



ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc.

1791 Tullie Circle, NE • Atlanta, Georgia 30329-2305 ☎404-636-8400 • Fax 404-321-5478

TC/TG/TRG MINUTES COVER SHEET

TC/TG/TRG NO.: TC 9.01 ISSUE DATE: January 3, 2013

TC/TG/TRG TITLE: Large Building Air-Conditioning Systems

DATE OF MEETING: June 26, 2012 LOCATION: San Antonio, Tx

MEMBERS PRESENT	TERM END	MEMBERS ABSENT	TERM END	ADDITIONAL ATTENDANCE
Kelley Cramm, Chair	6/30/2013	John L Kuempel Jr,	6/30/2014	<u>Corresponding Members:</u> Alonzo Blalock Julian De Bullet Steve Nicklas John Wolfert Jeff Traylor, Handbook Sub-C Chair <u>Liaisons / Staff / Ex-Officio Members:</u> Not Present <u>Guests:</u> Kasey Worthington Ray Good Myron Ramage
Howie McKew, Secretary	6/30/2015	Vice Chair		
Bill Klock, Research Sub-C Chair	6/30/2013	Dennis Wessel, Program Sub-C Chair	6/30/2012	
Charlie Henck, Standards Sub-C Chair	6/30/2013	Hollace Bailey, Member	6/30/2013	
Steve Duda Honors & Awards Sub-C Chair	6/30/2016	Quinn Hart, Member	6/30/2014	
Warren Hahn, Publication Liaison	6/30/2013	R. Lee Millies	6/30/2012	
Lynn Werman, Membership Sub-C Chair	6/30/2013	Harvey Brickman, Member	6/30/2012	
Mark Fly, Web Master	6/30/2013			
Gene R Strehlow ALI/PDC Coordinator	6/30/2014			
Doug Cochrane, Member	6/30/2013			
Jay Eldridge, Member	6/30/2015			
John I Vucci, Member	6/30/2015			
<u>Non-Quorum Members:</u>				
Rodney Lewis	6/30/2014			
Phil Trafton	6/30/2014			

DISTRIBUTION

ALL MEMBERS OF TC/TG/TRG

TAC COMMITTEE CHAIR: Charles Culp

TAC SECTION HEAD: Thomas M Lawrence

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DISTIRBUTION (continued)

LIAISONS:

CEC Liaison: Dennis Wessel (NP) Publications Liaison: Warren Hahn Special Pubs Liaison: Francis Mills (NP)

Handbook (Section Head): Thomas M Lawrence (NP) Research Liaison: Carl Huber (NP)

Professional Development Liaison: _____ CTTC Liaison: Thomas O. Lewis (NP)

Staff Liaison/Research/Technical Services: Michael R Vaughn (NP) Manager of Standards Liaison: Stephanie Reiniche (NP)

Standards Liaison: Cecily M Grzywacz (NP)

** NP Not Present



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ASHRAE TC/TG/TRG ACTIVITIES SHEET

ISSUE DATE: January 3, 2013

TC/TG/TRG NO.: T.C. 9.01 TC/TG/TRG TITLE: Large Building Air-Conditioning Systems

CHAIR: Kelley Cramm

VICE-CHAIR: John Kuempel Jr

SECRETARY: Howie McKew

TC/TG/TRG MEETING SCHEDULE

Location - Past 48 Months	Date	Location - Planned Next 36 Months	Date
Chicago, IL	1.27.2009	Dallas, TX	1.26.2013
Louisville, KY	6.23.2009	Denver, CO	6.22.2013
Orlando, FL	1.26.2010	New York, New York	1.18.2014
Albuquerque, NM	6.29.2010	Seattle, Washington	6.28.2014
Las Vegas, NV	2.01.2011	Chicago, IL	1.24.2015
Montreal, PQ (Canada)	6.28.2011	Atlanta, GA	6.27.2015
Chicago, IL	1.24.2012		
San Antonio, TX	6.23.2012		

TC/TG/TRG SUBCOMMITTEES

Function	Subcommittee Chair (& 12-26-12 Notes)
ALI/PDC Coordinator	Gene Strehlow
Handbook	Howard McKew (taking over for Jeff Traylor)
Honors and Awards	Steve Duda (taking over for Rodney Lewis)
Membership	Lynn Werman
Programs	Dennis Wessel (John Kuempel taking over for Dennis)
Publications	Warren Hahn
Standards	Charlie Henck
Research	William Klock
Standards Issues	No Assignment
Webmaster	Mark Fly

RESEARCH PROJECTS – CURRENT

Project Title	Contractor	Monitoring Comm. Chairperson	Report Made At Mtg.
<i>NONE</i>			

LONG RANGE RESEARCH PLAN

Rank	Title	W/S Written	Approved	To RAC
<i>NONE</i>				

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ASHRAE TC/TG/TRG ACTIVITIES SHEET (continued)

