

**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 1, 2005

TC/TG/TRG TITLE Liquid to Refrigerant Heat Exchangers

DATE OF MEETING Monday, February 7, 2005 LOCATION Orlando, FL

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Jim Bogart	2003	Steve Eckels	2004	Andreas Knoepfler
Axel Kreigsmann	2004	Jamal Yagoobi	2004	Justin Kauffman
Ben Dingel	2002			Mike Rumfola
Petur Thors	2001			Eric Mencke
Zahid Ayub	2001			Amir Jokar
Mahesh Valiya-Naduvath	2004	<i>Corresponding Members:</i>		Joachim Claesson
Kash Oza	2004	Nabil Hanna	2003	Gerhard Schuez
John Thome	2003	James Larson	2001	Robert Tatara
Josua Meyer	2001	Parviz Payvar	2002	Shin-Min Tzuoo
<i>Corresponding Members:</i>		Keith Starnier	1999	Gregory Zdaniuk
Ken Schultz	2003	Michael Ohadi	2001	Jason Oliver
Joe Huber	2003	James Bryan	2004	Harry Li
Satheesh Kulankara	2003			Mark Adams
Art Fovargue	2004			
Louay Chamra	2004			
John Judge	2004			
Olivier Pelletier	2004			
William McQuade	2002			
Samuel Yana-Motta	2004			

DISTRIBUTION

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

TAC SECTION HEAD:	Janice C Peterson
TAC CHAIR:	William P Bahnfleth
ASHRAE MANAGER OF RESEARCH AND TECHNICAL SERVICES:	Michael R. Vaughn, P.E.
ALL COMMITTEE LIAISONS AS SHOWN ON TC/TG/TRG ROSTERS:	William Walter —Handbook Liason Brian Dougherty —Standards Liason Jeff Traylor —Program Liason Thomas Kuehn —RAC Research Liason Kimball Ferguson —Special Publications Liason Mark Hydeman —Professional Development Comm (Educ) William Klock —Chapter Technology Transfer 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

February 7, 2005

2005 ASHRAE Winter Meeting, Orlando, FL, February 5-9, 2005

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

Chairman Jim Bogart called the meeting to order at 4:26 PM. The scope of TC 8.5 is: "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:

Jim Bogart	Flat Plate, Inc 2161 Pennsylvania Ave York, PA 17404
Ben Dingel	The Trane Company 3600 Pammel Creek Road La Crosse, WI 54601
John Thome	Swiss Federal Institute of Technology Lausanne, Switzerland 1015
John Judge	York International P.O. Box 1592-191A York, PA 17405
Mahesh Valiya Naduvath	York International 631 S. Richland Ave. York, PA 17403
Samuel Yana	Honeywell 20 Peabody St. Buffalo, NY 14210
Louay Chamra	Mississippi St. University 210 Carpenter Eng. Bldg. Mississippi State, MS 39762
Josua Meyer	University of Pretoria Pretoria, South Africa 0002
Ken Schultz	The Trane Company 3600 Pammel Creek Road La Crosse, WI 54601
Zahid Ayub	Isotherm, Inc. 3305 Thorntree Ct. Arlington, Texas 76016

Kash Oza	Standard Refrigeration Co. 2050 N. Ruby St. Melrose Park, IL 60160
Petur Thors	Wolverine Tube Inc. 2100 Market St. NE Decatur, AL 35601
Axel Kriegsmann	Wieland-Werke AG Seidlheck 7 Ulm, Germany D89081
Joe Huber	Ketema LP 2300 W. Marshall Grand Prairie, TX 75051
Satheesh Kulankara	York International 631 S. Richland Ave.-191A York, PA 17403
Andreas Knoepfler	Wieland-Werke AG Graf-Arco Str. 36 Ulm, Germany D-89079
Gerhard Schuez	Wieland-Werke AG Graf-Arco Str. 36 Ulm, Germany D-89079
Ralph Briesch	SWEP 3483 Satellite Blvd. Duluth, GA 30096
Art Fovargue	James Madison University MSC 7702 Harrisonburg, VA 22807
Justin Kauffman	York International 631 S. Richland Ave. York, PA 17403
Mike Rumfola	SWEP 41 Montrose Ave. Buffalo, NY 14214
Eric Mencke	SWEP International Hjalmar Brantings Vag Landskrona
Ollivier Pelletier	SWEP International Hjalmar Brantings Vag Landskrona
Amir Jokar	IER Kansas State University Manhattan, KS 66503

