Mechanical + Electrical Challenges

MINNESOTA HEALTHCARE ENGINEERS ASSOCIATION

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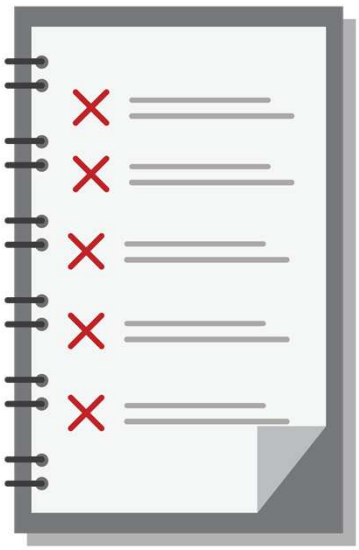
TODAY'S AGENDA

- **Pressures on Your Facility**
- **USP 797/800**
- **Emergency Power Systems**
- **Condensing Boilers**

----- BREAK -----

- Humidity Control
- Cold Temperature Operation
- Commissioning
- Electrical Testing
- Medivators
- Procedure Rooms



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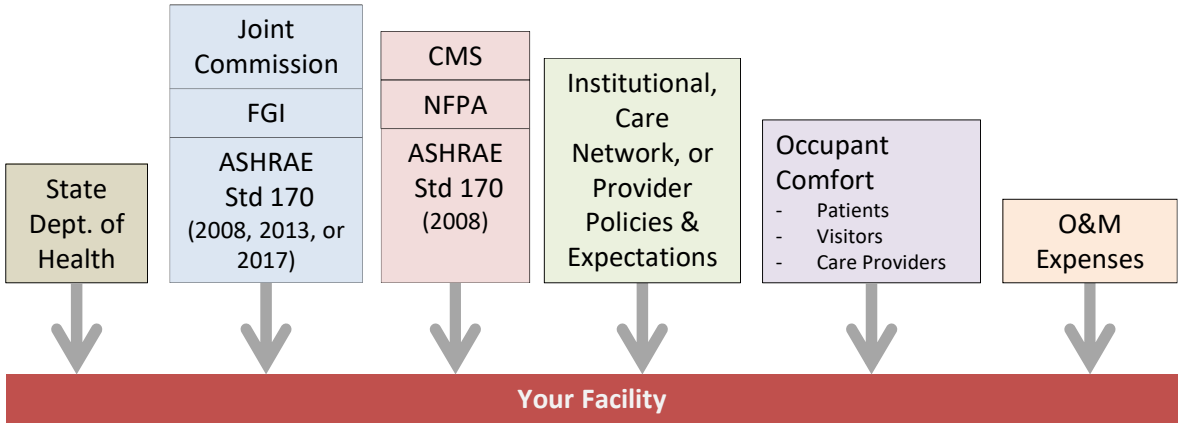

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DEPARTMENT OF HEALTH

- **Construction project review of drawing and construction review**
- **When does a remodel change the applicable code?**
  - Change of use – Yes
  - Moving walls – Yes
  - Painting the walls – No
  - Discuss early with DOH, design team, owner

DEPARTMENT OF HEALTH

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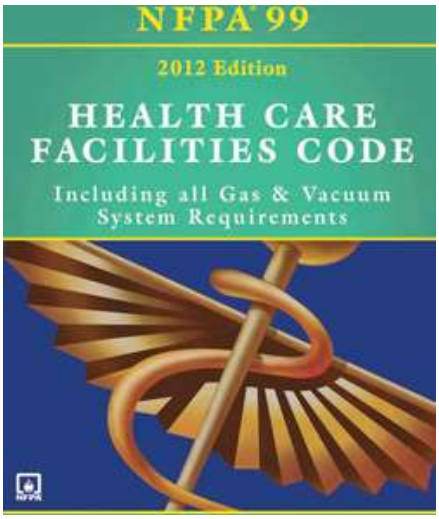
CMS (MEDICARE/MEDICAID)

CMS adopted NFPA 99-2012 in July 2016 with enforcement beginning in November 2016

- **ASHRAE 170-2008 (No Addenda)**



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JOINT COMMISSION

Joint Commission currently uses the 2014 Guidelines for Design and Construction of Hospitals

