ASHRAE HANDBOOK

"Applications" Edition

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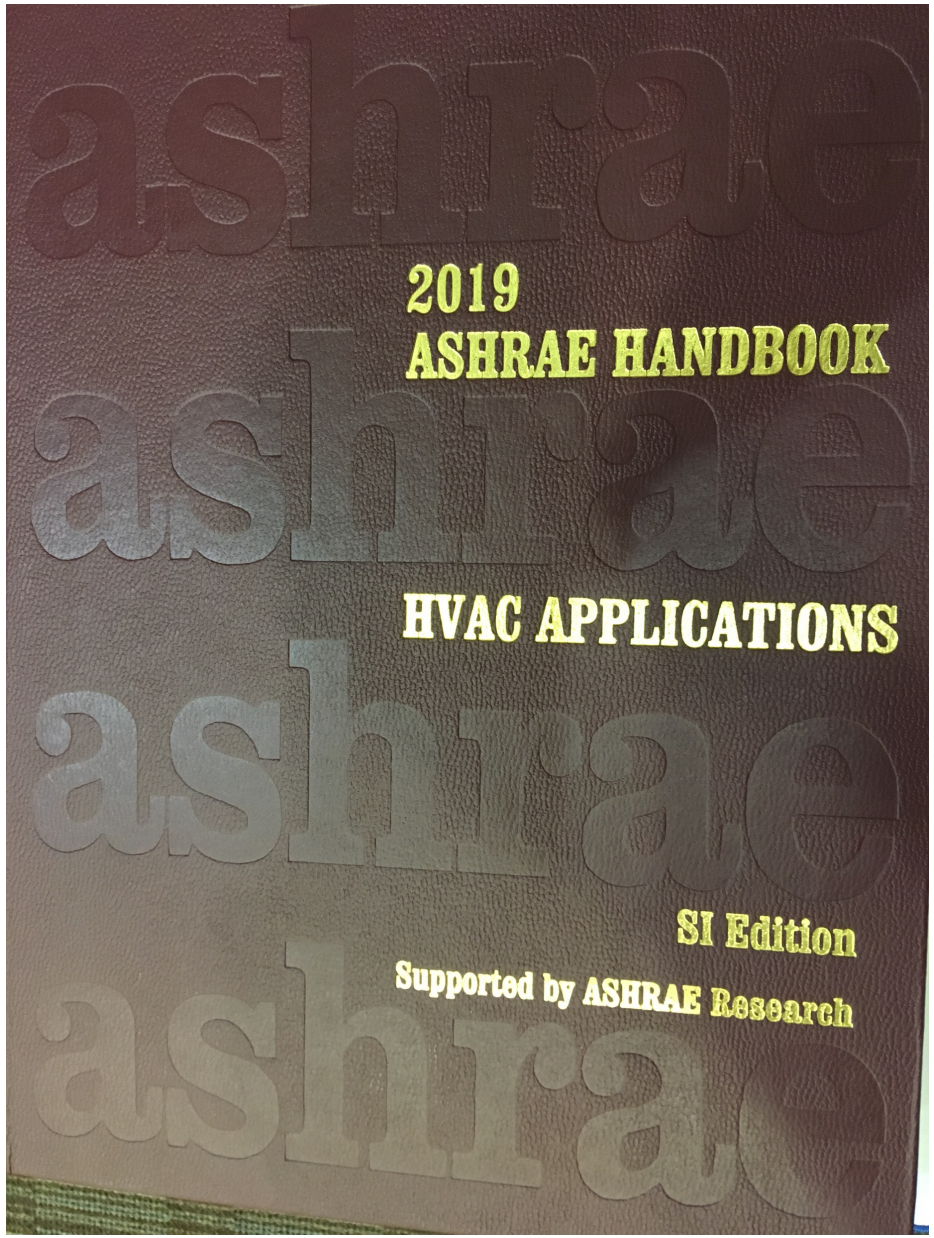

