

ASHRAE TC 5.5 Air-to-Air Energy Recovery
ASHRAE 2018 Annual Conference, Houston, Texas
June 26-26, 2018

These minutes were APPROVED by TC5.5 2019/01/15 7-0-0- CNV

Meetings	Time	Location
SPC 84 Method of Testing Air-to-Air Heat/Energy Exchangers	Monday, June 25, 2018 4:15pm – 6:30pm	Hilton, Level 2, Room 230
TC 5.5 Handbook, Program, Research	Monday, June 25, 2018 2:15 pm – 4:15 pm	Convention Center, Level 3, Room 370
TC 5.5 Air-to-Air Energy Recovery	Tuesday, June 26, 2018 3:30pm – 6:00pm	Hilton, Grand L, 4

Minutes TC 5.5 Full Meeting

1. Call to Order / Welcome
 - a. Chair Matthew Friedlander called the meeting to order at 3:30 pm.
2. TC Scope

TC 5.5 is concerned with air-to-air heat exchangers, their application and cost benefit relationship. It includes consideration of the needs and procedures for standardization and testing, rating and terminology applicable to air-to-air energy recovery.
3. Introduction & Sign up (current email & updates)
 - a. All participants introduced themselves, identified their affiliations and TC positions, and indicated their other activities within ASHRAE.
4. Roll Call of Voting Members (exhibit 1)
 - a. As of this meeting there are (6) voting members, (1) of which is non-quorum.
 - b. With D'Arcy, Erbe, Friedlander, Piscopo and Rice present, quorum was achieved.
5. Agenda Review
 - a. The agenda was accepted.
6. Approval of Minutes
 - a. Annual Meeting (Chicago) 2018-01-23 Meeting
 - i.
 - b. Webmeeting 2018-03-05
 - i.
7. Chair's Report (Matthew Friedlander)
 - a. Starting at the 2017 Winter Conference, CEC began recognizing student papers. Certificates were awarded to students at their assigned conference paper session. Certificates in the categories "*Best Paper*" and "*Honorable Mention*" were presented to graduate candidates and PhD candidates.
 - b. Winter Meeting in Atlanta (January 12-16 (!)) will have the following Technical Tracks:
 - Track 1: Systems & Equipment in the Built Environment
 - Track 2: Fundamentals and Applications
 - Track 3: Optimization in HVAC&R
 - Track 4: Commissioning New & Existing Buildings
 - Track 5: Occupant Health & Safety
 - Track 6: Modeling Throughout the Building Life Cycle
 - Track 7: Professional Development
 - Track 8: Research Summit
 - Track 9 (Mini-Track): Radiant Heating & Cooling Mini-TrackTC members who want to submit a program should consult the Track Chair for assistance in preparing a good abstract, learning objectives, and Q&A to help assure complete submission.
TCs and Sections are encouraged to work with a track chair to put together a series of sessions that can be used as a mini-track.
 - c. ASHRAE has a number of conferences coming up that include papers, and CEC (Conferences and Expositions Committee) seeks your help in reviewing them. Additionally, opportunities to chair a paper session are available.
Specifically, there is an immediate need for reviewers and session chairs for the 2019 Winter Conference and various topical conferences.

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

- d. 2018 Building Performance Analysis Conference and SimBuild, co-organized by ASHRAE and IBPSA-USA
<http://www.ashrae.org/BuildPerform2018>
September 26-28, 2018, Chicago, Illinois
- e. The Third International Conference on Efficient Building Design
<http://www.ashrae.org/Beirut2018>
October 4–5, 2018, Beirut, Lebanon

8. Section Chair Statement (Larry Smith)

- a. Section 5 Chair Larry Smith spoke to the importance of the ASHRAE Code of Conduct (attached here as Exhibit 1), particularly to the need to act in the interests of ASHRAE as distinct from any commercial interest that members may have. He drew attention also to ASHRAE's Vision and Mission Statement (attached here as Exhibit 2).
- b. Friedlander observed that the Code of Conduct has been routinely attached to the SPC84 agendas and stated it would be included in future TC5.5 agendas.

