

**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.**

These minutes have been approved by the committee.

TC/TG/TRG NO TC 3.1

Date: 22 July 2013

TC/TG/TRG TITLE Refrigerants and Secondary Coolants

DATE OF MEETING 24 June 2013

LOCATION Denver, CO

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Debra Kenroy (Chair) – voting	2010	Samuel Sami – voting	2011	Julie Majurin – Guest
Mark McLinden (Vice Chair) – voting	2012	Osami Kataoka – CM	2006	Kenji Takizawa – Guest
Sean Cunningham (Secretary) – voting	2011	Damon Johnson – CM	2010	Gustavo Pottker – Guest
Chris Seeton (Program) – voting	2012	Kapil Singhal – CM	2010	Tom Leck – Guest
Barbara Minor (Research) – voting	2010	William Aloys Schulte – CM	2010	Scott Wujek – Guest
Maryline Rassi – voting	2010	Karim Amrane – CM	1997	Bianca Hydutsky – Guest
Kevin Connor (Handbook) – voting	2011	John Andrepont – CM	2001	Hewitt Gaudin – Guest
Stephen Kujak – voting	2009	Earl Clark – CM	1992	Jack O’Leary – Guest
Warren Clough – voting	2012	Thomas Clemens – CM	2001	Jeremy Smith – Guest
Robert Richard – CM	2000	Denis Clodic – CM	2007	Travis Benanti - Guest
Marc Scancarello – CM	2010	Alan Cohen – CM	1999	Harrison Skye - Guest
Mark Spatz – Research Liaison	2012	Bill Walter (Standards) – CM	2012	
Dave Wilson – CM	2008	Barry Fields – CM	2001	
Sonny Sundaresan – CM	2012	Cynthia Gage – CM	1992	
Don Bivens – CM	2012	Richard Jacobsen – CM	1990	
George Kazachki – CM	2008	Jim Lavelle – CM	2010	
Knut Petry – CM	2012	Ken Lilje – CM	2001	
		Bert McJimsey – CM	1997	
		Nandini Mouli – CM	2003	
		Sunil Nanjundaram – CM	2008	

MEETING MINUTES

1. CALL TO ORDER (D Kennoy, Chair)

- A. Introductions of members and guests – Chair called the meeting to order at 4:20 P.M. and attendees introduced themselves.
- B. Agenda Revision/acceptance
No revisions were proposed to the agenda,

Motion to approve agenda was made by M. McLinden and seconded by K.Connor.

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

- C. Establishment of a quorum – There were 9 voting members present out of 10, which constitutes a quorum.

Voting members for this meeting:

Steve Kujak - present
Warren Clough - present
Mark McLinden - present
Chris Seeton - present
Maryline Rassi - present
Debra Kennoy - present
Sean Cunningham - present
Barbara Minor - present
Kevin Connor - present
Alice Riemer – absent (non-quorum)
Felix Flohr – absent (non-quorum)
Samuel Sami – absent

- D. ASHRAE Code of Ethics was reviewed.

2. APPROVAL OF DALLAS, JANUARY 2013 MEETING MINUTES

Motion to approve draft minutes was made by W. Clough and seconded by B. Minor.

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

3. CHAIRMAN'S ANNOUNCEMENTS (D Kennoy)

A. Section 3 Meeting Report

1. ASHRAE requests everyone to update their BIOs by July 1, 2013.
2. Hightower Award nominees judged on technical leadership to TC/TG/TRG in last society year. Current recipient wrote two guidelines, amongst other activities.
3. E&P Meetings (Electronic and Present Meetings) allow people to participate in meetings remotely. They are more available as costs are dropping and can help committees meet quorum.
4. Volunteers to review session papers are needed. Contact Chair if interested.
5. Thank-You Letters - ASHRAE will send out emails in early July.

- B. Roster Review
Summary of TC3.1 membership and changes, effective July 1st 2013 are in Attachment 1.