HANDBOOK RESPONSIBILITIES				
Year & Volume	Chapter Title	Chapter No	Reviser & Mentor-Reviser	Reviewer
2016 Systems & Equip	HVAC System Analysis and Selection	1	Mark Fly/Kasey Worthington	/ /
2016 Systems & Equip	Decentralized Cooling and Heating	2	Gene Strehlow/Steve Nicklas	
2016 Systems & Equip	Centralized Cooling and Heating	3	Steve Duda/ ___ TBD ___	
2016 Systems & Equip	Air-Handing and Distribution	4	Lynn Werman/ ___ TBD ___	
2016 Systems & Equip	In-Room Units and Distribution	5	Bill Klock/ ___ TBD ___	
STANDARDS ACTIVITIES - List and Describe Subjects				
<p>STD 15-2004 <i>Safety Standard for Refrigeration Systems</i> – Continuous Maintenance, Cognizant TC is 9.01, Steve Duda is liaison. Guideline 0-2005 <i>The Commissioning Process</i> – TC 9.01 is co-cognizant. Guideline 16-2003 <i>Selecting Outdoor, Return, and Relief Dampers for Air-Side Economizer Systems</i> – Cognizant TC is 9.01. Guideline 22—2008 <i>Instrumentation for Monitoring Central Chilled-Water Plant Efficiency</i>- Cognizant TC is 9.01</p>				
TECHNICAL PAPERS from Sponsored Research – Title, when presented (past 3 yrs. present & planned)				
1. None.				
TC/TG SPONSORED TRANSACTION SESSIONS – Title, when presented (past 3 yrs. present & planned) & Chair				
<p>1. Conference Paper – Rehab for DDC at Corporate National Training Center – Three Years of Therapy - Winter, 2011 – Las Vegas, Blalock</p> <p>2. Conference Paper - Application of ASHRAE Standard 15-2010 with Respect to Multi-Evaporator Split Air-Conditioning Systems – Summer 2011 – Montreal, Duda</p>				
TC SPONSORED SEMINARS – Title, when presented (past 3 years, present, & planned) & Chair; Speaker, Speaker, Speaker				
<p>1. <i>Introduction to 2008 Handbook</i> (2008 Annual – Salt Lake City) McKew; Duda & Maston.</p> <p>2. <i>Case Studies in Sustainable Retrofits to Reduce Energy Use of Existing Buildings</i> (2009 Winter – Chicago) / Trafton; Kuempel, McKew, Traylor.</p> <p>3. <i>Design and Case Studies for Indoor Sports Facilities</i> (2009 Annual – Louisville) / Trafton; Duda, R. Towell, Cramm.</p> <p>4. <i>Design Challenges & Solutions for Entertainment Venues</i> (2009 Annual – Louisville) / Millies; Kuempel, S. Braden, McKew.</p> <p>5. <i>Retrofitting HVAC in Older Buildings for Higher Efficiency</i> (2010 Annual-Albuquerque) Kuempel, Duda, Cramm</p> <p>6. <i>High Performance Run Around Energy Recovery Systems</i> (2010 Annual – Albuquerque) Niederer</p> <p>7. <i>HVAC Security- Less we forget</i>(2011 Winter-Las Vegas) McKew; Cogley, Dobbs, & Campbell</p> <p>8. <i>Case Studies: New Equipment & Applications to Improve Energy Efficiency</i> (2012 Winter-Chicago) Cramm; Kuempel, McKew, & Schwedler</p> <p><i>When Integrated Controls Are Not Integrated</i> (2012 Summer-San Antonio) Cramm; Rimmer, McKew, & Conlan</p>				

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ASHRAE TC/TG/TRG ACTIVITIES SHEET (continued)

TC/TG SPONSORED FORUMS - Title, when presented (past 3 years, present, & planned) & Moderator
1. None.
JOURNAL PUBLICATIONS , when published (past 3 years, present, & planned) & Author
1. No publication articles between January and June 2012 by TC 9.01 Members 12-26-12 Note: Steve Duda had an article in the July Journal titled “Applying VRF? Don’t Overlook Standard 15”.



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TC 9.01 Large Building Air-Conditioning Systems
Meeting Minutes

Meeting Date: July 26, 2012
San Antonio, Texas

I. Call to Order

- a) Chair Kelley Cramm called the meeting to order at 1:00 PM local time,

II. Introduction of Members And Guest

- a) Self-introductions of members and guests were made around the table as the attendance roster was circulated. Chair welcomed all members and visitors. A quorum was verified.

Voting Members: 9 Present 6 Absent, Quorum achieved_(3-more joined meeting later)
Voting Non-Quorum Members: 2 Present 0 Absent
Corresponding Members: 3 Present
Society Liaisons: 0 Present
Staff Liaisons: 0 Present
Guests: 3 Present

Note: Voting Non-Quorum members are voting members if present, but do not count against quorum if absent.)

