

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

Minutes

Technical Committee 8.5

Liquid-to-Refrigerant Heat Exchangers

Monday, June 24, 1996

ASHRAE Annual Meeting, San Antonio, TX, June 22-26, 1996

1. Introduction of Members and Guests/Signing of Attendance Sheets

Chairman Art Fovargue called the meeting to order at 4:15 PM. The agenda was presented. Members and guests introduced themselves. The following were present:

Keith Starner	York International Corp. PO Box 1592 York, PA 17404
Nabil Hanna	KOAX Corp. PO Box 1535 Oklahoma City, OK 73101-1535
Zahid Ayub	Thermofluid International Arlington, TX 76094-0685
Ram Laks	Dunham-Bush, Inc. 101 Burgess Road Harrisonburg, VA 22801-9700
Neel Gupte	Carrier
Satish Oza	Wieland America, Inc. 1052 Harvard Lane Buffalo Grove, IL 60089-4325
Parviz Payvar	Northern Illinois University Mechanical Engineering Dept. DeKalb, IL 60115-2854
Axel Kriegsmann	Wieland-Werke AG Metallwerke D-89070 Ulm, Germany
Joe Huber	Ketema Heat Transfer Div. 2300 W. Marshall Dr. Grand Prairie, TX 75051
Shane Moeykens	The Trane Company 3600 Pammel Creek Road La Crosse, WI 54601
Mark Spatz	Allied Signal 20 Peabody Street Buffalo, NY 14210-1523

Petur Thors	Wolverine Tube, Inc. 2100 Market Street, NE Decatur, AL 35601-2626
Kash Oza	Standard Refrigeration 2050 N. Ruby St. Melrose Park, IL 60160
Jim Conklin	Oak Ridge National Lab
Tony Jacobi	University of Illinois Urbana-Champaign
Richard Ertinger	Carrier Corp.
Jamal Seyed-Yagoobi	Texas Engineering Experiment Station Dept. of Mechanical Engineering Texas A&M University College Station, TX 77843-3123
S.A. Sherif	University of Florida Dept. of Mechanical Engineering Gainesville, FL 32611
Michael Pate	Iowa State University Mechanical Engineering Department 2095 Black Engr. Ames, IA 50011
John Kelly	Department of Mechanical Engineering 302 Durland Hall Kansas State University Manhattan, KS 66506
Steve Crown	University of Texas, Pan American
Mike Ohadi	University of Maryland Mechanical Engineering Department College Park MD 20742-3035
Jim Larson	The Trane Company 3600 Pammel Creek Road La Crosse, WI 54601-7511
Art Fovargue	Dunham-Bush, Inc. 101 Burgess Road Harrisonburg, VA 22801-9700

Art requested that members verify that the records had their correct address, phone and FAX numbers. If changes are needed please advise ASHRAE headquarters.

2. Establish Quorum Requirement

At the beginning of the meeting it was established that a quorum was present. Voting members present were K. Starner, N. Hanna, S. Oza, P. Payvar, M. Spatz, A. Fovargue and J. Larson. M. Ohadi arrived shortly after the start of the meeting.

3. **Review/Approve Atlanta Meeting Minutes**

Two corrections were made to the minutes of the Atlanta meeting:

1) Item 2 in the Long Range Research Plan was changed to "Waterside Fouling Inside Smooth and Augmented Condenser Tubes in Cooling Tower Water Applications".

2) The second project in Research Projects-Current should be RP-752.

After a motion by M. Spatz and a second by N. Hanna, the corrected minutes were accepted 7-0-0.

4. **Chairman's Comments**

A. Fovargue made the following comments from the Chairman's Breakfast:

- The R&T committee has been split into two groups; a Technical Activities Committee (TAC) and a Research Administrative Committee (RAC). Dick Hegberg will be the TAC Section Head for Section 8. Gil Avery will be the Research Liaison.
- August 12, 1996 is the final date to include items in the program for Philadelphia .
- The new Program Liaison is Chad Dorgan
- Handbook; '95 Applications and '96 Systems and Equipment will be offered on CD-ROM.
- The Research Plan is due August 1, 1996
- The ASHRAE Environmental Health Committee is available to help the TC with any work that involves environmental health issues.
- The number of meetings is increasing. Space for meetings in Philadelphia may be restricted. TC 8.5 will plan for a Research Project review meeting. We may need a Standards Subcommittee meeting, as well.
- The R&T meets next in October.

5. **Section Head's Comments**

Not Present.

6. **Comments from Liaisons (Handbook, Standards, Journal, Research, Program)**

None of the referenced liaisons were present.

7. **Handbook Subcommittee Report**

M. Ohadi reported that the 1996 Handbook updates of Chapters 35 and 37 are complete. They will be updated again in 2000.

8. **Program Subcommittee Report**

R. Laks reported that a Seminar; "Visualization of Two-Phase Flow Heat Transfer in HVAC Applications" was co-sponsored with TC 8.4 and TC 1.3 and a Symposium; "Heat Transfer and Fluid Flow Characteristics of Alternative Refrigerants and Refrigerant Mixtures" was co-sponsored with TC 1.3 during the summer meeting. Plans for the 1997 Winter meeting include:

Symposia: (1) "Heat Transfer and Fluid Flow Characteristics of Alternative Refrigerants/Refrigerant Mixtures";(2) "Visualized Heat Transfer and Fluid Flow Characteristics of Alternate Refrigerants and Refrigerant Mixtures"

Seminars: "Emerging Technologies in Heat Exchanger Design and Enhancement", "Visualization of Flow Boiling and Condensation of Alternate Refrigerants and Refrigerant Mixtures", "The Effect of Refrigerant Maldistribution on Evaporation and Condensation". (Subsequent to the meeting, "The Effect of Refrigerant Maldistribution on Evaporation and Condensation" was canceled.)

