
PDC
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2017
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& Construction
How You Can “Own”
ASHRAE Standard 170
Ventilation of Health Care Facilities
FLEXIBILITY
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SMITHGROUP JJR

Laurence V. Wilson, P.E.
Principal

SmithGroupJJR

35 E. Wacker Drive, Suite 900
Chicago, IL 60601

Greg Kozlik, MBA, CHFM
Director, Facility Resources

SAINT JOSEPH Health System

5215 Holy Cross Parkway
Mishawaka, IN 46545

Overview of SmithGroupJJR

- Good Morning, my name is Larry Wilson; I'm a Mechanical Engineer w/ SGJJR with a few decades of analytical, design and construction administration experience on health care projects

- SGJJR is a 1200 person A-E firm that has National Experience w/ Local Presence Servicing Sophisticated Clients, Partners

- Body of Work Includes Large, New Construction Projects as well as Small, Complex Renovation Projects

- Proficiency in High-Performance Building System Analysis, Design and Construction Administration

- Culture →*Relationship-Driven (Service), Mission-Driven (Product)*

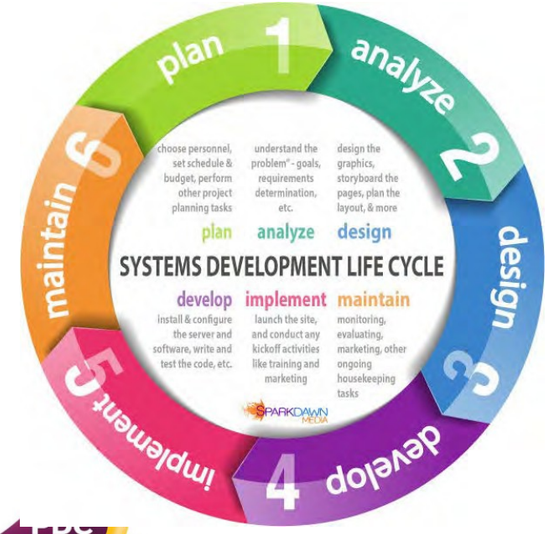
An Engineers' System Philosophy

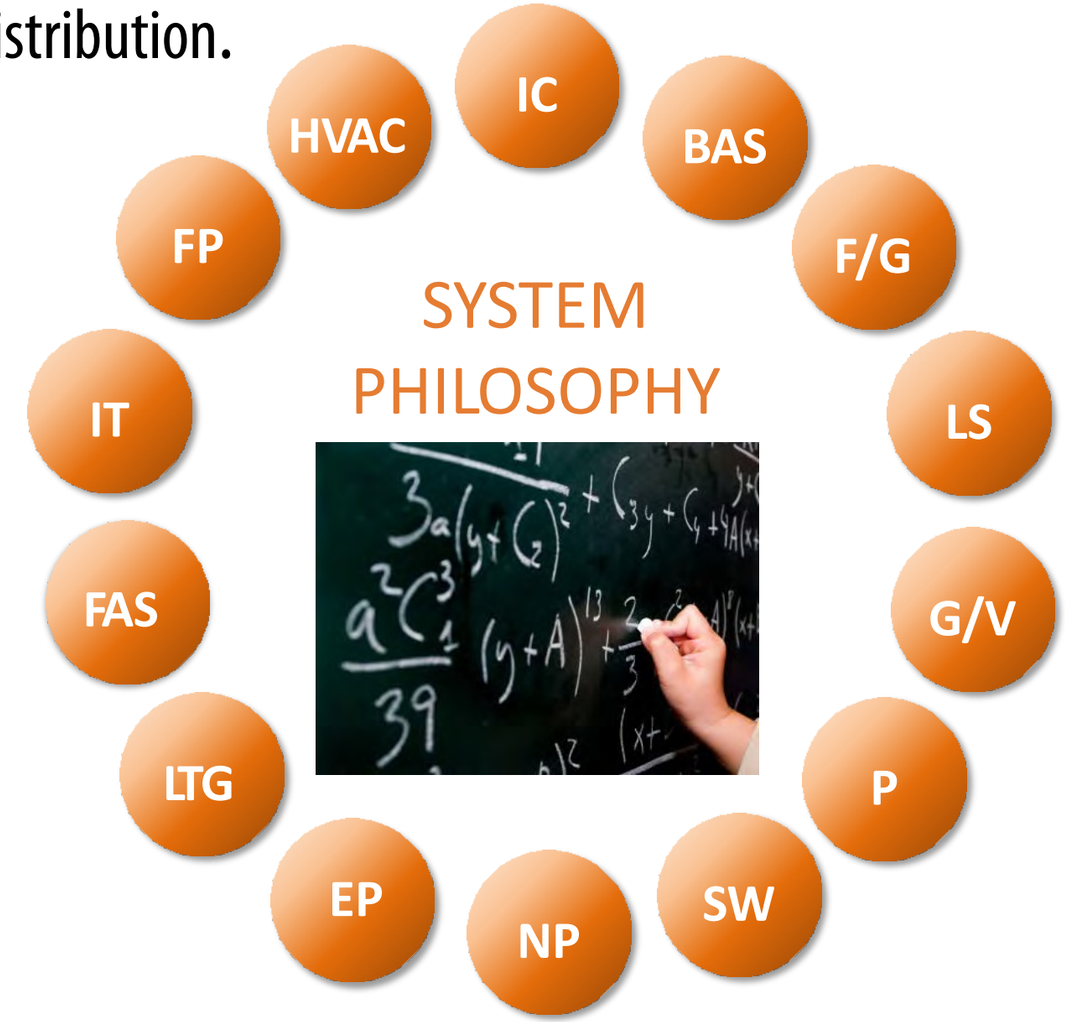
Systems consist of sources and distribution.

Systems:

living entities that are:

- conceived (design)
- born (construction)
- assessed (Cx)
- nurtured (O&M)





HVAC-Heating, Ventilating and Air Conditioning

IC-Instrumentation & Controls

BAS – Building Automation

F/G-Fuel Oil/Natural Gas

LS-Life Safety

G/V – Gas/Vacuum

P -Plumbing

SW-Special Water

NP – Normal Power

EP – Essential Power

LTG – Lighting FAS– Fire Alarm

IT – Information Technology

FP - Fire Protection

HVAC Systems – Sustainable Design Process

- Understand the **Outdoor Environment** completely
- Identify as much positive **External Load** harvesting as possible (solar load in Winter; impacts Envelope)
- Identify as much negative **External Load** reduction as possible (solar load in Summer; impacts Envelope)

- Understand the **Indoor Environment** completely
- Identify as much negative **Internal Load** reduction as possible (but make sure to maintain Program)
- Identify as much positive **Internal Load** harvesting as possible (recoverable heat gain in Winter)

- If the Outdoor Environment doesn't complement the Indoor Environment at every hour of the year, then the envelope will have to reconcile the difference (i.e. heat and mass transfer will occur); **Make the Best Envelope** you can in order to minimize the heat and mass transfer!

HVAC Systems – Sustainable Design Process

- Identify as much **Renewable Energy** as possible
- Identify systems that use modes of **Heat Transfer** such as natural convection or radiation in lieu of forced convection (systems generally don't use conduction directly)
- Identify systems that will satisfy all required **Mass Transfer** (be careful; "mass" means "water"……..)
- Identify the most **Efficient Equipment** possible
- Ensure that your design facilitates the most **Efficient Operations/Maintenance** possible by working directly with the MCE group
- Assess the **Optimum Combination** of all the parameters noted above in order to maximize energy efficiency and O/M while minimizing first cost and energy cost

HVAC Systems – Basis of Design (it's the story of the project)

- Laws/Codes/Standards/Guidelines
- Outdoor Environmental Analysis
- Indoor Environmental Analysis
- Envelope
- Steam, Heating Hot Water Loads
- Chilled Water, Condenser Water Loads
- Systems Description
- Materials
- Contract Considerations
- Unresolved Issues
- Quality Assurance (BS, QC, LL)
- Calculations

HVAC Systems – Basis of Design

Laws/Codes/Standards/Guidelines (critical first step)

- It is critical that a thorough analysis be done on each and every project in order to determine all applicable laws, codes, standards and guidelines.
- Compliance is required with laws and codes.
- Compliance is required with standards and guidelines only if a particular standard or guideline is invoked by a law or code.

HVAC Systems – Basis of Design

Laws/Codes/Standards/Guidelines (critical first step)

- Conflicting requirements must be identified and classified as either simple or complex in terms of their system implications.
- In simple cases, choosing the most conservative solution is usually appropriate.
- In complex cases, variances must be sought in order to satisfy all AHJ's.

HVAC Systems – Basis of Design

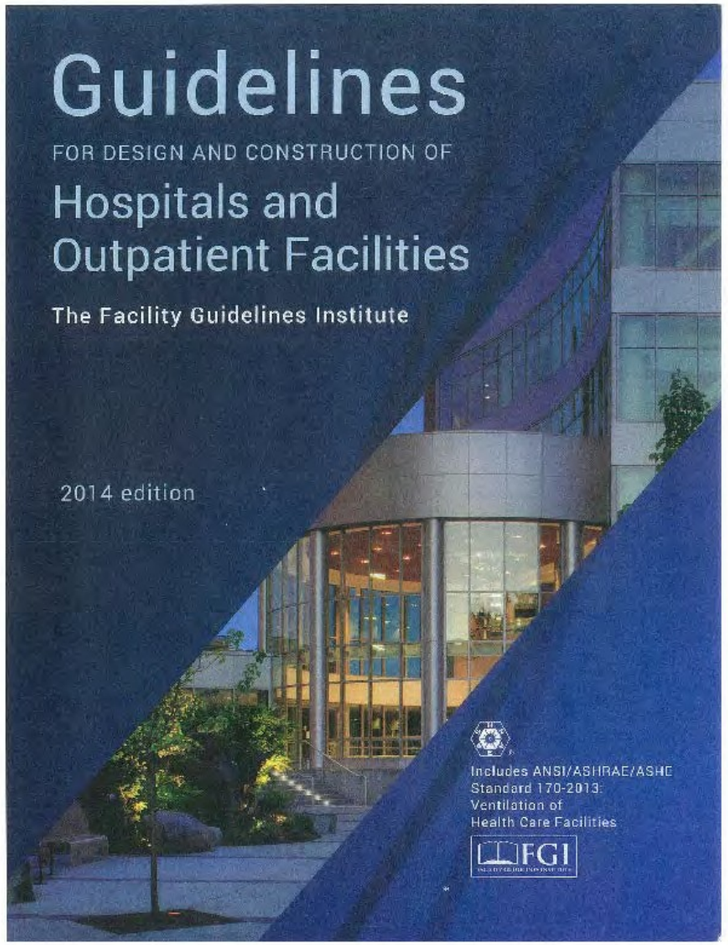
Laws/Codes/Standards/Guidelines (critical first step)

- Keep in mind that getting a "permit to build" a hospital is different from getting a "license to operate" a hospital which is different from getting a hospital "accredited to ensure CMMS reimbursements occur"

HVAC Systems – Basis of Design

Laws/Codes/Standards/Guidelines

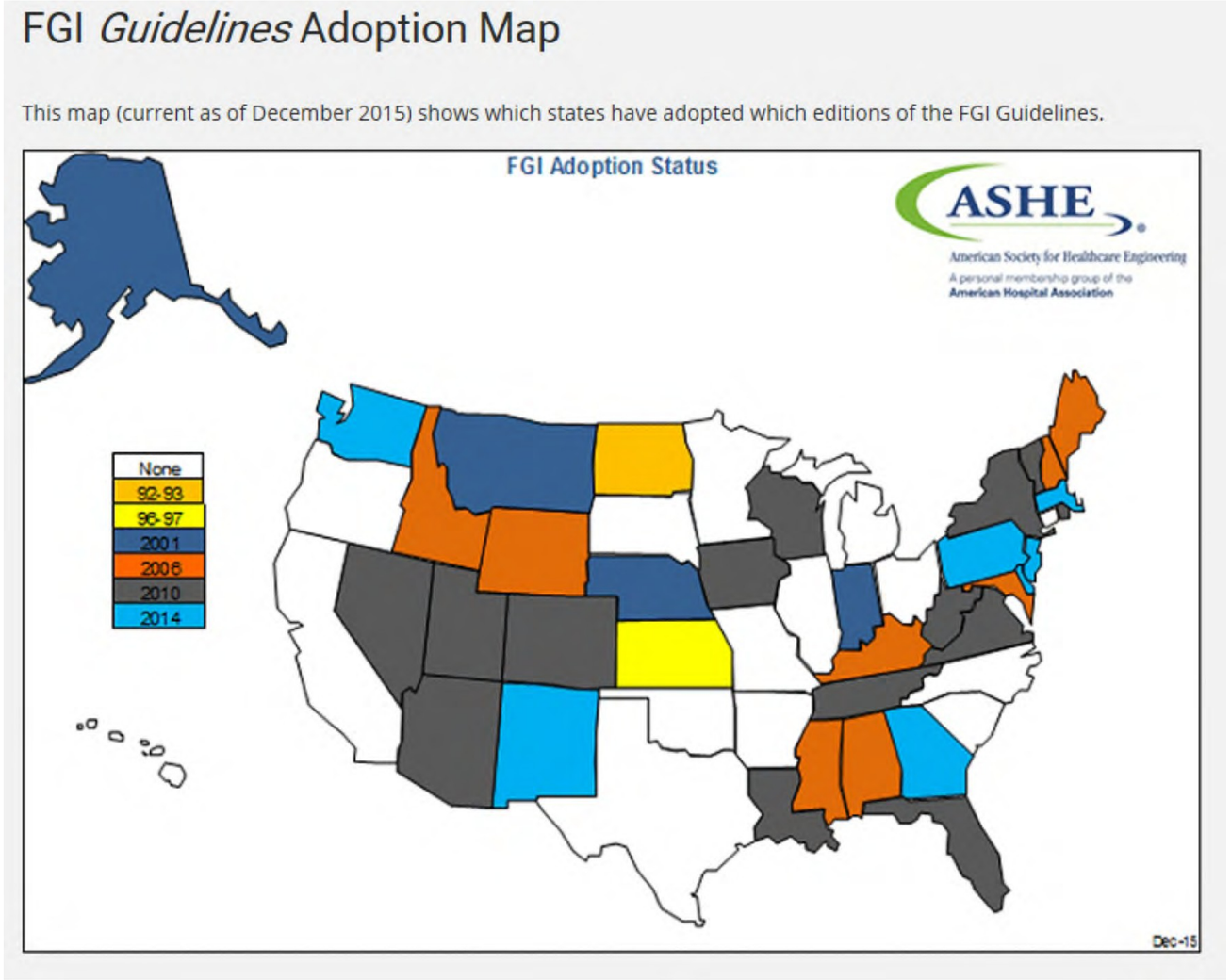
- FGI/AIA Guidelines for Design and Construction of Health Care Facilities, 2014 edition invokes ASHRAE Standard 170-2013; in fact, a copy of the entire standard is included in the document on pp. 369-395.



HVAC Systems – Basis of Design

Laws/Codes/Standards/Guidelines

- Not every state has adopted the same edition of the FGI/AIA Guidelines for Design and Construction of Health Care Facilities; in fact, some states have not adopted any edition of FGI/AIA Guidelines.



CENTERS for MEDICARE & MEDICAID SERVICES

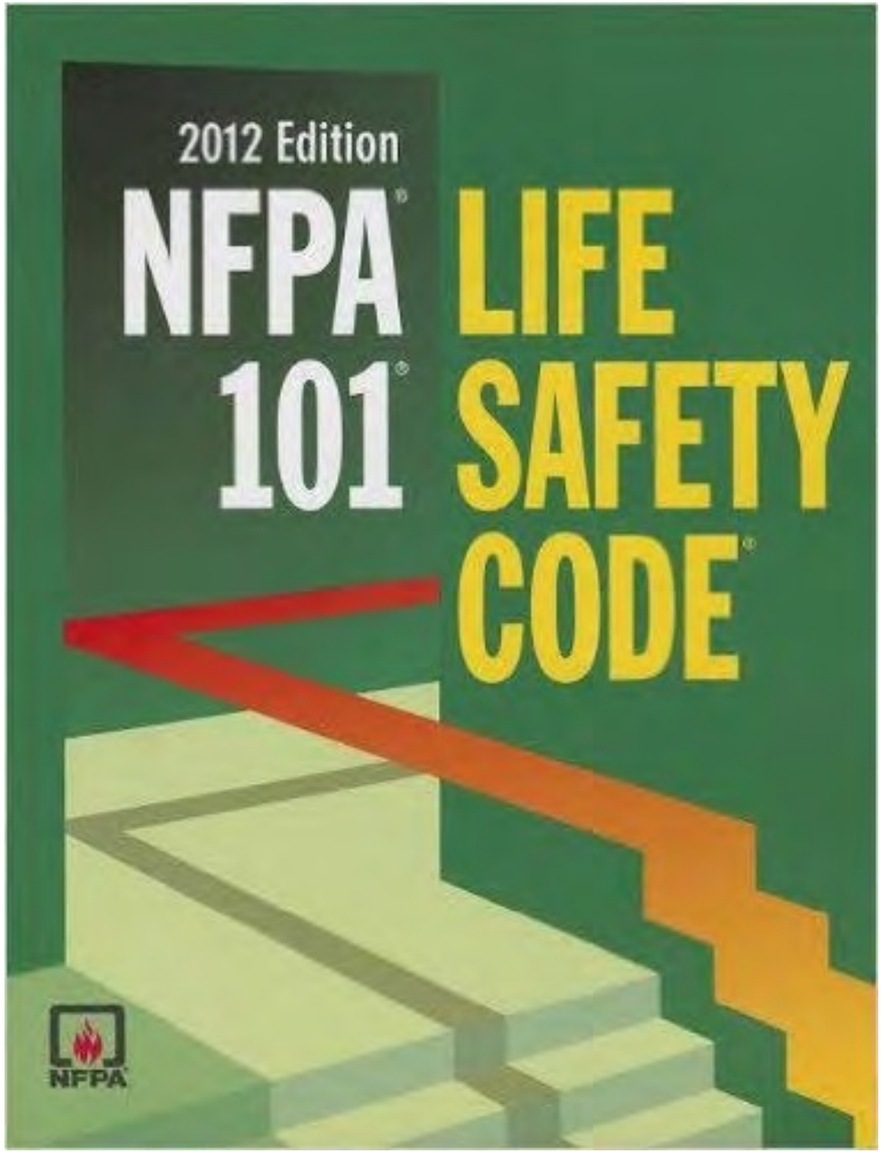
May 3, 2016

In the Spotlight

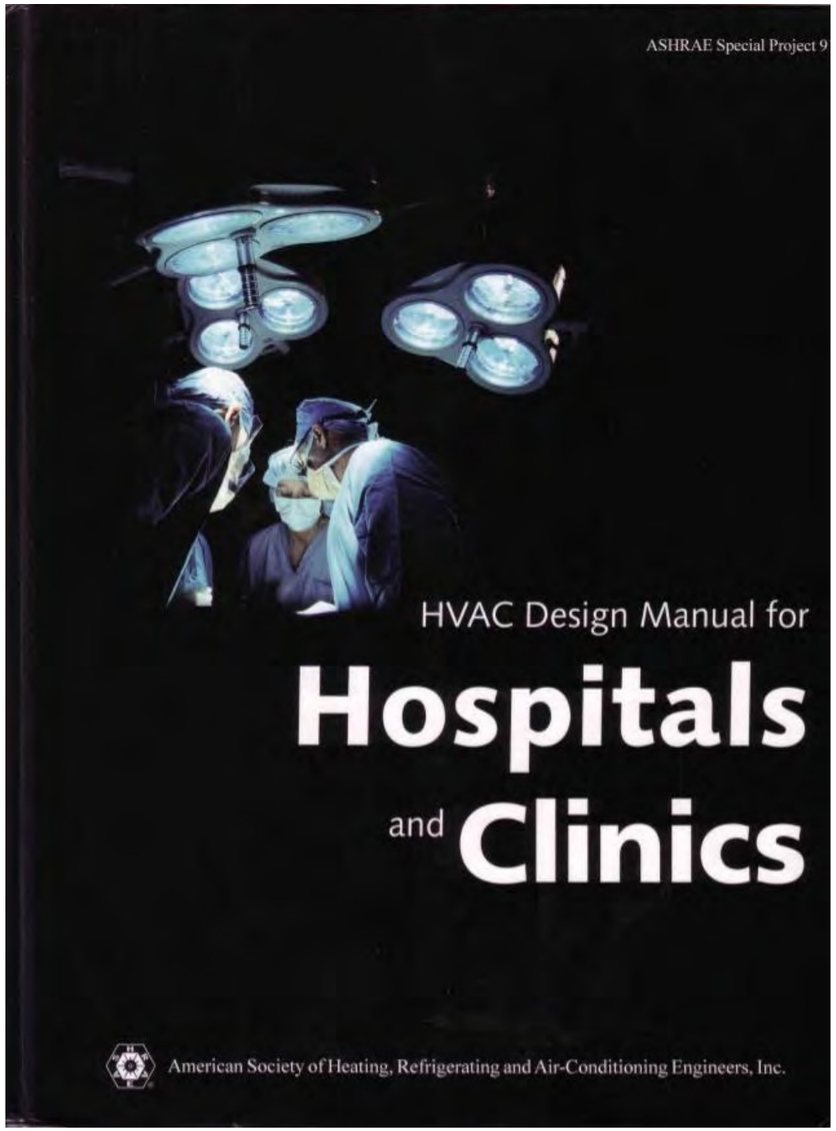
CMS adopts 2012 *Life Safety Code*®

The Centers for Medicare & Medicaid Services (CMS) has adopted the 2012 editions of NFPA 101 and NFPA 99, effective July 5. CMS made several changes to the code. For example, the emergency preparedness chapter of NFPA 99 is not included in the adoption. An ASHE Advocacy Alert sent to members earlier today outlines the changes. The alert, the full rule from CMS, and rule excerpts specific to hospitals are available on the ASHE website. ASHE will continue to keep members informed about the latest developments on this topic.

Continue reading



Hospital Design Manual for Hospitals and Clinics, 2003



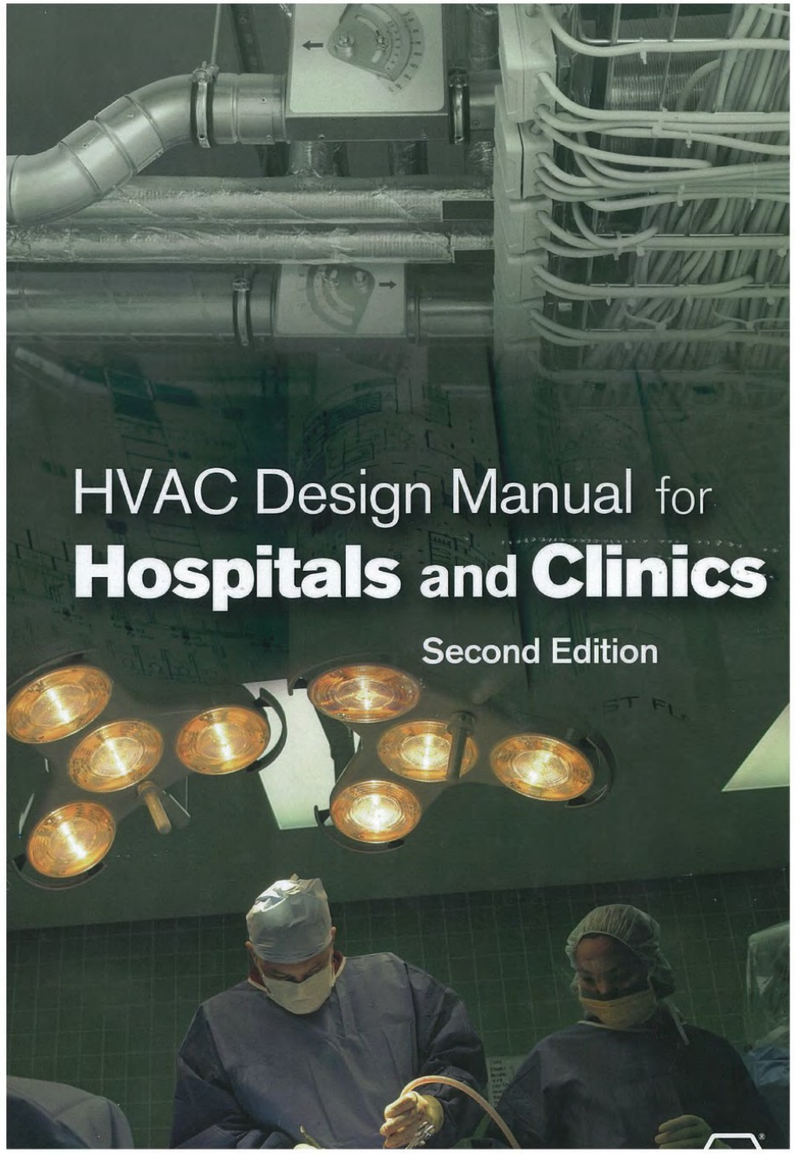
ASHRAE Standard 170-2008

The standard was created, in part, because of the risk that the 2003 ASHRAE HVAC Design Manual for Hospitals and Clinics would be invoked by various AHJ's (in much the same way that the ASHRAE Applications Handbook has been invoked over the years by various state departments of health) – AHJ's invoking documents written in a form that is not a proper standard could create confusion , problems or liability (the Design Manual is not a consensus document).