4. Research Subcommittee (Barbara Minor)

- A. Report from Research Subcommittee Chairs Meeting. Money is available for projects. Pipeline of projects for TC 3.1 starting to run dry, need more RTAR, New RTAR form is being developed to simplify process and limit the submittal detail required. Guidelines for Contractor Selection have been updated. For the Seattle meeting, there will be a section in the Program on refrigerants. ASHRAE will present a "Service to Research" award.
- B. Ongoing Project Reports
- a. Binary Refrigerant Flame Boundary Concentrations (1507-RP)
- Description: databank for useful binary pairs in commercial refrigerants (60 C and 100 C, 50% relative humidity @ 23 C). Identify standard flammable mixture for confirming accuracy of data from flame test apparatus. To aid assessment of new refrigerant blends for SSPC 34.
 - Project Monitoring Subcommittee: D. Kennoy, T. Leck, R. Richard, S.Sundaresan, X. Wang
 - Status: Testing completed. Some significant inconsistencies with the data, which will be noted in the report.
- b. Assessment of Burning Velocity Test Methods (1583-RP)
- Description: evaluate burning velocity test methods for precision and accuracy; investigate ways to simplify the methods and reduce costs without sacrificing quality.
 - Project Monitoring Subcommittee: D. Kennoy, B. Minor, R. Richard, W. Walter, X. Wang
 - Status: Complete. Two Papers will be presented tomorrow.
- c. Study of Input Parameters for Risk Assessment of 2L Flammable Refrigerants in Stationary Applications and Commercial Refrigeration (1580-RP)
- Description: develop critical input data which can be used in risk assessments for residential air conditioning, heat pumps and small commercial refrigeration applications in occupied spaces; identify and determine refrigerant charge sizes, leak rates and leak scenarios, potential ignition sources and whether these sources are capable of igniting 2L refrigerants.
 - Project Monitoring Subcommittee: D. Kennoy, B. Minor, C. Seeton, S. Sundaresan, W. Walter, X. Wang
Status: Project Report published. Technical paper is under review.
- d. Assessment of Alternative Approaches to Predicting the Burning Velocity of Refrigerants (1584-RP)
- Description: identify technically acceptable parameters to accurately predict or estimate the burning velocity of refrigerants; a reliable, less expensive approach to burning velocity will reduce the cost of safety classification and increase the participation in the development of new refrigerant candidates that may be only mildly flammable.
 - Project Monitoring Subcommittee: S. Cunningham, D. Kennoy, B. Minor, R. Richard, X. Wang (ARTI representative)

- iii. Status: Report approved by PMS, ready for TC3.1 vote.

Motion to approve 1584-RP report was made by B. Minor and seconded by M. McLinden.

Motion passed: 8 / 0 / 0 / 8 (CNV). (For / Against / Abstain / Total [Chair Voting [CV] or Chair Not Voting [CNV]])

C. New Work Statements - None

D. Proposed RTARs

- a. Improve accuracy and Reproducibility of ASTM E681 Test Method for flammability limit measurement of class 2L refrigerants (see attachment 3)

Motion to approve above RTAR was made by B. Minor and seconded by S. Kujak.

Motion passed: 8 / 0 / 0 / 8 (CNV). (For / Against / Abstain / Total [Chair Voting [CV] or Chair Not Voting [CNV]])

- b. Assessment of alternative approaches to the A/B chronic toxicity classification of refrigerants used by ASHRAE SSPC34. S. Kujak prepared a draft RTAR. Discussion required between SSPC15 and SSPC34 to determine if research is needed.
- c. Assess the feasibility of including higher humidity requirements to the burning velocity tests. RTAR prepared by S. Cunningham. SSPC34 should determine humidity level required before assessing if further research is required.

E. Research Plan (See Attachment 2)

Motion to approve Research Plan was made by S. Kujak and seconded by S. Cunningham.

Motion passed: 8 / 0 / 0 / 8 (CNV) (For / Against / Abstain / Total [Chair Voting [CV] or Chair Not Voting [CNV]])

F. ASHRAE Research Goals Liaisons Reports

- i. Alternative Lower Global Warming Potential Refrigerants. Regular meetings have been held; the next one will be on Wednesday, June 26th. The meetings focus on research and program activities in ASHRAE and AHRI related to lower GWP refrigerants.

5. HANDBOOK SUBCOMMITTEE (Kevin Connor)

- a. The 2013 Fundamentals Handbook has been published. If anyone is interested in working on the 2017 edition, contact Kevin Connor.
- b. The Environmental Properties section of Chapter 29 may be given its own chapter in the next revision.