Subcommittee Reports

- 9. Handbook (G.D. Mathur) 2019 Handbook – Systems & Equipment, Chapter 26 – Air-to-Air Energy Recovery Equipment
 - a. Schedule
 - i. The soft copy of the chapter was distributed to the TC members by Paul Pieper on March 22, 2017
 - ii. Chapter to be revised by December 2018
 - iii. To be distributed to the VM of TC: by Jan 2019
 - iv. Latter ballot voting by Feb 2019
 - v. Final chapter to be submitted to ASHRAE by July 5th, 2019 (Confirmed from ASHRAE; but I need to confirm from Heather Kennedy, editor)
 - b. Major changes:
 - i. Update literature review of all energy recovery systems
 - ii. I have completed reviews for heat pipes and two –phase thermosiphon loops
 - iii. I am reviewing all calculations
 - iv. Reviewed and corrected equations 4 & 5 – a few subscripts were incorrect. (Thanks to Mark Owen for alerting us.)
 - v. Need to add a section on controls – Paul Pieper had stated that he will add a section
 - vi. Others items to be added: work done by Prakash Damshala; Carey Simonson
 - c. Need feedback from the members after their reviews of the chapter – by end of Aug 2018
 - d. Items to be added (New Developments):
 - i. Liquid Desiccant technology.
 - ii. Desiccant and Desiccant Material: Internal cooled desiccant wheel in shell and tube arrangement improving latent capacity by 60% and sensible capacity by about 40%.
 - iii. Super Desiccant (a new carbon-based desiccant). Graphene oxide has a potential to improve dehumidification by 5 times and also require low temperatures for regeneration.
- 10. Fundamentals Handbook – possible representation of ERV in Chapter 4 Heat Transfer (March D'Arcy)
 - a. Mr. D'Arcy had received support from TC 1.3 to include some examples in their Heat Transfer chapter 4. According to Rick Couvillion, TC 1.3 handbook Chair: "...2 – 3 energy recovery examples that show the application of heat transfer principles via application to air-to-air energy recovery would be welcome. Some possible examples that come to my mind are: analyzing/sizing air-to-air HXs used for energy recovery followed by a brief description of an energy wheel and how it could be better than a straight HX; brief description of how heat pipes could be used to accomplish same; analyzing/sizing liquid-to-air HXs in a run-around loop used for same; then point to Systems and Equipment Handbook, Chap 44 for more info."
 - b. Mr. D'Arcy opined that TC5.5 will get some representation in the chapter but it will not be extensive. We would look to get in a fair picture of the energy recovery industry. He understands that TC 1.3 is taking on a project to revamp their chapters, so there was little interest in making a quicker change for the digital versions. Instead, they want to follow the cadence of the update every 4 years.
 - c. In the TC 5.5 handbook, program, research meeting on June 25th, the valid point was made that new members now have the option to get all four books digitally. The original impetus for representation of ERV in the Chapter 4 Heat Transfer was that students traditionally only purchase Fundamentals and are not exposed to the benefits of air-to-air energy recovery. Perhaps this is no longer true.
 - d. MR. D'Arcy proposed the group makes a draft addition to TC 1.3's Heat Transfer chapter for review in Atlanta by TC 5.5, followed by some process for TC 1.3 buy-in. The completed draft would be forwarded to TC 1.3 for inclusion when they review their chapter.

Ronnie Moffitt, Chair, Program Subcommittee

ASHRAE TC 5.5 Air-to-Air Energy Recovery program sub committee met Monday 6/25.

2019 ASHRAE Winter Conference in Atlanta, January 12-16:

<http://www.ashrae.org/atlanta>

Track 6: The Convergence of Comfort, Indoor Air Quality and Energy Efficiency

Title: *Using Exhaust Air Energy Recovery to help balance Comfort and IAQ vs Energy* Chair ?

- 1) Upgrading Your Rooftop: Exhaust Air Energy Recovery Applications in Packaged Unitary Systems (Kristin Sullivan)

Finding balance point where ERV becomes cost-effective-- common technologies that are available from equipment OEMs (ERW, fixed-plate), applications pitfalls (limited selection options, pressure drop, fitting ERV into small package sizes) and possibly alternative technologies that are not typically available from OEMs but can be applied in DX unitary systems

- 2) Disallowance of reheat (Adam Fecteau)

Why reheat may be needed for IAQ and Comfort but for energy efficiency, reheat may be disallowed.

- 3) Retrofit dehumidification (Marcus Darcy)

Retrofitting systems with Heatpipe to help with the energy vs IAQ and Comfort problem.
Schedule:

- a. Seminar, Forum, Debate, Panel and Workshop proposals are due August 3
- c. Program notifications go out September 14
- d. Web site opens for presentation uploads on November 30
- e. All presentations due online January 4, 2019

2019 ASHRAE Annual Conference in Kansas City, MO:

- a. Conference Paper Abstracts, Technical Papers and Paper Session requests due August 21, 2018
- b. Conference Papers due November 30, 2018

Conference Papers

- These sessions present papers on current applications or procedures, as well as papers reporting on research in process.
- Less rigorous than Technical Papers
- Can highlight case studies or ongoing research
- Maximum eight pages in length, single spaced. Not published in ASHRAE Transactions
- Single blind review process; subject to commercialism review

