



Welcome to the WHEA's

Lunch & Learn

July 9, 2020

Electrical Panel Requirements

Presented by Bill Lauzon, Heather Werner, Alex Werner



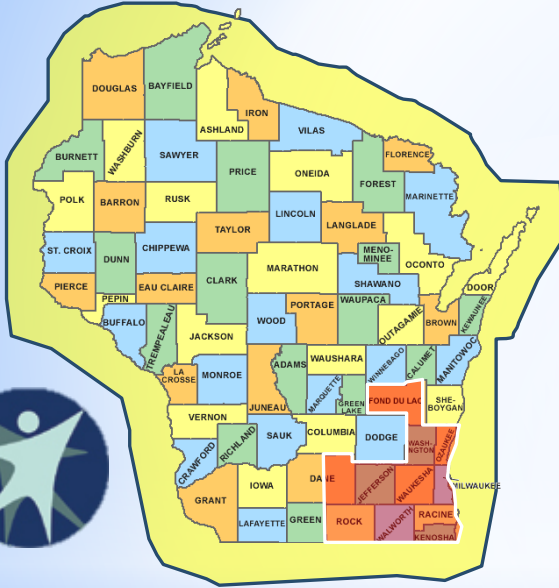


Lunch & Learn Schedule

MONTH	TOPIC
January	Electrical Generator Testing
February	SP 797-800
March	Water Treatment Overview
April	Sprinkler System Requirements
May	Healthcare Design Trends
June	Water Management Trends
July	Electrical Panel Requirements
August	Air Filtration
September	Steam Maintenance
October	Single Line Drawings
November	Humidification
December	Infection Control

Presenter:

Bill Lauzon (professional engineer)



1973-2006 (33 yrs)

“Facility Engineer”

Tomah – Fargo- Madison

Kenosha - Racine

2007-Present

Retired Life

Safety Consulting



WHEA

Code & Education Committees

2006-2011

DHS-DQA

“Surveyor &

Plan Reviewer”

Wis Liaison



Presenter:

Heather Lauzon Werner



Principle since 2015

3 Years - Director of
Environment of Care at
combined rehab hospital,
CBRF, RCC, and school

Since 2012 – Statewide Consultant

Presenter:

Alex Werner



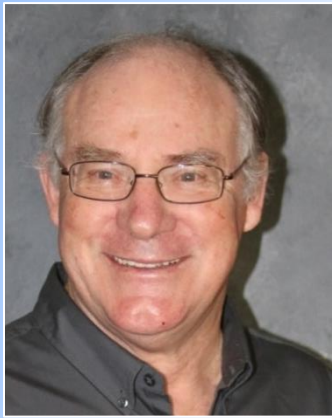
2018-Present

Coordinator

Lauzon Life Safety
Consulting, LLC

Earning a Business
Degree





Bill Lauzon



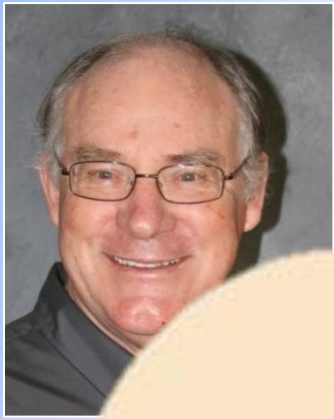
Electrical Panel Requirements

1. Electrical Panel Requirements

(Labeling, Clearances, Protection, Etc..)

2. Other Electrical Code Requirements

(Extension Cords & Power Strips, Open Boxes, Fire Stopping, Lock Out/tag Out, Arc Flash, Etc..)



Bi



Electrical Panel ents



Use the CHAT button to ask questions at any time during the presentation

Electrical Issues

**Typically in the Top 10 of
CMS/TJC Cites**



Electrical

Remember that most inspectors are NOT electricians and have only a limited knowledge of the NEC (except local electrical inspectors)

They tend to cite the “letter of the code”,
to which they have been orientated

(In other words, be familiar with CMS/TJC Citing Guidelines)



