Welcome!

Welcome to the ASHRAE TC 9.9 Hybrid In-Person/Virtual Meeting!

No need to say hello, we will begin promptly at 2:30 pm CST

High Level Agenda

- Welcome
- Hybrid Meeting Etiquette
- Introductions
- Membership
- Title, Purpose & Scope
- Liaison Reports
- Research
- IT Subcommittee
- Encyclopedia Updtes

Housekeeping

Audio

- Attendees are muted upon entry
- Do not un-mute your line
- If you are joining via computer and phone line, ensure both are muted

Video

- We encourage you to keep your video off
- If you do enable your video, be mindful that you are on display! Turn off your video when needed.

Q&A

- Use the chat function to ask questions
- Our moderator will share questions throughout the presentation with the speaker to answer.
- If you need to speak, please use the Raise Hand button and the moderator will enable your microphone.

Attendance

- Please complete the attendance form found at the URL at the bottom of this slide or use the QR code below.

Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

ASHRAE Winter Conference 2025
Main Meeting
Hybrid In-Person/Virtual

Agenda

Topic		Time	Presenter(s)	In-Person or Virtual
Welcome	Welcome, Agenda Review, Hybrid Meeting Etiquette	5	Matt Koukl	IP
Introductions	Introductions of All In-Person Attendees, Officers, Voting Members and Subcommittee Chairs	10	Matt Koukl	IP
TC Activity	Status of Voted on Topics	5	Matt Koukl	IP
Membership	Details of TC 9.9 Membership	5	John Groenwold	IP
Handbook	Handbook Update Summary	5	Robert McFarlane/ Jonell Watson	IP
Liaison Reports	Standard 90.1	5	Rick Pavlak	IP
	SPC-127 / AHRI 1360	15	David McGlocklin	IP
	Decarbonization Task Force	5	Lixia Wu	IP
	Standard 90.4	5	Marcus Hassen	IP
	International	5	Don Beaty	IP
	OCP	5	Matt /Mark/John	IP
Partnership	NEMA Data Center RFP	5	Michael Erbesfled	IP
	ASHRAE Data Center Forum	5	Nicolás E. Estefanell	IP
Webmaster	Website	5	Ecton English	IP
Research Program Worksession	Research Highlights	5	Brad Cochran	V
	Abstract Work	15	John Gross	IP
Break		10		
	COOLERCHIPS Update	40	Peter de Bock, Jungho Kim	V/IP
Break		10		
IT Subcommittee	Liquid Server Thermal Template	10	Dustin Demetriou	IP
	S-Class Definition and Addition of S20/25	20	Paul Artman	IP
	Liquid Cooling Resilience Tech Brief	10	Dave Quirk / Dustin Demetriou	IP
	Erosion Flow Velocity	10	Mark Steinke	IP
	CDU/ TCS Considerations	30	Dustin Demetriou/Tim Shedd	IP
Publications	ASHRAE TC 9.9 Datacom Encyclopedia	20	Dustin Demetriou	IP
	Upcoming Tech Briefs	5	John Gross	IP
	Total Time:	270	Minutes	

Virtual Meeting Etiquette

- Do not share your video due to the high number of virtual participants.
- Prior to speaking individuals should state their name so that others know who is speaking and speak into a microphone.
- Virtual participants should keep yourself muted unless giving permission to speak by the Host via chat.
- Please do not attempt to share your screen without being asked to do so by the Host or Co-Host.
- In-person participants are discouraged from joining the virtual meeting due to wireless bandwidth constraints.

Virtual Meeting Housekeeping

Virtual Host: Vice Chair - Mark Steinke

- Monitor the chat thread for questions and comments.
- Mute and Unmute Virtual Participants and Guests.
- Manage discussions and voting.
- Manage screen-sharing and in-person presentation

Virtual Co-Host: Secretary - John Gross

- Monitor time and keep the meeting on schedule.
- Record the event.
- Produce meeting minutes.
- Will repeat the attendance link multiple times during the meeting and upon chat request.
- Respond to audio problems.

In Person Setup

- Video projector that displays the presentation being shared virtually.
- Be aware that chat comments sent to the Host may be seen by those in-person in addition to general chat comments.
- There are audio speakers in the room but unmuted virtual commentators may not be immediately connected. Please be patient.

Attendance

ASHRAE TC 9.9 Attendance Record

ASHRAE Technical Committee 9.9 - Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment
2025 Winter Meeting

Programs, Research, & Publications
Hybrid Event Timing:

Sunday, February 9, 2025; 6:00-8:00 pm EST
Event Address: https://www.microsoft.com/microsoft-teams/join-a-meeting
Meeting ID: 252 046 633 687
Passcode: D5Hw6aM9
Physical Meeting Room:

Hilton Orlando Room: Lake Highland AB (Lobby Level)

Main Meeting
Hybrid Event Timing:

Monday, February 10, 2025; 2:30 - 7:00 pm EST
Event Address: https://www.microsoft.com/microsoft-teams/join-a-meeting
Meeting ID: 243 052 086 357
Passcode: ff2RX6eT
Physical Meeting Room:

Hilton Orlando Room: Orange D (Lower Level)

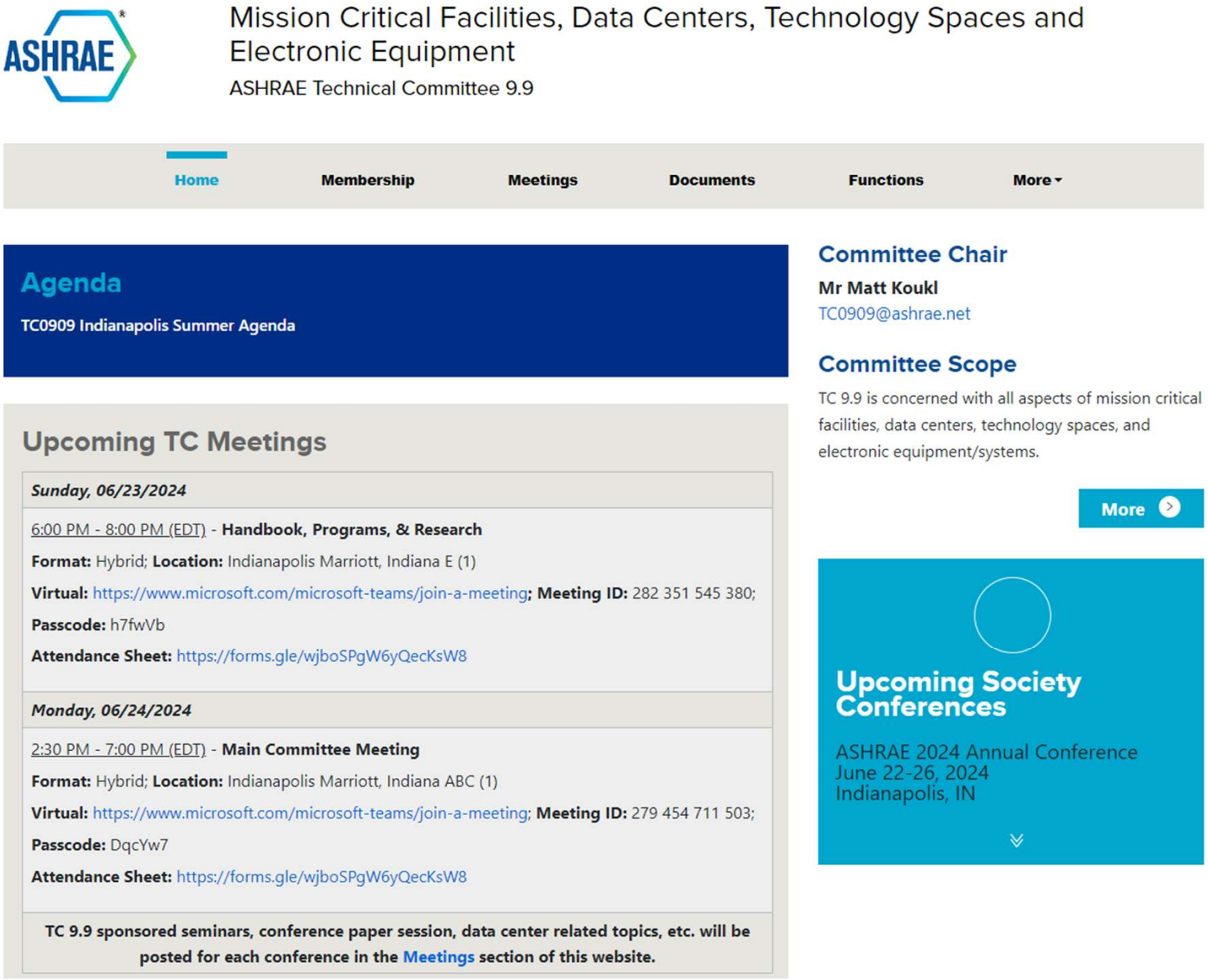
Contact us at tc99chair@gmail.com
Technical Committee Website: http://tc0909.ashraetcs.org