CHAPTER 20

DATA CENTERS AND TELECOMMUNICATION FACILITIES

DATA centers and telecommunication facilities are significantly different than most other facilities:

- Occupants of most facilities are people; the occupants in data centers are computer hardware and software applications.
- Load is more volatile and transient because hardware upgrades, software additions, and computing loads can change so rapidly.
- Computer hardware is the major equipment, and equipment lifetimes are often measured in months rather than years. This results in upgrade/life cycle mismatches between hardware and facility power/cooling.
- Often data centers have an actual power/cooling load density 10 times or more that of a typical office building.

The telecommunication industry is rapidly changing from predominantly regulated land lines to wireless technology that uses the same communications protocol (Internet Protocol or IP) as the data center industry. As a result, data centers and telecommunications facilities are converging. TC 9.9 uses the term "datacom" to indicate both data centers and telecommunication facilities. This chapter provides some basic information about datacom facilities and where to find additional information.

The main requirements for datacom facilities are space, power, cooling, and networking. Often, these are treated as services. Each service can have a service-level agreement (SLA), but the services are highly interdependent. Therefore, overall reliability/availability is best achieved when all aspects of these services are designed together, with the same performance goals. Because of the high densities, it is becoming increasing popular to provide metering for services at each service interface point, with centralized monitoring of the infrastructure.

Because of the high capital cost and short life cycles of datacom equipment, as well as the continued evolution of both public and private cloud computing (i.e., computing as a service), the trend is towards companies owning less of their own datacom facilities, and renting more resources from a third-party facility owner/provider. Rented or leased services and facilities come in many variation; a common general format is retail or wholesale colocation facilities.

A **colocation center** (also co-location, collocation, colo, or co-loc) is a type of datacom facility where equipment, space, and bandwidth are available for rent. Colocation facilities provide space, power, cooling, and physical security services for server, storage, and networking equipment. Their fiber services are typically redundant and diverse, and connect the facilities to various telecommunications and network service providers. However, the power and cooling redundancies can be significantly different from one colocation center to another, and should be evaluated before signing a contract, which should include a carefully worded SLA. Failures in these facilities can have widespread effects.

Figure 1 provides an overview of the major spaces in a typical datacom facility.

Datacom facilities provide space, power, cooling, and networking to datacom equipment (hardware), also known as information technology equipment (ITE) in the U.S. *National Electrical Code®* (NFPA *Standard* 70). The space within the datacom facility or data center that actually houses the datacom hardware may be called the data hall, the ITE equipment room, or the white space. Figure 1 shows the various elements that may make up a complete facility. The actual elements (and their arrangements) vary considerably in each project.

This chapter focuses on the most important facility requirements for the support of the datacom equipment, which include thermal, air quality, and power.

1. USEFUL DATACOM RESOURCES

ASHRAE Datacom Series

This series comprises 13 books produced by TC 9.9. To keep pace with the rapidly evolving datacom industry, some books have been revised several times, with new editions containing updated information. New titles are also planned for the future.

These books are equally useful for experts and people new to this industry. The following includes brief descriptions of each book.

***Thermal Guidelines for Data Processing Environments*, 4th ed. (ASHRAE 2015a).** The trend toward increased equipment power density in data centers presents significant challenges to thermal design and operation. Undesirable side effects include decreased equipment availability, wasted floor space, and inefficient cooling-system operation.

Avoiding a mismatch between datacom equipment environmental requirements and those of adjacent equipment, or between datacom equipment requirements and facility operating conditions, requires a standard practice solution to datacom equipment interchangeability that preserves industry innovation.

ASHRAE (2015a) provides a framework to align the goals of equipment hardware manufacturers, facility designers, operators, and managers. This book covers four primary areas: equipment operating environment specifications, facility temperature and humidity measurement, equipment placement and airflow patterns, and equipment manufacturers' heat load and airflow requirements reporting.