6. PROGRAM (Chris Seeton)

- a. See attachment 4 for deadlines for Program submission.
- b. Denver 22-26 June 2013. Program items related to TC 3.1:
 - i. Sponsoring Technical paper Session 6: Improved flammability Testing of Low GWP Refrigerants:

- ii. Assessment of Burning Velocity Test Methods for Mildly Flammable Refrigerants, Part 1; Closed Vessel Method and Part 2; Vertical tube Method. – K. Takizawa.
- iii. Co-sponsoring with Refrigeration Committee Seminar 46: Practical Experiences with Low-GWP and Natural Refrigerants in Supermarkets
 - 1. Practical Issues with Low GWP Replacements for R404A in Commercial Refrigeration Applications – G. Pottker.
 - 2. Implementation of Natural Refrigerant R744 (CO₂) in supermarket – S. Zha
 - 3. Best Practice HFC DX Design vs. Two CO₂ System Alternatives for a small supermarket – K. Larson
 - 4. Modeling the expected Energy Performance and Efficiency by Design of a High Efficiency Grocery store with Natural Refrigerants – K. Larson
- c. New York January 2014 (Seminar and Forum proposals due Aug 12th 2013)
 - i. Seminar – Code requirements needed for working with 2L refrigerants? Changes needed for the future? S. Sundaresan to Chair, C. Seeton to support.
 - 1. Understanding refrigerant classifications (Dave Wilson.)
 - 2. Application to ASHRAE 15 (Phil Johnson)
 - 3. Applications of ASHRAE Standards to building codes (S. Ferguson)
 - 4. Code Guy (Dave Conover, Jeff Saperio, ask Bill Walter)
 - ii. Seminar - Working with R22 replacement high glide blends. To coincide with AHR show. C. Seeton to chair, D. Kennoy to support. Possible speakers: Rob Yost (National), Curt Lawson (DuPont), Gustavo Pottker/Ron Vogl (Honeywell), Debbie Kennoy (Arkema)
 - iii. Co-sponsor with Refrigeration Committee; Refrigerants Today, Tomorrow and Beyond.
 - iv. Co-sponsor TC3.2; Pitfalls and Challenges with Current and Future Refrigerants.
- d. Seattle June 2014
 - i. Conference Paper; Compatibility Evaluation of Low GWP Refrigerants. S Kujak chair. Possible speakers: Rosine Rohatgi, Julie Majurin, Bianca Hydutsky Mark Spatz.

*Motion to approve Program was made by C. Seeton and seconded by S. Cunningham
 Motion passed: 8 / 0 / 0 / 8 (CNV) (For / Against / Abstain / Total [Chair Voting [CV] or Chair Not Voting [CNV]])*

7. STANDARDS (Bill Walter)

a. Guideline 6

- i. Team met yesterday. All sections have been through an initial revision. First draft target date is January 2014. First public review mid 2014.

b. ASHRAE Standard 34, Designation and Safety Classification of Refrigerants

- i. Four refrigerant classification applications were submitted for the Denver meeting
- ii. Standards Committee approved addenda ag (R-417C table addition), ah (R-445A table addition), ai (R-419B table addition), aj (R-422E table addition), ak (specific volume at critical point)
- iii. Addenda ac (R-444 table addition), ad (modifies 6.1.3.5a Heat of Combustion calculation), ae (R-30 change B2 to B1), af (RCL value corrections have been added to the ASHRAE website).
- iv. Continuing work with UMC on proposed code changes.

c. ISO Standard 817, Refrigerants –Designation and Safety Classification (W. Walter)

- i. Another ballot August 2013.

d. SPC-177P, MOT Fractionation Measurement of Refrigerant Blends (R. Richard)

- i. Waiting for completion of AHRTI project

8. WEB SITE (Sean Cunningham)

- a. Meeting minutes and presentations are posted on the ASHRAE website.
<http://tc31.ashraetcs.org/meetings.html>

9. OTHER BUSINESS

- a. FAQ (Frequently Asked Question) Three FAQs were revised (see attachment 5)
 - i. #24: Where can I find more design information on a new refrigerant? M. McLinden
 - ii. #46: What research is ASHRAE conducting regarding new, natural, or alternative refrigerants? B. Minor
 - iii. #84: Where can I find information on new refrigerants? S. Cunningham

Motion to accept FAQ revisions was made by K. Connor and seconded by M. McLinden

Motion passed: 11 / 0 / 0 / 11 (CV) (For / Against / Abstain / Total [Chair Voting [CV] or Chair Not Voting [CNV]])

