Welcome!

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

No need to say hello, we will begin promptly at 1:30 pm CST

High Level Agenda

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

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 Summer 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 Groenewold	IP
Webmaster	Website	5	Ecton English	V
Publications	ASHRAE TC 9.9 Datacom Encyclopedia	15	Dustin Demetriou	IP
	Workshop	60	Dustin Demetriou	IP
Break		20		
Handbook	Handbook Update Summary	5	Robert McFarlane/ Jonell Watson	IP
Liaison Reports	Standard 90.1	5	Rick Pavlak	IP
	SPC-127 / AHRI 1360	10	David McGlocklin	IP
	Standard 90.4	5	Marcus Hassen	IP
	90.4 Addendum D Discussion	30	Dave Quirk	IP
	OCP	5	Matt /Mark/John	IP
Research	Research Highlights	5	Brad Cochran	IP
IT Subcommittee	CDU Critical Role Tech Brief	10	Tim Shed	IP
	S-Class Definition (S20/25)	10	Paul Artman	IP
	Filtration Recommendations	10	Dustin Demetriou	IP
	TCS/FWS Coolant Quality	10	Dustin Demetriou	IP
	Tech Brief Roadmap	10	Dustin Demetriou	IP
Committee Updates	Incoming Committee Officers and Voting Members	10	Matt Koukl	IP
	Total Time:	250	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 - Chris Campbell

- 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 Summer Meeting

Programs, Research, & Publications

Hybrid Event Timing: Sunday, June 22, 2025; 4:00 - 6:00 pm MST
Event Address: https://www.microsoft.com/microsoft-teams/join-a-meeting
Meeting ID: 294 073 962 708
Passcode: cr7ze3Ce
Location: Phoenix Convention Center North Building, 230 (Level 2)

Main Meeting

Hybrid Event Timing: Monday, June 23, 2025; 1:30 - 6:00 pm MST
Event Address: https://www.microsoft.com/microsoft-teams/join-a-meeting
Meeting ID: 260 212 501 636
Passcode: PL9AP9FD
Location: Phoenix Convention Center North Building, 232ABC (Level 2)

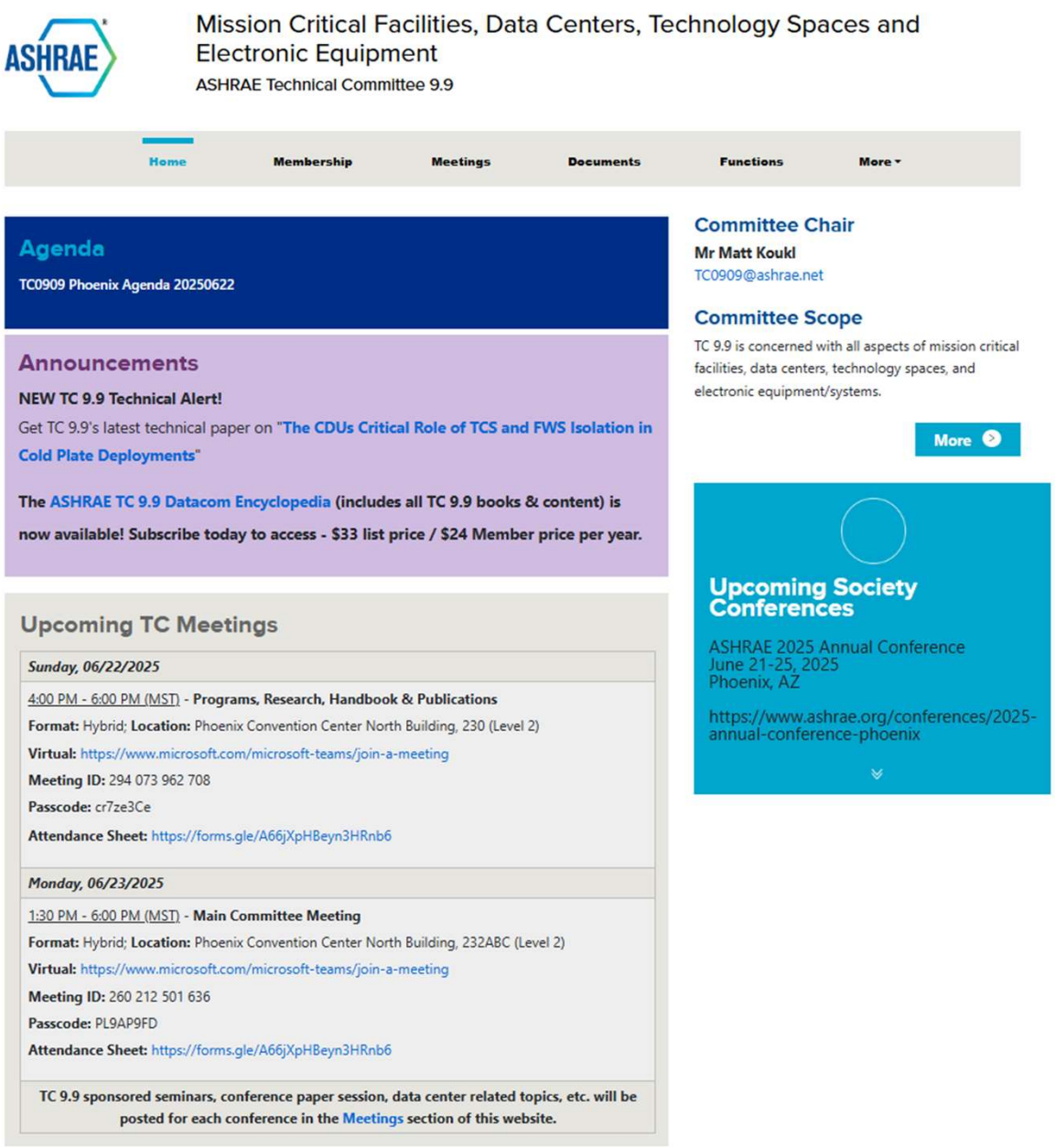
Contact us at tc99chair@gmail.com
Technical Committee Website: http://tc0909.ashraetcs.org

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

https://forms.gle/A66jXpHBeyn3HRnb6

Or use the QR Code below:

TC 9.9 Webpage



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

ASHRAE Technical Committee 9.9

Home | Membership | Meetings | Documents | Functions | More

Agenda

TC0909 Phoenix Agenda 20250622

Announcements

NEW TC 9.9 Technical Alert!

Get TC 9.9's latest technical paper on "The CDUs Critical Role of TCS and FWS Isolation in Cold Plate Deployments"

The ASHRAE TC 9.9 Datacom Encyclopedia (includes all TC 9.9 books & content) is now available! Subscribe today to access - $33 list price / $24 Member price per year.

Upcoming TC Meetings

Sunday, 06/22/2025

4:00 PM - 6:00 PM (MST) - **Programs, Research, Handbook & Publications**

Format: Hybrid; **Location:** Phoenix Convention Center North Building, 230 (Level 2)

Virtual: https://www.microsoft.com/microsoft-teams/join-a-meeting

Meeting ID: 294 073 962 708

Passcode: cr7ze3Ce

Attendance Sheet: https://forms.gle/A66jXpHBeyn3HRnb6

Monday, 06/23/2025

1:30 PM - 6:00 PM (MST) - **Main Committee Meeting**

Format: Hybrid; **Location:** Phoenix Convention Center North Building, 232ABC (Level 2)

Virtual: https://www.microsoft.com/microsoft-teams/join-a-meeting

Meeting ID: 260 212 501 636

Passcode: PL9AP9FD

Attendance Sheet: https://forms.gle/A66jXpHBeyn3HRnb6

TC 9.9 sponsored seminars, conference paper session, data center related topics, etc. will be posted for each conference in the Meetings section of this website.

Committee Chair

Mr Matt Koukl

TC0909@ashrae.net

Committee Scope

TC 9.9 is concerned with all aspects of mission critical facilities, data centers, technology spaces, and electronic equipment/systems.

More

Upcoming Society Conferences

ASHRAE 2025 Annual Conference
June 21-25, 2025
Phoenix, AZ

https://www.ashrae.org/conferences/2025-annual-conference-phoenix

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.