***IT Equipment Power Trends*, 3rd ed. (ASHRAE 2018).** Datacom equipment technology is advancing at a rapid pace, resulting in relatively short product cycles and an increased frequency of datacom equipment upgrades. Because datacom facilities

The preparation of this chapter is assigned to TC 9.9, Mission Critical Facilities, Data Centers, Technology Spaces, and Electronic Equipment.

TC 9.9 Chapter Changed From 19 to 20

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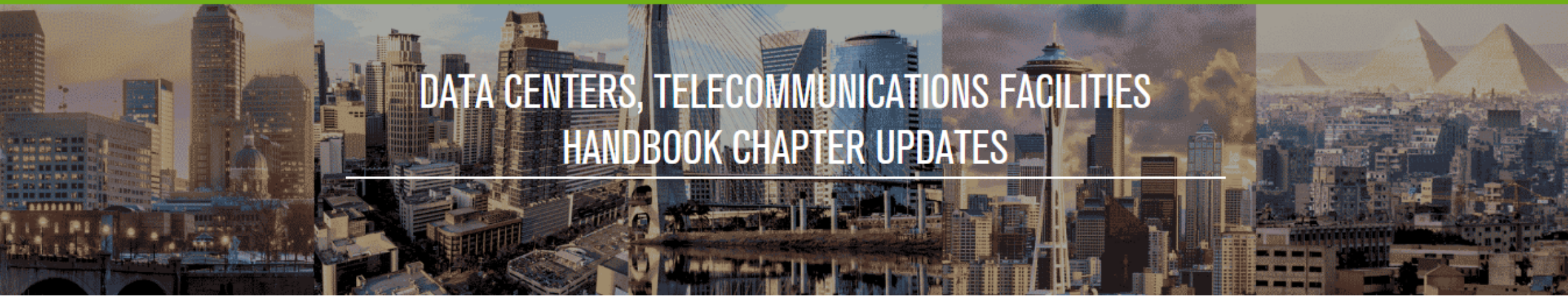
April 17, 2019 "*eSociety*" Newsletter

https://www.ashrae.org/news/esociety/data-centers-telecommunications-facilities-handbook-chapter-updates



Data Centers, Telecommunications Facilities Handbook Chapter Sees Another Round of Extensive Updates

From eSociety, April 2019

By: Robert E. McFarlane, Member ASHRAE
***Handbook* Chair for TC 9.9, Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment**
Voting Member for SSPC 90.4, *Energy Standard for Data Centers*

Data center technologies change so rapidly that extensive updates are needed on the four-year *Handbook* cycle

The "Data Centers and Telecommunications Facilities" chapter in the *2015 ASHRAE Handbook—HVAC Applications* was totally rewritten to correspond with the *Datacom Series* from TC 9.9, Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment.

The 2019 update to the *Handbook* continues to follow that format.

Since the 2015 *Handbook*, two new books in the *Datacom* series have been published, bringing the total to 13. This information is summarized in Chapter 20, which was formerly Chapter 19.

Server Efficiency – Metrics for Computer Servers and Storage, consolidates information on current server and storage subsystem energy benchmarks.

IT Equipment Design Impact on Data Center Solutions, provides guidance in making data center infrastructure equipment selections and design configurations.

Three other books in the *Datacom* series have been revised with new editions published. This information is now included in the *Handbook* chapter.

Thermal Guidelines for Data Processing Environments, 4th Ed., includes the dramatically expanded humidity range resulting from ASHRAE research. This proved far lower humidity levels can be maintained than have been industry practice for decades without concern about static generation and discharge.

The resulting change in the thermal envelope provides opportunities for enormous energy savings. Both tabular and psychometric chart formats of the new ranges are included in the revised chapter.

IT Equipment Power Trends, 3rd Ed., now extends to 2025 based on the latest information from leading datacom equipment manufacturers to help datacom facility designers more accurately predict future equipment loads.

