



MINNESOTA HEALTHCARE ENGINEERS ASSOCIATION

2026 Fall Conference | October 5–7 | St. Cloud, Minnesota

AIR HAPPENS **ASHRAE 170** ~~vs.~~ **+** **GUIDELINE 43**

From Design Intent to Daily Operations

Managing Ventilation Excursions with Guideline 43

• **Darin May, PE, FPE, LEED AP BD+C**

Executive Vice President | Dunham Associates

• **Ryan Schramm, CHFM, CHC, Sr. MECH, FASHE**

Director of Facilities Systems | Banner Health

One Designed It. One Runs It.



Darin May

PE, FPE, LEED AP BD+C

Executive Vice President

Dunham Associates

28+ years designing healthcare mechanical systems — operating suites, imaging, compounding pharmacies, central plants.

DESIGN · ENGINEERING · ASHRAE 170



Ryan Schramm

CHFM, CHC, Sr. MECH, FASHE

Director of Facilities Systems

Banner Health

Banner Remote Operations Center (ROC) — 26M+ sq ft, six states. Key role in Banner's temperature, humidity & pressure policy.

OPERATIONS · FACILITIES · GUIDELINE 43

RYAN *"Darin, why didn't you design it to handle this?"*

DARIN *"Ryan, I didn't design it for that."*

You'll hear this a lot today.

Designed Right. Still Out of Range.

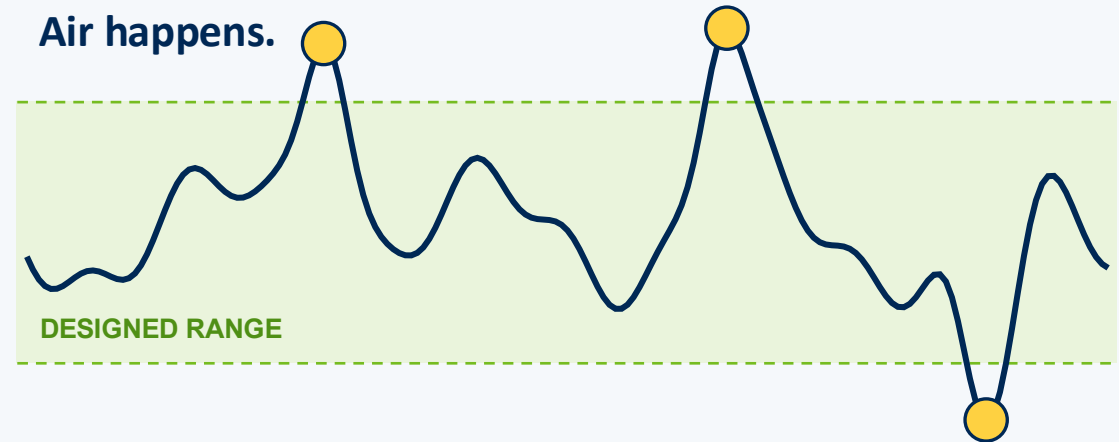
The building was designed correctly.

So why are we out of range?

*Here's what we THINK happens.
Here's what ACTUALLY happens.*

ONE YEAR IN THE LIFE OF AN OR

Air happens.



one year of operation →



Who has heard (or said) “We follow ASHRAE 170”?

Two Documents. Two Jobs.



DESIGN INTENT

ASHRAE/ASHE Standard 170

“What was this environment designed to do?”

- Original publication July 24, 2008
- Minimum design requirements — the “shall”
- The design team’s document



OPERATIONAL RESPONSE

ASHRAE/ASHE Guideline 43

“How are we going to manage it — every day?”

- Original publication July 15, 2025
- Operations guidance for systems in use — the “should”
- The operators’ document

“We follow ASHRAE 170” describes how the building was designed — not how you run it.

170 doesn’t disappear after construction. It becomes the baseline you manage against.

The Handoff



WHAT WE THINK GETS HANDED OVER

The design intent is written down and travels with the project

Built exactly as drawn

The “why” comes with the keys

It runs as designed — forever

WHAT ACTUALLY GETS HANDED OVER

The basis of design stays in the engineer’s files

Field changes and substitutions

Keys, O&M binders, and BMS graphics

People, weather, age, and change — starting day one

The drawings transfer. The design basis usually doesn’t.

Real Life Shows Up



“

Same boiler. Same air handler. Same coil. More load.