Joachim Claesson	Royal Institute of Technology Brinellv. 60 Stockholm, Sweden 10044
Robert Tatara	Northern Illinois University 315 Gilbert DeKalb, IL 60115
Shin-Miin Tzuoo	Wolverine Tube 2100 Market St. NE Decatur, AL 35602
Gregory Zdaniuk	Mississippi State University PO. Box ME Mississippi St., MS 39762-5925
Jason Oliver	Mississippi State University PO. Box ME Mississippi St., MS 39762-5925
Harry Li	Carrier Corporation 6304 Thompson Road Syracuse, NY 13090
Mark Adams	York International PO Box 1592 York, PA 17405
Bill McQuade	York International PO Box 1592-191A York, PA 17405

3. Establish Quorum Requirements

Voting members present included: Jim Bogart, Ben Dingel, Zahid Ayub, Josua Meyer, John Thome, Petur Thors, Axel Kriegsmann, Mahesh Valiya Naduvath, and Kash Oza. Nine of the eleven voting members (two of which are international members) were present, establishing the quorum.

4. Review/Approve Previous Meeting Minutes

Previously circulated minutes from the Anaheim (Winter 2004) meeting were unanimously approved with a correction made by Art Fovargue.

5. Chairman's Comments

Jim Bogart made a point to review a few procedural items from the Technical Committee Manual of Procedures (MOP). Particular note was made of the requirement "for approval of work statements, research proposals, final reports, handbook chapters, special publications, and matters related to standards and guidelines", which is affirmative votes by at least 2/3 of voting members (voting members and international members present at meeting). "Reasons for negative votes and abstentions for these types of motions shall be recorded and transmitted along with the motion to the next approving body as additional information." (quotes from MOP – Revised 04-10-04)

Additional comments were covered under the appropriate agenda items.

6. **Section Head Comments**

None.

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

None.

8. **Handbook Subcommittee Report**

Handbook subcommittee chairman Louay Chamra reported that the next handbook revision of relevance is the 2008 Systems and Equipment Handbook. Chapters 35 (Condensers) and 37 (Liquid Coolers) are the two chapters for which TC8.5 has responsibility. Any suggestions for revisions are needed by 2006.

Recent revisions were published in the 2004 Handbook, some of which were made without the review of TC8.5. Louay asked for volunteers to read the current chapters and suggest any changes. Josua Meyer, John Thome, Jim Bogart, and Art Fovargue all offered to provide assistance.

9. **Program Subcommittee Report**

Due to a change in employment, the existing Program Subcommittee Chairman, Rusty Smith, will no longer be part of TC8.5, leaving a vacancy for this subcommittee chair. Jim reported that a Seminar was scheduled for this meeting, but it was bumped by ASHRAE due to space limitations. Joe Huber has volunteered to chair the Seminar, which will be a summary of research conducted on TC8.5/TC1.3 sponsored research projects. A motion to reschedule this Seminar for the Denver Summer 2005 meeting was made and passed unanimously.

The working title for this seminar is: "Recent ASHRAE Research in Thermal and Fluid Flow Characteristics of HVAC, Refrigeration and A/C Processes".

10. **Membership Subcommittee Report**

The following individuals were discussed as potential new members: Harry Li from Carrier Corporation, Ty Newell from the University of Illinois, and Alison Andrews from ARI. Chairman Jim Bogart, with the unanimous approval of the committee, promoted all three to corresponding member status.

Kash Oza reported that the roster now has 29 members, with 11 voting members. The roster includes 9 university-affiliated members, 1 member from ARI, and 19 industrial members.

The voting members for the rest of the current 2004-2005 year are: Jim Bogart, Ben Dingel, Zahid Ayub, Josua Meyer, John Thome, Petur Thors, Steve Eckels, Axel Kriegsmann, Jamal Yagoobi, Mahesh Valiya-Naduvath, and Kash Oza. Beginning July 1, Petur Thors, Zahid Ayub, and Josua Meyer will be rolling off as voting members. Louay Chamra and Art Fovargue requested to begin new terms as voting members.