III. Minutes from Chicago, Winter Meeting 2012

- a) Jeff T moved that the meeting minutes be approved and Mark F seconded.
- b) Motion carried 11-0-0-0-0.

Secretary’s Note: All votes recorded herein are formatted as (Aye-Nay-Abstain-Chair not voting-Absent).

IV. Agenda Comments / Updates (K. Cramm)

- a) No Additions to Agenda requested.

V. Chairman’s Comments and Section 9 Report (K. Cramm)

- a) Kelley attended section meeting and mentioned a discussion on having Multi-Disciplinary Task Groups.

VI. ASHRAE Liaison Reports

- a) None Present

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January 2013



VII. TC 9.01 Subcommittee Reports

a) Membership (Werman): Lynn to review and provide update to July 1, 2012 Roster. In addition Kelley has sent out an email to all corresponding members to notify that they want to remain on the “corresponding member roster.” A “no response” to the email within a 60-day period will indicate the individual does not want to remain on the list. Effective January 1st, 2012, the TC 9.1 Members and Corresponding Members is as follows:

- Rolling off to CM status: H. Brickman, D. Wessel, & R. Lee Millies
- Joining as Voting Members: K. Gill, J. Traylor, S. Duda

b) Handbook (McKew): 2012 Systems and Equipment Handbook has been published and distributed and a new Reviser Group has been formed (see page 4 for Revisers).

c) Standards (Henck): Standard 22 being revised.

d) Research (Klock):

- RTAR-1448 – *Chiller Room Ventilation*, PMS: S. Taylor, S. Duda, J. Vucci. Steve provided an update on this document. . Steve asked to sponsor Standard 15 research “Dispersion of refrigeration to connecting spaces via transfer openings”.
 - Bill Klock moved to approve the RTAR and Phil Trafton seconded. Rodney asked that the RTAR specifically address heavier-than-air refrigerants. RP-1448 studied accidental refrigerant releases in a chiller room where the release is instantaneous and complete. Some aspects of this research may be a starting point. Steve sent the RTAR to the Research Liaison and the feedback was positive. The committee voted to approve, 14 in favor 0 opposed, and Chair-no vote.

e) Program (Wessel) Dennis could not make the TC 9.1 meeting. (**12-21-12 Note:** John Kuempel has offered to take over this assignment)

Steve Duda addressed the importance of Dallas, 2013 program titled, “Large Building A.C. Systems and the goal to have a minimum of 12-programs with 9-sessions so far identified.

12-26-12 Note: *The following were approved for the Dallas Winter Conference:*

- TC 9.01 co-sponsoring with TC 01.11 and TC 1.9 Seminar 6 – Smart Methods to Prevent Electric Harmonics Problems in Buildings
- TC 9.01 co-sponsoring with TC 6.01 Hydraulic Modeling

f) Professional Development (G. Strehlow):

- Committee is considering “certificate” program in addition to the certification programs and that a sub-committee was voted to proceed to review the concept.



g) Honors & Awards (Duda):

- Bill Klock and Howard McKew received the Distinguished Service Awards
- Carl Lawson and Charlie Henck received Exceptional Service Awards
- Steve requested individuals submit their recommendations for Honors & Awards (i.e., Fellow, Distinguished Service, etc.)
- It was also noted that if Members and/or Corresponding members have a nominee for the George B. Hightower Technical Achievement Award, that they should contact Stave Duda.
- Submission Due Dates:
 - Fellow Award: December 1st
 - Distinguished Service Award: May 1st and John Kuempel name has been submitted

h) Publications (Hahn):

- Warren provided update and request for data for Insights before Dallas

i) Website Report (M. Fly):

- Mark to confirm new ASHRAE logo on web page
- Kelley to send the latest roster to him for posting.

VIII. TC/PC Liaison Reports

- a) TC 1.12 – Moisture Management (J. Traylor) Jeff provided brief update on the need for more practitioners.
- b) TC 4.03 – Ventilation & Filtration (S. Duda) 1448 Research PMS voted to approve it.
- c) TC 5.06 – Control & Smoke (P Trafton) No new news.
- d) TC 6.01 - Hydronic and Steam Heating Equipment and Systems (K. Cramm): Meeting is concurrent with TC 9.1 so no new updates.
- e) TC 7.05 – Smart Building Systems (G. Strehlow) Committee is looking at control options.
- f) TC 7.07 - Testing & Balancing (Brickman) Rodney mentioned a research project was completed and the committee was looking for public review in 2012.
- g) TC 7.09 – Building Commissioning (J Traylor) Existing Building Commissioning is still being worked on. Jeff noted some states require a P.E.
- h) TC 8.07 - Variable Refrigerant Flow (Vucci) Addressed by Steve D earlier.
- i) TC 9.06 – Healthcare (J. Traylor) No new news.
- j) TC 9.08 – Large Building Applications (S Nicklas) Committee focusing on museums archives and the concept of a standardized “table of content”.
- k) TC 9.9 - Mission Critical Facilities (K. Gill) Not present to report.