Day one: design load



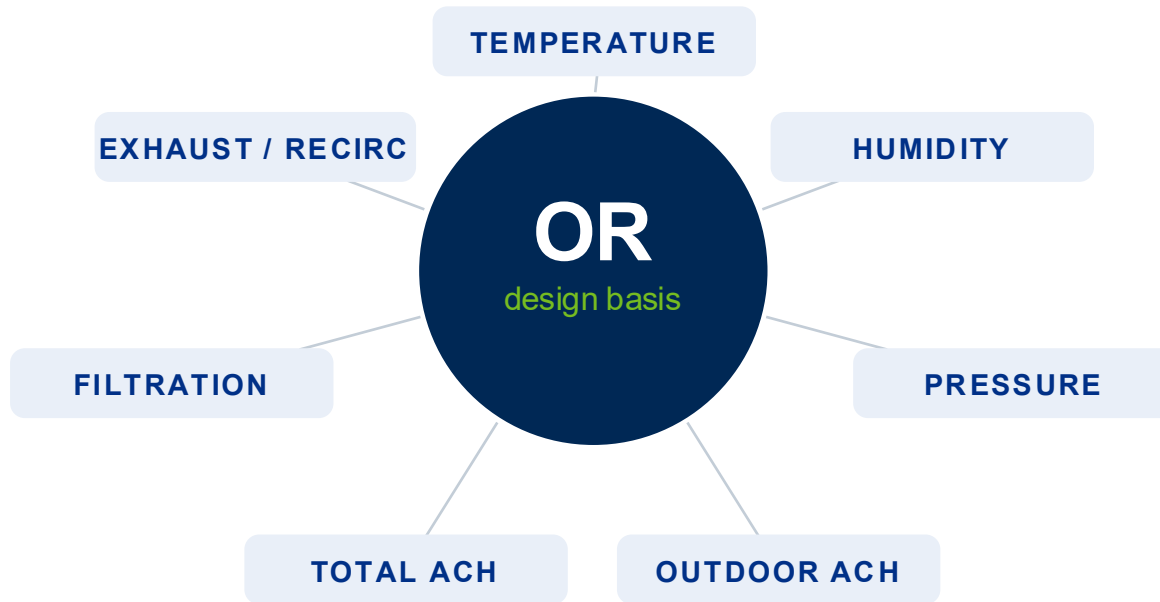
Year 15: actual load



Every change is small. Together they move the room outside its design.

What Did Darin Actually Design?

“RYAN “Darin, when you design an OR, what are you actually designing?”



CODE SETS THE MINIMUMS

- TEMPERATURE**
Outside air and return air — comfort
- HUMIDITY**
Dew point — condensing on equipment and instruments
- PRESSURIZATION**
Amount of outside air — blowing up a balloon
- FILTRATION AND ACH**
Minimize particulate and dilution

MINIMIZE HVAC IMPACT TO HAIs

170 sets the design basis — the conditions the system is engineered to deliver.

Designed for Which Day?

2025 ASHRAE Handbook — Fundamentals (IP)

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MINNEAPOLIS-ST PAUL, MN, USA

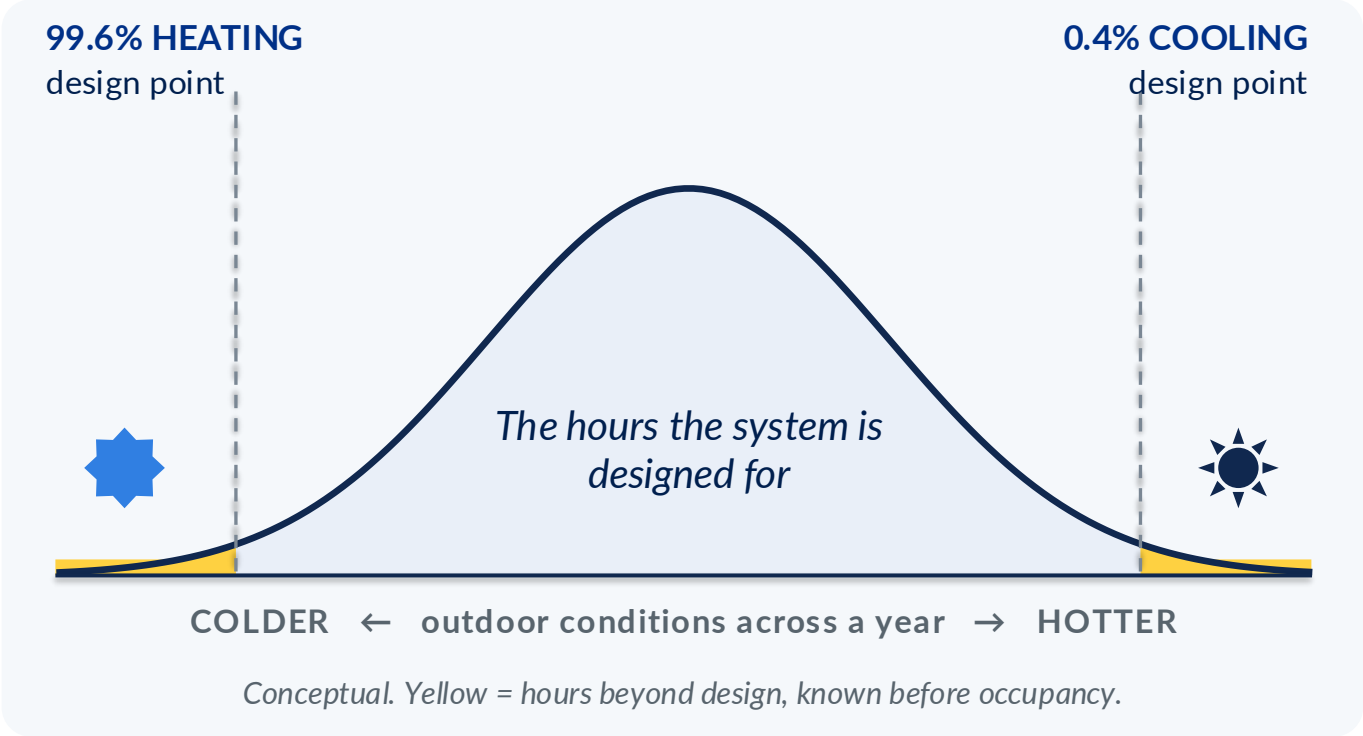
WMO: 726580

Lat: 44.885N Lon: 93.231W Elev: 835 StdP: 14.26 Time Zone: -6.00 (NAC) Period: 1999-2023 Grade: A WBAN: 14922