11. **Standards Subcommittee Report**

A teleconference was held between members of ASHRAE and ASME to discuss the proposed standard for a Method of Testing (MOT) that would accompany ARI Standard 400-2001 LIQUID TO LIQUID HEAT EXCHANGERS. The discussion focused on the similarities between this proposed standard (SPC-181) and the existing ASME standard PCT12.5. It was determined that the desired outcome was an ASHRAE specification specifically meant to accompany the ARI standard, similar to existing two-phase heat exchanger standards. However, because of the significant overlap, a new purpose and

scope that will limit the standard to air conditioning and heating applications must be drafted.

12. Journal/Insights/Webmaster Subcommittee Report

Joe Huber reported that the TC8.5 website is running and follows the recommended ASHRAE format. The website is available at <http://tc85.ashraetcs.org/>. The website includes a protected area that can be used for official committee business if needed.

13. Research Subcommittee Report

Ken Schultz shared a number of general items related to ASHRAE research.

- ASHRAE continues to work on a new Research Strategic Plan to guide the selection of future research projects. Currently, feedback is being solicited on a draft release, with final approval expected at the 2005 summer meeting in Denver.
- The key to getting approved research projects will be the RTAR. The RTAR should be strong enough to justify the project on its own and is expected to include more substantive information than in the past. If the RTAR is approved, then it is technically just a matter of proceeding through the system. Approved RTARs should nearly always result in funded research projects.
- RTARs will be reviewed 3 times per year, starting in October of 2005.
- There will be a 2-year limit from RTAR acceptance to when a work statement must be delivered.
- Finally, it was reported that the research “hopper” remains empty at this time—there is no current wait for funding of approved projects.

TC 8.5 currently has one active research project, one project that just completed the bidding process (considered a tentative research project – TRP), one project with a conditionally approved work statement, one approved RTAR for which a draft work statement has been completed, and one additional approved RTAR awaiting the completion of a work statement. The following is a summary of research projects and the status of each project.

RP-1205 – Water-side Fouling Inside Smooth and Augmented Copper Alloy Condenser Tubes in Cooling Tower Water Applications

Current Status: Active

PMS chair Art Fovargue reported on the progress of this project, which has entered the testing phase. Initial fouling tests under low velocity conditions began in September and results were presented at the research review meeting. Fouling resistances varying from 0.0001 to 0.00025 hr-ft²-F/Btu were calculated. An experimental uncertainty analysis was completed, indicating an uncertainty of +/-18% on the calculated fouling resistance. Test data showed some tubes exhibiting erratic behavior (a decrease in fouling resistance!) that was explained in one particular case by a leak in the test loop. Other erratic behavior of the data may have been caused by interruptions to the chilled water supply to the test loop. In addition to these questions about the data, test conditions did not match the stated saturation temperature requirements, so the PMS has requested that these initial tests be rerun.

A number of items were suggested to improve the consistency and acceptance of future tests. It was noted that the installation direction of the tubes might possibly impact the results of the test, so the flow direction will be standardized for all tube samples in future testing. The principle investigator (Louay Chamra) will provide data updates to PMS members on a weekly basis so any concerns about the quality of the data can be addressed as quickly as possible. Also, Axel Kriegsmann volunteered to provide guidance as to the predicted magnitude of heat transfer from the sample tubes as a check against experimental values.

The committee has also begun finalizing “medium” and “high” fouling constituent levels for future testing. The current contract extension is to May 31, 2005. Due to the amount of work remaining, it is unlikely that the project will be finished by that time. A motion was made to recommend a 1-year no-cost extension for this project. Motion passed unanimously.

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

Current Status: RTAR written and accepted by ASHRAE (RTAR# 2004-39) for priority status. Work Statement written, approved, and published as a Request for Proposal (RFP).

The PES (Project Evaluation Subcommittee) for this project consists of Petur Thors, Satheesh Kulankara, Ben Dingel, and Louay Chamra. The PES, the TC8.5 research chair, and the Section 8 research liaison met prior to the committee meeting to discuss the bids which were received for this project. The PES reported its unanimous recommendation to the committee. Other details concerning the bids will remain confidential until the project is officially awarded. A motion was made by Ben Dingel that the PES recommendation be accepted and that the acceptance of the selected proposal be forwarded appropriately for final approval. The motion was seconded by Mahesh Valiya Naduvath and approved by a vote of 8 for, 0 against, and 1 abstention (John Thome – project bidder).