Ideas for Seminars

Track on Professional Development:

- Updates on standards and certification programs: Standard 84, AHRI 1060, AHRI 920, ISO 16494, EN308, EU Energy Performance of Buildings,

Track on Equipment:

- 90.1 Addendum AY (H/ERV for high rise dwelling units)
- Ventilation practices for high-rise dwelling units

12. Research (John Dieckmann, Research S/C Chair)

- a. **Improved ERV submodels** -- at Long Beach Mr. Dieckman met with TC4.7, who handles building energy modeling. The initial purpose was to ask them to cosponsor the RTAR that had been drafted for this project. The outcome was the suggestion that we develop a white paper telling them (the building energy modelers) how air-to-air energy recovery should be modeled. An initial draft of this white paper has been sent to an ad hoc work group (Kristin Sullivan, Marc Tardif, and Marcus D'Arcy) for review and input. Mr. Dieckmann's goal is to complete this by early fall and send it on to TC4.7, and schedule a follow-up discussion with TC4.7 at the Atlanta meeting.
- b. **RTAR 1799, Validation of scaling test results of small energy recovery exchangers to geometrically similar, but larger exchangers.** The RTAR was conditionally approved several meetings back, the conditions being that the industry in the form of the AHRI AAERVE product section confirm that the available qualified test facilities are indeed limited as claimed in the RTAR (a communication was received from AHRI to this effect a while ago) and endorse the project as meeting an important need of the industry. In addition, an AHRI commitment to some cofunding (via ARTI) will make the project more attractive to RAC...Members of the [AHRI] product section are primed to review the draft statement of work in the first half of July, followed by a letter ballot to approve. Assuming the section does endorse the project and request that ARTI provide some cofunding, I will submit the WS to RAC before the mid-August deadline for consideration at the RAC Fall meeting.
- c. **RP 1780 Contaminant transfer.** At a telephone conference/web meeting in March the TC voted not to cosponsor the project. The project is proceeding without TC5.5, having been approved by RAC to go out for bid. At this point TC5.5 has no role in the project monitoring subcommittee.

13. Standards (Matthew Friedlander, Standards SC CHair)

- a. Standard 84-2013 *Method of Testing Air-to-Air Heat/Energy Exchangers* now under revision.
- b. Basic scope of work: (a) edit the standard into mandatory standards language; (b) add a method of test for fixed-bed regenerators.
- c. First meeting in St. Louis, summer 2016. (23) meetings since then. As of the June 25 2018 meeting the SPC has accomplished most of the editorial work, and major work on the new method of test, including methods of measurement of rapidly-changing temperatures and humidities. Challenges remain in the area of characterizing EATR, which is strongly impacted in some cases by the length of the attached ducts.
- d. Chair remains hopeful that the SPC will meet the targeted completion date of end of 2018.
- e. SPC 84-2013R Voting Members: John Bolster, TJ Farrell, Matthew Friedlander, Andy Kebernik, Richie Mohan, Ronnie Moffitt, Mary Opalka, James Scudamore, Carey Simonson, Marcus Thaw
- f. Non-Voting: Adam Fecteau, Chris Stone
- g. SPLS Liaison: Michael Gallagher Staff Liaison: Mark Weber

14. Website (James Scudamore)

- a. The TC website is available at tc0505.ashraetcs.org

- b. The new website format is easy to administer. The website has been cleaned up and is fully updated.
 - c. The full committee roster is available on the “Memberships” tab..
15. Membership (Matthew Friedlander)
- a. Friedlander reported that he is catching up on previous appointments that had not yet been processed:
 - b. Current voting members are: Friedlander, Scudamore, Erbe, Afshin, d’Arcy, Piscopo, Sullivan. (7 members)
 - c. Slated to roll on as of Long Beach, but not processed, were Prakash Dhamshala, John Deickman, and Ronnie Moffitt. Chair intends to process Dhamshala and Deickman, if they expect to be able to attend at least every second meeting. However, with Kristin Sullivan also from Trane and already a voting member, Ronnie will have to wait.
 - d. Chair stated that the TC needs up to three additional voting members that are (a) not from industry, and (b) able to attend at least every second meeting. He asked interested members to contact him at tc0505@ashrae.net.

