



1791 Tullie Circle, N.E./Atlanta, GA 30329
404-636-8400

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.)

These minutes have been approved by this committee

TC/TG/MTG/TRG No. TC 3.1 DATE January 30, 2017

TC/TG/MTG/TRG TITLE Refrigerants and Secondary Coolants

DATE OF MEETING June 27, 2016 LOCATION St. Louis, MO

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Mark McLinden (Chair) – voting	2014	Alice Riemer (non-quorum)- voting	2012	Kevin Connor (Handbook)
Steve Kujak (Vice Chair/Research) – voting	2014			Dave Wilson (Standards)
Warren Clough (Secretary) – voting	2014			Sean Cunningham (Webmaster)
Chris Seeton (Program) – voting	2012			
Ganesan (Sonny) Sundaresan – voting	2014			
Felix Flohr (non-quorum)- voting	2012			
Barbara Minor- voting	2015			
Marc Scancarello- voting	2015			
Debra Kennoy- voting	2015			

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

TAC Section Head: Jay Kohler	SHx@ashrae.net Where x is the section number
All Committee Liaisons As Shown On TC/TG/MTG/TRG Rosters (Research, Standards, ALI, etc.) Mark Spatz, Malcolm Knight, Sheila Hayter, Darin Nutter	See ASHRAE email alias list for needed addresses.
Mike Vaughn, Manager Of Research & Technical Services	MORTS@ashrae.net

Corresponding Members and Guests

Neil Turner	Julie Majurin	Greg Linteris
Yasuhiko Matsuoka	Jay Kohler (TAC Section Head)	Doug Gildehaus
Robert Low	Osami Kataoka	Valerie Shultz
Sunil Nanjundaram	Knut Petry	Els Baert
Jeff Salisbury	Kenji Takizawa	William Kopko
Stephen Spletzer	Tom Leck	Robert Richard
Evan Laganis	Jiro Inove	Katsuya Ueno
Michael Woodford	Samuel Yana Motta	Brandon Lane
Ken Shultz	Mark Spatz (RAC liason)	Mary Koban
Tatsuro Kobayashi	Patrick Coughlar	Motoki Shinohara
Roberto Urrego	John Withouse	Harrison Skype
Chihiro Furuta	Takashi Shibamura	Amir Jokar

KEY CONTACTS

SPLS Liaison*	Janice Peterson
TAC Chair:	Eric Adams
TAC Section Head:	Jay Kohler
All Committee Liaisons As Shown On TC/TG/TRG Rosters:	RAC Research: Mark Spatz Standards: Malcolm Knight Handbook: Sheila Hayter Chapter Technology Transfer: Stephen Piccolo ALI/PDC: Darin Nutter
Manager Of Standards*	Stephanie Reiniche
Manager Of Research & Technical Services	Michael R. Vaughn

*receives a copy of the TC 3.1 meeting minutes

MEETING MINUTES

1. CALL TO ORDER (M. McLinden, Chair)

- A. Chair called the meeting to order at 4:15 PM and attendees introduced themselves.
- B. Establishment of a quorum, 9 out of 10 voting members were present.

Voting members for this meeting:
 Mark McLinden – present
 Steve Kujak - present
 Warren Clough – present
 Chris Seeton – present
 Sonny Sundaresan – present
 Debra Kennoy- present
 Barbara Minor- present
 Marc Scancarello- present
 Felix Flohr – present (non-quorum)

2. AGENDA REVIEW

No revisions or corrections were noted on the agenda.

*Motion to approve St. Louis draft agenda was made by Steve Kujak and seconded by Sonny Sundaresan.
 Motion passed: 9 / 0 / 0 / CV. (For / Against / Abstain / Total [Chair Voting [CV] or Chair Not Voting [CNV]])*

3. APPROVAL OF ORLANDO, JUNE 2016 MEETING MINUTES

No corrections were noted on the meeting minutes.