Annual Heating, Humidification, and Ventilation Design Conditions															
Coldest Month	Heating DB		Humidification DP/MCDB and HR						Coldest Month WS/MCDB				MCWS/PCWD to 99.6% DB		WSF
			99.6%			99%			0.4%		1%				
	99.6%	99%	DP	HR	MCDB	DP	HR	MCDB	WS	MCDB	WS	MCDB	MCWS	PCWD	
1	-9.4	-5.1	-17.8	2.1	-8.3	-14.0	2.7	-4.0	24.2	14.3	21.9	17.0	8.2	300	0.579
Annual Cooling, Dehumidification, and Enthalpy Design Conditions															
Hottest Month	Hottest Month DB Range	Cooling DB/MCWB						Evaporation WB/MCDB						MCWS/PCWD to 0.4% DB	
		0.4%		1%		2%		0.4%		1%		2%			
		DB	MCWB	DB	MCWB	DB	MCWB	WB	MCDB	WB	MCDB	WB	MCDB	MCWS	PCWD
7	17.3	91.4	73.3	88.5	71.8	85.8	70.4	76.9	87.5	74.8	84.6	72.9	82.5	12.5	180
Dehumidification DP/MCDB and HR									Enthalpy/MCDB						Extreme Max WB
0.4%			1%			2%			0.4%		1%		2%		
DP	HR	MCDB	DP	HR	MCDB	DP	HR	MCDB	Enth	MCDB	Enth	MCDB	Enth	MCDB	
73.5	128.5	83.8	71.5	120.0	81.3	69.5	111.9	79.1	40.9	86.9	38.8	84.8	37.0	82.6	84.9
Extreme Annual Design Conditions															
Extreme Annual WS				Extreme Annual Temperature				n-Year Return Period Values of Extreme Temperature							
				Mean		Standard Deviation		n=5 years		n=10 years		n=20 years		n=50 years	
1%	2.5%	5%		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
23.1	20.5	18.4	DB	-15.6	96.9	5.1	2.9	-19.3	99.0	-22.3	100.7	-25.2	102.3	-28.9	104.4
			WB	-16.1	80.3	4.9	1.9	-19.7	81.7	-22.5	82.8	-25.3	83.9	-28.8	85.3

Designed for Which Day?

“ RYAN “Are you designing for the hottest and coldest day that could ever happen?”



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Annual Heating, Humidification, and Ventilation Design Conditions

Coldest Month	Heating DB		Humidification DP/MCDB and HR						Coldest Month WS/MCDB				MCWS/PCWD to 99.6% DB		WSF
	99.6%	99%	DP	HR	MCDB	DP	HR	MCDB	WS	MCDB	WS	MCDB	MCWS	PCWD	
1	-9.4	-5.1	-17.8	2.1	-8.3	-14.0	2.7	-4.0	24.2	14.3	21.9	17.0	8.2	300	0.579

Annual Cooling, Dehumidification, and Enthalpy Design Conditions

Hottest Month	Hottest Month DB Range	Cooling DB/MCWB						Evaporation WB/MCDB						MCWS/PCWD to 0.4% DB	
		0.4%		1%		2%		0.4%		1%		2%		MCWS	PCWD
7	17.3	91.4	73.3	88.5	71.8	85.8	70.4	76.9	87.5	74.8	84.6	72.9	82.5	12.5	180

Dehumidification DP/MCDB and HR									Enthalpy/MCDB						Extreme Max WB
0.4%			1%			2%			0.4%		1%		2%		
DP	HR	MCDB	DP	HR	MCDB	DP	HR	MCDB	Enth	MCDB	Enth	MCDB	Enth	MCDB	
73.5	128.5	83.8	71.5	120.0	81.3	69.5	111.9	79.1	40.9	86.9	38.8	84.8	37.0	82.6	

Extreme Annual Design Conditions

Extreme Annual WS			Extreme Annual Temperature				n-Year Return Period Values of Extreme Temperature								
			Mean		Standard Deviation		n=5 years		n=10 years		n=20 years		n=50 years		
1%	2.5%	5%	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
23.1	20.5	18.4	DB	-15.6	96.9	5.1	2.9	-19.3	99.0	-22.3	100.7	-25.2	102.3	-28.9	104.4
			WB	-16.1	80.3	4.9	1.9	-19.7	81.7	-22.5	82.8	-25.3	83.9	-28.8	85.3

Systems are engineered around defined design conditions — not the worst day imaginable.

The Day Outside Beat Design

RYAN “So, in an average year, not even counting extreme conditions, you already knew we’d spend about thirty-six hours outside the design envelope before we ever opened?”

