

**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**

(Minutes of all TC/TG/TRG Meetings are to be distributed to all persons listed below within 60 days following the meeting.)

TC/TG/TRG NO. TC 1.3 (page 1 of 2) DATE June 23, 2009

TC/TG/TRG TITLE Heat Transfer and Fluid Flow

DATE OF MEETING June 23, 2009 LOCATION Louisville, KY

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
S. Kulankara (Chair)	2007	Bruce Nelson	2006	Lorenzo Cremaschi
Eric Ratts	2006	Walid Charoun (Int. M)	2005	Tony Jacobi
Jon Hartfield	2006	John Thome (Int. M)	2008	Justin Kauffman
Zahid Ayub	2006	Amir Jokar	2008	Stanislav Perencevic
Rick Couvillion	2008			Andreas Knoepfler
Joe Huber	2007			Andreas Beutler
Mike Ohadi	2006			Axel Kriegsmann
Samuel Yanamotta	2008			S. A. Sherif
				Branko Korenic
				Payam Delgoshaei

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*All Members of TC/TG/TRG plus the following:*

TAC Section Head: Anthony Jacobi	
TAC Chair: Bryan Becker	
All Committee Liaisons As Shown On TC/TG/TRG Rosters:	
Manager Of Standards Manager Of Research & Technical Services	Claire Ramspeck Mike Vaughn

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				Ray Rite
				Mark Johnson
				Omar Abdelaziz
				Matt Huddleston
				Kostas Kontomaris
				Mustafa K. Yanik
				Mohamed Alshehhi
				Ebrahim Al-Hajri
				Gary Price

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## Meeting Minutes

### Louisville, Summer Meeting 2009

#### ASHRAE TC 1.3 - Heat Transfer and Fluid Flow

Meeting Date: Tuesday, 23 June 2009

1. Introductions (S. Kulankara)
  - a. S. Kulankara called the meeting to order at 1:03 and read the TC 1.3 Title Purpose and Scope.
  - b. Attendees introduced themselves to the group.
  - c. Twenty-seven attendees were present, including eight voting members, eleven corresponding members and eight visitors.
  
2. Confirmation of Quorum (S. Kulankara)
  - a. A quorum was established with seven of ten voting members present (twelve total voting members with two international members absent).
    - i. Members present include S. Kulankara, J. Hartfield, R. Couvillion, S. Yanamoto, Z. Ayub, E. Ratts, and J. Huber. M. Ohadi arrived shortly after the quorum was confirmed as the eighth voting member present.
    - ii. Voting members absent were J. Thome (International), B. Nelson, A. Jokar, and W. Chakroun (International).
  
3. Approval of Minutes from Chicago
  - a. Z. Ayub moved to approve the Chicago minutes as submitted.
  - b. R. Couvillion seconded the motion.
  - c. There were no comments.
  - d. The Chicago minutes were approved by a vote of seven for, none opposed, none abstained.
  
4. Liaison Comments (S. Kulankara)
  - a. No liaisons were present during the meeting.
  
5. Report from Membership Chairperson (J. Hartfield)
  - a. Current Roster
    - i. Current membership includes twelve voting members with six from academia and six from industry.
    - ii. Two voting members are international.
    - iii. The committee has thirty-five corresponding members.
  - b. Roster for 2009-2010
    - i. S. Kulankara, W. Chakroun and E. Ratts are rolling off as voting members.
    - ii. B. Korenic will be rolling on as chair.
    - iii. B. Korenic, A. Kriegsmann, J. Kauffman, and L. Cremaschi will be rolling on as voting members.
    - iv. Membership will include thirteen voting members, with five from academia and eight from industry. Two members will be international.
  - c. General Comments

- i. In 2010, four voting members will be rolling off, presenting an opportunity to rebalance the academia / industry membership, if desired.
  - ii. The membership information on the website is out of date.
    - 1. John Hartfield will contact webmaster to remedy.
  - iii. J. Hartfield presented the opportunity for visitors to join if they desired.
  