Attendance is being recorded using a Google Form. Please make sure you complete the form at:

https://forms.gle/Yzg85KnmqGRhbzo17

Or use the QR Code below:

TC 9.9 Webpage



http://tc0909.ashraetcs.org

ASHRAE TC 9.9 Overview

Title

- Mission Critical Facilities, Data Centers, Technology Spaces, and Electronic Equipment

Purpose

- To be recognized by ALL areas of the datacom industry as the UNBIASED engineering leader in HVAC and an effective provider of technical datacom information.

Scope

- All things datacom facilities: datacom refers to data processing and communication facilities. It includes rooms or closets used for communication, computers, or electronic equipment

Introductions

- In Room Only
  - Name
  - Business Title
  - TC Membership Status:
    - Voting Member
    - Corresponding Member
    - Provisional Corresponding Member
    - Guest
  - TC Leadership & Subcommittee Membership
    - Subcommittee Chair
    - Liaison
    - Subcommittee membership

Join TC 9.9

Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

ASHRAE Technical Committee 9.9

Home | Membership | Meetings | Documents | Functions | More

Member Roster

Join TC 9.9

Current as of 6/23/2024

If you want to become a provisional corresponding member of this TC, click on the "Join TC" button above. You will be automatically added to the roster and will receive all TC communications.

Committee members can download a copy of the complete roster in any of three formats by logging in to their ASHRAE member account, clicking on my account and selecting Committees.

A provisional corresponding member is a two year appointment. Once you demonstrate your engagement by participating in one or more of our subcommittees your membership will be changed to corresponding member. Once a corresponding member, based on your level of interest, participation, and engagement you can be considered for becoming a voting member of TC 9.9

http://tc0909.ashraetcs.org/membership.php

Join TC 9.9

Technical Committees
Provisional Corresponding Member Registration

If you do not have an ASHRAE ID, not applying for ASHRAE membership, and are applying for a position that requires an ASHRAE bio to be on file, please click here to request an ASHRAE ID. You may also use this link if you already have an ASHRAE ID as a non-member, but you no longer have a record of your number.

Please enter BOTH of the following:

ASHRAE ID

AND

Email Address Used In Bio

Get My Info

My Info

Name

Address

City State Zip

Committee Selection (You may select up to 3 Committees to serve on)

Available Committees

Committee Description

Scope

Add Selected

My Selections

Once you have added the committees you wish to join, please select the "Join Now" button below and you will immediately be appointed as a Provisional Corresponding Member.

The acceptance of provisional corresponding membership implies participation in committee activities through correspondence or in-person involvement. Provisional corresponding members serve 2 year terms. Although provisional corresponding members are not voting members, at the end of your term and based on participation in the committee, you may be considered for future voting membership.

Some of your information may be made publicly available, such as name and company name. Please review the ASHRAE Privacy Policy before joining. Questions regarding your privacy may be sent to GDPR@ashrae.org

Notification of acceptance to a TC is emailed upon completion.

Join Now

https://eweb.ashrae.org/eweb/TS_ProvisionalSignup.html

Membership

- Provisional Corresponding Members
  - Additions to Roster between roster update cycles.
  - Roster update always due Tuesday following main meeting during Winter Conference.
  - Usually at the request of someone wanting to participate.
  - If no action by TC leadership dropped from Roster after 2 years.
- Corresponding Members
  - Expected to participate in TC activities.
  - Attend Meetings when possible.
  - May serve as Vice-Chair or Secretary of TC if they attend meetings regularly.
  - Can be Voting Members.
  - Can serve as a subcommittee chair.

Keep Your ASHRAE Profile Updated!

How to Get Involved

- Handbook
- Online Encyclopedia
- Development of a Program
- Development of a Research Topic

TC 9.9 Officers and Subcommittee Chairs

Chair
Matt Koukl
Affiliated Engineers, Inc.

Vice-Chair
Mark Steinke
NVIDIA

Secretary
John Gross
J. M. Gross Engineering

Publications Chair
Don Beaty
Retired Founder/CEO of DLB Assoc.

Research Chair
Brad Cochran
CPP, Inc.

ITE Subcommittee Chair
Dr. Dustin Demetriou, PH.D.
IBM Senior Technical Staff Member

Standard Subcommittee Chair
Rick Pavlak
Heapy Engineering, Retired

Programs Chair
Eric Yang
Vantage Data Centers

Handbook Chair
Robert McFarlane
Shen Milsom & Wilke, LLC

Webmaster
Ecton English
U.S. Department of Defense

Marketing Subcommittee Chair
Paul Finch
KAO Data

Membership Chair
John Groenewold
Vantage Data Centers

Thank You

Roger R. Schmidt, Ph.D., P.E.
Past IT Subcommittee Chair

Dr. Roger R. Schmidt, IBM Fellow Emeritus (retired 12/2014), National Academy of Engineering Member, IBM Academy of Technology Member and ASME Fellow, has over 35 years experience in engineering and engineering management in the thermal design of IBM's large scale computers. He was IBM's Chief Engineer on Data Center Energy Efficiency. He has led development teams in cooling mainframes, client/servers, parallel processors and test equipment utilizing such cooling mediums as air, water, and refrigerants. He led IBM's Advanced Thermal Energy Efficiency Lab which develops advanced electronic cooling technologies and provides customer support for power and cooling issues in data centers. He has published more than 100 technical papers and has over 125 patents/patent pending in the area of electronic cooling. He is co-founder and past chair of the ASHRAE TC9.9 committee.

Mark Seymour
Past Research Chair

Mark Seymour, Member ASHRAE, CTO and a founder of Future Facilities, London, England. He has more than 35 years of simulation and measurement experience and over 25 years of experience in building HVAC. His company focuses on airflow/cooling in data centers from design and right through the operational life cycle. To do this it provides CFD engineering simulation services and the 6SigmaDCX engineering simulation software, specifically designed for data centers. He's research chair and an active member of ASHRAE TC 9.9 and The Green Grid and chair of the industrial advisory board for the National Science Foundation I/UCRC Energy Smart Electronic Systems (NSF-ES2) research project. He has authored and co-authored many papers and contributed to books on data center infrastructure management and specifically the use of simulation. As a consequence of his work he has received awards such as the Data 50 Award for Business Services and Consulting.