The standard also creates an opportunity to incorporate new research and technology without having to write another book.

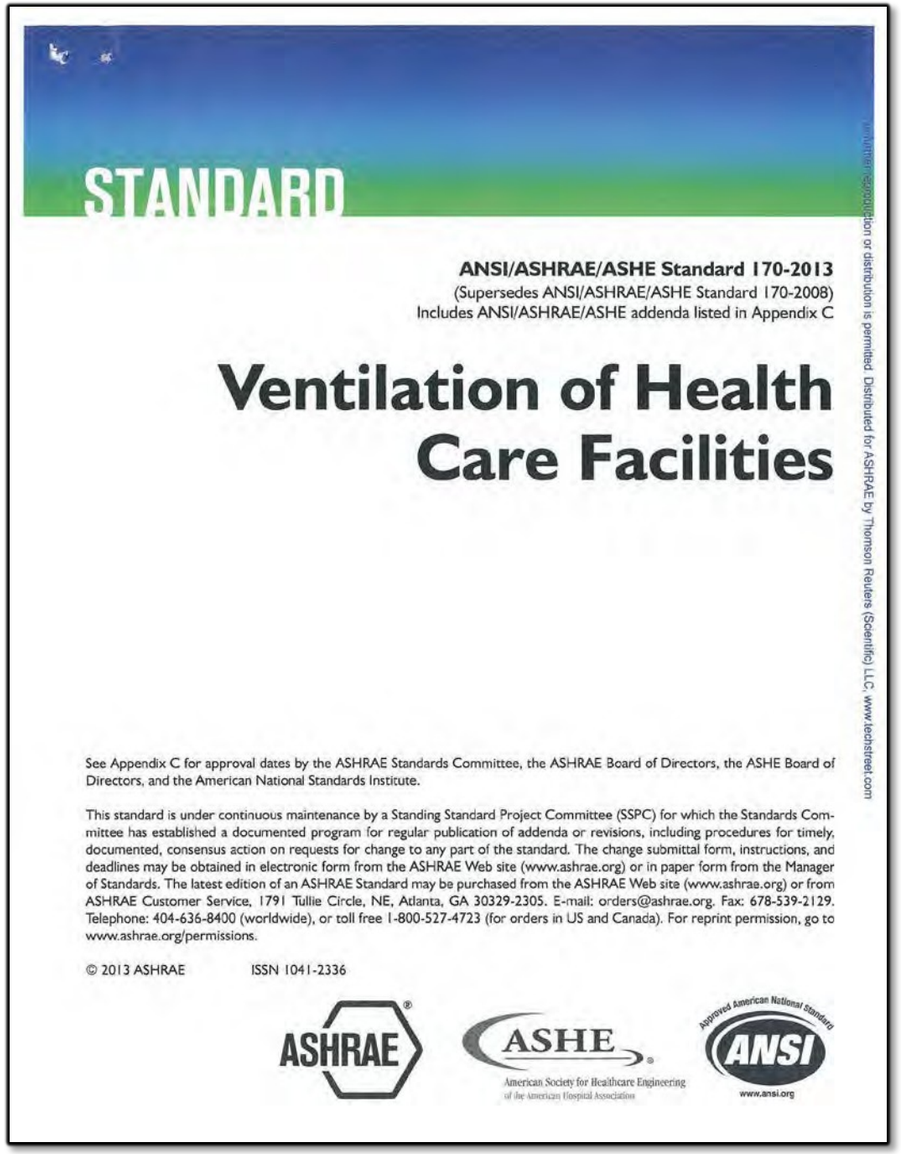
The Design Manual complements the Standard.

Hospital Design Manual for Hospitals and Clinics, 2013



ASHRAE Standard 170-2013

- The standard was updated, in part, because of the risk that the 2013 ASHRAE HVAC Design Manual for Hospitals and Clinics would be invoked by various AHJ's (in much the same way that the ASHRAE Applications Handbook has been invoked over the years by various state departments of health) – AHJ's invoking documents written in a form that is not a proper standard could create confusion , problems or liability (the Design Manual is not a consensus document).
- The standard also creates an opportunity to incorporate new research and technology without having to write another book.
- The Design Manual complements the Standard.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Includes ANSI/ASHRAE/ASHE addenda listed in Appendix C

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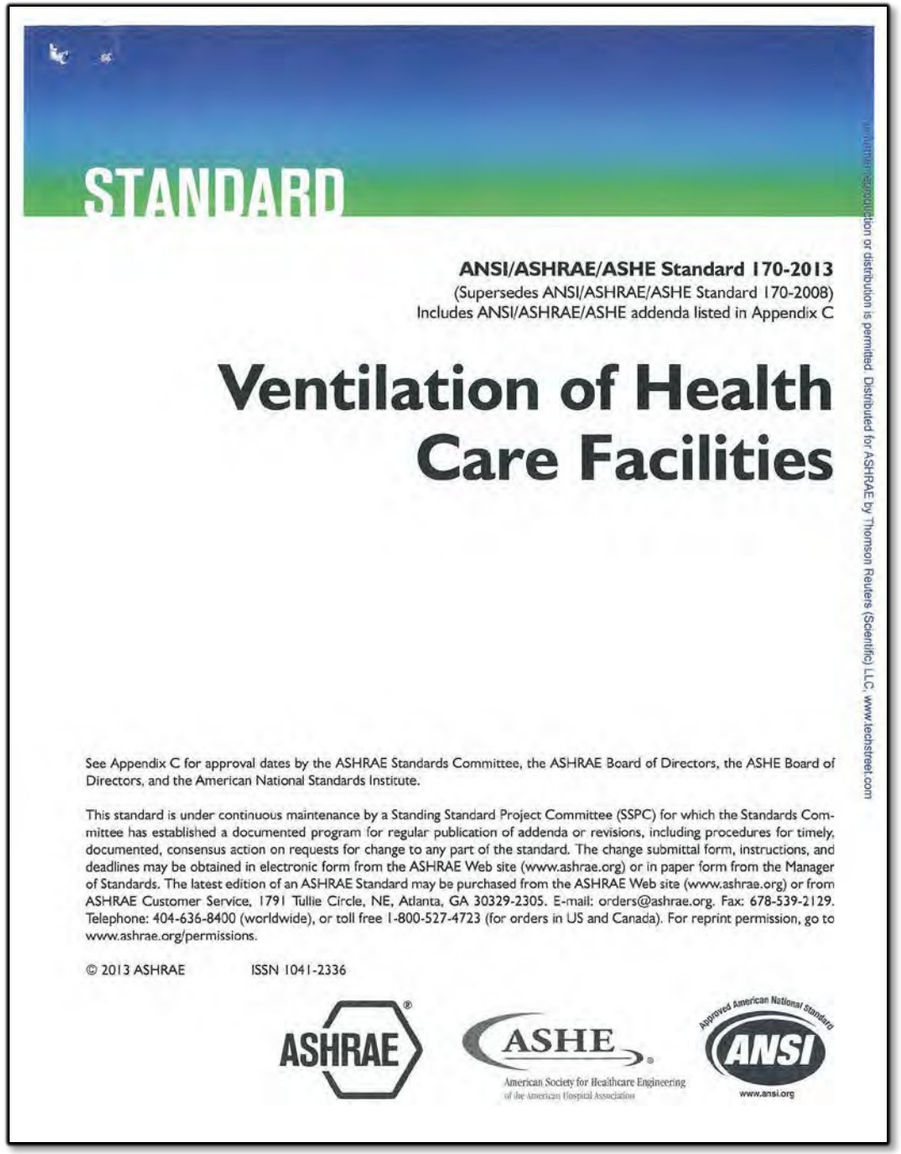
ASHRAE Standard 170-2013

- Sponsored jointly by ASHRAE and ASHE – unique when it first occurred!

- Consensus standard currently under "continuous maintenance" by ASHRAE Standing Standard Project Committee 170 and Technical Committee 9.6 – Health Care Facilities (read: continuous improvement)

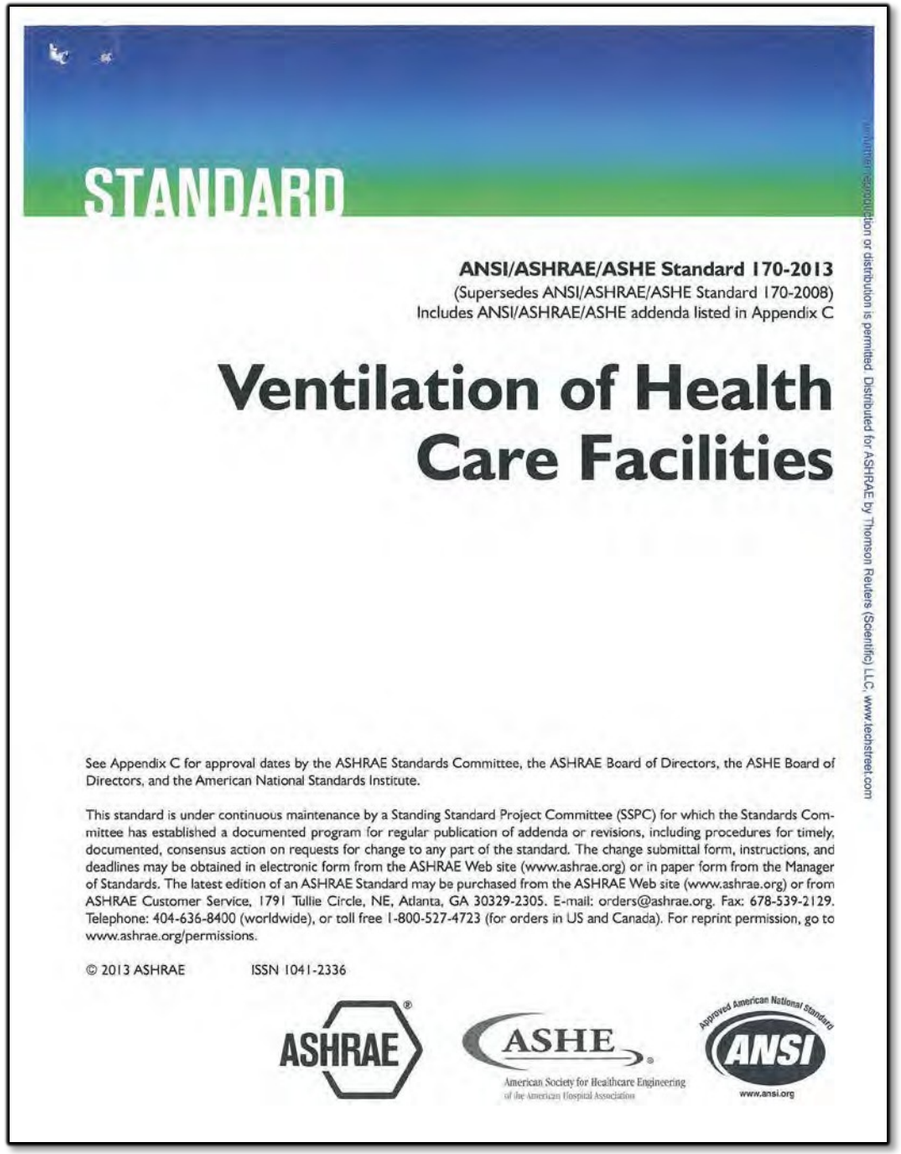
- Written in mandatory and enforceable language so it can be more easily invoked by AHJ's



1.0 Purpose

Purpose is to define HVAC system parameters (both at the source and out in the distribution) aimed at improving comfort, minimizing the risk of contamination control and minimizing the potential for odors in health care facilities.

- Planning
- Design
- Construction
- Operations
- Maintenance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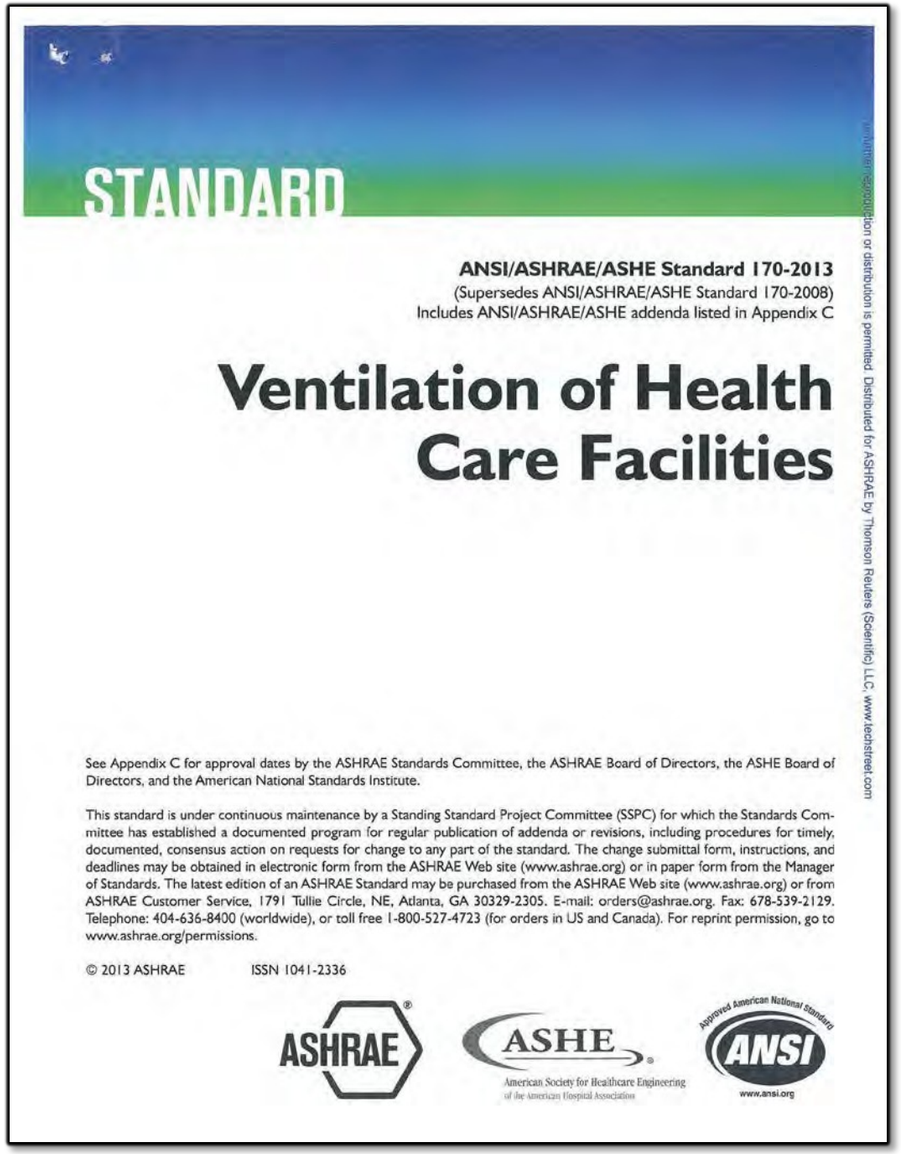
1.0 Purpose

Purpose is to define HVAC system parameters (both at the source and out in the distribution) aimed at improving comfort, minimizing the risk of contamination control and minimizing the potential for odors in health care facilities.

- Achieving comfort per ASHRAE Standard 170 does not guarantee compliance with ASHRAE Standard 55--Thermal Comfort (Tdb, Tmrt, RH, draft); design engineers must do Standard 55 calcs and adjust design within the constraints of Standard 170
- Achieving comfort per ASHRAE Standard 170 does not guarantee compliance with ASHRAE Standard 62.1---Acceptable Indoor Air Quality



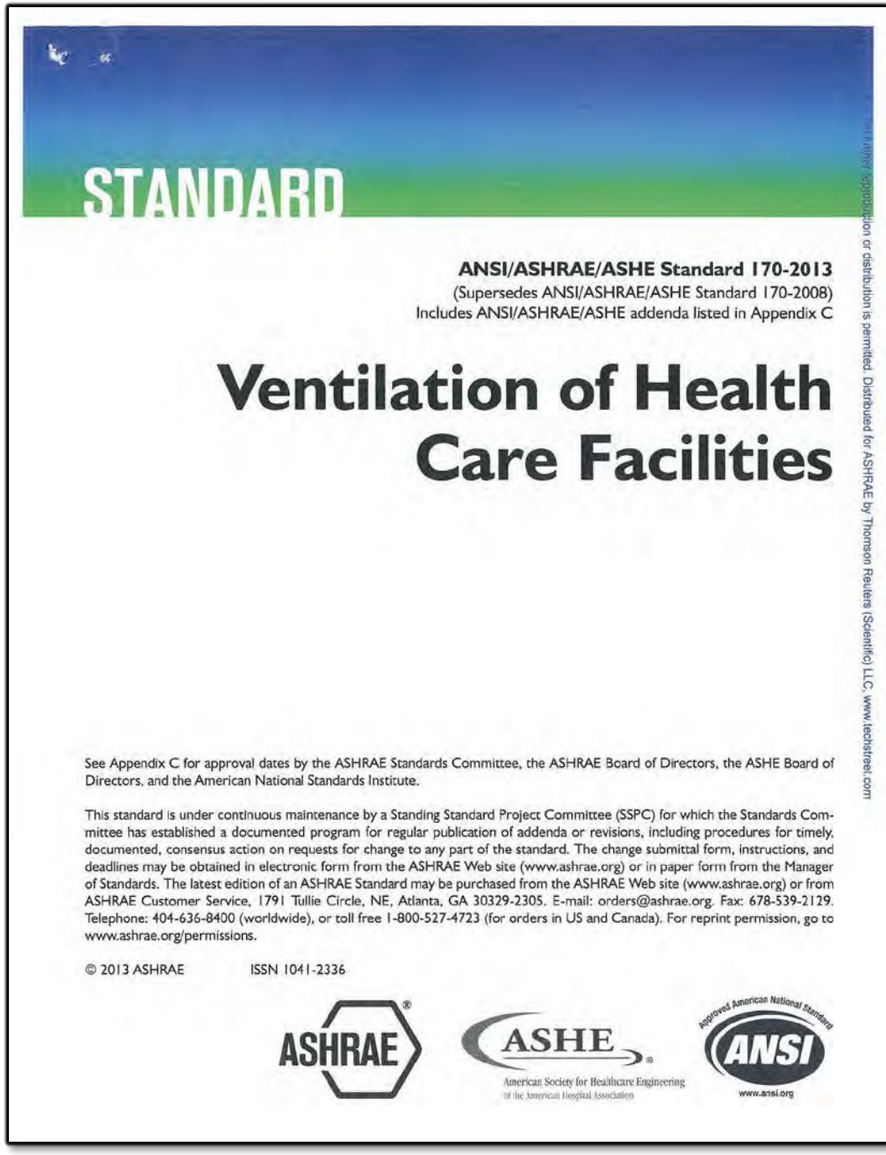
1.0 Purpose

- Contamination Control = asepsis environment = state of being free from particulates, particularly bacteria, viruses and fungi….HVAC is dominant

is not the same as

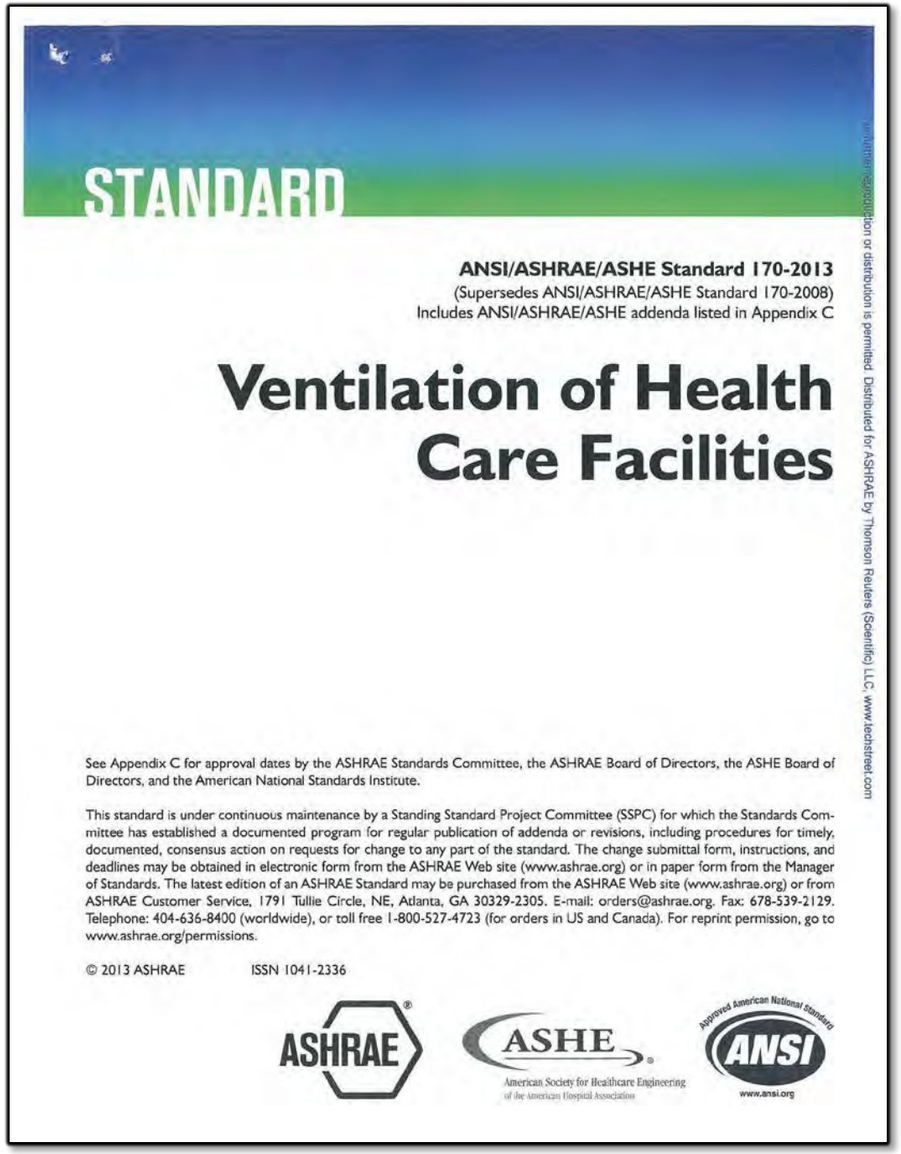
Infection Control = (dose x site x virulence x time)/(level of host defense)

…….HVAC is secondary



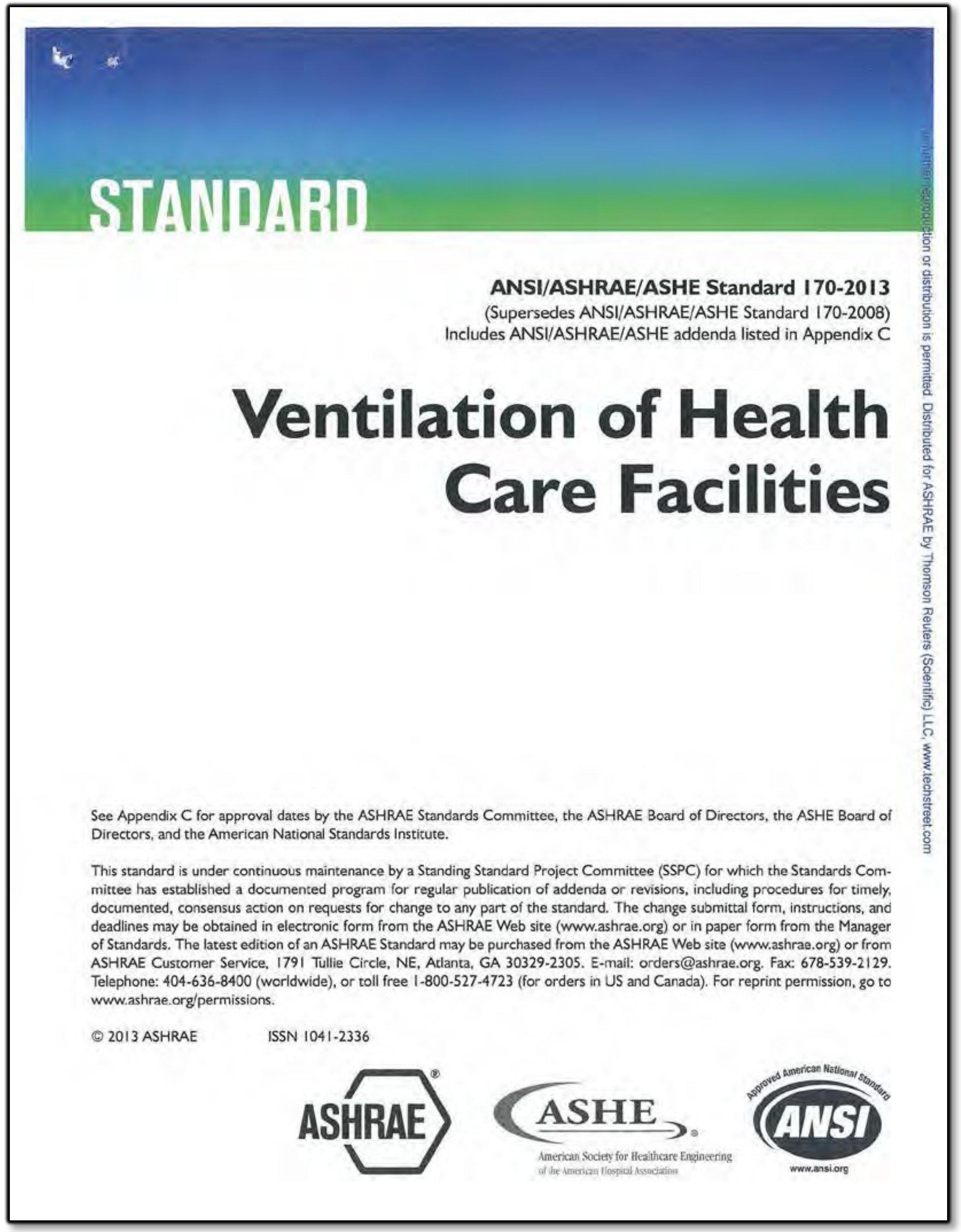
2.0 Scope

Scope applies to new buildings, additions, renovations and infrastructure upgrades for hospitals, ambulatory care centers and nursing facilities during both the design phase and the construction phase of a project (addresses O&M in an informational way only).