- 6. Report from Program Chairperson (A. Jokar)
  - a. A. Jokar was unable to attend, so S. Kulankara presented on his behalf.
  - b. For Louisville, the proposed seminar titled “Recent Developments in Heat Transfer and Fluid Flow” was rejected.
    - i. ASHRAE explanation was simply that more programs were submitted than could be accepted for the Louisville meeting.
  - c. Future Programs
    - i. Orlando
      - 1. S. Kulankara recommended resubmitting the seminar titled “Recent Developments in Heat Transfer and Fluid Flow”.
        - a. Proposed speakers are John Thome, A. Cavallini, and S. Perencevic.
      - 2. Z. Ayub and M. Ohadi suggested a forum on state-of-the-art work in nano and micro technologies titled “Potential Applications of Nano and Micro Technologies in HVAC&R”.
        - a. M. Ohadi will act as moderator and will prepare the required abstract.
      - 3. A. Jokar proposed a seminar in TC 8.5 for TC 1.3 co-sponsorship related to environmentally friendly refrigerants.
    - ii. Albuquerque
      - 1. A. Jacobi suggested a conference paper titled “Heat Exchangers for Applications in Hot, Dry Environments.”
        - a. Z. Ayub will chair.
        - b. A. Jacobi and Z. Ayub will present. Additional presenters are being sought.
      - 2. O. Abdelaziz mentioned that anyone interested in submitting a transaction paper for Albuquerque should contact him.
    - iii. R. Couvillion made a motion to submit the seminar “Recent Developments in Heat Transfer and Fluid Flow”, the forum “Potential Application of Nano and Micro Technologies in HVAC&R”, and co-sponsor the TC 8.5 seminar on environmentally friendly refrigerants for Orlando, and to submit the conference paper titled “Heat Exchangers for Applications in Hot, Dry Environments” for Albuquerque.
      - 1. J. Huber seconded the motion.
      - 2. The motion passed with a vote of six for, none opposed, none abstained.
  
- 7. Report from Handbook Chairperson (R. Couvillion)
  - a. Revised chapters were submitted in the middle of March.
    - i. The Fluids chapter and the Mass Transfer chapter include additional examples and were well received.
    - ii. The Heat Transfer chapter has been reorganized with sections rewritten to address the lack of cohesion between sections.
    - iii. The Two-Phase Flow chapter remains unchanged due to the late resignation of the previous reviser.

1. R. Couvillion will contact K. Schultz and S. Eckels who had expressed potential interest in revising the Two-Phase Flow chapter at the Chicago meeting.
      - iv. The subcommittee is awaiting reviews of the submitted changes.
    - b. The Fluid Properties chapter has remained unchanged for multiple review cycles and should be updated in the future.
    - c. In the future, the handbook liaison will not be attending the TC meetings, so the handbook chair should attend the Sunday handbook chair meeting and pass the pertinent information along to the TC.
    - d. R. Couvillion suggested that researchers or PMS members should contact him to include relevant information discovered through research projects that are applicable to the handbook.
      - i. In particular, results of RP-1270 and RP-1280 were thought to be strong candidates.
      - ii. J. Huber mentioned that ASHRAE requires researchers to complete a form suggesting where their research could be applied to the handbook.
        1. R. Couvillion will check with M. Vaughn to determine how this information is handled.
    - e. S. Kulankara and the TC thanked R. Couvillion for the excellent work on the handbook.
    - f. R. Couvillion added his thanks to M. Ohadi for his contributions to the handbook.
8. Report from Webmaster (D. Nutter)
  - a. D. Nutter was unable to attend, so S. Kulankara presented in his absence.
  - b. As far as D. Nutter and S. Kulankara know, the website is updated with minutes and meeting announcements, but the membership is not current.
    - i. J. Hartfield will contact Darren to resolve the membership issues.
  - c. S. Kulankara mentioned adding research summaries to the TC website and it was well received.
9. Report from Research Chairperson (J. Huber)
  - a. Research Subcommittee Chair Comments from Research Meeting
    - i. If working on an RTAR, the research liaison is to look over it before submission.
    - ii. In the future, the standard research agreement will require dual units.
      1. J. Huber suggested including dual units in work statements and RTARs going forward.
    - iii. In the future, assistance will be available for conducting literature reviews for work statements and RTARs.
    - iv. All active projects need to have the "Research Project Performance Evaluation" form filled out at each meeting to describe the research progress.
      1. Most importantly, major problems should be documented as they happen and not at the end of the project.
  - v. Strategic Plan 2010-2015
    1. The eleven research categories presented in Chicago have been combined into ten categories after goal champions solicited information from TCs.
    2. The goals are expected to be distributed in the winter of 2009-2010 for TCs to review and provide feedback
    3. The research strategy will be in two parts:
      - a. Research as Usual
        - i. Current methods, including RTARs, proposals, etc.
      - b. Strategic Goals