Past TC 9.9 Chairs

Don Beaty

Roger Schmidt

Fred Stack

Jack Glass

Dave Quirk

Robin Steinbrecher

Jason Matteson

Dustin Demetriou

John Groenewold

Voting Members

1. Matt Koukl, Affiliated Engineers, Inc.
2. Nick Gangemi, Microsoft
3. Rick Pavlak, Heapy- Retired
4. Mark Steinke, NVIDIA
5. Paul Finch, KAO Data
6. Mark Seymour, Cadence Design Systems
7. Jason Matteson, Iceotope Technologies
8. David Quirk, DLB Associates
9. Joe Prisco, IBM
10. Bob McFarlane, Shen Milsom & Wilke
11. Lixia Wu, Cushman & Wakefield

2024/2025 Votes

Vote	Date	Approved
Vote on Liquid Cooling Resiliency Technical Bulletin	**8/31/2024**	Yes
Vote on ASHRAE WS-1972 Data Center Direct-to-Chip Liquid Cooling Resiliency	**8/16/2024**	Yes

Membership

Membership	Quantity
Board, Chairs & Liaisons	23
Corresponding Members	357 ↓
Provisional Corresponding Members	185 ↑
Total	565 ↑
YEA	69 ↑

2024 Summer Attendance

Membership Type	Sunday	Monday
Board, Chairs, & Liaisons	11	12
Corresponding Members	22	33
Provisional Corresponding Members	16	21
Guests	2	5
Total	51	71

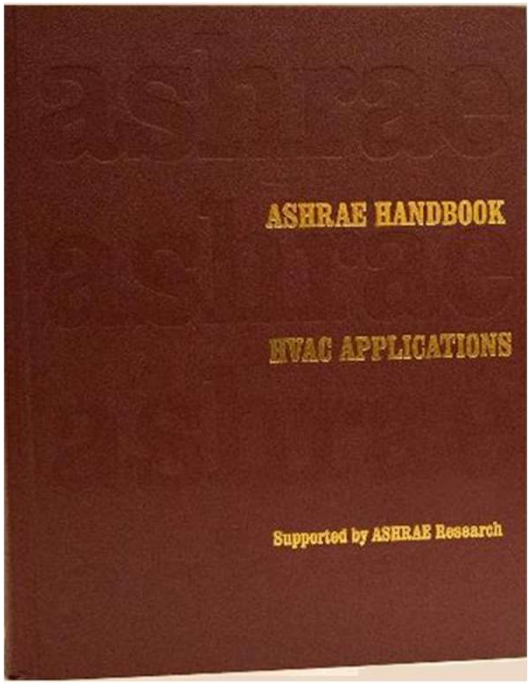
Membership - Member Location

Country	Total
CANADA	26
UK	19
INDIA	14
IRELAND	11
AUSTRALIA	9
BRAZIL	8
ARGENTINA	7
SINGAPORE	6
JAPAN	5
ITALY	5
NETHERLANDS	4
UAE	4
GREECE	4
HONG KONG	4
GERMANY	4
SOUTH KOREA	3
COLOMBIA	3
TAIWAN	3
MEXICO	3
PHILIPPINES	3
TURKEY	2
SPAIN	2
ISRAEL	1
PAKISTAN	1
SWITZERLAND	1
DENMARK	1
CHINA	1
MALAYSIA	1
SOUTH AFRICA	1
PORTUGAL	1
MOROCCO	1
KUWAIT	1
Grand Total	**159**

ASHRAE Handbook “Applications”

Chapter 20

“Data Centers & Telecommunication Facilities”



Agenda

- Background
- Timeline
- Volunteer Status
- Who Should Volunteer?
- Volunteer Commitment
- How To Volunteer
- Next Steps
- Contacts
- Q & A

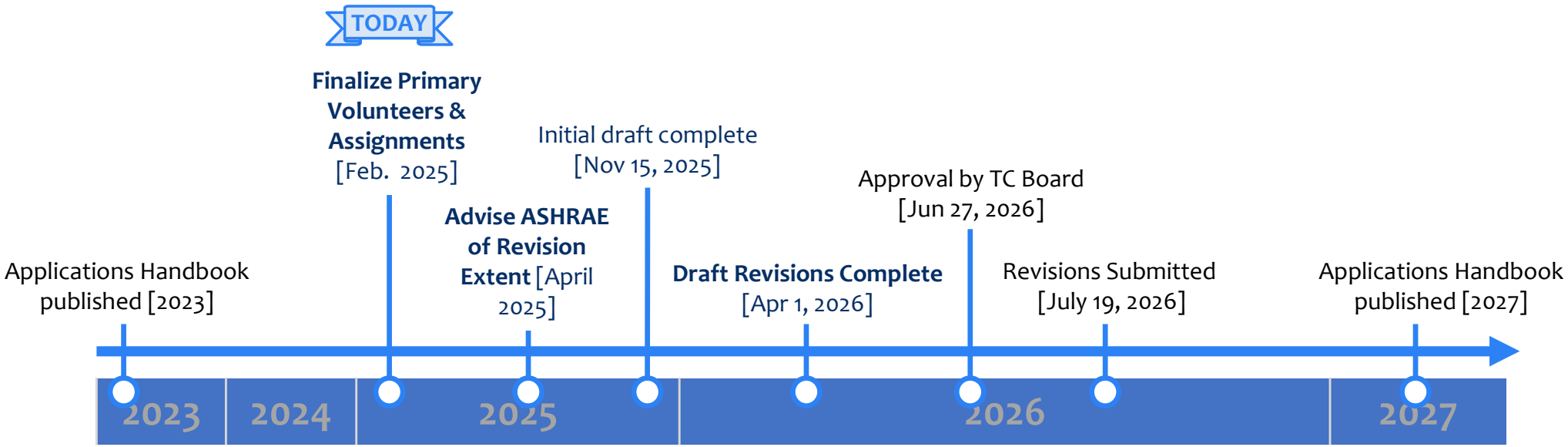
Background

- ASHRAE's Handbooks - Four Publications
    - Fundamentals
    - Refrigeration
    - **Applications**
    - HVAC Systems and Equipment
  - Published on four-year cycle
- TC9.9's Responsibility: Chapter 20 of "Applications"
    - "*Data Centers and Communications Facilities*"
- All revisions by Volunteers through TC9.9

Current Status

- The Applications Handbook last published 2023
- The Handbook revision cycle has already started!
- **Draft Revisions due April 1, 2026 for 2027 Edition**

(It's Coming Fast!)



Volunteer Status

- 33 People Have Volunteered
  - Some for Too Many Topics
  - We're Generally Limiting to 5 Per Person

- We Still Need Primary Reviewers for Multiple Topics

Let's Complete The Sign-up Sheet TODAY!!

Who Should Volunteer?

- Industry experts
- New TC 9.9 Joiners
- Less experienced, More experienced
- Anyone with Expertise!