K-Tag Numbers have meaning

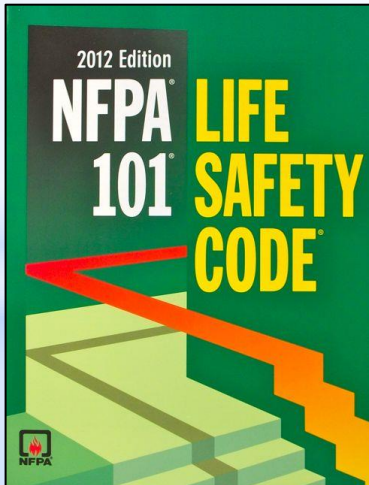
They follow the LSC chapter sequence

<u>K-Tags</u>	<u>Life Safety Code Sections</u>
100's	18/19.1 - General
200's	18/19.2 – Means of Egress
300's	18/19.3 - Protection
400's	18/19.4 – Special Provisions
500's	18/19.5 – Building Services
600's	18/19.6 – (not used)
700's	18/19.7 – Operational Features

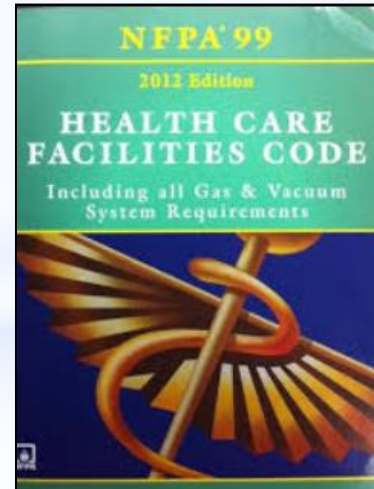
Electrical

Electrical K-Tags

**1 Tag from NFPA 101
Life Safety Code**



**10 Tags from NFPA 99
Healthcare Facility Code**





K-Tags – Life Safety Code

K511

Utilities – Gas and Electric

Equipment using gas or related gas piping complies with NFPA 54, *National Fuel Gas Code*, electrical wiring and equipment complies with NFPA 70, *National Electric Code*. Existing installations can continue in service provided no hazard to life.

18.5.1.1, 19.5.1.1, 9.1.1, 9.1.2

K-Tags – NFPA 99 - Categories

K915

Electrical Systems – Essential Electric System Categories

- ☐ Critical care rooms (Category 1) in which electrical system failure is likely to cause major injury or death of patients, including all rooms where electric life support equipment is required, are served by a Type 1 EES.
- ☐ General care rooms (Category 2) in which electrical system failure is likely to cause minor injury to patients (Category 2) are served by a Type 1 or Type 2 EES.
- ☐ Basic care rooms (Category 3) in which electrical system failure is not likely to cause injury to patients and rooms other than patient care rooms are not required to be served by an EES. Type 3 EES life safety branch has an alternate source of power that will be effective for 1 1/2 hours.

3.3.138, 6.3.2.2.10, 6.6.2.2.2, 6.6.3.1.1 (NFPA 99), TIA 12-3



K-Tags – NFPA 99 - Testing

K914

Electrical Systems – Maintenance and Testing

Hospital-grade receptacles at patient bed locations and where deep sedation or general anesthesia is administered, are tested after initial installation, replacement or servicing. Additional testing is performed at intervals defined by documented performance data. Receptacles not listed as hospital-grade at these locations are tested at intervals not exceeding 12 months. Line isolation monitors (LIM), if installed, are tested at intervals of ≤ 1 month by actuating the LIM test switch per 6.3.2.6.3.6, which activates both visual and audible alarm. For LIM circuits with automated self-testing, this manual test is performed at intervals ≤ 12 months. LIM circuits are tested per 6.3.3.3.2 after any repair or renovation to the electric distribution system. Records are maintained of required tests and associated repairs or modifications, containing date, room or area tested, and results.

6.3.4 (NFPA 99)

K-Tags – NFPA 99 - Outlets

K912

Electrical Systems – Receptacles

Power receptacles have at least one, separate, highly dependable grounding pole capable of maintaining low-contact resistance with its mating plug. In pediatric locations, receptacles in patient rooms, bathrooms, play rooms, and activity rooms, other than nurseries, are listed tamper-resistant or employ a listed cover.

If used in patient care room, ground-fault circuit interrupters (GFCI) are listed.

6.3.2.2.6.2 (F), 6.3.2.4.2 (NFPA 99)

K917

Electrical Systems – Essential Electric System Receptacles

Electrical receptacles or cover plates supplied from the life safety and critical branches have a distinctive color or marking.