3.0 Definitions

<u>Definitions</u> includes some very specific medical and technical terms; it's important for architects, engineers and health care workers to all understand the vocabulary they'll need to use when communicating with each other about common problems despite the very different worlds they each move around in!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American College of Surgeons – Guidelines for Optimal Ambulatory Surgical Care and Office-Based Surgery, 2000

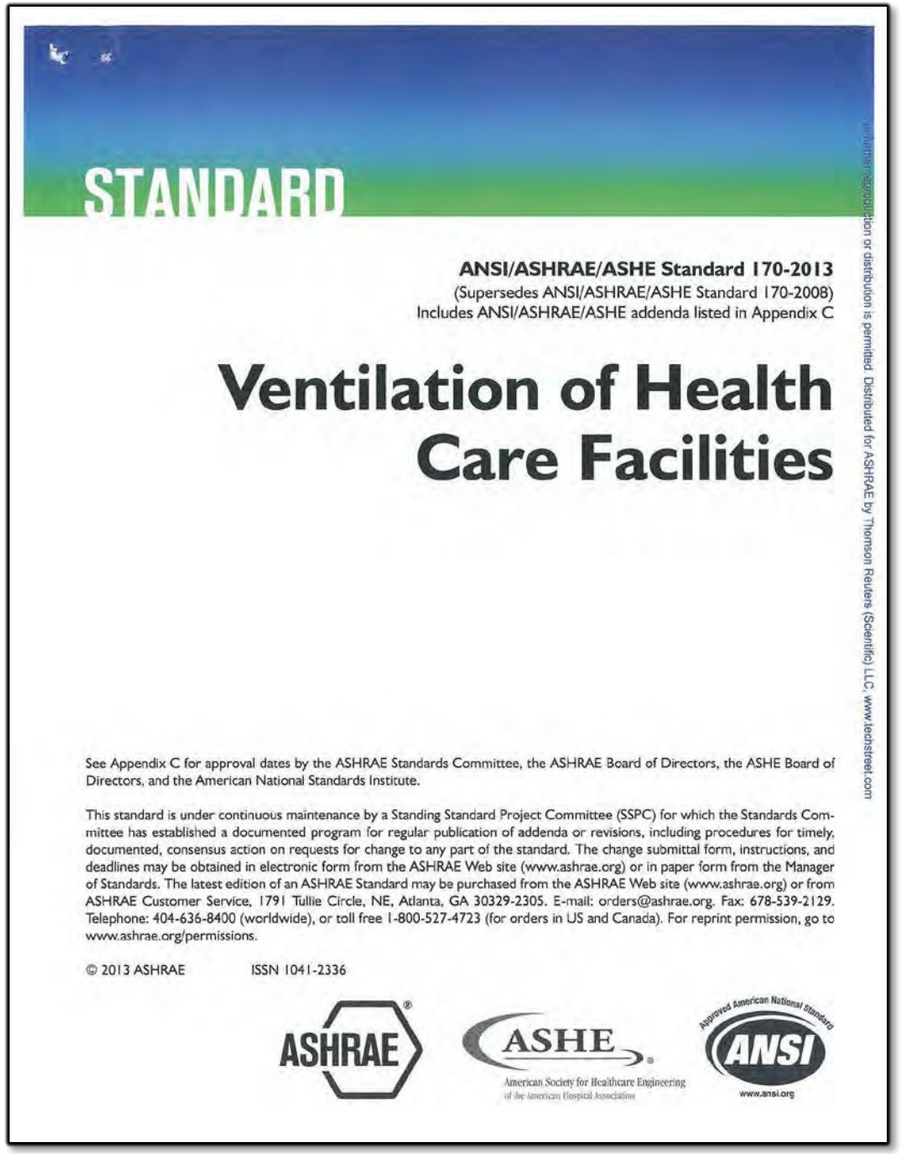
- Class A: Minor Surgical Procedures Performed Under Topical and Local Infiltration Blocks with or without Preoperative Sedation (Spinal, Epidural, Auxiliary, Stellate Ganglion Blocks, Regional Blocks, Supraclavicular, Infraclavicular, and Intravenous Regional Anesthesia are Excluded)

- Class B: Minor or Major Surgical Procedures Performed in Conjunction with Oral, Parenteral, or Intravenous Sedation or Performed with the Patient Under Analgesic or Dissociative Drugs

- Class C: Major Surgical Procedures that Require General or Regional Block Anesthesia and Support of Vital Bodily Functions

4.0 Compliance

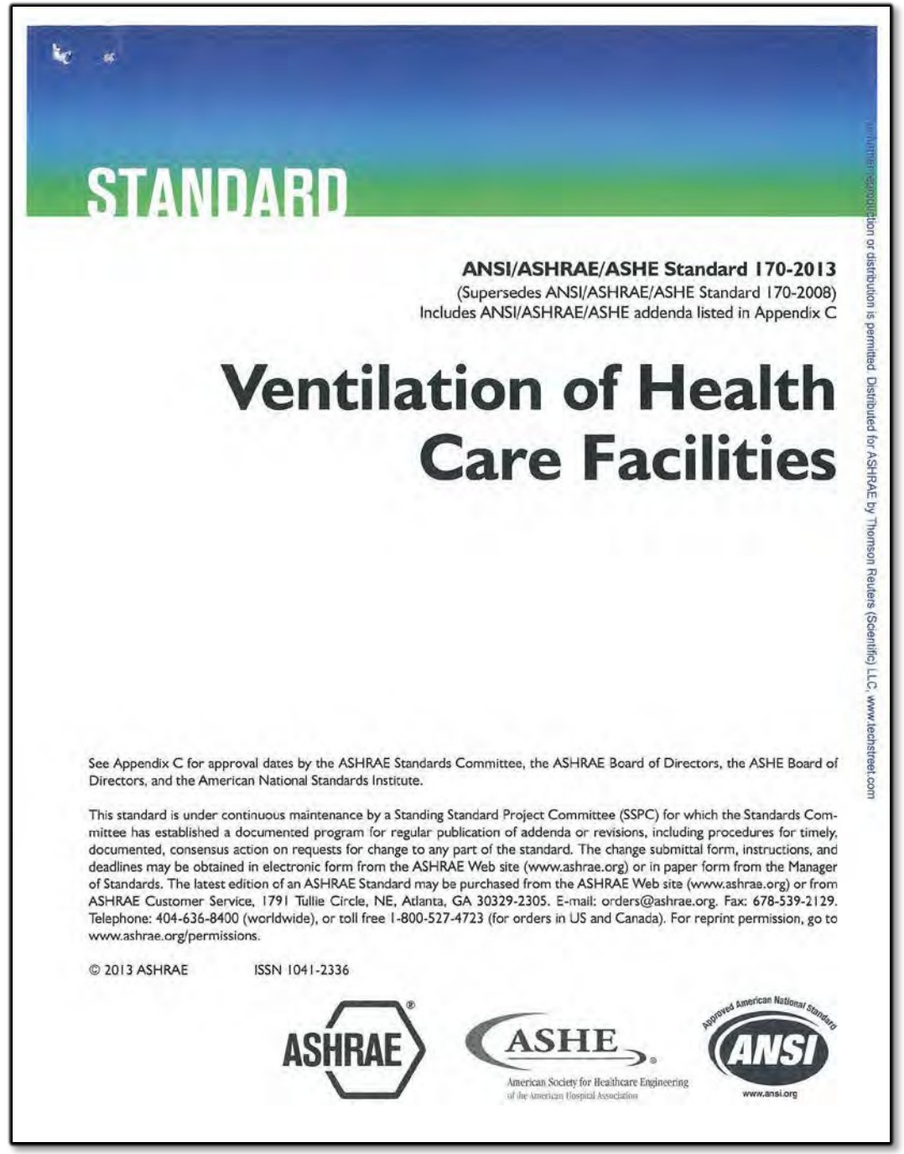
Compliance applies to both new buildings as well as additions and alterations to existing buildings/systems/spaces; the documentation required includes BoD with calcs as well as plans and specs; alternates to the prescriptive criteria put forward can always be put forward to the AHJ for their approval



5.0 Planning

Planning requires that the Owner prepare a detailed Program (ASHRAE defines this as an Owners Program Requirement (OPR)).

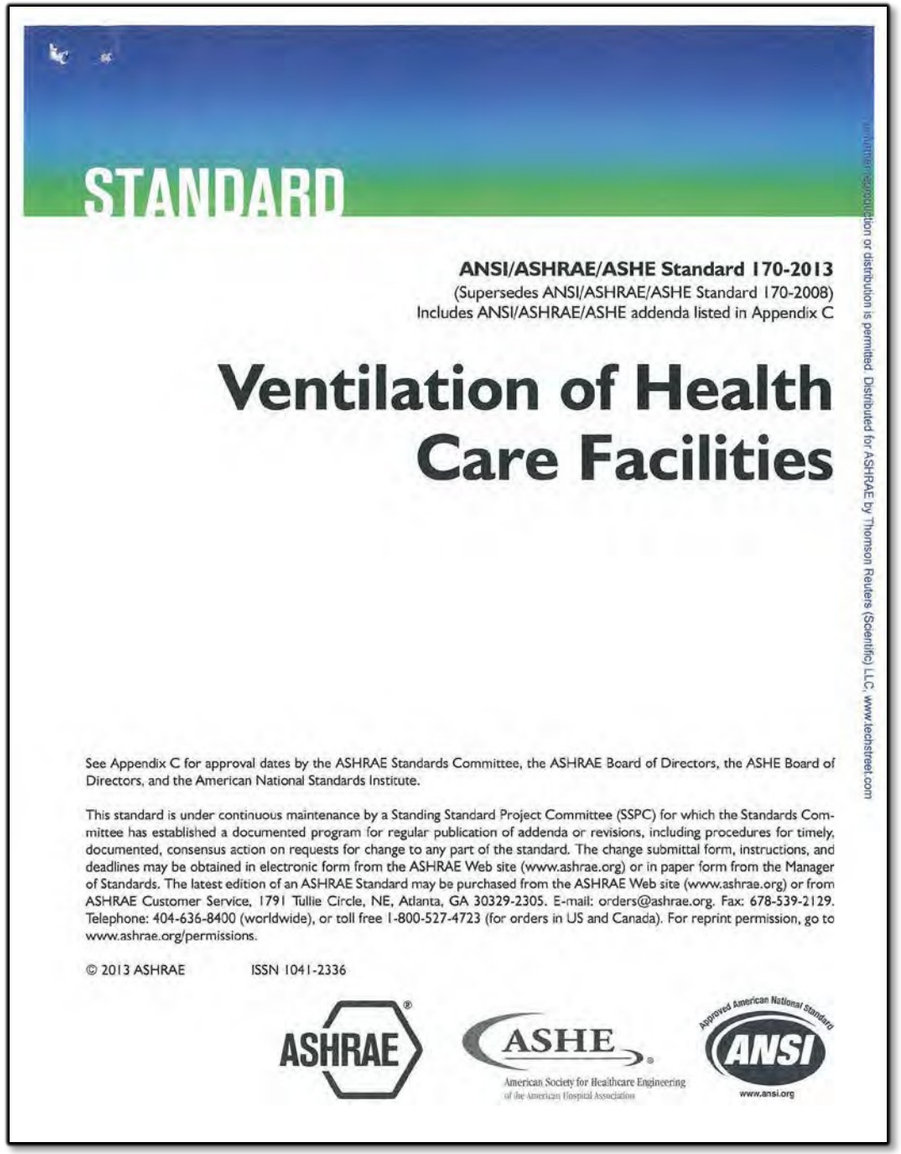
- define clinical needs including FF&E
- define research needs including FF&E
- define educational needs including FF&E
- define risk categories per NFPA 99-2012
- define administrative needs including FF&E
- define facility groups' needs (last but not least!)



ASHRAE Standard 170-2013-Errata

Issued February 27, 2014

- typo on inside cover page
- changed reference from 2013 Fundamentals to 2009 Fundamentals for Space Air Diffusion (air outlets)
- added four (4) D & T rooms types to Table 7.1 (dialysis treatment area, dialyzer reprocessing room, nuclear hot medicine lab, nuclear med treatment room)
- delete reference for Duct Design per the 2013 Fundamentals; change reference for Space Air Diffusion from 2013 Fundamentals to 2009 Fundamentals; typo in reference to 2013 Design Manual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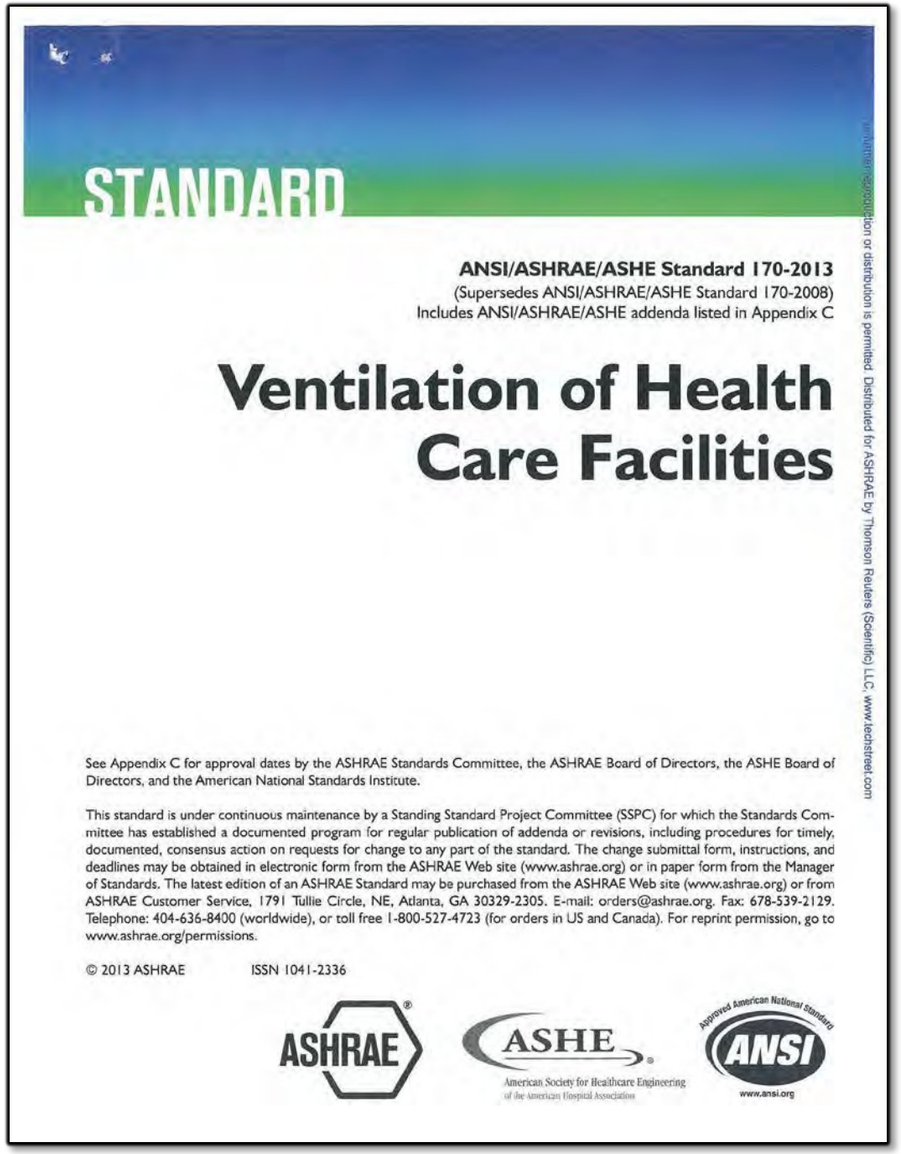
ASHRAE Standard 170-2013-Errata

Issued July 16, 2014

- disregard footnote (x) next to "treatment room" in Table 7.1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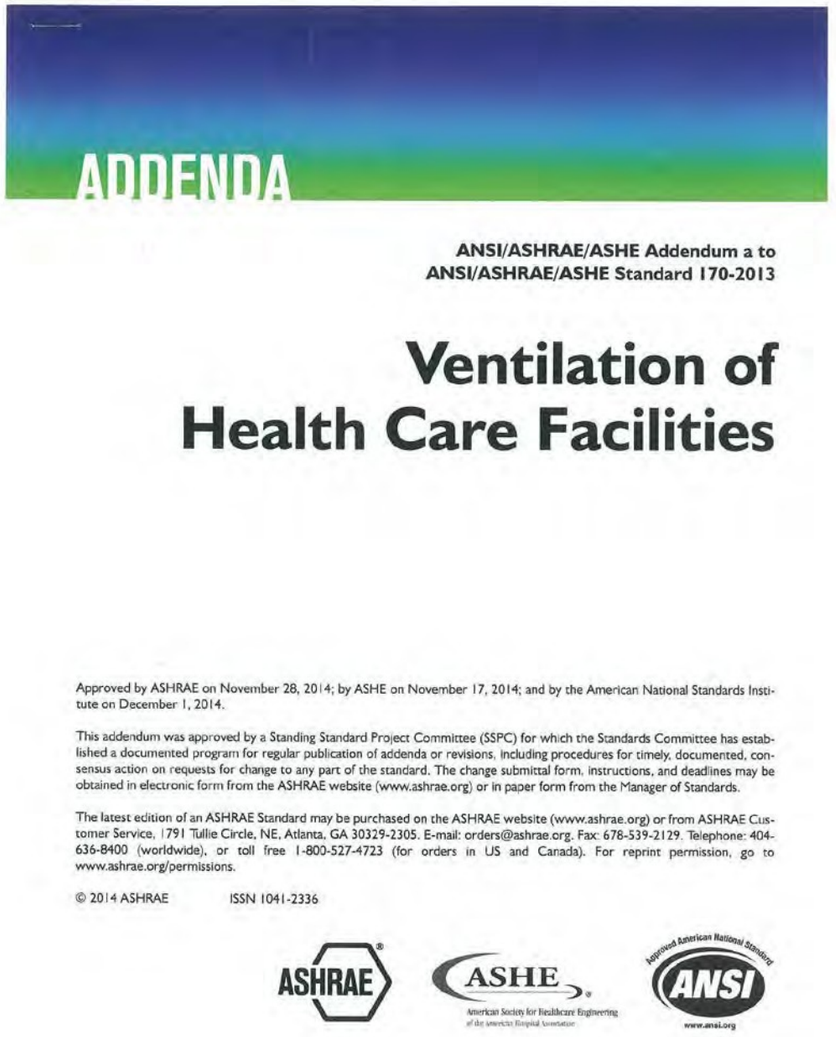
ASHRAE Standard 170-2013-Addendum (a)

- Approved by ASHE 11-17-2014
- Approved by ASHRAE Standards Committee 11-28-2014
- Approved by ASHRAE Board of Directors-xx-yy-zzzz
- Approved by ANSI 12-1-2014

- Separation between gas-fired packaged rooftop unit flue discharge and outdoor air intake can be less than 25 feet as originally defined in paragraph 6.3.1.1 as long as the separation distance meets or exceeds the separation distance noted in the 2010 edition of ASHRAE Standard 62.1 (happens to be 15 feet)


ADDENDA

ANSI/ASHRAE/ASHE Addendum a to
ANSI/ASHRAE/ASHE Standard 170-2013

Ventilation of
Health Care Facilities

Approved by ASHRAE on November 28, 2014; by ASHE on November 17, 2014; and by the American National Standards Institute on December 1, 2014.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE website (www.ashrae.org) or in paper form from the Manager of Standards.

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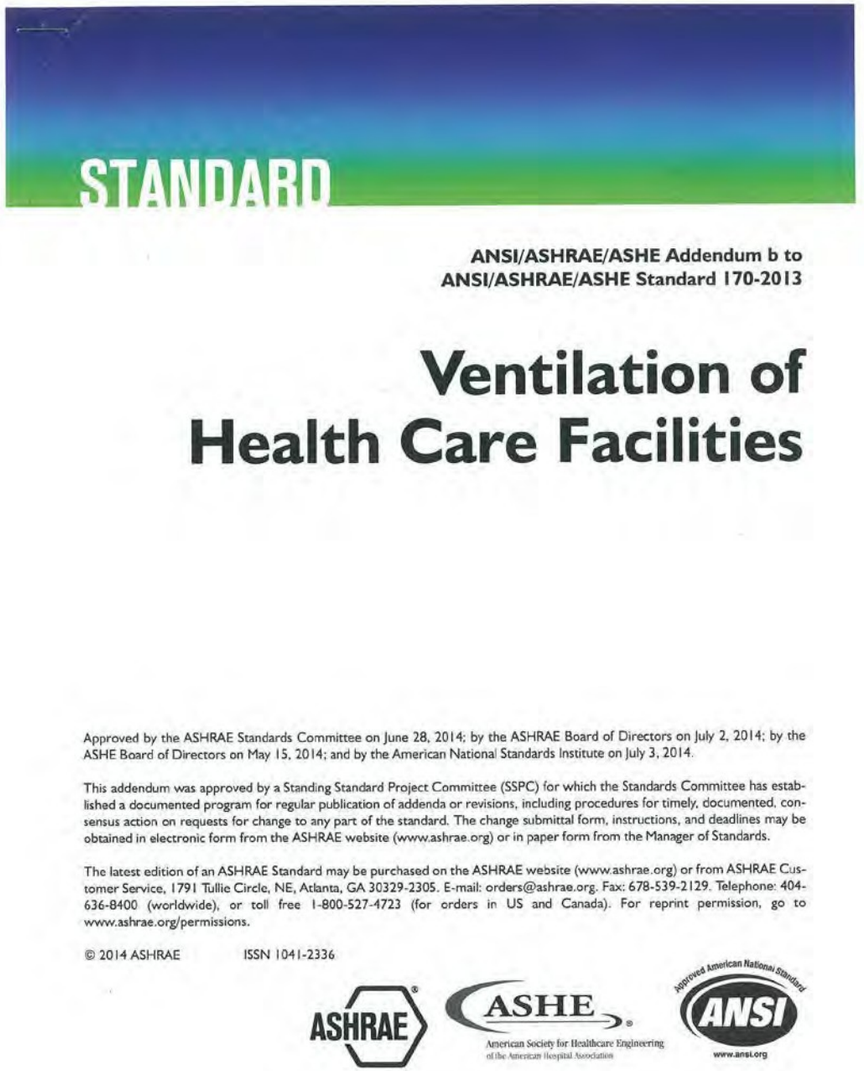
ASHRAE Standard 170-2013-Addendum (b)

- Approved by ASHE 5-15-2014
- Approved by ASHRAE Standards Committee 6-28-2014
- Approved by ASHRAE Board of Directors 7-2-2014
- Approved by ANSI 7-3-2014



- Added CDC references to definition of All room in Section 3 (definitions)
- Delete reference to FGI 2010 related to“heating and cooling sources” in paragraph 6.1.2.1
- Delete reference to FGI 2010 related to“filtration”in paragraph 6.4

ASHRAE Standard 170-2013-Addendum (b)

- Approved by ASHE 5-15-2014
- Approved by ASHRAE Standards Committee 6-28-2014
- Approved by ASHRAE Board of Directors 7-2-2014
- Approved by ANSI 7-3-2014

- Changed USP reference year from 2013 to 2012 in footnote (b) to Table 7.1; Deleted reference to FGI 2010 in footnote (i) to Table 7.1
- Changed reference to Standard 55-2010 to Standard 55-2013 related to PE Rooms in paragraph 7.2.2


STANDARD

ANSI/ASHRAE/ASHE Addendum b to
ANSI/ASHRAE/ASHE Standard 170-2013

Ventilation of
Health Care Facilities

Approved by the ASHRAE Standards Committee on June 28, 2014; by the ASHRAE Board of Directors on July 2, 2014; by the ASHE Board of Directors on May 15, 2014; and by the American National Standards Institute on July 3, 2014.

