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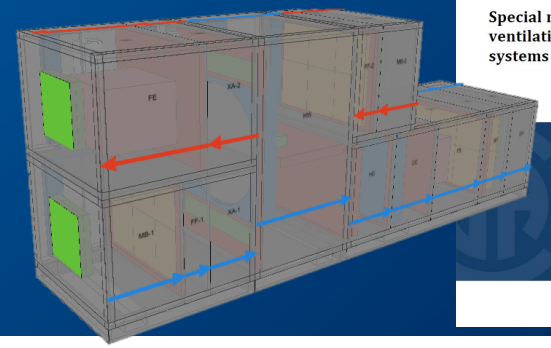
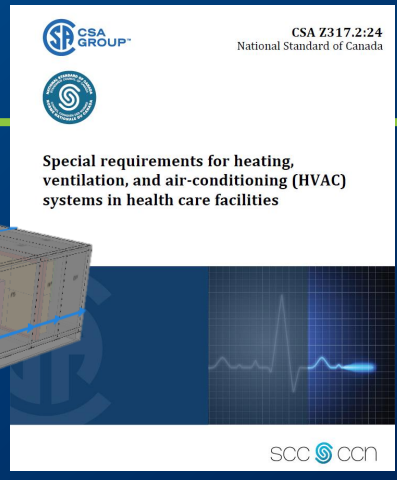
Air Handling Unit Design & Canadian Healthcare Standard CSA Z317.2:24

Feb 19, 2025





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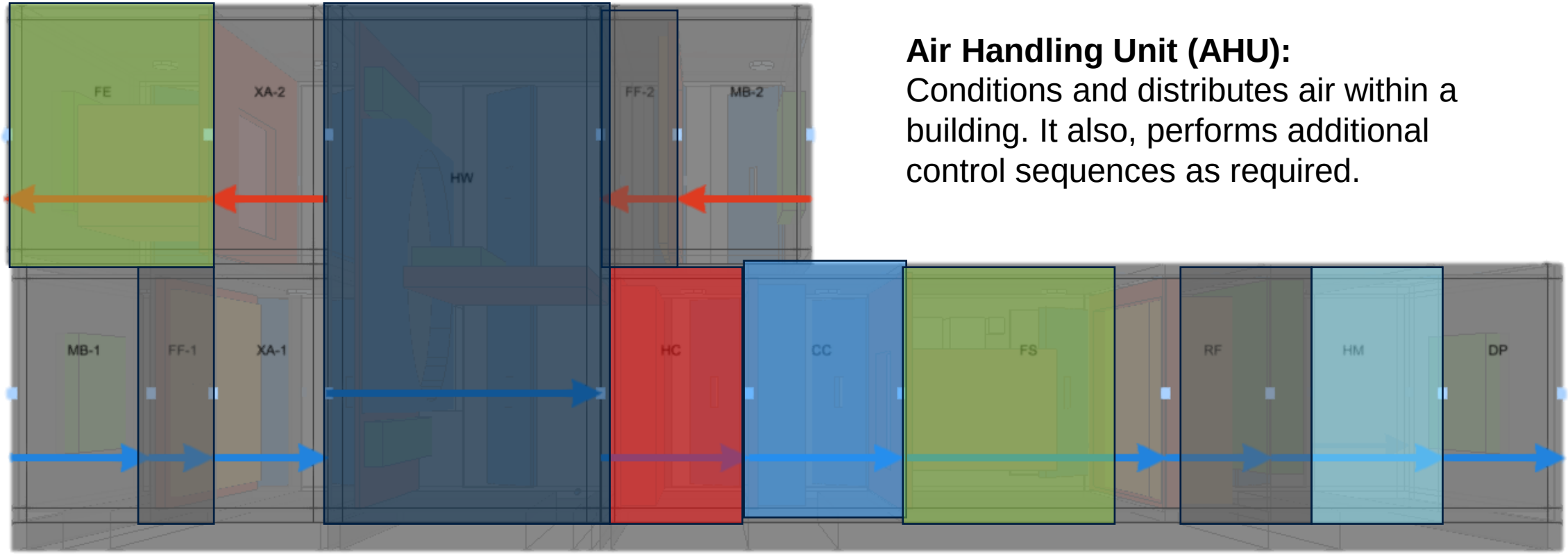
Today’s Agenda

- Health Care Facilities & Air Handling Unit Fundamentals
- Regulatory Overview
- Overview of CSA-Z317.2-24
- HCFs by Type & Class
- Design Criteria Clauses
- Clause 6.6: Air Handling Units
- Other Relevant Clauses

Health Care Facilities & Air Handling Unit Fundamentals

Air Handling Unit Fundamentals – Basic Configuration & Components



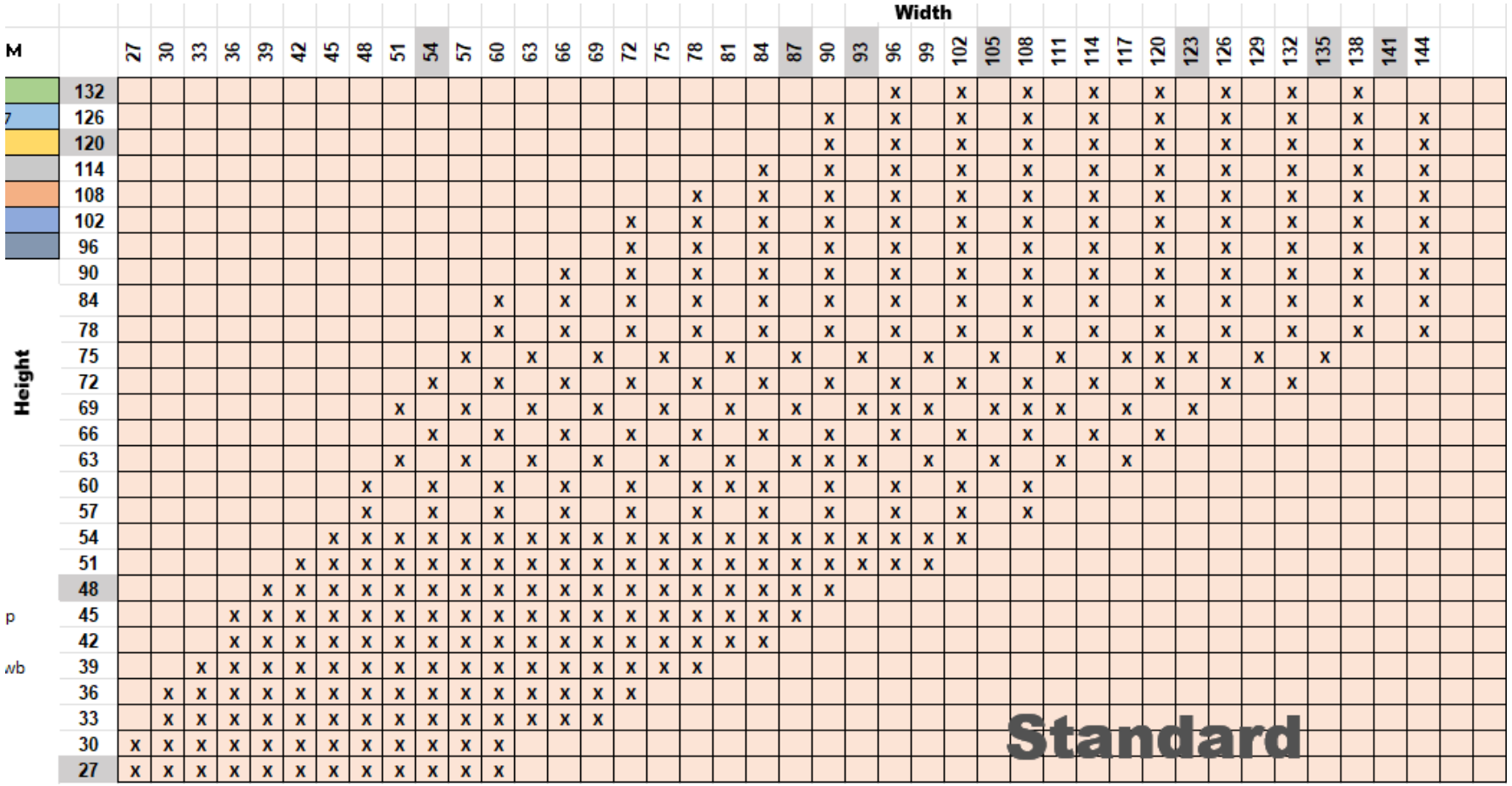
Air Handling Unit (AHU):
Conditions and distributes air within a building. It also, performs additional control sequences as required.

Filters: Cleans the air by removing particles and contaminants.
Energy Recovery: Transfers heat and moisture between incoming and outgoing air streams, reducing heating/cooling load
Heating Coil: Heats the air.
Cooling Coil: Dehumidifies and cools the air.
Fan(s): Moves the conditions air through the ducts.
Humidifier: : Adds moisture to the air to maintain comfortable humidity levels.

Air Handling Unit Fundamentals – Typical Solutions

Feature	Commercial/Packaged HVAC Equipment	Modular Air-Handling Units (Semi-Custom)	Custom Air-Handing Units
Cost	$	$$	$$$
Customization	Generally limited to standard factory features (ie. model number and options)	Greater Customization	Full Customization
Cabinet Sizes	Fixed based on nominal capacities required	Variable Cabinet Heights and Width (based on cabinet map)	Full Customization of Height and Width
Construction	Most basic/typical would single wall with fiberglass insulation	2”, Double-Wall Foam	2”, 3”, 4” Double-Wall Foam, Fiberglass
Casing Performance Leakage & Deflection	-	<1% @ ±8” w.g. L/240 @ ±8” w.g	Min <1/2% @ ±10” w.g. (up to 12") Min L/240 @ ±10” w.g. (up to 12")

Air Handling Unit Fundamentals – Cabinet Sizes & FPM



Cooling Coil Face Velocity
- 500 fpm limit typical

Heating Coil Face Velocity
- 700 fpm limit typical

Air Handling Unit Fundamentals – AHU Controls & Sequence

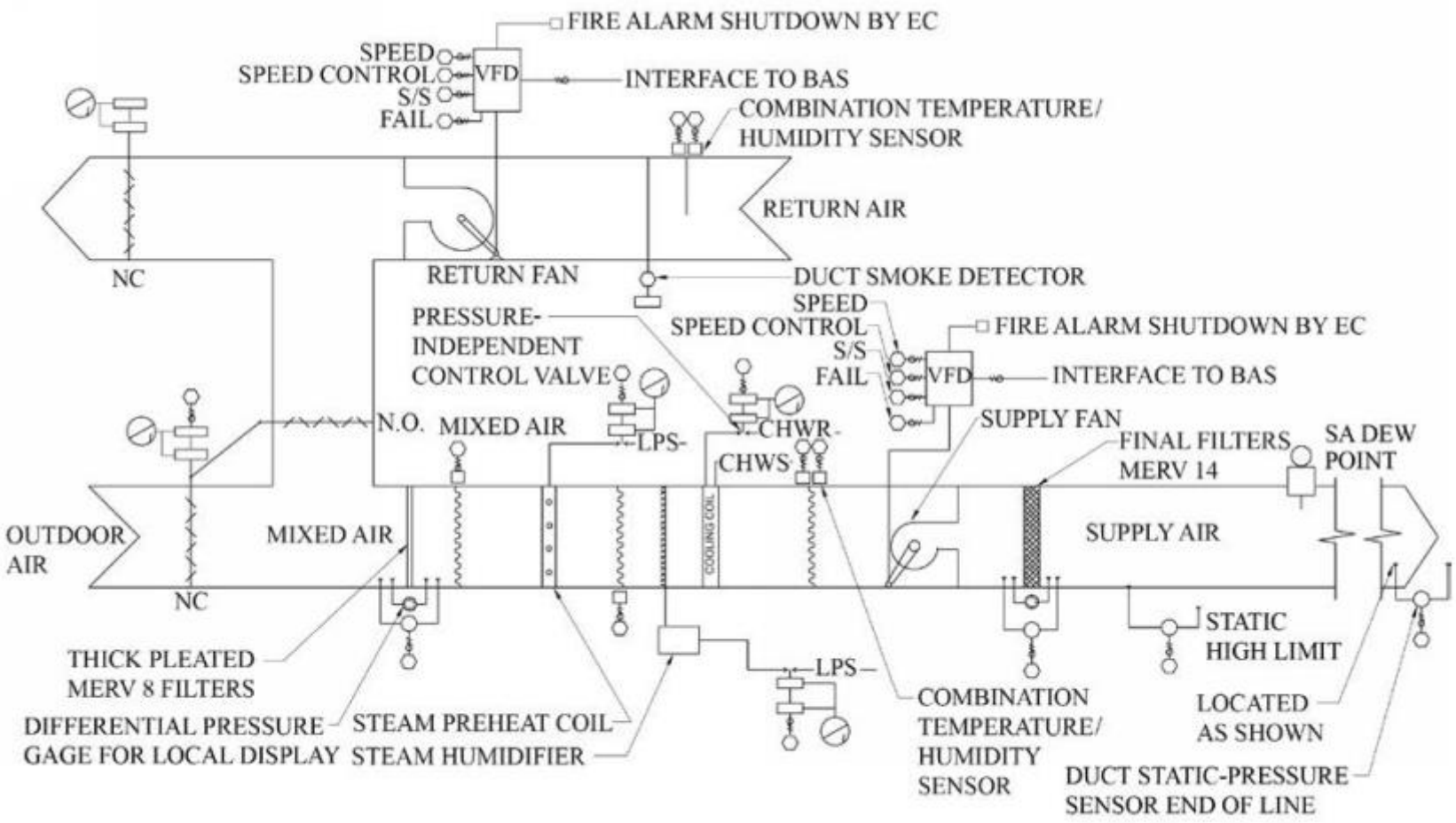


Figure 3-1 *Example AHU Control Schematic*

Don’t leave AHU schematic & sequence of operation for last! Thinking through the control sequence early ensures all necessary components have been included in the air-handling system

HCF Fundamentals – Overview of HCF Design Considerations

Health Care Facilities (HCFs) are entrusted with the noble mission of healing, first and foremost. From the HVAC design perspective, this often means complex regulatory, and process needs.

The key areas to consider during HVAC design of HCFs:

- Indoor Environmental Quality (IEQ)
- Life Safety
- Reliability
- Maintainability
- Energy Use and Efficiency
- Adaptability

Per ASHRAE, there is no consensus that the list is in a priority order.

However, **THERE IS** a consensus in the committee **that there is no higher priority than IEQ**.