1324-WS – Study of Single-Phase Flow-Induced Tube Vibration in Shell and Tube Heat Exchangers

Current Status: RTAR written and accepted by ASHRAE (RTAR#2004-38) – not prioritized. Work Statement written and conditionally accepted by ASHRAE.

Following the Sunday research review, a number of items were discussed by interested TC8.5 members related to adjustments/clarifications requested by the Research Administration Committee (RAC) in their conditional approval of this work statement. Anticipated work statement changes include an increase to the budget (\$190,000) and the project duration (30 months). Also suggested by the RAC was to add some specificity as to the type of tubes to be used in the study. An additional concern, expressed both by RAC and TC8.5 members, is the difficulty of obtaining a system capable of circulating the amount of refrigerant needed for the experimental work described in the work statement, as it is likely to be expensive. The work statement will be clear that this cost is not included in the project budget, but that equipment might be obtained from manufacturers associated with ASHRAE. Although it is hoped that equipment donation from the HVAC industry will be possible, nothing significant has been identified to date.

A motion by John Thome was made to proceed with work statement submittal without further approval of TC8.5 after the current RAC questions are addressed by the work statement author. The motion was seconded by Petur Thors and approved by a vote of 8 for, 0 against, and 1 abstention (Mahesh Valiya Naduvath – Work statement author).

RTAR# 2004-40: Performance and Cleanability of Brazed-Plate Type Condensers Operating Under Fouling Conditions

Current Status: RTAR written and accepted by ASHRAE – not prioritized.

Jim Bogart has drafted a work statement and a copy was circulated for review by TC8.5 prior to the meeting. Kash Oza suggested that the title have similar wording to RP 1205, for the sake of consistency. Mahesh suggested to be sure and follow the latest work statement format recommendations from ASHRAE, as they have changed recently. John

Thome suggested an increase of the project time to 30 months. Multiple committee members, based on recent work statement feedback from RAC and our research liaison, stressed that the Justification section needs to spell out clearly the benefit of the project to ASHRAE and its stakeholders. Any other comments should be emailed to Jim Bogart.

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

Current Status: RTAR written and accepted by ASHRAE.

This RTAR was written and circulated to TC8.5 via email in July of 2004. The RTAR was approved by the committee via electronic vote by a count of 12 for, 0 against. The RTAR was subsequently submitted to and approved by ASHRAE RAC. This project is now in need of a work statement. Zahid Ayub to pursue the drafting of a work statement.

Research Plan

The status of the current TC 8.5 research plan and proposed research topics were discussed. Additional research projects being considered by TC8.5 are:

Fouling of Tube-in-Tube Type Condensers

This potential research project was submitted to the committee as a request from ARI through Chairman Jim Bogart. Currently, there are no guidelines for fouling that apply to this particular application other than a presumably inappropriate guideline for water inside straight tubes. ARI is concerned about the lack of information for this application. Because of the involvement of ARI and the similarity of this potential project to current and proposed TC8.5 research projects on fouling, it is likely a strong justification can be made for ASHRAE to support this project. A motion was made by John Thome to add the general topic of waterside fouling of coiled tube-in-tube type condensers to the TC8.5 research plan. The motion was seconded by Ben Dingel and approved unanimously.

Electrostatic Removal of Contaminants from Refrigerant Flows

Current Status: RTAR written by Jamal Yagoobi.

Previously, an initial RTAR draft was circulated to the committee. Although this topic is listed on the TC8.5 research plan, there was general concern by the committee that this topic does not fall within the scope of TC8.5. A motion was made to remove this topic from the TC8.5 research plan and to refer the RTAR draft for consideration by TC3.3 (Refrigerant Contaminant Control). The motion passed unanimously.

Heat transfer enhancement of in-tube evaporation and condensation through the use of liquid phase EHD pumping.

Current Status: Awaiting writing of RTAR

14. New Business

Currently, James Bryan is the Vice-Chairman of TC8.5, but he would prefer not to be elevated to Chairman in 2005. Jim Bogart offered to remain as committee chairman for an additional year (2005-2006). John Thome moved to accept the offer by Jim to remain as TC8.5 chairman for the next year of service. The motion was seconded by Petur Thors and passed unanimously.

15. Schedule Next Meeting

The next meeting will be held on June 27, 2005 at 4:15 PM in Denver, CO.

16. Adjourn

At 6:39 PM the meeting was adjourned by unanimous vote.