Liaison Reports

16. **ASHRAE Learning Institute** (Paul Pieper, TC5.5 ALI Coordinators) (In Mr. Piper’s absence the Chair delivered his previously-prepared Report.)
- a. ALI Short Courses on ERV were not scheduled for the summer meeting, which is not unusual as they were presented in January and also as Part of the Spring Online series of ALI courses. It seems to average out to about two (2) per year.
 - b. Mr. Pieper presented the **AAERV: Best Practices** course on April 10th via Go To Meeting and. Estimated attendance was 15-20 people. The Course Evaluation Form, completed by 10 attendees, is attached as Exhibit 4.
 - c. Mr. Pieper revised the **AAERV: Best Practices** presentation with input from Art Hallstrom (who has taken over the ALI DOAS presentation formerly presented by Dr. Stanley Mumma). His presentation more closely follows the DOAS Design Guide for content and points in many areas to the **AAERV: Best Practices** Short Course, and includes some content cross-over.. Mr. Pieper is revising the **AAERV: Fundamentals** course and will provide to TC 5.5 as soon as it’s ready. In both he Best Practices and Fundamentals courses, the content relating to Controls is minimal and will be covered in the proposed Short Course for **AAERV: Controls**. The **AAERV: Fundamentals** revision and **AAERV: Controls** will be ready for the Winter Meeting.
17. **SSPC 90.1 Liaison** (Adam Fecteau, TC5.5 Liaison to SSPC 90.1. Mr. Fecteau is also a Consulting Member of SSPC 90.1.)
- a. Addendum DN
 - i. Addendum DN was voted as an ISC for a second public review and was considerably changed from its original format.
 - ii. If approved by SPLS, should be out for public review around August 3rd, 2018.
 - iii. It kept the clarification of exception 3 for 6.5.6.1 and can be summarized by :
 - iv. Where more than 60% of the outdoor air heating energy is provided from site-recovered energy or site-solar energy in Climate Zones 5 through 8.
 - v. The intent, by specifying climate zone, is to keep someone with virtually no heating zone to install a tiny solar panel and avoid ERV
 - vi. It abandoned the original intent of deleting exception 7 and instead set a minimal efficiency requirement for in series energy recovery. to do so :
 - vii. It defined Series Energy Recovery as A three-step process in which the first step is to remove energy from a single airstream without the use of mechanical cooling. In the second step the air steam is mechanically cooled for the purpose of dehumidification. In the third step the energy removed in step one is reintroduced to the air stream.
 - viii. It defined Series Energy Recovery Ratio as The difference between the dry bulb air temperatures leaving the series energy recovery unit and leaving the dehumidifying coil divided by the difference between 75°F and the dry bulb temperature of the air leaving the dehumidifying cooling coil.

- ix. and it rephrased exception 7 to something similar to : Systems in Climate Zones 0 through 4 requiring dehumidification that employ series energy recovery recovery in series with the cooling coil. and have a minimum SERR of 0.40.
 - x. The intent by defining a SERR is to avoid a designer to specify an inefficient heat pipe to avoid ERV.
- b. Addendum AY
- i. Addendum AY was voted for publication for public review and is subject to letter ballot.
 - ii. If approved by SPLS, should be out for public review around August 3rd, 2018.
 - iii. Addendum AY now requires air-to-air energy recovery in all dwelling/apartment multi-unit residential building in all climate zones except for 3C and for apartment smaller than 500 sq.ft in climate zones 0, 1, 2, 3, 4C, and 5C.
 - iv. Addendum AY was initiated by HVI and TC 55 and is the result of an extensive energy modeling effort.
 - v. The energy model showed Scalar Ratio (payback period) of less than 4 years.
 - vi. Some negative comments are to be expected from the Public Review process, the Home Builders Association voted no to this addendum and the addendum has already been challenged by some designers.
- c. Addendum H and AM
- i. Both addendum H and AM went through their public review without comments and will be published.
 - ii. Addendum H clarifies that the Enthalpy Recovery Ratio needs to be met at both Heating and Cooling design conditions.
 - iii. Addendum AM adds an exception for Pool application for only require a Sensible Recovery Ratio
- d. By-Pass damper working group
- i. Within SSPC 90.1 - MSC, there is a working group with the intent to modify 5.6.5.1 in order to require pressure relief around the ERV when the unit is in economizer mode.
 - ii. TC-55 liaison as well as several TC-55 members are members of this working group.
 - iii. The current proposal has not been presented to the SSPC 90.1 - MSC
 - iv. The current proposal could be summarized by :
 - 1. Provision shall be made such that during air economizer operation or when the energy recovery system is not operating the air pressure drop through both the outdoor air and exhaust air portions of the energy recovery system shall not exceed 0.35 in. H₂O (87 Pa) or control
 - 2. For energy recovery systems than cannot be stopped from transferring energy between airstreams, provision shall be made to prevent the airflow through either the outdoor air or exhaust air through the energy recovery system from exceeding 10% of the full design airflow .
 - 3. Any fans that operate exclusively for the purpose of moving air through the energy recovery system shall be stopped.
 - v. This proposal do not take into account the DOAS type of unit and do not show payback for all the technologies available in all the possible context.
 - vi. Members of the working group are advocating for an exception that could be summarized by :
 - 1. Except for application with 10 000 cfm or less of Outdoor Air during the Economizer mode.