- Do not have to be a member of TC9.9
- Do not have to be a Member ASHRAE

Volunteer Commitment

- **All Effort is Volunteer**
- **Level of effort Varies Based on Topic:**
  - Primary reviewers 2-10 hrs. per topic
  - Secondary reviewers 5-10 hrs. per topic
- **Commitment term**
  - Today to Draft Completion (Nov. 2025)
  - Ad-hoc Support to Apr. 2026

How to Volunteer

1. Sign-Up on the Topic Spreadsheet in-person **TODAY!!**
2. If Necessary: Will Also be Accessible via http://tc0909.ashraetcs.org/

   "TC 9.9 2025 Winter Meeting Presentations & Information"

1. Email us directly:
   - Select Review Topics **by Spreadsheet Line Number**
     - rmcfarlane@smwllc.com
     - Jonell.watson@accenture.com
   - **Include Name, Company, and Email Address**

NEXT STEPS

- Determine Extent of Revisions
- Access to ASHRAE "Authoring Portal"
  - Used for All Review and Revisions
  - Now Works on ALL Browser Platforms Including MAC
  - Can Work Simultaneously on the Same File
    - Most Recent "Save" Will Be Seen by Others
- All Work Must Use "Track Changes"
- New or Revised Illustrations
  - Require Written Permissions!!
    - Preference is "In Perpetuity"

Contacts

* Please advise Bob McFarlane or Jonell Watson
  * rmcfarlane@smwllc.com
  * Jonell.watson@accenture.com

  * IMPORTANT:
    * Make Us “Trusted Senders”
    * Reply ALL
    * Agree to “Read Receipt”

ADDITIONAL QUESTIONS?

QUESTIONS?

TC 9.9 Liaisons and Liaison Reports

- Standard 90.1: Rick Pavlak
- Standard 127: David McGlocklin
- Standard 90.4: Marcus Hassen
- Decarbonization Task Force: Lixia Wu

90.1 Liaison Report

Rick Pavlak

SSPC 127 & AHRI 1360

David McGlocklin

SSPC 127

Method of Testing for Rating Cooling Equipment Serving Data Center and Other Information Technology Equipment Spaces

Purpose: The purpose of the standard is to establish a uniform method of test requirements for rating cooling equipment that is applied in data center (DC) and other information technology facilities, spaces, and equipment..

Scope: This standard applies to classes of cooling equipment that are used to remove thermal loads in data center (DC) and other information technology facilities, spaces, and equipment.

2025 Feb Update & Plans:

127 is now operating as two subcommittees:

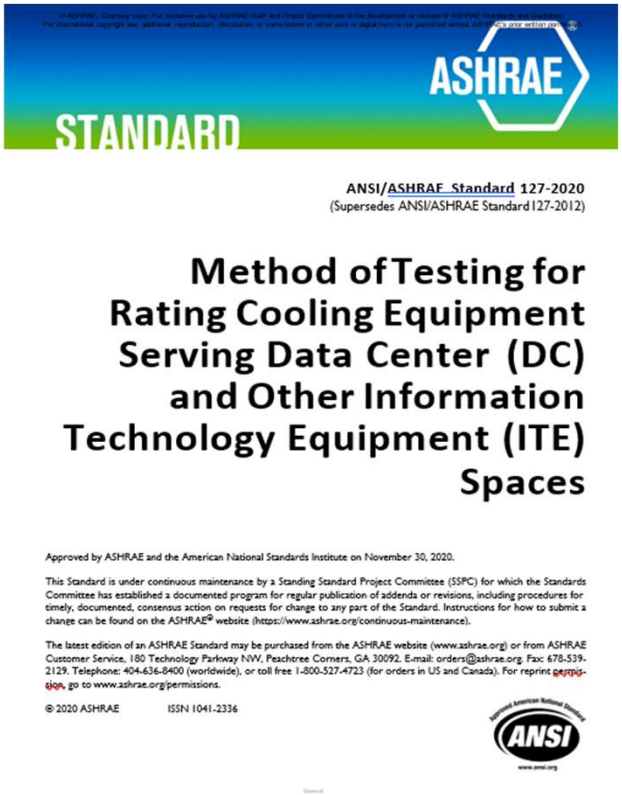
- Air Subcommittee – Chair Dave McGlocklin, Secretary Dave Meadows

- Liquid Subcommittee - Chair John Gross, Vice Chair Dr. Tim Shedd, Secretary Dustin Demetriou

Liquid Sub has made great progress releasing Addendum b covering the L2L CDU MoT for 45 day public review (go comment!). We have taken a poll among members on which topology to tackle next. We expect the lift should be easier with much of the groundwork and format done w/ the L2L.

Air Sub had been having joint meetings w/ AHRI 1360 to work on harmonization of the two standards. We have been on a pause since passing of AHRI 1360 Chair Dave Kelley, but look to resume work this year. Ben Dolcich will become chair of AHRI 1360.

Meeting Tuesday Feb 11th 8am-12pm (Hilton Orlando, Lake Florence AB (Lobby Level))



Decarbonization Building Task Force

Lixia Wu

Standard 90.4 Energy Standard for Data Centers - Update

Marcus Hassen - Chair 90.4

International

Don Beaty

ASHRAE and Open Compute Project (OCP) Collaboration

Matt Koukl,Mark Steinke, John Gross

ASHRAE and OCP Collaboration - Update

- Co-Presented with OCP Cooling Environments

- Developing a Memorandum of Understanding (MoU)
  Status: In review with ASHRAE

NEMA Data Center RFP

Michael Erbesfled

Items for Discussion

NEMA Data Center RFP

Proposed NEMA Std. Outline

Collaboration btwn. ASHRAE & NEMA

International Building Code

- NEMA proposal creates a new Chapter 4 section that points to the proposed NEMA standard and adds criteria for standby power, emergency power, and surge protection

International Existing Building Code

- NEMA proposal creates a new section that requires any alteration, addition, change of occupancy or relocation of a building is made to an existing building or structure or part of a building or structure that contain a data center to comply with the new IBC section proposed above

International Energy Conservation Code

- Support for proposal CE26 submitted by EEI pointing to all the requirements of ASHRAE 90.4 as a compliance option

NEMA
National Electrical Manufacturers Association

NEMA Standard Outline

I. Foreword

II. Introduction

III. Scope

IV. Referenced Standards

V. Terms and Definitions

VI. Federal, State, & Local Regulations

VII. Current Installation Requirements

VIII. NEMA Performance Criteria

IX. Specialty Equip. Applications

X. Machine Learning & A.I.

XI. Data Protection & Cybersecurity

XII. Annex Information

XIII. Figures

NEMA Standard Outline

Current Installation Requirements

A. National Electrical Code

A. National Energy Codes

A. Building & Fire Code

NEMA Performance Criteria

A. Compliance Paths (Performance/Prescriptive)

B. Enhanced Safety Domain

C. Enhanced Reliability & Resiliency Domain

D. Enhanced Efficiency & Sustainability

Contact Info.