	DESIGN BASIS ASHRAE 0.4% ≈ 36 hours per year	ACTUAL OUTDOOR AIR 8:00 AM July 27, 2026	ACTUAL OUTDOOR AIR 2:00 PM July 27, 2026
ENTHALPY BTU / lb dry air	~36	44	36.5
DRY BULB / WET BULB	91° / 73°	84° / 81.5°	100° / 73°
DEW POINT	65°	81°	60°

Shaded = past the design point



Running at 100% ≠ holding every condition

Capacity has a ceiling. Weather doesn’t.



Predictable before occupancy

Design points mean some hours outside design are expected.



Same storm. Different outcomes.

It depended on what each hospital could shed, shift, or protect.

Doing everything right can still drift. The question is what we do next.

Bigger Isn't Better

“ RYAN “So why don't we just make the system twice as big?”



BUILT FOR

The quarter mile

Enormous capability



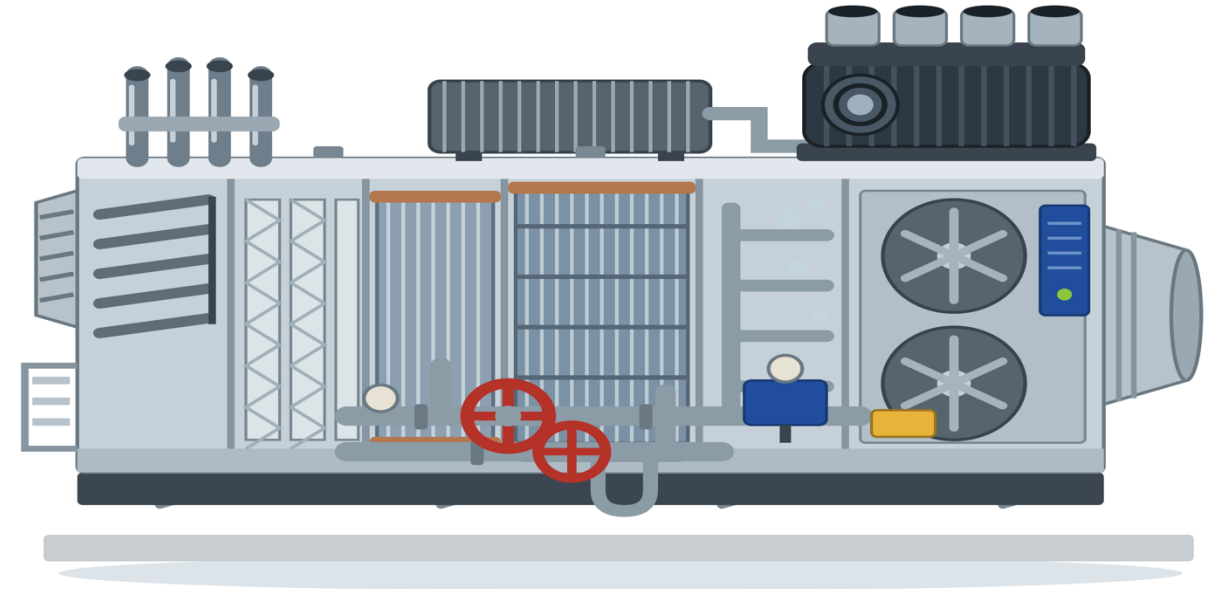
DRIVEN TO

The grocery store

Can it idle at a red light?

“

Putting a drag car on the road to go get groceries.



WHAT OPERATIONS SEES

Valve hunting

Short cycling

Can't turn down

Heat vs. cool fighting

Humidity swings

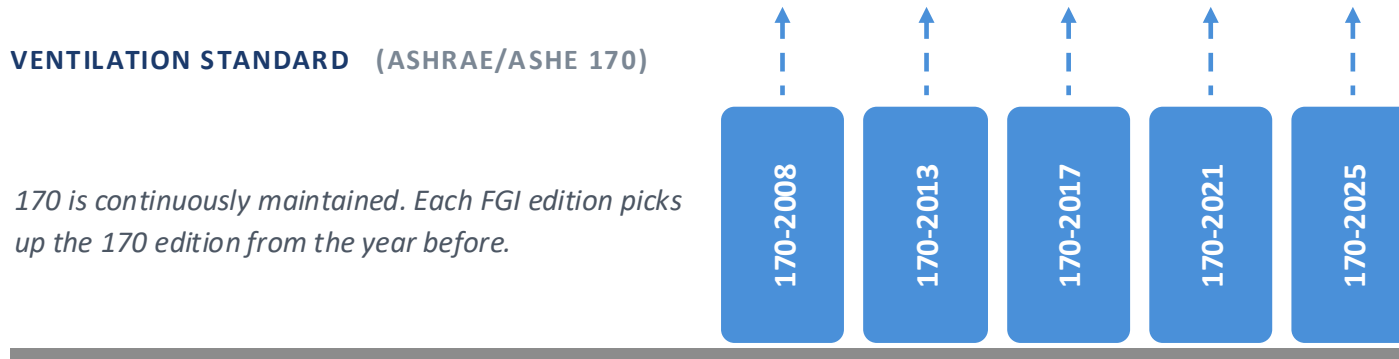
Size for the extreme day, and you pay for it on every normal day.