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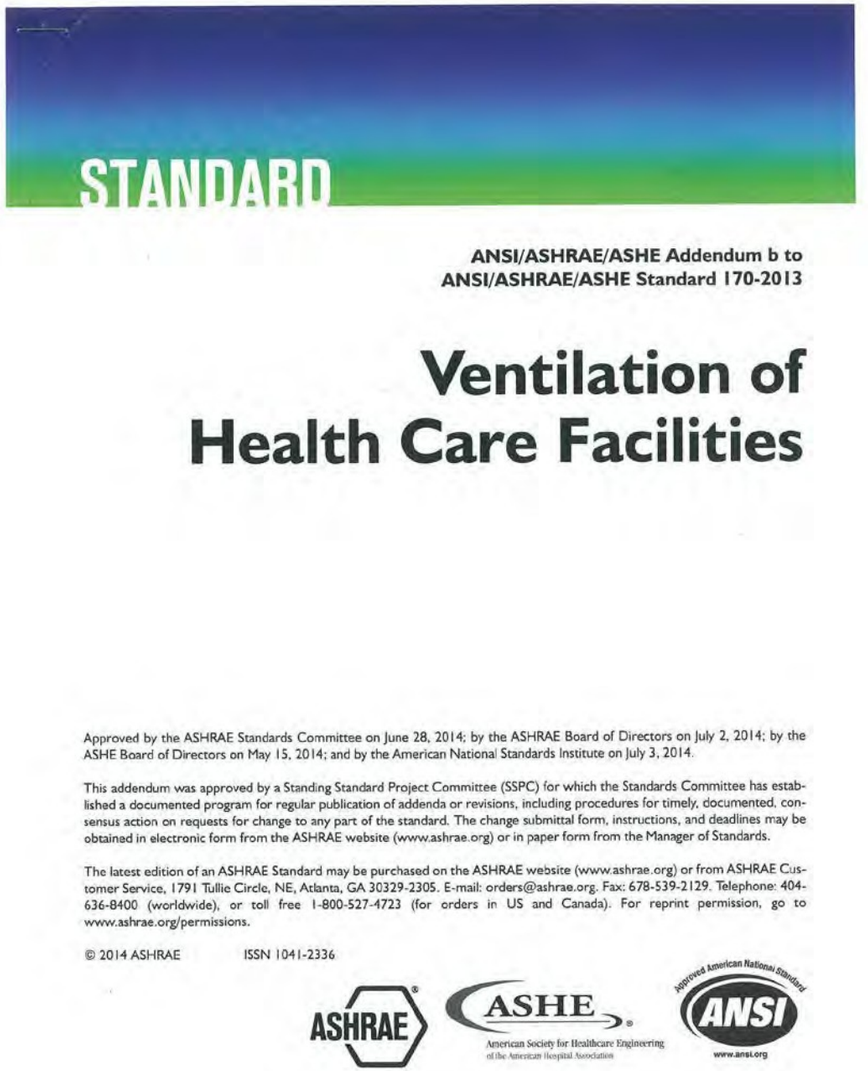
ASHRAE Standard 170-2013-Addendum (b)

- Approved by ASHE 5-15-2014
- Approved by ASHRAE Standards Committee 6-28-2014
- Approved by ASHRAE Board of Directors 7-2-2014
- Approved by ANSI 7-3-2014

- Various changes to Section 9.0 – Normative References (deleted reference to OSHA, changed years of several other documents,etc.)
- Various changes to Appendix B – Informative References and Bibliography (changed years of a couple of documents)


STANDARD

ANSI/ASHRAE/ASHE Addendum b to
ANSI/ASHRAE/ASHE Standard 170-2013

Ventilation of
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ASHRAE Standard 170-2013-Addendum (c)

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- Approved by ASHRAE Standards Committee 5-31-2016
- Approved by ASHRAE Board of Directors xx-yy-zzzz
- Approved by ANSI 6-1-2016

- Added filter clarification in table 6.4 for "laboratory work areas"
- Added clarification in table 7.1 for "laboratory work areas" and added a footnote that allows for deviations from cited air change per hour rate based on further design analysis
- Added references associated with lab design


STANDARD

ANSI/ASHRAE/ASHE Addendum b to
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ASHRAE Standard 170-2013-Addendum (d)

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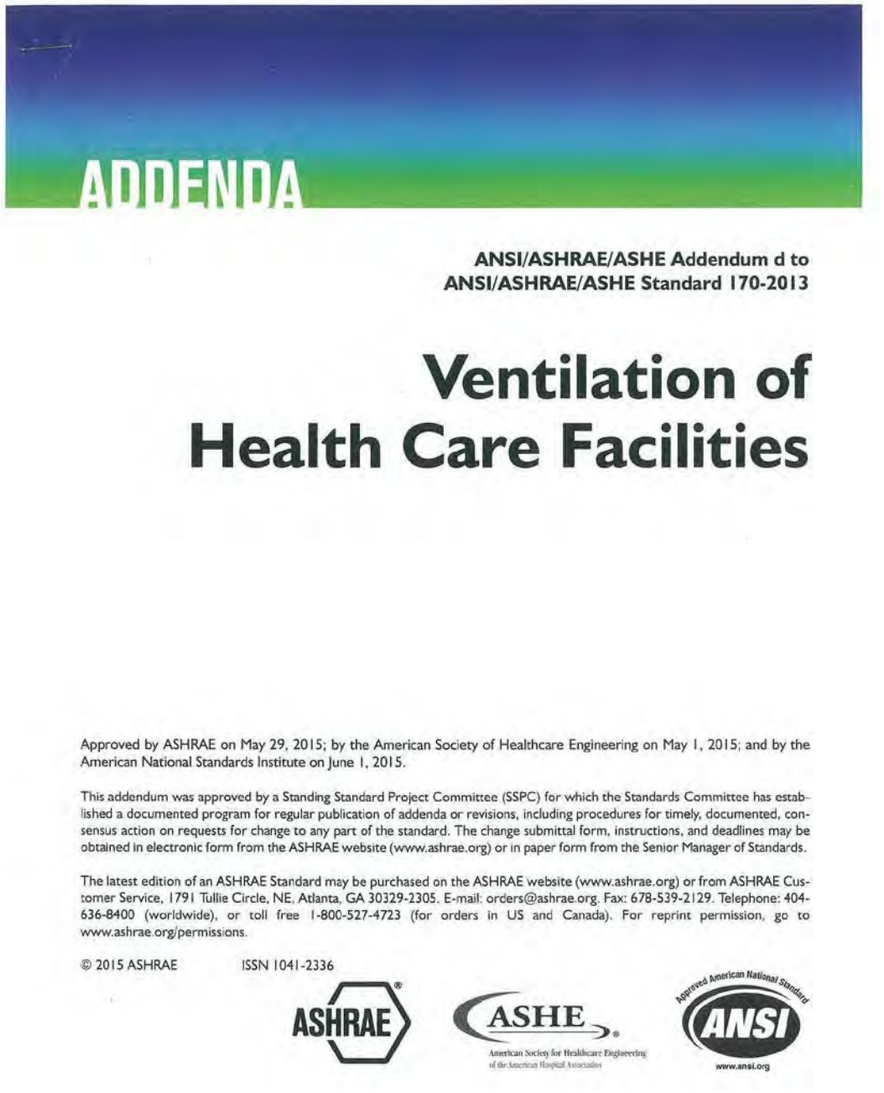
- Approved by ASHRAE Standards Committee 5-29-2015
- Approved by ASHRAE Board of Directors xx-yy-zzzz
- Approved by ANSI 6-1-2015

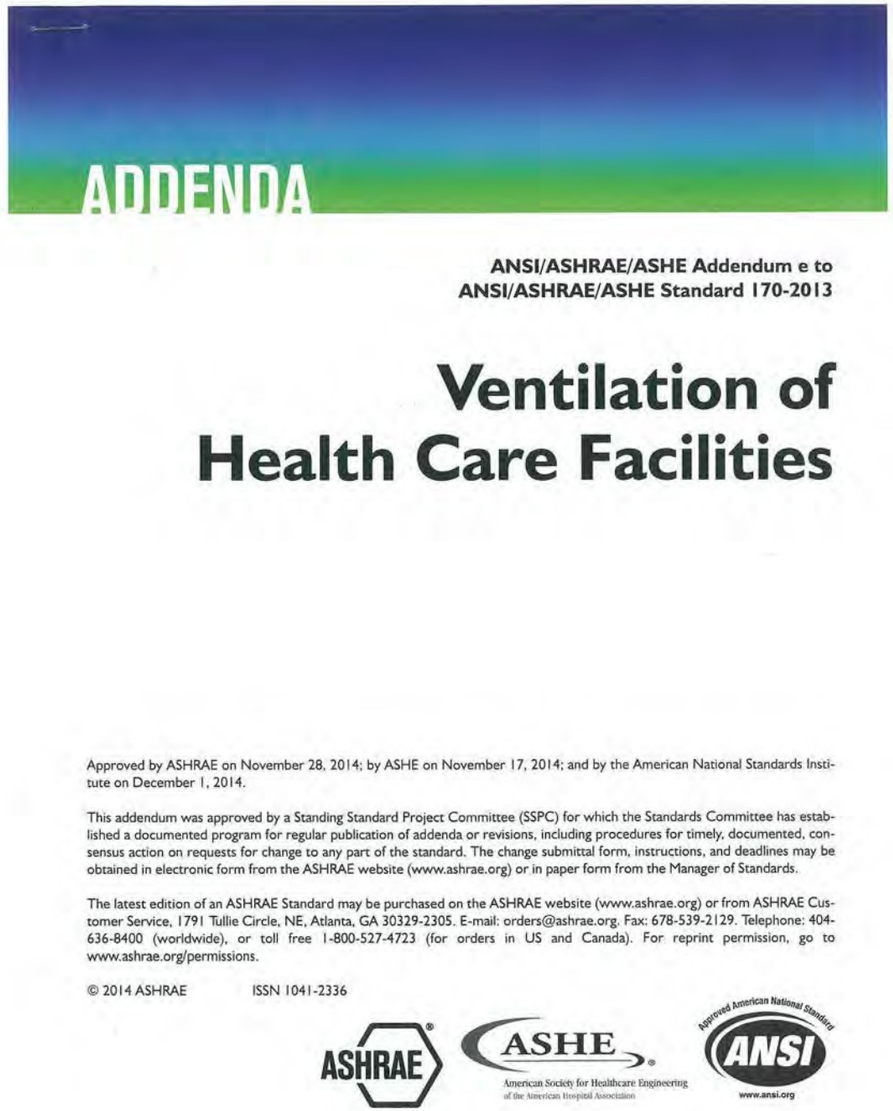


- Added several rooms related to“exhaust discharges”and stipulated that all ductwork inside a building, including fan rooms, be under negative pressure
- Stipulates that the exhaust air discharge point be located in order to reduce the potential for recirculation
- Changed“ER Waiting Rooms”to“Emergency Department Waiting Area” (still negatively pressurized and exhausted)

ASHRAE Standard 170-2013-Addendum (e)

- Approved by ASHE 11-17-2014
- Approved by ASHRAE Standards Committee 11-28-2014
- Approved by ASHRAE Board of Directors xx-yy-zzzz
- Approved by ANSI 12-1-2014

- Added a sentence prohibiting the provision of controls that would allow switching back and forth between positive and negative pressure in paragraph 7.1 (3) while at the same time eliminating the last sentence of footnote (u) to Table 7.1 that refers to this same subject


ADDENDA

ANSI/ASHRAE/ASHE Addendum e to
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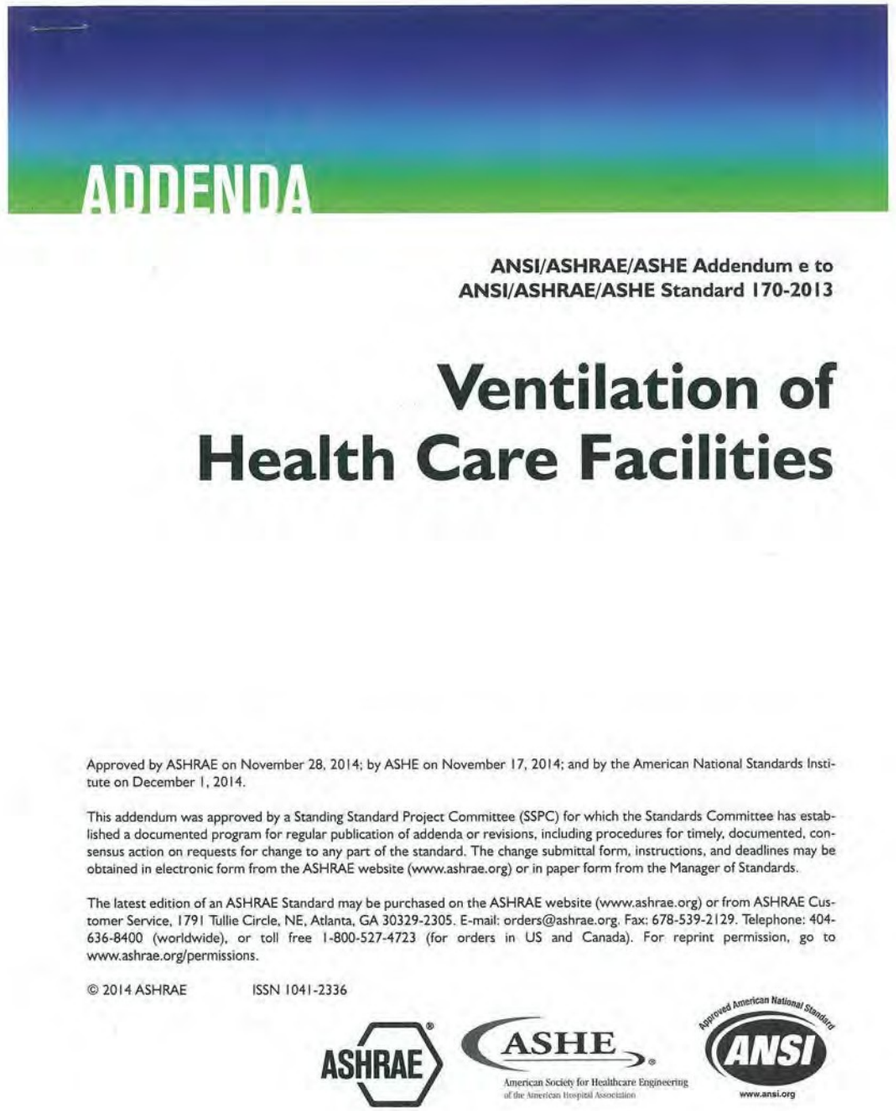
- Approved by ASHRAE Standards Committee 11-28-2014
- Approved by ASHRAE Board of Directors xx-yy-zzzz
- Approved by ANSI 12-1-2014

- Deleted footnote (n) to Table 7.1 that refers to the requirement that nuisance alarms associated with pressure monitoring device alarms for operating rooms and certain negative pressure rooms be prevented (i.e. nuisance alarms are not to be prevented; they are to be used to alert staff and actioned accordingly)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ASHRAE Standard 170-2013-Addendum (f)

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- Approved by ASHRAE Standards Committee 5-31-2016
- Approved by ASHRAE Board of Directors xx-yy-zzzz
- Approved by ANSI 6-1-2016

- Clarified that the primary supply diffuser array must extend 12” beyond the surgical table
- Clarified that the area associated with that 12” extension must be at least 70% diffuser (implies that 100% of the area above the surgical table proper must be diffuser)


STANDARD

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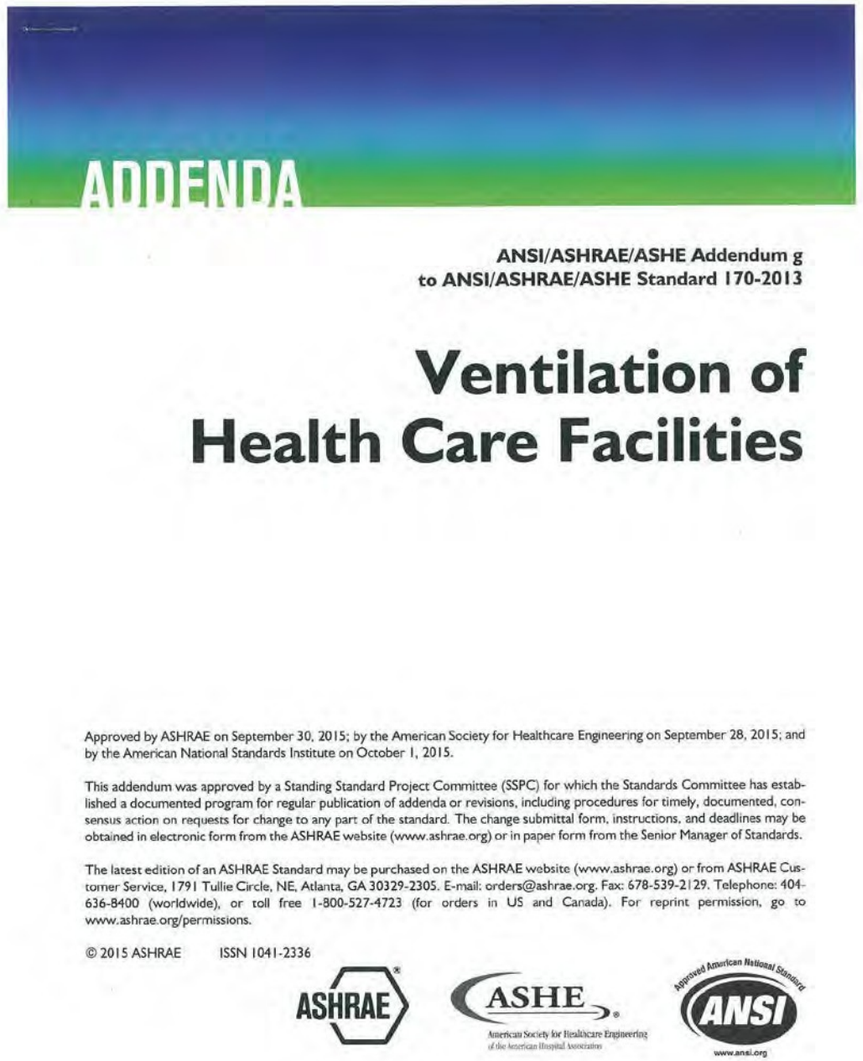
ASHRAE Standard 170-2013-Addendum (g)

- Approved by ASHE 9-28-2015
- Approved by ASHRAE Standards Committee 9-30-2015
- Approved by ASHRAE Board of Directors xx-yy-zzzz
- Approved by ANSI 10-1-2015

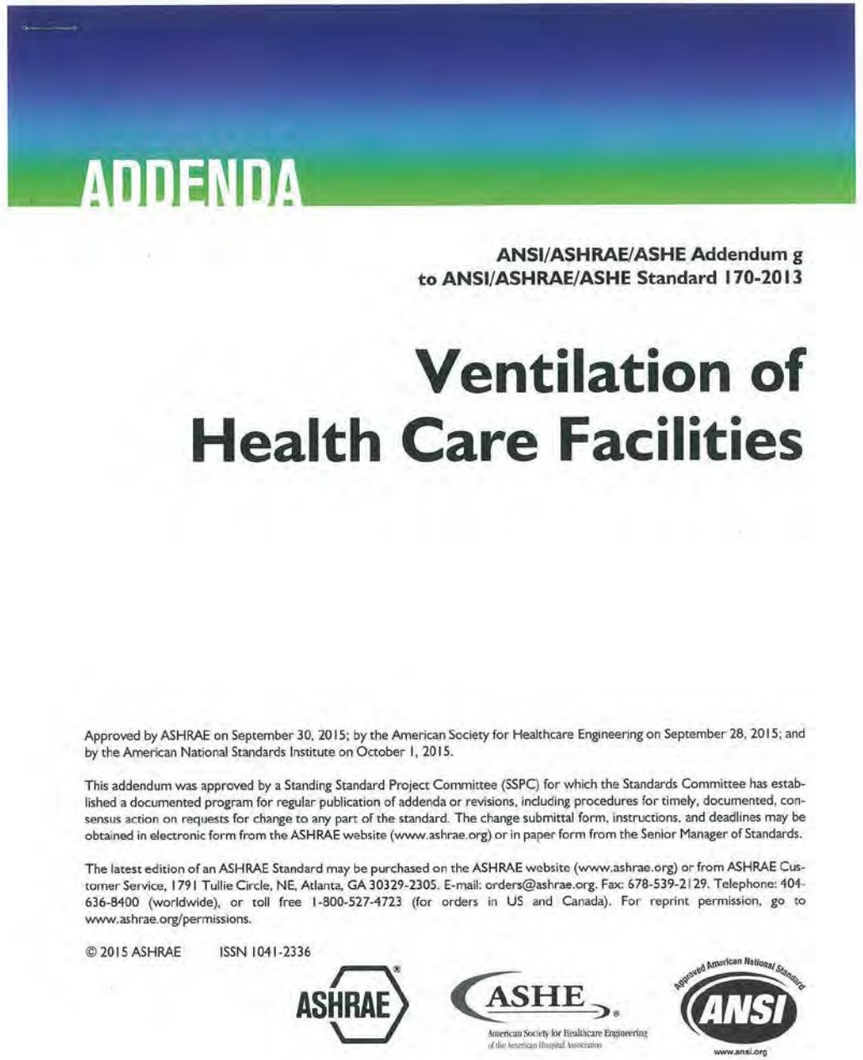


- Deleted the definitions of procedure room (class A), operating room (class B) and operating room (class C) in Section 3 (ACS 2000)
- All other references to A, B and C ---OR, Procedure Room fixed

ASHRAE Standard 170-2013-Addendum (g)

- Approved by ASHE 9-28-2015
- Approved by ASHRAE Standards Committee 9-30-2015
- Approved by ASHRAE Board of Directors xx-yy-zzzz
- Approved by ANSI 10-1-2015

- Added definitions for invasive procedure, operating room, procedure room and restricted area in Section 3; invasive procedures must be done in an OR; non-invasive procedures can be done in a procedure room; OR's need to meet the definition of a restricted area; procedure rooms do not need to meet the definition of a restricted area


ADDENDA

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to ANSI/ASHRAE/ASHE Standard 170-2013

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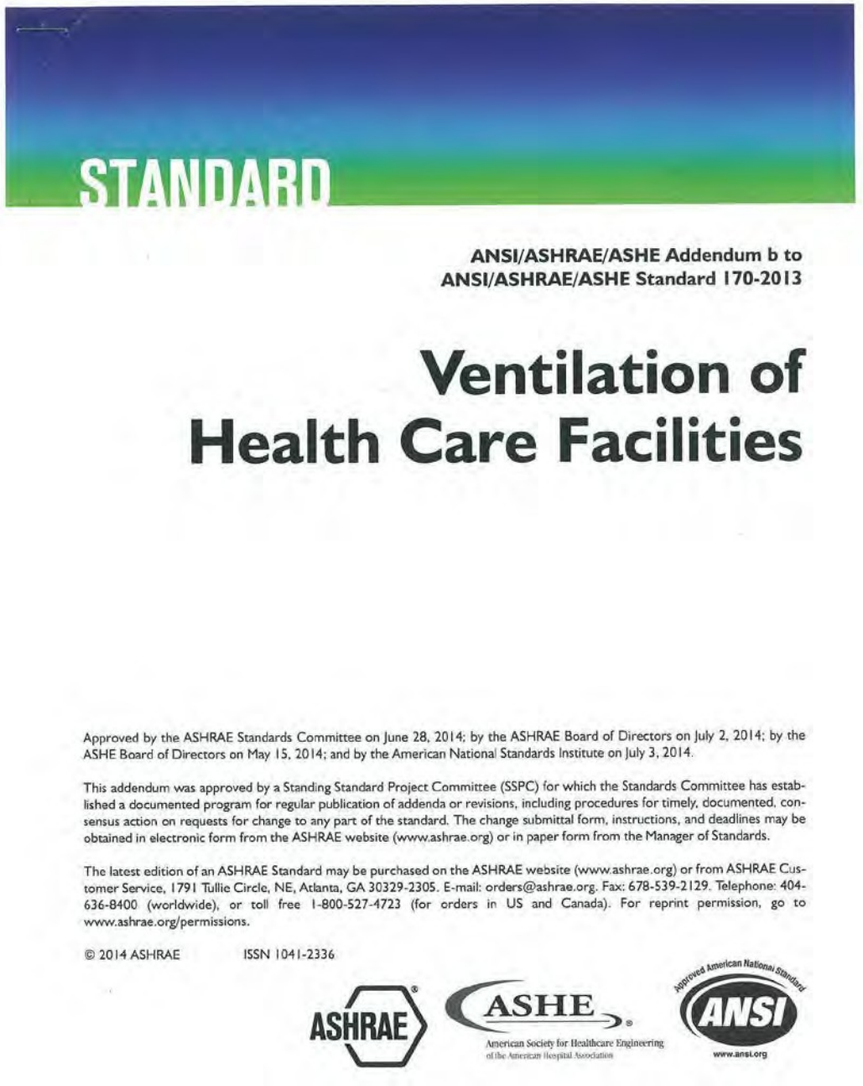
ASHRAE Standard 170-2013-Addendum (h)

- Approved by ASHE 5-23-2016
- Approved by ASHRAE Standards Committee 5-31-2016
- Approved by ASHRAE Board of Directors xx-yy-zzzz
- Approved by ANSI 6-1-2016

