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DRAFT

TC/TG/MTG/TRG MINUTES COVER SHEET

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

TC/TG/MTG/TRG No. 8.4 DATE Mar 21, 2018

TC/TG/MTG/TRG TITLE Air-to-refrigerant heat transfer equipment

DATE OF MEETING Jan 23, 2018 LOCATION Chicago, IL

| MEMBERS PRESENT | YEAR APPTD | MEMBERS ABSENT | YEAR APPTD | EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE |
|---------------------------|------------|------------------|------------|----------------------------------------------|
| Dr. Sankar Padhmanabhan | 2016 | Mr. Shenghan Jin | 2016 | Please see attached |
| Dr. Kashif Nawaz | 2016 | | | |
| Dr. Chad Bower | 2014 | | | |
| Dr. Kishan Padakannaya | 2017 | | | |
| Prof. Man-Hoe Kim | 2014 | | | |
| Mr. Matthew Richard Baker | 2017 | | | |
| Mr. Stanislav Perencevic | 2017 | | | |
| Dr. Vikrant Aute | 2017 | | | |
| Dr. Yang Zou | 2017 | | | |

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

| | |
|-------------------------------------------------------------------------------------------|---------------------------------------------------|
| TAC Section Head: Dustin Meredith | SH0804@ashrae.net |
| All Committee Liaisons As Shown On TC/TG/MTG/TRG Rosters (Research, Standards, ALI, etc.) | See ASHRAE email alias list for needed addresses. |
| Mike Vaughn, Manager Of Research & Technical Services | MORTS@ashrae.net |

Note: These draft minutes have not been approved and not the official, approved record until approved by the TC.

I. CALL TO ORDER and APPROVAL OF MEETING MINUTES

Sankar Padmanabhan, the Chair of TC 8.4, called the meeting to order at 3:30 p.m. The title, purpose and scope of the TC were read. Chair moved to approve the minutes of the Long Beach meeting. Committee voted to approve 9-0-0-CV. Minutes approved as submitted.

II. SELF INTRODUCTIONS AND ATTENDENCE:

Everyone present introduced themselves, and signed a roster sheet. One YEA member was welcomed. Chair identified 9 out of 10 voting members. Quorum was met.

| Voting Members at this meeting in Chicago are as follows: | | End of term (Jun 30 of...) | Present |
|-----------------------------------------------------------|----------------------------------------|-------------------------------|-----------------|
| 1. | Dr. Sankar Padmanabhan (Chair) | (2019) | Yes |
| 2. | Mr. Shenghan Jin (Vice-chair) | (2019) | No |
| 3. | Dr. Kishan Padakannaya | (2021) | Yes |
| 4. | Dr. Kashif Nawaz (handbook sub. Chair) | (2019) | Yes |
| 5. | Mr. Matthew Richard Baker | (2021) | Yes |
| 6. | Mr. Stanislav Perencevic | (2021) | Yes |
| 7. | Dr. Yang Zou | (2021) | Yes |
| 8. | Dr. Vikrant Aute | (2021) | Yes |
| 9. | Dr. Chad Bower (research sub. chair) | (2018) | Yes |
| Voting Member non-quorum in this meeting | | | |
| 10. | Prof. Man-Hoe Kim | (2018) | Yes |
| 11. | Dr. Hyunyoung Kim | (2017) | No |
| Total Present | | | 9 out of 10 VMs |
| Quorum | | | YES |

I. PROGRAM SUBCOMMITTEE REPORT

Program Sub-committee chair, Omar Abdelaziz, presented the report as Ed Vineyard had retired. Chad Bowers recommended, and the TC agreed, to recognize Ed for his efforts in leading the Program Sub Committee for the TC.

Kashif Nawaz volunteered to support a seminar on papers related to fin designs for frost. Tim Wagner volunteered to explore potential interest from UTRC on topics related to CFD simulation of frost on heat transfer surfaces. The seminar title proposed is "Design Approaches to Frost Mitigation on Heat Exchangers". Stanislav Perencevic volunteered to Chair. Chad Bowers moved to approve. Vikrant Aute seconded. 9-0-0-CV. Motion passed.

The Atlanta Meeting will have a track related to design of components with low GWP refrigerants. A call for seminar papers on heat exchangers to support this track was made. Sankar Padmanabhan, Ankit Sethi and Chad Bowers volunteered to submit papers. Satheesh Kulankara will explore potential content from JCI. Chad Bowers moved for the Committee to sponsor the seminar on how low GWP refrigerants affect heat exchanger design. Kashif Nawaz seconded. 9-0-0-CV. Motion passed.

The Committee agreed to support the TC1.13 Optimization track at the Kansas City Meeting in

II. MEMBERSHIP REPORT

Membership Sub Committee Chair, Kishan Padakannayya, reported on the TC's membership.