“Which 170?”

DESIGN GUIDELINES (AIA → FGI)



VENTILATION STANDARD (ASHRAE/ASHE 170)



170 is continuously maintained. Each FGI edition picks up the 170 edition from the year before.

Before anyone says “we follow 170”:

- 1 When was it designed?
- 2 Which edition applied?
- 3 What is the room used for today?

WHAT MINNESOTA ENFORCES TODAY

State of Minnesota Standards for Licensure

FGI 2022 + ASHRAE 170-2021 Effective January 1, 2024



Who knows which edition your oldest OR was designed under?

Don’t assume a 20-year-old room was designed to today’s book.

Read the Code Summary

“RYAN “If I pull my construction documents, where do I find which edition was used?”

CODE SUMMARY

GENERAL TYPE OF PROJECT		APPLICABLE ACCESSIBILITY CODES	
	YES	NO	
NEW BUILDING	☒	☐	ANSI A117.1 '03
ADDITION	☐	☒	MN ACC CODE '07
REMODEL	☐	☒	ADAAG (Almost Always)
BUILDING CODE(S) USED			
2000 IBC	☐	☒	
2006 IBC	☒	☐	
2000 NFPA 101 (LIFE SAFETY CODE)	☒	☐	
Other	☐	☐	
		OTHER RULE/CODES/STATUTES	
		MN State Rules	
		2010 FGI GUIDELINES	

1. OCC. CLASSIFICATION(S)

1

Check the code summary sheet

The code plan on the architectural set often names the edition.

2

Not listed? Use the design or permit date

Find the guidelines that were in effect at that time.

3

Write it down — per space

Put the edition in your source of truth.

Know the book before you quote the book.

Same Room. New Rules.

ENDOSCOPY ROOM REQUIREMENTS OVER TIME



Guidelines for Design & Construction of Healthcare Facilities	Pressure Relationship	Min OA ACH	Min Total ACH	Redirculated by Means of Room Units	RH%	Temp (°F)	Comments
1992-1993 AIA	-----	-----	-----	Not Addressed	-----	-----	-----
2001 AIA	Negative	2	6	No	30-60	68-73	New to the Guidelines
2006 AIA	No Requirement	2	6	No	30-60	68-73	
2010 FGI / ASHRAE 170-2008	Positive	2	15	No	30-60	68-73	CMS JC EC Reference
2014 FGI / ASHRAE 170-2013	No Requirement	2	6	No	20-60	68-73	
2018 FGI / ASHRAE 170-2017	No Requirement	2	6	No	20-60	68-73	WI DHS
2022 FGI / ASHRAE 170-2021	No Requirement	2	6	No	20-60	68-73	MDH
Bronchoscopy 2001 AIA to 2018 FGI	Negative (-0.01 in wg)	2	12	No	No Requirement	68-73	All Air Exhausted

ENDOSCOPY ROOMS

REQUIREMENTS BY EDITION • AIA / FGI / ASHRAE 170

BANNER POLICY 717 • TABLE 1 FOOTNOTE

“Endoscopy room preference is negative; however, the code has changed and in the field these rooms might be negative/neutral/positive based on the age of construction.”

Operations wrote the history into the policy.

The room didn’t change. The book did — and your policy has to know the difference.

Same Room. New Rules.

ENDOSCOPY ROOM REQUIREMENTS OVER TIME

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ENDOSCOPY ROOMS

REQUIREMENTS BY EDITION • AIA / FGI / ASHRAE 170

New Engine. Same Car.

“RYAN “If I replace the air handler, do my 1994 ORs become today’s ORs?”



NEW ENGINE

New air handler

Capable of 20 air changes



SAME DRIVETRAIN

Existing ductwork & diffusers

Sized for the original rooms



SAME CAR

Two 1994 ORs

Designed at 15 air changes

TODAY

Replace the failing unit

Rooms untouched — no automatic jump to 20.

LATER

Remodel the ORs

The capacity is already waiting for them.

EVERY PROJECT

Scope and review decide

Renovation scope, room function, and your AHJ — not the new nameplate.

Develop a plan and propose the plan based on the overall scope of work to the AHJ. Make progress towards bringing your space to today’s standards.

ACT III · THEN OPERATIONS GETS THE KEYS

Congratulations. It's Ours Now.



Every building. Every edition. Every day — including the days outside design.

BANNER POLICY 717 · SECTION III.E

“Not all existing mechanical infrastructure can support the identified parameters. In conditions where the systems are not able to meet these requirements, the temperature and RH must be held within the range of the code requirement the space was engineered and built to.”

“Which 170?” — written into operations policy.

Meet the Bridge: Guideline 43



DESIGN

ASHRAE 170

What was this environment designed to do?

GUIDELINE 43 → VENTILATION MANAGEMENT PLAN

“How are we going to manage it?”



OPERATIONS

Daily operations

What is the room doing right now?

ASHRAE/ASHE Guideline 43-2025, Operations Guideline for Ventilation of Health Care Facilities



Operations, not design

Guidance for systems already in use.



“Should,” not “shall”

A guideline is advisory. Your policy makes it real.



Design ≠ allowable operation

43 separates what was designed from what you can operate within.