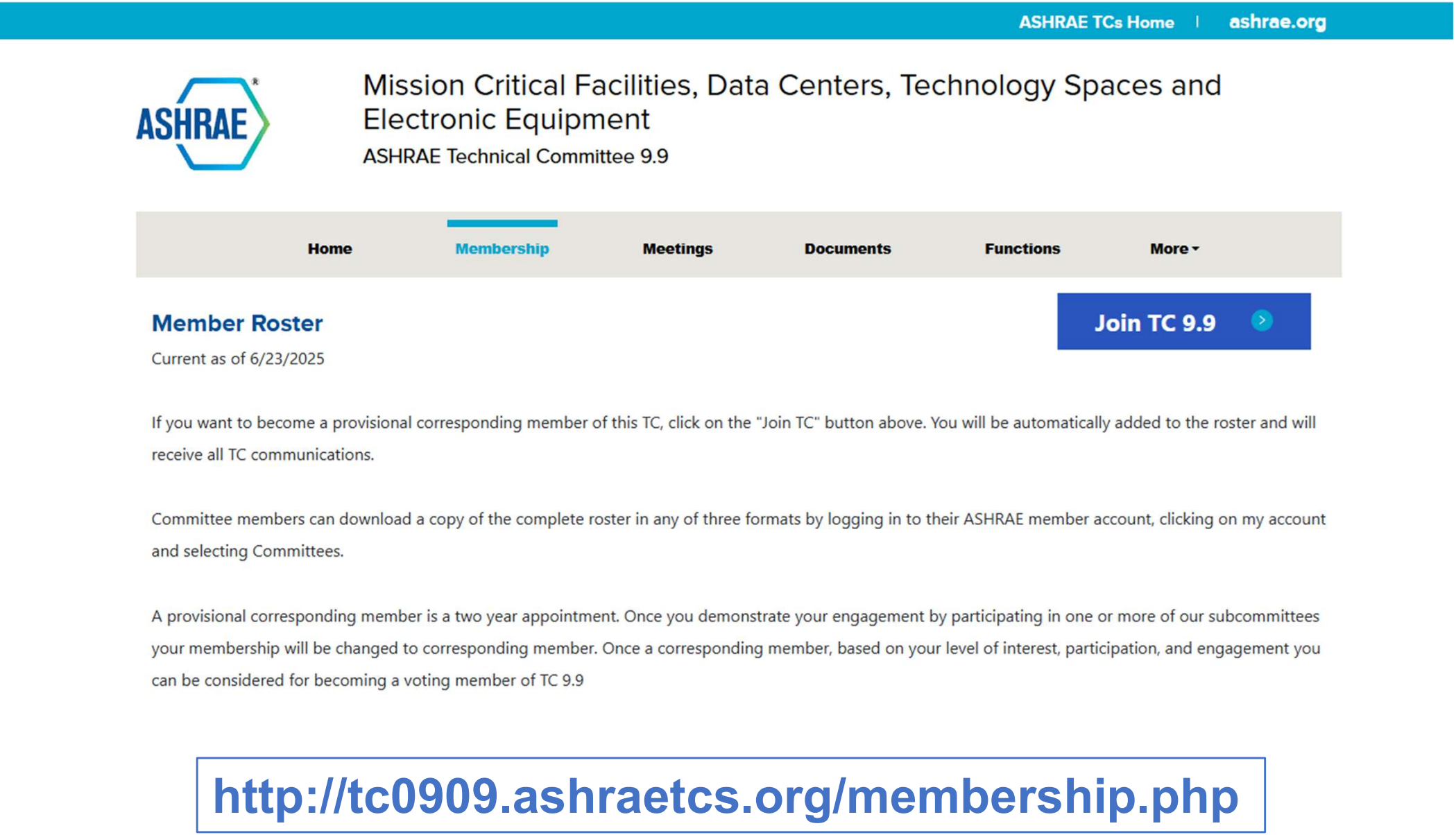
Scope

- 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



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
CBRE

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, nVent
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
Adoption of Summer 2024 Meeting Minutes	**6/22/25**	Yes
Adoption of Winter 2025 Meeting Minutes	**6/22/25**	Yes
TC 9.9 technical Alert	**2/21/25**	Yes
S-Class Updates to Encyclopedia	**5/5/25**	Yes

Membership

Membership	2024 Summer	2025 Winter	2025 Summer
Board, Chairs & Liaisons	23	23	23
Corresponding Members	365	357 ↓	357
Provisional Corresponding Members	139	185 ↑	259 ↑
Total	518	565 ↑	639 ↑
YEA	67	69 ↑	100 ↑

2024 Summer Attendance

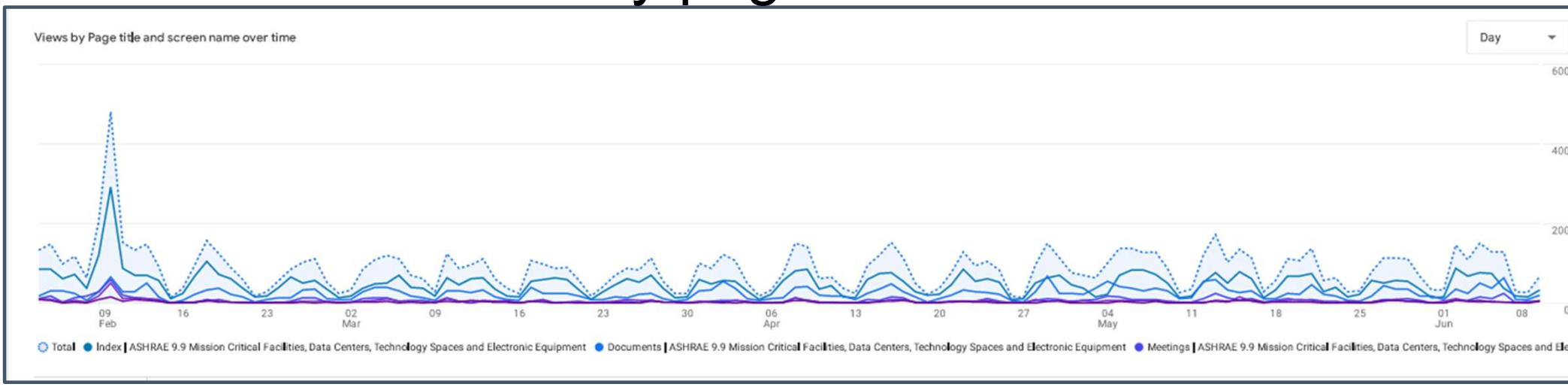
Membership Type	2024 Summer		2025 Winter	
	Sunday	Monday	Sunday	Monday
Board, Chairs, & Liaisons	11	12	7	9
Corresponding Members	22	33	18	44
Provisional Corresponding Members	16	21	28	45
Guests	2	5	1	3
Total	51	71	54	101