The committee has a total of 137 members on the roster with 10 voting members.

In the upcoming Society year effective July 1st 2018, the following changes are planned:

Chad Bowers and Man-Hoe Kim will be rolling off as voting members.

Arindom Joardar and Christian Bach will roll on. Chair called for more voting members.

The Vice-Chair relayed that he could not attend regularly. Chad Bowers volunteered to serve as Vice Chair.

Yang Zou volunteered to serve as Research Sub Committee Chair.

Arindom Joardar will take over the Secretary role from Satyam Bendapudi effective the Houston Meeting in June 2018.

Voting membership update: Beginning the 2017-2018 Society Year, Liping Liu and Hyunyoung Kim will roll off. Vikrant Aute, Kishan Padakannayya and Matthew Richard Baker will roll on. With these, the voting membership will be 10 with 2 non-quorum.

III. CHAIRS REPORT

Chair presented highlights from the Chair's breakfast. Report is appended to these minutes.

IV. SECTION HEAD REPORT

The Section 8 Head Dustin Meredith commented that the meeting is well attended. No new announcement was made from the board.

V. HANDBOOK SUBCOMMITTEE REPORT

Handbook Sub-committee chair, Kashif Nawaz, reported that TC 8.4 is responsible for the following chapters

1. Chapter 23 air cooling & dehumidification coils (Fundamentals)
2. Chapter 27 air heating coils (Fundamentals)
3. Chapter 39 condensers (Fundamentals)
4. Chapter 14 Forced circulation in coolers (Refrigeration)

- First three chapters have been published in ASHRAE Fundamentals (2017) while the forth chapter (Chapter 14 in Refrigeration) has been reviewed and shared with handbook liaison.
- All TC members have access through authoring portal to revise the chapters and are highly encouraged to participate. TC chair is looking for volunteers to assist with the review and revision.

VI. WEBMASTERS REPORT

Christian Bach relayed that the website was up to date. Research Project reports sponsored by this Committee are available online.

VII. MTG LIAISON REPORT

3 of 4 seminars at the show were initiated by the MTG, in additional to other co-sponsorships.

RP 1806: Scott Davis, Gexcon

Contract was extended to include additional work.

Previous work looked at mostly vapor leaks in the system. Most models can handle pure vapor leak.

AHRTI case had release of flashing liquid (as opposed to pure vapor), but the dispersion characteristics are very different. Additional effort was to conduct tests to validate the models.

T1: Model development, calibration and validation, T2: Simulation of ignition events to calculate severity; T3: Use data to come up with updated risk assessment.

PMS got project report on Monday and is reviewing it.

Additional task was to model impact of moisture - it changes flame velocity significantly.

Contractor was doing burning velocity tests, adding humidity effect tests led to additional tasks and hence some delay in project (one of the causes)

RP 1807:

PI (Goetzler Bill), gave an update on 1/21/2018.

Chad @ TC 8.4 is on PMS and can also be contacted for more details.

Conducted thorough analysis and collected data from EU, JP, CN, and AU and summarized codes, standards, regulations etc. PMS has an interim reports that is being reviewed, as well as by AHRI et al.

Shortly after this ASHRAE meeting, PMS will vote on the final report.

RP 1808: Stefan E.

About 85% complete, scheduled for completion early March (first draft of report).

Focus is to evaluate different fitting types (see previous notes).

Total 325 combinations; 25 brazed connections are used as baseline.

Refer to upcoming detailed report for findings.

AHRI - completed 3 projects, reports available on AHRI website.

(1) Modeling/testing of A2L leaks in house; (2) Refrigerant leak sensor technology; (3) Hot surface ignition of A2L refrigerants. These 3 reports are available on AHRI website.

Started new project on A3/R290 ignition. Objective is to understand risks of A3 refrigerants; event severity, charge level, variety of applications- PTACs, Mini-split, commercial refrigeration (single door reach-in cooler, and 3 door reach-in)

VIII. RESEARCH SUBCOMMITTEE REPORT

Research Sub-committee Chair, Chad Bowers, presented a report from the Research chair's breakfast. Notes attached.

IX. STANDARDS SUBCOMMITTEE REPORT

SPC 20 voted to approve unanimously the revised standard for public review in early December and it was submitted to ASHRAE on 12/8/17. It should be out for first public review by the end of the January. Thanks to the PC committee members for all their hard work (Ron Wood, Gordon Struder, Ted Wayne, Zan Liu, Konrad Chmielewski, and Ray Rite)

SPC 25 committee has completed the technical content portion regarding this method of test. It is in "clean-up" mode, ensuring mandatory language is used (throughout), appropriate references are cited and overall the document is clean.

The SPC committee has set a February 26th submission date to Mark Weber.

VII OLD BUSINESS

None.

XI NEW BUSINESS

None.