Michael Erbesfeld

Michael.Erbesfeld@nema.org 703.841.3262

ASHRAE Data Center Forum

Nicolas Estefanell

ASHRAE Shaping Tomorrow's Built Environment Today

II Data Center Technology Forum

Photo of ASHRAE Global Headquarters Building

I Data Center Technology Forum

2024

+350 Attendees **+14 Speakers** **+6 Hours of technical presentations**

II Data Center Technology Forum

Artificial Intelligence: A Sustainable Approach for Data Centers

+7 Countries Speakers

3 Workshops &
2 Round Tables

2 Ashrae Distinguished Lecturers

Research Promotion Event

7 Media Partners

10 RP Sponsors

+300m2 of Expo

+ info

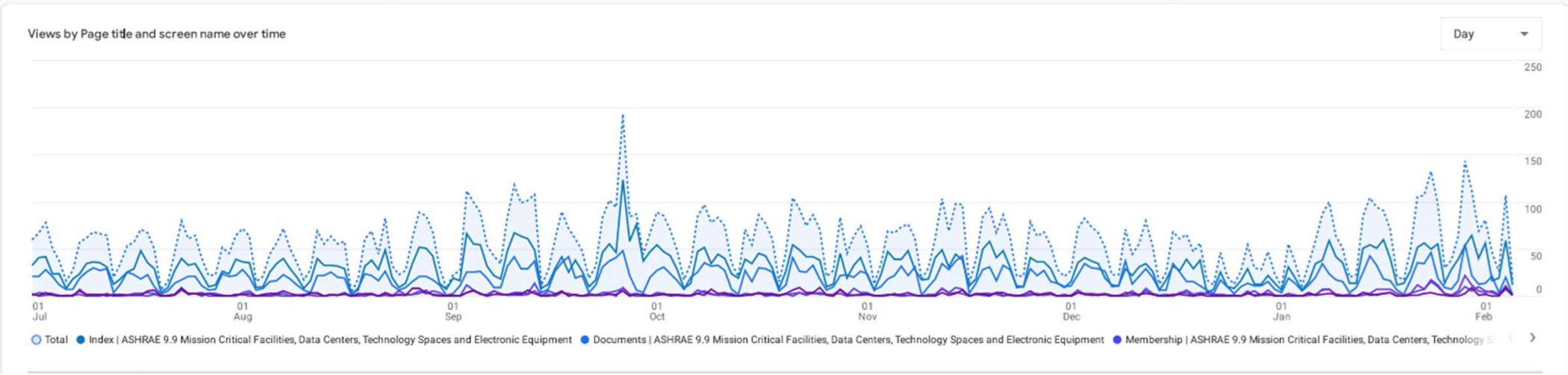
Arq. Nicolas E. Estefanell
ASHRAE Argentina CTTC Chairman
AOS™ ATP™ ATD™ ATS™ - CDCP® CTDC® CTIA®

Thank you

Website Update

Ecton English

Website Update



Plot rows | 9.9 | Rows per page: 10 | Go to: 1 | 1-10 of 65

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☑		Total	12,487 18.18% of total	7,417 27.37% of total	1.68 Avg -33.58%	31s Avg -33.03%
☑	1	Index | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	6,849	4,846	1.41	26s
☑	2	Documents | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	4,158	3,380	1.23	19s
☑	3	Membership | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	563	374	1.51	40s
☑	4	Meetings | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	459	335	1.37	24s
☑	5	Functions | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	439	354	1.24	29s
☐	6	ListServe Instructions | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	18	15	1.20	11s
☐	7	功能 |ASHRAE 9.9 关键任务设施、数据中心、技术空间和电子设备	1	3	0.33	25s
☐	8	Associação | ASHRAE 9.9 Instalações de missão crítica, data centers, espaços de tecnologia e equipamentos eletrônicos	0	1	0.00	1s
☐	9	Dizin | ASHRAE 9.9 Görev Kritik Tesisler, Veri Merkezleri, Teknoloji Alanları ve Elektronik Ekipmanlar	0	4	0.00	20s
☐	10	Documenten | ASHRAE 9.9 Missiekritieke faciliteiten, datacenters, technologische ruimtes en elektronische apparatuur	0	3	0.00	5s

Website Update

9.9

Rows per page: 10

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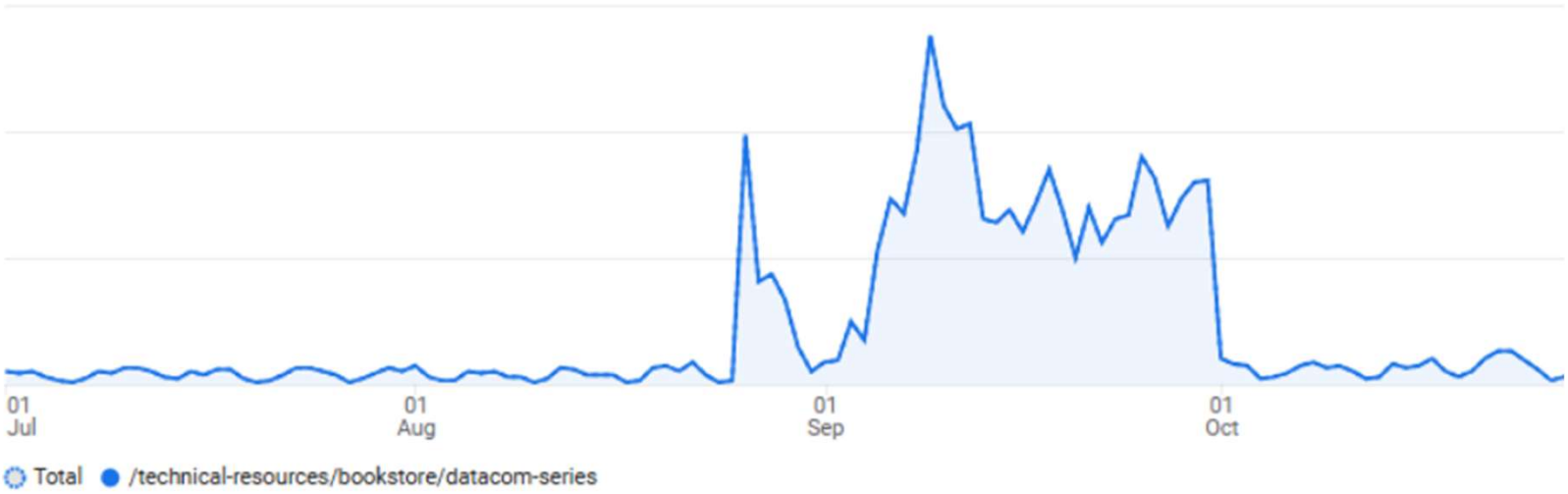
1	Index | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	787	564	1.40	33s	2,816
2	Documents | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	419	335	1.25	24s	1,430
3	Meetings | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	71	44	1.61	57s	174
4	Functions | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	70	54	1.30	39s	217
5	Membership | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	62	48	1.29	1m 07s	182
6	ListServe Instructions | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	1	1	1.00	35s	3
7	Indeks | ASHRAE 9.9 Fasilitas Kritis Misi, Pusat Data, Ruang Teknologi dan Peralatan Elektronik	0	1	0.00	1m 14s	2
8	Indice : ASHRAE 9.9 Installations critiques, centres de données, locaux technologiques et matériel électronique	0	1	0.00	31s	1
9	Inhaltsverzeichnis | ASHRAE 9.9 Geschäftskritische Einrichtungen, Rechenzentren, Technologieräume und elektronische Geräte	0	2	0.00	41s	4
10	Reuniões | ASHRAE 9.9 Instalações de missão crítica, data centers, espaços tecnológicos e equipamentos eletrônicos	0	1	0.00	24s	1

Website Update



datacom-series

Page path and screen class	Views	Active users	Views per active user
SHOW ALL ROWS			
Total	34,268 vs. 6,270 ↑ 446.54%	26,260 vs. 3,554 ↑ 638.89%	1.30 vs. 1.76 ↓ -26.03%
1 /technical-resources/bookstore/datacom-series			
Jul 1, 2024 - Feb 5, 2025	34,268	26,260	1.30
Jul 1, 2023 - Feb 5, 2024	6,270	3,554	1.76
% change	446.54%	638.89%	-26.03%

Research Update

Brad Cochran

TC9.9 General Research Notes

Brad Cochran has taken over as Research Chair from **Mark Seymour**

Conor Murray has taken over as Section 9 Research Liaison from **Roland Charneux**

Roland Charneux is now RPS Chair tasked with RTAR reviews

- Currently no RTAR under review by RAC across all TCs.
- So now is a good opportunity to submit RTARs, funding is available.

