

**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 8.5 DATE April 30, 2009

TC/TG/TRG TITLE Liquid to Refrigerant Heat Exchangers

DATE OF MEETING Monday, January 26, 2009 LOCATION Chicago, IL

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Amir Jokar	2008	Art Fovargue	2005	Scott MacBain
Zahid Ayub	2008	James Bryan	2008	Andreas Beutler
Samuel Yana-Motta	2005	Harry Li	2008	Jon Hartfield
Dan Kihm	2008			Steffen Rieger
Joe Huber	2008	<i>Corresponding Members:</i>		Omar Abdelaziz
Ken Schultz	2008			Justin Kauffman
Satheesh Kulankara	2008	Michael Ohadi	2001	John Dieckmann
John Thome	2008	Keith Starner	1993	Alberto Cavallini
Jim Bogart	2008	Tom Ortiz	2008	Massoud Neshan
Andreas Knoepfler	2008	William McQuade	2002	Rupal Choksi
<i>Corresponding Members:</i>		Ty Newell	2005	Mustafa Yanik
Axel Kreigsmann	2008	Josua Meyer	2005	Stanislav Perencevic
Kash Oza	2008	Parviz Payvar	2008	Omar Feliciano
Steve Eckels	2008	John Judge	2004	Jeb Schreiber
Petur Thors	2005	Lorenzo Cremaschi (prov)	2009	Michael Taras
Ben Dingel	2007			
Mahesh Valiya-Naduvath	2008			
Jamal Yagoobi	2007			
Olivier Pelletier	2004			
Ebrahim Al Hajri (provisional)	2009			

**DISTRIBUTION**

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

TAC SECTION HEAD:	<b>Vinod Gupta</b>
TAC CHAIR:	<b>Bryan Becker</b>
ASHRAE MANAGER OF RESEARCH AND TECHNICAL SERVICES:	<b>Michael R. Vaughn, P.E.</b>
ALL COMMITTEE LIAISONS AS SHOWN ON TC/TG/TRG ROSTERS:	Dan Dettmers — Handbook Liaison Tim McGinn — ALI/PDC Ron Bailey — RAC Research Liaison Nathan Hart — Chapter Technology Transfer Liaison Julia Keen — Special Publications Michael Martin — Standards Liaison

**ADDITIONAL DISTRIBUTION**

MANAGER OF STANDARDS	Claire Ramspeck
----------------------	-----------------

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

Minutes  
Technical Committee 8.5  
Liquid-to-Refrigerant Heat Exchangers  
January 26, 2009  
2009 ASHRAE Winter Conference, Chicago, IL, January 24-28, 2009

**1. Call to Order and Reading of TC8.5 Scope**

Chairman Amir Jokar called the meeting to order at 4:17 pm. The scope of TC 8.5 was read: "TC8.5 is concerned with the thermal and mechanical design, performance, and application of devices for accomplishing heat transfer between refrigerants (including secondary refrigerants) and liquids. Such devices include liquid cooled refrigerant condensers and refrigerant evaporators for cooling liquids".

**2. Introduction of Members and Guests (Sign attendance sheet)**

Members and guests introduced themselves. The following were present:

Amir Jokar	WSU Vancouver
Ben Dingel	Trane
John Thome	EPFL
Jim Bogart	GEA PHE Systems
Steve Eckels	Kansas State University
Ken Schultz	Trane
Petur Thors	Wolverine Tube, Inc.
Zahid Ayub	Isotherm, Inc.
Satheesh Kulankara	Johnson Controls
Joe Huber	Alfa Laval
Kash Oza	Alfa Laval
Mahesh Valiya Naduvath	Johnson Controls
Samuel Yana Motta	Honeywell
Axel Kriegsmann	Wieland-Werke AG
Andreas Knoepfler	Wieland-Werke AG
Andreas Beutler	Wieland-Werke AG
Steffen Rieger	Kobe Wieland
Daniel Kihm	SWEP N.A.