XII ADJOURNMENT

At 5.40pm, Stanislav Perencevic moved to adjourn. Vikrant Aute seconded. 9-0-0-CV. Meeting adjourned.

DRAFT



TC 8.4 Research Meeting: Air to Refrigerant Heat Transfer Equipment
Chicago, Monday, January 22, 2018, 6:30 – 9:00 PM
Room: Red Lacquer

Meeting Minutes

1. Welcome and Introductions

2. Update from Research Subcommittee Chair Breakfast

- 2 RTAR's considered by RAC – both accepted with comments
- 2 Work Statements considered by RAC – both returned
- Voted to release all outstanding TRPs for bid (the decks have been cleared)
- Selected the recipient for the Homer Adams award
- Selected 6 finalists for the Innovative Research Grant proposals
- New Investigator award will be reviewed and selected in the next few months
- Straight to WS form is slightly different than WS after RTAR form
- PMS training happened 88 in attendance (including myself)
- Remember, if we co-sponsor, we need to participate on the PES and PMS
- Conditionally approved RTAR's and WS's must acknowledge how the conditions were addressed and cleared with RL
- Milestones are now acting more like stage gates in research projects.
- Need to be diligent in completing Disposition of ASHRAE sponsored research results form
- Curt Eichelberger from JCI is RL (Curtis.eichelberger@jci.com),

3. Active Research Projects

Update on Research Project 1645 Development of New Corrosion Test for Aluminum Heat Exchangers

Contractor: Prof. Seifollah Nasrazadani, University of North Texas

Project Monitoring Subcommittee: David Ellerbrock, Hyunyoung Kim, Russell Tharp, Claudi, Stanislav

Final report submitted by the end of September 2017, but returned with comments. Have comments been addressed in revised version? If so, needs to go out to committee for review and vote. What's the status on paper publication? Final step will be Disposition of ASHRAE Sponsored Research Results

Is there a desire for a Work Statement for a Phase II follow on project? There was always the expectation of more work to come, but does the PMS and TC feel that this is a foundation we should keep building on? Who will work on WS?

Update on Research Project 1705 Investigation of Airside Fouling on Outdoor Heat Exchangers

Contractor: Prof David Yuill University of Nebraska

Project Monitoring Subcommittee: Hugh Henderson, Bill Fox, and Liping Liu, Looking for an additional PMS member. Omar volunteered during 8.11 Research meeting and has talked with Bill Fox. PMS met with PI on Monday to review progress in person. Asking for a 1 year no-cost extension due to the project falling behind.

Had both PI's host Webinars as there has been difficulty with both having conflicts with our research meeting. Who attended, how did they feel it went?

5. Potential Research Projects and Older Ideas

- Gordon's new idea – determine a comparative efficiency regarding energy and water for dry, adiabatic, hybrid, and evaporative heat transfer equipment. TC 8.6. Do we need to answer if this is more appropriate as a design guide. Gordon to go back to 8.6 and discuss further.

- RP1785 Refrigerant Charge Modelling in Coils for Residential Split Systems – WS by Ray Rite and Chad Bowers from TC8.11. TC8.4 co-sponsoring. Awarded to Oklahoma State University. Project started in September. Chad serving as non-voting member of PMS. Scott Wujek agreed to become voting representative of TC8.4. Update given during 8.11 research meeting. Coils identified and being sourced through JCI, volume ratio of OD/ID ranges from ~90% to 200%. Coil delivery in March. Facility designed and being constructed.
- .
- RP-1807 (Guidelines for Flammable Refrigerant Handling, Transporting, Storing and Equipment Servicing and Installation) – co sponsor with Low GWP MTG (status from Vikrant), Chad on the PMS. PI provided draft final report and is on 3rd iteration of revisions. Major changes around inclusion of data from Canada and how best to address recommendations and format of report.
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- RTAR – 1826 Bio-Inspired Liquid to Air Heat Exchangers for HVAC&R Applications. RAC reviewed in Long Beach and rejected. Spoke with RL at length about what could/should be done. He feels that if the literature review was beefed up and the wording of “bio-inspired” removed, we may get more traction. The current title made RAC think that this was too creative.
 - Tie it into additive manufacturing?
 - Move to optimization?
 - Check with 1.3
- TRP 1683 Conditionally Approved – we are cosponsors with TC 1.3. Chad Bowers serving as 8.4 representative on PES and PMS. 5 proposals received and being reviewed at this meeting. Would like to have recommendations for full TC meetings on Tuesday.
- Additional oil retention studies to add on to the data and modeling efforts from Project 1564. Chad Bowers and Scott Wujek (TC3.4 for co-sponsorship) worked on RTAR still about 80% complete. Chad and Scott met once since the last meeting and made some progress, but not complete. Aim for August 15th deadline? Nope. Chad and Scott slow, but still willing.
- Heat exchanger performance as a system diagnostic tool for leak detection. (A2L) – A2L project may already be covering, pursue through Low GWP MTG (what parameters in heat exchanger, fault diagnostic TC, performance) Yang Zhou. Yang has done a lot of work on background literature but is looking for some help in finishing up the RTAR. Not being covered by MTG. TC3.8 Refrigerant containment. Help from Ratnesh Tiwari. Looks like this is more appropriate for system level investigations.
- Air side heat transfer for small diameter tubes – Bill Fox to work with Vikrant on RTAR. DOE work from Maryland. 2mm-5mm. Vikrant will present in optimization session and come out at other conference. May need project to get heat exchangers and update coefficient based on experimental data, ideally smaller than 3-4mm. **Validation of theoretical correlation**, finding someone to build and testing wind tunnel testing. Additive mfg. Wait for mfg to catch up. Still static.
- Modelling microchannel headers – pressure drop in headers (ongoing at ACRC) and charge Stefan Elbel and Lorenzo to work on. Do we want to work on evaporators or condensers, intermediate? Maybe focus more on charge modelling easier to justify than pressure drop. (Continue to wait on ACRC)
- Performance degradation of “aged” or degraded coated coils (bring in phase II of corrosion project add coating (get knowledge from coaters)) – Sankar will work on RTAR. Is it precompetitive.
- Microchannel with bent tubes and the effects on performance – with uniform air profile (to validate CFD) Scott Wujek and Bill Fox to work on RTAR. No work. Keep it on the list.