9. **Membership Sub-Committee Report**

S. Oza proposed two candidates for membership; Axel Kriegsmann, Wieland Germany, (International member) and Kash Oza, Standard Refrigeration, (Corresponding member). A motion was made by Z. Ayub, seconded by M. Spatz and approved by the committee (8-0-0) to accept the candidates as members. J. Seyed-Yagoobi; Texas A&M, indicated that he is interested in becoming a member and will submit the application and biographical information.

10. **Standards Sub-Committee Report**

S. Moeykens reported that the call for members for the SPC to revise Standard 24, Methods of Testing for Rating Liquid Coolers, was published in the ASHRAE Journal. ASHRAE has records of two volunteers. A. Fovargue, N. Gupte, and J. Huber are also processing applications for the SPC. S. Moeykens will follow up on the status of those applications with S. Deppen.

He also reported that Standard 22, Methods of Testing for Rating Water Cooled Refrigerant Condensers, has been reviewed and needs only minor editorial changes. The committee had no additional changes to recommend. J. Larson moved and K. Starner seconded, to reaffirm Standard 22 with minor changes. The motion passed 8-0-0.

11. **Journal/Insight Article Subcommittee**

J. Huber reported that he has received one response for a future article; W. Stecker has indicated that he will write an article, but the timing for the article is not yet firm.

12. **Research Sub-Committee Report**

K. Starner reported that the Long Range Research Plan last submitted in July 1995. will need to be updated and submitted to by July 15. He proposed:

1. Oil and Liquid Refrigerant Inundation in Condensers.
2. Effect of Immiscible, Insoluble Oils on Heat Transfer.
3. Waterside Fouling Inside Smooth and Augmented Condenser Tubes in Cooling Tower Water Applications.

A work statement for the first project is currently out for ballot. The third project should avoid duplicating the waterside fouling work which is continuing at Penn State.

A motion was made by K. Starner, seconded by Z. Ayub to include the three proposed projects in the Long Range Research Plan. The motion passed 8-0-0. A fourth project could be included in the plan. To be added, project suggestions would need to be sent to K. Starner so that he could get committee approval prior to July 15.

13. **751-RP: Effect of Oil on Heat Transfer in Flooded Evaporators**

A. Fovargue and P. Payvar reported that the additional tests recommended in Atlanta were run with R-123 and confirmed the row-by-row data previously reported. It is believed, based on data from other sources that vapor blanketing within the bundle is the cause of the irregular change in heat transfer coefficient from row-to-row. All testing with R-123 and Turbo-B II is complete. Data was taken with no oil, and three increasing oil concentrations. This results in local concentrations ranging up to 10%, measured in the bundle.

Testing with R-123 and 26 FPI tube has begun. The tests with no oil are complete.

The project has a no cost extension thru March, 1997.

14. **752-RP: Heat Transfer - Brazed Plate HX's**

P. Payvar reviewed the progress since the last meeting. The heat transfer coefficients are now being calculated using the measured pressure to determine the saturation temperature used in the LMTD equation, and the data has been extended to lower capacities, as requested by the committee. The data was presented only in a single plot of refrigerant side heat transfer coefficient vs. mass flux, for both evaporation and condensation for all superheat and subcooling values.

Evaporator freezing is occurring at the lower capacities because the capacity is being controlled by throttling the expansion valve. This also makes interpretation of the data difficult because the evaporator saturation temperature is then varying over a wide range.

The committee asked P. Payvar to request the following from B. Stewart:

- 1) Improve data presentation by plotting evaporator data separate from condenser data; plotting evaporator data against superheat as well as mass flux, plotting condenser data against subcooling as well as mass flux.
- 2) Provide a schematic indicating where the temperatures and pressures are being measured.
- 3) Run the tests at constant water flow rate.
- 4) Improve capacity control (e.g. suction throttling valve or Hot Gas bypass).
- 5) Confirm that he will install a transducer in place of the pressure gauge, to resolve questions about pressure measurement accuracy.
- 6) Determine distributor inlet pressure drop as a function of mass flow, from the manufacturer, and use that information to determine evaporator inlet pressure and saturation temperature to use for the LMTD.

15. **857-RP: EHD Enhancement in Evaporating Refrigerants**

J. Larson and J. Seyed-Yagoobi reported that pool boiling data for R-123 & R-134a is complete. A video was presented at the project review which illustrated the effect of EHD on bubble formation and departure. Construction of the in-tube boiling apparatus is complete. Electrical properties of R-123, R-134a, and R-407c have been measured over the range -30° to +40° C.

Future work includes completion of electrical property measurements, completion of calibration of the in-tube boiling apparatus, and completion of the plain tube pool boiling tests, all by the end of August. The apparatus for long term effects testing will be completed by September.

The long term test will be at ambient temperature and 10 KV, with R-134a. The committee needs to determine the heat flux and tube type to be used in these tests by August.

16. **922-RP: EHD Enhancement in Condensing Refrigerants**

P. Thors reported that work on the project is just beginning. A literature review is in process and the test apparatus is being modified. Initial testing will be with R-123.

17. **New Business**

No new business was brought to the committee.

18. **Schedule Next Meeting and Adjourn**

The next meeting will be Monday at 4:15 PM during the Winter ASHRAE meetings in Philadelphia.

The meeting was adjourned at 6:15 PM.