6.4.2.2.6, 6.5.2.2.4.2, 6.6.2.2.3.2 (NFPA 99)



K-Tags – NFPA 99 - Generators

NOT addressing
in this
presentation.
If more info is
desired, please
see the Jan
2020 L&L

K918

Electrical Systems – Essential Electric System Maintenance and Testing

The generator or other alternate power source and associated equipment is capable of supplying service within 10 seconds. If the 10-second criterion is not met during the monthly test, a process shall be provided to annually confirm this capability for the life safety and critical branches. Maintenance and testing of the generator and transfer switches are performed in accordance with NFPA 110.

Generator sets are inspected weekly, exercised under load 30 minutes 12 times a year in 20-40 day intervals, and exercised once every 36 months for 4 continuous hours. Scheduled test under load conditions include a complete simulated cold start and automatic or manual transfer of all EES loads, and are conducted by competent personnel. Maintenance and testing of stored energy power sources (Type 3 EES) are in accordance with NFPA 111. Main and feeder circuit breakers are inspected annually, and a program for periodically exercising the components is established according to manufacturer requirements. Written records of maintenance and testing are maintained and readily available. EES electrical panels and circuits are marked and readily identifiable. Minimizing the possibility of damage of the emergency power source is a design consideration for new installations.

6.4.4, 6.5.4, 6.6.4 (NFPA 99), NFPA 110, NFPA 111, 700.10 (NFPA 70)



K-Tags – NFPA 99 – Wet Locations

K913

Electrical Systems – Wet Procedure Locations

Operating rooms are considered wet procedure locations, unless otherwise determined by a risk assessment conducted by the facility governing body. Operating rooms defined as wet locations are protected by either isolated power or ground-fault circuit interrupters. A written record of the risk assessment is maintained and available for inspection.

6.3.2.2.8.4, 6.3.2.2.8.7, 6.4.4.2



K-Tags – NFPA 99 – Cords

K920

Electrical Equipment – Power Cords and Extension Cords

Power strips in a patient care vicinity are only used for components of movable patient-care-related electrical equipment (PCREE) assemblies that have been assembled by qualified personnel and meet the conditions of 10.2.3.6. Power strips in the patient care vicinity may not be used for non-PCREE (e.g., personal electronics), except in long-term care resident rooms that do not use PCREE. Power strips for PCREE meet UL 1363A or UL 60601-1. Power strips for non-PCREE in the patient care rooms (outside of vicinity) meet UL 1363. In non-patient care rooms, power strips meet other UL standards. All power strips are used with general precautions. Extension cords are not used as a substitute for fixed wiring of a structure. Extension cords used temporarily are removed immediately upon completion of the purpose for which it was installed and meets the conditions of 10.2.4.

10.2.3.6 (NFPA 99), 10.2.4 (NFPA 99), 400-8 (NFPA 70), 590.3(D) (NFPA 70), TIA 12-5

K-Tags – NFPA 99 – Equipment

K921

Electrical Equipment – Testing and Maintenance Requirements

The physical integrity, resistance, leakage current, and touch current tests for fixed and portable patient-care related electrical equipment (PCREE) is performed as required in 10.3. Testing intervals are established with policies and protocols. All PCREE used in patient care rooms is tested in accordance with 10.3.5.4 or 10.3.6 before being put into service and after any repair or modification. Any system consisting of several electrical appliances demonstrates compliance with NFPA 99 as a complete system. Service manuals, instructions, and procedures provided by the manufacturer include information as required by 10.5.3.1.1 and are considered in the development of a program for electrical equipment maintenance. Electrical equipment instructions and maintenance manuals are readily available, and safety labels and condensed operating instructions on the appliance are legible. A record of electrical equipment tests, repairs, and modifications is maintained for a period of time to demonstrate compliance in accordance with the facility's policy. Personnel responsible for the testing, maintenance and use of electrical appliances receive continuing training.

10.3, 10.5.2.1, 10.5.2.1.2, 10.5.2.5, 10.5.3, 10.5.6, 10.5.8



K-Tags – NFPA 99 - Other

K911	<p>Electrical Systems – Other</p> <p>List in the REMARKS section any NFPA 99 Chapter 6 Electrical Systems requirements that are <u>not addressed by the provided K-Tags</u>, but are deficient. This information, along with the applicable Life Safety Code or NFPA standard citation, should be included on Form CMS-2567.</p> <p>Chapter 6 (NFPA 99)</p>
K919	<p>Electrical Equipment – Other</p> <p>List in the REMARKS section any NFPA 99 Chapter 10, <i>Electrical Equipment</i>, requirements that are <u>not addressed by the provided K-Tags</u>, but are deficient. This information, along with the applicable Life Safety Code or NFPA standard citation, should be included on Form CMS-2567.</p> <p>Chapter 10 (NFPA 99)</p>