10. MEETING ADJOURNED

Motion to adjourn was made by K. Connor and seconded by S. Cunningham

Motion passed: 11 / 0 / 0 / 11 (CV) (For / Against / Abstain / Total [Chair Voting [CV] or Chair Not Voting [CNV]])

ATTACHMENT 1: TC 3.1 Roster

Position	2012 / 2013		2013 / 2014		Roll-Off
	Name	Status	Name	Status	
Chair	Debra Kennoy	Voting	Debra Kennoy	voting	2014
Vice Chair	Mark McLinden	Voting	Mark McLinden	voting	2016
Secretary	Sean Cunningham	Voting	Stephen Kujak	non-voting	---
Webmaster			Sean Cunningham	voting	2015
Research Subcommittee Chair	Barbara Minor	Voting	Barbara Minor	voting	2014
Standards Subcommittee Chair	David Wilson	non-voting	David Wilson	non-voting	---
Program Subcommittee Chair	Christopher Seeton	Voting	Christopher Seeton	voting	2016
Handbook Subcommittee Chair	Kevin Connor	Voting	Kevin Connor	voting	2015
	Warren Clough	Voting	Warren Clough	voting	2016
	Stephen Kujak	Voting			
	Maryline Rassi	Voting	Maryline Rassi	voting	2014
	S. M. Sami	Voting	S. M. Sami	voting	2015
			S. Sundaresan	voting	2017
	Felix Flohr	voting (non quorum)	Felix Flohr	voting (non quorum)	2016
	Alice Riemer	voting (non quorum)	Alice Riemer	voting (non quorum)	2016
Liaisons: Alternative Lower Global Warming Potential Refrigerants	Barbara Minor (primary) Sean Cunningham (secondary)		Barbara Minor (primary) Sean Cunningham (secondary)		2013 (confirm annually)

ATTACHMENT 2: Current TC 3.1 Research Plan 2013

	ASHRAE Research Projects	Updated 6/24/13
	Project Title	Comments/Status
Current Research ASHRAE	<p>1507-RP: Binary Refrigerant Flame Boundary Concentrations and databank for useful binary pairs in commercial refrigerants.</p> <p>Identify standard flammable mixture for confirming accuracy of data from flame test apparatus. Databank to aid assessment of new refrigerant blends for SSPC34.</p>	<p>Still working to complete report. Need to add statements concerning issues on data accuracy. PMS: <u>Bob Richard</u>, Debra Kennoy, Sonny Sundaresan, Xudong Wang and Tom Leck</p>
	<p>1583-RP: Assessment of Burning Velocity Test Methods</p>	<p>Project and two final papers completed. Papers will be presented in Denver, Tues 8 am PMS: <u>B. Minor</u>, D. Kennoy, R. Richard, W. Walter, X. Wang</p>
	<p>1580-RP: Input Parameters for Risk Assessment of 2L Flammable Refrigerants in Stationary Applications</p> <p>a) residential a/c & heat pumps b) small commercial refrigeration</p>	<p>Final report completed, approved and published. Draft of technical paper is under review PMS: <u>B. Minor</u>, D. Kennoy, C. Seeton, W. Walter, S. Sundaresan, and X Wang</p>
	<p>1584-RP: Assessment of Alternative Approaches to Predict Burning Velocity of a Refrigerant</p>	<p>Final report has been approved by PMS. Expect to vote on report approval at TC 3.1, Denver PMS: <u>D. Kennoy</u>, B. Minor, R. Richard, S. Cunningham, Xudong Wang, Kenji Takizawa</p>
	<p>Phase II for RP-1484 - Energy and Performance of Secondary Coolant Low Temperature Refrigeration Systems</p>	<p>Draft final paper has been reassigned to a new student to finish. Don Bivens to follow up.</p>
AHRTI	<p>9005- Fractionation testing and error analysis for refrigerant blends in support of SSPC34</p> <p>SPC-177P title is: MOT Fractionation Measurement of Refrigerant Blends</p>	<p>Draft final report is under revision</p> <p>Contractor - Safety Consulting Engineers AHRTI PMS <u>R. Richard</u>, B. Minor S. Kujak, M. Scancerello, X. Wang M. McLinden</p>