- Table 7.1 now refers to SPD properly and lowers the space temperature setpoints of decontamination room (60-73), clean workroom (68-73) and sterile storage room (max 75)
- Table 7.1 now refers to ANSI/AAMI Standard ST-79-2013 related to the quality of steam required for sterilization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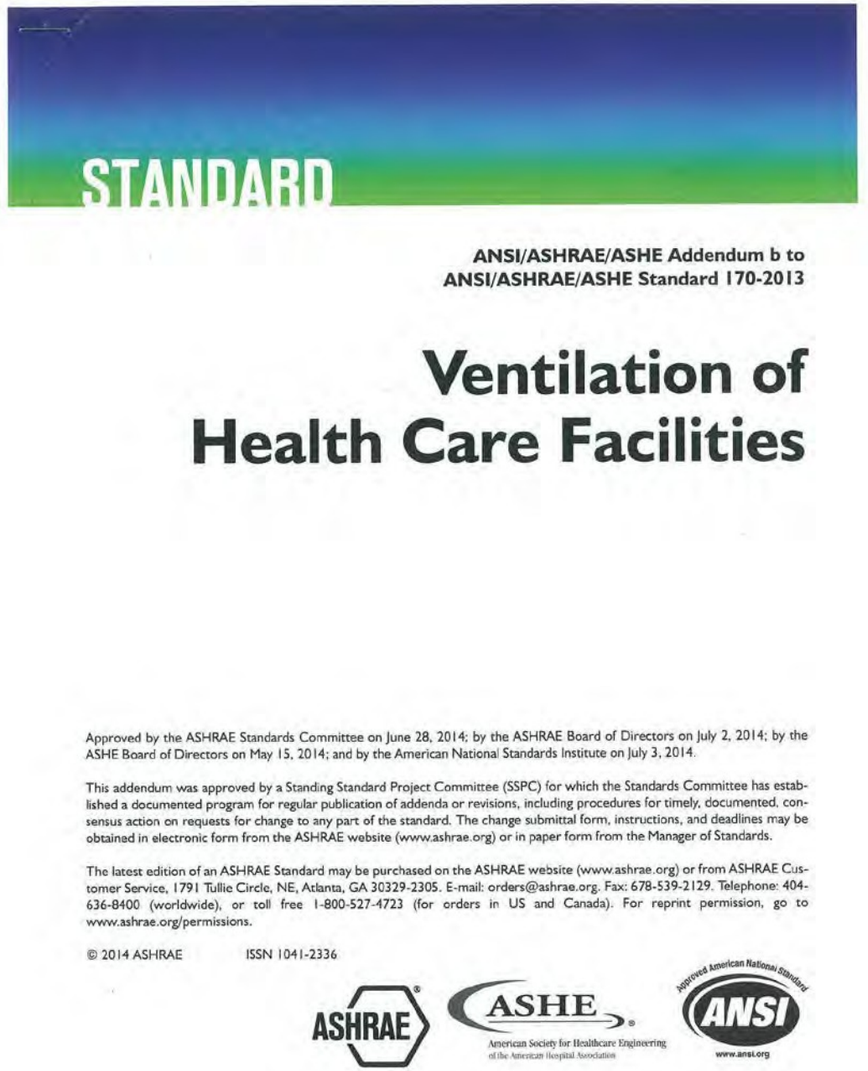
ASHRAE Standard 170-2013-Addendum (k)

- Approved by ASHE 7-25-2016
- Approved by ASHRAE Standards Committee 7-31-2016
- Approved by ASHRAE Board of Directors xx-yy-zzzz
- Approved by ANSI 8-1-2016

- Added a room named "Electro-Convulsive Therapy (ECT)" room to table 7.1 under the Diagnostic and Treatment group
- Neutral pressure, 2 ach oa, 4ach sa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ASHRAE Standard 170-2013-Addendum (m)

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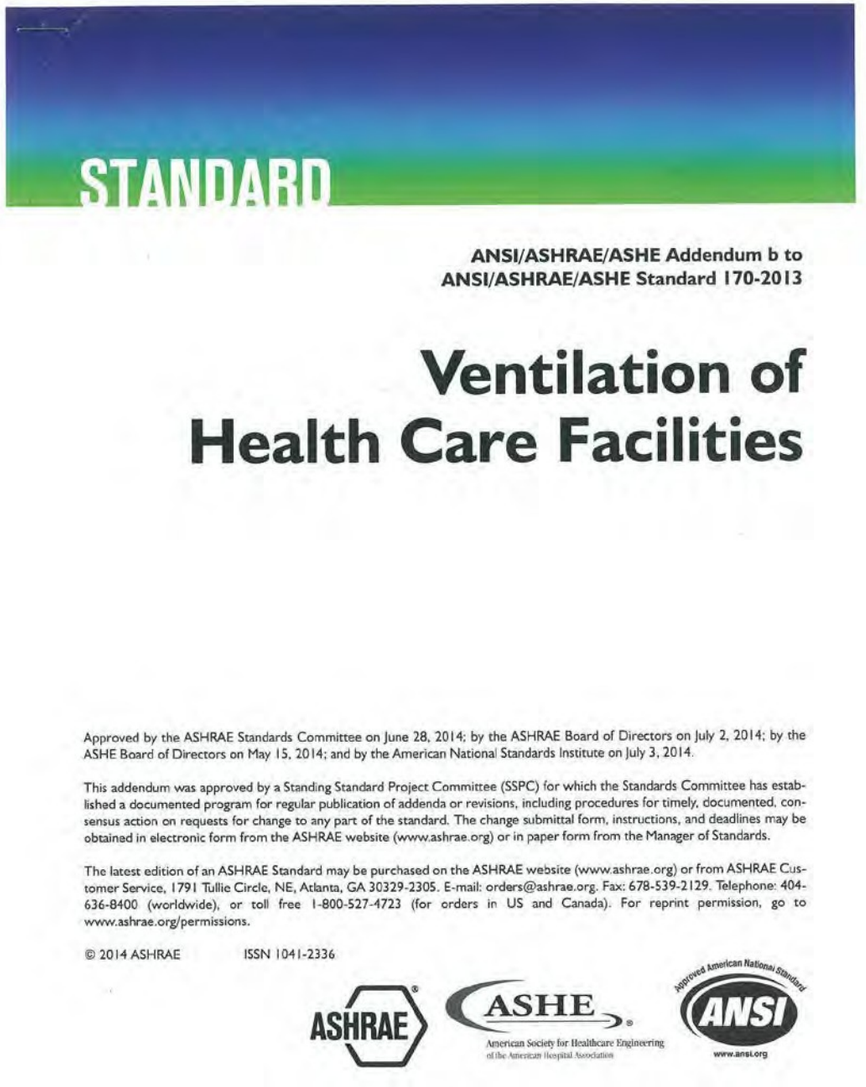
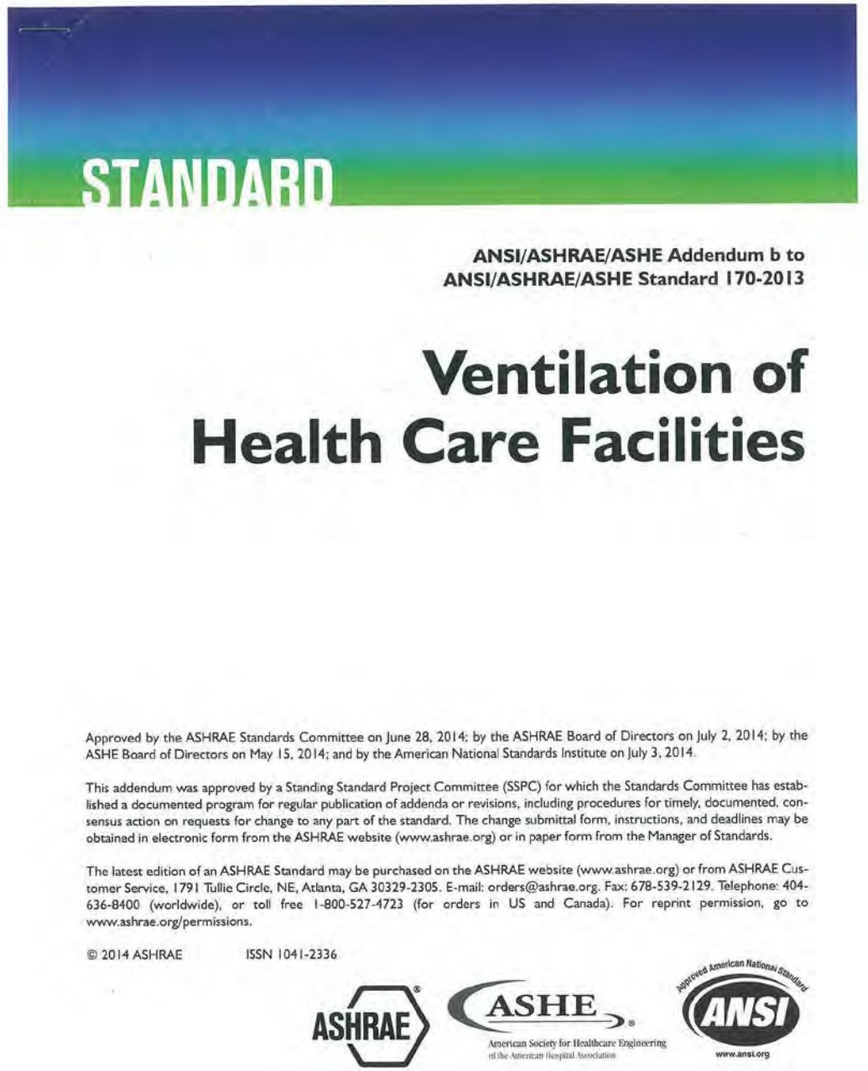
- Approved by ASHRAE Standards Committee 11-30-2016
- Approved by ASHRAE Board of Directors xx-yy-zzzz
- Approved by ANSI 11-30-2016



- Allows the use of “adiabatic high pressure water atomizing” humidifiers in lieu of steam humidifiers (be sure to check local state licensing acts)
- Requires that “adiabatic high pressure water atomizing” humidifiers use RO water, a UVC sterilization light and a sub-micron filter (refers to ASTM D-1193-06 (2011) Standard for Reagent Water

ASHRAE Standard 170-2013-Addendum (ad)

- Approved by ASHE 5-23-2016
- Approved by ASHRAE Standards Committee 6-25-2016
- Approved by ASHRAE Board of Directors 6-29-2016
- Approved by ANSI 7-27-2016
- Added a room named "general examination room" room to table 7.1 under the Diagnostic and Treatment group
- Neutral pressure, 2 ach oa, 4ach sa
- Changed "examination room" to "special examination room" which applies to rooms used for patients with undiagnosed GI symptoms, undiagnosed respiratory symptoms or undiagnosed skin symptoms.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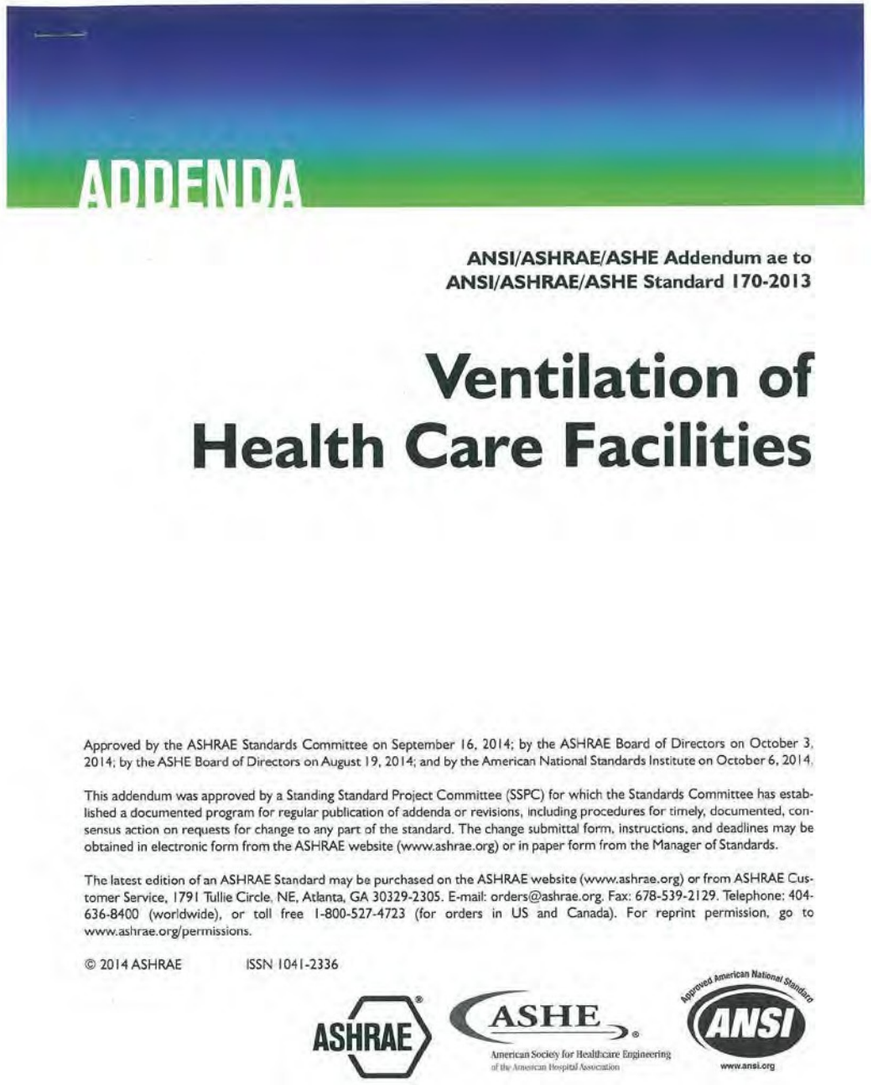
- Approved by ASHRAE Standards Committee 9-16-2014
- Approved by ASHRAE Board of Directors 10-3-2014
- Approved by ANSI 10-6-2014
- Changed the word“areas”to“spaces”in paragraph 7.1 (a) (2)
- Required use of ASHRAE Standard 62.1-2010 in paragraph 7.1 (a) (2)
- Clarified dP of .01“ in All rooms as a mimimum desired effect; not a limit in paragraph 7.2.1 (e)
- Clarified dP of .01“ in PE rooms as a mimimum desired effect; not a limit in paragraph 7.2.2 (a)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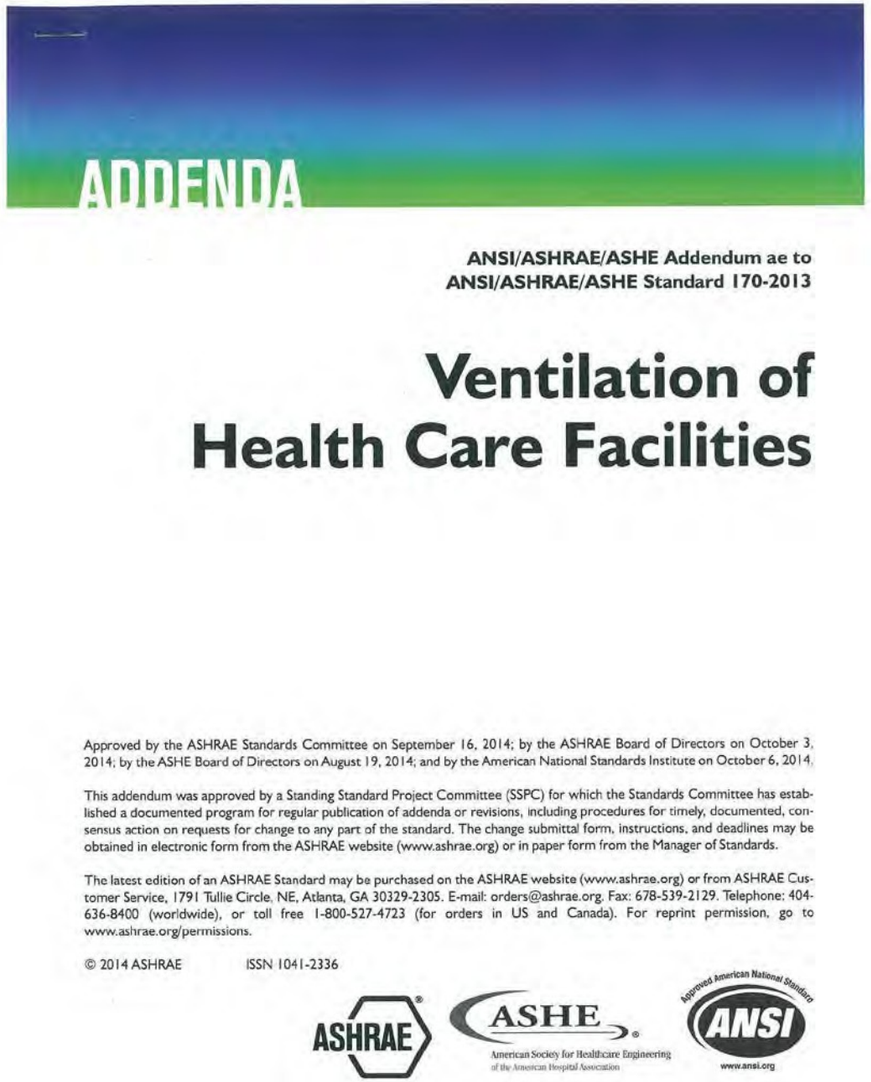
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- Clarified space in mechanical equipment rooms as “per manufacturers minimum required” in paragraph 8.2 (b)
- Clarified spaces in which supply diffusers need to cleaned in paragraph 8.6 (b)
- Added a space named “continued care nursery” to Table 7.1

6.0 Systems and Equipment

- 6.1 Utilities
- 6.2 Air Handling Unit Design
- 6.3 Outdoor Air Intakes and Exhaust Air Outlets
- 6.4 Filtration
- 6.5 Heating and Cooling Systems
- 6.6 Humidifiers
- 6.7 Air Distribution Systems
- 6.8 Energy Recovery Systems
- 6.9 Insulation and Duct Lining

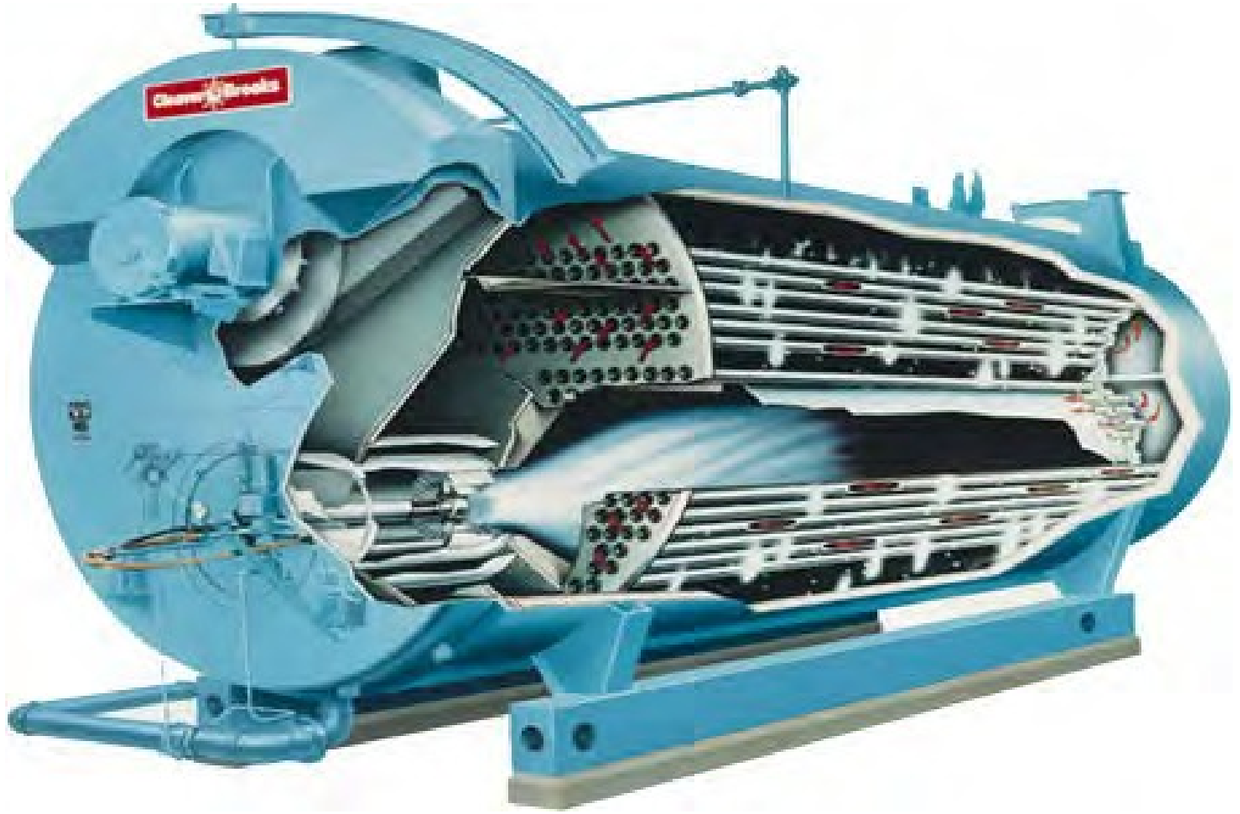
6.0 Systems and Equipment-6.1 Utilities

Ventilation Systems That Must be Connected to the Appropriate Branch of the Essential Power System:

- Airborne Infectious Isolation Rooms
- Protective Environment Rooms
- Operating Rooms including C- Section OR's and Cysto OR's
- Keep in mind that if space heating is accomplished by moving air, all those air systems must be connected to the EPS [suggestion]

6.0 Systems and Equipment – 6.1 Utilities

- Reserve Capacity (n+1) Required for DHW, Sterilization, Dietary, Humidification and Seasonal Space Heating for Operating, Delivery, Birthing, Labor, Recovery, Intensive Care, Nursery, and Inpatient Rooms
- Reserve Capacity (n+1) is <u>not</u> required if the ASHRAE 99% dry bulb is greater than or equal to 25 F; <u>however; Reserve Capacity (n+1) is still required for DHW, Sterilization, Humidification and Dietary</u>



6.0 Systems and Equipment – 6.1 Utilities

- Reserve Capacity (n + 1) Required for Enough of the Space Cooling Load to Meet the Owners' Program if the Seasonal Space Cooling Load and Process Cooling Load is Greater Than 400 Tons (serious discussion needed between Owner and Engineer)
- Don't forget about connection to EPS!