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- l) TC 9.12 – Tall Buildings (L. Werman) Meeting follows this meeting. Committee is looking at 2-research programs and looking to get a program for Dallas.
- m) SSPC 62- Indoor Air Quality (Open) No report
- n) SSPC 15 Mechanical Refrigeration Safety (Duda) Noted there was a vote to co-sponsor with TC 8.7. Also this standard doesn't apply to 1 or 2 family residence.
- o) TG-2- HVAC Security (McKew) Getting ready to start the reviser process for this Chapter 59 in the 2015 Handbook.
- p) TRG-7 Under-Floor Air (H. Brickman) Harvey was at the meeting but it was noted that a new design manual is being worked on.

IX. Old Business

- a) Mold Position Document (Hart/Cramm) No response on the document was required by this committee.

X. New Business

- a) John Vucci mentioned that TC6.1 is working on a Central Plant Design Guide. John will contact Steve Tredinnick to see if they would like to collaborate and potentially use a research project as a starting point

XI. Adjournment

- a) Next Meeting: Tuesday, January 29, 2013 at 1:00 pm in Dallas
- b) Meeting adjourned at 3:30 PM. Moved by Jeff Traylor and seconded by Phil Trafton.

XII. Attachments:

- A: TC 09 01 Roster Starting July 1, 2012
- B: TC 9 1 San Antonio 2012 Agenda and Attachments
- C: TC 901 Honors-awards Report

End of Minutes

Respectfully submitted by:

Howard McKew, Secretary



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SUMMARY OF MOTIONS:

Secretary's Note: All votes recorded herein are formatted as Aye-Nay-Abstain-Chair Not Voting-Absent.

Motion: Jeff Traylor

Second: Mark Fly

Text: Approve the Chicago Meeting Minutes.

Vote: Motion Carried 11-0-0-0-6

Motion: Bill Klock

Second: Phil Trafton

Text: Sponsor Standard 15 research "Dispersion of refrigeration to connecting spaces via transfer openings"

Vote; 14-0-0-0-0



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**ASHRAE 2012 Annual Conference / June 23 – 27, 2012
San Antonio, TX / Grand Hyatt San Antonio**

TC 9.01, Large Building Air Conditioning Systems

Tuesday, June 26, 2012, 1:00 – 3:30 pm CST in the Texas C Room (Level 4)

Programs:

Sponsoring Seminar 19: When Integrated Controls Are Not Integrated

Sunday, June 24, 2012, 3:15 pm - 4:45 pm; Henry B. Gonzalez Convention Center; Room: 007D

Co-Sponsoring Seminar 42: Sustainable Chiller Plant Efficiency: GPC 22 In Application

Tuesday, June 26, 2012, 8:00 – 9:30 am, Henry B. Gonzalez Convention Center; Room: 001B

Subcommittees & Related Meetings:

TC Chair's Breakfast for Section 9 Sunday 6:30 – 8:00am Hyatt; Bonham B (3)

TC Chair's Training Workshop Sunday 9:45 – 10:45am Convention Center; Room 007A (R)

TC Research Subcommittee Chair's Breakfast Monday 6:30 – 8:00am Hyatt; Texas D (4)

TC Program Subcommittee Chair Training Tuesday 11:15 am – Noon Speaker's Lounge, Convention Center, Room 102B (S)

TC 9.01 Research Tuesday Noon – 1:00pm Grand Hyatt, Room: Texas C (Level 4)

TC 9.01 Program Tuesday Noon – 1:00pm Grand Hyatt, Room: Texas C (Level 4)

TC 9.01 Handbook Tuesday Noon – 1:00pm Grand Hyatt, Room: Texas C (Level 4)

TC 9.01 Standards Tuesday Noon – 1:00pm Grand Hyatt, Room: Texas C (Level 4)

MEETING AGENDA

I. Call to Order (Cramm)

II. Welcome / Introductions (Cramm)

III. Minutes from Chicago, January 2012 Winter Meeting (McKew)

IV. Agenda Comments/Updates

V. Chairman Comments and Section 9 Report (Cramm)

VI. ASHRAE Liaison Reports:

A. Society (e.g., TAC, Standards, Research, Handbook)

B. Staff

VII. TC Subcommittee Reports:

A. Membership & Roster (Werman/Cramm)

*Prior to next roster cycle, verify that all corresponding members on the roster want to remain
July 1, 2012 roster was distributed with the agenda for this meeting*

B. Handbook (McKew)

Update on Handbook review philosophy

Call for reviewers

Upcoming activities and deadlines

C. Standards (Henck)

D. Research (Klock)

Research Subcommittee Breakfast Report.