TC3.1 Non-Prioritized Research Suggestions - updated 6/24/13		
	Project Title	Comments/Status
RTAR deadline 15-Aug	Improve Accuracy and Reproducibility of ASTM E-681 Flammability test Method for Flammability Limit Measurement of 2L Flammable Refrigerants	Debra Kennoy prepared a draft RTAR which was discussed and upgraded by TC 3.1 Research subcommittee RTAR was approved by TC 3.1. Also plan to review with Std 34, Std 15, and low GWP MTG to get support for cosponsoring and AHRI for co-funding.
	Assess the Feasibility of Including Higher Humidity Requirements to the Burning Velocity Test(s)	Sean Cunningham prepared a draft RTAR which was discussed by TC 3.1 Research. It was decided that Std 34 should determine what humidity level is required, then assess if a research project is still needed based on the required conditions.
	Assessment of Alternate Approaches to the A/B Chronic Toxicity Classification of Refrigerants used by ASHRAE Standard 34	Steve Kujak prepared a draft RTAR. An adhoc committee will be formed between Std 34 and Std 15 to discuss approaches and determine if research is needed

Attachment 3 Proposed RTAR

Unique Tracking Number Assigned by MORTS _____
RESEARCH TOPIC ACCEPTANCE REQUEST (RTAR) FORM
Sponsoring TC/TG/MTG/SSPC/EHC/REF: TC 3.1 Refrigerants and Secondary Coolants

Title:

Improve Accuracy and Reproducibility of ASTM-E681 Test Method for Flammability Limit Measurement of 2L Flammable Refrigerants

Applicability to ASHRAE Research Strategic Plan:

This project supports the ASHRAE Research Strategic Plan 2010 – 2015 for support of research into new alternative Low Global Warming Potential refrigerants by addressing difficulties experienced in their flammability assessment and identifying corrections needed in the test approach to result in proper safety data development and classification for flammability. (See Plan Goal 8).

Research Classification:

Basic / Applied Research

TC/TG/MTG/SSPC Vote:

TC 3.1 Vote: 9 / 0 / 0 / 1 / 10

Reasons for Negative Votes and Abstentions:

(Negative Votes) - none

(Abstentions) - none

Estimated Cost:

\$150,000 to \$200,000

Estimated Duration:

12 to 18 months

RTAR Lead Author

Debra Kennoy, debra.kennoy@arkema.com

Expected Work Statement Lead Author

Debra Kennoy, debra.kennoy@arkema.com

Co-sponsoring TC/TG/MTG/SSPCs and votes:

SSPC 34 - to be approached

SSPC 15 - to be approached

Possible Co-funding Organizations:

AHRI / AHRTI (Xudong Wang, xwang@ahrinet.org) - to be handled by Barbara Minor

Application of Results:

ASHRAE Handbook Fundamentals Chapter 19; ANSI/ASHRAE Standard 34

State-of-the-Art (Background):

ASHRAE SSPC 34 has incorporated the 2L subclassification for flammability into ANSI/ASHRAE Standard 34. 2L-classified refrigerants are identified based on lower flammability limit testing, heat of combustion, and a burning velocity measurement. 2L refrigerants are considered to be more mildly flammable than those classified as a 2 for

flammability and, additionally, some of these refrigerants result in flames that are less stable making flammability property measurement more difficult. For a given CFR of a blend, there was a wide variation in the test results causing difficulty in classifying the blend in ASHRAE Standard 34 for flammability which would be a safety concern that impacts Standard 15 and codes.

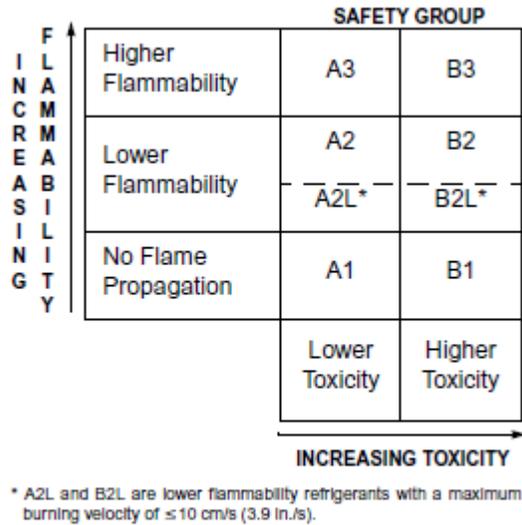


Figure 1 Refrigerant safety group classification.
(from ANSI/ASHRAE Standard 34-2010)

Recent shared technical experience has brought the challenges encountered when testing many of the new alternative low GWP (Global Warming Potential) refrigerants for flammability (Lower Flammable Limit- LFL) following ASTM E681, Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases).