*Motion to approve Orlando draft minutes was made by Steve Kujak and seconded by Debra Kennoy.
 Motion passed: 9 / 0 / 0 / CV. (For / Against / Abstain / Total [Chair Voting [CV] or Chair Not Voting [CNV]])*

4 CHAIRMAN’S ANNOUNCEMENTS (M. McLinden, Chair)

- A. Section 3 Meeting Report attached.
- B. Roster Review

Summary of TC3.1 membership and changes, effective July 1st 2016

Position	Members
Chair	Stephen Kujak (V)
Vice Chair, Program Subcommittee Chair	Christopher J Seeton
Secretary	Warren Clough
Research Subcommittee Chair	Ken Shultz
Standards Subcommittee Chair	Debra Kennoy (V)
Handbook Subcommittee Chair	Kevin C Connor (V)
Webmaster	Sean Cunningham (V)
Voting member	Robert Richards (V)
Voting member	Sonny Sundaresan (V)
Voting member	Barbara Minor (V)
Voting member	Marc Scancarello (V)
Member Non-Quorum	Knut Petry (V)
Member Non-Quorum	Kenji Takizawa (V)

Rolling off TC as voting members (will continue as corresponding members):

Mark McLinden, NIST
Warren Clough, Carrier
Christopher Seeton, Shrieve Chemical
Felix Flohr, Solvay Fluor (non-quorum)
Alice Riemer, Danfoss (non-quorum)

New/Continuing members starting July 1st

Stephan Kujak, Ingersoll Rand, Chair (2018)
Debra Kennoy, Arkema, Standards Subcommittee Chair (2019)
Ganesan (Sonny) Sundaresan, Consultant (2017)
Barbara Minor, Chemours (2019)
Marc Scancarello, Emerson (2019)
Kevin Connor, Dow Chemical, Handbook Subcommittee Chair (2020)
Sean Cunningham, Mexichem Fluor, Webmaster (2020)
Robert Richard, Honeywell (2020)
Kenji Takizawa, AIST (non-quorum) (2020)
Knut Petry, Carrier (non-quorum) (2020)

Other committee officers (non-voting):

Warren Clough, Carrier, Secretary
Christopher Seeton, Shrieve Chemical, Vice-Chair and Program Subcommittee Chair
Kenneth Schultz, Ingersoll Rand, MTG-GWP Liaison and Research Subcommittee Chair

5. RESEARCH (Steve Kujak)

A. Report from Research Subcommittee Chairs Meeting

There are a large number of projects with the addition of three AHRI flammability projects. The intent is to have more frequent meetings of the TC (via phone/web) to better manage this activity.

B. Status of current research projects

1507-RP, Binary Refrigerant Flame Boundary Concentrations

Contractor: Safety Consulting Engineers; PI: Andrew Kusmeirz. Robert Richard and Debra Kennoy are working with the contractor to jointly write the final report.

The initial draft of the report is complete.

Action: Close to finalizing the report by Las Vegas.

1717-RP, Improve Accuracy and Reproducibility of ASTM E-681 Flammability Test Method for Flammability Limit Measurement of 2L Flammable Refrigerants

A contract was awarded by ASHRAE on March 3, 2015 to the University of Maryland, with Peter Sunderland as the P.I. The PMS consists of Debra Kennoy (lead), Sean Cunningham, Scott MacLeod, Barbara Minor, Robert Richard, and Xudong Wang.

There has been significant further development regarding this project: David Underwood, ASHRAE President, met with White House staff in March regarding mildly flammable (A2L) and flammable refrigerants (A2 & A3). This work was identified as one of four High Urgency–High Impact projects. Underwood was asked if funding from a government agency to accelerate RP-1717 would allow for earlier updates to ASTM E681, and subsequently ASHRAE Standards 15 and 34. The PMS and PI were asked to identify options for accelerating this work including a revised plan, timing, and cost.

In subsequent discussions, Mike Vaughn, ASHRAE Manager of Research and Technical Services, asked if TC 3.1 would support a funded extension request for RP-1717. He feels ASHRAE could easily fund this additional work faster than through the government. Then the revised project could move ahead, and ASHRAE will work with the White House for funding.

The PMS and PI worked together on a proposal to expand the scope and funding of the project. This was sent to TC voting members on April 13 for letter ballot. It was approved by a vote of 10/0/0/CV. The additional requested funding of \$72K would put the total project at \$267K, and this level of funding would require approval by the ASHRAE Board of Directors. RAC approved the request on May 16. Next, Technology Council will consider the request at their meeting on June 16. If they approve, it will go to the Board in St. Louis.