18. HVI/TC5.5 Working Group Report: Mo Afshin

- a. This working group was formed at the TC's face to face meeting at 2017 ASHRAE Annual conference to investigate a request, made by Home Ventilation Institute (HVI), to SSPC 90.1 to

include ventilation requirements for Multi Unit Residential Buildings (MURBs) in section 6.5.6.1 of the Standard 90.1

- b. A comprehensive cost and energy savings analysis show that use of Energy Recovery Ventilators meet the savings requirements of the 90.1 in all climate zones (except CZ 3C) for a typical two bedroom (1000 sqft) apartment when compared to other mechanical ventilation methods w/o the use of ERVs. As a result of the work done at this Working Group, a proposal was drafted to be presented at the 90.1 MSC meetings at ASHRAE Annual conference in Houston (June, 2018).
- c. Specific changes to section 6.5.6.1 are proposed as Addendum AY, which would divide 6.5.6.1 into two sub sections:
 - i. 6.5.6.1.1: for non-transient Dwellings that covers the ventilation requirements to use ERVs in residential dwellings in MURBs. The term Non-Transient was included in the proposal so that this section is applied to hotel rooms.
 - ii. 6.5.6.1.2: all other applications; this portion remains the same as 90.1 2016 version

19. Standard 62.1 (Tom Rice)

- a. Change proposal in process:
 - i. Add Class 1 to Table 5.5.1 Air Intake Minimum Separation Distance with regard to distances between OA intake and EA discharges
 - ii. Modify note a on 5.5.1 to include OA intake/EA discharge on the same system not just one system to another
- b. Systems group is looking at needing to add verbiage to the standard regarding “exhausted air not being outside air” or that “recirculated air cannot be considered ventilation air”
- c. These items will also impact Appendix B which talks about string distance between OA/EA openings.
- d. Section 5.9 Dehumidification Systems: it has been proposed that the occupied-space humidity limit be changed from a maximum of 65%RH to a maximum of 60F dewpoint; and not only for occupied but also unoccupied spaces. Consideration of this proposal is on the SSPC’s work plan for the next year.
- e. SSPC 62.1 proposes to create an “Enhanced IAQ Guideline”. A work group includes Brian Harfarhager, Richard Taft, Tom Rice.

Old Business

There was no old business.

New Business

- 20. TC5.5 Position on use of ERV in applications with life safety risks.
- 21. Recommendation by Drake Erbe that TC5.5 meeting include reporting on:
 - a. Recommend reporting on ISO TC 86 WG 10
 - b. Recommend reporting on TC 205
 - c. Recommend reporting on Eco-Design/EPBD

Next Meeting

Next face-to-face meetings will be at the Annual Conference in Atlanta GA TX held January 12-16, 2019

- Matthew Friedlander, Chair TC 5.5
updated 2018-__

Exhibit 1:

ASHRAE Code Of Ethics

(Approved by ASHRAE Board of Directors January 30, 2013)

1.140.001.1 As members of ASHRAE or participants in ASHRAE committees, we pledge to act with honesty, fairness, courtesy, competence, integrity and respect for others in our conduct.

A. Efforts of the Society, its members, and its bodies shall be directed at all times to enhancing the public health, safety and welfare.

B. Members and organized bodies of the Society shall be good stewards of the world's resources including energy, natural, human and financial resources.

C. Our products and services shall be offered only in areas where our competence and expertise can satisfy the public need.

D. We shall act with care and competence in all activities, using and developing up-to-date knowledge and skills.

E. We shall avoid real or perceived conflicts of interest whenever possible, and disclose them to affected parties when they do exist.

F. The confidentiality of business affairs, proprietary information, intellectual property, procedures, and restricted Society discussions and materials shall be respected.

G. Each member is expected and encouraged to be committed to the code of ethics of his or her own professional or trade association in their nation and area of work.

H. Activities crossing national and cultural boundaries shall respect the ethical codes of the seat of the principal activity.

Exhibit 2:

ASHRAE Vision and Mission

Mission

To advance the arts and sciences of heating, ventilating, air conditioning and refrigerating to serve humanity and promote a sustainable world.

Vision

ASHRAE will be the global leader, the foremost source of technical and educational information, and the primary provider of opportunity for professional growth in the arts and sciences of heating, ventilating, air conditioning and refrigerating.