- **Referenced in the Environment of Care**

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OPERATING ROOMS

Version of Guidelines for Design & Construction of Healthcare Facilities	Pressure Relationship	Min. OA ACH	Min. Total ACH	Recirculated by means of room units	RH%	Temp (°F)	Comments
1992-1993 AIA	Positive (no magnitude)	3	15	No	50-60	70-75	
2001 AIA	**Positive (+0.01" wg)**	3	15	No	30-60	68-73	
2006 AIA	Positive (+0.01" wg)	3	15	No	30-60	68-73	
2010 FGI / ASHRAE 170-2008	Positive (+0.01" wg)	**4**	**20**	No	30-60	**68-75**	**CMS Enforced**
2014 FGI / ASHRAE 170-2013	Positive (+0.01" wg)	4	20	No	**20-60**	68-75	**JC EC Reference**
2018 FGI / ASHRAE 170-2017	Positive (+0.01" wg)	4	20	No	20-60	68-75	

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ENDOSCOPY ROOMS

Guidelines for Design & Construction of Healthcare Facilities	Pressure Relationship	Min. OA ACH	Min. Total ACH	Recirculated 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 Enforced
2014 FGI / ASHRAE 170-2013	No Requirement	2	6	No	20-60	68-73	JC EC Reference
2018 FGI / ASHRAE 170-2017	No Requirement	2	6	No	20-60	68-73	
Bronchoscopy 2001 AIA to 2018 FGI	Negative (-0.01 in wg)	2	12	No	NR	68-73	All Air Exhausted

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USP 797/800

- Final Versions to be issued September 2019
- Enforcement December 2019

- 797 Non-Hazardous
- 800 Hazardous

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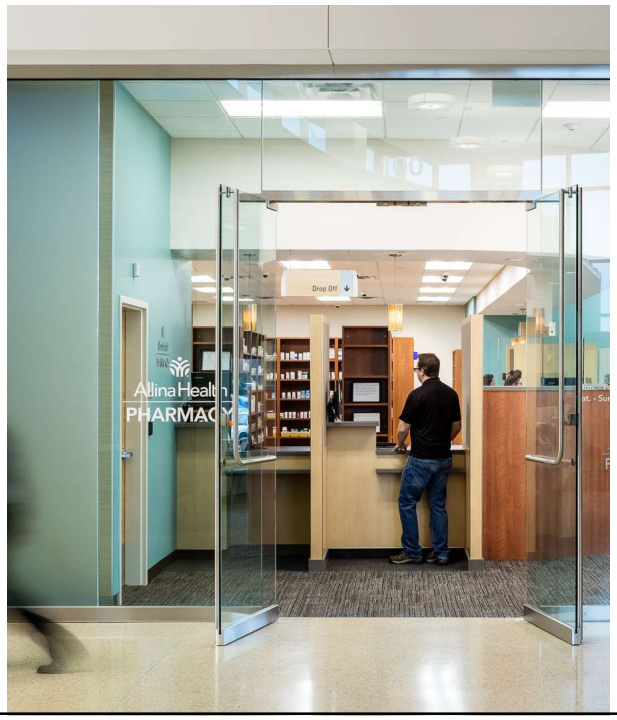
WHAT DO I NEED?

- Category 1 vs 2 Compounding
  - 12 Hour BUD
- Category 1 Segregated Compounding Area
- Category 2 Ante-Room and Buffer Room(s)



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HAZARDOUS COMPOUNDING

- Hazardous Compounding Room
  - ISO 7
  - 30 ACH (supply)
  - -0.01 to -0.03 in WC
  - 68° F
  - Low exhaust for Refrigerator
- Ante Room
  - ISO 7
  - 30 ACH
  - +0.02 to +0.05 in WC
  - 68° F
  - Low return

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NON-HAZARDOUS COMPOUNDING

- Non-Hazardous Compounding Room
  - ISO 7
  - 30 ACH
  - +0.02 to +0.05 in WC
  - 68° F
  - Low return
- Ante Room
  - ISO 8
  - 20 ACH
  - +0.02 to +0.05 in WC
  - 68° F
  - Low return

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HAZARDOUS STORAGE

- Inside Hazardous Compounding Room
- Separate Room
  - Non-classified
  - 12 ACH Exhaust
  - -0.01 in WC

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WHAT ARE WE COVERING

- Existing facility
- New or existing generator
- Existing or new ATS's
- Testing compliance requirements
- Documentation