Website Update

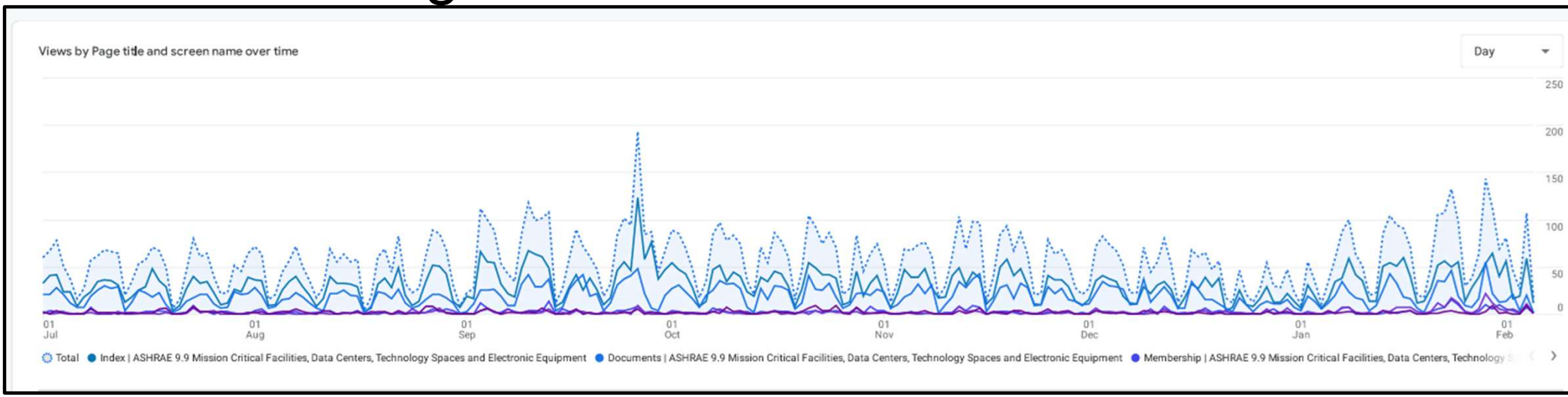
Ecton English

Website Update

Past 6 Months Views by page



Orlando Meeting



Website Update

Plot rows | 9.9 | Rows

		Page title and screen name	Views	Active users	Views per active user	Average engagement time per active user
		Total	11,017 21.81% of total	6,235 31.74% of total	1.77 Avg -31.29%	33s Avg -33.51%
☑	1	Index | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	6,215 (56.41%)	4,209 (67.51%)	1.48	28s
☑	2	Documents | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	3,033 (27.53%)	2,619 (42%)	1.16	18s
☑	3	Meetings | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	812 (7.37%)	662 (10.62%)	1.23	14s
☑	4	Membership | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	590 (5.36%)	372 (5.97%)	1.59	45s
☑	5	Functions | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	344 (3.12%)	259 (4.15%)	1.33	28s
☐	6	ListServe Instructions | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	18 (0.16%)	18 (0.29%)	1.00	17s
☐	7	Dokumente | ASHRAE 9.9 Geschäftskritische Einrichtungen, Rechenzentren, Technologieräume und elektronische Geräte	1 (<0.01%)	1 (0.02%)	1.00	56s
☐	8	Inhaltsverzeichnis | ASHRAE 9.9 Geschäftskritische Einrichtungen, Rechenzentren, Technologieräume und elektronische Geräte	1 (<0.01%)	3 (0.05%)	0.33	2m 10s
☐	9	指数 |ASHRAE 9.9 关键任务设施、数据中心、技术空间和电子设备 — Index | ASHRAE 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment	1 (<0.01%)	1 (0.02%)	1.00	15s
☐	10	索引 | ASHRAE 9.9 关键任务设施、数据中心、技术空间和电子设备	1 (<0.01%)	6 (0.1%)	0.17	54s

ASHRAE TC 9.9 Main Meeting

Publications Update

Datacom Encyclopedia

June 23, 2025

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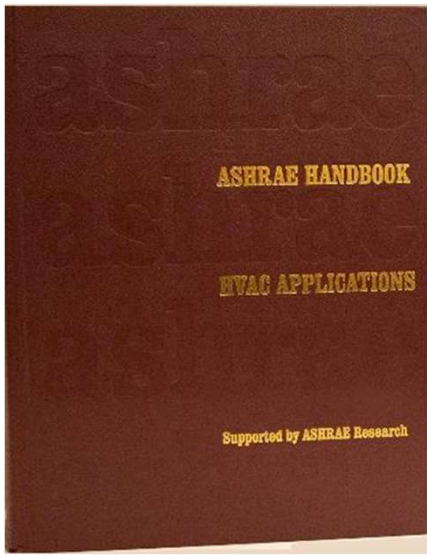
ASHRAE HANDBOOK "Applications"

Chapter 20

"Data Centers & Telecommunication Facilities"



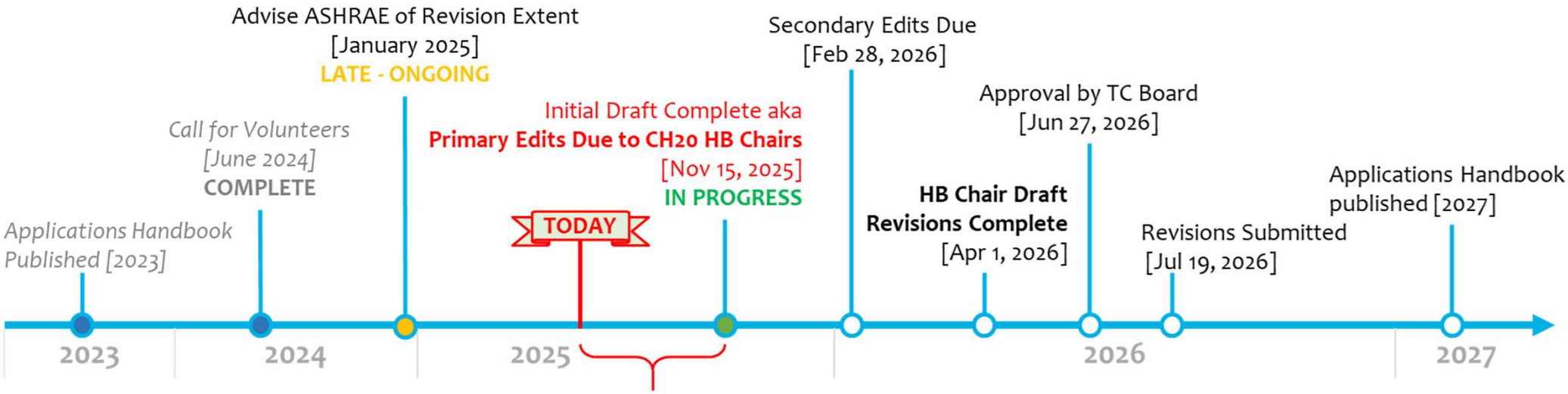
Current Status

We are currently in the middle of a revision cycle for the Applications Handbook!

Chapter 20 Has 120 Topics:

- 37 Initial Reviewers Assigned. 29 Responded ***THANK YOU!!***
  - 19 Require Major Revision or Rewrite
  - 31 Require Minimal Revision
  - 21 Are Fine "As Is"
  - **46 Still Not Reviewed**
    - **30 Of Those Were Assigned, But Not Reviewed => Will be Reassigned**
  - 3 New Topics Suggested for Addition
    - Heat Pipe Technology
    - Above Hot Aisle Air Delivery
    - Controls

Current Status



Between now and Nov 15…

1. **<TODAY> Get volunteers for unassigned topics**
2. **Consolidate topics requiring significant edits to and assign Primary Reviewers**
3. **Receive acknowledgement and acceptance by assigned PR's**
4. **Provision access for PRs to ASHRAE Authoring Portal**
5. **Primary Reviewers to make their edits in Authoring Portal (SharePoint backend)**
6. **Handbook chairs to do final once-over**

Today's Priorities

Unassigned Topics		
ID	**Section**	**Topic**
10 / 113	2.3 DATACOM EQUIPMENT (HARDWARE)	Datacom Equipment Airflow (#113 - Fig. 4)
11 / 114	2.3 DATACOM EQUIPMENT (HARDWARE)	Liquid-Cooled Datacom Equipment (#114 - Fig. 5)
12	2.3 DATACOM EQUIPMENT (HARDWARE)	Contamination
13 / 135	2.3 DATACOM EQUIPMENT (HARDWARE)	Environmental Guidelines for Air-Cooled Equipment (#135 - Table 1)
14 / 136	2.3 DATACOM EQUIPMENT (HARDWARE)	Environmental Guidelines for Liquid-Cooled Equipment (#136 - Table 2)
17 / 116 / 117 / 137	2.3 DATACOM EQUIPMENT (HARDWARE)	Power Trends (#116 - Fig 7, #117 - Fig 8, & #137 - Table 3)
37	3.1 General Considerations	Lighting
86	4. RESOURCES => ASHRAE DATACOM SERIES	8. Particulate & Gaseous Contamination (2014a)
87	4. RESOURCES => ASHRAE DATACOM SERIES	9. Real-Time Energy Consumption (2010)
90	4. Resources => ASHRAE Datacom Series	12. Server Efficiency Metrics (2015b)
92	4. Resources => ASHRAE Datacom Series	14. Advancing DCIM w/ IT Equipment Integration (2019a)
96	4. RESOURCES => ASHRAE DATACOM SERIES	Data Center Handbook, 2nd ed (2021)
97	4. Resources => ASHRAE Datacom Series	ANSI/TIA Std. 942-B-2017
98	4. Resources => ASHRAE Datacom Series	ANSI/BICSI Std. 002-2019