TJC Electrical Standards

**Revised Yearly in TJC
EOC Standards Manual**



**TJC also sells a
Crosswalk Manual**



**Very similar to CMS/NFPA requirements
But with different organization & numbering**



Heather
Lauzon Werner



Electrical Panel Requirements

1. **Electrical Panel Requirements**
(Labeling, Clearances, Protection, Act)
2. **Other Electrical Code Citations**
(Extension Cords & Power Strips, Open Boxes, Fire Stopping, Arc Flash)



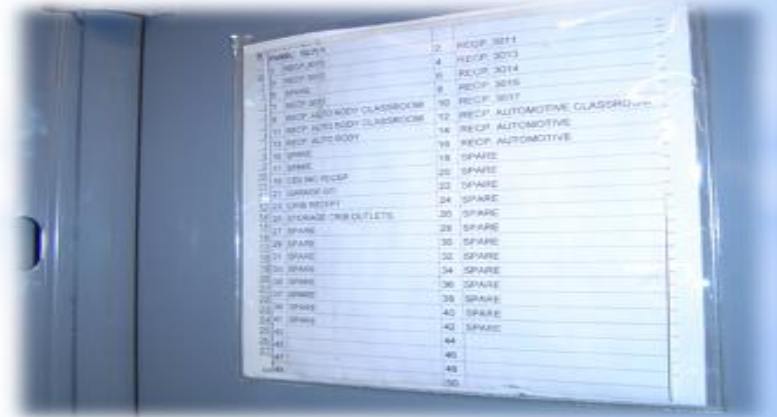
Labeling

Codes on Breaker Labeling

NEC-NFPA 70 (2017): Art 408.4(A) OSHA: 1910.303(f)(2) –(3)

Overcurrent devices or disconnecting devices:

- shall be legibly marked to indicate its purpose
- shall be of sufficient durability to withstand the environment involved.



