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 3.1 DATE 14 July 2009
TC/TG/TRG TITLE Refrigerants and Secondary Coolants
DATE OF MEETING 21 July 2009 LOCATION Louisville, KY

<table>
<thead>
<tr>
<th>MEMBERS PRESENT</th>
<th>YEAR APPTD</th>
<th>MEMBERS ABSENT</th>
<th>YEAR APPTD</th>
<th>EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sean Cunningham (Chair) – voting</td>
<td>07/2008</td>
<td>Kevin Connor (Handbook) - voting</td>
<td>07/2006</td>
<td>Steve Brown – Guest</td>
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<tr>
<td>David Wilson (Vice Chair) – voting</td>
<td>07/2008</td>
<td>Felix Flohr – voting (international)</td>
<td>07/2007</td>
<td>Umar Khokhar – Guest</td>
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<tr>
<td>Don Bivens (Research) – voting</td>
<td>07/2008</td>
<td>Gustavo Rolotti – voting</td>
<td></td>
<td>Julie Majurin – Guest</td>
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<tr>
<td>Debra Kennoy (Secretary) – non-voting CM</td>
<td>08/2008</td>
<td>Earl Clark –CM</td>
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<td>Kenji Takizawa – Guest</td>
</tr>
<tr>
<td>Barbara Minor (Webmaster) – non-voting CM</td>
<td>07/2006</td>
<td>Thomas Clemens – CM</td>
<td></td>
<td>Gary Zyhowski – Guest</td>
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<tr>
<td>Robert Doerr – CM</td>
<td>07/2008</td>
<td>Denis Clodic - CM</td>
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<td>Georgi Kazachki – CM</td>
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<td>Alan Cohen –CM</td>
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<td>Sunil Nanjundaram – CM</td>
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<td>Barry Fields – CM</td>
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<td>Robert Richard – CM</td>
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<td>Cynthia Gage –CM</td>
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<td>Richard Jacobsen –CM</td>
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<td>Osami Kataoka – CM</td>
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<td>Dominic Kolandayan - CM</td>
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<td>Steve Kujak – CM</td>
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<td>KEY CONTACTS</td>
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<td><strong>SPLS Liaison</strong></td>
<td>Janice Peterson</td>
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<td><strong>TAC Section Head</strong></td>
<td>Brian Michael Silvetti</td>
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<td><strong>TAC Chair</strong></td>
<td>Bryan R. Becker</td>
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<tr>
<td><strong>All Committee Liaisons As Shown On</strong></td>
<td><strong>RAC Research</strong>: Raymond Cohen</td>
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<tr>
<td><strong>TC/TG/TRG Rosters</strong></td>
<td><strong>Special Pubs</strong>: Julia Keen</td>
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<td></td>
<td><strong>Standards</strong>: Samuel D. Cummings, Jr</td>
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<td><strong>Handbook</strong>: Hassan M. Bagheri</td>
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<td><strong>Chapter Technology Transfer</strong>: Nancy J. Mitchell-Veeck</td>
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<td><strong>Professional Development</strong>: Tim J. McGinn</td>
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<td><strong>Manager Of Standards</strong></td>
<td>Stephanie Reiniche</td>
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<tr>
<td><strong>Manager Of Research &amp; Technical Services</strong></td>
<td>Michael R. Vaughn</td>
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* receives a copy of the TC 3.1 meeting minutes
1. CALL TO ORDER (Sean Cunningham, Chair)

A. Introductions of members and guests – Chair called the meeting to order at 4:25 P.M. and attendees introduced themselves.

B. Agenda Revision/acceptance
   i. Motion to accept the agenda made by W. Walter and seconded by S. Sundaresan and passed 5 / 0 / 0 / 5 CNV

C. Establishment of a quorum – There were 6 voting members present out of 9, which constitutes a quorum. Note that one missing member is an international member and his absence is not counted against the quorum determination.