Today's Priorities

Unassigned Topics		
ID	**Section**	**Topic**
99	4. Resources => ASHRAE Datacom Series	ANSI/ASHRAE Std. 202-2018
100	4. Resources => ASHRAE Datacom Series	ASHRAE Guideline 0-2019
101	4. Resources => ASHRAE Datacom Series	BICSI 009-2019
102	4. Resources => ASHRAE Datacom Series	The Green Grid White Paper #79
103	4. Resources => ASHRAE Datacom Series	The Green Grid White Paper #68
104	4. Resources => ASHRAE Datacom Series	DIN EN 50600
105	4. Resources => ASHRAE Datacom Series	ISO/IEC 22237 Series
106	4. Resources => ASHRAE Datacom Series	European Commission - The European Code of Conduct for Energy Efficiency in DCs
115	FIGURES	Fig. 6 - Environmental Classes for Datacom Equipment Classes…
135	TABLES	Table 1 - 2021 Thermal Guidelines: Equip. Environmental Specs for Air Cooling
137	TABLES	Table 3 - Workload Types

Please advise Bob McFarlane and Jonell Watson

rmcfarlane@smwllc.com | Jonell.Watson@gmail.com

Immediate Next Steps

- Assigning Primary Editors for Content Requiring Change
  - Based on Initial Feedback
  - May Not Be Same People. (Topics Being Consolidated)
  - **Require Confirmation of Assignments !!!**
    - **Response Within 2 Weeks or Topics Re-Assigned**

- **Secondary Reviewers Will Be Assigned Next Year**

Next Steps

- Assign Revisions to Selected Reviewers
  - Topics Will Be Grouped to Reduce Number of Revisors
  - Not Everyone who Responded Will Do Actual 1st Edits.
    - You May Become Reviewers
- Provide Access to Authoring Portal
  - You Will Receive Email From:
    - *Kennedy, Heather is inviting you to collaborate on ASHRAE Authoring Portal*

ADDITIONAL QUESTIONS?

QUESTIONS?

Please advise Bob McFarlane or Jonell Watson

rmcfarlane@smwllc.com | Jonell.watson@gmail.com

TC 9.9 Liaisons and Liaison Reports

- Standard 90.1: Rick Pavlak
- Standard 127: David McGlocklin
- Standard 90.4: Marcus Hassen
- OCP: Matt Koukl
- Research Update: Brad Cochran

90.1 Liaison Report

Rick Pavlak

90.1 NEWSLETTER

Summer 2025

Meeting Info

90.1 will convene at the ASHRAE Annual (Summer) Conference in Phoenix, AZ, later this month.

- Subcommittee dates: 6/19 - 6/22
- Full committee dates: 6/21, 6/22, 6/23
- Locations and virtual links are available in the online program

RECENTLY PUBLISHED ADDENDA

Published in April

Addendum aj - Indoor Pool Energy Recovery
Addendum am - Fenestration Updates
Addendum as - 205 Alignment
Addendum bg - Staggered Insulation
Addendum bh - Hospital Setback
Addendum bl - Pool Covers
Addendum bp - TSPR no MPF
Addendum bv - Sec 12 Fan Power Equation

Published in May

Addendum ab - Exterior Lighting
Addendum aq - On-site Renewables
Addendum bd - Interior Lighting Controls
Addendum br - Energy Monitoring Dash
Addendum af - Electric Motors 10 CFR 431
Addendum be - Egress Lighting
Addendum by - Hospital Economizers
Addendum cb - Section 10 Compliance
Addendum cd - Acronyms
Addendum ce - Baseline Motor Refinement
Addendum cf - ECB or PRM (editorial)
Addendum cg - Percent Improvement Calc
Addendum ch - Steel Wall U-Factors

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.

SSPC Leadership:

SSPC 127 – Chair Dave McGlocklin, Vice Chair John Gross, Secretary Dave Meadows

- Air Subcommittee – Chair Dave McGlocklin, Secretary Dave Meadows

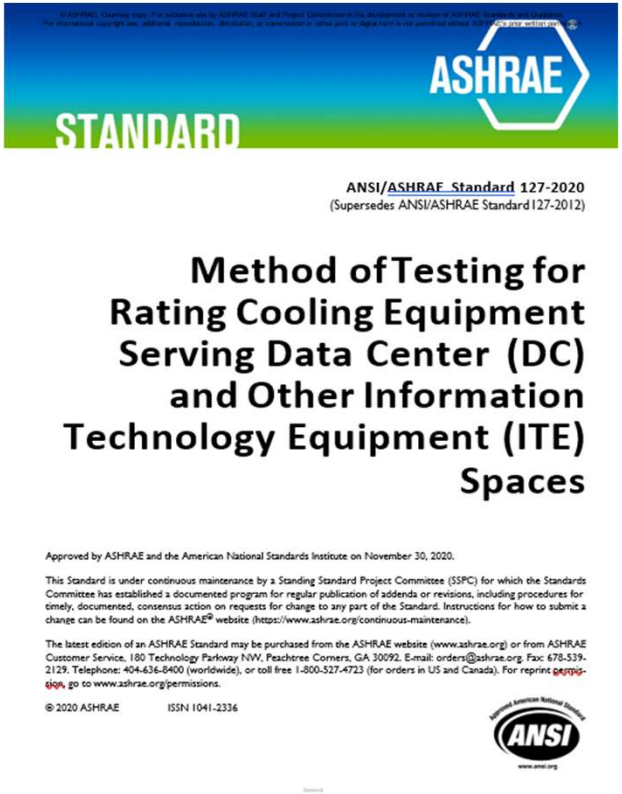
- Liquid Subcommittee - Chair John Gross, Vice Chair Dr. Tim Shedd, Secretary Dustin Demetriou

2025 June Update & Plans:

Liquid Sub has made great progress releasing Addendum b covering the L2L CDU MoT We received 37 public comments from the PPR Draft, which we have worked through and compiled the updates into a new version of Addendum b, which we will go over and seek to vote out for another PPR at this conference. The results of the topology poll mentioned in Orlando showed the L2A CDU will be next.

Air Sub will join in on the L2A work product effort, and we will after a long absence be able to joint meetings w/ AHRI 1360 to work on harmonization of the two standards. Ben Dolcich has recently been formally elected chair of AHRI 1360. I will be conferring with him and AHRI staff in the coming weeks on the new work plan for AHRI 1360 to also begin work on how liquid cooling rating will be adopted in AHRI 1360.

Meeting Tuesday June 24th 8am-12pm (Sheraton Phoenix Downtown, Deer Valley (Level 2))



Standard 90.4 Energy Standard for Data Centers - Update

Marcus Hassen - Chair 90.4

- Addendum d was issued for public review and there were 93 review comments.
- Review comments were discussed during the Sunday and Monday meetings
- Comments have been provided to the commenters comments.
- Review comments were voted on and were discussed

- Green Building Initiative (GBI) has launched its Green Globes for Data Centers certification program – references 90.4 as a path to compliance

GBI launches 'Green Globes Data Center Campus Certification' - Data Centre & Network News

- CEBD AI Data Center Framework Project
- TC9.9 / 90.4 Congressional Briefing – 4Q 2025
- 90.4-2025 Publication Summary

ASHRAE and Open Compute Project (OCP) Collaboration

Matt Koukl,Mark Steinke, John Gross

ASHRAE and OCP Collaboration - Update

- Developing an Agreement between ASHRAE and Open Compute Project (OCP)

  Status: Signing of document
- Expected to present with OCP Cooling Environments at the 2025 Global Summit
- Proposal submitted for ASHRAE Winter Conference Program for Panel session

  Title: OCP & TC 9.9 Collaboration - Status, Workstreams, & Path Forward

Research Update

Brad Cochran

TC9.9 General Research Notes

- Only 1 RTAR submitted to RAC for Review in Spring.
- No RTARs being reviewed at this meeting
- 2 Work Statements reviewed
- 2 Accepted
- 8 Tentative Research Projects
- So now is a good opportunity to submit RTARs, funding is available.
- $2.7M Raised so far this year with one week to go, hope to exceed $3M.

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*

- 4 Bids Received and Reviewed by PES
- Bidder Selected and Approved by TC9.9?