Source: ASHRAE 2023 Applications: Chapter 9 Health Care Facilities

HCF Fundamentals – Overview of Facility Classifications

Buildings where health care services are provided are commonly categorized into one of the three major facility classifications:

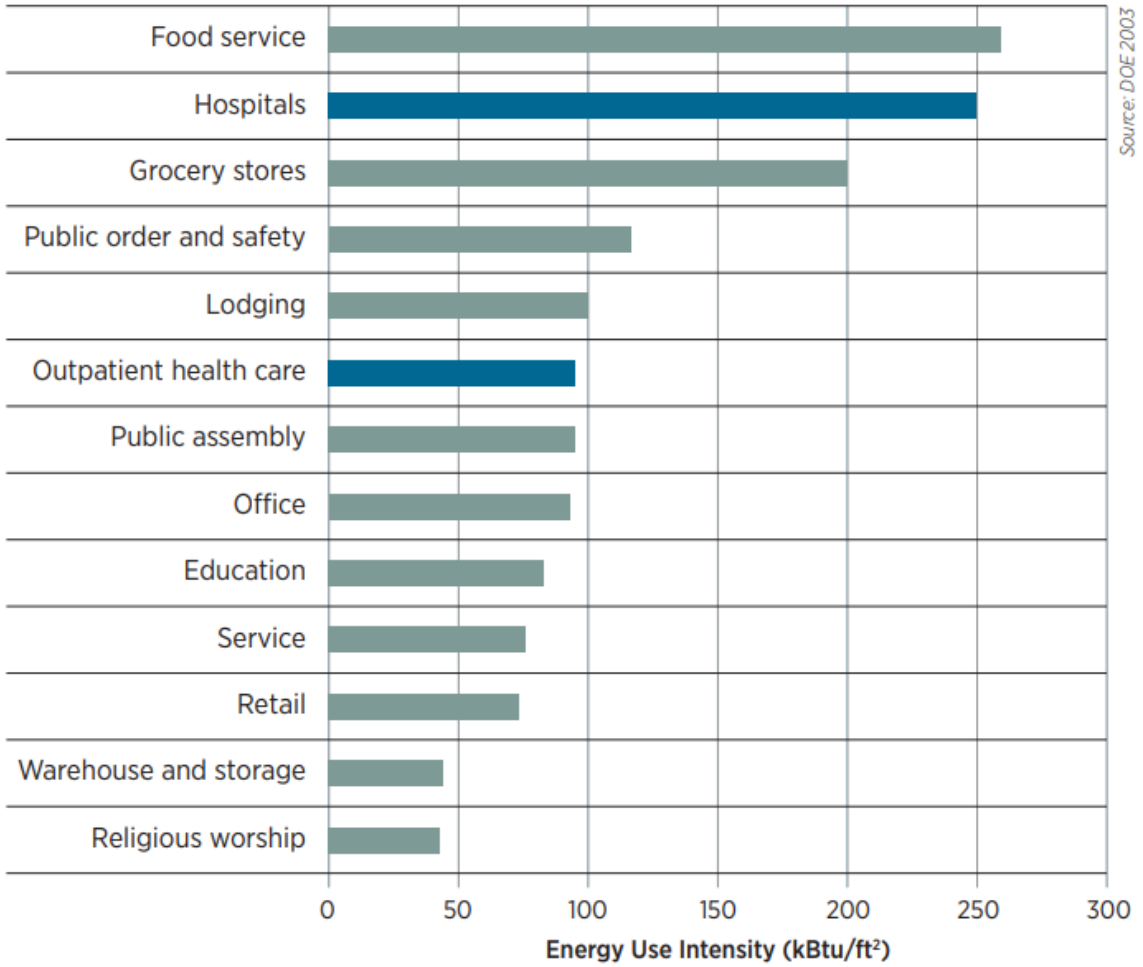
1) **Hospitals or Inpatient** (typically support overnight or >23 h stays)
2) **Ambulatory or Outpatient** (do not require overnight, typically <23 h stays)
3) **Residential or Senior Living**

Facility and clinical terminology can vary regionally, which we will see in clarified in CSA Standard Z317.2-24

Health Care Facility design is heavily regulated primarily for patient and staff safety.

Consult with your authority having jurisdiction (AHJ) to clarify code adoption & design requirements unique to your application

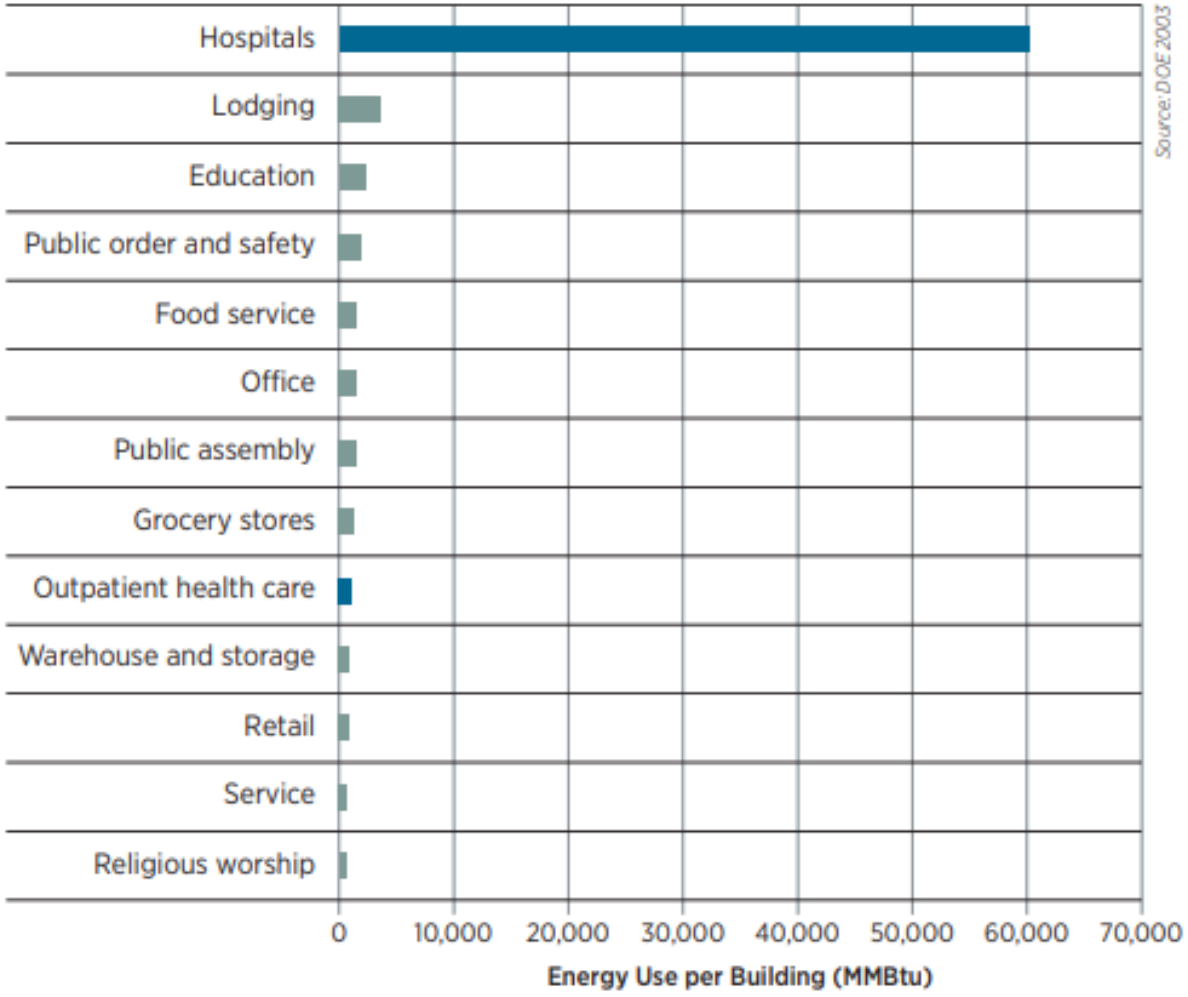
HCF Fundamentals – Energy Perspective: Energy Usage Intensity



- Health Care Facilities (HCFs), including hospitals and outpatient faculties, represent one of the most energy-intensive market segments
- Hospitals have the highest energy use intensity (EUI) than any other facility type in the commercial and institutional sector with the exception of food and beverage stores.

Source: Department of Energy – Advanced Energy Retrofit Guide – Healthcare Facilities

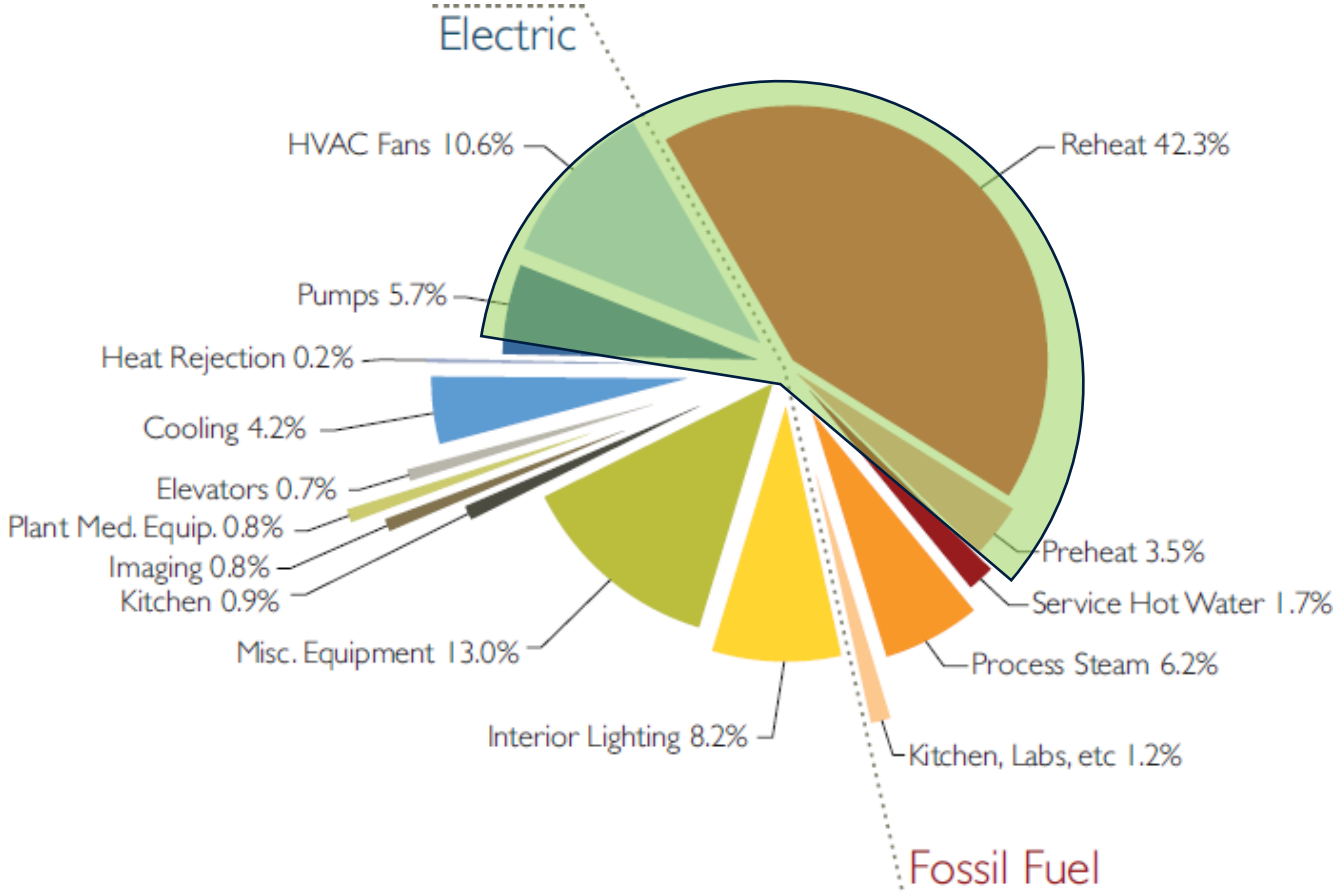
HCF Fundamentals – Energy Perspective: Energy Use per Building



- On a per-building basis, hospitals use an average of 600,000 MMBtu, far outpacing any other building type
- Outpatient health care is more-or-less in alignment with other common building types.

Source: Department of Energy – Advanced Energy Retrofit Guide – Healthcare Facilities

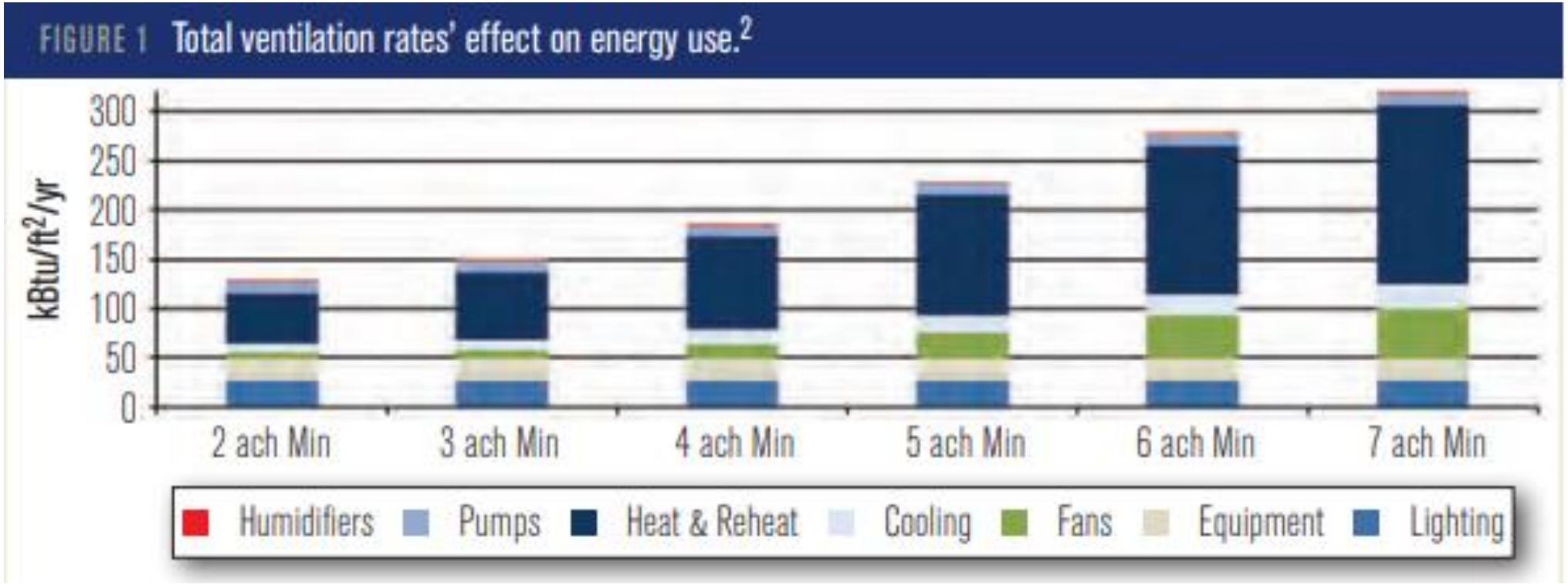
HCF Fundamentals – Measured Energy End Use in US Hospitals



Ventilation Related: ~ 66%

Source: 2024 Decarbonizing Hospital Buildings Guide

HCF Fundamentals – Air Changes per Hour & Effect on Energy Use



Source: ASHRAE Journal – A Brief History of Health-Care Ventilations

Regulatory Overview & CSA Z317.2:24

Regulatory Overview: CSA Z317.2:24 & Version History

CSA Z317.2:24 is the 6th & most current edition:

- Developed by CSA Group (not-for-profit standards organization)
- Published in November 2024.
- Supersedes the previous editions.
- ~160 pages (for comparison: 2019 is ~130 pages; 2015 is ~110 pages)

Regulatory Overview: CSA Z317.2:24 Significant Changes

- Addition of more content, clauses, improved organization (ie. more in-depth breakdown of clauses in the table of contents).
- Addition of **Table 7** to show the breakdown of requirements in **Clause 6: Detailed design requirements**, as per HCF classification (Classes A to D)
- Updated Requirements in **Table 1 – HVAC design criteria.**
- Expansion & updated examples of HCF according to class in **Annex B**
- Updated guidance on adiabatic humidification systems.
- Addition of Sustainable Development Goals (SDG) relating to sustainability & resilience