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DEFINITIONS

EPS – Emergency Power Supply
EPSS – Emergency Power Supply System
EES – Essential Electrical System

- Level 1 – Loss of human life or serious injury (110)
- Level 2 – Less critical (110)

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GENERATORS

NFPA 70 (NEC): 701.3:

- Test periodically
- Maintain unit
- Record maintenance
- Informational note refers to 110

NFPA 99

- Minimum 12 tests per year
- Does not need to meet 10 second start every month
- Refers to 110.8

NFPA 101: SEE 110

NFPA 110: 8.4:

- 30 minutes/month
  - Minimum exhaust temperature recommended by the generator manufacturer
  - OR minimum 30% of standby nameplate KW
- If the above is not met:
  - Load-bank one a year at 50% for 30 minutes and 75% for 1 hour.
- Document time, date, duration, etc.

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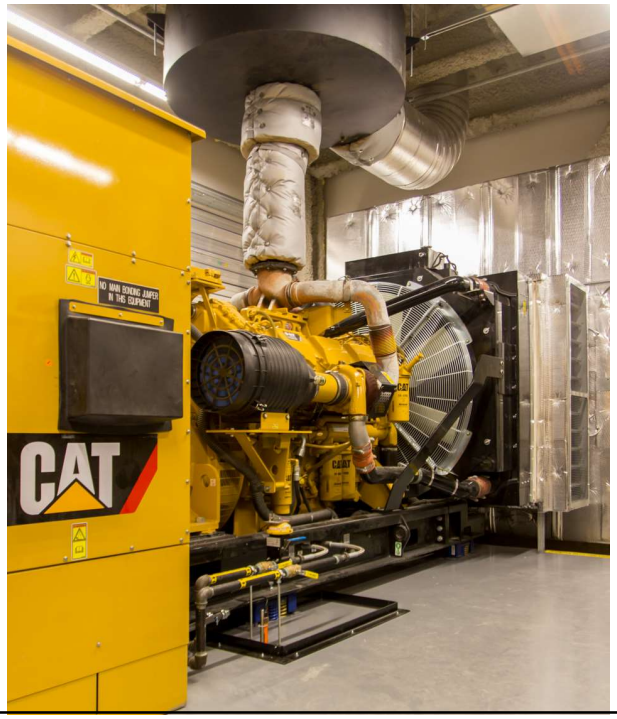
GENERATORS

Typical Commissioning Issues:
Interior and Exterior:

- Low coolant temp
- ECM vs. Generator Controller points
- Batteries in acid resistant tray
- Battery cover or not?
- Breakers can be shut off without alarm
- Engine idle/cool down not annunciated
- Emergency lighting (battery pack at unit)
- ISO 8528 – 5 (2018) Performance: G3

Exterior

- Dampers fail open
- Remote shut-down
- Fuel class



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ATS

- Existing facility
- New or existing generator or ATS with controls upgrades
- Testing compliance requirements
- Documentation

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ATS

NFPA 70 (NEC): 701.3 and 5:

- Test periodically
- Maintain unit
- Record maintenance
- SCC Rating marked on the EXTERIOR of enclosure

NFPA 99

- 10 second criteria is spelled out here (Type 1)
- Does not need to meet 10 second start every month
- Refers to 110.8

NFPA 101: SEE 110

NFPA 110: 8.4.3.1:

- Initiate start from a different ATS each month
- Level 1 EPSS full test required once every 36/mo.
- DOCUMENT from which ATS the start signal was initiated

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ATS

Typical Commissioning Issues:
Interior and Exterior:
- **Settings: Who determines?**
- **Fault current ratings**
- **Circuit breaker settings and coordination**
- **Labeling**
- **Testing**
- **Thermoscanning**

Exterior
- **Service entrance rating**
- **Internal heat and MONITORING**

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CONDENSING BOILERS

- **Why?**
  - Efficiency
  - Scarcity of Licensed Boiler Operators
  - Maintenance