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

- WS Approved by RAC in Spring
- Should go out for bid in Fall

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

- TC4.10 is the cognizant TC, TC9.9 is a Co-Sponsor
- WS returned w/ comments

TC9.9 Research Status Summary

New RTAR – *Study of Height Limitations in U101.DVN.8.1*

- Getting co-sponsorship with SSPC 15 (meeting on Tuesday)

RTAR in Development – *Guidelines for Data Center External Dispersion Modeling*

- On Hold

RTAR in Development – *Flow Velocity Limits for Erosion Control*

Proposed RTAR - *Digital twin for data center environments for liquid cooling and how that might be able to be developed*

Proposed RTAR – *Commissioning/Flushing requirements for fluid mixing in direct to chip cooling applications*

RAC is developing a new on-line RTAR process. It is currently looking for BETA testers. Get with me if you would like to participate (bcochran@cppwind.com) .

RTAR form online at:
https://www.ashrae.org//File%20Library/Technical%20Resources/Research/RTAR-Form-Template_2019--2-.DOCX

TC9.9 Research Status Summary

Moving RAC into the 21st Century:

RAC is developing a new on-line RTAR process. It is currently looking for BETA testers. Get with me if you would like to participate (bcochran@cppwind.com) .

Or:

RTAR form online at:
https://www.ashrae.org//File%20Library/Technical%20Resources/Research/RTAR-Form-Template_2019--2-.DOCX

Research Objectives

2021 ASHRAE Research Strategic Plan

(Updated on 8-year cycle)

https://www.ashrae.org/file%20library/technical%20resources/research/research-strategic-plan.pdf

Research Initiatives:

1. Resilience
2. IEQ – Environmental Quality in Occupied Spaces and Impacts on Work and Learning Health and Well Being, and Transmission of Airborne Infectious Viruses
3. Sustainability, Decarbonization, Energy and Resources
4. HVAC&R Equipment, Components, and Materials
5. Tools and Applications
6. Education and Outreach

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

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

ASHRAE TC 9.9 Main Meeting

Publications Update

Datacom Encyclopedia

June 23, 2025

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

What's New

June 24, 2025	• Datacom Encyclopedia V2 (beta) launched
May 10, 2025	• Liquid-cooling Infrastructure Considerations for Technology Cooling Systems updated to introduce S20 and S25 classes • Clarification provided around S- vs. W-classes and CDU approach temperature
March 5, 2025	• The CDUs Critical Role of TCS and FWS Isolation in Cold Plate Deployments published. • PDF version also available in the ASHRAE Datacom Series PDFs page.
November 7, 2024	• Liquid Cooling thermal template published in Thermal Guidelines for Data Processing Environments, Chapter 6 (Version 1.1)
September 2, 2024	• Liquid Cooling: Resiliency Guidance for Cold Plate Deployments published. • PDF version also available in the ASHRAE Datacom Series PDFs page.

Updated to Encyclopedia 1.0 pages

ASHRAE TC 9.9 DATACOM ENCYCLOPEDIA

THERMAL GUIDELINES FOR DATA PROCESSING ENVIRONMENTS

Published 11/7/2024

6 Equipment Manufacturers' Heat and Cooling Reporting

This chapter provides guidance to users for estimating heat release from information technology equipment (ITE) similar to what was developed by Telcordia in GR-3028-CORE (2001) for the telecom market.

Some ITE manufacturers provide sophisticated tools to more accurately assess power and airflow consumption.

When available, the manufacturer should be consulted and data from their tools should be used to provide more specific information than may be available in the thermal report provided by the ITE manufacturers.

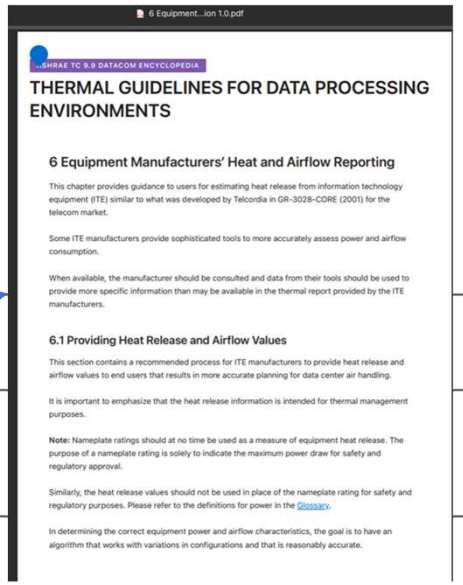
6.1 Providing Heat Release and Cooling Values

This section contains a recommended process for ITE manufacturers to provide heat release and cooling values to end users that results in more accurate planning for data center cooling.

Page version: 1.1

Index of Topics

Version Control



1.0	• As published in *Thermal Guidelines for Data Processing Environments, 5th Edition.*
1.1	• Changed focus from *airflow* reporting to *cooling* reporting • Added liquid-cooling thermal template and accompanying reporting guidance • Updated nominal airflow reporting conditions from 18 °C to 24°C – 27°C

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.

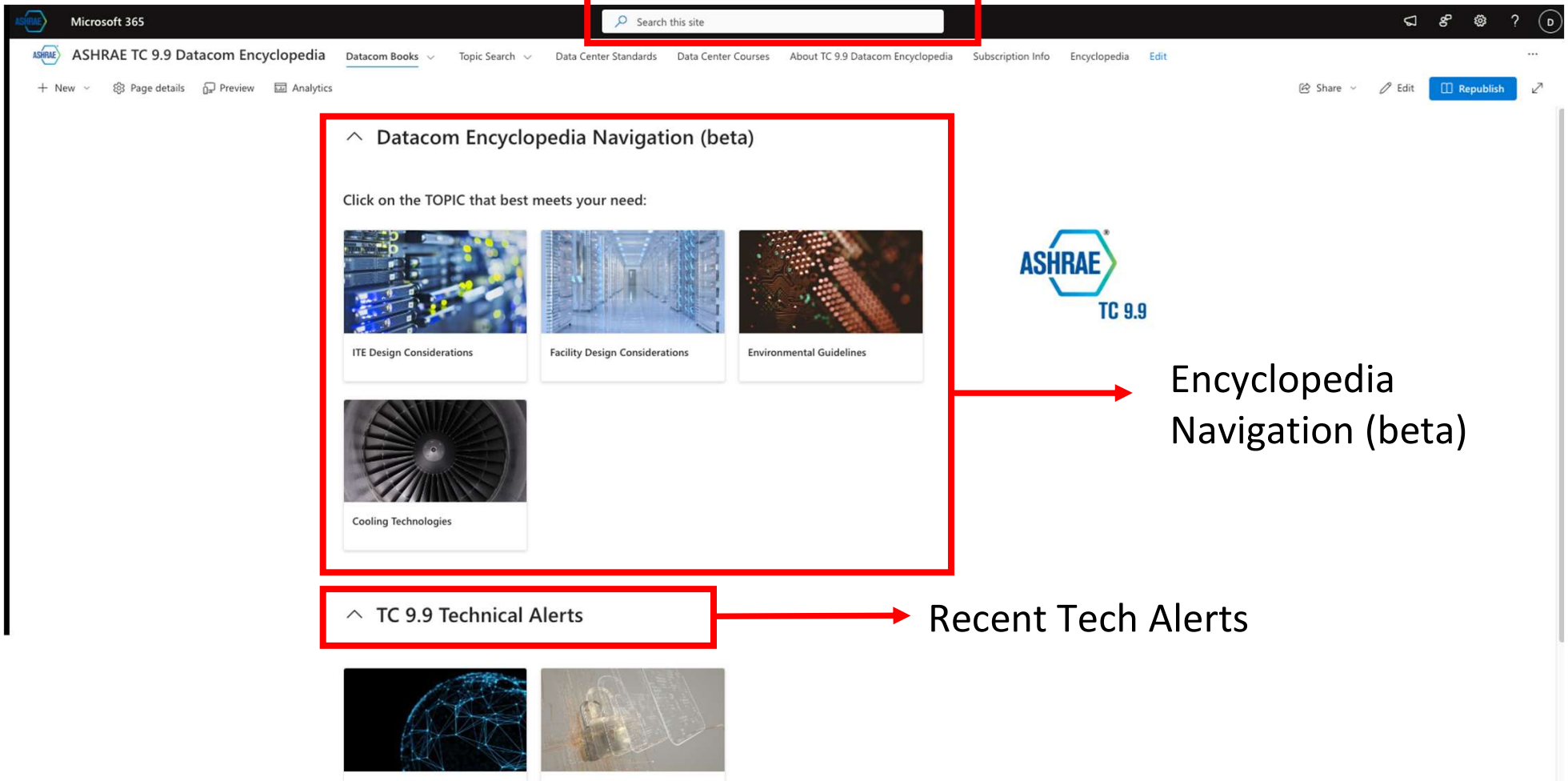
March 2024	TC 9.9 Datacom Encyclopedia is launched with updates to Design Considerations for Datacom Equipment Centers & Liquid Cooling Guidelines for Datacom Equipment Centers.
Summer 2024	Process is introduced and approved by TC 9.9 for providing content updates and version tracking.
Winter 2025	TC 9.9 Datacom Encyclopedia begins to incorporate existing material from other Datacom Series book, white papers, and technology briefs.
Summer 2025	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
2026	Transition of Datacom Series books complete.
On-going	Quarterly updates, approved by TC 9.9, begin.