Regulatc

- Additic … n (ie. more i … ents).
- Additic … ents in **Claus** classif
- Updat … **eria.**
- Expan … ass in **Anne**
- Updat
- Additi … ting to sustai … ability & resilience

Table 7 (Continued)

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.3			x	x		x	x					
6.4	x											
6.5	—	—	—	—	—	—	—	—	—	—	—	—
6.5.1	x											
6.5.2	x											
6.5.3	x											
6.5.4	—	—	—	—	—	—	—	—	—	—	—	—
6.5.4.1		x										
6.5.4.2	x											
6.5.4.3	x											
6.5.5	x											
6.5.6	—	—	—	—	—	—	—	—	—	—	—	—
6.5.6.1	x											
6.5.6.2			x	x		x						
6.5.6.3					x		x					
6.5.6.4									x			
6.5.6.5								x		x	x	x
6.5.7	x											
6.6	—	—	—	—	—	—	—	—	—	—	—	—
6.6.1			x	x	x	x	x		x			
6.6.2	x											
6.6.3	x											
6.6.4		x										
6.7	—	—	—	—	—	—	—	—	—	—	—	—

(Continued)

Regulatory Overview: CSA Z317.2:24 Code Terminology

- **“Shall”**
  - is used to express a requirement

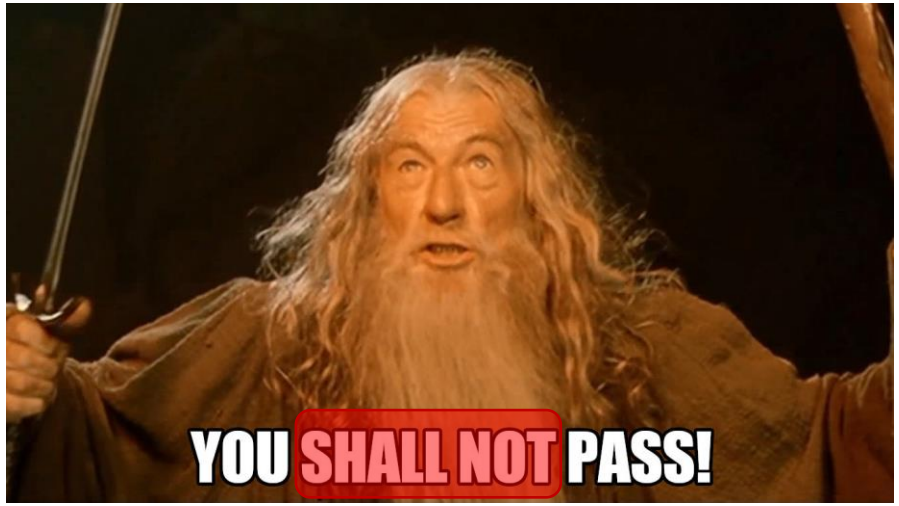
    ie. a provision that the user is obliged to satisfy in order to comply with CSA Z317.2

- **“Should”**
  - is used to express a recommendation

    ie. that which is advised but not required in order to comply with CSA Z317.2

- **“May”**
  - is used to express an option

    ie. that which is permissible within the limits of the standard



1.6 Terminology

In this Standard, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; “should” is used to express a recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the Standard.

Regulatory Overview: CSA Z317.2 & Ontario Building Code (OBC)

The 2024 OBC came into effect on January 1, 2025, with a three-month grace period until March 31, 2025 for certain designs that are already underway.

Ontario Building Code (OBC) 2024

Part 6: Heating, Ventilating and Air-Conditioning

6.2.1.1. Good Engineering Practice

(1) Heating, ventilating and air-conditioning systems, including related mechanical refrigeration systems, shall be designed, constructed and installed to conform to **good engineering practice appropriate to the circumstances** such as described in, but not limited to,

(a) the ASHRAE Handbooks and Standards,
(b) the HRAI Digest,
(c) the Hydronics Institute Manuals,
(d) the NFPA Standards,
(e) the SMACNA Manuals,
(f) the ACGIH manual entitled "Industrial Ventilation: A Manual of Recommended Practice for Design,"
(g) CSA B214, "Installation code for hydronic heating systems,"
(h) CAN/CSA-Z317.2, "Special requirements for heating, ventilation, and air-conditioning (HVAC) systems in health care facilities,"
(i) EPA 625/R-92/016, "Radon Prevention in the Design and Construction of Schools and Other Large Buildings," and
(j) ASHRAE Guideline 12, "Minimizing the Risk of Legionellosis Associated with Building Water Systems."

Regulatory Overview: CSA Z317.2 & Ontario Building Code (OBC)

Ontario Building Code (OBC) 2024

1.3: Referenced Documents and Organizations

1.2.1.2. Applicable Editions

(1) Where documents are referenced in this Code, they shall be editions designated in Table 1.3.1.2.

Table 1.3.1.2. (Cont'd)
Documents Referenced in the Building Code
Forming Part of Sentence 1.3.1.2.(1)

Issuing Agency	Document Number	Title of Document	Code Reference
CSA	CAN/CSA-Z317.2-15	Special requirements for heating, ventilation and air conditioning (HVAC) systems in health care facilities	6.2.1.1.(1) 6.2.3.15.(6)

OBC 2024 that just came into effect is still referencing CSA Z317.2-15, but it's only a matter of time before the 2024 code gets to updated (either formally adapted or adopted in a Code Adopted Document (CAD).

Any new designs should be taking that into consideration and speak to their local AHJ for confirmation of adoption timeline when deciding which code to follow.

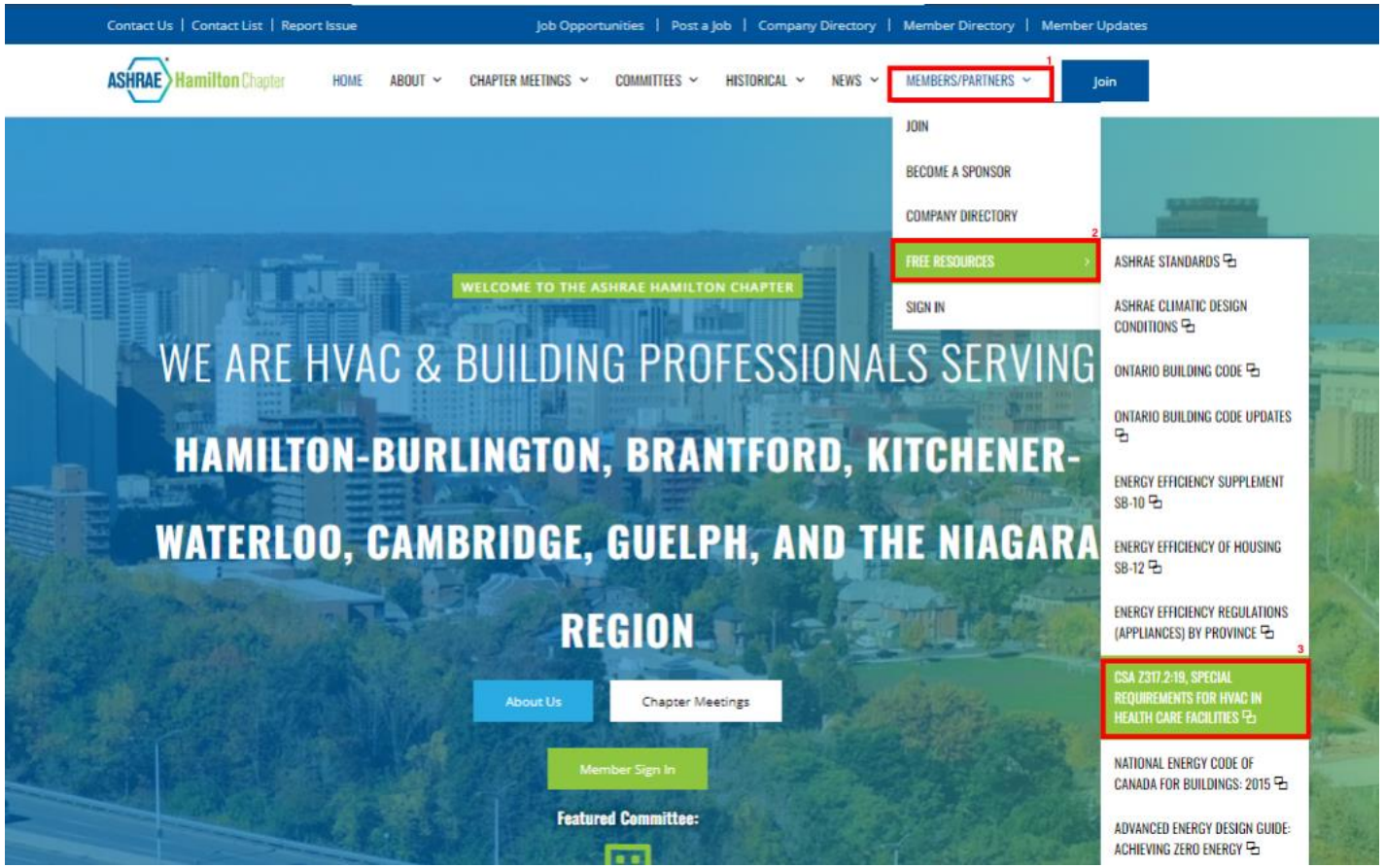
Free Access to 2019 (5th Edition): CSA Z317.2:19

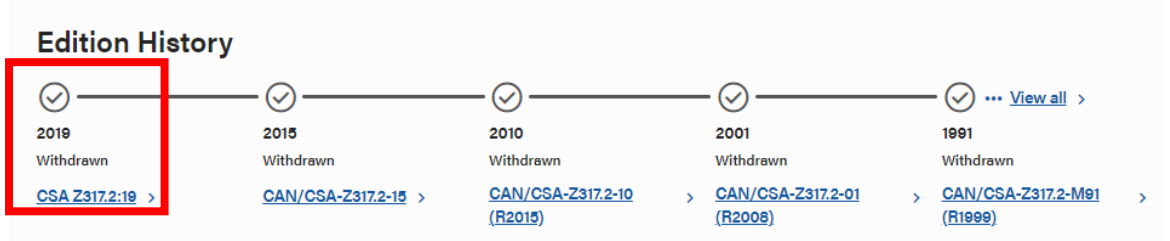
CSA Z317.2:19 is available for **FREE** view-access only online.

"In response to the COVID-19 outbreak, the Canadian Standards Association (CSA Group) has made a selection of relevant standards available for no-fee view access through the online platform CSA Communities"

The complimentary access requires users to **register** but it is free if you are accessing the content in Canada.

Link can be found in the "Free Resources" on the ASHRAE Hamilton Website:





Overview of CSA-Z317.2-24

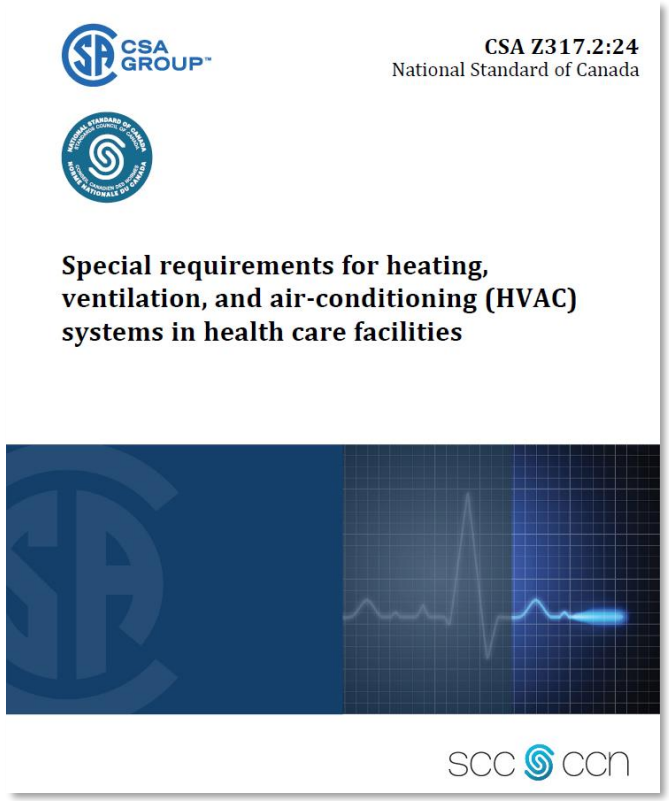
Overview of CSA-Z317.2-24 – Purpose & Intended Use

Standard Intended for Use By:

- Architects, Engineers, Planners, Consultants, and Health Care Facility Staff

Provides requirements for:

- Planning
- Design
- Construction
- Operation
- Maintenance



This Standard:

a) Specifies **minimum** values for certain parameters

b) Establishes suitability of different design options

c) Establishes recommendations for zoning, controls, and monitoring

d) Outlines best practice for energy conservation, **decarbonization, and adaption to climate change**.

Overview of CSA-Z317.2-24 – Purpose & Intended Use

This Standard applies to:

- New Buildings
- Additions to Existing Buildings
- Alterations to Existing Buildings (alterations include changes in function or sizes of spaces and the rearrangement, replacement or addition of HVAC equipment). See **Clause 5.9.5** **Direct replacement of a major system element (basically mandates HCF to perform & document a risk assessment for "like-for-like" replacements for major systems like AHUs, cooling sources, and heating sources)**

It does **NOT** address:

a) Building envelope
b) Structure
c) Electrical power / lighting
d) Plumbing system
e) Fire protection
f) ***detailed*** AHU designs or layouts

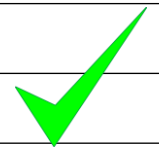
HCFs by Type & Class

HCFs by Type & Class - Overview

Hospitals or Inpatient (typically support overnight or >23 h stays)

Ambulatory or Outpatient (do not require overnight or <23 h stays)

Residential or Senior Living

	Type I	Type II	Type III
Class A-1			
Class A-2			
Class A-3			
Class B-1			
Class B-2			
Class B-3			
Class C-1			
Class C-2			
Class C-3			
Class D			

Red = The only HCF Classes covered by CSA Z317.2:15

Highlighted = HCF Classes added to CSA Z317.2:24

Refer to **Clause 3.1 Definitions**; **Table 1**; **Clause B.7 Examples of Health Care Facilities Classification** for more details & examples

HCFs by Type & Class – HCF Area Classifications (“Types”)

To be determined by HCF based on:

(1) room function(s)

(2) severity and urgency of a patient condition

(3) mitigation of risks to occupants associated with the circumstances,

Type I - patient care area where the invasiveness of procedures, the level of risk of morbidity (ie. injury) and mortality to patients, or the level of risk of adverse outcomes to care providers necessitate more stringent HVAC and environmental requirements.

Type II - a patient care area, or an area that is intended for the provision of services that directly supports patient care areas (e.g., lab, medical device reprocessing department).