Separately, the ASHRAE Board of Directors ASHRAE Board recently unanimously approved pulling \$1.2 million from ASHRAE Research Reserve fund to support expedited A2L refrigerant research.

Testing by the contractor in 12L flask identified issues with the stopper as a likely reason behind results not being reproducible. Burst relief valve being investigated to improve reproducibility. Holding regular phone conferences and PMS is pleased with the progress.

Action: PMS will continue to monitor the progress of this project.

AHRI/ASHRAE/DOE Collaboration on Flammable Refrigerants

AHRI Flammability Sub-committee- identified caps in flammability testing. AHRI, ASHRAE, DOE agreed to conduct research projects. Top priority is benchmarking risk by real-life leaks and ignition testing. This work has started. Project includes testing an A1 refrigerant with oil as a benchmark. It covers both residential and commercial applications.

Currently seven projects have been initiated (total funding to date \$5.2M)

1. Benchmarking risk by real life leaks and ignition testing (AHRI funded)
2. Flammable refrigerants post-ignition risk assessment (ASHRAE funded)
3. A2L Refrigerant Handling and system installation and servicing- developing guidelines (ASHRAE funded)
4. A2L Refrigerant Handling and system installation and servicing- Assessment of field made joints (ASHRAE funded)
5. Detection of A2L refrigerants in HVACR equipment (AHRI funded)
6. Determination of setting charge limits for various types of equipment employing A2L refrigerants (DOE funded)
7. Investigation of ignition temperature for 2L refrigerants

Proposed Work Statement 1773: "Ignition Potential from Electrical Devices in Commercial and Residential Applications using 2L Refrigerants"

Team: Warren Clough (Lead), Marc Scancarello, Barbara Minor, Eric Smith, K. Takizawa, R. Richard. The TC previously approved an RTAR for this project by letter ballot [vote was 9/0/0/9 (CV)] and then the WS by letter ballot [vote was 9/1/0/10 (CV)]

There were several suggestions that came back from RAC on changes to the work statement. These changes were incorporated into the work statement. After reviewing the AHRI study (WS #8017), "Investigation of Energy Produced by Potential Ignition Sources in Residential Applications," they are well along with this work being conducted by the University of Maryland. Their work will be complete

by April of 2017. Maryland has looked at ignition sources and their energy levels, and then plan on testing some of these components with A2L refrigerants. Therefore, it was agreed that we should see what data comes out of the AHRI activity before moving any further with 1773. The AHRI conclusions may require additional work in this area, and it also gives us some time as to sort out the importance of MIE vs. MIC with respect to 2L refrigerants.

Action: Place this WS on hold until the AHRI 8017 is complete. The WS Committee will meet in March 2017 to review the AHRI results and consider path forward.

Proposed RTAR 1791: “Humidity effects on burning velocity”

Team: Debra Kennoy (lead), Robert Richard, Julie Majurin, Tom Leck, Els Baert.

This RTAR was approved by the TC at the Atlanta meeting in June 2015 [vote was 7/0/0 (CV)] and submitted to Mike Vaughn, ASHRAE Manager of Research and Technical Services on November 9, 2015. At their Orlando meeting, RAC voted to “conditionally accept” the RTAR and provided comments.

Work statement is complete and was voted on below. BV tests are currently conducted in dry air. The purpose of this work it to investigate the impact humidity has on the BV. The WS outlines refrigerants to test and range of F/H ratios. The consensus from the Research Subcommittee was to move forward with the WS, although some minor edits were needed. Els Baert dropped off. Julie Majurin, Xudong Wang, Bob Richard, Felix Flohr, Debra Kennoy will be the PMS. Need potential bidders- Greg Linteris (NIST), Chemours mentioned. August 15 is the deadline to submit to RAC for their fall meeting.

Motion was made to accept Work Statement 1791 as modified by Steve Kujak and seconded by Chris Seeton

Motion passed: 9 / 0 / 0 [CV]. (For / Against / Abstain / Total [Chair Voting [CV] or Chair Not Voting [CNV]])

Action: Submit to RAC for approval.