TC9.9 Research Status Summary

TRP-1913 - *Study of the Corrosion Impact on Information Technology Equipment in Data Centers Located in Coastal Regions with High Sea Salt Concentration*

WS-1972 - *Data Center Direct-to-Chip Liquid Cooling Resiliency – Failure Modes and IT Throttling Impacts*

WS-1956 - *Compact CFD Modeling Guidance for Thin Flow Resistances*

New RTAR – *Volume Calculations for ITE Cooling Appliance Using ATLs*

Future RTAR – *Guidelines for Data Center External Dispersion Modeling*

Future RTAR – *Flow Velocity Limits for Erosion Control*

1913-WS Status

1913 - Study of the Corrosion Impact on Information Technology Equipment in Data Centers Located in Coastal Regions with High Sea Salt Concentration

- TRP-1913 went out for bid last fall
- Four bids have been received
- Need to set up a call between the PMS and RAC to go over the bid review process (in the works).

1972-WS Status Update

1972 - Data Center Direct-to-Chip Liquid Cooling Resiliency – Failure Modes and IT Throttling Impacts

- December: WS resubmitted to MORTS Changes include:
  - Increased cost estimate from $300K to $350K
  - Total estimated corporate support (cash + in-kind) $51K
  - Up to three more potential sponsors
  - Added Letters of Support from:
    - IBM
    - J.M. Gross
    - Vantage Data Centers
    - DLB Associates
    - Strategic Thermal Labs

- Upon discussions with RAC, it appears that they did not receive the updated WS. It has since been resubmitted (Thanks Tom!).

1956 -WS Status Update

1956-WS Compact CFD Modeling Guidance for Thin Flow Resistances

- WS returned to PES with comments

PES is concerned that RAC didn't understand the purpose of the work. Too precise, they may have been expecting larger, bigger expansive, expensive project.

- We will set up a call between the PES and RAC to review the WS together to make sure that everyone clearly understand the intent of the research.

RTAR Status - Volume Calculations for ITE Cooling Appliances

Volume Calculations for ITE Cooling Appliance Using ATLs

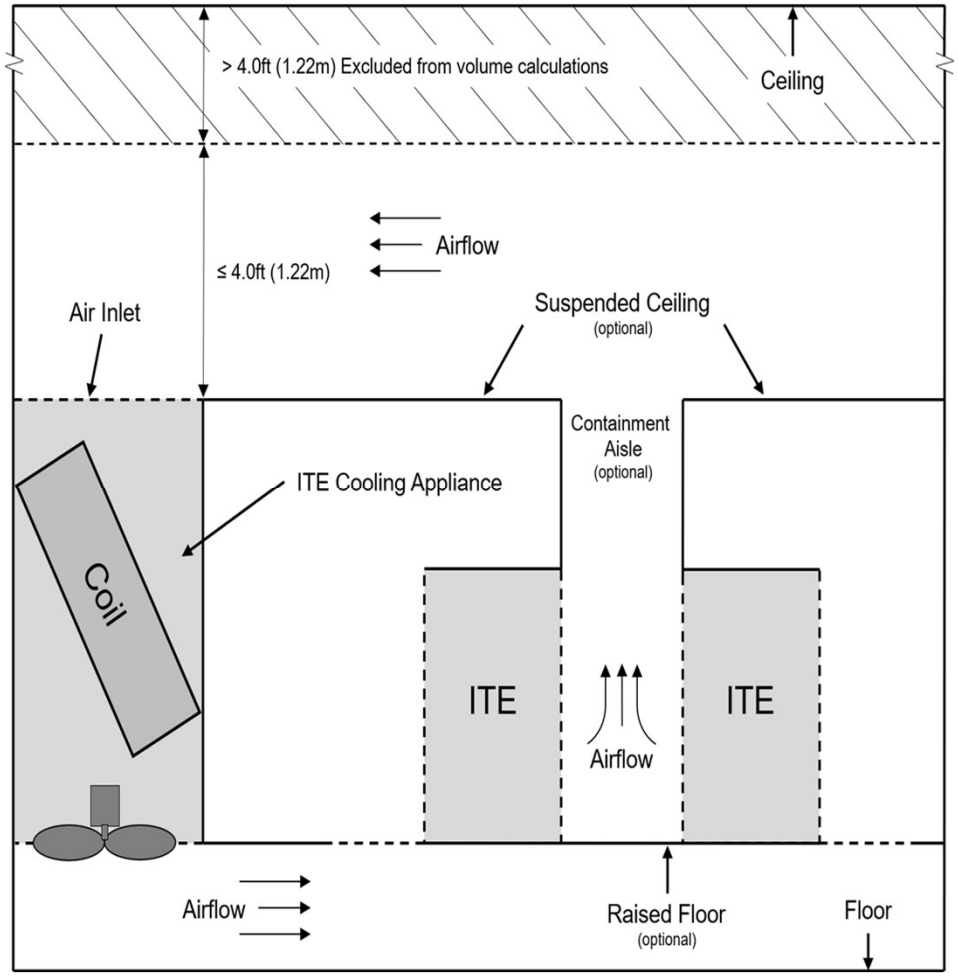
- RTAR has been reviewed by Research Chair (Mark)
- Distributed to TC9.9 Voting Members for Review
- Need to hold vote to accept RTAR
- If RTAR is approved, will need to be forwarded to SSPC 15 for possible Co-Sponsoring

Proposed RTAR / WS Authors

- Richard Pavlak
- Ben Dolcich, Vertiv (ret)
- Bill Kinas

Volume Calculations for ITE Cooling Appliances Using ATLs

- Existing standards - Standard 15-2022 and UL/CSA are not designed for data centers
- Studies on 2L refrigerants are based on comfort cooling with low airflow rates
- There are inconsistent practices with regard to airflow volume – Only 4ft in height above drop/false ceiling is included inUL/CSA 60335-2-40 4th edition further limits refrigerant capacity



Objectives

- Build a CFD geometric model based on the parameters in U101.DVN.8.1.
- Evaluate the effectiveness of the dilution of the refrigerant charge specified in ASHRAE Standard 15-2022, the air flow pattern into the return air, comparing these results to the safety metrics established in Standard 15-2022.
- If the base model identifies the effective volume is well mixed at the prescribed 4-foot limit, raise the height. (The authors believe the 4’ limit is too low).

Objectives

- If the base model shows a dead air space below 4-foot limit lower the height to determine and verify whether there is a height with all acceptable circulation.

- The expectation is that the 4’ limit is too low and that increasing the limit height above the return air opening in viable. Thus, the objective is to run successive models increasing the height limit until the total volume does not mix and a boundary layer of room air appears in the CFD model.

RTAR Status - Volume Calculations for ITE Cooling Appliances

- Motion for TC9.9 to accept RTAR as the responsible TC?
- Second?
- Vote Tally:
    - For:
    - Against:
    - Abstaining:
    - Absent:

Guidelines for Data Center External Airflow Modeling

Proposed RTARS

Guidelines for Data Center External Airflow Modeling

- Evaluate the accuracy of various plume dispersion models (analytical, CFD, physical modeling) to predict the increase in intake temperatures due to hot emission sources. (Results to be compared to measured data at an operating data center).
- Provide guidance on how to improve the accuracy of each model.
- Evaluate how well different modeling techniques (Number of WS and WD, for example) are at predicting design worst-case intake temperatures.
- Provide owner/engineer with guidance on the best approach to meet the acceptable margin of error of the worst-case intake temperature for a specific project.

- Looking for volunteers to help Brad Cochran and Mark Seymour put the final touches on the RTAR

Flow Velocity Limits for Erosion Control

Proposed RTARs

Flow Velocity Limits for Erosion Control

Develop a guideline that will replace the online reference regarding water velocities in liquid cooling applications.