Type III – all support services not designated as Type I or II

See Table 1 for Area Classifications based on Function/room name

HCFs by Type & Class – HCF Area Classifications (“Types”)

See Table 1 for Area Classifications based on Function/room name

Table 1 (Continued)

Refer-ence	Function/ room name	Type	Minimum outdoor air changes/ h*	Minimum total air changes/ h*	Relative pressuri-zation	Temper-ature†, ‡, §, °C	Relative humidi-ty**, %	Exhaust	Comments
21.4	Dining room	III	2	6	—	20–24	30–60	—	—
22	**Patient waiting room††**	II	4	12	Neg	22–24	30–60	—	—

HCFs by Type & Class – Class A

	Class Description	Sub-Class Description	Examples (not all encompassing)
Class A-1	**Inpatient Care (ie. Patients Receive Treatment and Stay in the facility > 24 h)** Typically provide trauma and emergency services and have surgical operating rooms	Supports the provision of acute care services and because of its location, role in the community, or the nature of its specialized services, **requires additional backup systems**, as well as the capacity to be self-sufficient for a defined period in the event of equipment failures, catastrophic events, or other events that disrupt business continuity.	Trauma HCFs, Emergency Care HCFs, Some Rural HCFs, Some Rural Hospitals, Forensic Care Facilities, Designated HCFs for Catastrophic Event Planning (ie. pandemics)
Class A-2		Provides acute care services but **has the option to reduce or modify services or transfer patients** in the event of equipment failure or a catastrophic event.	Accident and emergency treatment HCFs, Cancer care/treatment HCF (with inpatient beds), Pediatric HCFs that provide overnight stay and observation
Class A-3		Provides a limited range of acute care services, and often transfers more complex acute care patients to other unaffected Class A HCFs**. Class A-3 HCFs also have the option for a short period of time to reduce or modify services or transfer patients in the event of equipment failure or an event that disrupts business continuity.**	Small acute care HCFs (typically less than 50 beds), Independent HCFs providing overnight stays & observation (e.g., using anesthesia; providing invasive surgery)

HCFs by Type & Class – Class B

	Class Description	Sub-Class Description	Examples (not all encompassing)
Class B-1	**Inpatient Care (ie. Patients Receive Treatment and Stay in the facility for >24 h)** HCF in which residents or patients are accommodated on the basis of need focused on a range of care services, including minimally invasive and non-invasive procedures, and whose residents or patients might not be able to function independently because they might experience cognitive, mental, or physical limitations	Provides care services support to residents or patients for which such care **requires a continually reliable service**. A total or partial loss of building equipment or systems **will require the residents to be relocated from the HCF that is without the active building equipment or systems**. The residents or patients in a Class B-1 HCF might have multiple co-morbidities and require the highest non-acute level of care in order to ensure their health, safety, and comfort.	Complex continuing care HCFs, Chronic Care HCFs, Dementia including Alzheimer's Care HCF
Class B-2		Provides ongoing **support to residents who, by the nature of required care, might be able to sustain short-term or partial loss of building equipment/systems, but the HCF remains habitable under these non-normal conditions**. The health and safety of the residents is not impacted, but there could be negative comfort-related conditions while the building system is in a non-normal condition.	Long-term care homes (e.g., nursing homes), Mental care/treatment HCFs, Special care homes, Addition treatment HCFs
Class B-3		Provides ongoing support to residents who, by the nature of required care, **can sustain loss of building equipment or systems for an extended period of time**. The health and safety of the residents is not impacted, but there could be negative comfort-related conditions while the building system is in a non-normal condition.	Private Nursing Homes (Generally Smaller Scale), Assisted-living facilities, Addition treatment centers, End of life/hospice/palliative care faculties

Class B HCFs do not include more purely residential focused or group home facilities where residents are able to maintain an independent lifestyle but could also receive occasional medical assessments or assistance with some part-time home care services (See Class D HCF).

HCFs by Type & Class – Class C

	Class Description	Sub-Class Description	Examples
Class C-1	**Ambulatory or Outpatient (do not require overnight. typically, <23 h stays)** Facility where ambulatory patients are provided a possible range of medical services, including operative procedures, invasive procedures, minimally invasive procedures, and non-invasive procedures including supportive, diagnostic, and treatment services on an outpatient or occasional basis (<24 hours).	Elective operative or invasive procedures or diagnostic procedures are performed that could temporarily render a patient physically or cognitively incapable of independently acting to protect their own well-being, or where a service interruption could otherwise endanger patients.	Eye surgery centers (depending on the type of sedation or anesthetic use and duration of treatment), Chemotherapy centers, Birthing centers with limited post-partum care, Vitro fertilization centers, Mental health clinic or treatment, Pediatric Treatment Centers,
Class C-2		Provides a range of invasive procedures, minimally invasive procedures, non-invasive procedures, or diagnostic procedures on an outpatient or occasional basis, in which patients remain capable of self-preservation.	General dental offices, including those performing dental extractions, Laser eye clinics, Mental health and counselling (ie., no treatment spaces), Diagnostic imaging centres
Class C-3		Providing ambulatory care services that might provide a range of non-invasive procedures or diagnostic procedures in a clinic or medical office on an outpatient or occasional basis, in which patients remain capable of self-preservation.	General physician offices (with no invasive treatment spaces), Diagnostic imaging centers, Walk-in clinics, Mental health & counselling (i.e., no treatment spaces), Physiotherapy centres

HCFs by Type & Class – Class D

	Class Description	Sub-Class Description	Examples
Class D	**Residential or Senior Living** Residents are provided a possible range of nonmedical services to support them in day-to-day living activities. **Residents might receive minimal physical or cognitive support, but are generally independent in their activities.**	N/A	Group homes, Special care homes for adults requiring cognitive assistance, Special care homes for adults requiring physical assistance.

HCFs by Type & Class – Use Table 7 & HCF Class to Determine Relevant Clauses

Table 7 (Continued)

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.3			x	x		x	x					
6.4	x											
6.5	—	—	—	—	—	—	—	—	—	—	—	—
6.5.1	x											
6.5.2	x											
6.5.3	x											
6.5.4	—	—	—	—	—	—	—	—	—	—	—	—
6.5.4.1		x										
6.5.4.2	x											
6.5.4.3	x											
6.5.5	x											
6.5.6	—	—	—	—	—	—	—	—	—	—	—	—
6.5.6.1	x											
6.5.6.2			x	x		x						
6.5.6.3					x		x					
6.5.6.4									x			
6.5.6.5								x		x	x	x
6.5.7	x											
6.6	—	—	—	—	—	—	—	—	—	—	—	—
6.6.1			x	x	x	x	x		x			
6.6.2	x											
6.6.3	x											
6.6.4		x										
6.7	—	—	—	—	—	—	—	—	—	—	—	—

Design Criteria Clauses

Design Criteria Clauses: Table 1 – HVAC Design Criteria

Table 1 (Continued)

Refer-ence	Function/ room name	Type	Minimum outdoor air changes/ h*	Minimum total air changes/ h*	Relative pressuri-zation	Temper-ature†, ‡, §, °C	Relative humidi-ty**, %	Exhaust	Comments
21.4	Dining room	III	2	6	—	20–24	30–60	—	—
22	**Patient waiting room††**	II	4	12	Neg	22–24	30–60	—	—

6.11.1.3.1 Air flow into or out of a given area

When controlling air flow into or out of a given area, minimum air change rate can be defined by either the supply or the return/exhaust, depending on the situation. If defined by the return/exhaust flow rate, supply flow shall be chosen/configured to ensure consistent air quality and to meet heating and cooling needs.

$$CFM = \frac{ACPH \cdot V}{60}$$

CFM = Cubic feet per minute
ACPH = Air Changes per hour
V = Volume (L x W x H) of the space in feet

Design Criteria Clauses: Heating and Cooling Design Requirements

6.1.3 Heating and cooling design requirements by Class

For all Class A-1, A-2, B-1, B-2, and C-1 HCFs shall be designed to provide heating and cooling capacities to ensure operations in accordance with **Table 1**, utilizing the **1%** design criteria for January (heating) and July (cooling). **Climate projections shall be incorporated into the design criteria in accordance with Clause 5.8.2**.

Notes:

1) *Design criteria are specified in the* National Building Code of Canada *and jurisdictional building codes, and have been based on historical data. This Standard provides additional design criteria to apply for business continuity.*

2) *Calculation of design conditions should take into account the heat island effect in urban areas.*

Province and Location	Elev., m	Design Temperature			
		January		July 2.5%	
		2.5% °C	1% °C	Dry °C	Wet °C
Guthrie	280	-24	-26	29	23
Haileybury	210	-32	-35	30	22
Haldimand (Caledonia)	190	-18	-20	30	23
Haldimand (Hagersville)	215	-17	-19	30	23
Haliburton	335	-27	-29	29	23
Halton Hills (Georgetown)	255	-19	-21	30	23
Hamilton	90	-17	-19	31	23

295 ft 1.4 degF -2.2 degF 86degF 68degF

Design Criteria Clauses: Heating and Cooling Design Requirements

6.2.2 Design load – heating

Applies to all Class A, B-1, and B-2 HCFs

6.3.2 Design load – Cooling

Applies to all Class A-1, A-2, B-1, and B-2 HCFs.

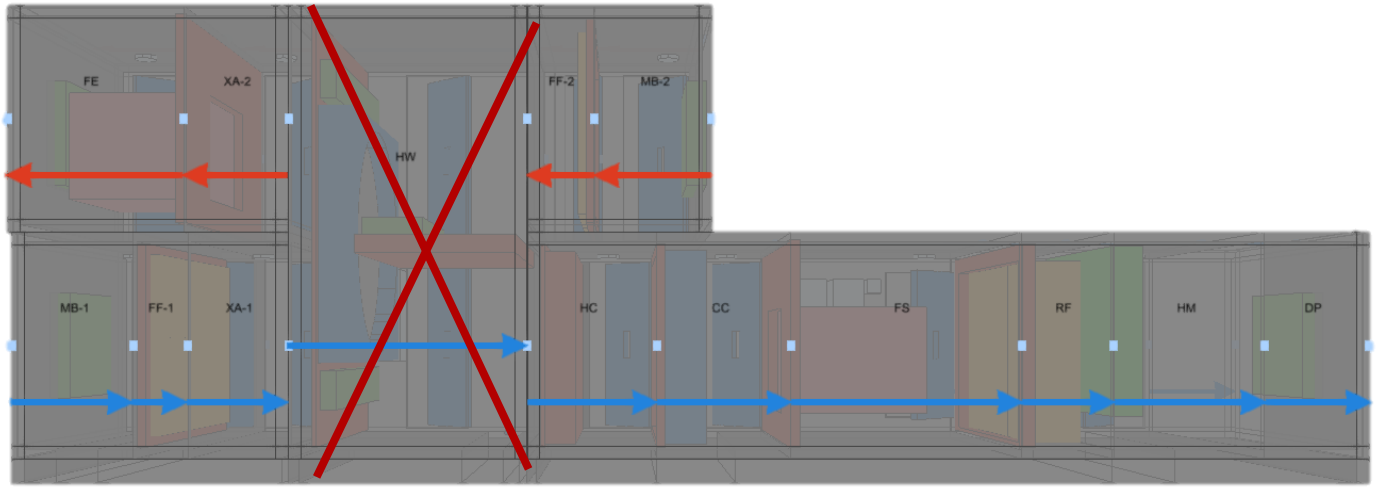
Design loads shall be determined with

a) all systems operating at normal conditions;

b) design conditions in accordance with **Clause 6.1.3**; and

c) the largest heat recovery system or component out of service.

Note: *Examples of the largest heat-recovery system or component include a heat wheel with the largest heat- recovery capacity or a glycol loop.*



Clause 6.6: Air Handling Units

- 6.6.1 Construction

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.6.1			x	x	x	x	x		x			

Air Handling Units: 6.6.1 Construction

6.6.1.1

Non-ferrous materials **shall** be used in locations where condensation or moisture can occur (e.g., drain pans, cooling coil headers, casings and racks, and liners in cooling coil and humidifier sections).

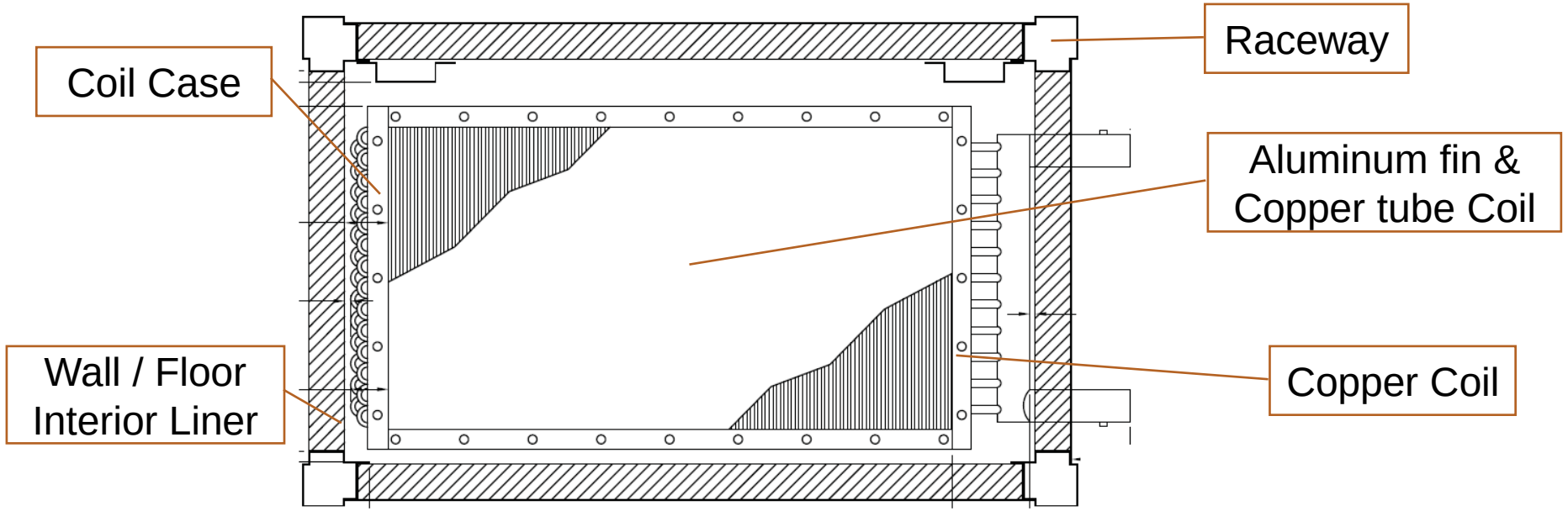
Notes

1. *The intent of this Clause is not to limit the choice of materials, but to preclude the use of materials subject to rust/corrosion in moist or wet locations.*
2. *Consideration should be given to using the following materials in cooling coil and humidifier sections:*
   a. *stainless steel or aluminum for drain pans;*
   b. *stainless steel for casings, racks, or filter-holding frames;*
   c. *stainless steel or aluminum liners; and*
   d. *stainless steel or copper coil headers*
3. *AHU interiors should be designed for visibility through the use of adequate lighting (see Clause 6.6.4.3) and surface treatments, so that the condition and cleanliness of interior surfaces can be quickly and easily assessed.*