Proposed RTAR-1792: “ASHRAE 34 Toxicity data documentation and mixture calculation”

The TC approved this RTAR by letter ballot [vote was 10/0/0/10 (CV)], and it was submitted to Mike Vaughn, ASHRAE Manager of Research and Technical Services on December 9, 2015. At their Orlando meeting, RAC voted to “conditionally accept” the RTAR and provided comments. Their main concern was that the work was more “publication” than “research.”

Work statement being drafted. Sonny Sundaresan will lead. Bob Richard and Julie Majurin volunteered to work on it as well.

Action: Develop a work statement for discussion at the Las Vegas meeting.

Proposed RTAR 1794: “The Incorporation of Odorants in Flammable Refrigerants to Improve Leak Detection and Safety”

A draft RTAR was prepared by Marc Scancarello (lead). The RTAR was letter balloted by the TC and approved by a vote of 10/0/0/10 (CV). It was submitted to Mike Vaughn, ASHRAE Manager of Research and Technical Services on February 29, 2016. It will be considered by RAC at their St.

Louis meeting. We will likely learn of the RAC action by the time of the meeting. Volunteers that helped: Valerie Baish, Julie Majurin, Earl Clark

This RTAR was rejected by RAC. More explanation is required on the value of this work. It will be resubmitted. RAC did not understand the project. It needs a clearer explanation.

Action: Revise work statement with a clear value of this work and submit to RAC by August 15th.

Proposed Work Statement 1797: "Risk Assessment Investigations to Develop Alternative Acute Toxicity Classification Approaches to the A or B Chronic Toxicity Classification of Refrigerants used by ASHRAE 34."

Suggestion from Standard 34 Toxicity Subcommittee; work statement prepared by Debra Kennoy, George Rusch, Gary Jepson, Chris Seeton, Steve Kujak.

This was discussed at the Seattle meeting (June 2014). The Seattle meeting minutes indicated that: "Work statement has been prepared and submitted to RAC" but, the draft WS was only provided to the RAC liaison for feedback. It was never put to a TC vote and, thus, was never formally put on the RAC agenda. The TC did vote on the WS at their Orlando meeting, and it was approved by a vote of 10/0/0/10 (CV). It was submitted to Mike Vaughn, ASHRAE Manager of Research and Technical Services on May 9, 2016. It will be considered by RAC at their St. Louis meeting. We will likely learn of the RAC action by the time of this meeting.

The WS was returned from RAC with comments.

Action: Re-submit work statement with corrections to RAC by August 15th.

C. Proposed RTARs and Ideas

Proposed RTAR 1802: "Defining the 2/2L Flammability Boundary in Standard 34"

This topic aims to resolve a continuous maintenance item submitted to SSPC 34 (which proposed changing the burning velocity defining the 2/2L boundary from 10 cm/s to a lower value). A draft RTAR was prepared by Debra Kennoy (lead) and discussed at the Orlando meeting; it was approved by a vote of 10/0/0/10 (CV). It was submitted to Mike Vaughn, ASHRAE Manager of Research and Technical Services on May 13, 2016. It will be considered by RAC at their St. Louis meeting. We will likely learn of the RAC action by the time of this meeting.

The RTAR was approved with no comments. Barbara Minor is willing to take the lead on writing the WS. Debra Kennoy, Felix Flohr, Bob Richard, Steve Kujak volunteered to assist. Greg Linteris is also willing to review it.

Action: Write a work statement ASAP. Draft by December 2016.

D. Update on the TC Research Plan

1. Effect of lubricant on the flammability of refrigerants- leave in hopper
2. Understanding of energy transfer from Ignition sources to refrigerant gases- leave in hopper
3. Electrical properties of new refrigerants- Julie Majurin and Ken Schultz to start writing a RTAR
4. Re-evaluate Calibration of 200L to 12L Flammability Limits for Borderline Cases- go back and review the original work as the starting point. Original RP 1073.

5. Assessment of the Alternative approaches to predict burning velocity of a refrigerant

6. HANDBOOK (Kevin Connor)

The next revision will be for the 2017 edition.