Sub-committee meeting notes

1. Handbook (G.D. Mathur)

a. Sub-committee

- i. Tried to solicitate TC1.3 help. They are supportive of putting a couple of our examples but not too much.
- ii. Discussed to have our own chapter in Fundamentals. Not too much faith by Handbook sub-committee members.
- iii. Members (Mo, Marcus and John B.) to come up with proposals for TC55 and TC13 to approve.

a. Program Sub-committee

i. No program for Houston

ii. Idea for Atlanta

1. Construction

a. Upgrading your rooftop

b.

2. Common issues

3. Convergence of confort and energy efficiency

a. Chair tbd, Ronnie Moffitt for the moment.

b. Loss of confort with disallowance of reheat. (A. Fecteau)

c. Retrofit heat-pipe in dehumidification systems. (Heat-pipe technology)

d. Upgrading your rooftop (Christine Sullivan)

e. Deadline for proposal on August 3rd.

f. Passive Hause (Mo Afshin) ???

iii. For Kansas city

1. track on equipment, presenting the RERV working group results, common practice, ...

2. track on development, changes to ASHRAE 84, Changes to AHRI 1060, AHRI 920, Europe regulation

a. Standard Sub-committee

iv. Standard 84

1. Good progress and possibility to publish by the end of the year

2. Possibility for fast-track if TC unanimous vote to approve.

v. Should we sponsor a new standard? Ex: ASHRAE 205.

1. Should TC55 appoint a liaison to SPC205? Some members think that we should. Christine Sullivan may be interested.

2. Action -> Chair to ask for interested volunteers during the Full Meeting.

3. Liaison will be unofficial for the moment

vi. CEC asked the industry's opinion on their new simulation project for residential ERV and TC referred them to HVI.

Exhibit 3: Voting Members and Officers as of 3/31/2018

Matthew Friedlander	Voting	Chair/standards Subc ch
Tom Rice	Voting	Vice Chair
Marcus D'Arcy	Voting	Member
Drake Erbe	Voting	Member
James Piscopo	Voting	Member
Peter Grinbergs	Voting	Member Non Quorum
Adam Fecteau	Non-voting	Secretary
Prakash Dhamshala	Non-voting	Handbook Subcommittee Co-Chair
G D Mathur	Non-voting	Handbook Subcommittee Co-Chair
John Dieckmann	Non-voting	Research Subcommittee Chair
Ronnie Moffitt	Non-voting	Program Subcommittee Chair
James Scudamore	Non-voting	Webmaster
Paul Pieper	Non-voting	Ali Coordinator

Exhibit 4: Course Evaluation Form: April 10 2018 presentation of “AAERVE: Best Practices”

2018 Online Course - Air-to-Air Energy Recovery Applications: Best Practices; Tuesday, April 10, 2018. 1:00 ‐ 4:00 PM

Q1 INSTRUCTOR - Paul Pieper, P. Eng., Member ASHRAE

Answered: 10 Skipped: 0

	5 STRONGLY AGREE	4 AGREE	3 UNDECIDED	2 DISAGREE	1 STRONGLY DISAGREE	TOTAL	WEIGHTED AVERAGE
The instructor was knowledgeable in the subject.	90.00% 9	10.00% 1	0.00% 0	0.00% 0	0.00% 0	10	4.90
The instructor presented the concepts and principles clearly and understandably.	50.00% 5	50.00% 5	0.00% 0	0.00% 0	0.00% 0	10	4.50
The instructor related the material to practical applications.	60.00% 6	40.00% 4	0.00% 0	0.00% 0	0.00% 0	10	4.60

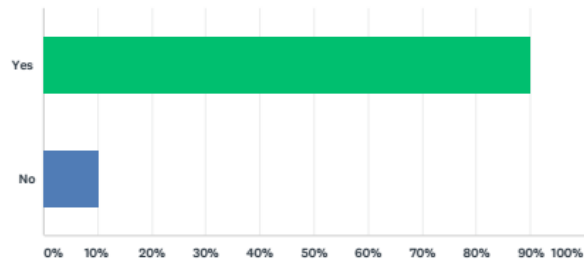
Q2 COURSE CONTENT

Answered: 10 Skipped: 0

	5 STRONGLY AGREE	4 AGREE	3 UNDECIDED	2 DISAGREE	1 STRONGLY DISAGREE	TOTAL	WEIGHTED AVERAGE
The objectives of the training were clearly stated.	70.00% 7	30.00% 3	0.00% 0	0.00% 0	0.00% 0	10	4.70
The content quality and format of the course notes make them valuable as a future reference.	60.00% 6	40.00% 4	0.00% 0	0.00% 0	0.00% 0	10	4.60
The quality and clarity of the visuals (A/V materials) enhanced my ability to understand the course concepts.	80.00% 8	20.00% 2	0.00% 0	0.00% 0	0.00% 0	10	4.80
The organization and order of presentation of the course material supported effective mastery of the training topic.	60.00% 6	30.00% 3	10.00% 1	0.00% 0	0.00% 0	10	4.50
The material presented will be of practical use in my work.	60.00% 6	30.00% 3	10.00% 1	0.00% 0	0.00% 0	10	4.50
The degree of difficulty (level) of this training was correct to meet my needs and expectations.	40.00% 4	60.00% 6	0.00% 0	0.00% 0	0.00% 0	10	4.40

Q3 GENERALAre you an individual member of ASHRAE?