Datacom Encyclopedia V2 **Beta**

- Since the Winter meeting, a subgroup has worked on converting the content to a “Wikipedia” format
- The beta version of the new experience is available in the **Datacom Encyclopedia Naviagation**
- It is important that we receive feedback from the committee on this new format

Datacom Encyclopedia V2 **Beta**

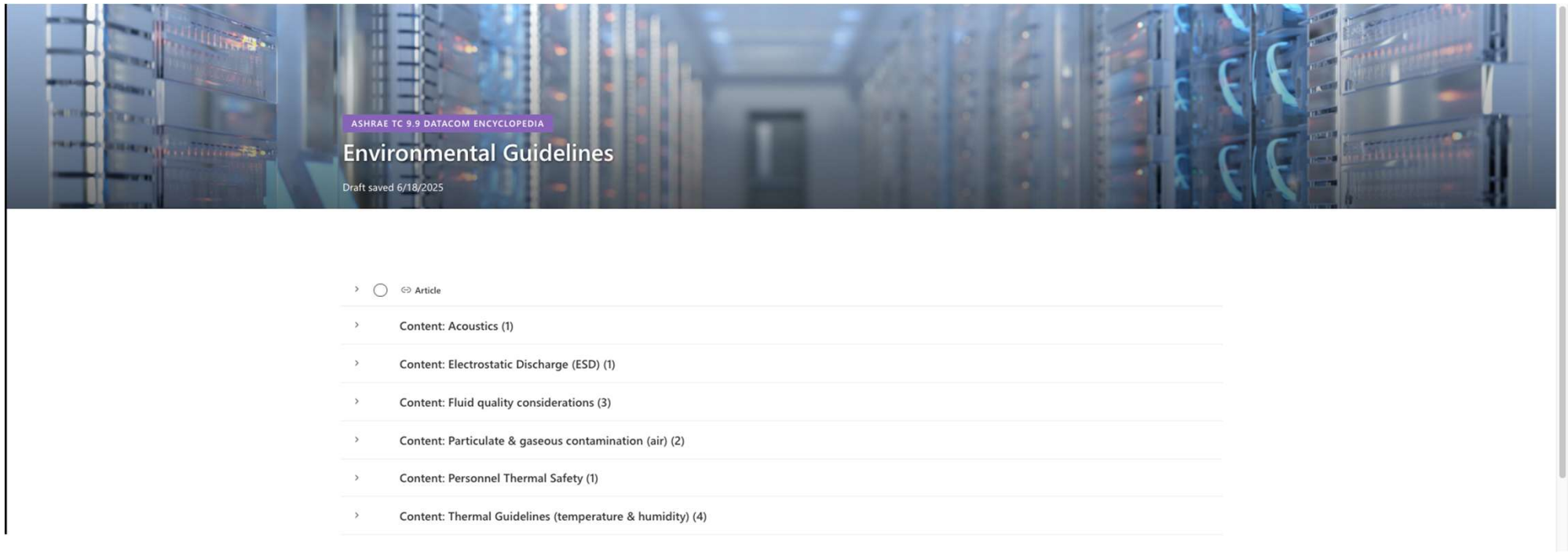
Site search



Encyclopedia Navigation (beta)

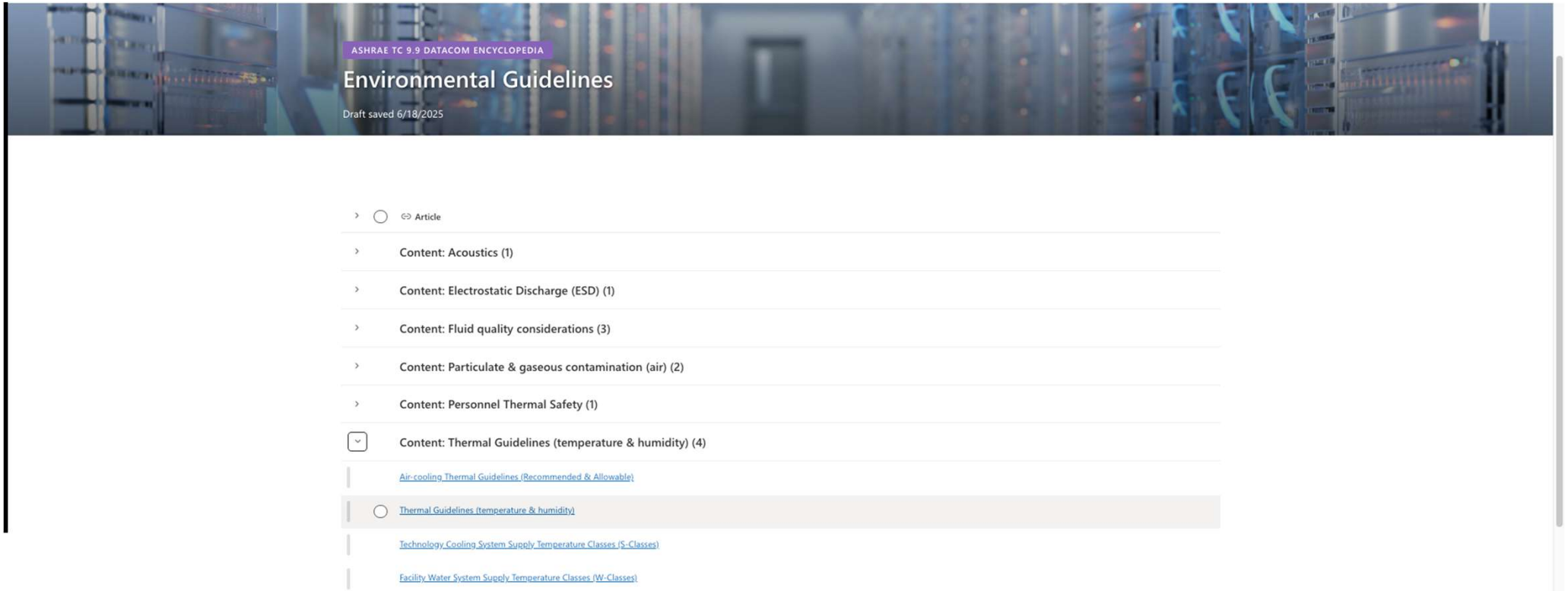
Recent Tech Alerts

Topic Navigation: Environmental Guidelines



- Single click to get to a sub-navigation of all articles related to *Environmental Guidelines*

Article Navigation: Environmental Guidelines



- Expandable table to see primary articles related to *Environmental Guidelines* > *Thermal Guidelines (temperature & humidity)*
- Not all articles will be listed in the navigation
- Navigation is meant to get you “close”
- Encyclopedia search can be used if a very specific topic is requested

Article: Air Cooling Thermal Guidelines

ENVIRONMENTAL GUIDELINES

Air-Cooling Thermal Guidelines (recommended & allowable)

Draft saved 2/3/2025

Direct link to older books

In the fifth edition of *Thermal Guidelines* (2021), more enhancements to the recommended envelope were made to aid in data center energy improvements.

Environmental Guidelines for Air-Cooled Equipment Definitions

These data center environmental guidelines were developed by members of the ASHRAE TC 9.9 committee representing information technology equipment (ITE) manufacturers.