6. New Ideas

- Fouling of indoor condensers (refrigerators and freezers, kitchens, laundries). TC8.9, TC8.11
Do we want to look at heat pump dryers? Do we want to wait on 1705? Harshad Inamdar (provisional member)- send him the RTAR template
- Better HALT testing, external environmental testing. What is a good test to accelerate “aging” of coils. Couple all accelerated testings. Automotive does aging tests, can we look into what they do. Bill won't lead. Do we need materials people. Bo Shen will lead effort to write RTAR.



ASHRAE TC 8.4, Air-to-Refrigerant Heat Transfer Equipment

2018 Winter Conference, Chicago, Illinois

TC Committee Meeting:

Tuesday, 23rd January 2018, 3:30 PM - 6:00 PM, Room: Clark 3 (Palmer House, 7th floor)

TC Research Subcommittee Meeting:

Monday, 22nd January 2018, 6:30 PM - 9:30 PM, Room: Red Lacquer (Palmer House, 4th floor)

TC 8.4 Scope

Technical Committee 8.4 is concerned with design, performance, and application of heat transfer equipment in which a refrigerant, including water or brine, is used to remove heat from air. The processes of concern to the committee include both sensible heat transfer and combined sensible and latent heat transfer.

Agenda (DRAFT)

1. Call to Order (Sankar Padhmanabhan)
2. Introduction of members and guests (Sankar Padhmanabhan)
3. Establish quorum requirements (Sankar Padhmanabhan)
3. Review/approve minutes from Long Beach meeting (Satyam Bendapudi)
4. Section Head Comments (Dustin Meredith)
5. Liaison/Staff Comments
 - Dustin Meredith – Section Head
 - Curt Eichelberger - Research Liaison
 - Steve Ferguson – Manager of Codes, ASHRAE
 - Other Liaisons
6. Membership Subcommittee (Sankar Padhmanabhan)
7. Handbook Subcommittee (Kashif Nawaz)
8. Program Subcommittee (Ed Vineyard)
 - a. Status of current/proposed programs
 - b. Thank you to Paper Reviewers
 - c. Panel discussion/Forum “Low GWP Refrigerants in Heat Exchange Equipment” for Chicago
9. Webmaster (Christian Bach)
10. MTG Liaison: Low GWP Refrigerants (Liaison - Vikrant Aute, Alt#1 – Yirong Jiang, Alt#2 – Patrick Geoghegan)
11. Research (Chad Bowers)
 - a. Ongoing research projects
 - b. Pending research topics and future research plans
12. Standards Subcommittee (Bill Fox)
 - a. SPC 20
 - b. SPC 25
12. Chair Comments (Sankar Padhmanabhan)
13. New Business
 - Honors and Awards chair (Shengan Jin)
14. Next meeting: Tuesday, 26th June 2018, 3:30-6:00 pm, Houston, TX
15. Adjourn

VOTING MEMBERS FOR THIS MEETING

1. Sankar Padhmanabhan (Chair)
2. Shengan Jin (Vice chair)
3. Chad Bowers (Research chair)

4. Kishan Padikkinaya (Membership chair)
5. Kashif Nawaz (Handbook chair)
6. Vikrant Aute
7. Yan Zou
8. Mathew Baker
9. Stanislav Perencivic (Member NQ)
10. Man-Hoe Kim (Member NQ)