

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

**1791 Tullie Circle, N.E./Atlanta, GA 30329
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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 August 2, 2004

TC/TG/TRG TITLE Liquid to Refrigerant Heat Exchangers

DATE OF MEETING Monday, June 28, 2004 LOCATION Nashville, TN

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Jim Bogart	2003	John Thome	2003	
Art Fovargue	2000	Josua Meyer	2001	Mark Paquette
Ben Dingel	2002	John Judge	2000	Massoud Neshan
Petur Thors	2001	Louay Chamra	2000	Tony Jacobi
Zahid Ayub	2001			Tom Lestina
James Bryan	2000	<i>Corresponding Members:</i>		Bob Utter
		Nabil Hanna	2003	Andreas Knoepfler
<i>Corresponding Members:</i>		James Larson	2001	
Ken Schultz	2003	Parviz Payvar	2002	
Axel Kreigsmann	2000	Keith Starner	1999	
Joe Huber	2003	Michael Ohadi	2001	
Kash Oza	1999	Steve Eckels	2003	
Russell Smith	2003	Mahesh Valiya-Naduvath	2003	
Satheesh Kulankara	2003	William McQuade	2002	
		Jamal Yagoobi	2003	

DISTRIBUTION

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

TAC SECTION HEAD:	Eckhard Groll
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
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**AMERICAN SOCIETY OF HEATING, REFRIGERATION,
AND AIR-CONDITIONING ENGINEERS, INC.**

Minutes

Technical Committee 8.5

Liquid-to-Refrigerant Heat Exchangers

June 28, 2004

2004 ASHRAE Annual Meeting, Nashville, TN, June 26-30, 2004

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

Chairman Jim Bogart called the meeting to order at 4:22 PM. Although omitted after the initial call of the meeting to order, the scope of TC8.5 was later read aloud to the attendees. 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
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 Seldcheck 7 Ulm, Germany D89081
James Bryan	University of Missouri-Columbia Dept. Mechanical and Aerospace Engineering Columbia, MO 65211
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
Massoud Neshan	Wolverine Tube, Inc. 200 Clinton Ave. Suite 100 Huntsville, AL 35801
Tony Jacobi	University of Illinois 1206 W. Green St. Urbana, IL 61801
Mark Paquette	Intertek 3933 US Route 11 Cortland, NY 13045
Rusty Smith	SWEP 3483 Satellite Blvd. Suite 210 Duluth, GA 30019
Art Fovargue	James Madison University 1043 Chestnut Dr. Harrisonburg, VA 22801
Tom Lestina	HTRI 150 Venture Dr. Texas, 77845
Bob Utter	Innovative Thermal Solutions 3402 Chase Road Adrian, MI 49221

3. Establish Quorum Requirements

Voting members present included: Jim Bogart, Ben Dingel, James Bryan, Art Fovargue, Zahid Ayub, and Petur Thors. Six of the ten voting members (two of which are international members) were present, establishing the quorum.

4. Review/Approve Previous Meeting Minutes

Circulated minutes from the Anaheim (Winter 2004) meeting were unanimously approved.

Jim informed the secretary that all draft copies of minutes circulated prior to approval at the subsequent meeting should include a disclaimer stating "These draft minutes have not been approved and are not the officially approved record until approved by this committee."

5. Chairman's Comments

Jim Bogart passed along the following comments and information from the Chairman's breakfast. Additional comments were covered under the appropriate agenda items.

- There is a FAQ (Frequently Asked Questions) page on the ASHRAE website in which the responsibility for the answers is assigned to individual Technical Committees.

The section head will determine if TC8.5 is responsible for any of this material and inform the committee.

- Starting with this conference, Seminars are being videotaped and will be available through ASHRAE for a fee. Videotaping is not a formal requirement, and presenters may opt not to be recorded. Just prior to the meeting, of the 180 presentations that could be recorded, 100 had agreed to be videotaped, 50 had declined, and 30 had not yet decided. ASHRAE is contemplating recording Forums, but is concerned that may discourage free discussion of the attendees.
- With the reorganization of the Technical Committees, some concern was expressed about maintaining the continuity of Handbook chapter review/updates. Extra attention/cooperation by TCs may be required.