These environmental guidelines are for terrestrial-based systems and do not cover electronic systems designed for aircraft or spacecraft applications. The term server is used to generically describe any ITE, such as servers, storage, and network products, used in data-center-like applications.

Several key definitions need to be highlighted:

Direct link to figures, images, etc

recommended environmental range:

- Facilities should be designed to achieve, under normal circumstances, ambient conditions that fall within the recommended range.
- This recommended range may be as defined either as stated below or by the process outlined whereby the user can apply metrics to define a different recommended range more appropriate to meet specific business objectives.
- The recommended envelope was chosen based on a number of inputs, the primary being reliability of ITE, power increases of ITE with higher ambient temperatures, acoustical impacts with higher ambient temperatures, and providing a buffer for excursions to the allowable limits caused by facility cooling fails.

allowable environmental envelope:

- The allowable envelope is where IT manufacturers test their equipment to veri
- To enable the greatest latitude in use of all the classes, power and thermal ma excursions outside the capability of the ITE under extreme load conditions.
- Typically, IT manufacturers perform a number of tests prior to the announcem environmental envelope.
- This is not a statement of reliability but one of the functionality of the ITE. In a dew point (DP) and maximum elevation values are part of the allowable operat

Page Topics

- Environmental Guidelines for Air-Cooled Equipment...
- Overview of the Latest Edition of the Air-Cooled...
- 5th Edition of the Air-Cooled Equipment...
- Environmental Class Definitions for Air-Cooled...
- Environmental Class Definition for High-Density Air-...
- Altitude Derating
- Allowable Server Inlet RH Limits versus Maximum...
- Allowable Server Inlet Temperature Rate of Change
- ETSI Environmental Specifications

Supplemental Information

Related Topics

Links to other topics

Thermal Guidelines

Technology Cooling System Supply Temperature Classes (S-Classes)

Relationship Between TCS and FWS Classes

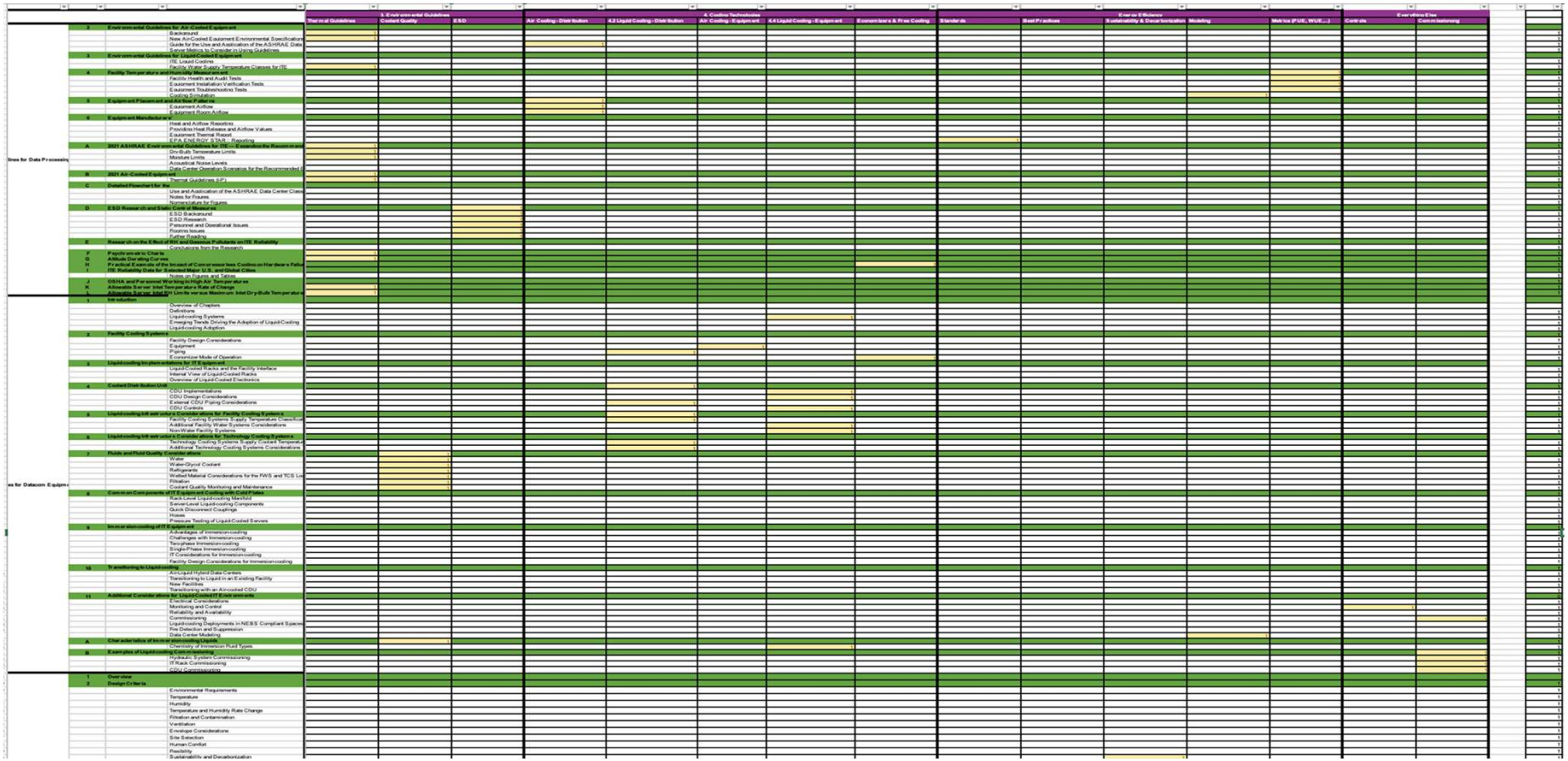
References

Versions

References

1. Zhang, J., R. Zhang, R. Schmidt, J. Gilbert, and B. Guo. 2019. Impact of gaseous contamination and high humidity on the reliable operation of information technology equipment in data centers. ASHRAE Research Project 1755, Final Report. Peachtree Corners, GA: ASHRAE.
2. Pommerenke, D., A. Talezadeh, X. Gao, F. Wan, A. Patnaik, M. Moradian-pouchehrazi, and Y. Han. 2014. The effect of humidity on static electricity induced reliability issues of ICT equipment in data centers. ASHRAE RP-1499 Final Report. Peachtree Corners, GA: ASHRAE.
3. ISO. 2015. ISO 14644-1:2015, Cleanrooms and associated controlled environments—Part 1: Classification of air cleanliness by particle concentration. Geneva: International Organization for Standardization
4. ETSI. 2014. ETSI EN 300 019-1-3 V2.3.2, Equipment engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weather protected locations. Valbonne, France: European Telecommunications Standards Institute.

How did we get here?



- List of all book chapters, mapped to the relevant topics was create at the Summer 2024 Meeting.
- Basic editing of topics done at Winter 2024 meeting for three primary books
- All of the material (across books) that relate to a topic and edit/re-write into a “Wikipedia” style topic.

Original Set of Topics

1. **Facility Design Considerations**
   a. Design Criteria
   b. HVAC Loads
   c. Availability & Reliability
   d. Electrical Systems and Equipment
   e. Ancillary Spaces
   f. Transition to Liquid Cooling
   g. Structural & Seismic
   h. Fire Protection & Suppression
2. **ITE Design Considerations**
   a. ITE Heat & Airflow Reporting
   b. ITE Components
   c. ITE Power Trends
   d. ITE Reliability (x-Factor)
   e. ITE Cooling
3. **Environmental Guidelines**
   a. Thermal Guidelines
   b. Coolant Quality
   c. Acoustics
   d. Thermal Comfort (OSHA)
   e. ESD
4. **Cooling Technologies**
   a. Air Cooling – Distribution
   b. Liquid Cooling – Distribution
   c. Air Cooling – Equipment
   d. Liquid Cooling - Equipment
   e. Economizers & Free Cooling
5. **Energy Efficiency**
   a. Standards
   b. Best Practices
   c. Sustainability & Decarbonization
   d. Modeling
   e. Metrics (PUE, WUE)
6. **Everything Else**
   a. Controls
   b. Commissioning