We will discuss lighting later

Classes: A-1, A-2, A-3, B-1, B-2 and C-1

Air Handling Units: 6.6.1 Construction



Typical Options

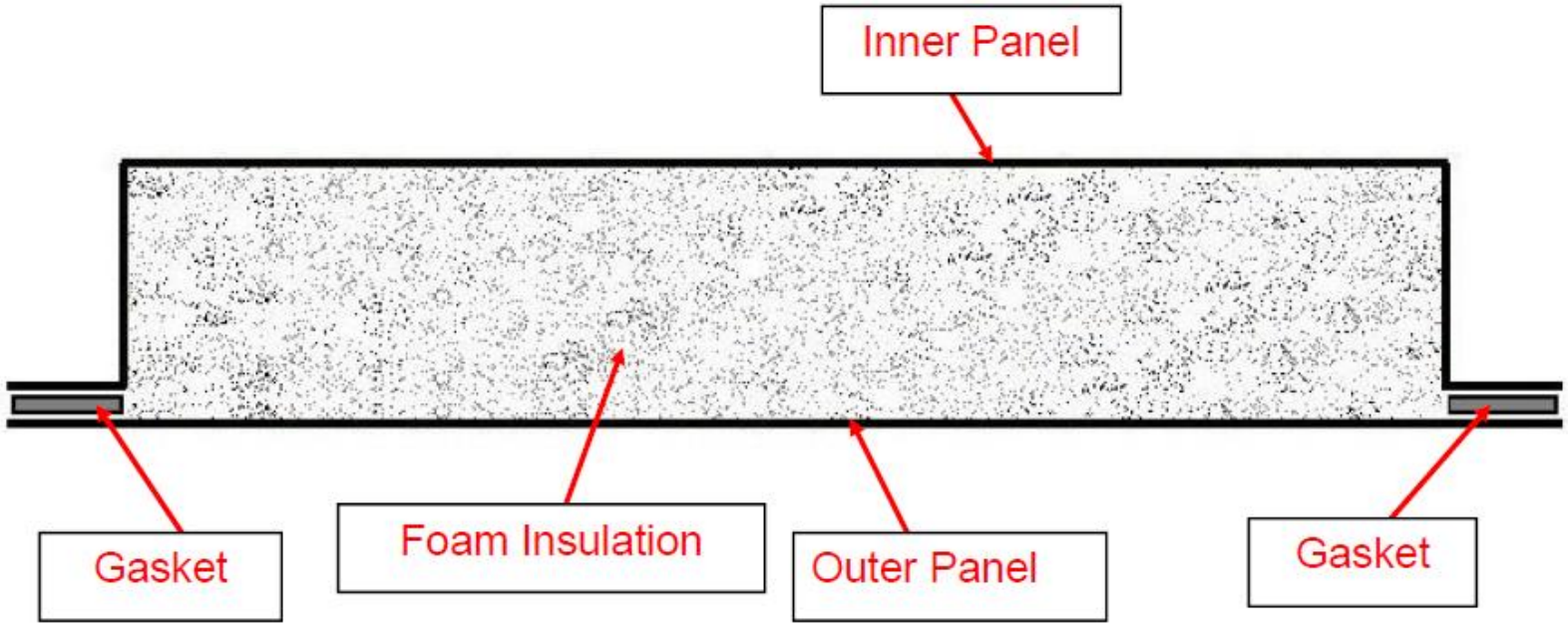
- Wall / Floor Interior Liner: 304 SS, (optional 1/8” Aluminum tread plate floor)
- Coil Case: 304 SS
- Coil Bulk Head: 304 SS
- Coil Rack: 304 SS
- Drain Pan: 304 SS

Classes: A-1, A-2, A-3, B-1, B-2 and C-1

Air Handling Units: 6.6.1 Construction

6.6.1.3

Air handling unit walls shall be acoustically insulated, **without perforation**, and of **solid**, **double-skin construction**. Acoustic silencers shall only be used in dry sections downstream of Filter #1 of the air handling unit.



Classes: A-1, A-2, A-3, B-1, B-2 and C-1

Air Handling Units: Clarification on Recommended AHU Insulation

CSA Z317:2 makes no direct reference to AHU panel insulation considerations.

From ASHRAE's HVAC Design Manual for Hospitals and Clinics:

Fibrous AHU insulation should be isolated from the airstream using an impermeable liner (e.g., polyester film) or "sandwiched" double-wall sheet metal construction. The primary concern is that exposed fibrous insulation can collect dust and moisture to form a perfect growth environment for dangerous microorganisms—although the insulation media may be of inert material that will not of itself support microbial growth. Once contaminated, there is virtually no way of effectively cleaning or disinfecting insulation.

In recent years, **foam-filled panel walls** have become more common for AHU construction. These panels use rigid, foam-type insulation sandwiched between metal panels. **Generally, this offers a more rigid panel with higher thermal resistance and less air leakage than the same thickness of fiber insulation**.

The panels in double-wall casings should have a "thermal-break" construction to prevent condensation on the outside surface in humid summer weather (condensation also depends on expected humidity levels of the mechanical room space).

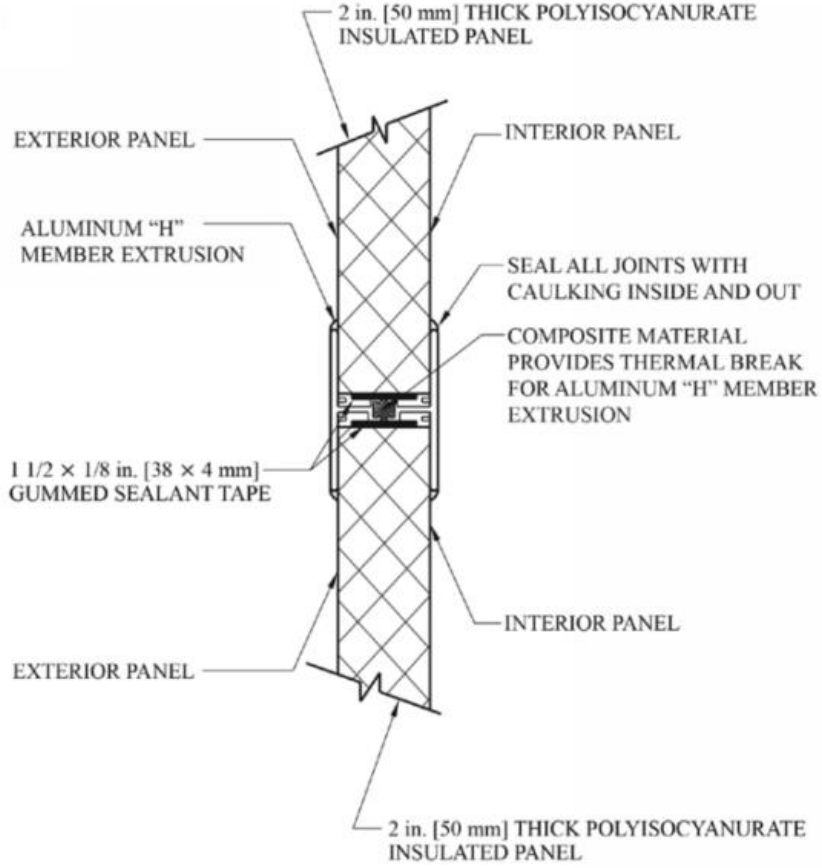


Figure 3-4 *Thermally Broken Panel Construction Detail*

Clause 6.6: Air Handling Units

- 6.6.2 Water Removal

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.6.2	x											

Air Handling Units: Clause 6.6.2 Water Removal

6.6.2.1.1

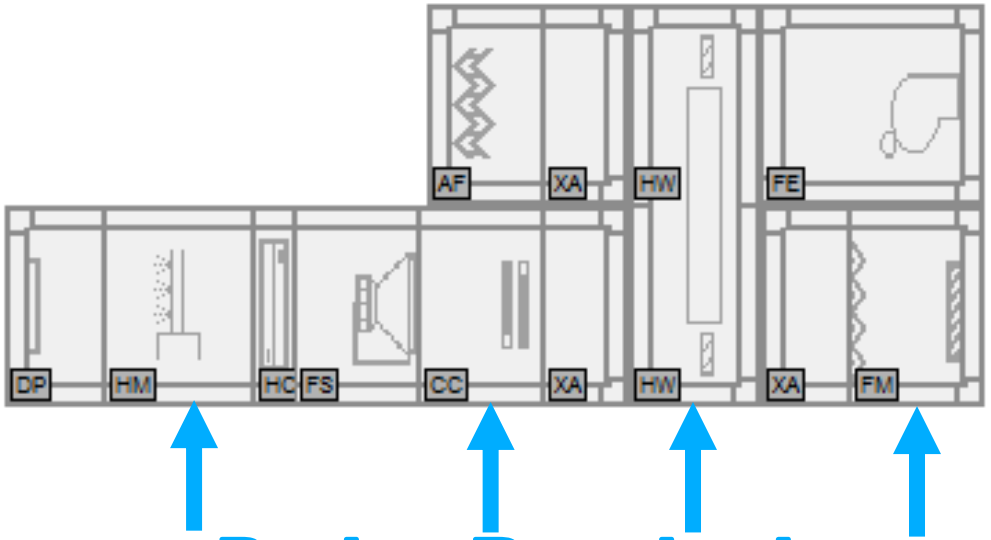
Air handling units shall be configured to

a. continuously drain water that has entered through outdoor air intakes or appeared through condensation (e.g., from cooling coils, humidifiers, or energy recovery coils);

b. prevent the accumulation of standing water; and

c. mitigate mold and bacteria growth due to condensation.

Drain pans shall be sloped to drain in a minimum of two directions and at a minimum slope of 2%.



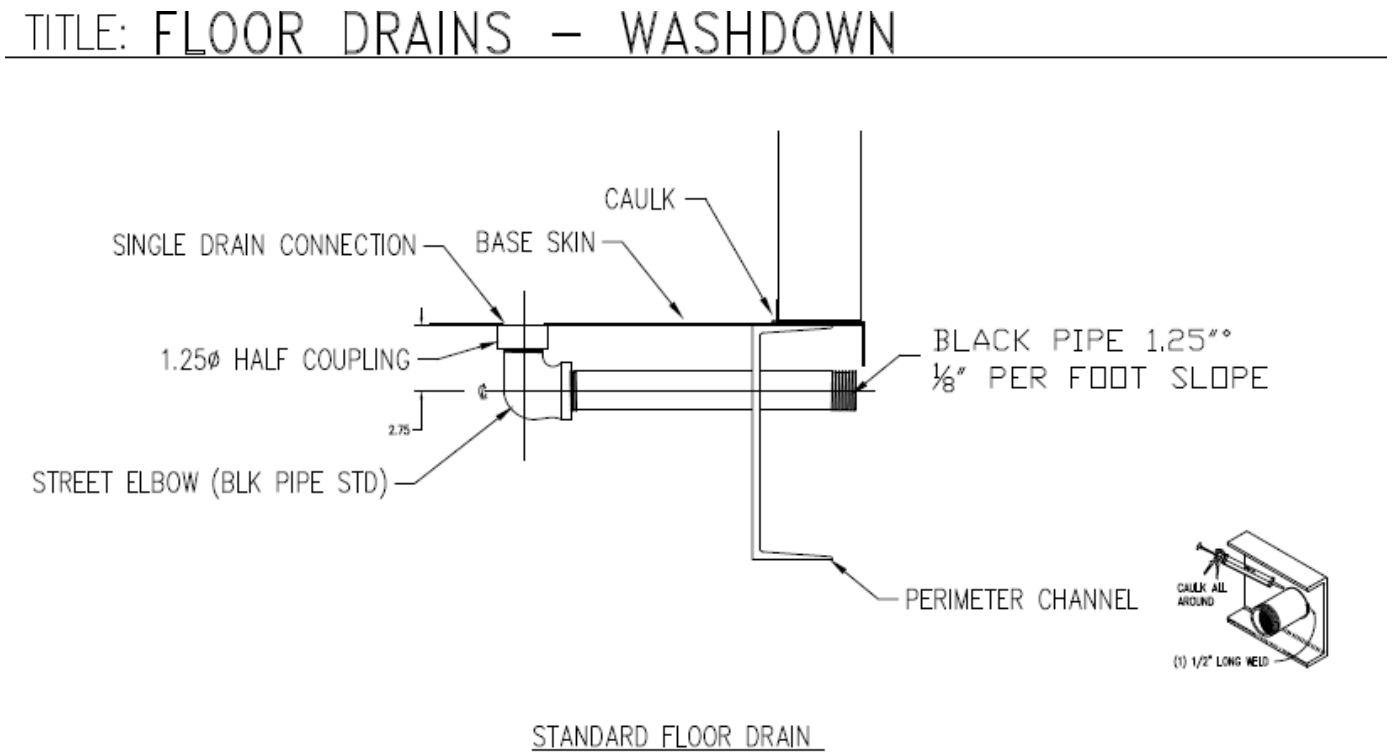
Classes: A to D

Air Handling Units: Clause 6.6.2 Water Removal

6.6.2.1.3

Drains shall be provided in each section of an air handling unit where water might accumulate.

Note: Consideration should also be given to draining of water used for washing of AHUs, if applicable.

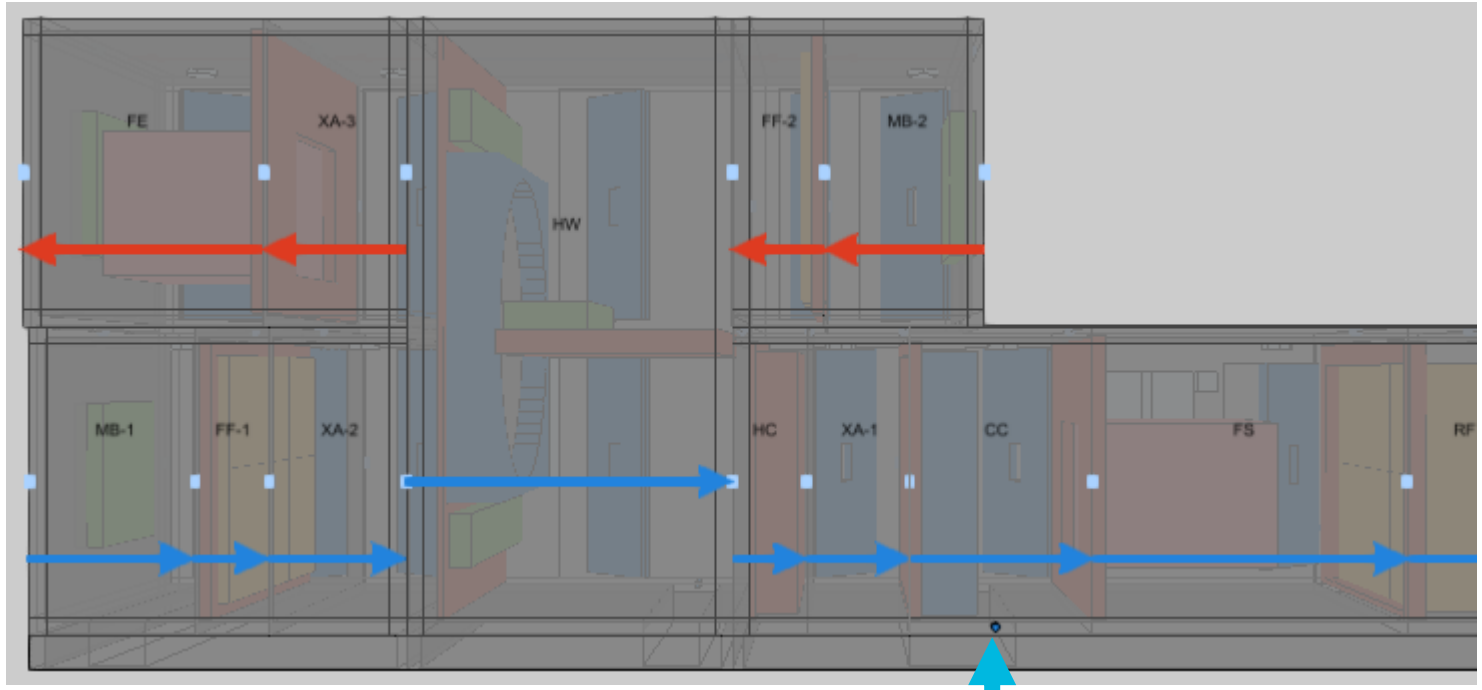


Classes: A to D

Air Handling Units: Clause 6.6.2 Water Removal

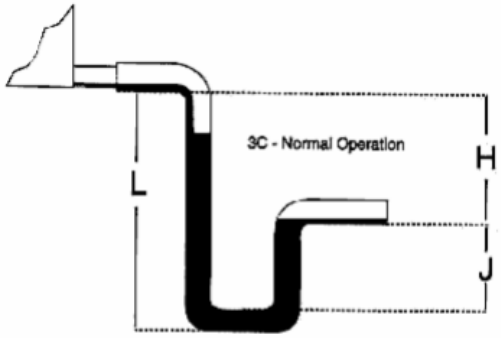
6.6.2.1.2

Air handling units shall be mounted at a sufficient height above the floor to allow for trapping of drains in accordance with Clause 6.6.2.2.