Chapter 29- Refrigerants (Lead—Barbara Minor)

Chapter 30- Thermophysical Properties of Refrigerants (Lead—Mark McLinden)

Chapter 31- Physical Properties of Secondary Coolants (Lead—Kevin Connor)

TC 3.1 is responsible for Chapters 29 (Refrigerants), 30 (Thermophysical Properties of Refrigerants), and 31 (Physical Properties of Secondary Coolants) in the Handbook of Fundamentals. The next revision will be for the 2017 edition.

Draft revisions of chapters 29 and 31 were circulated to the TC on March 18 for comments and letter ballot. Chapter 31 was approved by a vote of 8/0/0 (2 ballots not returned, CV). It was submitted to ASHRAE on May 8, 2016.

The revisions to Chapter 30 were circulated to the TC on May 31 for letter ballot; it was approved by a vote of 9/0/0 [CV] (1 ballot not returned).

Following the Orlando meeting the TC 2.5 (Global Climate Change) Handbook Chair reported that the “global environmental properties” section of Chapter 29 was planned to be put into a new chapter to be prepared by TC 2.5. The new chapter did not happen. TC 2.5 prepared (and approved) a section on “global environmental properties,” and this was reinserted into Chapter 29 on short notice. The vote of TC 3.1 was 7/1/0 (2 ballots not returned, CV). The negative vote centered around the GWP values for the refrigerants: The new section reported GWP values from an older reference; the logic was that these older values were specified in regulations. However, the commenter wanted the most recent “scientific” values. The solution was to include both, with a footnote explaining the difference. The Handbook committee has granted an extension to July 15 for approval of this chapter. The revisions to Chapter 30 include the addition of R1233zd(E), and revised transport property values for R245fa, R1234yf, and R1234ze(E). The chapter will be circulated to the TC by the end of May for letter ballot. (Approval deadline for Chapter 30 is June 14.)

Motion was made accept the revisions to Chapter 29 was made by Kevin Conner and seconded by Steve Kujak.

Motion passed: 9/ 0/ 0/ [CV]. (For / Against / Abstain / Total [Chair Voting [CV] or Chair Not Voting [CNV]])

7. PROGRAM (Chris Seeton)

A. Current Program Session (St. Louis 2016)

1. Wednesday, 8:00-9:30, Seminar 55, “System Efficiency Impacts of Low GWP Refrigerants: Is This our Fall From Grace?”

B. Future Program Plans

Proposals for Seminars, Forums, and Workshops for the Las Vegas meeting are due August 8, 2016. There is no track explicitly for “refrigerants” or “refrigeration.”

There was a request from Steve Brown, associate editor of *Science & Technology for the Built Environment* (formerly ASHRAE’s *Journal of HVAC&R Research*) to co-sponsor a seminar in Las Vegas with papers from a November 2016 special issue on low-GWP refrigerants.

Motion was made by Chris Seeton and seconded by Debra Kennoy to sponsor or co-sponsor a seminar based on papers published in the Nov 2016 issue of Science & Technology for the Built Environment (formerly ASHRAE's Journal of HVAC&R Research)

Motion passed: 9/ 0/ 0/ [CV]. (For / Against / Abstain / Total [Chair Voting [CV] or Chair Not Voting [CNV]])

Seminar Title: Track: Either Track 2: HVAC&R Systems and Equipment or Track 6: Effects of Climate Change on HVAC&R Format: Either a seminar or a workshop Title: Research update on activities toward the safe use of flammable refrigerants.

Session abstract/Goal: AHRI, ASHRAE, and the U.S. Department of Energy (DOE) are collaborating to fund vital research that will establish a more robust fact base about the properties and the use of flammable refrigerants. This \$5.2 million research program is coordinated by the AHRTI Flammable Refrigerants Committee. This session will provide the society with a summary and status update on these key research projects so that the audience can learn the industry's challenge and effort on implementing flammable refrigerants and has an open dialogue during the discussion phase.