An example of a set of topics

ITE Design Considerations	
ITE Heat & Airflow Reporting	
ITE Components	
Thermal Resistance	
ITE Power Trends	
ITE Relaibility	
ITE Air-cooling	
ITE Liquid-cooling	
ITE Liquid-cooling Adoption	
Trends of TCS Classifications for ITE	
ITE Conductive Cooling	
Cold Plates	
ITE Hoses	
Quick Disconnect Couplings	
ITE Immersion Cooling	

- Hierarchy of topics is unimportant and only provided for ”book-keeping”
- Each item on the list is a Topic within the encyclopedia (see previous slide)
- Item is italics are “Supplemental Information” within the Topic
- Every topic (and supplemental information) can be linked to from other topics and searched

Status

Facility Design Considerations
Design Criteria
HVAC Loads
Humidification
Dehumidification
Ventilation
Availability and Reliability
Electrical Systems and Equipment
Ancilary spaces
Transition to Liquid Cooling
Structural and Seismic
Fire Protection & Suppression

ITE Design Considerations
ITE Heat & Airflow Reporting
ITE Components
Thermal Resistance
ITE Power Trends
ITE Relaibility
ITE Air-cooling
ITE Liquid-cooling
ITE Liquid-cooling Adoption
Trends of TCS Classifications for ITE
ITE Conductive Cooling
Cold Plates
ITE Hoses
Quick Disconnect Couplings
ITE Immersion Cooling

Energy Efficiency
Standards
Best Practices
Sustainability & Decarbonization
Modeling
Energy modeling
CFD modeling
Metrics (PUE, WUE)

Environmental Guidelines
Thermal Guidelines (temperature & humidity)
Air-cooling Thermal Guidelines (Recommended & Allowable)
5th Edition Tables in I-P Units
5th Edition Psychrometrics Charts
History of Expanding the Recommended Envelope
Technology Cooling System Supply Temperature Classes (S-Classes)
Facility Water System Supply Temperature Classes (W-Classes)
Relationship Between TCS and FWS Classes
Fluid quality considerations
Characteristics of Immersion-cooling Liquids
Liquid filtration
Wetted materials
Particulate & gaseous contamination (air)
Air filtration
Acoustics
Personnel Thermal Safety
Electrostatic Discharge (ESD)

Cooling Technologies
Air-cooling
Air distribution
Aisle Containment
Liquid-cooling
Liquid distribution
Piping Arrangements for the Cooling Plant
External CDU Piping Considerations
Cooling Equipment
Approach Temperature
Coolant Distribution Unit
Close-Coupled Cooling
Economizers & Free Cooling

Everything Else
Controls
Commissioning

- Topics is Red need owners

Workshop # 1

- Seeking volunteers (with a datacom encyclopedia subscription) to use the beta format and provide feedback
- Should spend 30 minutes reading the content and navigating the site
- Complete a survey to provide your feedback

Workshop #2

- Seeking volunteers to help edit the remaining content to convert it into a Wikipedia style format
- Completing this task at the Summer meeting is the only way to get this fully published by the end of the year
- The content from three books (Thermal Guidelines, Best Practices, Liquid Cooling) has been consolidated into the topics shown previously
  - The content in each topic has not been edited
- You do not need to be a SME to help edit a topic
  - You will not be adding or changing any of the content.
  - We need to edit the content so that it reads as a cohesive topic
- Expected commitment is 30 minutes – 2 hours depending on the topic

Acknowledgement

- Thank you to the following people who helped getting the beta version of the encyclopedia launched
  - John Han
  - Ed Gutowski
  - Dave Moss
  - Nicolas Estefanell

ASHRAE TC 9.9 Main Meeting
IT Subcommittee Update
June 23, 2025

Agenda

Topic	Presenter	Duration (min)
CDU Critical Role Tech Brief	Tim Shedd	10
S-Class (S20/S25)	Paul Artman	10
Tech Brief Roadmap	Dustin Demetriou	15

New Technical Alert

ASHRAE TC 9.9 DATACOM ENCYCLOPEDIA

The CDUs Critical Role of TCS and FWS Isolation in Cold Plate Deployments

Published 3/5/2025

TL; DR

Ever increasing extreme loads such as AI lack the benefits of best practices or substantial installed base. This ITE costs more than lower density ITE resulting in its damage being a costly risk.

Metallurgy, chip heat transfer, flow, pressure, delta T, etc. can vary greatly between IT platforms, even for the same manufacturer.

There are unintended consequences of developing and / or applying CDUs without understanding why they were originally developed and the critical nuances to the design considerations.

The CDU's role in isolating ITE systems is critical to enabling the rapid growth and scaling of liquid cooling. This is why the best practice is to connect only a single ITE platform to each CDU. Smaller, platform-specific, CDU-isolated TCS loops enable optimal operating environments, simpler maintenance and service, and a scalable architecture where the TCS grows with the ITE deployment.

Read the Alert

Obvious Benefits of Isolation

- **Filtration** — Finer filtration to eliminate cold plate clogging
- **Chemistry and Materials** — Minimizing corrosion and negative material interactions
- **Contamination** — Minimizing biological or particulate contamination
- **Temperature & Pressure control** — Avoid damage to TCS components

Why Dedicate a CDU to Each Platform

- **Vendor isolation** — Isolating ITE systems deployed from different vendors
- **Platform requirements** — Managing platform-specific requirements
- **CapEx** — Optimizing CapEx spend
- **Blast radius** — Minimizing the blast radius
- **Scalability** — Enabling scalability

Updated S-classes

Published on May 10, 2025

- https://ashraeorg.sharepoint.com/sites/Datacom/SitePages/Liquid_Cooling_Ch6.aspx
- https://ashraeorg.sharepoint.com/sites/Datacom/SitePages/S_Classes.aspx

Table 6.1 TCS liquid-cooling classes (S-classes)

TCS Fluid Class	Equipment Environment Specifications for Liquid Cooling		
	Typical Infrastructure Design		Maximum TCS Supply Temperature °C (°F)[a]
	Common FWS Facilities	TCS Facilities	
S20	Chiller / cooling tower	CDU	20 (68)
S25			25 (77)
S30			30 (86)
S35			35 (95)
S40	Cooling tower		40 (104)
S45	Cooling tower / dry cooler		45 (113)
S50	Dry cooler		50 (122)

a) Minimum water temperature for all classes is 2°C (3.6°F) above the measured data center air dew point, to avoid condensation

Engagement

Post analytics

12,437
Impressions

ASHRAE TC9.9 posted this • 3w

ASHRAE TC9.9 Datacom Encyclopedia Critical Update: the definition of TCS classes (S-classes) are driven by the ITE (information technology equipment) manufacturers requirements for sufficiently cooling the product while delivering the necessary computational performance, energy efficiency, and reliability. The TCS tempe ...show more

Targeted to: All followers

Organic engagement

1,222	9.8%
Engagements	Engagement rate

Clicks	974
Click-through rate	7.8%
Reactions	225 →
Comments	7 →
Reposts	16 →

IT Subcommittee Publishing

Goal: Speed to market

a. **Technical Alert / Advisory** - Time sensitive
b. **Technical Snapshot** - Single technical topic - limited scope to achieve speed to market
c. **Technical Bulletin** - Single technical topic - full detail created using a strong outline

Approach

- Small team(s), put together document, following template
- 1-week review and comment by IT Subcommittee
- 1-week review and vote by TC 9.9
- Publish in datacom encyclopedia, with extract published publicly for first release
- Updates made to datacom encyclopedia version only
- Technical Briefs mapped to datacom topics

Tech Brief Roadmap

- S-class vs. W-class Use cases
- Critical Guidance for the Design and Commissioning of Cold Plate Deployments leading to Operational Readiness
- Implications for not upgrading data centers for liquid cooling
- Why do we need lower S-classes to drive continued compute performance
- Fluid quality: bacteria count vs. biofilm

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5. Ecton English -U.S. Department of Defense
6. Paul Finch, KAO Data
7. Jason Matteson, NVENT
8. David Quirk, DLB Associates
9. Dustin Demetriou -IBM
10. Bob McFarlane, Shen Milsom & Wilke
11. Lixia Wu, Cushman & Wakefield
12. Tim Shedd - Dell
13. David McGlocklin - Schneider Electric

Thank You

TC 9.9 Website:
tc0909.ashraetcs.org