Olivier Pelletier	GEA PHE SYSTEMS
Justin Kauffman	JCI
Jon Hartfield	Trane
Scott MacBain	Carrier
Omar Abdelaziz	University of Maryland
Ebrahim Alhajri	University of Maryland
John Dieckmann	TIAX LLC
Alberto Cavallini	University of Padova
Omar V. Feliciano	SWEP
Jamal Yagoobi	Illinois Institute of Technology
Jeb Schreiber	JCI
Rupal Choksi	AHRI
Mustafa Yanik	JCI
Stanislav Perencevic	Gunter AG&Co KG
Michael Taras	Carrier
Massoud Neshan	

**3. Establish Quorum Requirements**

Voting members present were: Amir Jokar, Jim Bogart, John Thome, Andreas Knoepfler, Samuel Yana Motta, Ken Schultz, Joe Huber, Dan Kihm, Zahid Ayub, and Satheesh Kulankara. Voting members absent were: James Bryan, Art Fovargue, and Harry Li. With ten of thirteen voting members present, the quorum was satisfied.

Votes below are listed as [for-against-abstain] and should add up to ten.

**4. Review/Approve Previous Meeting Minutes**

Minutes from the previous meeting (Salt Lake City) were circulated prior to the meeting. The committee voted [9-0-1] to approve the minutes as circulated. Abstention was due to momentary absence from the room. Meeting minutes will become official and re-circulated.

**5. Chairman's Comments**

Amir Jokar shared a number of comments:

- Nomination form is available for the Hightower Award (for excellence in service in the area of TC/TG/TRG technical leadership and contribution). Requirements for nominations are available on the ASHRAE website. The 2008/2009 winner is Chris Wilkins from TC 4.1.

- TC8.5 has a number of subcommittee chairs that need to be filled. Both the Program subcommittee chair and the Standards subcommittee chairs have been vacated. After soliciting volunteers, Omar Abdelaziz agreed to serve as the Program subcommittee chair and Joe Huber agreed to serve as Standards Subcommittee chair.
- The Vice Chairman position for TC8.5 is also currently vacant, as Amir is starting his first term as committee chairman. Ben Dingel suggested he would be willing to serve as secretary for the current ASHRAE year (January and June), then become vice-chair for the 2010 year, during the second year of Amir's position of Chairman. This will open up the issue of finding someone else to fill in for the secretary duty following the June committee meeting.

**6. Section Head Comments**

Vin Gupta (Section 8 head) offered the following comments:

- Appreciation and thanks was expressed for the leadership and work that has been exhibited by TC8.5.
- Three specific objectives were outlined by Vin (in accordance with a "manage by objectives" philosophy) that should be given due attention by the committee. First, the membership of the committee should be appropriately managed by keeping the membership roster complete, up to date, and with no vacancies in major positions. Second, the Committee Activities Sheet needs to be filled out and submitted by Tuesday evening following each TC meeting. Lastly, the TC website needs to be up to date and complete per ASHRAE's policies. Vin offered the comment that following a recent audit of all TC websites by TAC, the TC8.5 website was listed as "totally complete" and "totally up to date".

**7. Comments from Liasons (Handbook, Standards, Journal, Research, Program, TEGA, Technical Services, Refrigeration)**

Harris Sheinman, Handbook – TC8.5 is responsible for Chapters 38 and 41 in the 2012 Systems and Equipment Handbook. Deadline for revisions is June 2011. Revision timeline has been provided to subcommittee chairman Jim Bogart. The College of Fellows will be reviewing chapters, meaning there may be an increased chance for feedback on handbook material. Also, it was suggested that the 2012 handbook "may" be a web-based product and the 2016 Systems handbook "will" be a web-based product. 2009 Fundamentals is planned to be a beta test of the online version of the handbook.

**8. Handbook Subcommittee Report**

TC8.5 is responsible for two chapters in the HVAC Systems and Equipment Handbook – Condensers and Liquid Coolers. Jim Bogart reported that one reviewer did leave positive feedback on updates made to the 2008 version. Following a request for members, Justin Kaufman and Kash Oza volunteered to assist Jim on the Handbook subcommittee.