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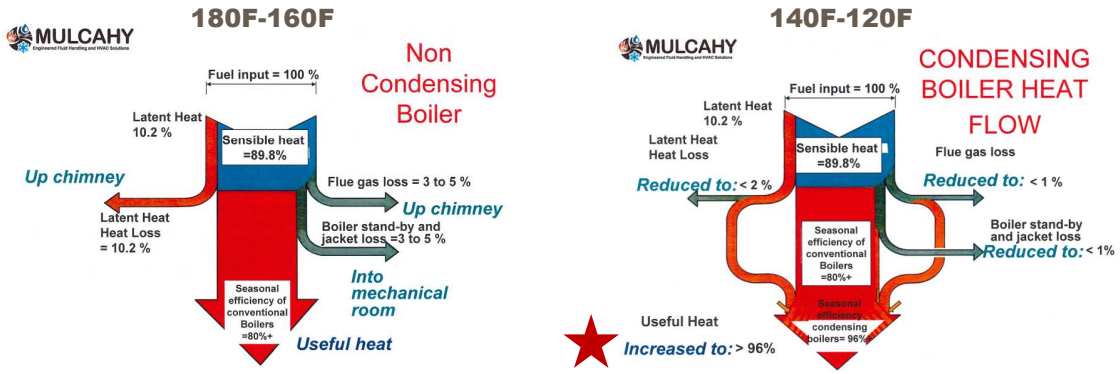
CONDENSING BOILERS

- **Why are condensing boilers more efficient?**



- **Because they can capture and use latent heat**

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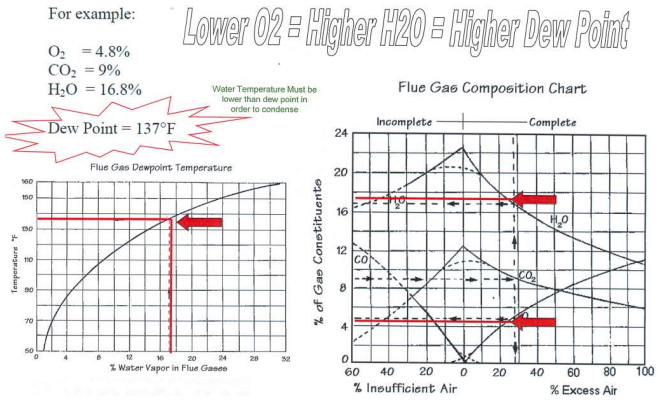
CONDENSING BOILERS

- **Water Temp < Dew Point Temp = Condensation**

Boiler combustion = fuel + oxygen



Graphs courtesy of Mulcahy Co.

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CONDENSING BOILERS

- **Efficiency**
  - Lower return water temp

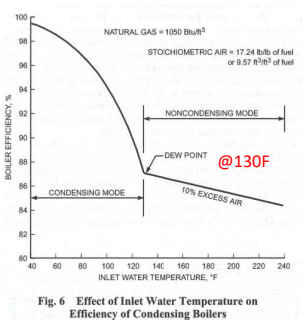
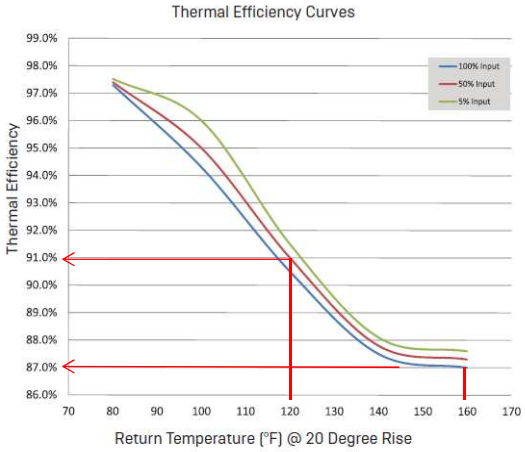


Fig. 6 Effect of Inlet Water Temperature on Efficiency of Condensing Boilers

2016 ASHRAE HVAC Systems and Equipment
Chapter 32



Boiler Thermal Efficiency Curve
Courtesy of Aerco

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CONDENSING BOILERS

- **Improving efficiency with existing HIGH TEMP hydronic components**

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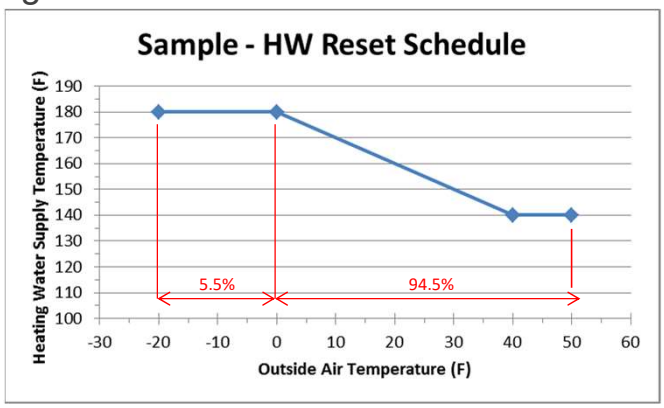
CONDENSING BOILERS