- i. Larger budget research with multiple sources, multiple projects, strategic research, bigger picture

b. Current Research

- i. RP-1352 (Evaporation in Corrugated Plate Heat Exchangers with Ammonia and Ammonia/miscible oil) (PI: S. Khan, PMS Chair: Z. Ayub)
  1. Dr. Khan was unable to attend, so Z. Ayub presented at the research session on Sunday. He summarized his comments for the TC.
  2. Single-phase work is complete with correlations and a paper ready for publication.
  3. Two-phase work is underway with three plate types to be tested
    - a. Plate types are hard, soft, and mixed.
    - b. Hard and soft plates have been tested, covering the range outlined in the work statement.
      - i. Early data was presented at the research meeting, but detailed analysis has not been completed.
    - c. Mixed plate remains to be tested, but is getting underway.
  4. Miscible oil tests also remain.
    - a. The PMS suggests testing only the mixed plate with oil to review the impact before proceeding with oil tests on hard and soft plates.
  5. The PI has recently had pump problems.
  6. Z. Ayub made a motion to provide a one year, no cost extension to the project, extending the completion date to after the 2010 summer meeting.
    - a. John Hartfield seconded the motion.
    - b. The motion passed with a vote of eight for, none opposed, none abstained.
- ii. RP-1444 (Experimental Evaluation of Two-Phase Pressure Drop and Flow Patterns in U-bends for R134a, R410A, and Ammonia) (PI: J. Thome, PMS Chair: B. Nelson)
  1. J. Thome was unable to attend the TC meeting, so J. Hartfield presented a summary of comments from the research meeting.
  2. The project is getting started in the lab.
  3. Preliminary work has been done with two-phase flow in a single 5/8" U-bend to find optimal instrumentation locations.
  4. Early results indicate that some pressure measurements may be redundant.
  5. Significant pressure gradients were found both upstream and downstream of the U-bend.
  6. Test facility limitations have been found.
    - a. The highest flows at the highest quality are unachievable with the existing pump.
    - b. The lowest flows show instabilities.
    - c. J. Thome proposed narrowing the test range.
      - i. This will be discussed by the PMS and feedback will be provided.
  7. J. Thome is hoping to have data to present at the Orlando meeting.
  8. The project is currently approximately two months behind schedule, but John anticipates that the time may be able to be made up.
  9. Currently the project expenses appear to be on track.

10. S. Kulankara mentioned that ASHRAE has not received a project update since December.
  - a. According to J. Huber, reports have been submitted to the PMS and to D. Daniel.
    - i. S. Kulankara will look into this to find the disconnect.
- iii. RP-1327(Flow regime and pressure drop determination for two-phase ammonia upward flow in various riser sizes) (PI: L. Reinhold)
  1. G. Price presented a summary of the project.
  2. The Danish Technical Institute is carrying out this research project.
  3. The first PI left the Institute, so a new PI has been named.
  4. The project has experienced a number of mechanical problems.
    - a. The most critical has been with the donated rotary vane compressor.
      - i. The donor has been offering considerable support.
      - ii. The probable cause was water in the system.
    - b. A clear quartz pipe section was to be included for visualization.
      - i. The first three have been broken.
  5. The compressor is now working and data is being collected.
  6. The data is preliminary, but the PI is hoping to have data to present in Orlando.
  7. Due to the mechanical problems, a significant portion of the project funds have already been spent.
- iv. New Investigator Award(Using micro-scale anisotropic surface chemistry to manipulate condensate droplets on aluminum) (PI: A. Sommers)
  1. Aluminum surfaces have been developed by etching with acidic solution and coating with PDMS.
  2. Work was presented comparing parallel and perpendicular channels with impacts on droplet blow-off, drainage, and contact angles.
  3. So far the PI has been unsuccessful in chemical stripe depositing methods
    - a. Two methods have been attempted but have been unsuccessful to date.
    - b. The PI is still researching alternative methods.
- c. Long Range Research Plan
  - i. WS-1556 “Characterization of liquid refrigerant flow emerging from a flooded evaporator tube bundle” (J. Hartfield)
    1. TC comments were addressed by John Hartfield and the work statement has been submitted to RAC.
    2. The RAC vote is expected to occur Wednesday morning in Louisville.
      - a. J. Huber mentioned that the RAC meetings are open and that it may be helpful to have a representative at the meeting to answer any questions that arise.
        - i. Z. Ayub volunteered to attend.
    3. S. Kulankara and Z. Ayub expressed interest in being PES members if the project moves forward.
  - ii. New Investigator Award (A. Jokar)
    1. J. Huber noted that A. Jokar has been awarded a New Investigator Award.
    2. The project will not begin until PI completes his current research project for TC 8.5, but this work is likely to fall under TC 1.3.
  - iii. Other topics of interest
    1. Two-Phase flow fundamentals through tees and orifices