**9. Program Subcommittee Report**

Ex-subcommittee chair and current chairman Amir Jokar reported on Program status.

TC8.5 co-sponsored Seminar 51 "Nanofluids for HVAC&R?" at the Salt Lake City meeting, and it was well received. Of attendees, 16 people filled out feedback forms. Of those, 77% voted the program as the "Best of Meeting". A CFD seminar was requested for both Salt Lake City and the current Chicago meeting, but was refused.

Upcoming deadlines include Transaction Sessions Proposals (Orlando) due Feb. 15, with papers due by May 1.

Two current TC8.5 research projects are working with natural refrigerants, which could serve as the basis for a future program. Papers have been submitted to ASHRAE for publication, so it is not clear what the appropriate venue for presentation would be. Amir will follow-up and make a proposal for a seminar as appropriate.

Audio recording of seminars is moving forward as the standard ASHRAE practice.

Future ideas for programs were discussed briefly. It was tentatively suggested that a seminar titled "Recent Advances in ASHRAE Heat Transfer and Fluid Flow Research" would be submitted for the Louisville meeting.

**10. Membership Subcommittee Report**

Subcommittee chair Kash Oza reviewed the list of current members. It was reported that following this meeting the committee will consist of 29 corresponding members, 1 provisional corresponding member, and 12 voting members. Provisional members can be assigned by ASHRAE staff and have a 2 year term. Dan Kihm will be stepping down as a voting member to corresponding member following the meeting.

Omar Abdulaziz will be added to the committee as a corresponding member. Omar will be taking over the Programs subcommittee responsibilities from Amir.

It was mentioned that members can check their membership status with TC8.5 on the ASHRAE website. From the ASHRAE website, go to "Manage your membership", find the "Biographical Record System" and look for "My Committee". This can be used for members to identify roster mistakes.

**11. Standards Subcommittee Report**

No new information to report.

**12. Journal/Insights/Webmaster Subcommittee Report**

Webmaster Joe Huber reported that he continues to update the committee website as needed.

Please contact Joe with material to publish or with any website errors or omissions. The URL for TC 8.5's website is: <http://www.tc85.ashraetcs.org/>.

**13. Research Subcommittee Report**

In addition to the discussion of specific research projects (see below), Research Subcommittee Chairman Ken Schultz reported on information shared at the Research Chair Breakfast. The following text was provided by Ken following the meeting, but was summarized and discussed during the meeting:

*The business section of the research breakfast was shortened to allow time for a presentation on the status of the next Research Strategic Plan 2010-2015. RAC is holding a meeting on Feb 23rd; the deadline for submitting new RTAR's and WS's for consideration at this meeting is Feb 9th. WS's approved at the Feb meeting could go out for bid this spring as there is money available in the research budget. The next opportunity/deadline for submitting RTAR's and WS's is May 15th. RAC is encouraging that WS's should call out intermediate goals and objectives that can be monitored and used to ensure projects stay on track. How to do this was left quite open. PMS chairs were asked to make sure the "Disposition of*

ASHRAE Research” form is filled out and submitted to MORTS following the completion of projects.

#### *Research Strategic Plan (RSP) 2010-2015*

*RAP recognizes the value of and need for two types of research: tactical and strategic. Tactical research is analogous to battle field activities – actions taken to get done the work that is needed. The TC’s have been very good in doing the tactical research that drives ASHRAE. On the other hand, ASHRAE has not done so well with strategic research – the high level view that gives purpose to the organization.*

*With development of the new plan, RAP is taking this opportunity to look at things from a broader perspective and to look for strategic opportunities. The desire is to achieve a balance between tactical and strategic research. The strategic side is to provide guidance, motivation, and prioritization for the tactical work and open opportunities for broader scope, larger dollar, multi-TC projects.*