- **Heating Water Reset**
  - Winter Setpoint: 180°F or 190°F, from original system design
  - Spring and Fall: 140°F



For Minneapolis:
8760 Bin Hours
0F to 50F: 4,478 hrs
-30F to 0F: 256 hrs

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Mechanical + Electrical Challenges Pt. 2

MINNESOTA HEALTHCARE ENGINEERS ASSOCIATION

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TODAY'S AGENDA

- Pressures on Your Facility
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- Emergency Power Systems
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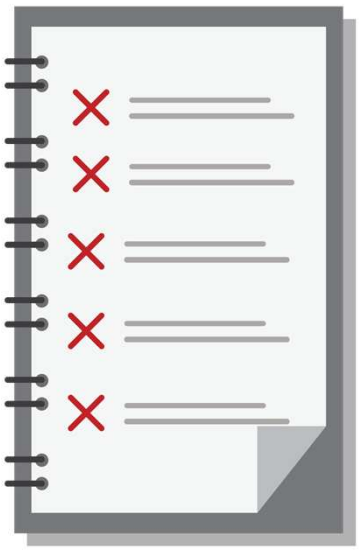

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OPERATING ROOM HUMIDITY

Why?

- **Important For**
  - Reduction of infections
  - Reduction of electrostatic discharge
  - Integrity of sterile supplies and equipment
  - Preventing development of mold

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OPERATING ROOM HUMDITY

- **Regulatory Requirement**
  - FACITLITY GUIDELINES INSTITUTE (FGI)
  - ASHRAE STANDARD 170
  - CENTERS FOR MEDICARE & MEDICATE SERVICES (CMS)

RELATIVE HUMDITY

20% ⟷ 60%

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OPERATING ROOM HUMDITY

- **Humidification**
  - Central system / Point-of-use
  - Building steam / Clean steam
  - Vapor barriers
  - Windows & exterior walls

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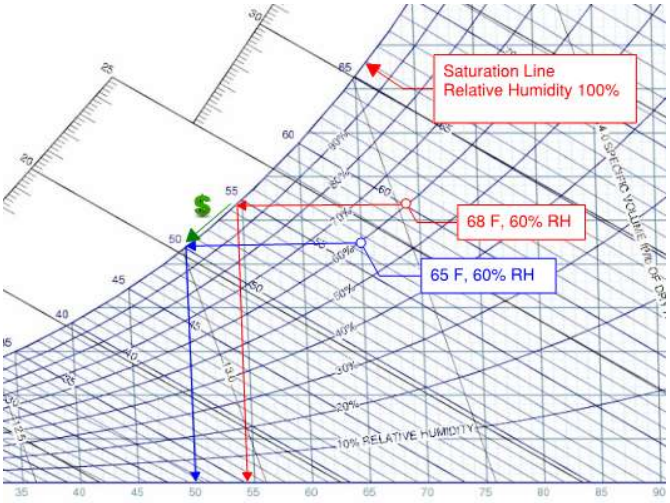
OPERATING ROOM HUMDITY

- **Dehumidification**
  - 68F Room Temp vs. 65F
  - Lower Coil Leaving Air Temperature
  - Increased Reheat



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OPERATING ROOM HUMDITY

- **HVAC systems**
- **System capability**
- **Infrastructure investment**

- **Increased operating costs**
  - Efficiency options
    - › Leaving air temperature reset
    - › Heat recovery coils
    - › Energy wheels

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OPERATING ROOM HUMDITY

- **Compliance policy**
  - Infection control
  - Duration / Magnitude
  - Local / BAS alarming
  - Staff training
  - When / Who to call

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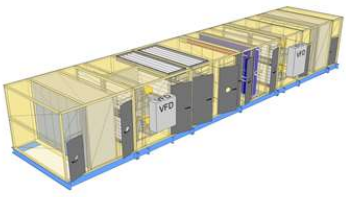
AHU RESTART