Liquid Cooling Guidelines for Datacom Equipment Centers, 2nd Ed., includes a revised table showing new liquid cooling classifications and temperatures, made necessary by the steadily climbing rack heat loads which air cooling can no longer handle in a growing number of high performance and high density data centers.

One of the most significant changes is the inclusion of ANSI/ASHRAE Standard 90.4, *Energy Standard for Data Centers*. The standard was published in 2016 and has been updated with two addenda.

Written as a non-prescriptive "sister" to Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, it provides new metrics for assessing data center energy efficiency in the design stage.

This ensures that the best available practices can be used consistent with achieving reliability within the space, climate and budget realities of the project, and easily demonstrated to the AHJ.

Next, the issue of contamination has also been updated to reflect ASHRAE-sponsored research, showing that silver corrosion is a better indicator of gaseous contamination effects than the previously accepted method of copper corrosion. This is a very significant difference for data centers located where air pollution and humidity are high.

Also noted are concerns about particulate contamination from suspended ceilings and zinc whiskers formed on electro-galvanized metals, particularly when used in air return plenums.

The following updates have been made and included in the chapter:

- Emphasis on raised access floors has been reduced, particularly as a means of conveying cooling air, although it does recognize newer types of airflow tiles and dampers. Further considerations are added for overhead infrastructure installations, particularly regarding ducted air delivery. The importance of CFD modeling of air flow design has been emphasized, along with cautions about the limitations of modeling, particularly if not done by experienced users.
- There is an expanded discussion of backup power systems, with lithium-Ion batteries added as a consideration for UPS systems.
- There are also precautions about the exposure of backup generators, primary switchgear and busduct to natural disasters.
- Extreme density hard disk drives have become more vulnerable to vibration, which can be from other equipment or gas fire protection discharge.
- Information on both LED and PoE-driven lighting has also been added to further energy efficiency.
- Information on use of the *Power Utilization Efficiency* or *PUE™* metric developed by *The Green Grid* has been expanded, as well as on their *Water Utilization Effectiveness* or *WUE™* metric, since water availability is becoming a greater concern in more regions.
- And lastly, the chapter expands the discussion of economizers, particularly adding information on the new refrigerant-side economizer option.

Summary of 2019 Revisions

- Chapter Number Change from 19 to 20
- Added References for Datacom Series Books #12 & #13
  - *Server Efficiency – Metric for Computer Servers & Storage*
  - *IT Equipment Design Impact on Data Center Solutions*
- Noted Updates to Three Datacom Series Books:
  - "*Thermal Guidelines*", "*Power Trends*", and "*Liquid Cooling*"
- Added Information on Standard 90.4
- Other Updates:
  - Reduced Emphasis on Raised Access Floors
  - Expanded Backup Power Section & Added LiON Batteries
  - Added Precautions Re: Exposure of Systems to Natural Disasters
  - Added Concerns About Hi-Density Hard Disk Exposure to Vibration & Gas Discharge
  - Added Information on LED and PoE-Driven Lighting for Data Centers
  - Expanded Information on TGG PoE & WUE Metrics
  - Expanded Information on Economizers, and Added Refrigerant-side Economizers

New Handbook Update Timeline

- **IN YEARS AFTER PUBLICATION**

• Year 1	7/2019 – 6/2020:	Full Review of Newly Published Chapter Proposed Revision Summary to Handbook Publications
• Year 2	7/2020 – 6/2021:	Major Section Re-Drafts & Board Review Out-Of-Sequence Updates (On-Line Version Only)
• Year 3	7/2021 – 6/2022:	Revision Completion & TC Board Approval Probably Requires Letter Ballot. Should Not Wait Until Jan.
• Year 4	7/2022 – 6/2023:	Handbook Submission & Galley Proof Review Our Board Approval Will Probably Be Late 2022