RP-1448 – Chiller Room Ventilation (PMS: S. Taylor, S. Duda, J. Vucci). Has this been approved?

Dispersion of Refrigerant Releases to Connecting Spaces via Transfer Openings (S. Duda)

E. Program (Wessel)

San Antonio Programs

Update on Dallas Programs

Deadlines for future program submissions

Updates on program/CEC issues

F. Professional Development Committee (Strehlow, Cramm)

G. Honors & Awards (Duda)

H. Publications (Hahn)

Topic Suggestions, Authors

I. Website (Fly)

VIII. TC / TG / PC Liaisons

A. TC 1.04 – Control Theory & Application (Open/Concurrent)

B. TC 1.12 – Moisture Management (Open)

C. TC 4.03 – Ventilation and Infiltration (Duda)

D. TC 5.06 – Control of Fire and Smoke (Open)

E. TC 6.01 – Hydronic and Steam Heating Equip & Systems (Cramm/Concurrent)

F. TC 7.05 – Smart Building Systems (Strehlow)

G. TC 7.07 – Testing and Balancing (Brickman)

H. TC 7.09 – Building Commissioning (Traylor)

I. TC 8.07 – Variable Refrigerant Flow (Vucci)

J. TC 9.06 – Healthcare (Wessel)

K. TC 9.08 – Large Building Applications (Nicklas)

L. TC 9.10 – Laboratory Systems (Sestak/Lawson)

M. TC 9.12 – Tall Buildings (Werman)

N. SSPC 62.1 – Indoor Air Quality (Open)

O. SSPC15 – Safety Standard for Refrigeration Systems (Duda)

P. TC 7.2 – HVAC&R Contractors and Design Build Firms (Open)

Q. TG 2 – HVAC Security (McKew)

R. TG 7 – Under-Floor Air Distribution. (Brickman)

IX. Old Business

A. Mold Position Document (Hart/Cramm)

X. New Business

XI. Next Meeting (January 29, 2013, 1:00 pm CST in Dallas, TX)

XII. For Good & Well Being

XIII. Adjourn

Unique Tracking Number Assigned by MORTS _____

RESEARCH TOPIC ACCEPTANCE REQUEST (RTAR) FORM

(Generally 2 to 6 pages, with 10 pt Times New Roman font)

Sponsoring TC/TG/MTG/SSPC/EHC/REF: [TC 9.01 Large Building Air-Conditioning Systems](#)

Title: [Dispersion of Refrigerant Releases to Connecting Spaces via Transfer Openings](#)

Applicability to ASHRAE Research Strategic Plan:

This research will indirectly support Goal 1 “Maximize the actual operational energy performance of buildings and facilities.” In many cases, Variable Refrigerant Flow (VRF) Systems can be shown to offer very attractive seasonal energy efficiency at a reasonable first cost, particularly when some thermal zones are in heating while other thermal zones demand cooling simultaneously. VRF is mentioned as a viable strategy in the 50% Advanced Energy Design Guide Series¹, so there is certainly a sustainability component supporting interest in VRF. However, some design engineers, contractors, and code-enforcement bodies are hesitant to consider VRF in HVAC design because of ambiguities directly related to refrigerant safety and compliance with safety standards such as ANSI/ASHRAE Standard 15. (Those ambiguities are described in more detail in the “State of the Art/ Background” portion of this RTAR). If these ambiguities can be better defined, more designers may be willing to consider the energy benefits of VRF systems. This research is needed to address safety concerns and provide a firm technical foundation with which to pursue changes to safety standards such as ANSI/ASHRAE 15² by removing the current ambiguities that exist and providing guidance to designers in order to achieve not only energy-efficient but safe system implementations. Thus, this research indirectly supports Goal 1.

Research Classification:

Basic/Applied Research

TC/TG/MTG/SSPC Vote:

(For –Against-Abstentions-Absent-Total)

Reasons for Negative Votes and Abstentions:

(Negative Votes & Abstentions)

Estimated Cost:

\$85,000

Estimated Duration:

Fifteen (15) Months to complete

RTAR Lead Author

Stephen W. Duda, P.E. sduda@rossbar.com

Expected Work Statement Lead Author

Stephen W. Duda, P.E. sduda@rossbar.com

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

Unconfirmed: SSPC 15 / TC 8.07 / TC 4.03.

Possible Co-funding Organizations:

None.

Application of Results:

It is intended that the results of this research will allow SSPC 15 to clarify, better define, and/or modify Paragraph 7.3.1 and related portions of Standard 15².

It is also anticipated that the results will be summarized in future Editions of the Handbook’s VRF Chapter, first published in the 2012 ASHRAE *HVAC Systems & Equipment Handbook*³; thereby providing more complete guidance as to how to account for connecting spaces when designing a refrigeration system.