Potential Speakers: Representatives from AHRI, ASHRAE, and DOE will briefly present the audience about these projects' tasks and purposes, followed by a discussion session) Sponsor Committee: MTG on Lower GWP Refrigerants Potential co-sponsoring committee: Research Administration Committee, Refrigeration Committee, SSPC-15, SSPC-34, and TC 3.Xs

Motion was made by Steve Kujak and seconded by Barbara Minor to co-sponsor a seminar "Research update on activities toward safe use of flammable refrigerants"

Motion passed: 9/ 0/ 0/ [CV]. (For / Against / Abstain / Total [Chair Voting [CV] or Chair Not Voting [CNV]])

C. Future program idea:

1. For Long Beach: How to design systems with refrigerants – “The perils and pitfalls of NOT using Guideline 6”, Steve Kujak
2. Leak detection technologies and sensors; potential co-sponsor with TC 3.8
3. Seminar on R404A replacements (TC 10.7 is leading and submitting)
4. Results from AREP II testing (Alternative Refrigerant Evaluation Program, organized by AHRI— Air Conditioning, Heating, and Refrigerating Institute.
5. Work Workshop on A/B toxicity classification. (Wait until proposed research project is started; give an update on progress and get feedback.)

Upcoming- Conference in Kobe, Japan. Kenji Takazawa briefly described “New Refrigerant and Environmental Technology 2016.” Topics include Environmental issues, New Refrigerants and their System, 2L Refrigerants, Compressor and Lubricants, Energy conservation.

D. Program tracks Las Vegas and Long Beach

January 2017- Las Vegas	June 2017—Long Beach
Systems and Equipment	Fundamentals and Applications
Fundamentals and Applications	HVAC&R Systems and Equipment

Water Energy Nexus	Refrigeration
Commercial and Industrial IAQ	Building Life Safety Systems
Mission Critical Design and Operation	Controls- Smart building systems and the Security Concerns as Technology Emerges
Effects of Climate Change on HVAC&R	Commissioning- Optimizing New and existing Buildings and their Operation
Energy Efficient Industrial Buildings	Zero Net energy Buildings- The International Race to 2030
Building Operation and Performance	Residential Buildings- Standards Guidelines and Codes
	Research Summit

8. STANDARDS (Debra Kennoy)

- A. ASHRAE Standard 34, *Designation and Safety Classification of Refrigerants* (D. Kennoy)
 - Six new applications were submitted at St. Louis
 - Two new refrigerants on the website, along with new CO2 data
 - 10 new refrigerants for BOD to approve
 - 2 public reviews proposals with comments came back are being resolved
 - 4 new continuous proposals
- B. ASHRAE Guideline 6 (S. Kujak)
 - The 2015 edition of this Guideline has been published and is available through the ASHRAE bookstore.
- C. ASHRAE Guideline 39p (formerly SPC-177P), *MOT Fractionation Measurement of Refrigerant Blends* (R. Richard)
 - This MOT was converted to a Guideline. It was sent out for a 45-day public review (March 4 – May 9, 2016).
 - Went out for public comment, and no comments were received. It is complete and will be going to publication.
- D. ISO Standard 817, *Refrigerants –Designation and Safety Classification*
 - Meeting June 28 (Tuesday) from 8am-12pm. The Designation & Nomenclature, Flammability, and Toxicity subcommittees continue to update the refrigerant property tables as new refrigerants are approved by ASHRAE.
- E. ISO Standard 5149, *Refrigeration Systems and Heat Pumps*
- F. ISO Standard 17584:2005 *Refrigerant Properties* will be revised; Felix Flohr is the convenor for the working group revising the standard. A first meeting is planned for Las Vegas.

9. WEB SITE (Sean Cunningham)

ASHRAE has migrated the TC web sites to a new format, and the TC 3.1 web site is now in the new format. Our web page has the agenda for the current meeting, minutes from past meetings, slides from past presentations, and more. The new URL for the TC 3.1 web page is:

<https://tc0301.ashraetcs.org>

10. OLD BUSINESS

None

11. NEW BUSINESS

Intermediate meetings will be scheduled on research. Will meet every 4-6 weeks.

This is Mark Spatz last meeting as TC 3 Research Section head. Appreciation of his services was noted. Steve Kujak will become the new RAC TC 3 Section head.

12. MEETING ADJOURNED at 6:03 pm.

Section 3 Breakfast meeting report attached.



TC Section Brkst
Handout.A16.r1.pdf