6. Section Head Comments

Eckhart Groll will be leaving his post as Section Head. The new section head will be Patricia Graef.

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

No liaisons were in attendance.

8. Handbook Subcommittee Report

Handbook subcommittee chairman Louay Chamra was not in attendance.

It was noted that the revisions made by TC8.5 were published in 2004 Systems and Equipment handbook.

As mentioned in Anaheim, portions of Chapter 35 were revised without the involvement of TC8.5. The extent of the revisions was not known by those in attendance.

Jim Bogart stressed the concept of making handbook chapters “living” documents rather than trying to review updates/changes at the last minute.

9. Program Subcommittee Report

The program subcommittee chair (Rusty Smith) reported that there are four confirmed speakers for a Seminar at the Orlando meeting. These include John Thome, Ty Newell, Steve Eckels, and Jamal Yagoobi. These speakers will present summaries of their research conducted on TC8.5/TC1.3 sponsored research projects. Joe Huber has volunteered to chair the symposium. Final plans and paperwork for this symposium need to be completed prior to an August 6 deadline.

Previous committee plans were to attempt to organize a Symposium for the Denver meeting. Due to the time required to prepare a Symposium, it was suggested that this direction should be changed to organize a Seminar instead. A motion was made by Jim Bogart to modify the committee plans and to organize a Seminar for the Denver meeting. The motion was seconded by Petur Thors and was passed unanimously. Zahid Ayub volunteered to chair the seminar. Deadline for Seminar submission for the Denver meeting is February 18, 2005.

The working title for these sessions is: “Recent ASHRAE Research in Thermal and Fluid Flow Characteristics of HVAC, Refrigeration and A/C Processes”.

10. Membership Subcommittee Report

Kash Oza reported that the current roster has 27 members, with 10 voting members. The roster includes 9 university-affiliated members and 3 international members.

The following members were deleted from the roster: Ralph Briesch, Ming Chyu, Neel Gupte, Mark Spatz, and Satish Oza. The following members were added as corresponding members: Samuel Yanna-Motta and Ollivier Pelletier.

As of July 1, the number of voting members will increase to 12. The voting members for the 2004-2005 year will be: Jim Bogart, Ben Dingel, Zahid Ayub, Josua Meyer, John Thome, Petur Thors, Steve Eckels, Axel Kriegsmann, Jamal Yagoobi, Rusty Smith, Mahesh Valiya-Naduvath, and Kash Oza.

11. Standards Subcommittee Report

James Bryan reported on the status of standard development for a Method of Testing (MOT) that would accompany ARI Standard 400-2001 LIQUID TO LIQUID HEAT EXCHANGERS. At the Anaheim meeting a TPS (Title, Purpose, and Scope) was approved by TC8.5 for this standard. Subsequently, the TPS was approved by the Planning, Policy and Interpretations Subcommittee (PPIS) of the Standards Committee with minor editorial changes and is awaiting approval by the Standards Committee.

12. Journal/Insights/Webmaster Subcommittee Report

Joe Huber reported that the TC8.5 website now follows the recommended ASHRAE format. The website is available at <http://tc85.ashraetcs.org/>. The website contains the same basic content as the previous one, but site navigation is slightly different. The website includes a protected area that can be used for exchanging files between those with access. Joe also requested that updates to the publication list be submitted to him so that the reference list for TC sponsored research can be kept up to date.

13. Research Subcommittee Report

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

- ASHRAE continues to work on a new Strategic Research Plan. Currently, a draft is planned for February with formal release at the 2005 summer meeting in Denver.
- It is intended that the research plan be reviewed on a 5 year cycle.
- The prioritization process for proposed research is being refined and formalized. Categories and weightings are being added. The top category (45% weighting) is "Does the project support the research plan". Others include: applications of benefits (10%), cofunding (10%), TC vote (10%), RAC vote(10%), Tech Council feedback (5%). The ranking system is being tested against past research projects to test suitability.
- The key to getting approved research projects will be the RTAR. The RTAR should be strong enough to justify the project on its own. 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. As reported previously, RTARs will have a new form and will have a 3 page limit
- All project recommendations made by RAC were approved by Tech Council this time around. The research "hopper" is empty – looking for new work statements. Next date for submission of RTAR's is August 1st. Given that the process takes time and that the membership of RAC changes with time, it is suggested that changes to RTAR's and WS's be tracked to help reviewers understand the history.