- **AHU shutdown on freezestat? Now what**
  - Close the OA damper and Relief Air dampers
  - Open the Return Air damper
  - If bitterly cold,
    consider manual override of heating water control valve
  - Restart fans; run for 5-10 minutes to stabilize
  - Slowly open OA and Relief Air dampers; let unit stabilize after each subsequent opening



Note

It is possible to automate this sequence, however it is difficult to estimate how slow the OA damper should open, especially in frigid cold

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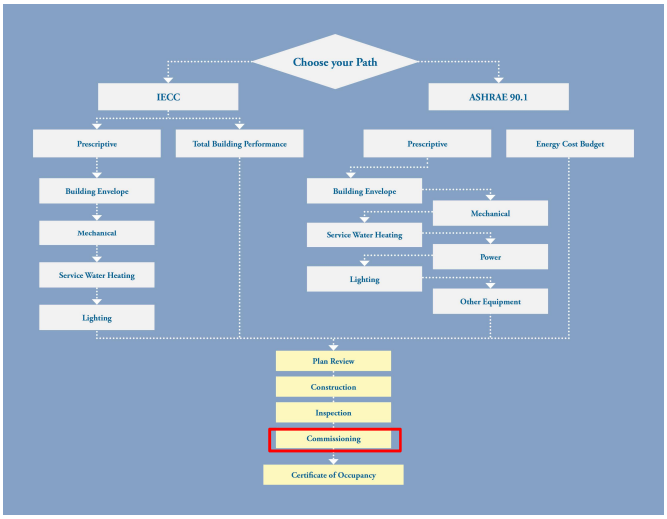
COMMISSIONING IN HEALTHCARE FACILITIES

– Required per 2015 MN Energy Code

IECC, C408.2 SYSTEM COMMISSIONING
Exemption:

1. **< 40 TONS COOLING & < 600 MBH HEATING**
2. **Sleeping Units in Hotels & Motels**



ASHRAE 90.1, 6.7.2.4 SYSTEM COMMISSIONING
Required:

1. **> 50,000 SF**
   Except warehouses and semi-heated spaces

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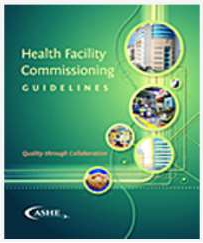
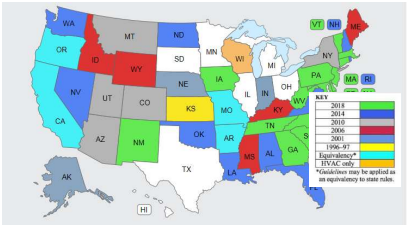
COMMISSIONING IN HEALTHCARE FACILITIES

– Required per 2014 FGI Guidelines

- 1.2-7.1 Installation of new or modification of existing, the following shall be commissioned:
  - BAS system
  - Domestic hot water
  - Fire alarm and fire protection
  - Essential power systems





State Adoption of the FGI Guidelines

Areas of Concern

- CRITICAL AND INTENSIVE CARE
- SURGICAL SERVICES
- ISOLATION ROOMS
- PHARMACIES
- AREAS CONTAINING HAZARDOUS MATERIALS

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WHAT ARE WE COVERING

- Breaker coordination
- Arc Flash study
- Breaker testing
- Lighting testing
- Panelboard load metering
- Battery testing
- Receptacle testing
- Compliance documentation

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BREAKER COORDINATION

NEC Article 100:

- **Coordination (Selective)**
- **Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the choice of overcurrent protective devices, and their ratings for settings.**

Tools used:

- SKM – Power Tools for Windows
- Easy Power
- EDSA
- ETAP

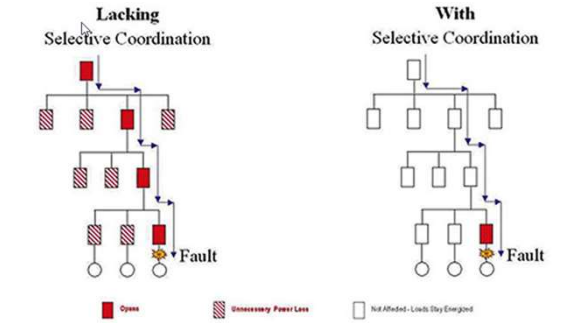

Figure 1. System lacking selective coordination

Figure 2. System providing selective coordination

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ARC FLASH STUDY

- **How is it Calculated?**
  - NFPA 70E
  - IEEE 1584
  - Preferred Method
- **Facility Responsibilities**
  - Employee training
  - Written safety program
  - Available PPE
  - Insulated tools
  - Arc Flash hazard calculations
  - Proper labeling