Voting members for this meeting:
- Don Bivens
- Kevin Connor (absent)
- Sean Cunningham
- Felix Flohr (International member - absent)
- Gus Rolotti (absent)
- Samuel Sami
- Sonny Sundaresan
- Bill Walter
- Dave Wilson

D. Roster Review

<table>
<thead>
<tr>
<th>2008 – 2009</th>
<th>2009 - 2010</th>
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<tbody>
<tr>
<td><strong>Position</strong></td>
<td><strong>Position</strong></td>
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<tr>
<td>Sean Cunningham</td>
<td>Chair / ALI Coordinator</td>
</tr>
<tr>
<td>David Wilson</td>
<td>Vice Chair</td>
</tr>
<tr>
<td>Kevin Connor</td>
<td>Handbook Subcommittee Chair</td>
</tr>
<tr>
<td>Don Bivens</td>
<td>Research Subcommittee Chair</td>
</tr>
<tr>
<td>Samuel Sami</td>
<td>Program Subcommittee Chair</td>
</tr>
<tr>
<td>Felix Flohr</td>
<td>International Member</td>
</tr>
<tr>
<td>Gus Rolotti</td>
<td>Member</td>
</tr>
<tr>
<td>Ganesan Sonny Sundaresan</td>
<td>Member</td>
</tr>
<tr>
<td>William Walter</td>
<td>Member</td>
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<tr>
<td>Debra Kennoy</td>
<td>Secretary – Non-Voting</td>
</tr>
<tr>
<td>Barbara Minor</td>
<td>Webmaster – Non-voting</td>
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</tbody>
</table>
S. Cunningham, K. Connor, S. Sami, and G. Rolotti will roll off of TC 3.1 after the next Annual meeting in June 2010. S. Sami indicated that he would be amenable to reappointment.

2. APPROVAL OF 26 JANUARY 2009 MEETING MINUTES

Corrections noted:
- D. Kennoy updated the identification of the ASHRAE contacts.
- S. Szymurski noted that the footer had the wrong meeting information.

S. Sundaresan motioned and W. Walter seconded to accept minutes as modified.
Motion passed 6 / 0 / 0 / 6 (CV)

3. CHAIRMAN'S ANNOUNCEMENTS (Sean Cunningham)

A. Section 3 Meeting Report

1) Thank you letters
ASHRAE will send thank you letters to employers in appreciation for time spent advancing ASHRAE. They can be requested on-line through the ASHRAE website.

2) Hightower Award reminder
Individuals can be nominated based on technical leadership such as activity on technical committees.

3) Upcoming events
- Climate 2010 in Turkey
- Natural Refrigerants - in Sydney, Australia April 12 – 14 in 2010

4) Voting Member – Non-Quorum
ASHRAE recognizes the difficulty of some to travel to every meeting. They are considering a new category called voting member – non-quorum. There will be a maximum of 2 members per committee. This would be directed towards international members, retired members, etc. If this is enacted, the International Member category would be eliminated.

B. Roster review

1) Members rolling off in July 2010:
- Sean Cunningham, Samuel Sami, Kevin Connor, Gus Rolotti

   After the next Annual Meeting (June 2010):
   - Chair: D. Wilson
   - Vice chair: D. Kennoy
   - Secretary: open
2) The committee will need a secretary and voting members. Members must have been a Corresponding Member for one year. Contact the chair if interested.

4. Research Subcommittee  (Don Bivens) - see Appendix 1

   a. Report from Research Subcommittee Chairs Meeting
      D. Bivens will maintain the required forms for the research activities for TC 3.1

   b. Completed Research Projects
      2 projects completed in the last 6 months:
      i. Partitioning of Non-Condensable Gases in Refrigerant Liquid and Vapor Phases (1303-TRP)
      ii. Identification and Evaluation of Working Fluids for High Temperature Heating Applications (1308-TRP)

   c. Ongoing Projects
      i. Binary Refrigerant Flame Boundary Concentrations (1507-RFP)
         i. Description: databank for useful binary pairs in commercial refrigerants (60 C and 100 C). Identify standard flammable mixture for confirming accuracy of data from flame test apparatus. To aid assessment of new refrigerant blends for SSPC 34.
         ii. Committee: Bob Richard, Debra Kennoy, Sonny Sundaresan as PES.
         iii. Status: Bids were received for this project. A closed meeting will be held at the end of this TC 3.1 meeting to review the bids and allow members to vote. Results are confidential and must be filed with RAC to complete the process. ASHRAE will notify the winning bidder.