TC 8.5 currently has one project that was just completed, one active research project and three RTARs (one with priority) which have been accepted by ASHRAE. Of the three projects with approved RTARs, two projects have completed work statements and one project has a work statement that has been conditionally approved for bidding. The following is a summary of research projects and the status of each project.

RP 1089 “Flooded Evaporation Heat Transfer Performance Investigation for Tube Bundles Including the Effects of Oil Using R-410A and R-507A”

This project is complete. Several journal articles resulting from this research have already been published and more are expected.

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

Art Fovargue reported on this project, which saw little progress since the Winter Meeting in Anaheim. Test conditions for the project are set, including 9 internal tube surfaces and water velocities of 2, 5, and 7 ft/s. Since it is not possible to keep all variables of interest identical for each tube test section, the PMS has recommended that the saturation temperature and water velocity remain constant from test section to test section, while leaving water temperature and heat flux may be varied. The PMS has estimated the difference in heat flux needed to keep the saturation temperature constant for the different tubes. Due to the heat rejection requirements of the test sections, the experimental apparatus has been modified to use chilled water as a heat sink. “Shakedown” tests have been run to verify the operation of the experimental system. Unfortunately, some difficulties were encountered when a failure of the chilled water supply led to the bursting of a rupture disc in the refrigeration loop. In spite of this setback, the test apparatus is considered ready for use.

The PI (Louay Chamra) and PMS have been struggling with how to define the water chemistry requirements for three “test waters” containing various levels of fouling constituents – defining waters with “low”, “medium” and “high” fouling potential. Fortunately, the PMS has solicited the help of W.E. (Bill) Pearson II, CWT Director Consulting & Technical Services, Southeastern Laboratories, Inc. - Goldsboro, NC. Bill is an ASHRAE liaison with the Association of Water Technologies (AWT) and is involved with Technical Committee 3.6 “Water Treatment”. With Bill’s help, the PMS has agreed on a path to define the fouling constituent levels. The PMS will look at “source” water quality that will be “cycled up” or concentrated based on tools at Bill’s disposal that are used to predict water chemistry in typical cooling tower applications. These results will be compared to results of the previously conducted cooling tower water quality survey and constituent levels will be recommended to the PI. Because this project is focused on scaling and particulate fouling, Bill will also prescribe types and quantities of corrosion inhibitors and biocides that will be used in experimental tests. The level of additional treatments should be kept constant for all tests.

The PI was granted a six month no-cost extension at the last meeting. It is expected that an additional no-cost extension will be requested in order to complete the work, but it was not voted on at this meeting of TC8.5 due to the absence of the PI. An email ballot prior to the next meeting will be required.

WS# 1316 – 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 and approved by TC8.5 via email in November (9-for, 0-against, 2 abstentions). The work statement was submitted to ASHRAE on December 10 and was conditionally approved (pending minor revisions).

Required revisions include an increase in cost estimate, some expansion of the Justification section, and a statement outlining frequent PMS/PI interaction. Ben Dingel will make the required revisions and forward to Ken Schultz. After approval by TC8.5 (email ballot expected) the work statement will be forwarded to our Research Liaison.

RTAR# 2004-38 – Study of Single-Phase Flow-Induced Tube Vibration in Shell and Tube Heat Exchangers

Current Status: RTAR written and accepted by ASHRAE – not prioritized. Work Statement written and approved by TC8.5 via email in November (9-for, 0-against, 2 abstentions).

The work statement for this project has not yet been submitted. A necessary list of potential bidders needed for WS submittal was supplied by Mahesh. In addition, Ken has suggested including the type of general information requested by the RAC in their conditional acceptance of WS#1316. It is expected this work statement will be submitted prior to the end of the year.