Author - Mark Steinke (msteinke@nvidia.com)

Looking for volunteers to help Mark assemble the RTAR

Flow Velocity Limits for Erosion Control

- ASHRAE Handbook
  - Does call out a 1.5 m/s as a velocity limit to keep pumping power minimized.
  - Does call out a 3.0 m/s limit on erosion with normal operation of 6,000 hr/yr. This is originally sourced from a Carrier study in 1960.
- ASHRAE TC9.9 Liquid Cooling guidelines – 3rd Edition
  - FWS section does have the callout for 1.5 m/s for energy consideration but states 3.0 m/s for >6,000 hr/yr (back to ASHRAE Handbook reference)
  - TCS section does call out a 1.5 m/s for any flexible hose and the table appears to confirm that, but this is more pointing towards pumping power. However, it does not clearly state that.
- ASHRAE TC9.9 Liquid Cooling guidelines – Online encyclopedia
  - FWS section does have the callout for 1.2 m/s for energy consideration but states 3.0 m/s for >6,000 hr/yr (back to ASHRAE Handbook reference).
  - TCS section has this guidance removed.
- Therefore…
  - There is not a current guideline for flow velocity limits to prevent corrosion
  - Some industry hose suppliers have references that call out 6.1 m/s
  - Should we consider an RTAR to provide a recommendation?

Table 23 Maximum Water Velocity to Minimize Erosion

Normal Operation, h/yr	Water Velocity, fps
1500	15
2000	14
3000	13
4000	12
6000	10

Source: Carrier (1960).

5.1.2.3. Velocity Considerations. The velocity of the water in the FWS loop piping must be controlled to ensure mechanical integrity is maintained over the life of the system. Excessive water velocity can lead to erosion, sound/vibration, water hammer, and air entrainment. Particulate-free water will impart less damage to the tubes and associated hardware. Table 5.2 provides guidance on maximum velocities in piping systems that operate over 8,000 hours per year. Flexible tubing velocities should be maintained below 1.5 m/s (5 ft/s). Excessive water velocity in piping systems also increases the pressure drop and energy usage of the system.

5.1.2.4. Liquid Quality/Composition. Table 5.3 identifies the water quality requirements that are necessary to operate the liquid-cooled system. The reader is encouraged to refer to Chapter 49 of the 2011 *ASHRAE Handbook—HVAC Applications*. This chapter, titled "Water Treatment," provides a more in-depth discussion about the mechanisms and chemistries involved.

Table 5.2 Maximum Velocity Requirements

Pipe Size	Maximum Velocity (fps)	Maximum Velocity (m/s)
>3 in. (7.6 cm)	7	2.1
1.5 to 3 in. (3.8 cm to 7.6 cm)	6	1.8
<1 in. (< 2.5 cm)	5	1.5
All flexible tubing	5	1.5

Other Ideas for Research?

- Digital twin for data center environments for liquid cooling and how that might be able to be developed - Ali Heydari
-
-
-

Attendance

ASHRAE TC 9.9 Attendance Record

ASHRAE Technical Committee 9.9 - Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment
2025 Winter Meeting

Programs, Research, & Publications
Hybrid Event Timing:

Sunday, February 9, 2025; 6:00-8:00 pm EST
Event Address: https://www.microsoft.com/microsoft-teams/join-a-meeting
Meeting ID: 252 046 633 687
Passcode: D5Hw6aM9
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Contact us at tc99chair@gmail.com
Technical Committee Website: http://tc0909.ashraetcs.org

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ARPA-E COOLERCHIPS Update

Peter de Bock, Jungho Kim

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Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

ASHRAE Summer Conference
2025
IT Subcommittee
Hybrid In-Person / Virtual

ASHRAE TC 9.9 Datacom Encyclopedia

Dustin Demetriou

The [ASHRAE TC 9.9 Datacom Encyclopedia] evolved in 2024 from the longstanding ASHRAE Datacom Series, a series of print books that provides information on data center-related subjects.

The Datacom Encyclopedia offers **updated, previously unpublished content** formerly covered by the Datacom Series books *Thermal Guidelines for Data Processing Environments*, ***Design Considerations for Datacom Equipment Centers***, and ***Liquid Cooling Guidelines for Datacom Equipment Centers***, as well as **PDFs of every edition of the 14 books in the ASHRAE Datacom Series** for historical reference. Over time, the pertinent information from all the books will transition to be housed in this online encyclopedia.

Subscribe today to access the ASHRAE TC 9.9 Datacom Encyclopedia. Access is granted via payment of an annual fee ($33 list price per year / $24 Member price per year).

To enable and disable access to the encyclopedia, visit https://datacom.ashrae.org/ and click Manage Subscription in the top blue bar. Users can review ASHRAE's privacy policy at www.ashrae.org/privacy-policy.

Updates Available on the TC 9.9 Datacom Encyclopedia

Design Considerations for Datacom Equipment Centers

The content previously covered in *Design Considerations for Datacom Equipment Centers* has been almost entirely rewritten to reflect the current trends in the data center industry. Every chapter has had major revisions. The content included on this site provides expanded and new information covering the following topics:

- Design criteria, HVAC loads, HVAC equipment, facility fluid distribution systems, air distribution, liquid cooling, ancillary spaces, contamination, acoustics, structural and seismic design, fire suppression, commissioning, availability and reliability, energy efficiency, and economizers.

Liquid Cooling Guidelines for Datacom Equipment Centers

The content previously covered in *Liquid Cooling Guidelines for Datacom Equipment Centers* has been almost entirely rewritten to include the most current industry thinking and consensus on the need for further guidance on liquid cooling. The content included on this site provides expanded and new information, including the following:

1. A discussion on the IT component power trends that are driving the need for liquid cooling to support the next generation of IT workloads.
2. Introduction of a new set of environmental classes (S Classes) for the supply temperature of the Technology Cooling System (TCS) coolant.
3. Expanded treatment of the differences in fluid quality requirements for the TCS and FWS loops.
4. Details on the design characteristics of conductive cold-plate and immersion cooling systems.
5. Design guidance for air-cooled facilities that are being upgraded to support liquid-cooled IT equipment.

https://datacom.ashrae.org

Vision for the Encyclopedia

- TC 9.9 Datacom Encyclopedia, TC 9.9 has developed a central hub for providing on-demand access to frequently updated datacom-related content anytime, on any device, anywhere.