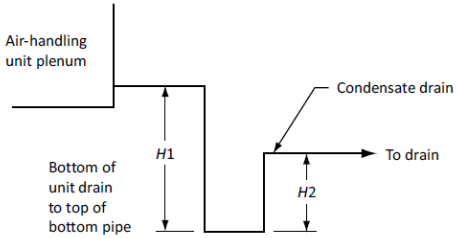


Drain Pan Connection for P-Trap

Classes:A to D



Annex C:



Negative static pressure		
Pressure, Pa	*H*1, mm	*H*2, mm
125	70	32
249	89	38
374	108	44

Positive static pressure		
Pressure, Pa	*H*1, mm	*H*2, mm
125	64	38
249	76	51
374	89	64

Clause 6.6: Air Handling Units

- 6.6.3 Ultraviolet Disinfection Systems

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.6.3	x											

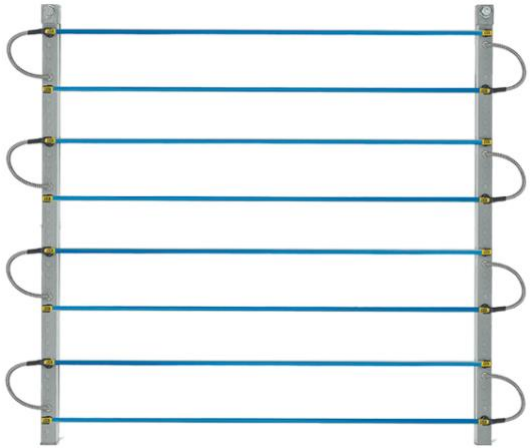
Air Handling Units: Clause 6.6.3. UV Disinfection System

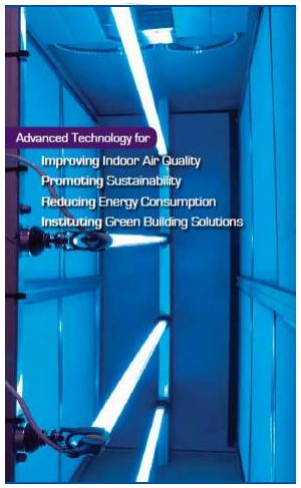
6.6.3.1

Internally mounted disinfection systems using ultraviolet light (UV systems) should be considered as a supplemental measure for HVAC systems, particularly for those that serve rooms or areas where there could be an elevated risk of infection from the supplied air. The Interdisciplinary Design Team (IDT) should evaluate the most recent available clinical evidence when deciding whether and where to install UV systems.

UVGI systems are intended as a supplement to normal good practice for protecting air quality. UV systems are not in any way to be used as a substitute for regular HVAC system maintenance, including the monitoring and replacement of filters, and periodic cleaning of coils and ductwork

See ASHRAE Handbook — 2019 *HVAC Applications, Ch. 62, Ultraviolet and surface treatment.*





Classes: A to D

Clause 6.6: Air Handling Units

- 6.6.4 Access

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.6.4		x										

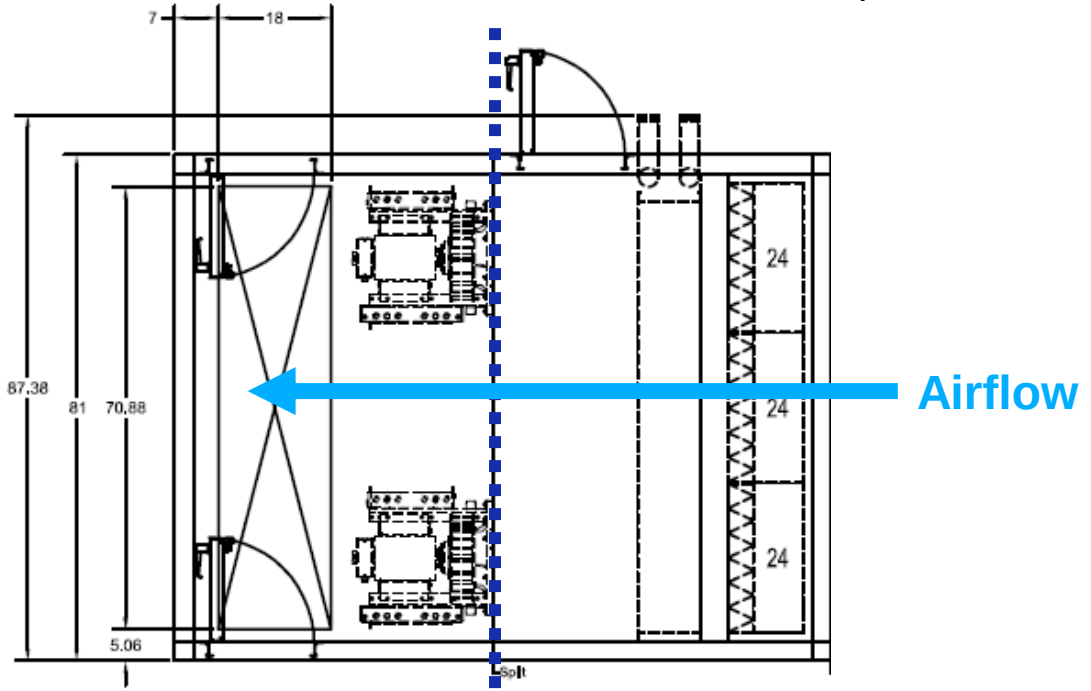
Air Handling Units: Clause 6.6.4 Access

6.6.4.1

For all Class A, Class B and Class C HCFs, hinged doors shall be provided for all internal sections of air handling units to allow ease of access. Doors shall be arranged to open against internal air pressure.

Notes:

- 1) *In negative pressure sections, the doors should open outward; in positive pressure sections, the doors should open inward. This helps prevent leakage at the access door component.*



Positive Pressure Upstream of Fan | Negative Pressure Upstream of Fan

Classes: A to C

Air Handling Units: Clause 6.6.4 Access

6.6.4.2

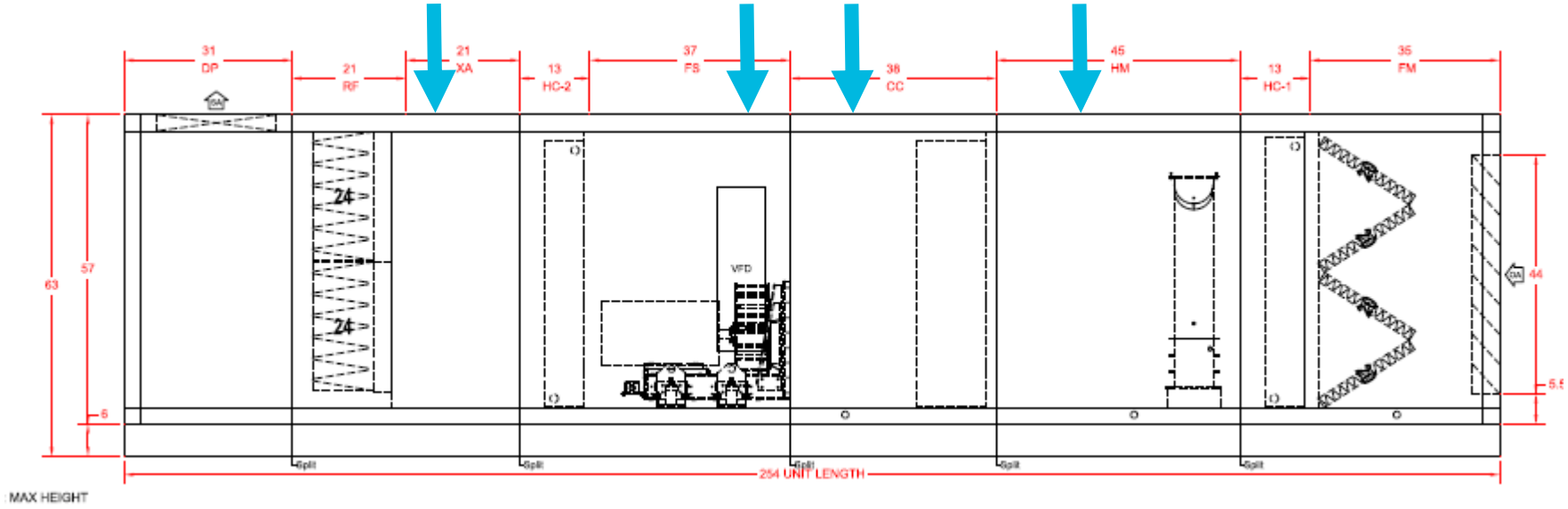
Air handling units serving **Type I** areas shall be provided with glazed windows to allow assessment of

a) fan operation;

b) final filter integrity;

c) humidifier operation; and

d) cooling coil drainage.



Classes: A to C

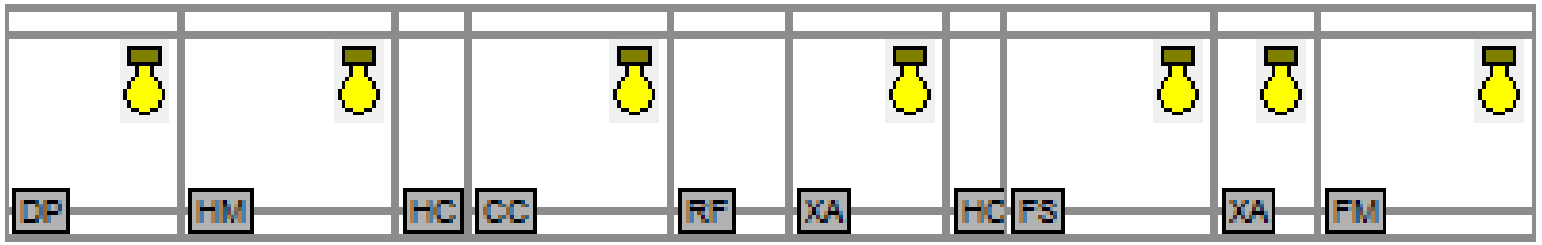
Air Handling Units: Clause 6.6.4 Access

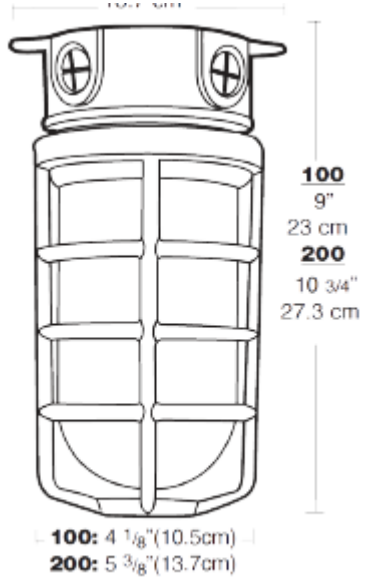
6.6.4.3

In all Class A, Class B and Class C HCFs, air handling units shall be equipped with internal lighting.

6.6.1.1 – Note 3

AHU interiors should be designed for visibility through the use of adequate lighting (see Clause 6.6.4.3) and surface treatments, so that the condition and cleanliness of interior surfaces can be quickly and easily assessed.





Clause 6.7: Air filtration

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.7.1	x											
6.7.2		x										
6.7.3	x											
6.7.4	x											

Clause 6.7 Air Filtration

Health Care Facilities

- Typically have a minimum of 2 stages of filtration
  - MERV 8 & MERV 13/14
  - Critical spaces may require a 3rd stage HEPA filtration (i.e. burn units)

Table 2-3 *Minimum Efficiency Reporting Values (MERVs) and Filter Efficiencies by Particle Size*

MERV	0.3-1.0 µm	1.0-3.0 µm	3.0-10 µm
Category E-3			
6	—	—	35 to 50%
7	—	—	50 to 70%
8	—	—	70 to 85%
9	—	—	85% +
Category E-2			
10	—	60 to 65%	85% +
11	—	65 to 80%	85% +
12	—	80% +	85% +
Category E-1			
13	< 75%	90% +	99% +
14	75 to 85%	90% +	99% +
15	85 to 95%	90% +	99% +
17	99%	99%	99%

Source: Adapted from ANSI/ASHRAE Standard 52.2-2007 (ASHRAE 2007).

1st Stage

MERV 8

2nd Stage

MERV 13, & 14

3rd Stage

MERV 17, 18, & 19

Clause 6.7 Air Filtration

6.7.1

Air filtration systems shall be provided to remove particulates from circulated outdoor and indoor air.

6.7.2

For all Class A, Class B and Class C HCFs, central ventilation or air-conditioning systems shall be equipped with filters with **minimum** efficiencies in accordance with Table 3 →.

6.7.3

Filters with antimicrobial treatments should be avoided in HCF HVAC systems. Should such filters be considered, independent test results and documentation s should be requested

6.7.4

Where MERV ratings are referenced, filters shall meet the requirements of both MERV and MERV-A tests when conducted in accordance with ASHRAE 52.2.

