lot of zoning requirements only set dBA requirement, but screw chillers often end up producing awful tones
    - The AHRI standard doesn't address tones because the criteria currently don't – criteria will have to change to lead the standards development.

  - What question(s) do we want to answer with the proposed research? Members suggested the following:
    - When do you need to alter what you're doing?
    - Psychoacoustics questions to be able to correlate tones to annoyance levels?
    - Less interested in effects of tones on performance (because that effect is not as clearly measurable or simple to detect, based on RP-1322 results)
    - When do 50% say that it's OK? (Or 90%?)
      - Typically 50% don't care, 10% won't change their mind (will always be annoyed), so what we're really interested in is working on the remaining 40%
    - Goal is to reduce complaints

  - How should the tones be quantified or measured?
    - Current methods for quantifying 'tonalness' include:
      - 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 still unclear?)
      - Check new ISO loudness standard (based on work by Moore and Glasberg) ... and review how this metric changes with tonal components. Muehleisen reports that there is a way to include a temporal component as well.
    - Although easy to apply, 1/3 octave band data do not always show the tonal problem… There is an expectation from those in industry that more tones at higher frequencies are going to be emitted in the future, so then the 1/3 octave band method really won't catch them. We could mandate a narrowband FFT

procedure, maybe even produce an easy app through this RTAR that can calculate 'tonalness'?
        - Peppin reports that there is currently no standardized FFT procedure, though, because too difficult to get all interested parties to agree. So one could get different results, depending on what FFT process is used.
        - We could provide signals which can be used to 'calibrate' FFT procedure... e.g. "you should get 10 dB difference in tone between these two given examples".
        - Jack Wang reports that he currently has an app that can measure tones.
        - Difficulty in deciding how to measure the tone … what time interval (5 minutes, but if tone disappeared then what? Fluctuating tones… Multiple tones…)
        - Another difficulty comes from the fact that the same piece of equipment may not produce a stable signal, particularly under different operation requirements.

    - What do current consultants do? Do any of them specify a limit on tones for certain jobs?
        - Papadimos stated that he sometimes does ... typically he does it to engage manufacturers in conversation.
        - Some consultants attempt to dampen the tone's level to an acceptable one by adding attenuators.
        - Some municipal code ordinances (e.g. Connecticut) do specify dBA with a 5 dB penalty based on apparent tones detected by 1/3 octave band method.

- Other items on the agenda were tabled until future meeting, including the following:
    - Further details on development of RTAR on Tones
        - What tonal metric(s) to vary? And in what range?
            - RP-1322 only tested tones with PR = 5 or 9 … next round of testing should include tones with PR from 9 to 18, which are listed as limits of acceptability in the current ANSI S1.13-2005 standard.
            - Use instrumentation that is readily available
            - Be realistic, with input from equipment manufacturers on what is feasible … because there's always tones in it
        - What types of subjective tests should be used?
            - Attention
            - Working memory
            - Cognitive load
    - Development of RTAR on Fluctuations
    - Other input to standards/documents
        - IGCC proposed changes
        - ASHRAE Performance Measurement Protocols (PMP) Best Practices Guide
        - ASHRAE Advanced Energy Design Guide for K-12 School Buildings

Minutes submitted by L. Wang, Criteria Subcommittee Chair

[Note: at subsequent TC 2.6 Research Subcommittee meeting in Chicago, there was consensus to have a 2-hour working meeting in San Antonio to hammer out an RTAR on Tones. Hunter Mattocks agreed to

review current material and make a short presentation to start it off. Jerry Lilly's and Lily Wang's previous presentations plus other info on tones will be posted to the TC 2.6 webpage for dissemination to foster discussion.]

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, Jan. 23, 2012, 8-9:00am
Palmer House 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 at this winter meeting. A conference call is scheduled for April to continue.

5 RESEARCH

Research Topic Acceptance Request (RTAR)formely1560 – 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 incorporated into the revised RTAR by Robert. The revised rtar was sent to the TC members and corresponding members. Reviewers with comments should send comments to Robert Simmons and Curt Eichelberger by February 10. Curt will confer with the section head to determine best protocol to affectively submit the new rtar. Attached is a copy of the RTAR and the letter to ASHRAE addressing comments to the original 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 sent the errors that need to be reviewed and corrected by Robert and Karl. During the review there were comments by some that felt that there was some questions regarding the vibration isolator table. Volunteers will make comment and send to Steve to coordinate with publications.

7 Adjourn

ASHRAE TC 2.06
Sound and Vibration Control
Vibration Isolation Subcommittee

Attachment 9a:

RTAR Response to Comments - Robert Simmons

January 22, 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 (formally#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:

Attachment 9b:

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 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, 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.

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 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 experience serious vibration transmission through the isolators to the structure, resulting in objectionable noise. Unfortunately, at present no test standard for measuring the 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 so that a 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. 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