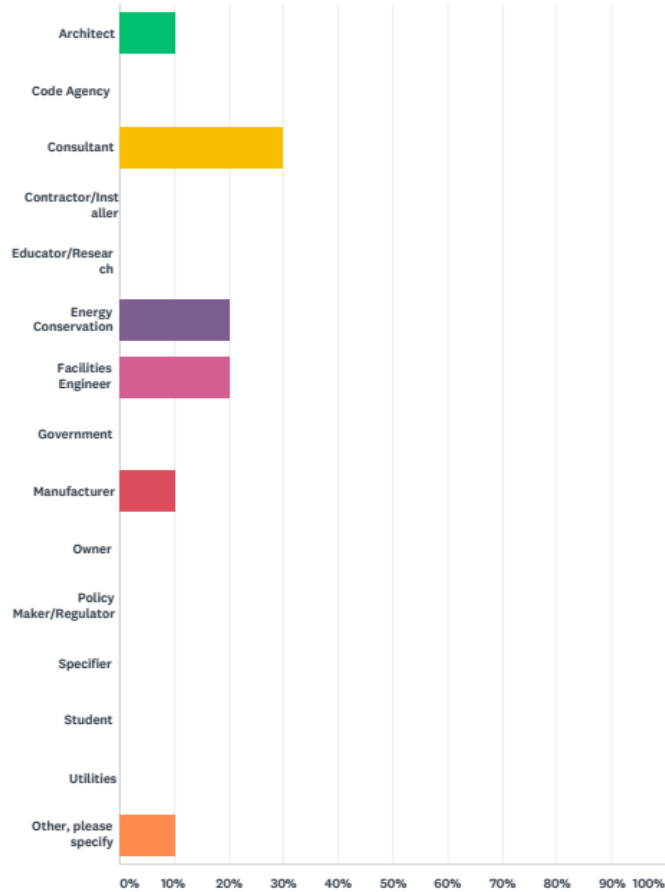
2018 Online Course - Air-to-Air Energy Recovery Applications: Best Practices; Tuesday, April 10, 2018. 1:00
– 4:00 PM



ANSWER CHOICES	RESPONSES	
Yes	90.00%	9
No	10.00%	1
TOTAL		10

Q4 Which description best characterizes your primary job function?

2018 Online Course - Air to Air Energy Recovery Applications: Best Practices, Tuesday, April 10, 2018, 4:00 PM
 – 4:00 PM



ANSWER CHOICES	RESPONSES	
Architect	10.00%	1
Code Agency	0.00%	0
Consultant	30.00%	3
Contractor/Installer	0.00%	0
Educator/Researcher	0.00%	0
Energy Conservation	20.00%	2

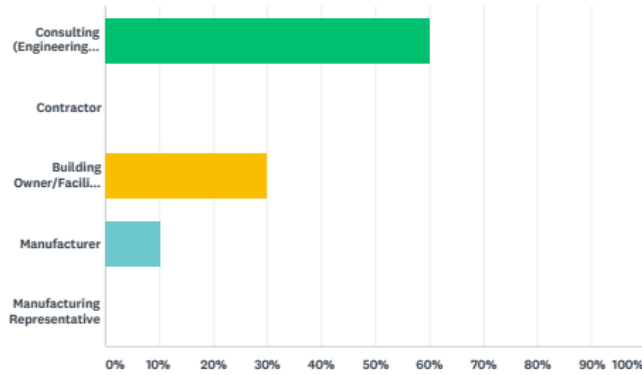
4 / 9

Facilities Engineer	20.00%	2
Government	0.00%	0
Manufacturer	10.00%	1
Owner	0.00%	0
Policy Maker/Regulator	0.00%	0
Specifier	0.00%	0
Student	0.00%	0
Utilities	0.00%	0
Other, please specify	10.00%	1
TOTAL		10

#	OTHER, PLEASE SPECIFY	DATE
1	AHRI Certification Engineer	4/10/2018 4:06 PM

Q5 What is the principal activity of your firm?