         i. Description: Literature Research and Industry Review (includes model identification and verification vs operating systems)
         ii. Committee: Kevin Connor, Xudong Wang, D. Bivens, and David Hinde (TC 10.7) as PMS.
         iii. Other information: Eckhard Groll – PI, with Joe Poland/Travis Horton
         iv. Status: E. Groll requested a no-cost extension from July to December 2009. They found extensive work being done in Europe by Linde / Carrier. The student is working there for 3 months. The result should be a stronger report.

         Motion to extend work for 3 months at no cost to ASHRAE made by S. Sundaresan and seconded by W. Walter. Motion passed: 5 / 0 / 0 / 5 (CNV)

   d. RTARs
i) **Assessment of Burning Velocity Test Methods** (RTAR 1583)

1. This is an approved RTAR.
2. B. Minor will head this activity.
3. Volunteers for participation:
   - S. Cunningham, R. Richard, S. Szymurski, K. Takizawa
4. **TC vote:** 9 / 0 / 0 (previous meeting)
   - estimated cost: $80,000 ($40,000 per contractor) - potential co-sponsor: AHRI
   - estimated duration: 12 months
5. Work statement needs to be prepared and submitted to TC 3.1 (to D. Bivens and S. Cunningham). It needs to be letter balloted by TC 3.1. Submittal date is 15SAug09 for consideration in January 2010.

ii) **Alternative Approaches to Predicting the Burning Velocity of Refrigerants** (RTAR 1584)

1. This is an approved RTAR.
2. D. Kennoy will head this activity.
3. Volunteers for participation:
   - S. Cunningham, R. Richard, S. Szymurski
4. **TC vote:** 9 / 0 / 0 (previous meeting)
   - estimated cost: $60,000 - potential co-sponsor: AHRI
   - estimated duration: 9 - 12 months
5. Work statement needs to be prepared and submitted to TC 3.1 (to D. Bivens and S. Cunningham). It needs to be letter balloted by TC 3.1. Submittal date is 15Aug09 for consideration in January 2010.

iii) **Risk Assessment of 2L Flammable Refrigerants in Stationary Applications and Commercial Refrigeration.** (RTAR 1580)

1. B. Minor distributed copies of a draft work statement for consideration
2. Following Research Subcommittee discussion, a few modifications were made such as:
   a. Add 1234ze (trans isomer)
   b. Reduce step 5 – develop the framework for a risk assessment rather than the actual risk assessment
3. Motion to accept the modified Work Statement 1580 as presented by B. Minor was made by S. Sundaresan and seconded by S. Sami. Motion failed: 3 / 2 / 0 (CNV). Need 2/3 of vote. Why 5, not 6 votes?
   a. actual risk assessments are better performed by the interested OEM
   b. there could be legal concerns with section 6
4. path forward - B. Minor will perform the following:
   a. drop sections 5 and 6
   b. reduce budget proportionally
   c. change the title to better reflect revised contents
   d. make any other necessary changes to align with the above modifications
Motion to approve the work statement contingent on the above changes was made by S. Sundaresan and seconded by W. Walter. Motion passed: 6 / 0 / 0 (CNV).

e. On Hold

i. Fractionation testing and error analysis for refrigerant blends (supports SSPC 34)
   Continuing on hold until new SPC 177P (MOT Fractionation Measurement of Refrigerant Blends) committee determines if needed for further research.

f. Non-Prioritized Research Suggestions

i. Identification of new fluids for high temperature energy conversion applications (CHP/organic Rankine cycle); also low grade heat recovery. See completed project report 1308-RP.
   (1) 1303 is a completed project.
   (2) S. Sami wants high temperature applications. He will make literature available. He will work with D. Bivens to put together an RTAR.
   (3) Steve Brown will also work on this.