State-of-the-Art (Background):

ASHRAE Standard 15² is the *Safety Standard for Refrigeration Systems*. Among other provisions, it sets limits on the amount of refrigerant that can be safely applied in a given refrigeration system, depending on the particulars of that system. Standard 15-2010 as currently published states in part as follows:

7.3 Volume Calculations. The volume used to convert from refrigerant concentration limits to refrigerating system quantity limits for refrigerants in Section 7.2 shall be based on the volume of space to which refrigerant disperses in the event of a refrigerant leak.

7.3.1 Nonconnecting Spaces. Where a refrigerating system or a part thereof is located in one or more enclosed occupied spaces that do not connect through permanent openings or HVAC ducts, the volume of the smallest occupied space shall be used to determine the refrigerant quantity limit in the system. Where different stories and floor levels connect through an open atrium or mezzanine arrangement, the volume to be used in calculating the refrigerant quantity limit shall be determined by multiplying the floor area of the lowest space by 8.2 ft (2.5 m).

Paragraph 7.3.1 becomes important when applying networked direct-expansion systems such as VRF. The nature of a VRF system is such that more than one direct-expansion (DX) evaporator is served by one common condensing unit and one common network of interconnecting refrigerant piping. Because of the interconnecting refrigerant piping, a VRF system has the theoretical potential to discharge a significant quantity of refrigerant into a small room during a catastrophic leak occurrence.

In 2011, ASHRAE published a peer-reviewed Conference Paper⁴ that highlighted some ambiguities of the Standard that become critical when applying VRF systems. A key component of the above-excerpted paragraphs is the determination of the volume of the smallest occupied space not connected to other spaces through permanent openings. Paragraph 7.3.1 implies that if two or more rooms are connected by permanent openings, the volume of those rooms may be combined to find the maximum refrigerant limit (thereby increasing the allowable system size). A potentially serious ambiguity exists in the evaluation of what constitutes a permanent opening. Does an undercut door or a transfer grille qualify as a permanent opening? If so, how large an undercut or transfer opening would be needed to qualify and still ensure safety? These questions are not specifically addressed in Standard 15.

Clearly, undercut doors or transfer openings would *eventually* permit a large leak of refrigerant in one small room to disperse to adjacent rooms. However, without detailed study or modeling, we do not know that this will occur quickly enough to protect the safety of the room's occupants. Because of this ambiguity, interpretation and enforcement varies widely across the industry.

A Japanese Refrigeration Standard⁵ defines a permanent opening as one that has an area of 0.15% or more of the total floor area of the smaller enclosed occupied space in which refrigerant-containing parts are located. To illustrate, a transfer opening of 26 square inches in a room 12 feet by 10 feet would qualify under this criteria – which equates to a ¾-inch undercut of a 36-inch wide door.

Since VRF systems originated in Japan, some VRF system manufacturers publish the 0.15% figure in their technical manuals as guidance for engineers using VRF systems worldwide. However, the technical justification of that 0.15% criterion is not published, and is suspect since the efficacy of the safety requirement may depend on additional requirements and/or system design features not considered. For example, does the 0.15% criteria vary depending on the specific refrigerant, or location of the opening (near floor or near ceiling), or the amount of refrigerant charge, or air flow rate between the two occupied spaces (if any, whether by mechanical ventilation or induced by differential pressure)?

Both SSPC 15 and TC 8.07 have expressed interest in clarifying Paragraph 7.3.1 to more accurately define and clarify specifically what size opening between rooms constitutes an effective and safe path for

refrigerant to disperse in an accident scenario, to reduce or eliminate this ambiguity and provide an enforceable, industry-accepted rule.

This dilemma was experienced by ASHRAE first-hand during the renovation of the ASHRAE Headquarters Building in Atlanta, when questions arose during installation of that building's VRF system.

Any attempt to specifically define what size opening is sufficiently safe should be defensible via peer-reviewed independent Research.

Advancement to the State-of-the-Art:

The most direct advancement to the State-of-the-Art this Research will produce is allowing SSPC 15 to clarify Paragraph 7.3.1 of ASHRAE Standard 15, which in turn is likely to be incorporated into future editions of the International Mechanical Code. Sizing of transfer openings between enclosed adjacent rooms based on scientific principles will help ASHRAE responsibly enhance public safety.

VRF is mentioned as a viable strategy to achieve 50% energy savings in the Advanced Energy Design Guide Series¹. However, if one interprets Paragraph 7.3.1 of the current Standard 15 too conservatively and disregards even very generous permanent openings between rooms, the immediate consequence is that the refrigeration system size is limited to the smallest individual room served by that refrigeration system. This may increase the cost of a VRF system by necessitating more, smaller systems; while at the same time reducing some of the energy advantages of a VRF system. Maximum energy advantage of a VRF system is achieved when many rooms are networked onto one system, especially when simultaneous heating and cooling are required.