ASHRAE is currently funding a research project to assess the flammability of some commercial refrigerant binaries. The principal investigator for ASHRAE Research Project 1507-TRP (“Binary Refrigerant Flame Boundary Concentrations”) reported concern that the current test approach is deficient when testing some 2L-type refrigerants. Discussions ensued and early concerns related to some variables in the test approach, previously thought to be innocuous, point to the idea that additional attention is necessary when testing mildly flammable refrigerants. These variables may include, but may not be limited to, the static and dynamic pressure effects of the lid, the vessel size, electrode configuration, the camera specification, the dynamics of venting, and the flow pattern under the flame (these flow patterns will effect flame stretch and flame stability (flame extinguishing)).

Due to their flames which are found to have a weak and unstable nature, it has been difficult to achieve precise reproducibility between laboratories. We suspect that some test details, which have not been an issue for refrigerants with stronger flammability attributes such as R-152a, must be studied and addressed in order to improve accuracy and precision for the mildly flammable refrigerants. With these corrections, ASHRAE SSFC 34 will be able to better assign safety classifications based on consistent, accurate test results for these new alternative refrigerants.

Advancement to the State-of-the-Art:

The project will identify modifications needed for testing new alternative refrigerants for flammability following ASTM E681. With the incorporation of these modifications into ANSI/ASHRAE Standard 34, applicants will be better suited to submit accurate, precise flammability data in their submissions for new refrigerants. As a result, the

SSPC 34 committee will be in a better position to accurately assign flammability safety classifications to new refrigerants and to note the proper LFL in ASHRAE Standard 34.

Justification and Value to ASHRAE:

As a consequence of phase-out regulations, the industry is looking to the development of new refrigerants that are both safe and functional. ASHRAE SSPC 34 assesses the safety of submitted newly-proposed refrigerants and offers a safety classification following a peer-review process. With the flammability test challenges posed by some of the new alternative refrigerants, appropriate test modifications need to be identified, confirmed, and incorporated into the test procedure included in ASHRAE Standard 34. With this, the proper flammability classification will be assigned to further ensure safety for both the individual (upon handling and using) and the environment (with the introduction of new alternative low GWP refrigerants).

Since the modifications would be incorporated into ANSI/ASHRAE Standard 34, those interested in introducing new refrigerants through the ASHRAE Standard 34 process would be compelled to adopt the modifications.

Objectives:

Select a contractor to perform the following tasks:

1. Acquaint themselves with the ASTM E681 test method:
 - a. A literature search of test reports developed using this approach especially those referencing materials not considered to be refrigerant-related – this is intended to identify findings that may have been reported from use in other industries
 - b. Study and report on the theoretical basis of the test method as currently prescribed
 - c. Conduct survey or interviews and document findings related to test equipment and procedure differences with acknowledged refrigerant test facilities currently performing ASTM E681 especially related to evaluations performed on new alternative low GWP refrigerants
2. Test the candidate fluid, identified by the PMS, in a cubic meter vessel to identify an accurate CFR value following ASTM E918.
3. Set up test facility, if not already available, to perform ASTM E681 testing following the instructions found in the Normative Appendix B of ANSI/ASHRAE Standard 34 (“Details of Testing – Flammability”). Confirm the ability to perform accurate testing by assessing the flammability of known refrigerants and comparing against industry values. Assure equipment has flexibility to perform under varied conditions identified in the survey
4. Assess the flammability of some new alternative low GWP refrigerants currently assigned a 2L classification and compare results to reported findings.
 - a. Suggested refrigerants include but are not limited to R-32, R-1234yf, R1234ze, and low flammability refrigerant mixtures with the test fluids to be confirmed by the PMS.
 - b. Include varying conditions and physical setup and measuring difference in results.
 - i. Can work with PMS members and experienced test facilities interested in this challenge to help identify parameters of concern for precise findings.
 - ii. Variables may include, but may not be limited to, the static and dynamic pressure effects of the lid, the vessel size, electrode configuration, the camera specification, the dynamics of venting, and the flow pattern under the flame. The contractor will need to reconfigure their equipment to address these ideas and determine the impact of the changes on the quality of the test results.
 - iii. Evaluate the critical flammability ratio (CFR) of blends of flammable and non-flammable refrigerants (with the test fluids to be confirmed by the PMS) in order to improve reproducibility.
 - iv. CFD and dynamic modeling of the flame and apparatus would be instructive in understanding the problem and in finding solutions.
5. Show if a technically sound, reproducible flammability limit method for mildly flammable, less stable refrigerants can be developed to improve the precision and accuracy of the flammability test results.
6. Document these findings in a report and prepare / present to the ASHRAE community as requested.