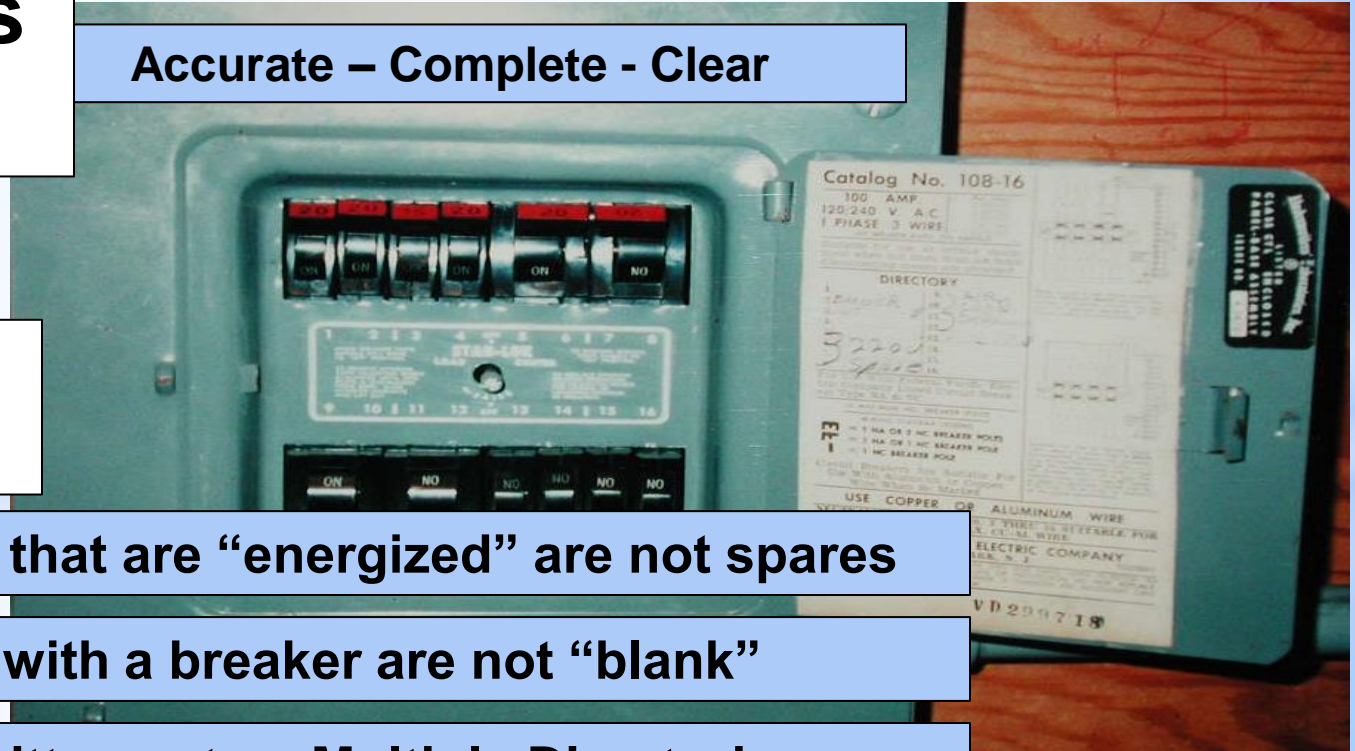
Directories

**Directories
Must be:**

Accurate – Complete - Clear

**Typically
miss-labeled:**

- 1. Spares that are “energized” are not spares**
- 2. Blanks with a breaker are not “blank”**
- 3. Handwritten notes; Multiple Directories**



Source Identification

NEC-NFPA 70 (2017): Art 408.4(B)

Directory must
include the
“upstream”
source of
power

So it can be
de-energized,
if needed

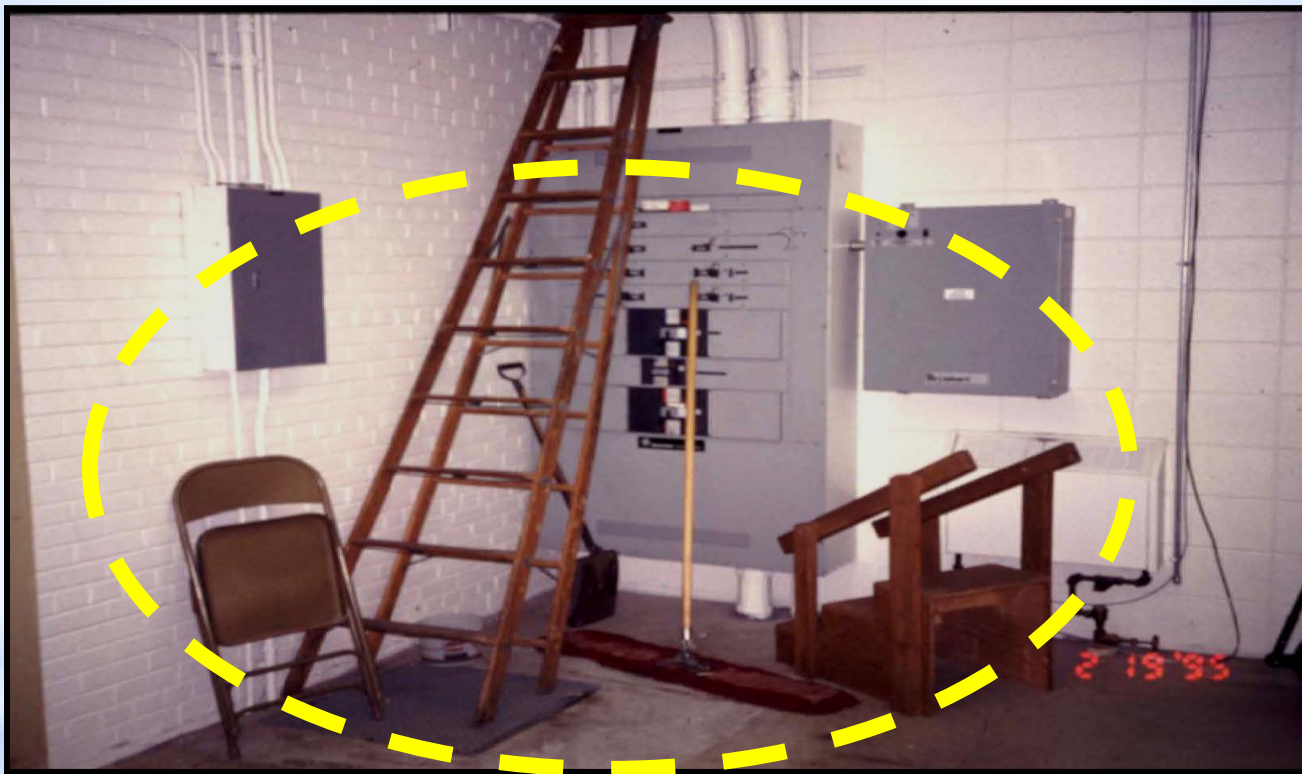


Recommended Directory

[illegible]