ii. What are required properties needed to design equipment and rooms for use of flammable refrigerants, particularly 2L flammable refrigerants
   (1) There is a Standard 15 ad hoc committee formed to address this. Members include B. Minor and D. Wilson.

g. New suggestion

i. Risk Assessment of 2L flammable refrigerants in applications using large quantity refrigerants such as centrifugal chillers, supermarket racks, sea containers
   (1) There was an interest expressed in developing this idea into an RTAR
   (2) RTAR to be prepared by members of TC8.2, 10.7, TC3.1
       David Hinde, Phillip Johnson, Norbert Mueller, Minor (?)

h. ASHRAE RESEARCH GOALS LIAISONS - update

i. Natural Refrigerants and Charge Reduction (Liaison: B. Minor)
   i. Cooperation and communication with this group has been problematic.
   ii. Zayoub document – presenting at RAP (Research Advisory Panel)
   iii. Goal is to ensure fairness

ii. HVACR Components Research (Liaison: S Sundaresan)
   i. There have been 2 conference calls.
   ii. Sonny volunteered to prepare a work statement on the need for industry-wide research on the malfunction of expansion devices in order to improve specific components of HVAC&R systems.

5. HANDBOOK SUBCOMMITTEE (Sean Cunningham for Kevin Connor)

Nothing to report
6. PROGRAM (Sam Sami)


   i) Seminar 47: R-22 Retrofit of R-22 in A/C  
      a. Of the original presenters, only DuPon presented in this seminar  
      b. S. Sundaresan prepared an presentation on materials compatibility and oil return in R-22 retrofits to also present in this seminar

   ii) The forum on ISO 817 (to be chaired by Bill Walter) was not approved

   iii) Seminar 57: Systems with Natural Refrigerants: Components and Field Experience  
        a. Co-sponsor with TC 8.1 and TC 10.7

B. Orlando, 23-27 January 2010: Program packages (seminar) due to ASHRAE by 10JUL09. (Presented in order of priority defined by TC 3.1 during this meeting)

      a. See if the cognizant TC for SSPC 15 will co-sponsor.

       a. Volunteers: Purdue University, K. Connor, G. Rolotti  
       b. G. Kazachki may be able to present something here if needed

   iii) Forum: ASHRAE Standard 34 400 and 500 Series Blends – Do We Need the Distinction? Chairman Dave Wilson

   iv) Seminar: Systems with Natural Refrigerants – Components and Field Experience  
       a. Requested by ASHRAE Refrigeration Committee

C. Albuquerque, 26-30 June 2010: Program packages due in February 2010

    TC will discuss this during the January 2010 meeting.

D. Other information

   v) New ASHRAE policy – conference paper  
      a. ≤ 8 pages in length  
      b. papers are managed and reviewed by the TC  
      c. will replace Transactions in the long term

Motion to approve the program plan was made by W. Walter and seconded by S. Sami. Motion passed: 5 / 0 / 0 (CNV).

7. STANDARDS (Sean Cunningham for Jim Lavelle)
A. SPC-177P for Measuring Fractionated Compositions of Refrigerant Blends (Bob Richard)

- SPC 177P is moving along
  - GC procedure and draft for fractionation – good information derivable from round robin studies
  - A draft MOT to identify test apparatus is in progress
  - 2012 is the target for an MOT on fractionation for public review

B. ASHRAE Standard 34, Designation and Safety Classification of Refrigerants (Bill Walter)

- Meeting of full committee immediately after this meeting.

- Topics:
  - Addendum 34 w (classification of R-1234yf as A2) move forward with unresolved commenter.
  - Addendum 34z (extend rules for numbering refrigerants to include ethane and propene based refrigerants) – further discussion to a resolution
  - 3 new continuous maintenance proposals in progress

C. ISO Standard 817, Refrigerants – Number Designation (Bob Doerr)

ISO 817 has been held up due to missed deadlines. Hoping for a public review beginning this summer then a meeting to review comments in January 2010.