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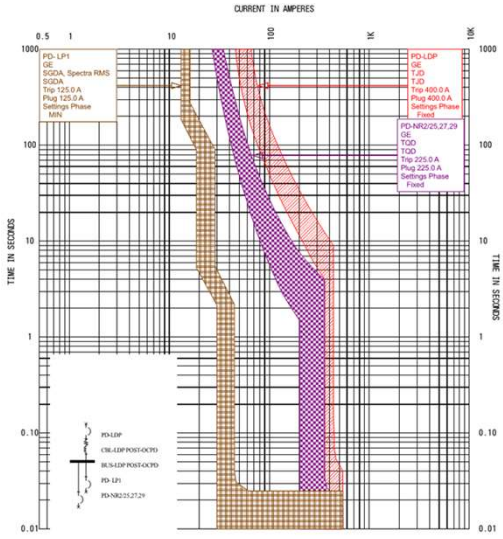
BREAKER TESTING

Why test breakers:

- **Known failure**
- **Nuisance tripping**
- **Suspicion of issues**
- **Confirm operation prior to installation in a critical system**

How to test:

- **Primary injection (preferred) – confirms sensors and electronics are functioning**
- **Secondary injection – only confirms electronics**
- **Follow NETA, NEMA and Manufacturers recommended procedures.**



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LIGHTING TESTING

- Verify egress path
- Verify critical lighting
- Verify controls conform to construction documents
- Verify interfaces to A/V and other systems
- Test with scheduled outage
- Documentation

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PANELBOARD LOAD METERING

Why:

- Confirm distribution capacity
- Manage load growth

Where to Implement:

- On more critical systems where load growth is likely
- Where additional distribution is most costly (generation)

How:

- Integral to panelboards, ATS's, breakers
- Separate system

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BATTERY TESTING

Visual inspection

Voltage testing

Float current

- **Current delivered by the charger when battery is fully charged**
- **Track for baseline and watch for increases**

Ripple current – Bad charger?

Temperature – leads to short life

Specific gravity – Verify battery chemistry

Impedance testing – Indicator of battery health

Discharge testing – Verifies capacity, but not health of system

Documentation – confirm compliance and establishes baselines

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RECEPTACLE TESTING

NFPA 99: 6.3.3.2

- **Visual inspection**
- **Ground continuity**
- **Polarity**
- **Retention force – 115g (4oz)**
- **New devices at patient bed locations or deep sedation shall be tested.**
- **Additional testing as required by documented performance data?**
  - Documented failure rates from manufacturer
  - Reports of receptacle issues
- **Non-Hospital grade receptacles: 12 month intervals**
- **Document**

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MEDIVATORS

- What can go wrong?

- Mixing valve
- Hot water temperature
- Water pressure
- Water quality
- Odors

- Fixes

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MEDIVATOR FIXES

- Mixing valve approved by Medivator
- Reduce “dead leg”
- Heat trace
- Buffer tank with Booster pump
- Back flushing Pre-filter
- Connected exhaust duct

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PROCEDURE ROOMS

- **ASHRAE 170 Requirements**
  - Positive pressure
  - 15 Total ACH/ 3 ACH OA
  - 70-75° F
  - 20-60% RH
  - Group E diffusers, laminar flow
  - MERV 13 filter bank number 1

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PROCEDURE ROOMS

- **ASHRAE 170-2008 and 2013**
  - procedure room (Class A surgery): provides minor surgical procedures performed under topical, local, or regional anesthesia without preoperative sedation. Excluded are intravenous, spinal, and epidural procedures, which are Class B or C surgeries.

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PROCEDURE ROOMS

- **ASHRAE 170-2017**
- **procedure room*: a room designated for the performance of procedures that do not meet the definition of "invasive procedure" and may be performed outside the restricted area of a surgical suite and may require the use of sterile instruments or supplies. Local anesthesia and minimal and moderate sedation may be administered in a procedure room as long as special ventilation or waste-anesthesia gas-disposal systems are not required for anesthetic agents used in these rooms.**

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QUESTIONS?

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