Clearances



Work Space Clearance

Panel Clearance

NFPA 70, Art 110-26

Depth:
min 36''*

Width:
Same as panel
(min 30'')

Height:
From floor to
min 6-1/2'



**No
exceptions
for easy
moveability**

* General requirement
(see OSHA Table for
precise depth)

Minimum Depth of Working Space

1910.303(g)(1)(i)(A) Table S-1

Lines help, but are typically ignored



Rules apply to more than panels



Note: Clearance depth may be 42"-48" for 208v and over, depending on degree of access to live parts



Panel Location

Panel Locations

In Rated Walls

- Must have a rated back box, or
- Must maintain wall rating behind panel box

Panel Locations

After 2016: NFPA 99 (2012) 6.3.2.2.1.3

- (A) Only authorized personnel shall have access to breakers in Category 1 & 2 rooms
- (B) Breakers for Category 1 & 2 rooms shall not be permitted in public access spaces (i.e. corridors)



Fire Alarm Power

Power Sources

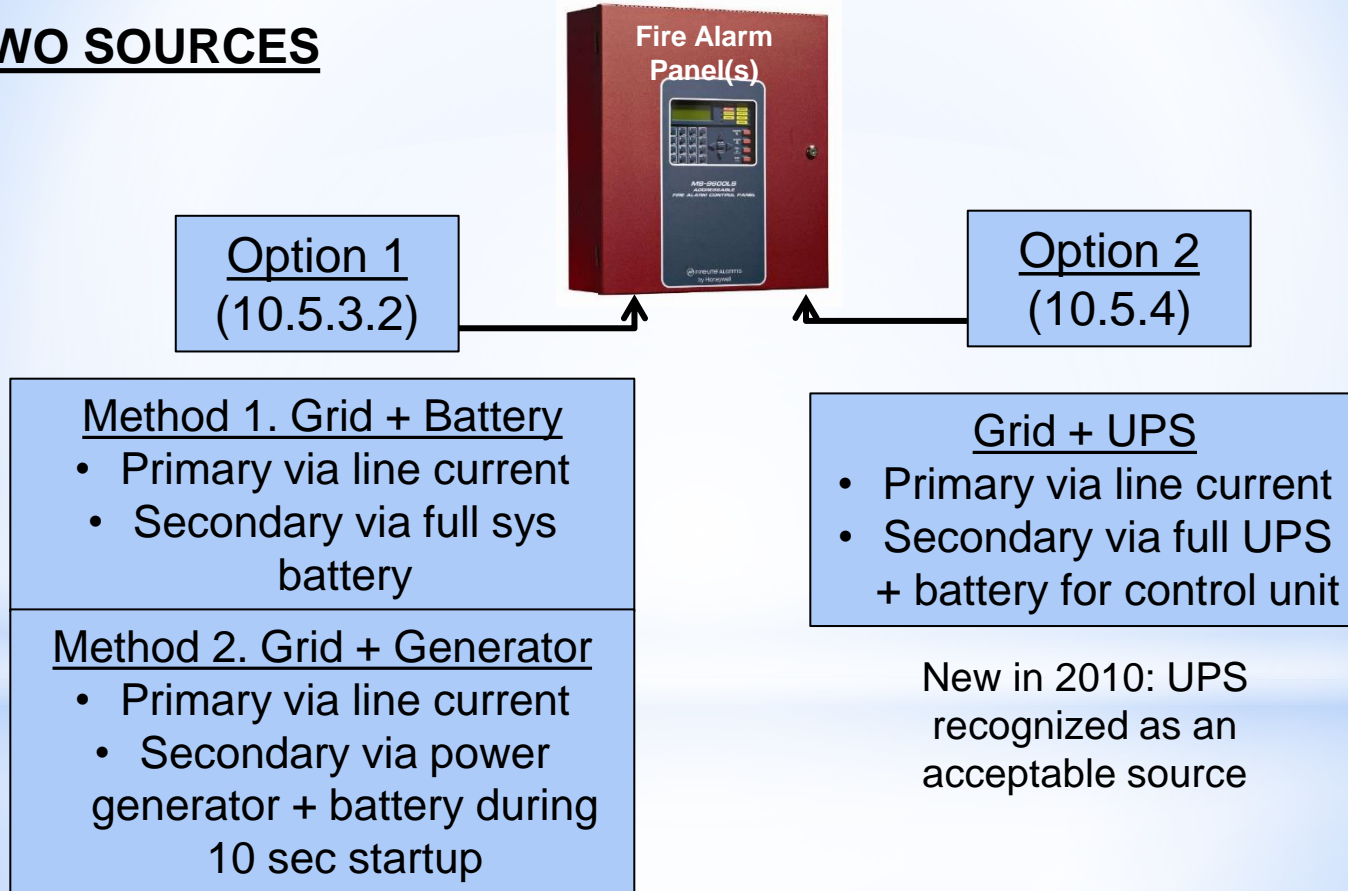
TWO POWER SOURCES REQUIRED for the fire alarm system
(NFPA 72, 10.5.3.2)