6.0 Systems & Equipment – 6.2 AHU Design

- Air Handling Unit Casing
  - Prevent Water Intrusion
  - Resist Corrosion
  - Permit Access for O&M
- Air Handling Unit Interior Surfaces
  - Comply with ASHRAE Standard 62.1-2010
  - Resistant to Mold Growth
  - Resistant to Erosion

6.0 Systems & Equipment – 6.2 AHU Design

- Air Handling Unit Interior Surfaces [suggestion]
  - Consider Perforated Inner Wall adjacent to any Cooling Coil
  - Consider Perforated Inner Wall u.s. of Final Filter
  - Use Solid Inner Wall d.s. of Final Filter

6.0 Systems & Equipment – 6.3 OAI

- OAI must be at least 25 feet from cooling towers and exhaust discharges
- OAI must be at least 6 feet above grade and 3 feet above a roof
- OAI must be protected from public access (moderate and high-risk)
- OAI must prevent entrainment of wind-driven rain with features to drain away precipitation
- OAI must have birdscreen mesh (no smaller than ½ inch)
- Relief air is considered Class 1 air per ASHRAE Standard 62.1-2010 and is not subject to the 25 foot restriction

6.0 Systems & Equipment – 6.3 RAO

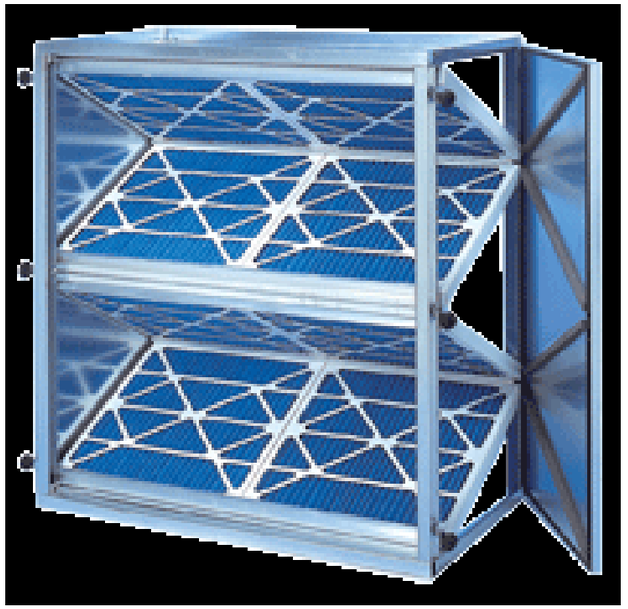
- Relief air is considered Class 1 air per ASHRAE Standard 62.1-2010 and is not subject to the 25 foot restriction (relief is considered to be air that is otherwise recirculated)

6.0 Systems & Equipment – 6.3 EAO

- Addresses AII, bronchoscopy and sputum collection and pentamidine administration rooms, ED public waiting rooms, nuclear hot labs, radiology waiting rooms, pharmacy hazardous drug exhausted enclosures and lab work area chemical fume hoods all have specific exhaust discharge requirements
- All exhaust air ductwork inside a building, including inside a fan room, must be under negative pressure; if that can't be accomplished, the EAO ductwork must be sealed
- Positively pressurized exhaust ductwork within a building including a fan room should be welded w/o any sort of flexible connection d.s. of the fan [suggestion]
- Vertical discharge, height above roof of at least 10', speed greater 2500 fpm required

6.0 Systems & Equipment – 6.4 Filtration

- Refer to Table 6.4 for Filter Efficiency Requirements
- Filter Bank 1 must be upstream of heating and cooling coils such that all mixed air is filtered
- An intermediate Filter Bank is often installed between 1 and 2 in order to extend the life and cleanliness of Filter Bank 2
- Filter Bank 2 must be downstream of Cooling Coils and Supply Fans and shall have Sealing Interface Surfaces
- Blank –off panels must be permanently attached to the filter frame
- Emphasis on Eliminating Bypassed Air
- Leakage should be tested by Cx Agent [suggestion]



6.0 Systems & Equipment – 6.4 Filtration

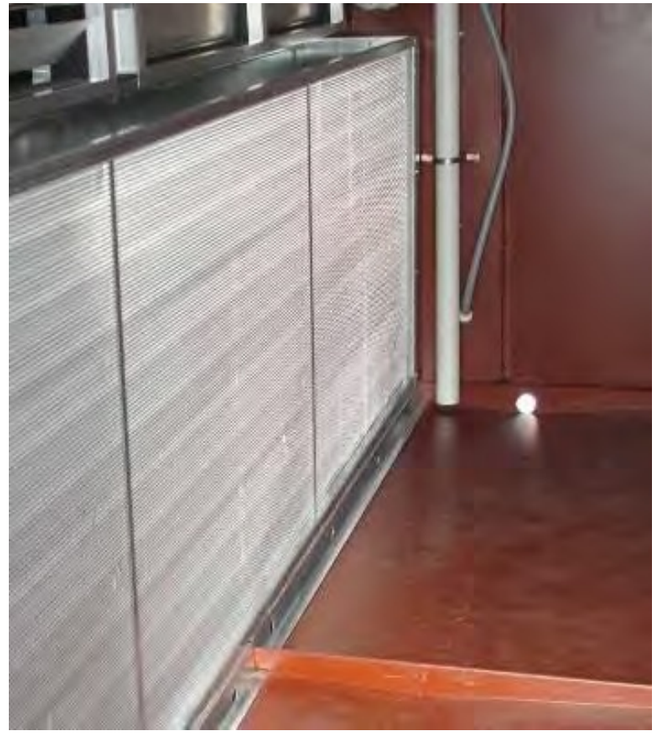
Table 6-2 Space Designation	Filter Bank 1-MERV	Filter Bank 2-MERV
Operating Rooms; Inpatient and Ambulatory Diagnostic and Therapeutic Radiology; Inpatient Delivery and Recovery Spaces	7	14
Inpatient Care, Treatment, Diagnosis, and those Spaces Providing Direct Service or Clean Supplies and Clean Processing	7	14
Airborne Infectious Isolation (AII) Rooms	7	14
Protective Environment (PE) Rooms	7	HEPA
Laboratories, Procedure Rooms	13	N/R
Administrative, Bulk Storage, Soiled Holding Spaces, Food Preparation Spaces, and Laundries	7	N/R
All Other Outpatient Spaces	7	N/R
Skilled Nursing Facilities	7	N/R

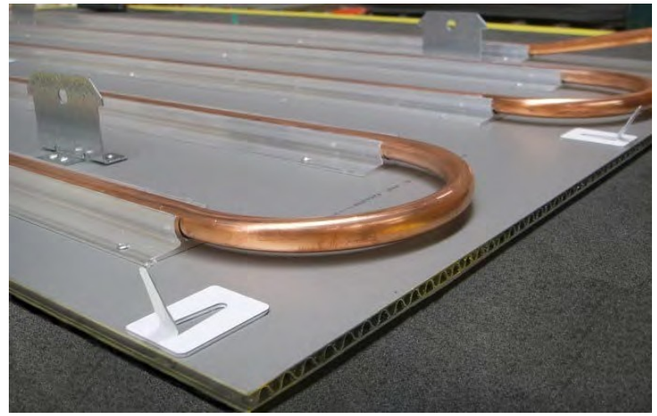
6.0 Systems & Equipment – 6.4 Filtration

	U.S. Standards					Particle Size Range, μm	Applications
	ASHRAE 52.2			**ASHRAE 52.1**			
MERV	Particle Size Range			Test			
		1 to 3 μm	0.3 to 1 μm	Arrestance	Dust Spot		
1	<20%	-	-	<65%	<20%	>10	Residential, light, pollen, dust mites
2	<20%	-	-	65 - 70%	<20%		
3	<20%	-	-	70 - 75%	<20%		
4	<20%	-	-	>75%	<20%		
5	20 -35%	-	-	80 - 85%	<20%	3.0 - 10	Industrial, dust, molds, spores
6	35 - 50%	-	-	>90%	<20%		
7	50 - 70%	-	-	>90%	**20 -25%**		
8	>70%	-	-	>95%	25 - 30%		
9	>85%	<50%	-	>95%	40 - 45%	1.0 - 3.0	Industrial, Legionella, dust
10	>85%	50 - 65%	-	>95%	50 - 55%		
11	>85%	65 - 80%	-	>98%	60 - 65%		
12	>90%	>80%	-	>98%	70 - 75%		
13	>90%	>90%	<75%	>98%	**80 - 90%**	0.3 - 1.0	Hospitals, Smoke removal, bacteria
14	>90%	>90%	75 - 85%	>98%	**90 - 95%**		
15	>90%	>90%	85 - 95%	>98%	-95%		
16	>95%	>95%	>95%	>98%	>95%		
17	-	-	**≥99.97%**	-	-	<0.3	Clean rooms, Surgery, chem-bio, viruses
18	-	-	≥99.99%	-	-		
19	-	-	≥99.999%	-	-		
20	-	-	≥99.9999%	-	-		

6.0 Systems & Equipment – 6.5 Heating and Cooling Systems

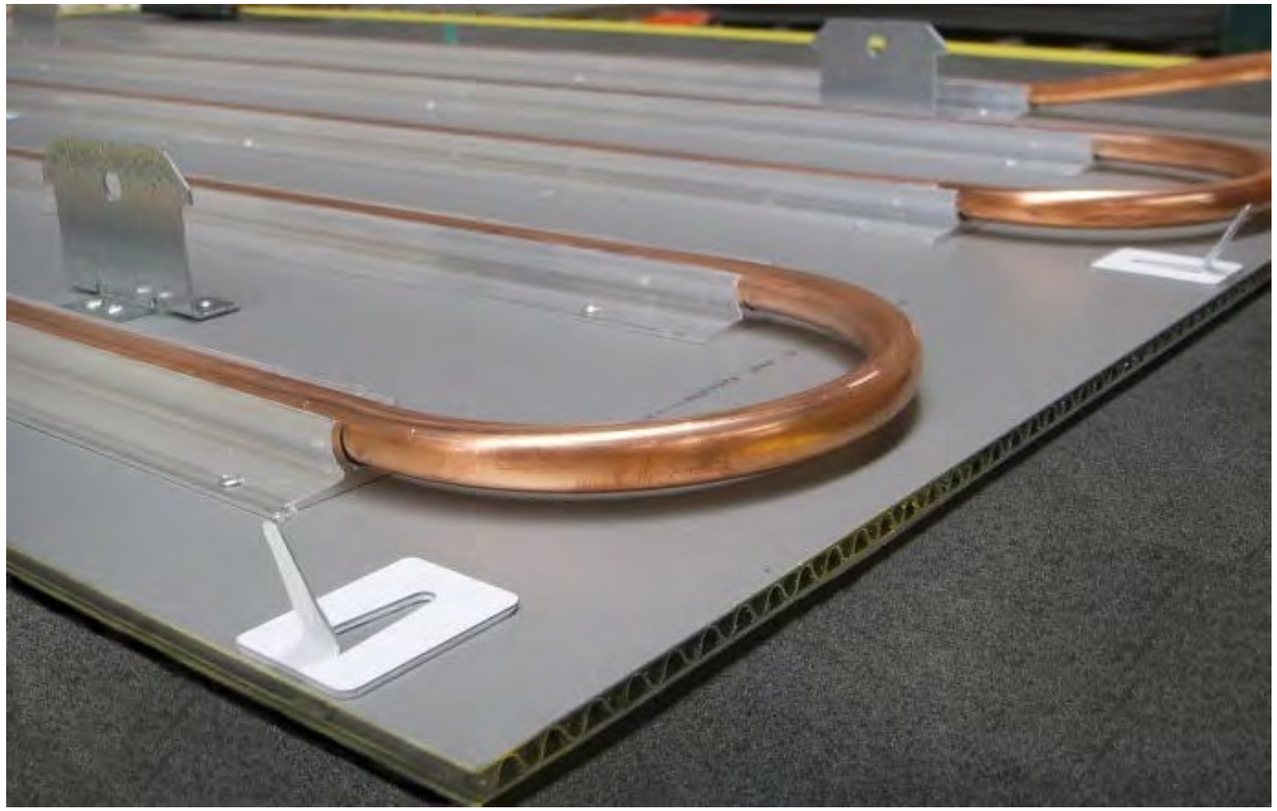
- Cooling coil drain pans must comply with ASHRAE Standard 62.1-2010
  - Sloped 1/8″ per foot
  - Drain outlet at lowest point (two outlets)
  - Trap seal must be designed to match SP that the system develops
  - Minimum drain pan dimensions
- Chilled water supply temperature for ceiling-mounted radiant cooling panels must be higher than the space dewpoint temperature (address what you'll expect in the ceiling plenum)





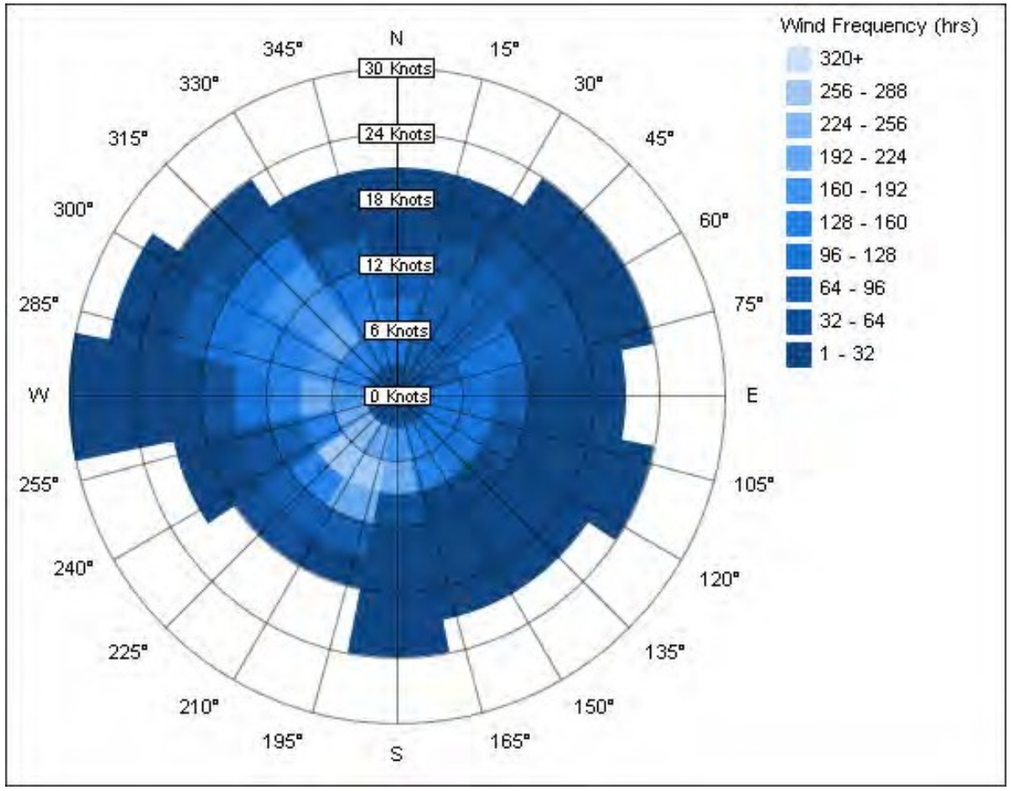
6.0 Systems & Equipment – 6.5 Heating and Cooling Systems

Ceiling-mounted radiant heating panels in All Rooms, PE Rooms, and Burn Units must have smooth, flat, cleanable surfaces; radiant floors may also be used



6.0 Systems & Equipment – 6.5 Heating and Cooling Systems

Consider wind speed, direction and frequency when locating cooling towers in order to avoid drift from entering OAI's or otherwise causing a nuisance



6.0 Systems & Equipment – 6.6 Humidifiers

- Humidifiers are required when internal moisture sources are insufficient to maintain minimum RH levels indicated in Table 7.1 (typically only WICU and NICU now)—check potential for condensation on interior of envelope at center-of-glass, edge-of-glass, mullion – RUMC)
- Local humidifiers no longer needed at OR's because 40% RH is no longer required
- Chemical additives must comply with FDA requirements (clean steam not required any more)
- High RH limit set at 90% is required
- Humidifier control valves must close when the AHU is not operating

6.0 Systems & Equipment – 6.6 Humidifiers

- Adiabatic high pressure water atomizing humidifiers are now allowed
- Must use RO water
- Must use a UV-C sterilization light
- Must use a sub-micron filter
- Check with local AHJ's before using this type of humidifier

6.0 Systems & Equipment – 6.7 Air Distribution Systems

- Maintain pressure relationships as specified in Table 7.1 in all modes of operation
- Provide fully ducted return air paths for all rooms that are (+) or (-); need terminal units on supply and return/exhaust
- Provide fully ducted return air paths for several other rooms such as PACU and ICU rooms; need terminal units on supply and return
- Design must account for filter loading
- Access doors required for inspection and cleaning

6.0 Systems & Equipment – 6.7 Air Distribution Systems

Group A: Outlets mounted in or near the ceiling that discharge air horizontally.

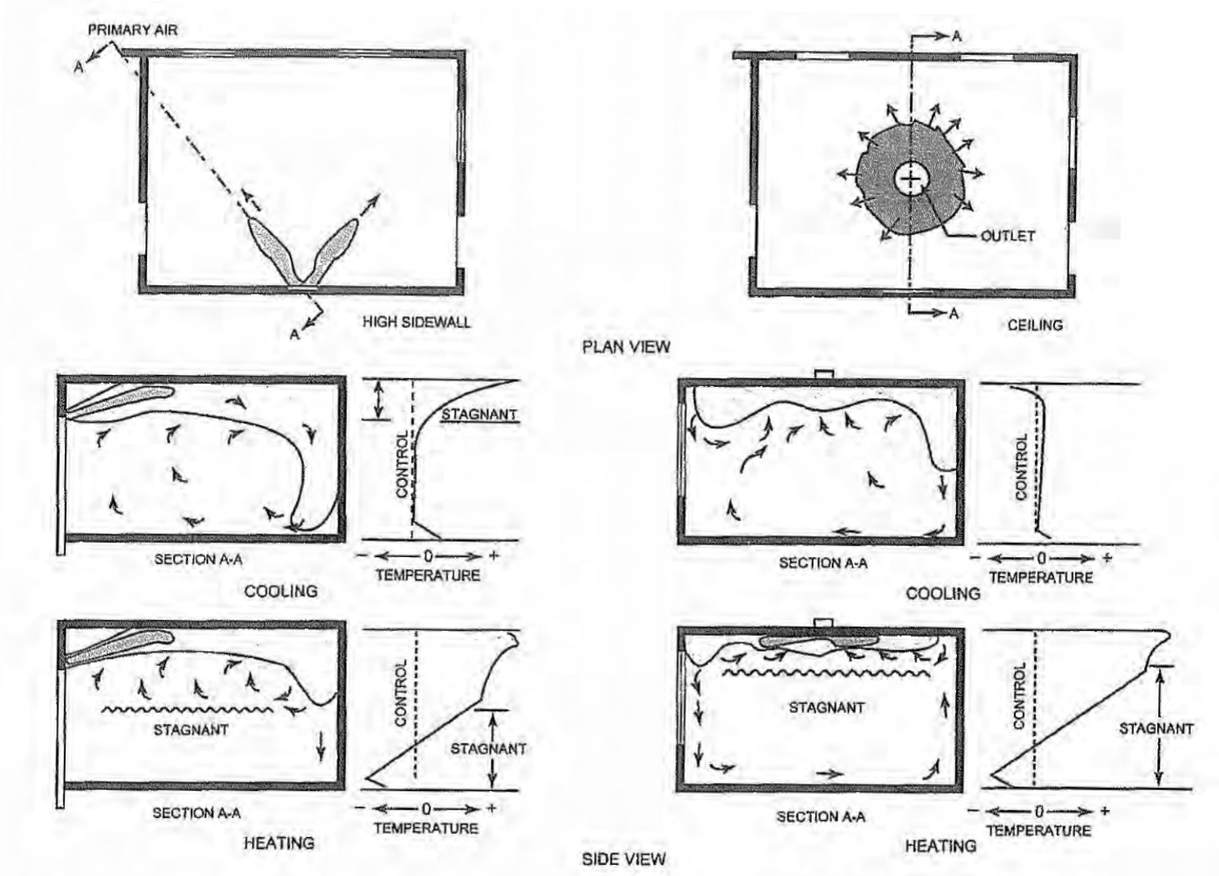


Fig. 5 Air Motion Characteristics of Group A Outlets
(Straub et al. 1956)

6.0 Systems & Equipment – 6.7 Air Distribution Systems

Group B: Outlets mounted in or near the floor that discharge air vertically in a non-spreading jet.

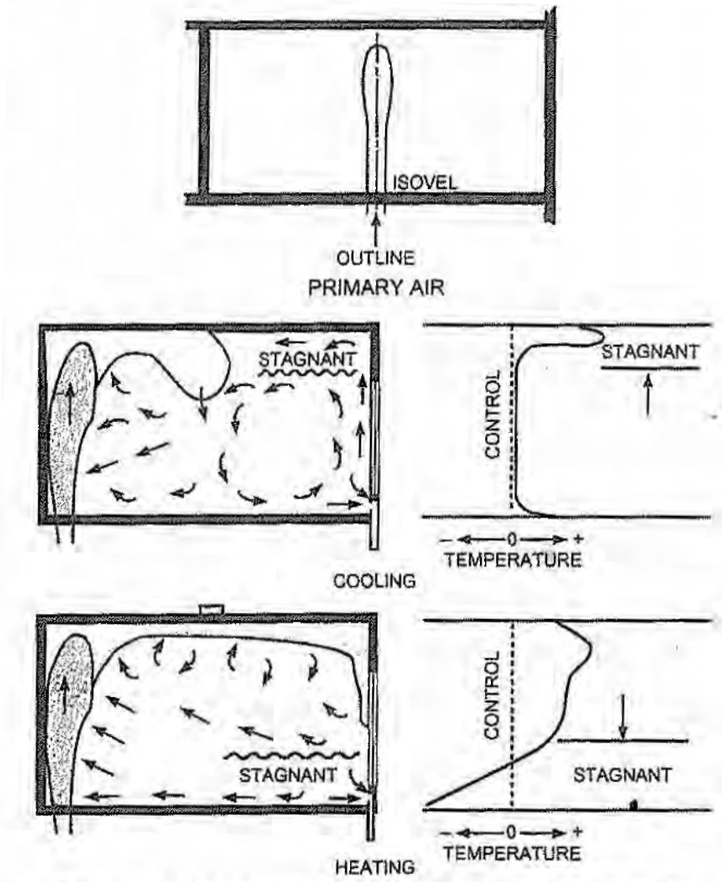


Fig. 6 Air Motion Characteristics of Group B Outlets
(Straub et al. 1956)

6.0 Systems & Equipment – 6.7 Air Distribution Systems

Group C: Outlets mounted in or near the floor that discharge air vertically in a spreading jet.

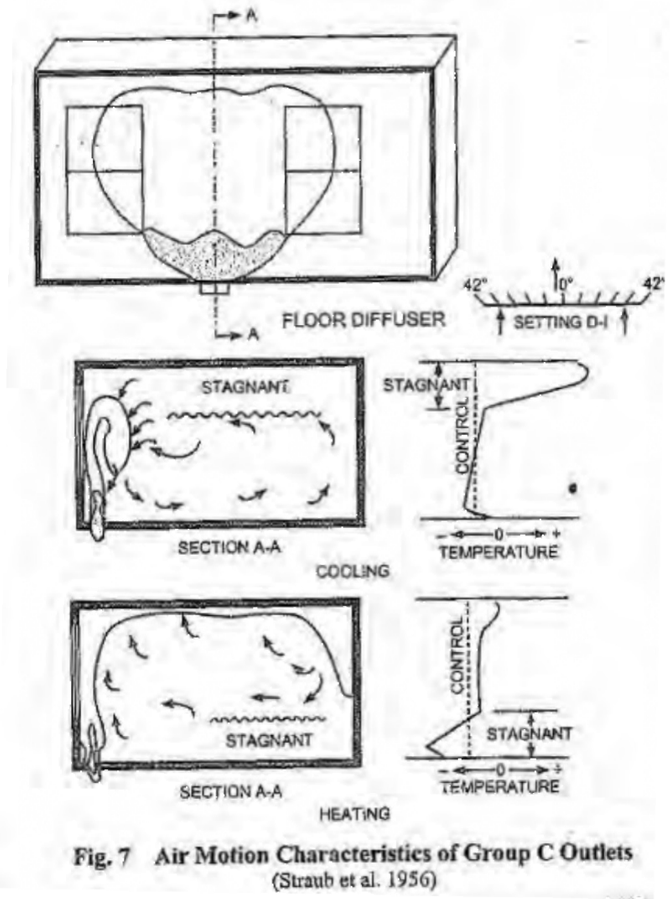


Fig. 7 Air Motion Characteristics of Group C Outlets
(Straub et al. 1956)

6.0 Systems & Equipment – 6.7 Air Distribution Systems

Group D: Outlets mounted in or near the floor that discharge air horizontally.