170 tells you what the room was designed to do. 43 helps you decide what to do when it can't.

You've Built One of These Before

WATER MANAGEMENT PLAN

Program team

Describe the water system

Control locations

Control limits

Corrective actions

Document and verify



VENTILATION MANAGEMENT PLAN

Multidisciplinary governance

Source of truth: spaces + design basis

Monitored spaces, by function

Condition indicators and ranges

Excursion response and roles

Documentation and ongoing review

Same playbook.
Different fluid.

*We borrowed what we needed from
Guideline 43 — not every page on day
one.*



If you've built a water management plan, you already know how to build a ventilation management plan.

Who Was Sitting Around the Table?



“Everybody who owns part of the risk.”

Not Facilities sitting in a room writing its own rules.

32

facilities in scope

7

approving groups

2013

first issued

Title: Temperature, Humidity, and Pressure Guidelines for Critical Space	
Number 717, Version 9	Original Date: 04/10/2013
Effective Date: 07/16/2019	Last Review/Revision Date: 03/04/2026
Next Review Date: 03/04/2029	Author: Josh Brackett
Approved by: BH System Practice Oversight Team, Facility Services Leadership, Infection Prevention Senior Leadership, Perioperative Service Line Operations Oversight Team, PolicyTech Administrators, Regulatory Team, Risk Management	

Policy 717 v9 approval block (revised 03/04/2026)

Know the Space



CATEGORY 1 · TEMPERATURE + HUMIDITY + PRESSURE

- Operating rooms
- OB/GYN operating rooms
- Cath/EP labs
- Interventional radiology
- Cystoscopic rooms
- ED trauma
- Endoscopy
- Bronchoscopy
- Endoscopy / bronchoscopy
- CSPD clean assembly & sterile storage
- Compounding pharmacy (IV prep & hazardous)

CATEGORY 2 · PRESSURE ONLY

- Airborne infection isolation (AIIR)
- Protective environment (PE)
- CSPD decontamination
- ER decontamination
- Endoscope cleaning

“Category 2” doesn’t mean less risk — pressure is what we trend.

Function of Space	Pressure Relationship to Adjacent Areas(n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors	Air Recirculated by Means of Room Units	RH, %	Design Temperature, °F
Operating Rooms*	Positive	4	20	N/R	No	30-60%	68-75F

Banner Policy 717, Table 1 — Operating Rooms row

Organized by **FUNCTION** of space

— not the sign on the door.

* = the pre-FGI 2010 OR footnote

Your source of truth starts with what the space does.

Your OR Just Hit 60.5% RH.

BMS ALARM



OR 4 · RELATIVE HUMIDITY

60.5%

Normal range: 30–60% RH

Duration: just started

What happens next?

- A** Shut the room down.
- B** Call the surgeon and cancel the next case.
- C** Call Facilities and start fixing it.
- D** Document it and keep going.



Pick one. Defend it. Then decide who gets to make the call.

Out of Range ≠ Out of Compliance

● OUT OF RANGE

A monitored value falls outside the policy range.

→ starts a response

● OUT OF COMPLIANCE

Outside the range AND past the time or severity limit.

→ starts a risk decision



Banner example for invasive procedural rooms with a 30–60% RH range (Policy 717, Tables 3 & 4). Your thresholds may differ.

Table 3: Thresholds for Response to High RH		
Humidity ≤10% over upper limit (>60% to ≤70% RH)		Humidity >10% over upper limit (> 70% RH)
> 6 hours continuously	> 12 hours continuously	Immediately

Table 4: Thresholds for Response to Low RH		
Humidity up to 15% below lower limit (<30% to 15% RH)		Humidity <15% below lower limit (< 15% RH)
> 6 hours continuously	> 12 hours continuously	Immediately

Out of range starts the clock. Out of compliance starts the conversation.

What Happens Next

1

NORMAL

BMS trends it; clinical logs where there's no BMS

2

OUT OF RANGE

Clinical calls Facilities + work order; impacted space notified

3

FACILITIES RESPONSE

Correct the system · > 6 h continuous: notify Periop + IP

4

TIME / SEVERITY THRESHOLD

> 12 h continuous, or > 70% / < 15% RH = out of compliance

5

MULTIDISCIPLINARY RISK ASSESSMENT

AOC, C-suite, dept. leadership, IP, Facilities, Risk, physician

6

CONTINUE · RELOCATE · CANCEL

Continue only with mitigations — or relocate or reschedule

7

DOCUMENT · RESTORE · CLOSE

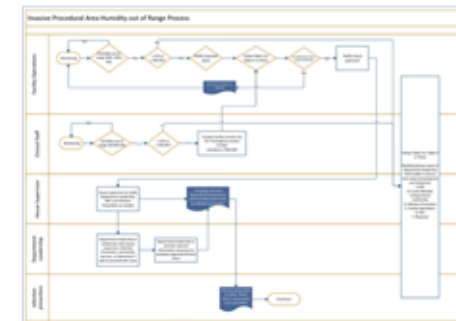
Event form → IP committee · Verge report · WO closed



Who decides whether that room stays open?

Not Facilities alone.

The people who own the risk decide — together.



*The real flowchart:
Policy 717, p. 9*

“We Want It Colder.”