Key References:

ANSI/ASHRAE Standard 34 (“Designation and Safety Classification of Refrigerants”)

ASTM E681 (“Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases)”)

ASHRAE Research Project 1507-TRP (“Binary Refrigerant Flame Boundary Concentrations”)

ATTACHMENT 4: Program Deadlines

	2014 ASHRAE Winter Conference	2014 ASHRAE Annual Conference
Dates	18 – 22 JAN 2014	28 JUN – 02 JUL 2014
Location	New York, NY	Seattle, WA
Conference website	www.ashrae.org/newyork/	www.ashrae.org/seattle/
Conference Paper Abstracts due	15 MAR 2013	23 SEP 2013
Conference Paper Abstracts Accept / Reject notifications	05 APR 2013	07 OCT 2013
Technical Papers due for review	19 APR 2013	23 SEP 2013
Web Site Open (for Seminar, Forum, TPS and CPS Proposals)	03 JUN 2013	06 JAN 2014
Final Conference Papers submitted for review (include learning objectives and Q&A)	03 JUL 2013	09 JAN 2014
Seminar, Forum, TPS and CPS Program Proposals due	12 AUG 2013	13 FEB 2014
Technical Papers final review due	12 AUG 2013	25 FEB 2014
Upload of PPTs begins	06 DEC 2013	06 MAY 2014
all PPTs due online	03 JAN 2014	02 JUN 2014

ATTACHMENT 5 : FAQs

ID 24

Question Where can I find more design information on a new refrigerant?

The [\(replace following links with similar link to 2013 Handbook\) 2009 ASHRAE Handbook - Fundamentals](#) has two chapters devoted to refrigerants. Chapter [F29](#) provides a general discussion of the different refrigerants, and Chapter [F30](#) provides pressure-enthalpy diagrams and summary tables of the thermodynamic and transport properties of the more common refrigerants. Chapters [R06](#), [R07](#), and [R12](#) of the [2010 ASHRAE Handbook - Refrigeration](#) provide information on refrigerant system chemistry, the control of moisture, and lubricants for use with refrigeration systems. The "NIST Reference Fluid Thermodynamic and Transport Properties Database ([REFPROP, Standard Reference Database 23](#)), Version 9.1", provides more detailed properties for more than 100 pure fluids (including some of the "new" HFO refrigerants), 72 predefined mixtures (such as R410A) and allows the user to obtain properties for any arbitrary mixture with up to 20 components.

Answer

[ASHRAE Standard 34-2010](#) defines the nomenclature used to name refrigerants and provides safety (flammability and toxicity) classifications for 53 pure fluids and 45 blends. These classifications are referenced by [ASHRAE Standard 15-2010](#), which defines allowable refrigerants in different applications. The "NIST Leak/Recharge Simulation Program for Refrigerant Mixtures ([REFLEAK, Standard Reference Database 73](#)), Version 4.0," allows the user to conduct fractionation analyses on refrigerant blends. Extensive data on lubricants and materials compatibility are available in the reports resulting from the Materials Compatibility and Lubricants Research Program of the Air-Conditioning and Refrigeration Technology Institute, similar work on the new low-GWP refrigerants continues under the AHRI Low-GWP Alternative Refrigerants Evaluation Program see: <http://www.ahrinet.org/research.aspx>.

Some of the equipment and refrigerant manufacturers provide their customers design data and/or computer programs for their equipment and fluids. When new refrigerants (especially blends) are introduced, design data can be obtained from the refrigerant manufacturer.

The handbook and other publications may be purchased and/or individual chapters of the handbook may be purchased and downloaded on-line at our website, www.ashrae.org or by calling 1-800-527-4723 in the USA and Canada or 1-404-636-8400 worldwide.

[NIST](#) - National Institute of Standards and Technology, www.nist.gov
[ARTI](#) - Air-Conditioning and Refrigeration Technology Institute, www.arti-research.org.

[ASHRAE Standard 34-2010](#), "Designation and Safety Classification of Refrigerants", plus [ASHRAE BOD approved addenda](#).