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.7.1	x											
6.7.2		x										
6.7.3	x											
6.7.4	x											

Clause 6.7 Air Filtration

Table 3
Filter efficiency
(See Clauses 6.7.2, 6.12.4.1, and 6.12.4.3)

Room type	Minimum MERV rating (Filter #1)	Minimum MERV rating (Filter #2)	HEPA filter required (Filter #3)
General ORs	8	14	—
Specialized OR (transplants, orthopedics)	8	14	✓
Burn units	8	14	✓
AIRs (supply)	8	14	—
AIRs (exhaust)*	8	—	✓
PERs (supply)	8	14	✓
Diagnostic imaging treatment areas (e.g., angiography)	8	14	—
Patient care areas	8	14	—
Sterile processing, clean and sterile storage	8	14	—
Laboratories	8	13	—
Administrative areas	8	13	—
Food preparation areas	8	13	—
Clean laundry storage and supply	8	13	—
Soiled laundry, bulk storage, soiled holding	8	13	—
Resident spaces for Class B HCFs	8	13	—

** If required where exhaust cannot be clear of air intake or is being exhausted into areas where people might be located.*

Airborne isolation Rooms

Protective Environment Rooms

Clause 6.7 Air Filtration

6.7.5

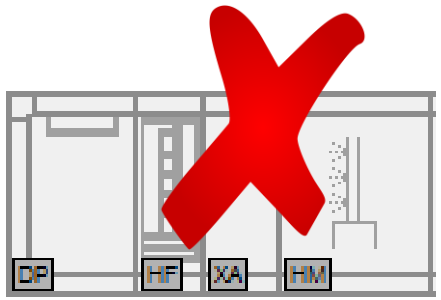
Air filters and associated systems shall be

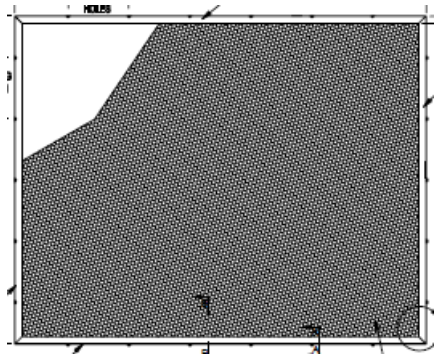
a. designed, installed, and located so as to avoid wetting from humidifiers, cooling coils, or other sources of moisture

b. composed of materials that do not pose carcinogenic or other health hazards;

c. designed and installed for ease of access to allow for changing of filters;

d. equipped with manometers or other pressure-drop monitoring devices;

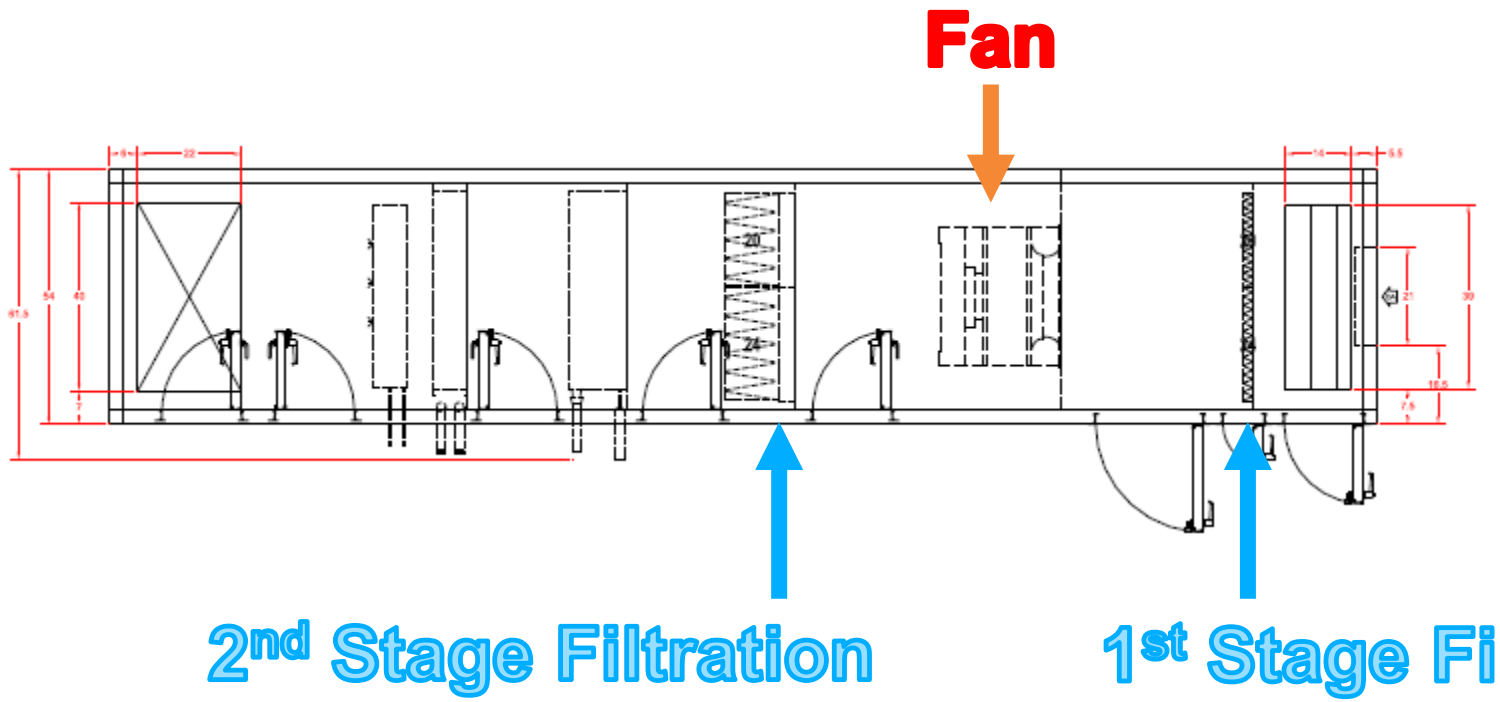




Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.7.5	x											

Clause 6.7 Air Filtration

Serving Area Type I & II
1st and 2nd stage filtration

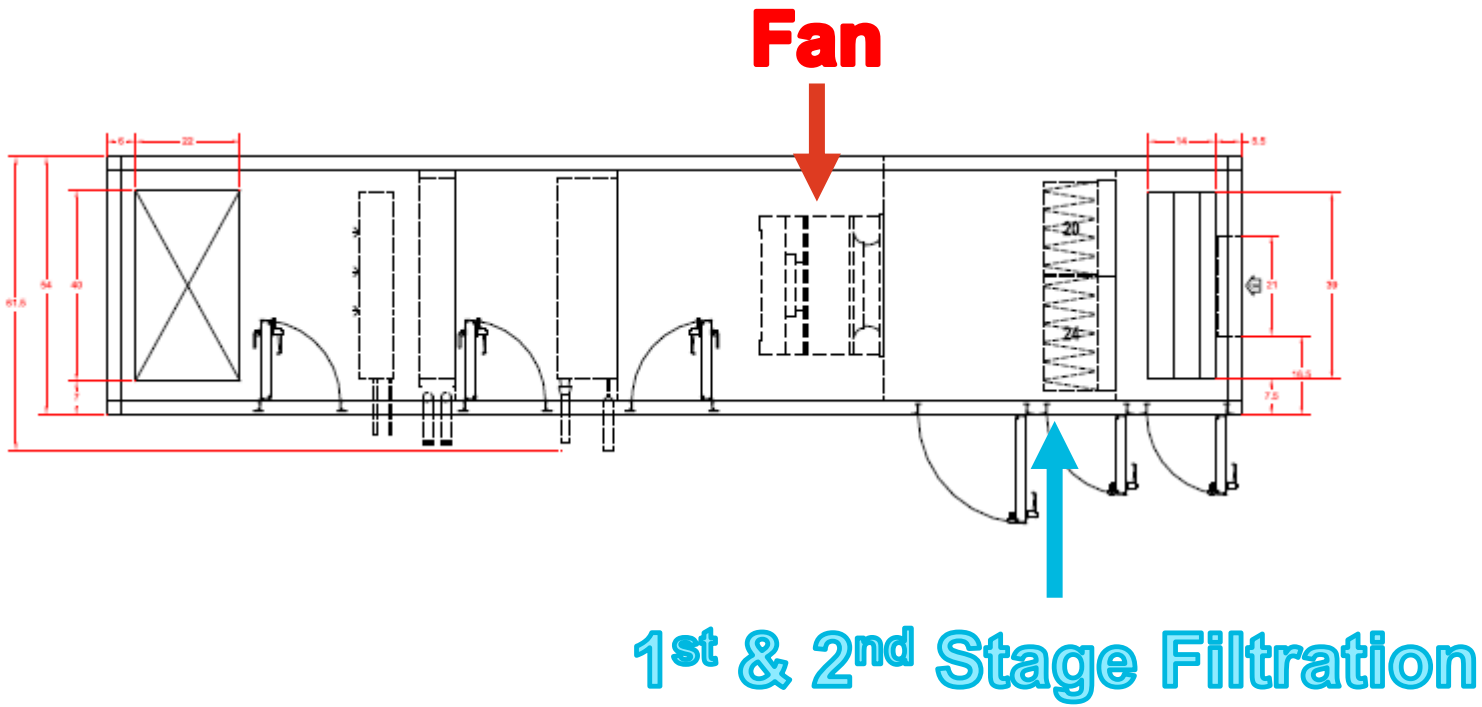


6.7.6
For all Class A, B-1, B-2, C-1 and C-2 HCFs, a minimum of two stages of filtration shall be installed. The first stage of filtration (filter #1) shall be installed upstream of the air-conditioning equipment.
For systems serving **Type I and II areas**, the second stage of filtration (filter #2) shall be located in the positively pressurized section of a supply air system, downstream of the supply air fan or in terminal air distribution devices.

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.7.6			x	x	x	x	x		x	x		

Clause 6.7 Air Filtration

Serving Area Type III
1st and 2nd stage filtration combined



6.7.6 …continued
For all Class A, B-1, B-2, C-1 and C-2 HCFs, a minimum of two stages of filtration shall be installed. The first stage of filtration (filter #1) shall be installed upstream of the air-conditioning equipment.
For systems serving **Type III areas**, the second stage of filtration may be located upstream of the supply air fan.

The return-exhaust air side (if applicable) shall be equipped with a prefilter with a minimum MERV 8 rating upstream before heat recovery systems.

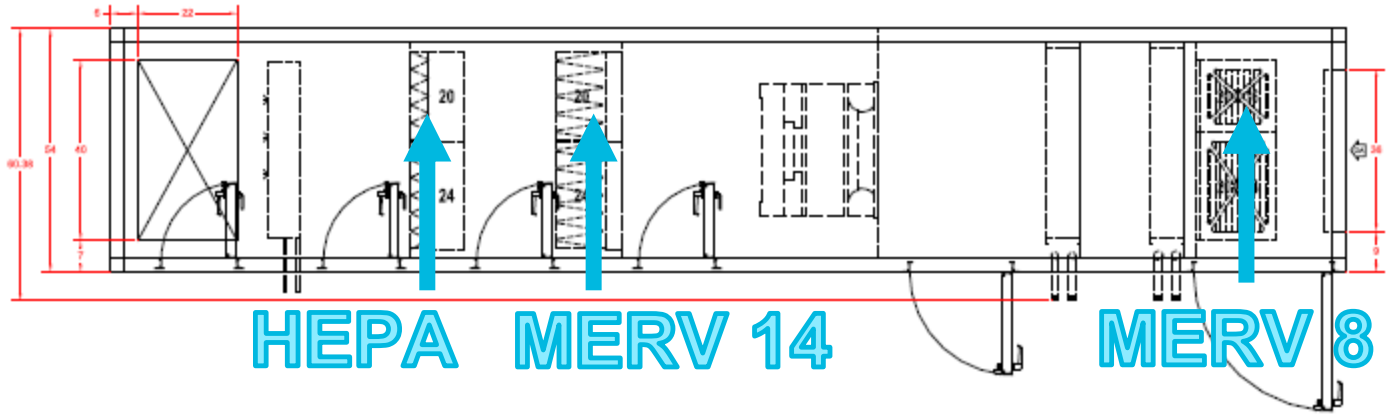
Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.7.6			x	x	x	x	x		x	x		

Clause 6.7 Air Filtration

6.7.7

Where present, HEPA filters in supply air systems shall be

a. protected at minimum by a MERV 8 prefilter and/or a MERV 14 secondary filter;



Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.7.7	x											

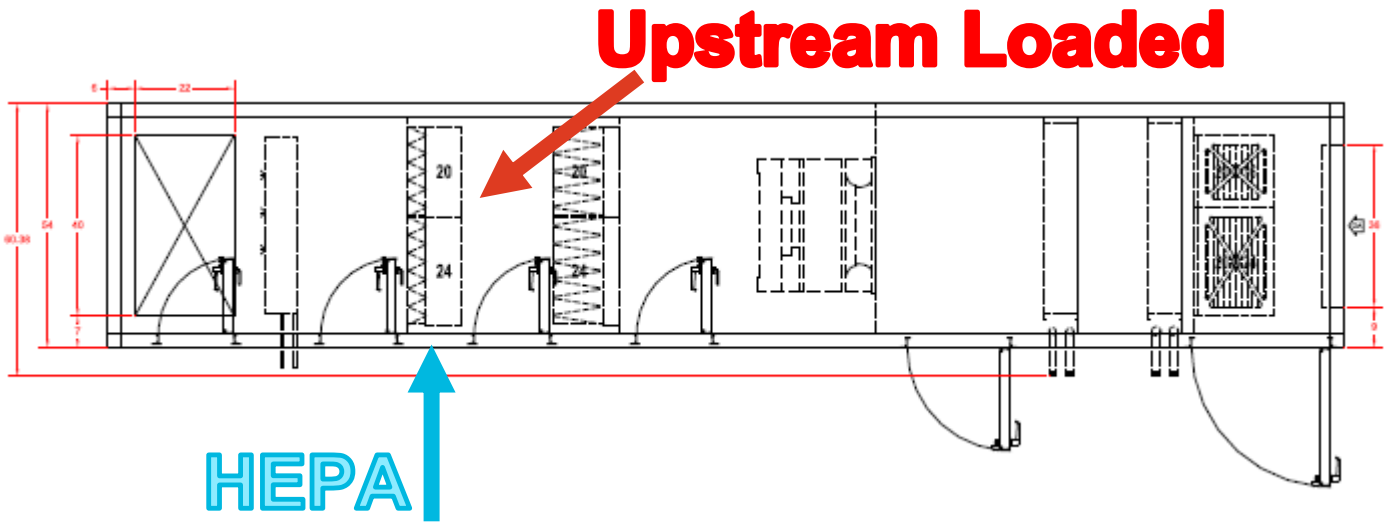
Clause 6.7 Air Filtration

6.7.7 … continued

Where present, HEPA filters in supply air systems shall be

d. designed to permit removal, disposal, and replacement of filters without introducing contamination into the downstream air-delivery system or the area served; and

e. provided with a means to indicate operating pressure drop via a unit-mounted differential pressure gauge with a local alarm or a unit-mounted pressure transducer alarming on the BAS.



6.13.5.2 HEPA filters

HEPA filters that are located downstream of a possible contaminant source (e.g., AIR or OR) shall be housed in a "bag-in, bag-out" filter housing.

Clause 6.8: Humidification

Clause 6.8: Humidification

6.8.1.3

Humidification, where needed, shall be provided by **steam humidifiers** or **pressurized spray adiabatic humidifiers**. The following types of humidifiers shall not be used:

a) Any device relying on evaporation of moisture on a surface to achieve absorption performance (e,g., evaporative wetted media humidifiers, spray coils).

b) Pan type humidifiers.

Notes

1) Evaporative wetted media humidifiers and pan-type humidifiers require extensive cleaning and maintenance to avoid bacterial contamination and, thus, are not appropriate for use in HCFs.

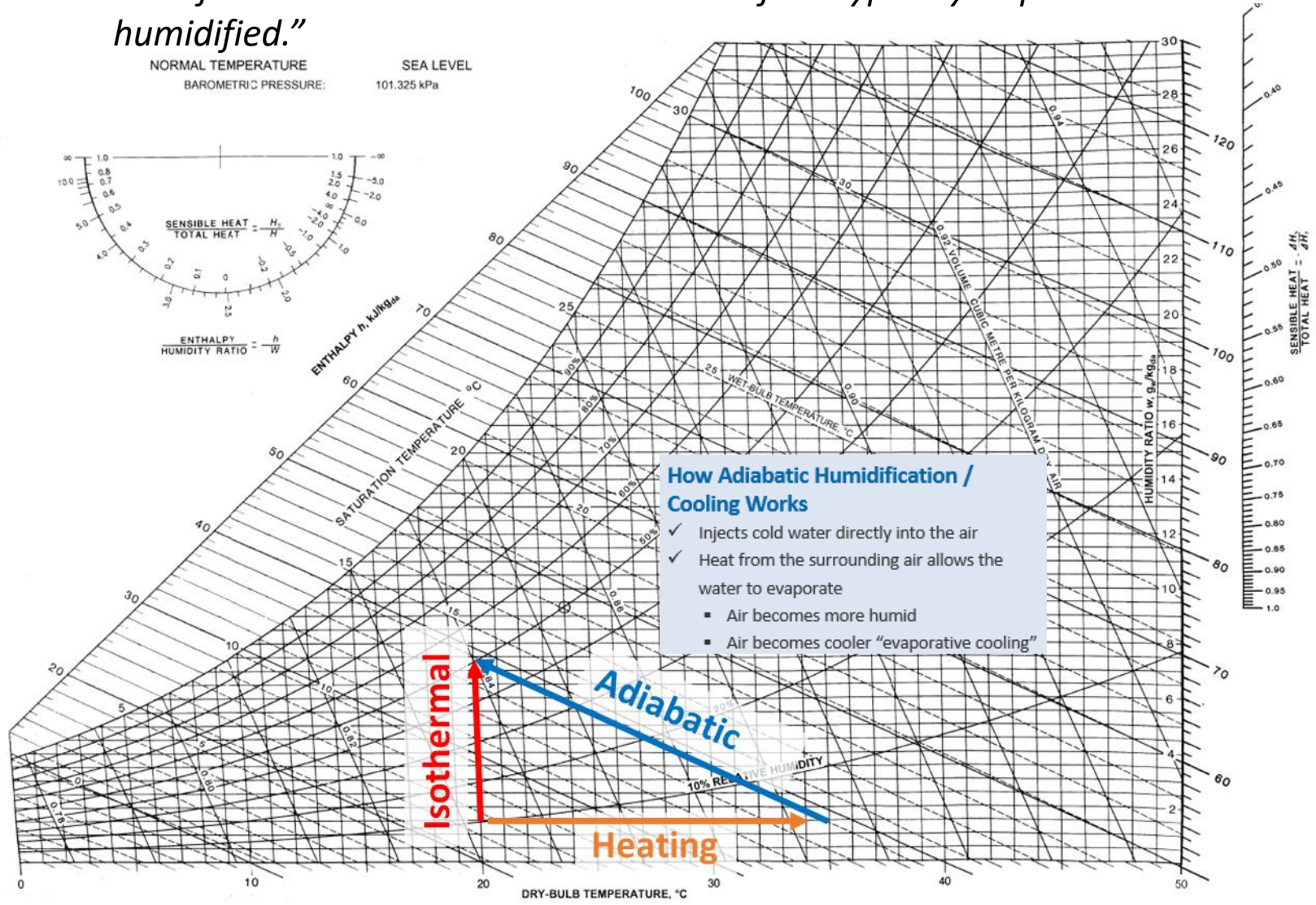
2) Water reservoirs in the airstream have a high potential for bacterial growth which can contribute to infection risk.