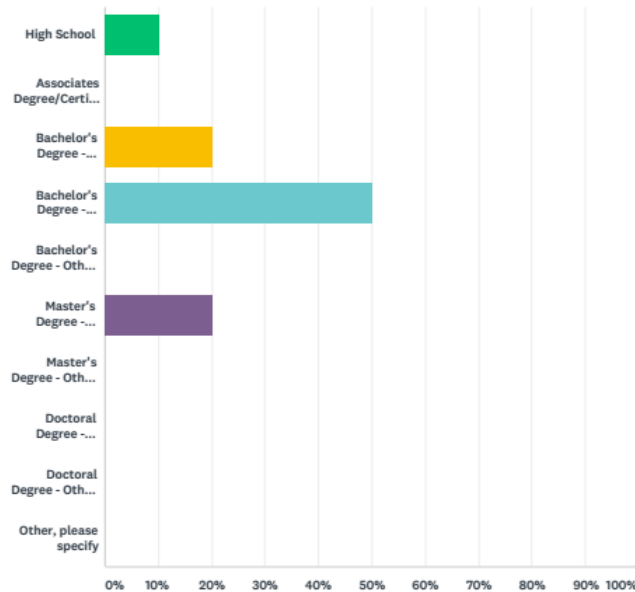
Answered: 10 Skipped: 0



ANSWER CHOICES	RESPONSES	
Consulting (Engineering or Architectural)	60.00%	6
Contractor	0.00%	0
Building Owner/Facility Management	30.00%	3
Manufacturer	10.00%	1
Manufacturing Representative	0.00%	0
TOTAL		10

Q6 Which describes your highest level of education?

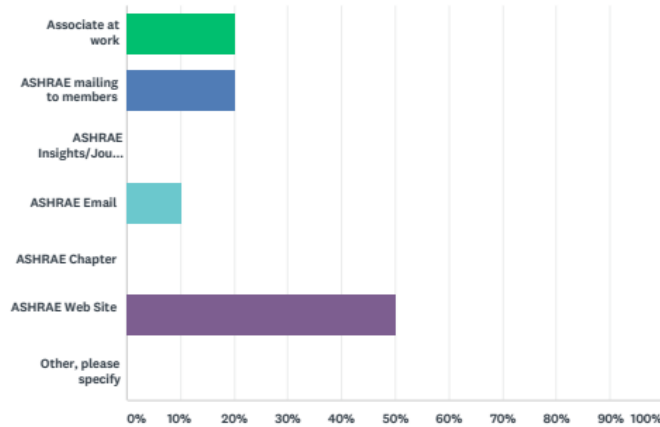
Answered: 10 Skipped: 0



ANSWER CHOICES	RESPONSES	
High School	10.00%	1
Associates Degree/Certificate Program	0.00%	0
Bachelor's Degree - Engineering Technology	20.00%	2
Bachelor's Degree - Engineering	50.00%	5
Bachelor's Degree - Other than Engineering	0.00%	0
Master's Degree - Engineering	20.00%	2
Master's Degree - Other than Engineering	0.00%	0
Doctoral Degree - Engineering	0.00%	0
Doctoral Degree - Other than Engineering	0.00%	0

Q7 How did you hear about this course?

Answered: 10 Skipped: 0



Q8 What topics would you suggest for future seminars?

#	RESPONSES	DATE
1	Ion generators and their effects on outside air, and applications	4/12/2018 4:26 PM
2	VRF, chilled beam, OA requirements	4/10/2018 4:08 PM
3	TEST	4/10/2018 3:29 PM

Q9 General Comments regarding any aspect of the seminar, including suggestions for improvement:

Answered: 4 Skipped: 6

#	RESPONSES	DATE
1	I think it would be helpful to make the video available for download after the seminar. Also it would be better to start the webinar later in the day, not just catering to east coast time zone.	4/12/2018 4:26 PM
2	More info on controls and economizer sequences	4/10/2018 5:32 PM
3	nothing at this time	4/10/2018 4:08 PM
4	TEST	4/10/2018 3:29 PM

Q10 ASHRAE would like to communicate the value of its training. Please provide a brief quote about your experience at this session, emphasizing the value it provided to you. Your quote may appear in online or printed promotions, but only your first name, last initial and title will be included. City, state and country information is optional.

Answered: 4 Skipped: 6

#	RESPONSES	DATE
1	The course was well presented, highlighting changes and what to expect in the future.	4/13/2018 5:51 PM
2	This webinar was a valuable experience	4/12/2018 4:26 PM
3	The Air-to-air energy recovery applications course was very helpful to better understand AAERV's, their applications, when/where to use the technology, and special considerations for best applications.	4/10/2018 4:08 PM
4	TEST	4/10/2018 3:29 PM