8. WEB SITE (Barbara Minor)

- The web site is active.
- Suggestion: post the Research Plan.

9. OTHER BUSINESS

none

10. MEETING ADJOURNED – 5:50 PM

Committee members remained for a closed session - review of bids for Binary Refrigerant Flame Boundary Concentrations (1507-RFP)
## APPENDIX 1

### TC 3.1 RESEARCH PLAN (2008 – 2009 - 2010)

With modifications at Louisville meeting on June 22, 2009

<table>
<thead>
<tr>
<th>ASHRAE Research Projects</th>
<th>Comments/Status</th>
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<tbody>
<tr>
<td><strong>2002-2003 Research Plan</strong></td>
<td></td>
</tr>
<tr>
<td>Partitioning of Non-Condensable Gases In Refrigerant Liquid &amp; Vapor Phases (1303-TRP)</td>
<td>Project completed. R.C. Cavestri PI. Minor, Rolotti, Richard - PMS. Poster presentation at Salt Lake City meeting.</td>
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<tr>
<td><strong>2003-2005 Research Plan</strong></td>
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<tr>
<td>Identification And Evaluation Of Working Fluids For High Temperature Heating Applications. (1306-TRP)</td>
<td>Project completed. Steven Brown PI. Minor. Watson, Meurer, Pucciano (TC 9.4) – PMS. Poster presentation by Brown at Salt Lake City meeting.</td>
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<tr>
<td><strong>2006-2009 Research Plan</strong></td>
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<tr>
<td>1507-RFP: Binary Refrigerant Flame Boundary Concentrations and databank for useful binary pairs in commercial refrigerants (60 C and 100 C). Identify standard flammable mixture for confirming accuracy of data from flame test apparatus. To aid assessment of new refrigerant blends for SSPC 34.</td>
<td>Project rewritten with clarified work statement. Bid proposals being evaluated 6/22/09. Committee: Bob Richard, Debra Kennoy, Sonny Sundaresan as PES.</td>
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<tr>
<td><strong>Priority</strong></td>
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<tr>
<td>1</td>
<td>Burning Velocity Method Survey and Cost, Error, and Ease of Use Analysis</td>
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<tr>
<td>3</td>
<td>RTAR: Assessment of Alternative Approaches to Predict Burning Velocity of a Refrigerant</td>
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<tr>
<td>2</td>
<td>RTAR: Risk Assessment of 2L Flammable Refrigerants in Stationary Applications (occupied spaces) a) residential a/c &amp; heat pumps b) commercial refrigeration</td>
</tr>
<tr>
<td>On hold pending SPC 177P</td>
<td>Fractionation testing and error analysis for refrigerant blends (supports SSPC 34)</td>
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## TC 3.1 Non-prioritized Research Suggestions
Updated June 22, 2009 at Louisville meeting

<table>
<thead>
<tr>
<th>Non-Prioritized Research Projects (long range)</th>
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<tbody>
<tr>
<td><strong>Secondary fluids for refrigeration:</strong> properties of low temperature secondary coolants such as formate/acetate water solutions …….reconsider after completion of 1484-RP</td>
</tr>
<tr>
<td><strong>Identification of new fluids for high temperature energy conversion applications (CHP/ organic Rankine cycle); also low grade heat recovery.</strong> See completed project report 1308-RP.</td>
</tr>
<tr>
<td><strong>What are required properties needed to design equipment and rooms for use of flammable refrigerants, particularly 2L flammable refrigerants.</strong></td>
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<td><strong>Low GWP refrigerant properties, stability, materials compatibility – receive summary of papers on this topic scheduled for NIST conference late June, 2009</strong></td>
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<tr>
<td><strong>Ice Slurry Properties……..Thermal Storage</strong></td>
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<td><strong>Lubricants for carbon dioxide</strong></td>
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<td><strong>New June 22, 2009</strong></td>
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ASHRAE TC 3.1  Refrigerants and Secondary Coolants
Final Minutes – June 2009 (Louisville, KY)