ASHRAE TC/TG/TRG ACTIVITIES SHEET

DATE: February 7, 2005

TC/TG/TRG NO.: TC 8.5 TC/TG/TRG TITLE: Liquid-to-Refrigerant Heat Exchangers

CHAIRMAN: Jim Bogart VICE CHAIRMAN: James Bryan SECRETARY: Ben Dingel

TC/TG/TRG MEETING SCHEDULE				
Location-Past 12 Months	Date	Location-Planned Next 12 Months	Date	
Orlando	Feb 2005	Denver	June 2005	
Nashville	June 2004	Chicago	Jan 2006	
TC/TG/TRG SUBCOMMITTEES				
Function		Chairman		
Program		Vacant		
Membership		Kash Oza		
Research		Ken Schultz		
Handbook		Louay Chamra		
Standards		James Bryan		
Journal/Web/Insights		Joe Huber		
RESEARCH PROJECTS-CURRENT				
Project Title	Contractor	Monitoring Comm. Chpt.	Report Made At Meeting	
RP 1205 Waterside Fouling Inside Smooth and Augmented Copper-Alloy Condenser Tubes in Cooling Tower Water Applications.	Mississippi State University	Art Fovargue	No	
1316-TRP Experimental Evaluation of the Heat Transfer Impacts of Tube Pitch in a Highly Enhanced Surface Tube Bundle	N/A Work Statement approved and released for bid.	Petur Thors	N/A	
1324-WS Study of Single-Phase Flow-Induced Tube Vibration in Shell and Tube Heat Exchangers	N/A Work Statement is conditionally approved. Expected to be eligible for bidding in early 2005.	N/A		
LONG RANGE RESEARCH PLAN				
Rank	Title	W/S Written	Apprv.	To R&T
1.	Performance and Cleanability of Brazed-Plate Tybe Condensers Operating Under Fouling Conditions	Draft	No	No
2.	Study of Carbon Dioxide Condensation in a Chevron Angle Plate Geometry Exchanger	No	No	No
3.	Heat Transfer Enhancement of In-tube Evaporation and Condensation Through the Use of Liquid Phase EHD Pumping	No	No	No
				No

(OVER PLEASE)

HANDBOOK RESPONSIBILITIES					
Year & Volume	Chapter	Title	No.	Deadline	Handbook Subcom Liaison
2008 Systems	Chapter 37:	Liquid Coolers		7/31/07	William Walter
2008 Systems	Chapter 35:	Condensers		7/31/07	William Walter
STANDARDS ACTIVITIES-List and Describe Subjects					
Standard 22: No current activity					
Standard 24: No current activity					
Standard ??: Create new standard for Method of Testing for Liquid to Liquid Heat Exchangers (to accompany ARI standard 400)					
TECHNICAL PAPERS from Sponsored Research-Title, when presented (past 3 yrs. present & planned)					
TC/TG Sponsored Symposia-Title, when presented (past 3 yrs. present & planned)					
Advances in Thermal and Fluid Flow Characteristics of HVAC, Refrigeration and A/C Processes Honolulu, 2002					
TC/TG Sponsored Seminars-Title when present (past 3 yrs. present & planned)					
Recent ASHRAE Research in Thermal and Fluid Flow Characteristics of HVAC, Refrigeration and A/C Processes Denver, 2005					
TC/TG Sponsored Forums-Title, when presented (past 3 yrs. present & planned)					
JOURNAL PUBLICATIONS, when published (past 3 yrs. present & planned)					
<u>RP-984</u> An Investigation of Condensation Heat Transfer Performance of HFC-134a on Single Enhanced Tubes <i>International Journal of HVAC&R Research</i> Volume 9, Number 1/January 2003					
<u>RP-1089</u> Local Bundle Boiling Heat Transfer Coefficients on a Plain Tube Bundle <i>International Journal of HVAC&R Research</i> Volume 10, Number 1/January 2004					
Local Bundle Boiling Heat Transfer Coefficients on an Integral Finned Tube Bundle <i>International Journal of HVAC&R Research</i> Volume 10, Number 3/July 2004					
Local Bundle Boiling Heat Transfer Coefficients on a Turbo-BII HP Tube Bundle <i>International Journal of HVAC&R Research</i> Volume 10, Number 4/October 2004					

Submitted By: Ben Dingel