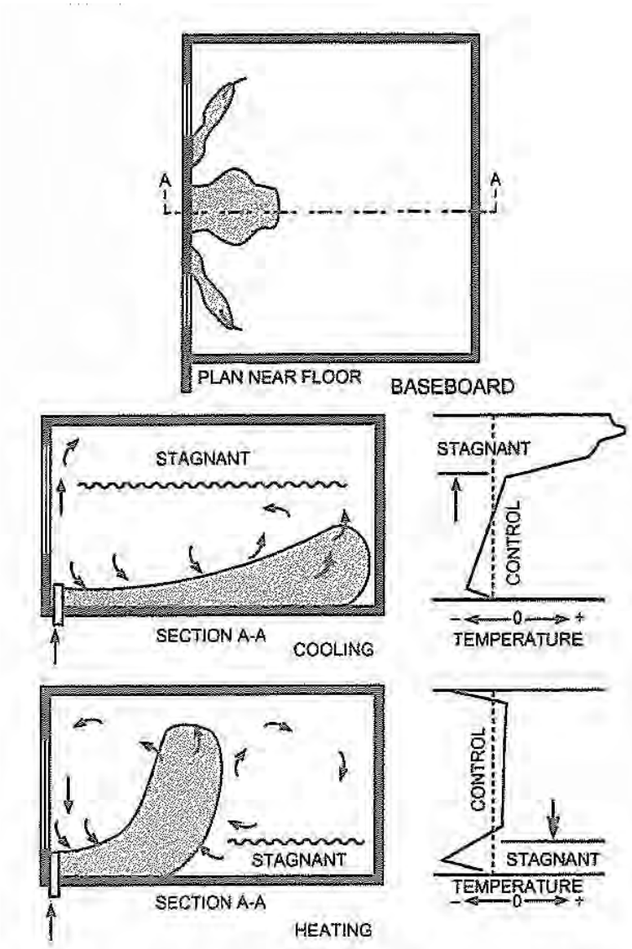


Fig. 8 Air Motion Characteristics of Group D Outlets
(Straub et al. 1956)

6.0 Systems & Equipment – 6.7 Air Distribution Systems

Group E: Outlets mounted in or near the ceiling that project primary air vertically (most rooms)

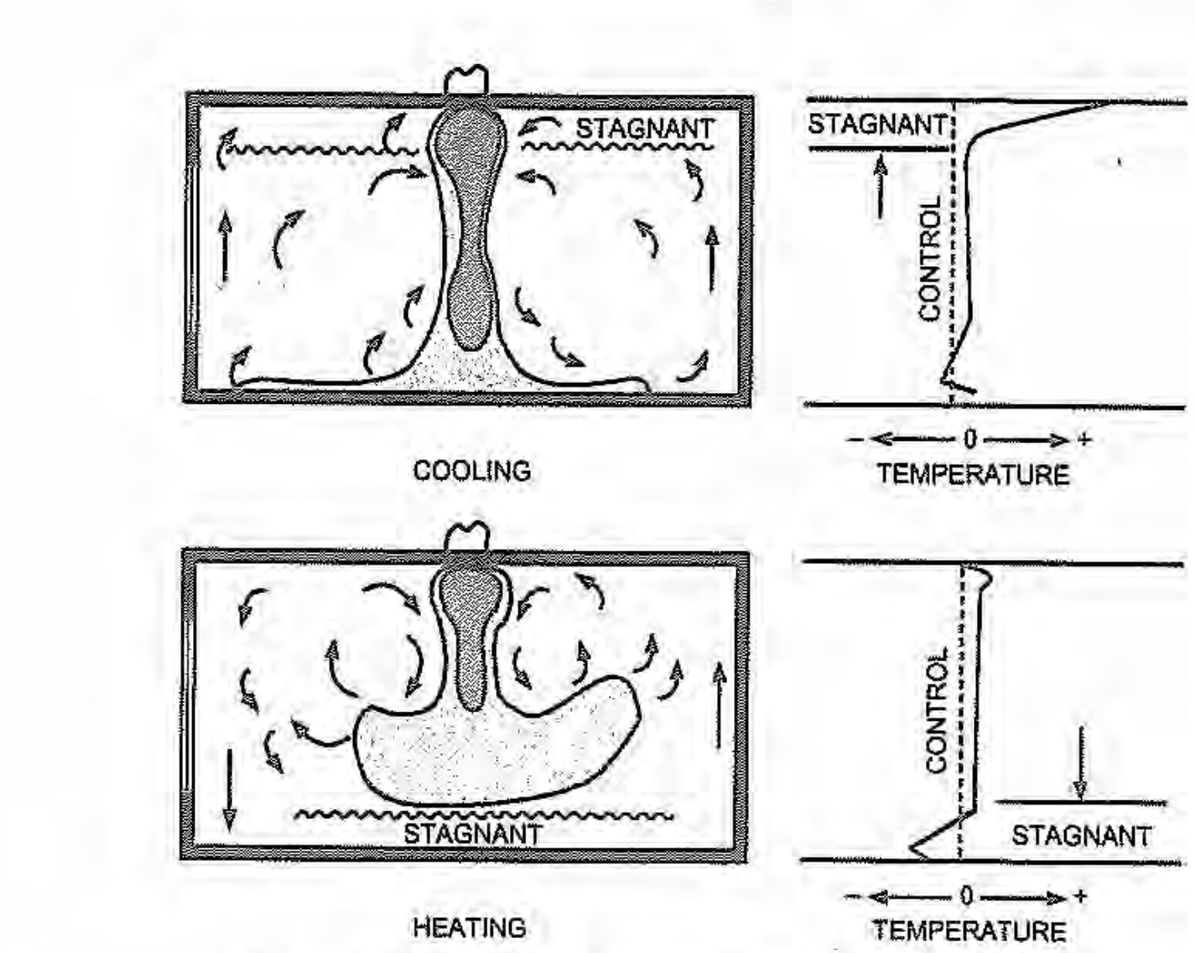
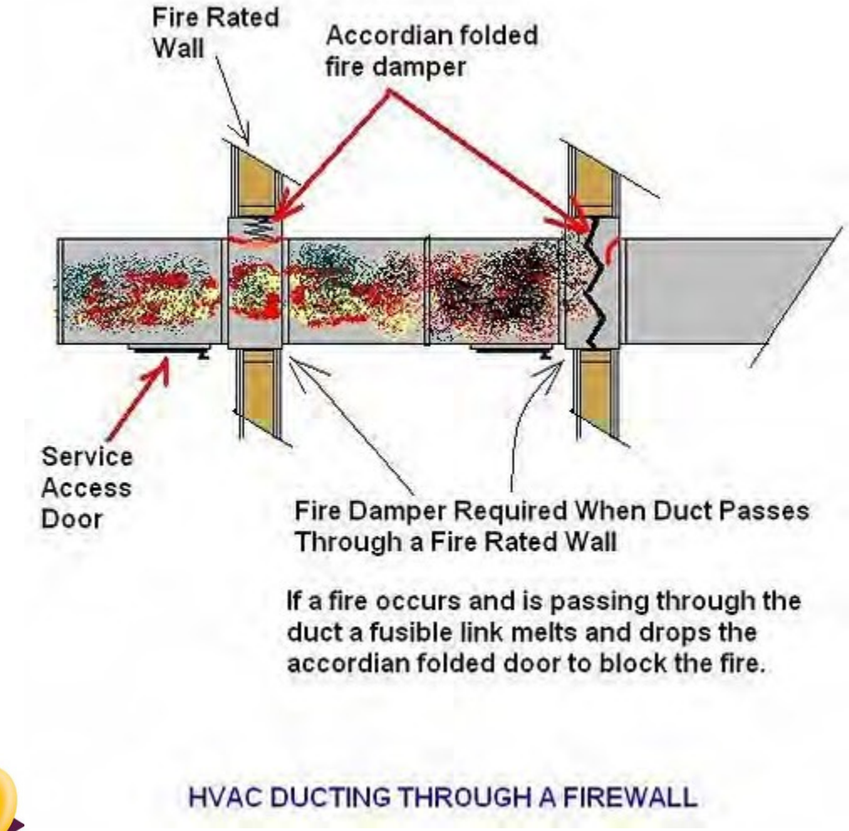


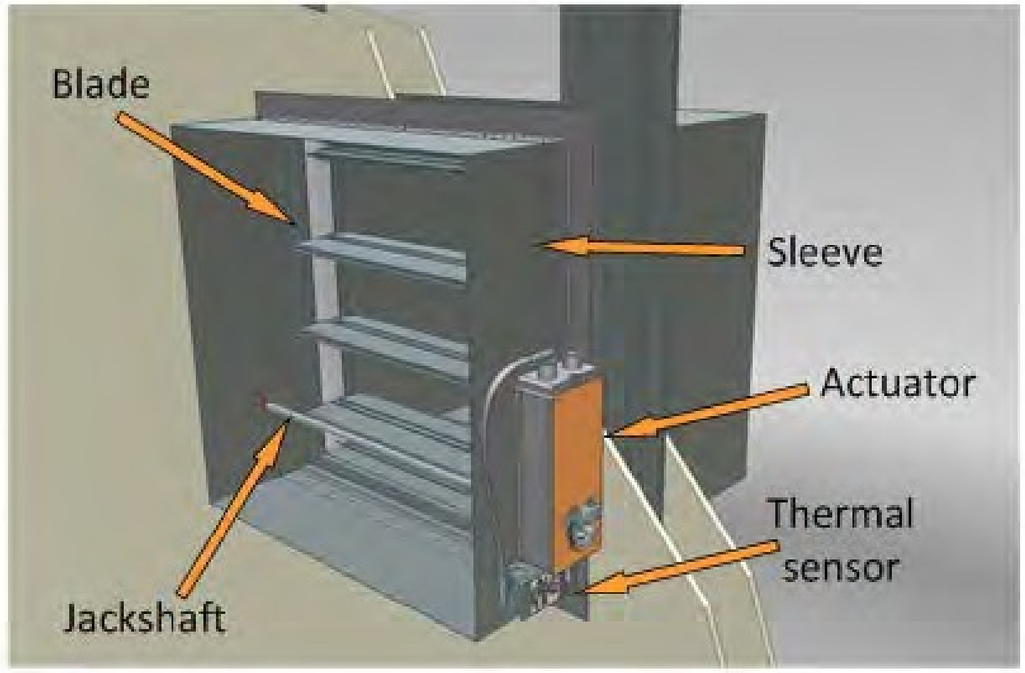
Fig. 9. Air Motion Characteristics of Group E Outlets
(Straub et al. 1956)

6.0Systems & Equipment – 6.7 Air Distribution Systems

- Protect openings in fire-rated walls with fire damper
- Protect openings in smoke barriers with smoke dampers (try to minimize use of smoke dampers by matching HVAC zones with smoke compartments

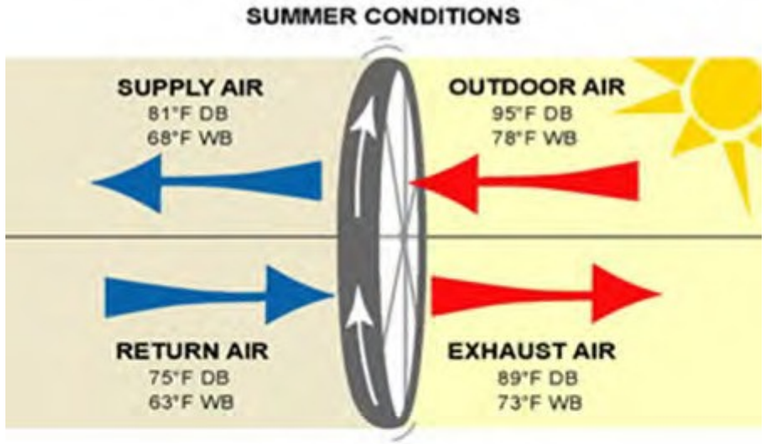


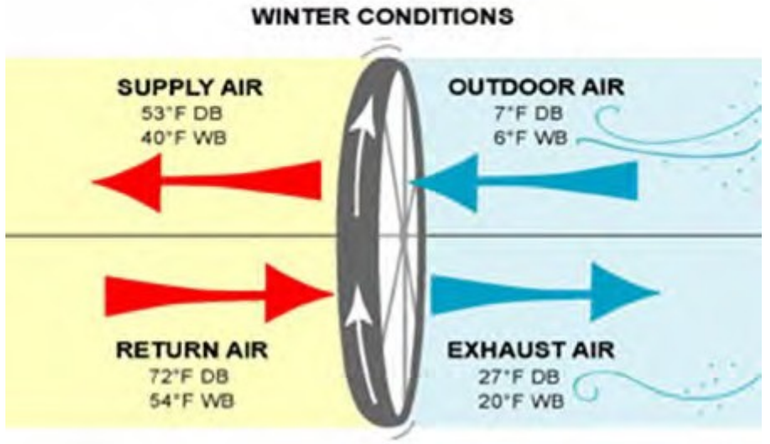
HVAC DUCTING THROUGH A FIREWALL



6.0 Systems & Equipment – 6.8 Energy Recovery Systems

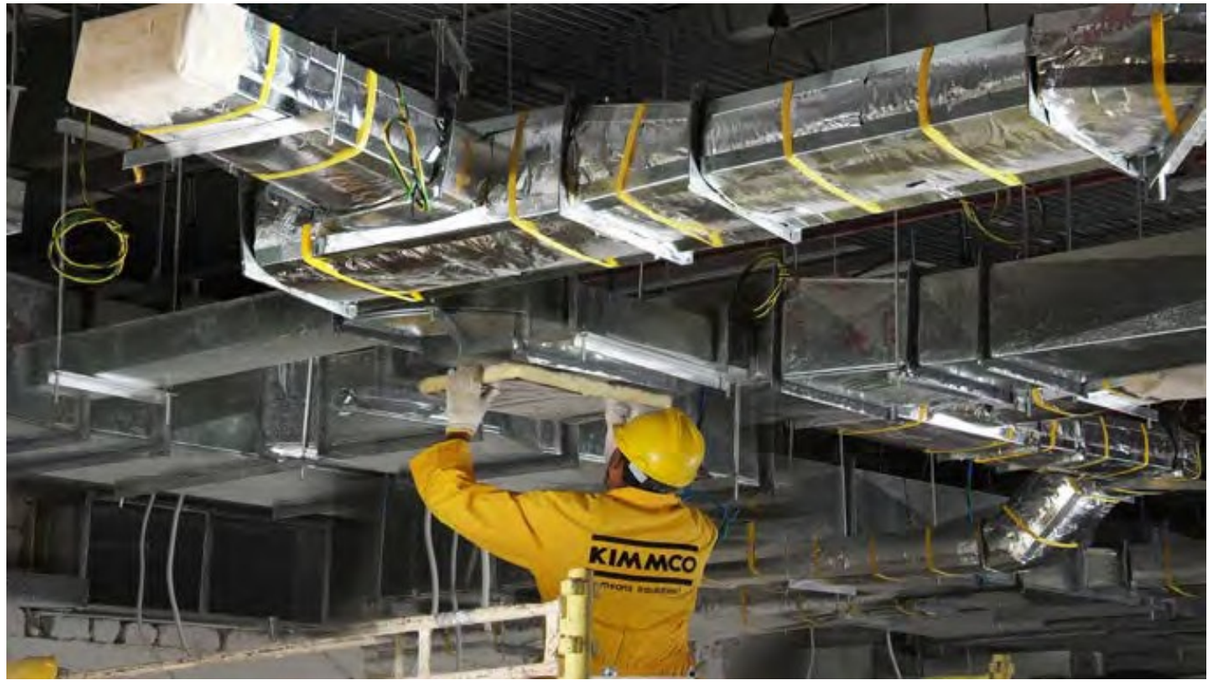
- Air-to-air energy recovery wheels must be located upstream of filter bank #2
- Air-to-air energy recovery wheels can be used with relief air with no more than 5% leakage
- Air-to-air energy recovery cannot be used with All room or other exhaust systems moving toxic/noxious air





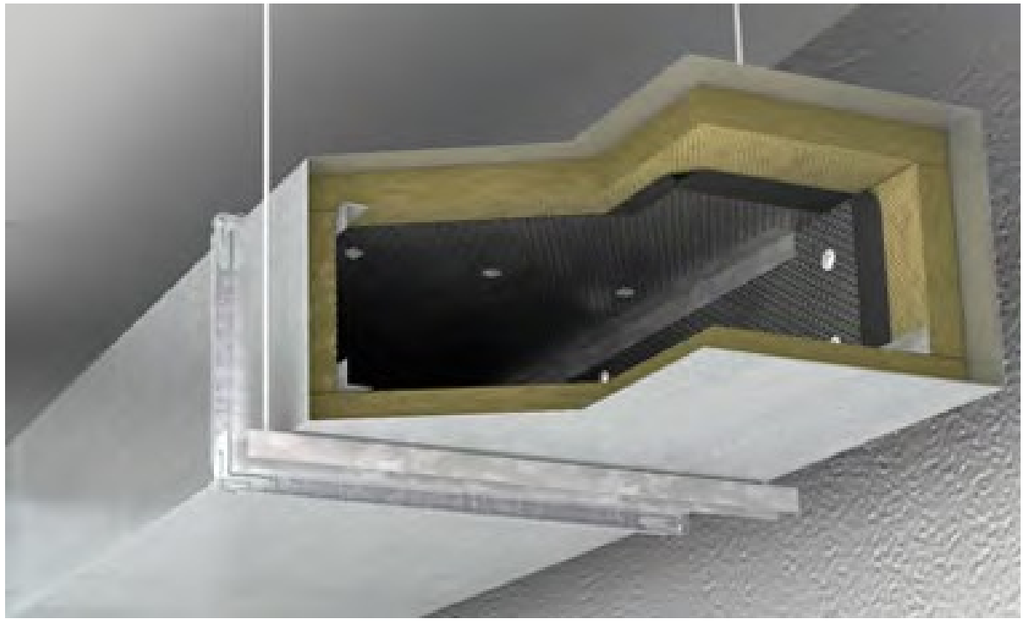
6.0 Systems & Equipment – 6.9 Insulation and Duct Lining

- Vapor barrier required for all ductwork carrying cold air
- Don't forget to insulate local duct risers in the corners of OR's carrying return air (the return can be as cold as 58-60 F); use vapor barrier, too



6.0 Systems & Equipment – 6.9 Insulation and Duct Lining

- No duct lining downstream of filter bank #2
- No duct lining within 15 feet of humidifiers (this likely refers to duct-mounted humidifiers) – good engineering practice is to comply with the statement above throughout the system (i.e. no duct lining anywhere downstream of filter bank #2)
- Inside face of air handling units should not have perforated panels downstream of filter bank #2



7.0 Space Ventilation

- 7.1 General
- 7.2 Room Specific Requirements
- 7.3 Critical Care Units
- 7.4 Surgery Rooms
- 7.5 Support Spaces
- 7.6 Psychiatric Patient Areas

7.0 Space Ventilation – 7.1 General

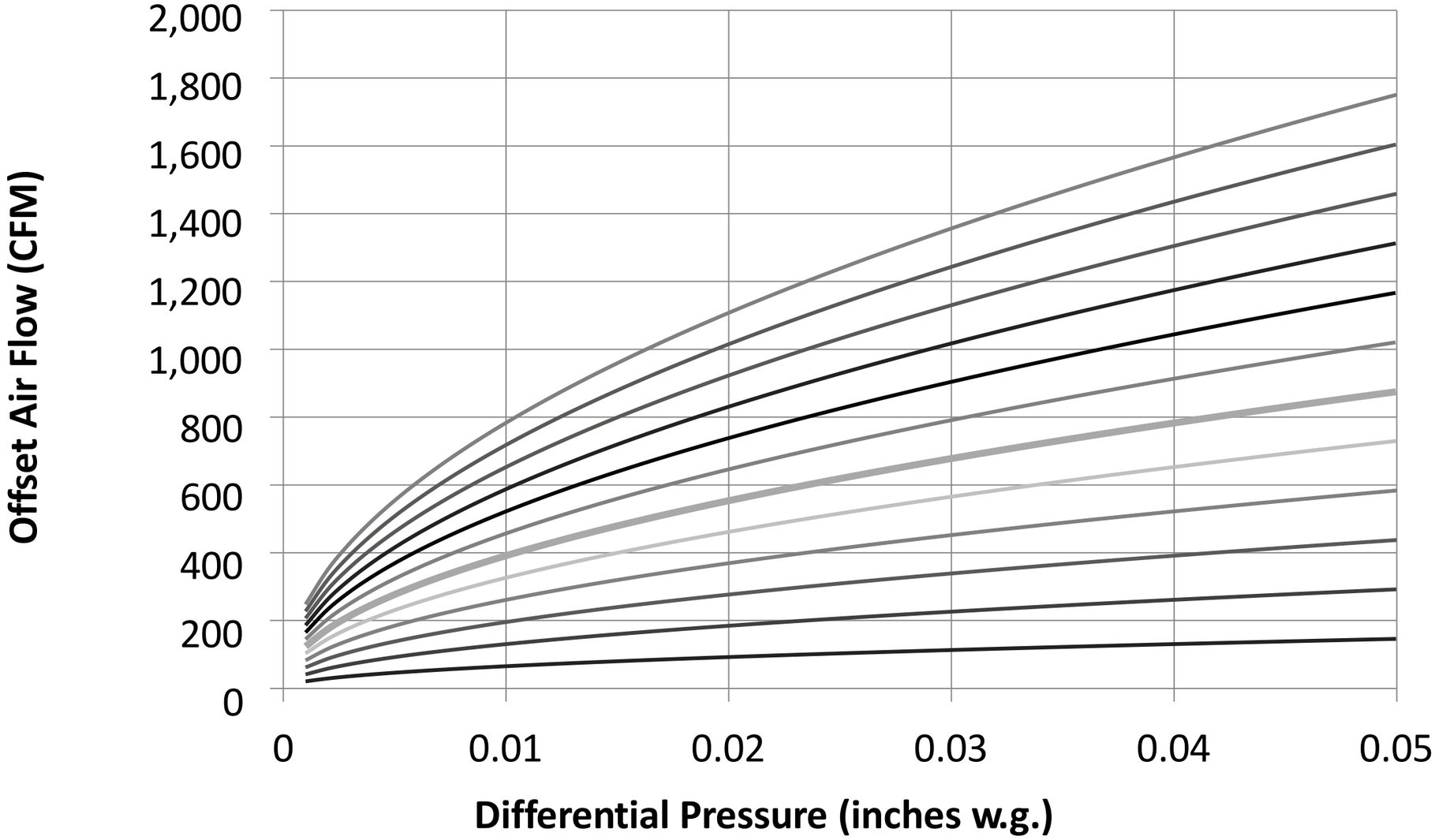
- Table 7.1 defines several design parameters
- Air movement should always be from clean to less clean
- VAV systems cannot compromise pressure relationships or minimum air change requirements
- Air change rates shall be based on supply for positive pressure rooms and shall be based on exhaust for negative pressure rooms
- Air changes can be reduced when a space becomes unoccupied provided that required air pressure relationship is maintained
- Higher air change rates may be required to maintain room temperatures
- Recirculating room HVAC units can be used where allowed per Table 7.1 such as Passive Chilled Beam, Active Chilled Beam or Fan Coil Units but must be provided with a MERV 6 filter upstream of any cooling coil (keeps the cooling clean)

7.0 Space Ventilation – 7.1 General

- ASHRAE Standard 62.1-2007 and earlier additions had very limited information related to how much outdoor air must be provided to various spaces within a health care facility – that information lived in various ASHRAE handbooks and some codes (all were a little light)
- ASHRAE Standard 170-2008 resolved this important issue – very specific OA data for dozens of room types!
- ASHRAE 62.1-2010 and more current editions now simply refer the designer to ASHRAE Standard 170 for outdoor air flow rates
- Designer must recognize that room-by-room pressurization is a separate issue from building pressurization; building pressurization is handled at the AHU level (the goal being, in this climate, to positively pressurize the building envelope when the outdoor dewpoint is higher than the indoor dewpoint and to negatively pressurize the building envelope when the outdoor dewpoint is lower than the indoor dewpoint)

7.0 Space Ventilation – 7.1 General (pressurization)

Room Porosity Determines delta Airflow Required to Achieve the Design delta Pressure



7.0 Space Ventilation – 7.2 Room Specific Requirements (All)

- Permanently installed device required in order to constantly monitor differential pressure
- Local visual monitor required
- All air to be exhausted directly outdoors (12 AC/HR)
- Existing rooms that are retrofitted may recirculate air through units equipped with HEPA filters
- Dedicated exhaust system is required for All rooms (multiple rooms can, and should, be serviced by a single system)
- Exhaust grilles should be positioned behind the patients' bed
- Room envelope must be sealed
- Differential pressure should be at least -0.01"w.g. (-2.5 Pa); [design .03" --- alarm .01"]
- Anterooms not required but preferred
- Airflow from corridor to anteroom to patient room

7.0 Space Ventilation – 7.2 Room Specific Requirements (PE)

- Permanently installed device required in order to constantly monitor differential pressure
- Local visual monitor required
- Supply air diffusers should be positioned above the patients' bed (12 AC/HR)
- Return air grilles should be positioned near the patient room door
- Existing rooms that are retrofitted may recirculate air through units equipped with HEPA filters
- Room envelope must be sealed
- Differential pressure should be at least -0.01"w.g. (-2.5 Pa); [design .03"---alarm .01"]
- Anterooms not required but preferred
- Airflow from patient room to anteroom to corridor

7.0 Space Ventilation – 7.3 Room Specific Requirements (WICU,NICU)

Burn unit patient rooms (WICU) require booster humidifiers in order to achieve a relative humidity level of 40%
Neonatal intensive care rooms (NICU) should be provided with booster humidifiers in order to achieve a relative humidity level of 40% [suggestion]

Space Ventilation – 7.4 Room Specific Requirements (Surgery Rooms)

- **Sterilization Rooms**
  - Exhaust hoods shall be provided for steam and ETO sterilizers (less common now?)
- **Imaging Procedure Rooms**
  - Ventilation same as Class A Surgery
  - Ventilation same as Class B or C Surgery if Anesthetic Gases are Administered

Space Ventilation – 7.4 Room Specific Requirements (Surgery Rooms)

At least 0.01" w.g. positive pressure at all times; [design .03"---alarm .01"]

Primary supply diffuser array must extend 12" beyond the footprint of the surgical table; additional supply diffusers may be located elsewhere in the OR

At 70% of the area associated with the 12" extension must be diffusers (implies that 100% of the area associated with the surgical table must be diffusers)

TABLE 6.7.2 Supply Air Outlets

Space Designation (According to Function)	Supply Air Outlet Classification[a]
Operating rooms, procedure rooms (all class A, B, and C surgeries[b])	Primary supply diffusers Group E, nonaspirating additional supply diffusers, Group E
Protective environment (PE) rooms	Group E, nonaspirating
Wound intensive-care units (burn units)	Group E, nonaspirating
Trauma rooms (crisis or shock)	Group E, nonaspirating
All rooms	Group A or Group E
Single-bed patient rooms[c]	Group A, Group D, or Group E
All other patient-care spaces	Group A or Group E
All other spaces	No requirement

Notes:

a. Refer to the 2009 *ASHRAE Handbook—Fundamentals*, Chapter 20 (see ASHRAE [2009] in Informative Appendix B), for definitions related to outlet classification and performance.

b. Surgeons may require alternate air distribution systems for some specialized surgeries. Such systems shall be considered acceptable if they meet or exceed the requirements of this standard.

c. Air distribution systems using Group D diffusers shall meet the following requirements:
   1. The system shall be designed according to "Design Guidelines" in Chapter 7 of *ASHRAE System Performance Evaluation and Design Guidelines for Displacement Ventilation*.[11]
   2. The supply diffuser shall be located where it cannot be permanently blocked (e.g., opposite the foot of the bed.)
   3. The room return/exhaust grille shall be located in the ceiling, approximately above the head of the patient bed.
   4. The transfer grille to the toilet room shall be located above the occupied zone.