CANNON FALLS — BEFORE A VENTILATION MANAGEMENT PLAN

SURGEON “We want the OR colder.”

DARIN “I didn’t design it to operate at that temperature.”

RYAN “But I have a surgeon who wants it.”

OWNER ASKED

68°F

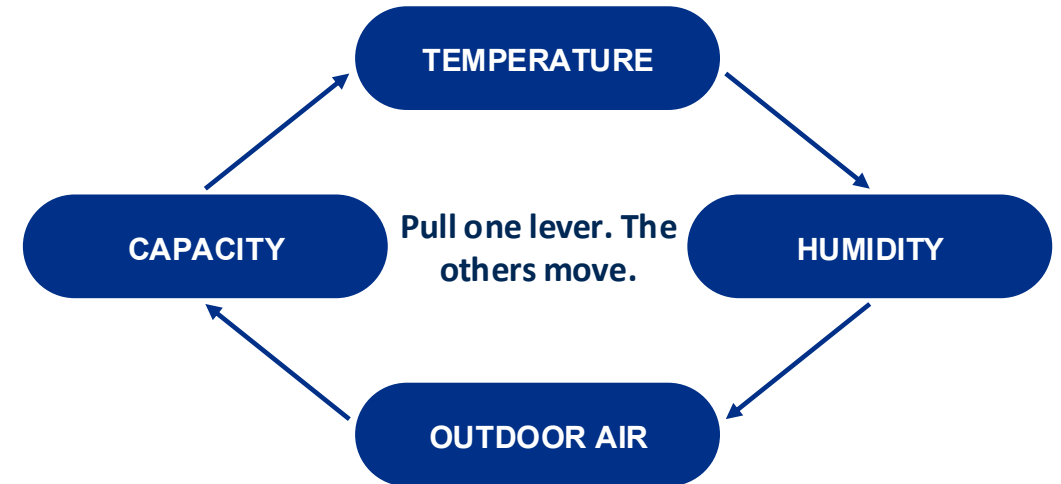
DESIGNED DOWN TO

65°F

SURGEON WANTED

~60°F

WHY IT’S ONE SYSTEM



COLDER AIR. SAME MOISTURE.

68°F
60% RH

65°F
66% RH

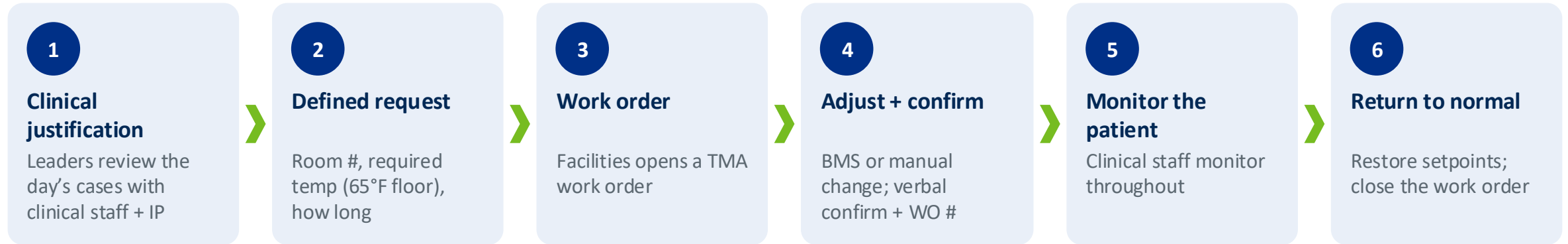
TEMP ▼ RH ▲

60°F
80% RH

60% RH is the ASHRAE 170 ceiling for an OR. Colder air crosses it.

Temperature, humidity, outdoor air, and capacity are one system — change one and the others move.

Colder — By Process



Banner Policy 717 — Specialized Temperature Request (65°F is the lowest)



THE MIDNIGHT RULE

Every temporary OR override resets to normal parameters at midnight.

Forget to put it back? The BMS doesn't. Today's exception never becomes tomorrow's normal.

WHY A WORK ORDER?

≈13,000*

lower-temperature requests at one campus since July 2024

Now surgical + IP leadership ask why — not Facilities.

What Room Is This?

 **EXAM ROOM**

DESIGNER HEARS
An exam room

CLINICIAN HEARS
“An exam room.”

 **TREATMENT ROOM**

DESIGNER HEARS
An exam room (in a clinic)

CLINICIAN HEARS
“I can do procedures here.”

 **PROCEDURE ROOM**

DESIGNER HEARS
A procedure room — designed and reviewed as one

CLINICIAN HEARS
“The big room for casts and families.”

ROOM NAME $\neq$ ROOM FUNCTION $\neq$ DESIGN REQUIREMENT

WHAT THE FUNCTION SETS

- Air Changes

Pressure Relationship

Humidity, Filtration

Diffuser Type

 Who has changed what happens in a room — without changing the room?

The sign doesn’t set the airflow. The function does — and Clinical + IP define the function.

Negative Is a Direction. 0.01 Is a Number.



REQUIRED RELATIONSHIP

The direction the room must hold — e.g., AIIR negative, OR positive.