*To help provide guidance during development of the plan, RAP conducted a survey of members. 388 were received comprising 187 TC/TG/TRG members representing 100 of the 103 committees. The full report of the survey can be found at <http://www.ashrae.org/RSPsurveyresults>. The top issues among respondents were energy efficiency, energy conservation, and indoor air quality.*

*A list of 11 goal topics has been drafted to capture the results from the survey and other input. Each goal topic will have a champion assigned to it. The topics are still generic and TC’s will be asked to provide input to frame them further. The 11 topics are:*

- 1. Maximize actual operational energy performance of buildings and facilities.*
- 2. Progress toward cost-effective net-zero energy buildings.*
- 3. Residential retrofit energy efficiency.*
- 4. Quantification of IEQ benefits.*
- 5. Energy standards development, compliance, and enforcement.*
- 6. Building information modeling (BIM) of energy efficient, high performing buildings.*
- 7. Load calculation methods, energy calculation methods, and design procedures suitable for low energy and net-zero energy buildings.*
- 8. Natural refrigerants and refrigerant charge reduction.*
- 9. Improve specific components of HVAC&R systems.*
- 10. Support Advanced Energy Design Guides.*
- 11. Transform engineering and architectural education.*

*At this point, TC 8.5 has been identified as a contributor to goal topics #8 and #9. These seem quite clear and logical. The champion for “natural refrigerants ...” is Zahid Ayub. The champion for “components” is Wayne Reedy. Ultimately, the RSP is expected to be divided into two categories: work to be done within the existing funding stream and goals for which additional funding will be sought. The thought is that roughly half of the research budget (currently \$2.5M) will be directed toward tactical projects and the other half allocated to the larger strategic projects. Outside agencies have said that it would be easier to support a bigger, broader “strategic plan” than tracking 100’s of tactical projects.*

*The schedule is tentatively laid out as follows... Jan-May 2009: Goal champions hold discussions with TC members and others to quantify scope, benefits, costs, etc. The RSP draft with goals, but not prioritized, will be written. In Jun09, RAP will prioritize goals. Jul09-Mar10 will be used to review and revise the document that will be submitted to RAC and Tech Council in April 2010. Approval is targeted for Jun 2010.*

Following is a summary of TC8.5 sponsored research projects and the status of each project.

1316-RP – Experimental Evaluation of the Heat Transfer Impacts of Tube Pitch in a Highly Enhanced Surface Tube Bundle

Current Status: Active

At the research review meeting, Steve Eckels presented an update and overview of the progression of this research project. Bruce Babin, the original Principal Investigator, has left Kansas State University. Steve Eckels will serve as Principal Investigator for the remainder of the project. As reported in the previous meeting, pool boiling tests have been completed for both enhanced and smooth tubes in both R134a and R123. Two journal papers have been written for publication. After an initial failure a new, more robust and more manufacturable bundle test vessel was designed and constructed. The current project extension lasts until the summer of 2009, but the planned schedule for the project will likely require that another extension to be discussed at the next meeting.

1345-RP – Waterside Fouling Performance of Brazed-Plate Type Condensers in Cooling Tower Applications

Current Status: Active.

The Principal Investigator for this project is Lorenzo Cremaschi at Oklahoma State University. A presentation was given during the Sunday research review which summarized the status. After review of the test matrix by the PI and the PMS, test conditions for the project were modified from the original plan. Two conditions, representing an "ARI-like" and a "high" heat flux/temperature application will be examined. The water flow rate will be fixed (3 gpm/ton), as will be the cooling water inlet temperature (85°F) and entering refrigerant superheat (65°F). The difference between the two test conditions will be the refrigerant saturation temperature, which will be either 105°F or 120°F. An analysis run on the revised operating conditions indicates that the uncertainty in the fouling factor could be up to 38% at the "ARI" operating point and 19% at the higher heat flux/temperature condition assuming a nominal fouling factor of .00025 is reached.