3) *Adiabatic humidifiers typically require heat to be added to the air before it is humidified.*

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.8.1.3	x											

Clause 6.8: Humidification

Note from CSA Z317.2: "Adiabatic humidifiers typically require heat to be added to the air before it is humidified."



HEATING

Moisture content: Constant
Temperature: Increases

ISOTHERMAL HUMIDIFYING

Moisture content: Increases
Temperature: Constant

ADIABATIC HUMIDIFYING & COOLING

Moisture Content: Increases
Temperature: Decreases as sprayed water evaporates absorbing heat from the air

Clause 6.8: Humidification - Adiabatic

6.8.1.5

In adiabatic humidification systems,

a) **sufficient airflow distance** shall **be provided for absorption**. The system shall spray directly into the air and not rely on evaporation of water from surfaces;

b) a **means of moisture elimination** shall **be provided at the end of the humidifier section**. The eliminator **shall** be a corrosion-resistant cleanable surface. The eliminator shall not be relied upon to achieve absorption performance and shall be used as a safety measure only;

c) humidifier water shall be treated with, at minimum, carbon filtration, a reverse osmosis process, a UV-C process, and a sub-micron filter;

d) all manifolds and headers and piping shall be arranged and provided with automatic valves such that all of the water in the system drains completely when not in use;

e) all internal surfaces within the humidifier section shall be designed to be wet, shed moisture to the drain pans, and resist corrosion; and

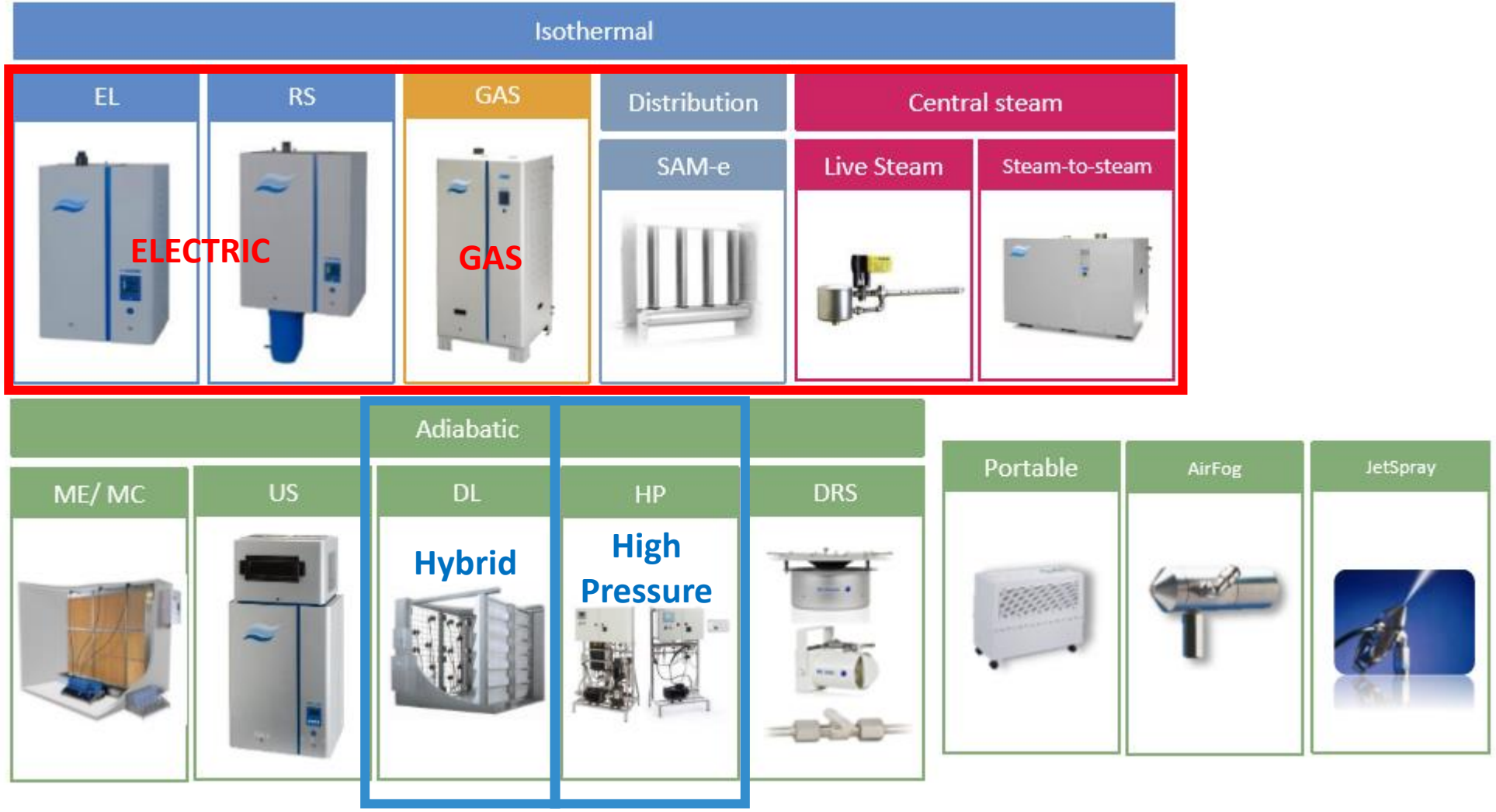
f) if aluminum coils are installed directly downstream of the adiabatic humidification system, they shall be coated to prevent corrosion and creation of aluminum dust..

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.8.1.5	x											

Clause 6.8: Humidification – Available Technologies for Health Care

ISOTHERMAL HUMIDIFYING
Types:
Electric, Gas
Moisture content:
Increases
Temperature: Constant

ADIABATIC HUMIDIFYING & COOLING
Types:
Hybrid, High Pressure (Fogging)
Moisture Content:
Increases
Temperature:
Decreases as sprayed water evaporates absorbing heat from the air



Clause 6.8: Humidification – Adiabatic for HCF





	Ultrasonic	Compressed Air Fogging	High-Pressure Fogging	Evaporative Media	Hybrid Fogging
Energy	Electricity	Compressed Air	Electricity	Electricity	Electricity
Water Type	RO, DI	Potable, RO, DI	RO, DI	Potable, RO	RO, DI
Capacity	5 – 50 lb/h 2 – 23 kg/h	5 – 1000+ lb/h 2 – 450+ kg/h	200–3000+ lb/h 90 – 1300+ kg/h	50–2000+ lb/h 22 – 900+ kg/h	50–2000+ lb/h 23–900+ kg/h
Capital Cost	$$	$	$$	$$$	$$$
Operating Cost	$$	$	$$	$ - $$$	$
Key Advantage	Packaged Product	Low First Costs	Largest capacities	Highest Cooling Performance	Compact Footprint

Applicability to HCF:

Width of Media

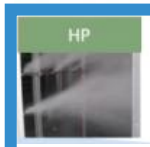
Wetted Media/ Direct or Indirect Evaporative Cooling is primary use. 27 to 31 ½ inches (**Primary** use Data Center Cooling)
(**NOT** for Hospital applications)

3 feet/ High Pressure Air

Compressed Air/ Direct 36 inches
Can see aerosolization in AHU
(**NOT** for Hospital applications)

2-3 feet Very Good Water Eff.

Hybrid Humidifier 24 – 36 Section
18" before 4" after **(OK for Hospitals)**



6-8 feet of section length to achieve Good Water Efficiency (must have mist eliminator

High Pressure (Fogging) Humidifier
(OK for Hospitals)

Consult with your authority having jurisdiction (AHJ) when considering new technologies not explicitly covered in the standard

Clause 6.19: Energy efficiency, GHG emission reduction, and sustainability

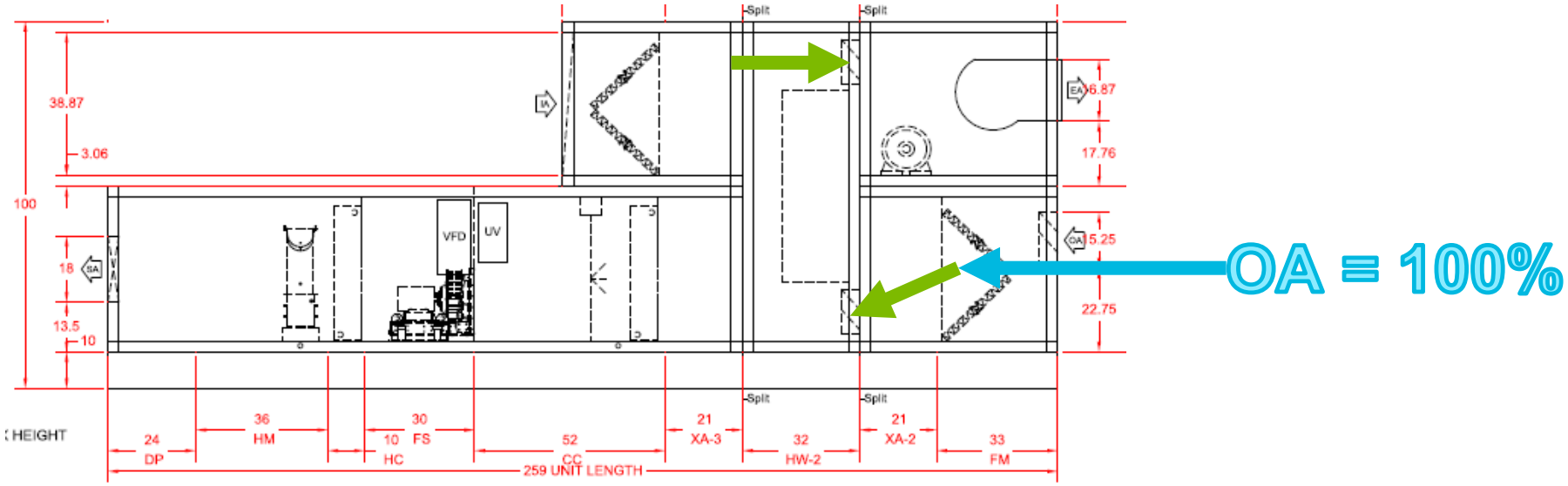
- 6.19.3 Energy Recovery Devices
- 6.19.7.1 Energy Recovery Devices

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.19.3	x											
6.19.7	x											

Clause 6.19.3 Energy Recovery Devices

6.19.3.2

100% outdoor air systems shall be two-fan systems utilizing energy recovery devices. During economizer cycles, outdoor air and relief air streams shall bypass the energy recovery devices, and fan speeds shall be reduced to the reduced static pressure requirements of the system.



Bypass Dampers Required

Clause 6.19.3 Energy Recovery Devices

6.19.7.1

High efficiency energy recovery devices shall be incorporated on all HCF ventilation systems using more than 35% outdoor air during normal operation. High efficiency energy recovery devices should be considered on the outdoor air path on all ventilation systems. Outdoor air and relief air streams should bypass the energy recovery devices to reduce pressure drop when energy recovery is not advantageous.

Final Remarks

Final Remarks: Other Relevant Clauses to AHU Design

- 6.5.6 Air handling unit redundancy
- 6.5.7 Outdoor air intakes
- 6.16 Business Continuity
- 6.17 Acoustics and vibration control

Clause	Classes A to D	Classes A to C	Class A-1	Class A-2	Class A-3	Class B-1	Class B-2	Class B-3	Class C-1	Class C-2	Class C-3	Class D
6.5.6	—	—	—	—	—	—	—	—	—	—	—	—
6.5.6.1	x											
6.5.6.2			x	x		x						
6.5.6.3					x		x					
6.5.6.4									x			
6.5.6.5								x		x	x	x
6.5.7	x											
6.16	x											
6.17			x	x	x	x	x		x			

Final Remarks: Helpful Resources

ASHRAE

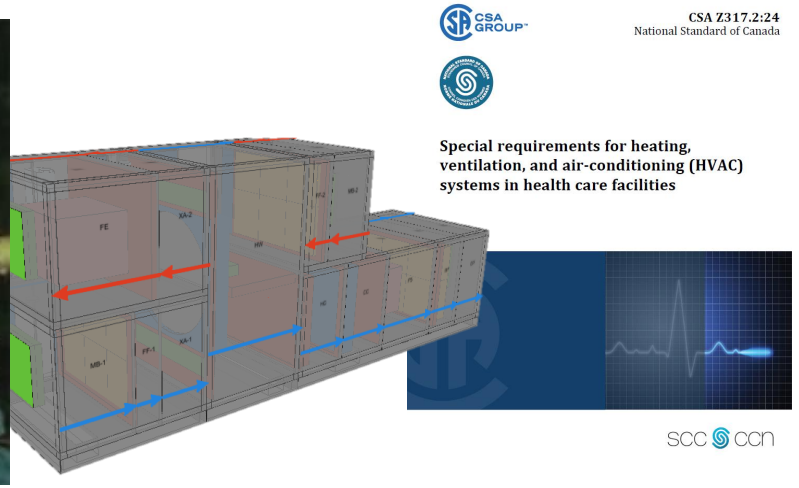
- ASHRAE HVAC Design Manual for Hospitals and Clinics 2013, 2nd Edition
- ASHRAE Standard 170-2021 – Ventilation of Health Care Facilities
- ASHRAE Handbook Applications 2023 – Chapter 9 Health Care Facilities
- Decarbonizing Hospital Buildings

Department of Energy:

- Advanced Energy Retrofit Guide – Healthcare Facilities

- **Facilities Guidelines Institute**
- FGI Guidelines for Design and Construction Documents

Questions/Discussion



CSA Z317.2:24
National Standard of Canada

Special requirements for heating, ventilation, and air-conditioning (HVAC) systems in health care facilities

scc ccn

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Thank you for your time & attention!

Johnson Controls