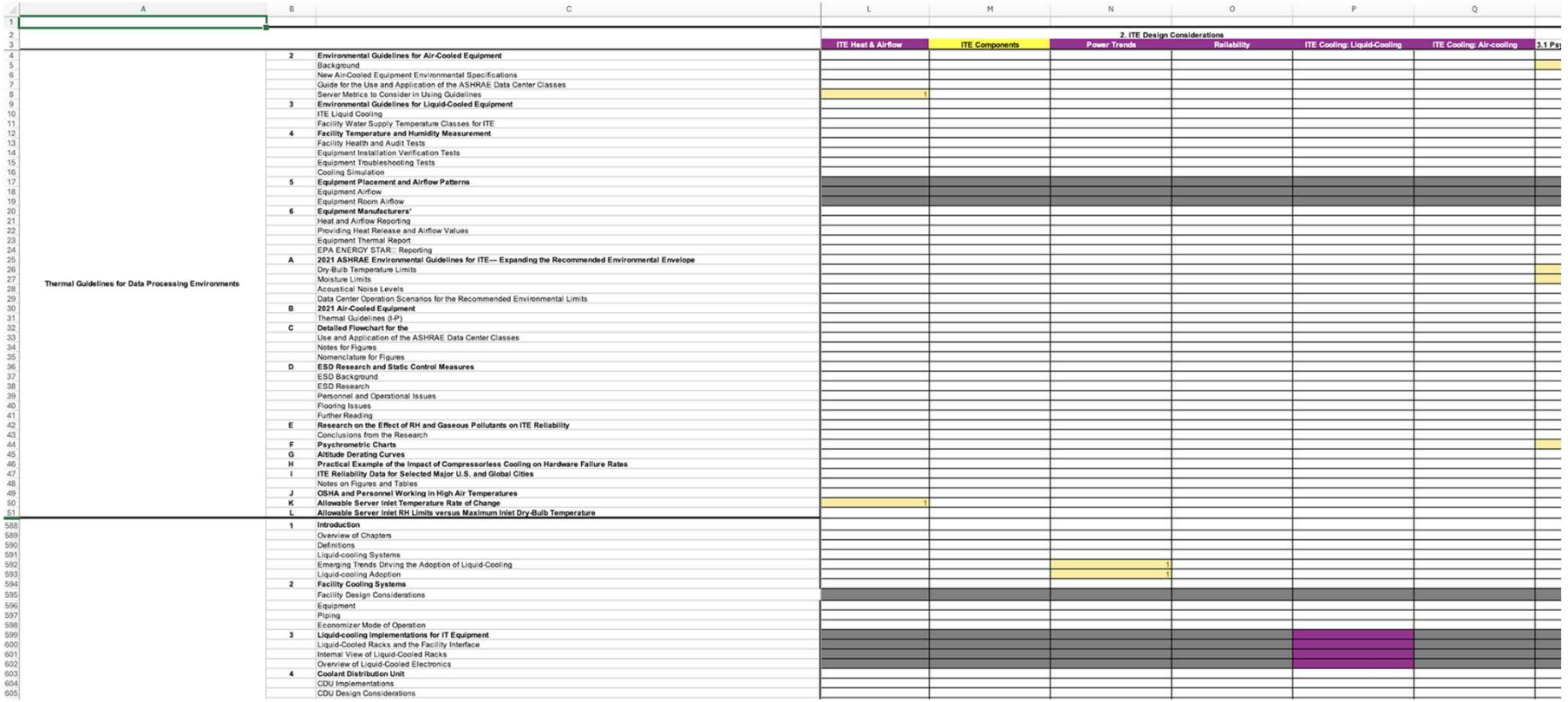
- In time, this site will evolve to incorporate the pertinent information from all of the existing TC 9.9 Datacom Series books, white papers, and technical bulletins, and the books will go out of print.

Timeline[1]:

•This timeline is being provided for informational purposes only. The dates and content are subject to change.

March 2024	TC 9.9 Datacom Encyclopedia is launched with updates to Design Considerations for Datacom Equipment Centers & Liquid Cooling Guidelines for Datacom Equipment Centers.
Now	Process is introduced and approved by TC 9.9 for providing content updates and version tracking.
2024	TC 9.9 Datacom Encyclopedia is transitioned to an encyclopedia format that incorporates Thermal Guidelines for Datacom Equipment Centers, Design Considerations for Datacom Equipment Centers
	TC 9.9 Datacom Encyclopedia begins to incorporate existing material from other Datacom Series book, white papers, and technology briefs.
	Transition of Datacom Series books complete.
	Quarterly updates, approved by TC 9.9, begin.

Next Steps



			L	M	N	O	P	Q	
					2. ITE Design Considerations				
			ITE Heat & Airflow	ITE Components	Power Trends	Reliability	ITE Cooling: Liquid-Cooling	ITE Cooling: Air-cooling	3.1 Pa
Thermal Guidelines for Data Processing Environments	2	Environmental Guidelines for Air-Cooled Equipment							
		Background							
		New Air-Cooled Equipment Environmental Specifications							
		Guide for the Use and Application of the ASHRAE Data Center Classes							
		Server Metrics to Consider in Using Guidelines	1						
	3	Environmental Guidelines for Liquid-Cooled Equipment							
		ITE Liquid Cooling							
		Facility Water Supply Temperature Classes for ITE							
	4	Facility Temperature and Humidity Measurement							
		Facility Health and Audit Tests							
		Equipment Installation Verification Tests							
		Equipment Troubleshooting Tests							
		Cooling Simulation							
	5	Equipment Placement and Airflow Patterns							
		Equipment Airflow							
		Equipment Room Airflow							
	6	Equipment Manufacturers'							
		Heat and Airflow Reporting							
		Providing Heat Release and Airflow Values							
		Equipment Thermal Report							
		EPA ENERGY STAR:: Reporting							
	A	2021 ASHRAE Environmental Guidelines for ITE— Expanding the Recommended Environmental Envelope							
		Dry-Bulb Temperature Limits							
		Moisture Limits							
		Acoustical Noise Levels							
		Data Center Operation Scenarios for the Recommended Environmental Limits							
	B	2021 Air-Cooled Equipment							
		Thermal Guidelines (I-P)							
	C	Detailed Flowchart for the							
		Use and Application of the ASHRAE Data Center Classes							
		Notes for Figures							
		Nomenclature for Figures							
	D	ESD Research and Static Control Measures							
		ESD Background							
		ESD Research							
		Personnel and Operational Issues							
		Flooring Issues							
		Further Reading							
	E	Research on the Effect of RH and Gaseous Pollutants on ITE Reliability							
		Conclusions from the Research							
	F	Psychrometric Charts							
	G	Altitude Derating Curves							
	H	Practical Example of the Impact of Compressorless Cooling on Hardware Failure Rates							
	I	ITE Reliability Data for Selected Major U.S. and Global Cities							
		Notes on Figures and Tables							
	J	OSHA and Personnel Working in High Air Temperatures							
	K	Allowable Server Inlet Temperature Rate of Change	1						
	L	Allowable Server Inlet RH Limits versus Maximum Inlet Dry-Bulb Temperature							
	1	Introduction							
		Overview of Chapters							
		Definitions							
		Liquid-cooling Systems							
		Emerging Trends Driving the Adoption of Liquid-Cooling			1				
		Liquid-cooling Adoption			1				
	2	Facility Cooling Systems							
		Facility Design Considerations							
		Equipment							
		Piping							
		Economizer Mode of Operation							
	3	Liquid-cooling Implementations for IT Equipment							
		Liquid-Cooled Racks and the Facility Interface							
		Internal View of Liquid-Cooled Racks							
		Overview of Liquid-Cooled Electronics							
	4	Coolant Distribution Unit							
		CDU Implementations							
		CDU Design Considerations							

- **List of all book chapters, mapped to topics was created at the Winter Meeting.**
- **Next step is to take all of the material (across books) that relate to a topic and edit/re-write into a "Wikipedia" style topic.**
- **Volunteers are requested that can help with this editing.**

Agenda

- Liquid Server Thermal Template (Dustin Demetriou)
- S-Class Definition and Addition of S20/25 (Paul Artman)
- Thermal Guidelines Tech Brief (Mark Seymour/Dustin Demetriou)
- IT Equipment Power Trends (Mark Steinke)
- Chip BC for Cold Plate (Mark Steinke)

Thank You

TC 9.9 Website:

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ASHRAE TC 9.9 Datacom Encyclopedia Work Session

Dustin Demetriou

Activity

Volunteers needed for sub-topic and book compression

Word documents with mapped content to be reviewed

Content to be edited

- **remove duplicate text**
- **move sentence/ paragraphs for readability**

No rewriting (modifications or editing) of content