If one interprets Paragraph 7.3.1 of the current Standard 15 too broadly and accepts *any* opening between rooms – no matter how small – the immediate concern is one of safety: a catastrophic leak of refrigerant into a small room may not disperse through a small opening quickly enough, endangering the room's occupants. Although very unlikely, the possibility exists that a sufficiently large discharge of refrigerant into a sufficiently small room could result in occupant fatality via asphyxiation. Common refrigerants are colorless and odorless and are therefore not self-alarming.

This research project will advance the state-of-the-art by allowing a system designer to confidently apply VRF to maximize the energy benefit promised by the AEDG without creating an undue safety hazard for building occupants.

Justification and Value to ASHRAE:

A large number of ASHRAE members (system design Engineers, Consulting Engineers, and Design/Build Contractors in particular), code officials, and vendors of refrigerant-based HVAC systems will benefit since transfer openings between adjacent spaces will now be sized properly to provide appropriate protection against refrigerant leaks. It is anticipated that within three (3) years, the results of this project can influence revision of Paragraph 7.3.1 of ASHRAE Standard 15 and the similar clause in the International Mechanical Code.

This research project will enhance ASHRAE's value to its members by allowing a system designer to confidently apply VRF to maximize the energy benefit promised by ASHRAE's AEDG without creating an undue safety hazard for building occupants.

Objectives:

The objective of this proposed project is to conduct research that will allow SSPC 15 to, if necessary, revise the requirements for transfer openings to connecting spaces currently in ASHRAE Standard 15. We expect the research to pursue strategies that:

- Reflect the fundamentals of dilution.
- Account for the varying concentration limits and physical properties of each refrigerant.
- Are simple enough to use in standards and building codes for determining and enforcing safe sizing of transfer openings between connecting spaces.

The research plan will include the following features:

- The researcher will use Computational Fluid Dynamics (CFD) for modeling.
- The researcher will account for refrigerant dispersion and buoyancy properties.
- The researcher will consider a variety of refrigerants used in commercial comfort air-conditioning including but not limited to R-410A.
- The researcher will assume ASHRAE Standard 34 is correct and valid with respect to exposure limits and Refrigerant Concentration Limits (RCL) for the various refrigerants studied.
- The researcher will model a catastrophic (instantaneous) leak of refrigerant in the breathing zone.
- The amount of refrigerant leaked will be modeled as a function of time and space for rooms of varying sizes and configurations; and the researcher will calculate the transient concentrations in the room and report the results for various spatial locations.
- The researcher, in consultation with the Project Monitoring Subcommittee, will establish a time frame within which the exposure limit can be briefly exceeded without undue consequence (e.g., 60 seconds, 90 seconds, or similar).
- The researcher will determine what size permanent opening in a room's boundary allows the refrigerant to disperse to a level below the exposure limit or RCL within the allotted time found in the previous step.
- The researcher will investigate whether the opening size is best expressed as one of the following (a) a fixed size (b) a size that is a direct function of the amount of refrigerant charge (c) a size that is a direct function of the room's floor area (d) a size that is a direct function of the room's cubic volume, or (e) some other quantification.
- The researcher will investigate whether the appropriate opening size is a function of the refrigerant itself. If so, the researcher will devise a method for communicating the appropriate opening size in a manner simple enough to use in standards and building codes; perhaps via a Table or Chart.
- The researcher will investigate the background and derivation of the criterion for 0.15% of floor area, including any underlying assumptions or prerequisite requirements, through literature search and correspondence with Japanese experts or researchers. Compare and contrast with the findings of this research project.
- The researcher will investigate whether the appropriate opening varies with the vertical location of that opening – e.g., investigate whether an opening near the floor is as effective as one in or near the ceiling.

Depending on the results of this Research, a follow-up research project may be initiated to investigate refrigerant detection (including detector placement) and associated alarms or other mitigation measures. For example, if an individual space has its RCL exceeded, a follow-up project may investigate the possibility of using refrigerant detectors and alarms – analogous to smoke alarms – or emergency ventilation, to enhance occupant safety.

Suggested Chapter Reviser/Mentor Process
TC 9.1 Large Building Air Conditioning
2016 Handbook

Date: **January 30, 2012**

Prepared by: **Howard McKew**

Introduction

I'd like to propose to the TC 9.1 Members that we approach the updating of Chapters 1 thru 5 of the 2016 HVAC Systems and Equipment Handbook by implementing a Lead Reviser/Mentor and a 2nd Reviser following the guidance of their Mentor. This approach will recruit less experienced but equally conscientious Revisers to our 5-Chapters. This approach should also encourage these 2nd Revisers to become more active within ASHRAE at a national level. It can be assumed (at least from my point-of-view), although not assured by our TC 9.1 that the 2nd Reviser brings with them a fresh look at our Chapters, valuable computer-literate experience, and a high energy level that could make our approach the standard for future Chapter revisions. Also, in light of the challenge ahead of us to combine years of HVAC experience with being able to share this on an annual basis via the Handbook Online+ potentially new, more computer literate TC 9.1 new corresponding members will be better prepared to tackle the challenge of keeping our 5-Chapters current each year and increase the knowledge-base of our entire TC 9.1.