Space Ventilation – 7.4 Room Specific Requirements (Surgery Rooms)

Primary supply diffusers at a speed of 25 to 35 ft/min w/ unidirectional flow (term "laminar flow" is N/A); parallel streamlines likes straws in a box-same speed-one pass

At least two (2) low sidewall return grilles (bottom at 8" AFF) on opposite sides of room; wall-mounted return air grilles located high as well as ceiling-mounted returns are preferred (current research supports these flow patterns)

TABLE 6.7.2 Supply Air Outlets

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Notes:

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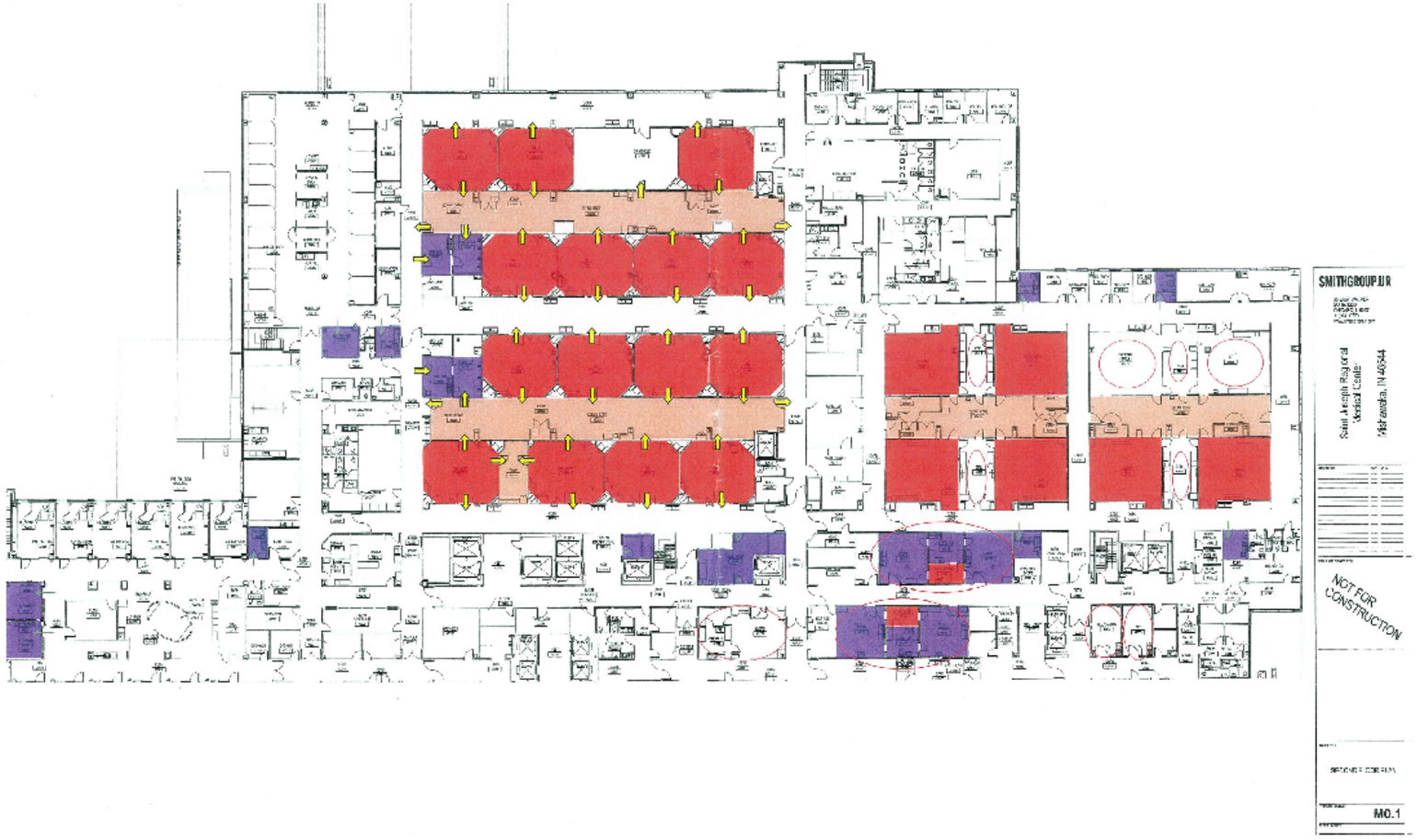
   4. The transfer grille to the toilet room shall be located above the occupied zone.

8.0 Planning, Construction and System Start-Up

- Provide access to equipment above ceilings outside the footprint of occupied spaces
- Pre-test all HVAC systems at the outset of a renovation process (rob Peter to pay Paul)
- Have ICRA process in place
- Have ILSM process in place
- Maintain project documentation including as-builts, specs, BIM and OPR/BoD
- Keep ducts wrapped during construction
- Change filters based on dP
- Test filters for leakage

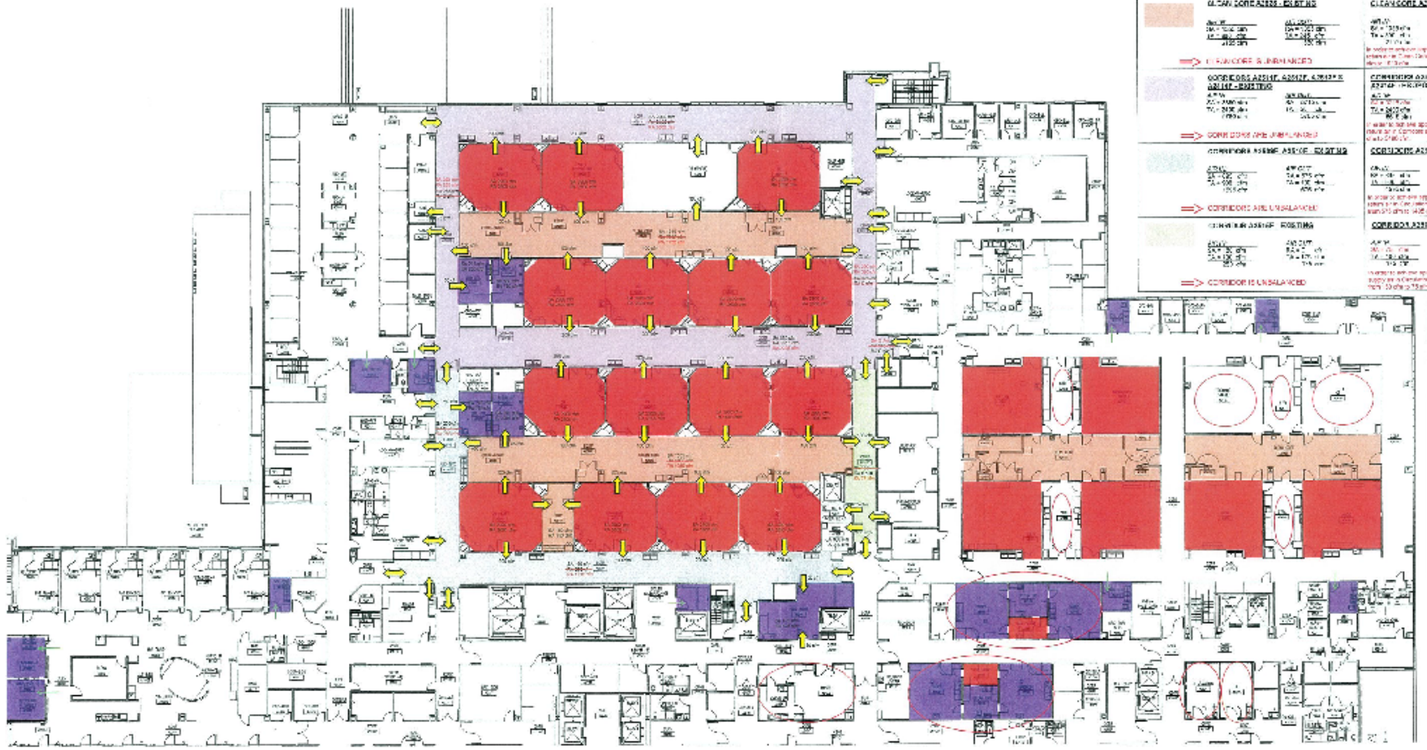
8.0 Planning, Construction and System Start-Up

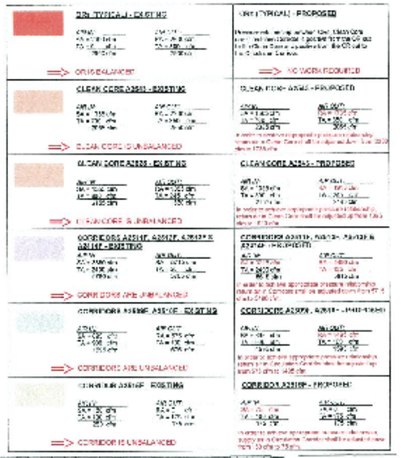
- Define "effective preventative maintenance cycle"
- Maintain critical environment testing done at regular intervals
- Proactively trend as much data as possible in order to effectively carry out troubleshooting when required
- Retro-commission systems never commissioned
- Re-commission systems commissioned at the beginning of their life


SMITHGROUPJJR
Saint Joseph Regional Medical Center
Mishawaka, IN 46544
NOT FOR CONSTRUCTION
M0.1

EXISTING CONDITION - 15 OPERATING ROOMS ARE IN THE OCCUPIED MODE (FULL LOAD)

SUPPLY AIR AT FULL LOAD = 15 ORs x 2900 cfm = 43500 cfm (XX hrs/year)





SMITHGROUP JR

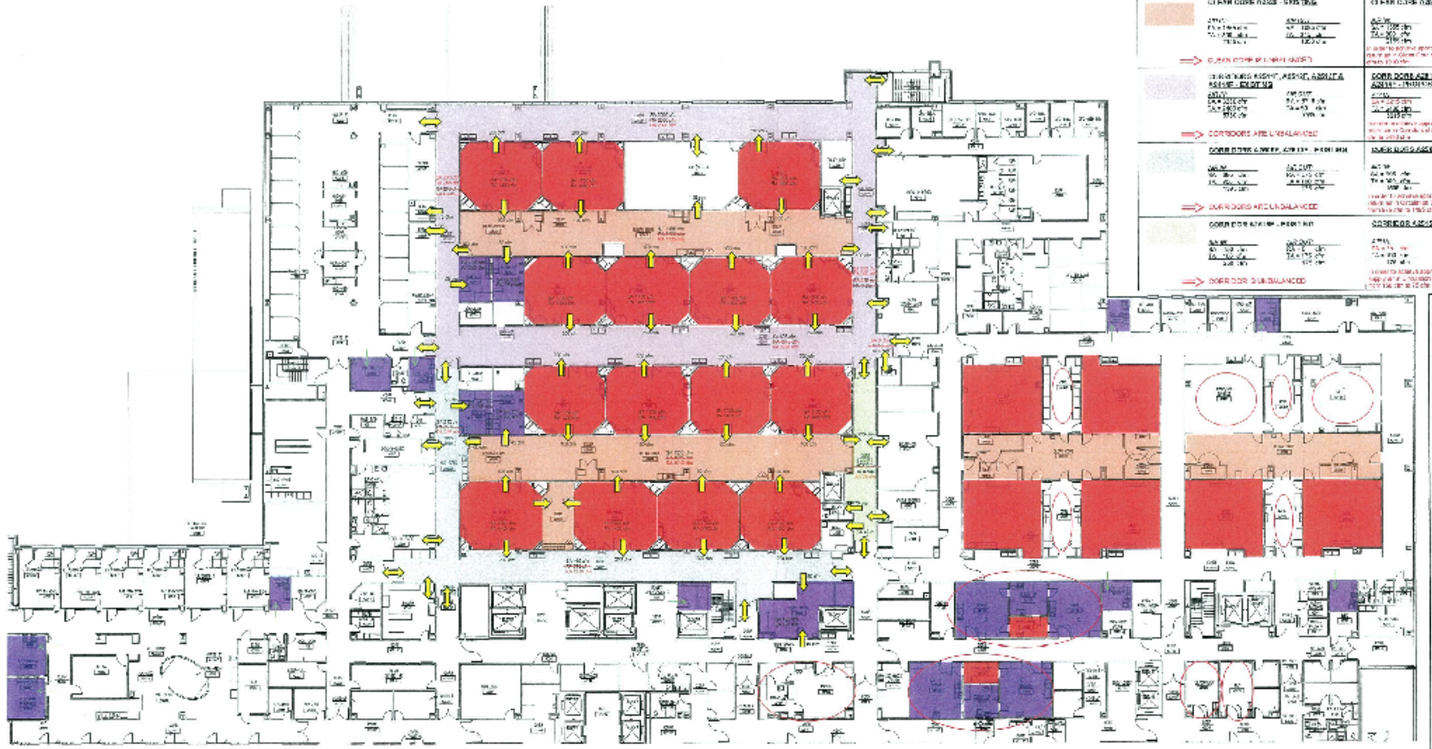
Saint Joseph Regional Medical Center
Mishawaka, IN 46544

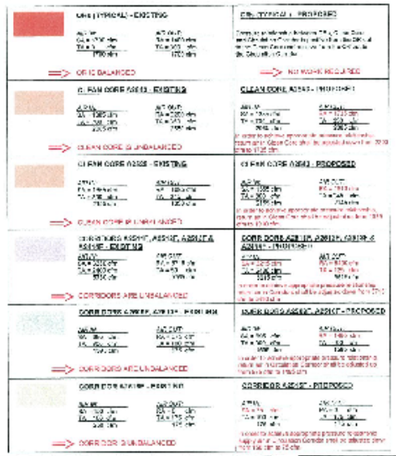
NOT FOR CONSTRUCTION

M0.2

EXISTING CONDITION - 15 OPERATING ROOMS ARE IN THE OCCUPIED MODE (CODE MINIMUM)

SUPPLY AIR AT CODE MINIMUM = 15 ORs x 1700 cfm = 25500 cfm (YY hrs/year)





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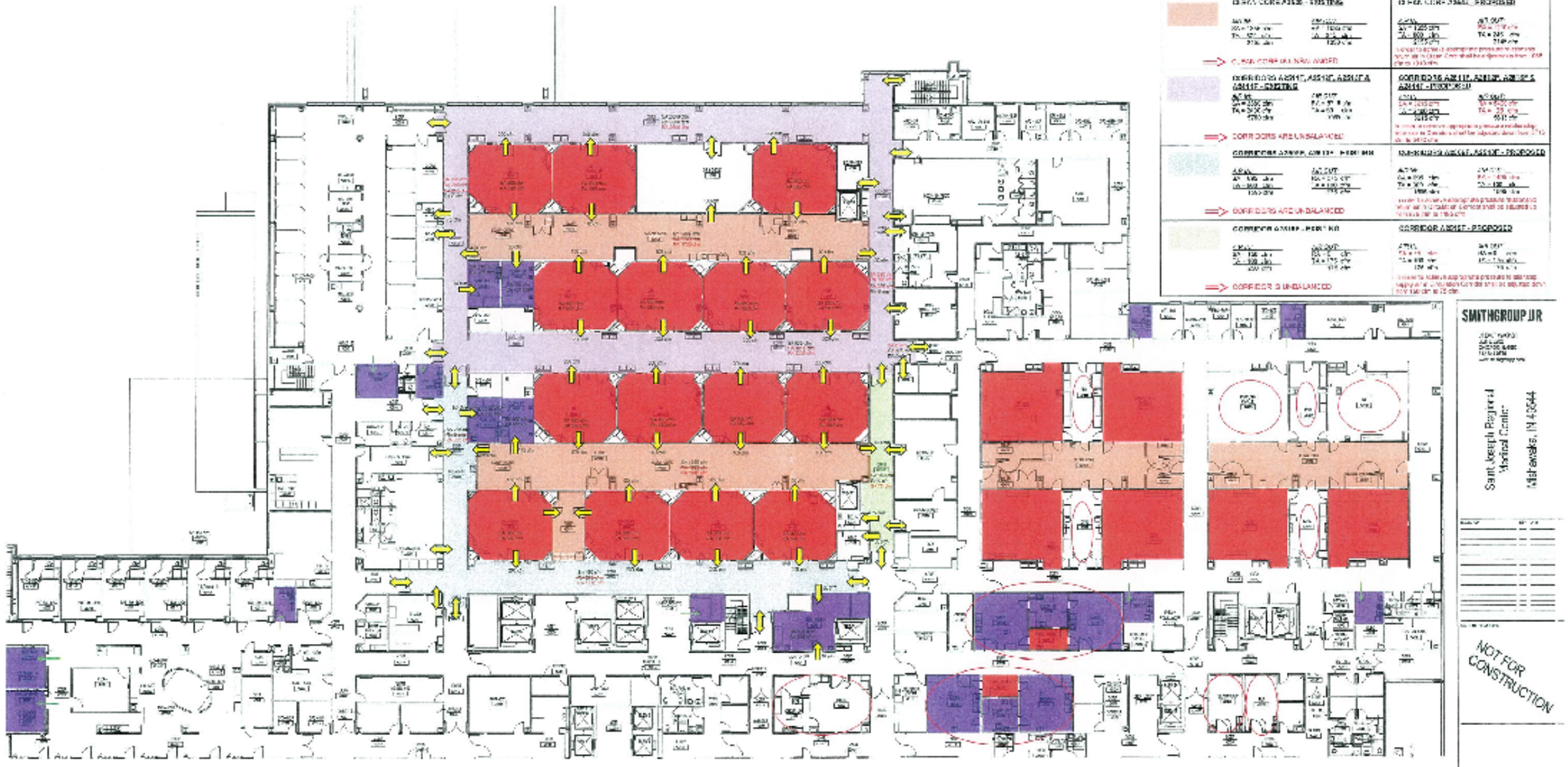
SECOND FLOOR RENOVATION PLAN

M0.3

PROPOSED SOLUTION - 15 OPERATING ROOMS ARE IN THE UNOCCUPIED MODE (ABSOLUTE MINIMUM)

SUPPLY AIR AT ABSOLUTE MINIMUM = 15 ORs x 880 cfm = 13200 cfm (ZZ hrs/year)



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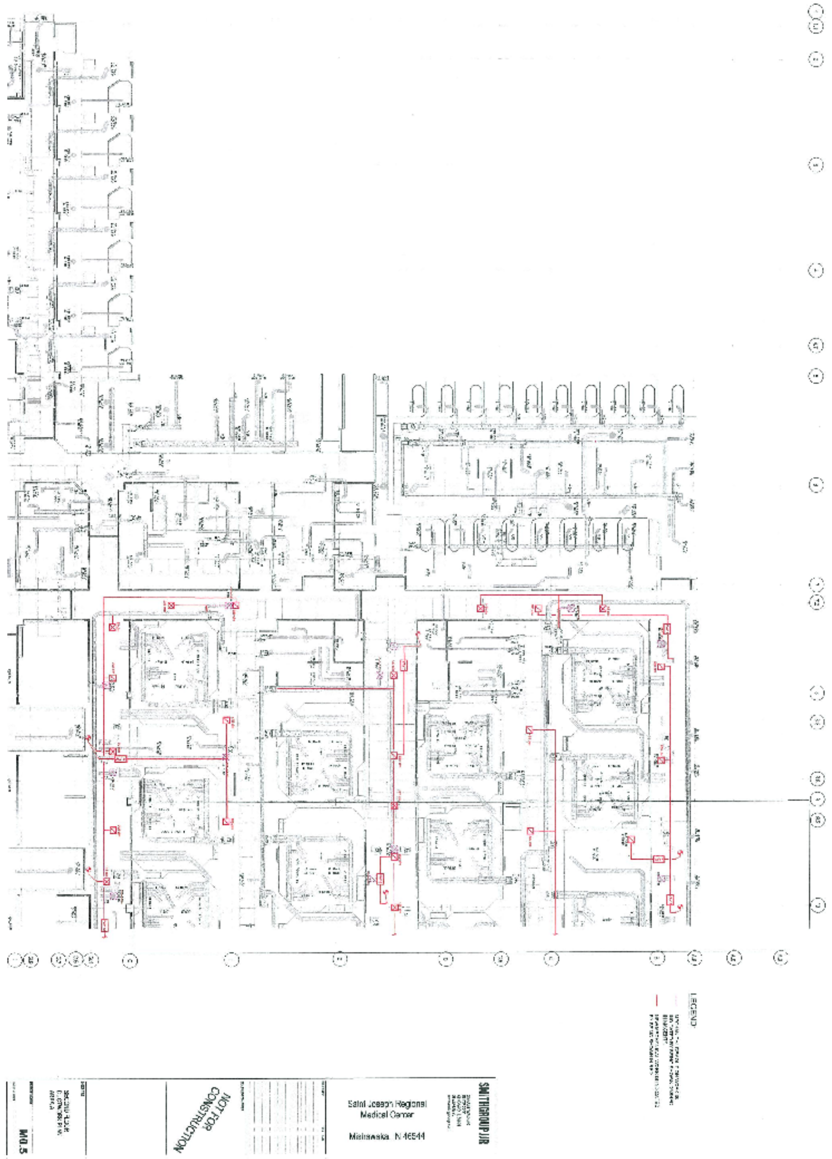
SECOND FLOOR RENOVATION PLAN (ABSOLUTE MINIMUM)

M0.4

THE FUTURE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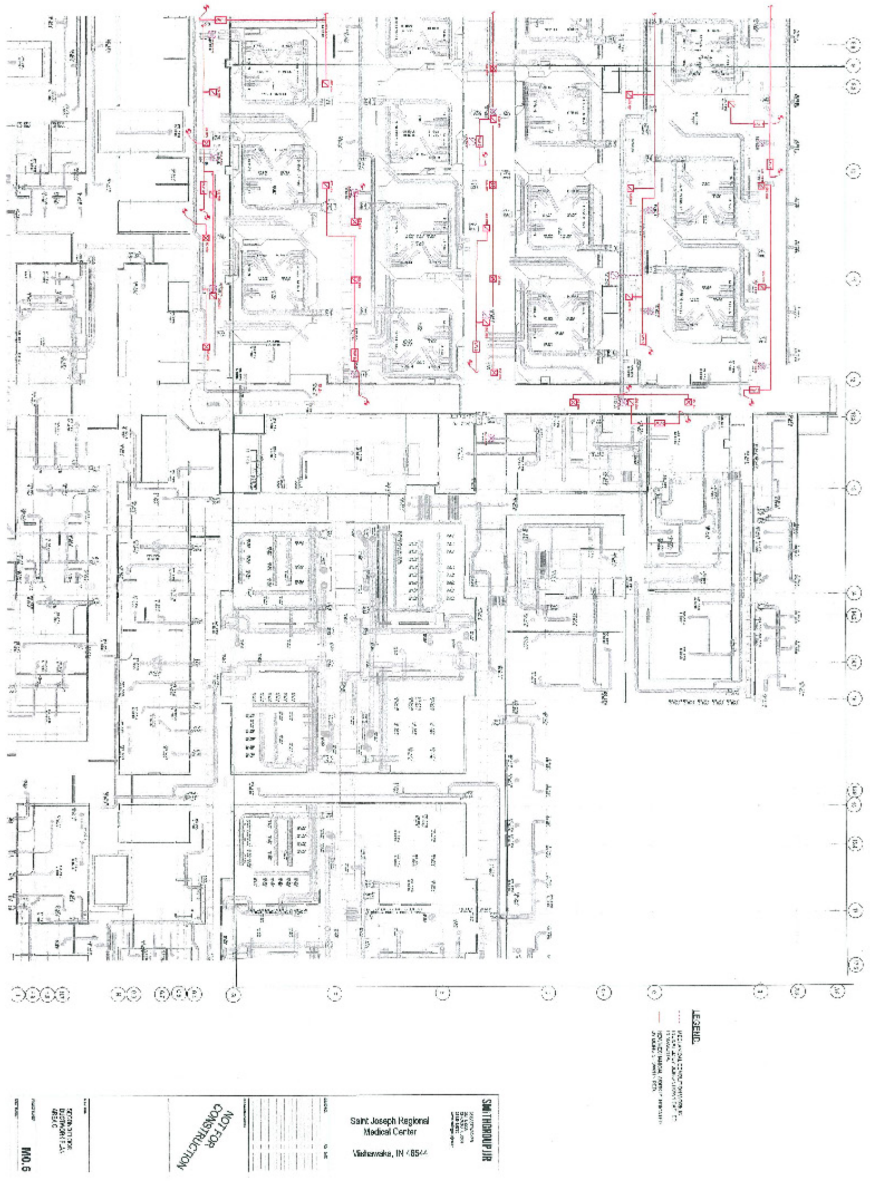
LEGEND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- Academic Research to Support FGI and ASHRAE Standard 170 (per 2017 Winter) to meet ANSI requirements); scrub all references
- ASHRAE multi-committee effort to evaluate the technical basis and adoption of airflow rates in terms air changes per hour
- USP 800
  - Publish ASHRAE Standard 170 again in late 2017 or early 2018 for inclusion into the 2018 FGI

Questions?
Comments?

Contact Information

SMITHGROUP JJR

35 East Wacker Drive

Suite #900

Chicago, IL 60601

www.smithgroupjjr.com

Laurence V. Wilson, P.E.

ASHRAE HFDP, LEED AP

Principal

312-898-1224 cell

laurence.wilson@smithgroupjjr.com

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