The test facility is constructed and has been modified to be able to test two heat exchangers at one time. Preliminary heat balance and instrumentation checks have been conducted on the facility.

1394-RP – Study of Carbon Dioxide Condensation in a Chevron Angle Plate Geometry Exchanger

Current Status: Active

The Principal Investigator for this project is Amir Jokar at WSU-Vancouver. Current project status was summarized at the Sunday research review. Single-phase testing of the various plate configurations has been completed using a modified Wilson plot technique. Single phase correlations for water and dynalene as the working fluid have been developed, although the same correlation does not apply for both working fluids. A paper describing this work has been submitted and accepted for publication. The two-phase facility is ready for data collection.

Dynalene has been used as a working fluid in this project, but a concern with its compatibility with test equipment/test samples has been identified. Over time, the dynalene used in the test loop has become green. Alternatives for either the heat exchanger or an alternate fluid may be considered.

Fouling of Tube-in-Tube Type Condensers

Jim Bogart has been tasked with writing the RTAR for this project. HTRI has expressed interest in doing this project. ARTI has indicated co-funding might also be available for this

project. It was suggested that this project would be a logical successor to the currently active project on fouling in brazed plate heat exchangers, therefore further progression of this project through the committee hinges partially on the results of 1345-RP.

#### Future Research Projects

One recurring suggestion has focused on continuing to examine water-side fouling in enhanced tubes on a more fundamental level and completing the experimental study of fouling on enhanced tube surfaces that was left largely unfinished by RP-1205. This type of work could focus on creating a more fundamentally based model for fouling that could be used in place of a generic fouling factor "constant". As with tube-in-tube heat exchanger fouling, it was suggesting that progression of this project through the committee should be at least partially dependent on the results and progression of 1345-RP in order to demonstrate that a fouling study can produce meaningful results and be completed successfully.

Jon Hartfield has written an RTAR titled "Characterization of Liquid Refrigerant Flow Emerging from a Flooded Evaporator Tube Bundle" This RTAR (1556) was approved by TC 1.3 in August of 2008 and accepted by RAC during the October meeting. Jon has since circulated a draft work statement for review by TC 1.3 members. Jon is looking for and has received feedback on the work statement from both TC 1.3 and TC 8.5 members. The project is aimed at examining the size and velocity of particles leaving the top of a flooded evaporator tube bundle. After some discussion, Ken Schultz moved that TC8.5 should co-sponsor the research project, pending review of the final work statement. The motion was seconded by Satheesh and passed unanimously [8-0-2] with two abstentions due to early departure from the meeting. Jon will revise the work statement based on feedback and it will be circulated to committee members when complete.

Dr. Jamal Yagoobi submitted an idea to the committee titled "Enhancement of Internal Flow Heat Transfer Coefficient with Micro-Encapsulated Phase Change Material". A PhD student recently completed a project in this area. The research consists of seeding particles which encapsulate a phase-change material in a working fluid. The additional latent heat available inside the particles enhances the effective heat transfer coefficient of the fluid under certain conditions. Dr. Yagoobi suggested that he would like to look at applying this technique to flow and heat transfer conditions that would be representative of equipment used/manufactured by ASHRAE members. Dr. Yagoobi was asked to send a copy of the thesis abstract and literature review to the research chair. There was some discussion on whether this work might be of a more fundamental level that would better be done under TC 1.3, at least initially. This topic will be brought to TC 1.3 for discussion.

With the recent development of new refrigerants with low direct GWP (HFO 1234ze), Samuel Yana-Motta offered the idea that determination of the heat transfer characteristics of these new refrigerants would be of benefit to the ASHRAE community. Again, there was some discussion about the level of this work and whether it best fit with the scope of TC 1.3 or TC 8.5.

**14. New Business**

No additional new business.

**15. Schedule Next Meeting**

The next committee meeting will be held on June 22, 2009 at 4:15 PM in Louisville, KY.

**16. Adjourn**

The meeting was adjourned by unanimous vote [10-0-0] at 6:20 pm.