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 and Rusty Smith are trying to draft a Work Statement. They would like to include some information based on the water chemistry test specifications used in RP-1205. In addition, there may be some opportunity to collaborate with TC6.8.

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:

Electrostatic Removal of Contaminants from Refrigerant Flows

Current Status: RTAR written by Jamal Yagoobi. An initial draft was circulated to the committee, but general consensus was that the RTAR needed more work.

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

Current Status: RTAR written by Zahid Ayub. Zahid will modify his current draft and it will be circulated for committee approval prior to the end of July. August 1 is the next deadline for submission to RAC. This research topic was previously titled “Evaluation of Enhanced Surfaces for Ammonia/Carbon Dioxide Cascade Condensers” in the previous research plan. A motion was made by Jim Bogart to change the name of this topic on our research plan to the updated RTAR title. The motion was seconded by Petur Thors and was 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

After some discussion, a motion to approve the following prioritization of TC8.5 research projects was made by Art Fovargue:

- #1: Experimental Evaluation of the Heat Transfer Impacts of Tube Pitch in a Highly Enhanced Surface Tube Bundle
- #2: Study of Single-Phase Flow-Induced Tube Vibration in Shell and Tube Heat Exchangers
- #3: Performance and Cleanability of Brazed-Plate Type Condensers Operating Under Fouling Conditions
- #4: Study of Carbon Dioxide Condensation in a Chevron Angle Plate Geometry Exchanger
- #5: Electrostatic Removal of Contaminants from Refrigerant Flows

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

The motion was seconded by Jim Bogart and approved unanimously.

There was some confusion as to what projects should remain on TC8.5's research priority list. It was decided that the tube pitch project (WS #1316) could be removed since the work statement has already been conditionally approved and the RTAR was accepted with priority. The updated TC8.5 Research Plan is therefore:

#1: Study of Single-Phase Flow-Induced Tube Vibration in Shell and Tube Heat Exchangers

#2: Performance and Cleanability of Brazed-Plate Type Condensers Operating Under Fouling Conditions

#3: Study of Carbon Dioxide Condensation in a Chevron Angle Plate Geometry Exchanger

#4: Electrostatic Removal of Contaminants from Refrigerant Flows

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

14. New Business

The section head is requiring that TC8.5 have a Vice Chairman, which for this committee is a position that has historically not been occupied. James Bryan agreed to accept the Vice Chairman position. A formal nomination was made in the form of a motion by Jim Bogart, which was seconded by Ben Dingel. The motion carried unanimously.

15. Schedule Next Meeting

The next meeting will be held on February 7 at 4:15 pm in Orlando, FL.

16. Adjourn

At 6:10 PM the meeting was adjourned by unanimous vote.

ASHRAE TC/TG/TRG ACTIVITIES SHEET

DATE: June 28, 2004

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	
Nashville	June 2004	Orlando	Feb 2005	
Anaheim	Jan 2004	Denver	June 2005	
TC/TG/TRG SUBCOMMITTEES				
Function	Chairman			
Program	Rusty Smith			
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	
WS 1316 Experimental Evaluation of the Heat Transfer Impacts of Tube Pitch in a Highly Enhanced Surface Tube Bundle	N/A Work Statement is conditionally approved. Expected to be eligible for bidding in the fall of 2004.	N/A	N/A	
LONG RANGE RESEARCH PLAN				
Rank	Title	W/S Written	Apprv.	To R&T
1.	Study of Single_Phase Flow-Induced Tube Vibration in Shell and Tube Heat Exchangers	Yes	Yes	No
2.	Performance and Cleanability of Braze-Plate Tube Condensers Operating Under Fouling Conditions	No	No	No
3.	Study of Carbon Dioxide Condensation in a Chevron Angle Plate Geometry Exchanger	No	No	No
4.	Electrostatic Removal of Contaminants from Refrigerant Flows	No	No	No
6.	Heat Transfer Enhancement of In-tube Evaporation and Condensation Through the Use of Liquid Phase EHD Pumping	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 Orlando, 2005					
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					

Submitted By: Ben Dingel