- a. In the past, J. Thome noted that there has been little work in this area.
  - b. Results of RP-1444 may yield insights into feasibility of researching other connection types.
- 2. Nanofluids in HVAC
  - a. K. Schultz and P. Thors will review this area for Orlando.
- 3. Effect of dust on fouling of air side heat exchangers
  - a. There is an active RTAR in C 8.4, developing a method of test for testing and analyzing particle fouling effects.
    - i. M. Johnsons will send the RTAR to TC 1.3 for review.
- 4. Low temperature correlations for CO<sub>2</sub> and NH<sub>3</sub>
  - a. J. Huber was unable to contact B. Nelson for feedback before the meeting.
  - b. If there is no progress by Orlando, this item will be removed from the list.
- 5. Heat transfer enhancement with micro encapsulated phase change materials
  - a. Dr. Yagubi is willing to work with someone to develop an RTAR, but he is unable to take the lead.
  - b. There may be potential to integrate this work with A. Jokar's new investigator award.
- 6. Heat transfer performance of new low GWP refrigerants
  - a. The initial proposal was for shell-side heat transfer performance of R-1234ce, R-1234yf, R-410A, and a baseline of R-134a.
    - i. It was decided that this fits better with TC 8.5.
  - b. S. Yanamotta will prepare an RTAR using the refrigerants listed above but for in-tube heat transfer performance.
- 7. M. Ohadi suggested research on the effects of particle fouling on CO<sub>2</sub> sequestration equipment.
  - a. Depending upon the success of the TC 8.4 dust fouling RTAR this may be of interest.
- 8. M. Ohadi suggested co-sponsoring research with TC 10.4 (cryogenics) regarding heat transfer and pressure drop correlations of refrigerant mixtures in low-temperature applications.
  - a. TC 10.4 presented the idea at the Louisville meeting and is working toward an RTAR.
- 9. M. Ratz suggested research on the effects of fouling on airside droplet condensation in heat exchangers.
  - a. TC 8.4 saw resistance to this topic in the past.

10. New business (S. Kulankara)

- a. J. Hartfield and the TC expressed their thanks to S. Kulankara for his service as chair.

11. Announcements from TC chairperson meeting (S. Kulankara)

- a. ASHRAE added a section to the website noting the current technical focus
- b. The Advanced Engineering Guide for highway lodging has been released. The guide on healthcare facilities will be released later this year
- c. The first of two reviews for the 50% AEDGs are planned for fall 2009.
- d. Conference proceedings will be added as a conference medium beginning in Albuquerque.

- i. Maximum eight-page papers will be single-blind reviewed by the TC
  - ii. The presentations will not be recorded, hoping to address some speakers' concerns about the ASHRAE recording policy.
- e. TAC is also considering allowing presenters to forfeit their free registration in lieu of having their presentations recorded.
- f. Thank-you letters are available for request on the ASHRAE website at [www.ashrae.org/thankyouletter](http://www.ashrae.org/thankyouletter)
- g. Hightower award nominations are being accepted
  - i. Award to be based on achievement of a specific task in the past four years (extended from one year)
- h. There is a proposal to replace international membership with a new type of member
  - i. Up to two members could be assigned to the new member type by the TC chair.
  - ii. Members of the new member type would count toward a quorum, but not count against it, in the same way that international members are handled today.
  - iii. But, this would provide flexibility for the TC chair to give this option to two members whether they are domestic or international.
  - iv. John Hartfield expressed interest in having ASHRAE measure the results of this change over the coming years to see if the desired results were achieved.

## 12. Adjourn

- a. R. Couvillion motioned to adjourn the meeting.
- b. J. Huber seconded the motion.
- c. The motion passed by vote of seven for, none opposed, none abstained.
- d. The meeting adjourned at 2:50 pm.