NUMERIC DIFFERENTIAL

Airborne Infection Isolation Room, Protective Environment Room, Surgery Rooms (OR's, Cysto, C-Section, Class 3 Imaging) Morgue, Autopsy, Bronchoscopy, Pharmacy Compounding

OPERATIONAL BENCHMARK

0.01 in. w.c. as a BMS alarm point — a great benchmark, not automatically pass/fail.

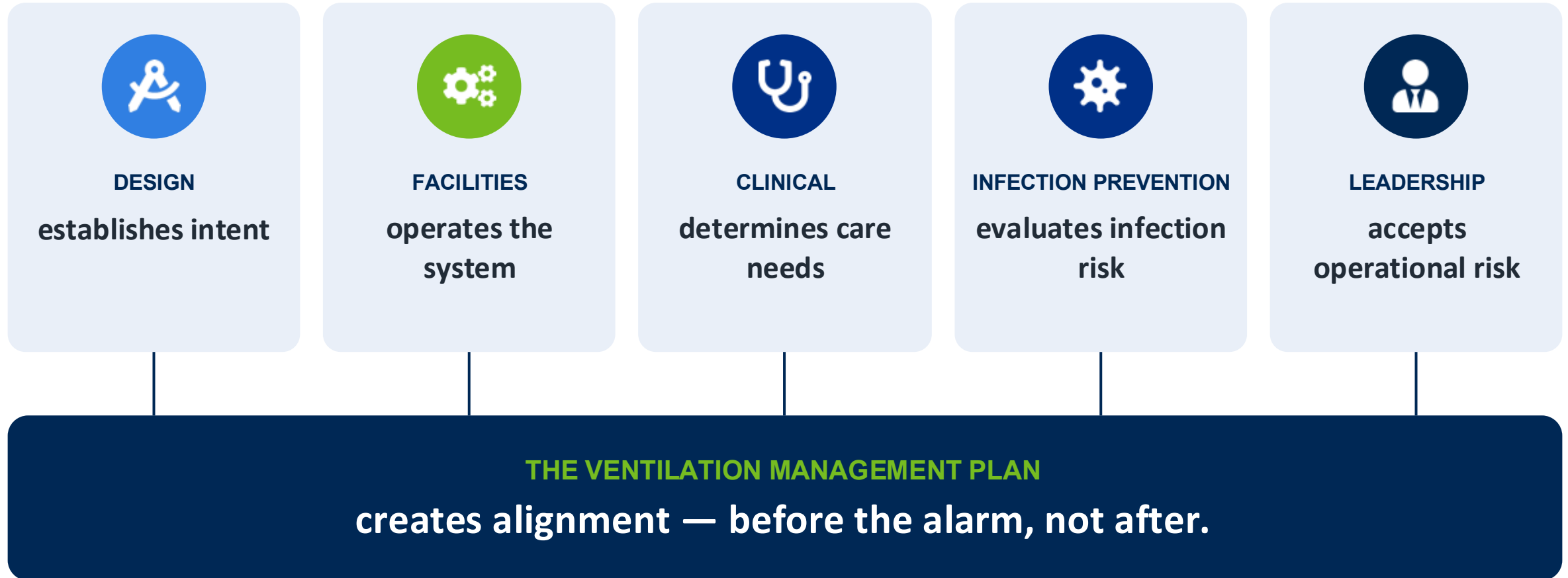
Function of Space	Pressure Relationship to Adjacent Areas(n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors	Air Recirculated by Means of Room Units
AIIR	Negative	2	12	Yes	No

Banner Policy 717, Table 2 — a relationship, no number

We program monitors at 0.01 in. w.c.
— as a benchmark, by choice.

Know what the standard requires before your BMS alarm point becomes your definition of compliance.

So Who Owns the Air?



Everybody owns a piece of the air. The VMP is where the pieces meet.

When Air Happens

1 KNOW THE SPACE

What does this room do today?

MONDAY MORNING

List critical spaces by function — not by the sign.

2 KNOW THE DESIGN

What was it built to — and under which book?

MONDAY MORNING

Find the edition for your oldest OR.

3 KNOW THE CONDITION

Out of range, or out of compliance?

MONDAY MORNING

Write down your time and severity thresholds.

4 KNOW THE RISK

What does this mean for the patient on the table?

MONDAY MORNING

Agree on risk factors with IP and Periop.

5 KNOW WHO DECIDES

Continue, relocate, or cancel — whose call?

MONDAY MORNING

Name the decision-makers before the alarm.

6 DOCUMENT THE RESPONSE

Could you prove it tomorrow?

MONDAY MORNING

Close every excursion with a record.

Monday morning: pick one OR and walk it through all six.

170 + 43

ASHRAE 170

DESIGN INTENT

What the room was designed to do



GUIDELINE 43

OPERATIONAL RESPONSE

How we manage it — every day



SAFE + RESILIENT
clinical environment

170 without 43

A great design with no plan for the bad day.

43 without 170

A response plan with no baseline to defend.

It was never 170 ~~vs.~~ 43. It's 170 + 43 — every day the building is open.

Buildings are designed on paper.
Patients are cared for in the real world.

Air happens.

QUESTIONS? · LET'S KEEP THE CONVERSATION GOING



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SCAN TO CONNECT ON LINKEDIN



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