ASHRAE Pubs

[ASHRAE Standard 15-2010](#), "Safety Standard for Refrigeration Systems", plus [ASHRAE BOD approved addenda](#).

[2009 ASHRAE Handbook - Fundamentals](#), Chapter [F29](#) & [F30](#)

[2010 ASHRAE Handbook - Refrigeration](#), Chapters [R06](#), [R07](#), & [R12](#)

Topic References Refrigerants, Thermodynamic properties, Transport properties, Lubricants

	Cognizant ASHRAE Committees	Refer to Organization
1	TC 3.1	NIST
2	TC 3.2	ARTI
3	TC 3.3	
4	TC 3.4	
5	SSPC 34	

FAQ 46

ID 46

Question What [research](#) is ASHRAE conducting regarding new, natural, or alternative refrigerants?

New refrigerants are not typically developed through ASHRAE research. Manufacturers may submit new refrigerant formulations to SSPC 34, Designation and Safety Classification of Refrigerants, to obtain an ASHRAE number designation based on criteria in the standard. In the United States, most approved refrigerants are non-flammable blends with HFCs as the major components.

Each year ASHRAE devotes the October issue of the [ASHRAE Journal](#) to that year's Research Report. The following relevant active projects are listed in the October 2012 issue:

Answer

1327-RP Flow Regime and Pressure Drop Determination for Two-Phase Ammonia Upward Flow in Various Riser Sizes

1409-RP Stability of Candidate Lubricants for CO₂ Refrigeration

1410-RP Effect of System Chemicals Toward the Breakdown of Lubricants and Refrigerants

1444-RP Experimental Evaluation of Two Phase Pressure Drops and Flow Patterns in U-Bends for R-134a, R-410a, and Ammonia

1472-RP Experimental Validation of Modeling Tools for Mixed Gas Refrigeration Cycles

1476-RP Woven Compressor Enabling Economic and Scalable R718 Chillers – Phase I: Proof of Concept

1495-RP Effect of Lubricant on the Distribution of Water Between Vapor and Liquid Phases of Refrigerants

1507-RP Binary Refrigerant Flame Boundary Concentrations

1580-RP Study of Input Parameters for Risk Assessment of 2L Flammable Refrigerants in Residential Air Conditioning and Small Commercial Refrigeration Applications

1583-RP Assessment of Burning Velocity Test Methods

1584-RP Assessment of Alternative Approaches to Predicting the Burning Velocity of a Refrigerants

Final reports to completed ASHRAE research projects are available (for free to ASHRAE members) at the [Research](#) page of www.ashrae.org.

ASHRAE Pubs

The October issue of the [ASHRAE Journal](#) each year summarizes ASHRAE's current research efforts.

Topic References

Research

	Cognizant ASHRAE Committees	Refer to Organization
1	TC 3.1	
2	RAC	
3		
4		
5		

FAQ 84

ID

84

Question

Where can I find information on new refrigerants?

Long Answer

Refrigerants being developed for commercialization are generally submitted to ASHRAE for assignment of unique reference numbers and safety classifications. [ASHRAE Standard 34-2010](#) plus [ASHRAE BOD approved addenda](#) lists refrigerants with an ASHRAE number together with the chemical name, chemical formula and the composition of refrigerant blends. The standard identifies requirements to apply for designations and safety classifications for refrigerants, including blends, in addenda or revisions to the standard.

The [2013 ASHRAE Handbook - Fundamentals](#) also has two chapters devoted to refrigerants. Chapter [F29](#) provides data on refrigerant properties, refrigerant performance, material compatibility, safety classification and environmental properties, and Chapter [F30](#) provides pressure-enthalpy diagrams and summary tables of the thermodynamic and transport properties of refrigerants.

The standard and Handbook may be purchased and downloaded on-line at our website, www.ashrae.org or by calling 1-800-527-4723 in the USA and Canada or 1-404-636-8400 worldwide.

ASHRAE Pubs [ASHRAE Standard 34-2010](#), "Designation and Safety Classification of Refrigerants", plus [ASHRAE BOD approved addenda](#).
 [2013 ASHRAE Handbook - Fundamentals](#), Chapter [F29](#) & [F30](#)

Topic References refrigerants

	Cognizant ASHRAE Committees	Refer to Organization
1	TC 3.1	
2	SSPC 34	
3		
4		
5		