Role of the Lead Reviser/Mentor:

Using the latest Author & Reviser Guide, the Lead Reviser/Mentor (LR/M) will recruit an individual within his/her company to spearhead the actual revision process. The LR/M shall do the following:

- Review the Author & Reviser Guide with the 2nd Reviser
- Review the Guide "Timeline" for milestones to be met and agree on due dates
- Review the additional "Things-To-Consider" matrix (to be provided by Howie McKew TC 9.1 Handbook Subcommittee Chair in the coming month) and add have the 2nd Reviser include these tasks to the Timeline "due dates".
- Raise awareness to other technical resources that may be helpful to draw upon in revising the Chapter
- Raise awareness to the requirements to produce CAD documents where needed following the standard symbols to be used for consistency of appearance from Chapter to Chapter
- Provide a list of specific resources to draw upon (i.e., if the Reviser is a design engineer, who should they seek out from a contractor, facility manager, etc. point-of-view)
- Review the progress of Chapter revisions at key dates in the revision process
- Meet with the TC 9.1 Handbook Subcommittee Chair semi-annually at ASHRAE (January & June) Handbook meetings and provide progress status at that time
- Submit an educational proposal/seminar to their local ASHRAE Chapter regarding this process to encourage others to get involved

Key References:

1. ASHRAE. 2011. *Advanced Energy Design Guide for Small to Medium Office Buildings*. Atlanta: ASHRAE, Inc.
2. ANSI/ASHRAE. 2010. *Standard 15 Safety Standard for Refrigeration Systems*. Atlanta: ASHRAE, Inc.
3. ASHRAE. 2012. *HVAC Systems and Equipment Handbook*. Chapter 18. Atlanta: ASHRAE, Inc.
4. Duda, Stephen. 2011. *Application of ASHRAE Standard 15-2010 with Respect to Multi-Evaporator Split Air-Conditioning Systems*. ASHRAE Transactions, Volume 117, Part 2. Atlanta: ASHRAE, Inc.
5. JRA GL-13:2012. *Guideline of Design Construction for Ensuring Safety Against Refrigerant Leakage from Multi-split System Air Conditioners*. Tokyo: Japan Refrigeration and Air Conditioning Industry Association. http://www.jraia.or.jp/download/e-book/JRA_GL13/index.html The cited Guideline actually references the 0.15% value from another Japanese standard “KHK S 0302-3 (2011)” published by The High Pressure Gas Safety Institute of Japan, also known as KHK.

Role of the 2nd Reviser

Under the direction of the LR/M, the 2nd Reviser will be responsible for the majority of research, review, and revisions for the Chapter each is assigned. This individual will become familiar with and use the Author & Reviser Guide August 2011 to perform their responsibilities. They shall also be responsible for meeting the assigned timeline due dates in sync with their fellow Chapter 2nd Revisers. The 2nd Reviser shall do the following:

- Meet with their Mentor to kick off this 2016 Chapter revision initiative.
- Draw upon the Mentor for routine guidance and direction and meet on a regular basis to address progress
- Commit to meeting the Reviser Guide “Timeline” required milestones
- Fulfill the additional “Things-To-Consider” matrix (to be provided by Howie McKew TC 9.1 Handbook Subcommittee Chair in the coming month)
- Seek out technical resources that can be helpful to draw upon in revising the Chapter
- Work in sync with fellow TC 9.1 Chapter 2nd Revisers, so as to provide a consistency of format (i.e., CAD standards, abbreviations, etc.)
- Produce required CAD documents to explain the process as needed
- Seek out and include electronic documents for the Handbook Online+ so that others can download these checklists, system flow diagrams, etc. for their use in designing HVAC systems
- Seek out other potential resources to draw upon (i.e., design engineers, equipment manufacturers, contractors, facility managers, etc.) to cover all aspects of HVAC systems
- Review the Chapter revisions at key dates in the revision process.
- If possible, attend the TC 9.1 Handbook Subcommittee Chair semi-annually at ASHRAE (January & June) Handbook Subcommittee meetings
- Co-submit a proposal to present the final approved Chapter Revisions in an educational seminar at their local ASHRAE Chapter and high-light the Handbook Chapter revision experience to those in attendance.

Summary

The suggested Reviser/Mentor and 2nd Reviser approach is intended to improve our management of the 5-Chapters TC 9.1 is responsible for in the HVAC Systems and Equipment Handbook. This approach is also intended to encourage/recruit new TC 9.1 corresponding members by getting them involved early in our TC 9.1 responsibilities and to do so hopefully in a high tech, computerized approach to the business-at-hand.

Comments and suggestions are welcome.

Howie