- Primary
- Secondary

Power Sources Options

TWO SOURCES



Primary Power Source

1. Fire alarm system must be fed from a DEDICATED branch circuit from the primary source (10.5.5.1)

2. No other equipment can be powered from the same circuit (to minimize overload trips)



- Same power circuit CAN feed other fire alarm control panels in the same system
- Does NOT need to be tapped ahead of the main disconnect
- CAN come from a power sub-panel

3. Fire Alarm Control Panel permanently marked with feeder electrical panel & circuit #

Electrical Panel Requirements (NFPA 72, 10.5.5.2)



1. Wording:

- “Fire Alarm Circuit” – NFPA 72, 2010 ed
- “Fire Alarm Circuit Control” – NFPA 72, 1999 ed.

2. Red marking

3. Accessible to authorized persons only

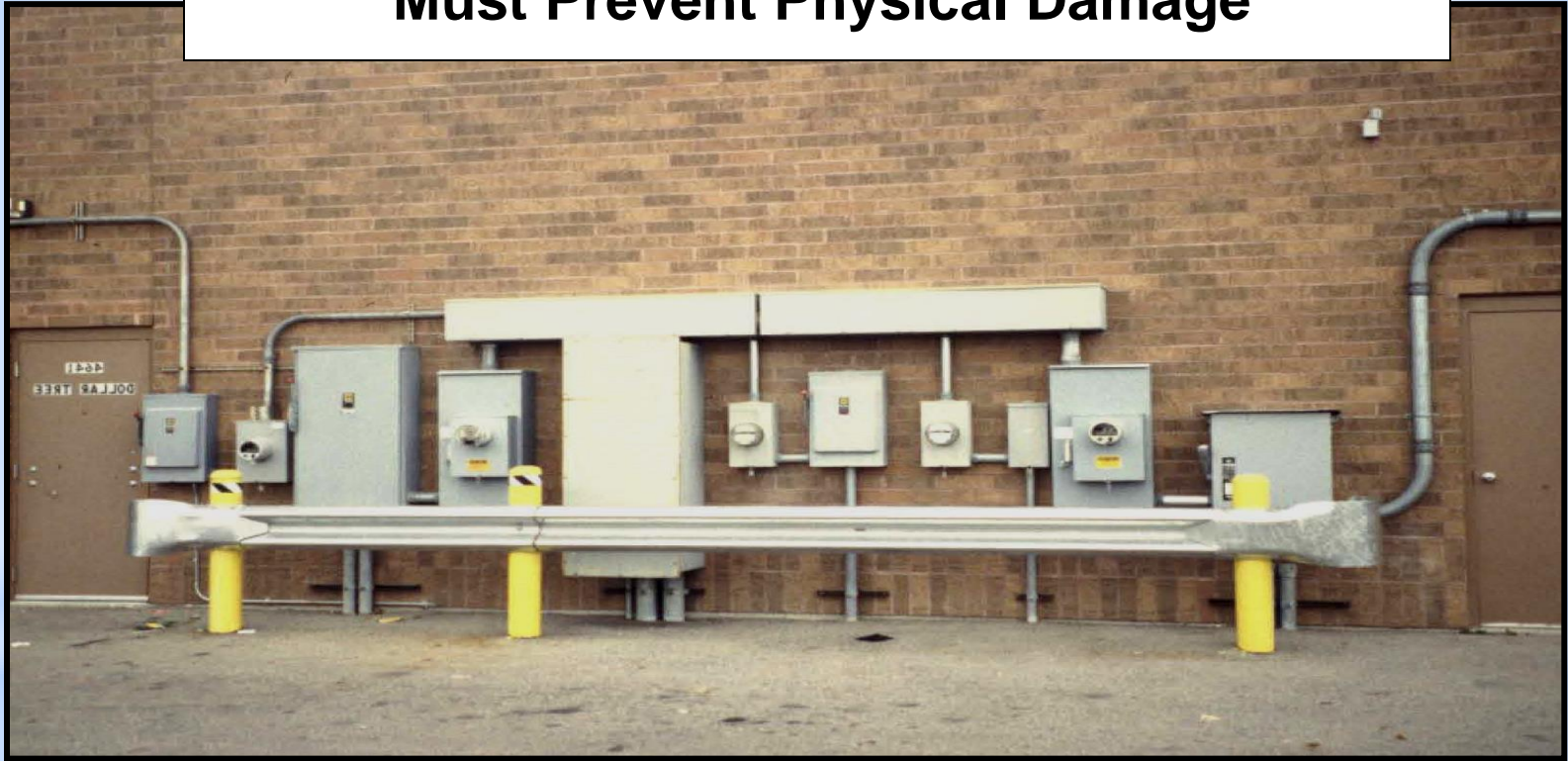
4. Equipped with a breaker lock

5. Mechanically protected from being damaged & disconnected/unplugged



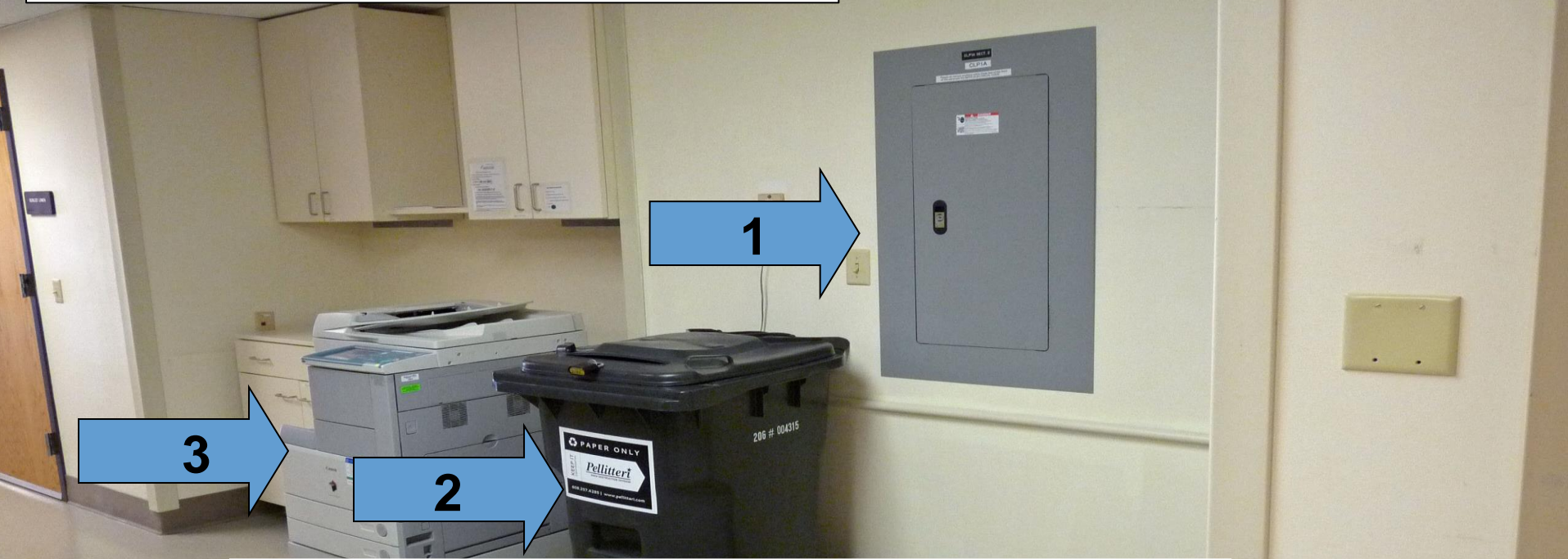
Protection

Must Prevent Physical Damage



Can You Spot the Deficiencies?

What is the violation?

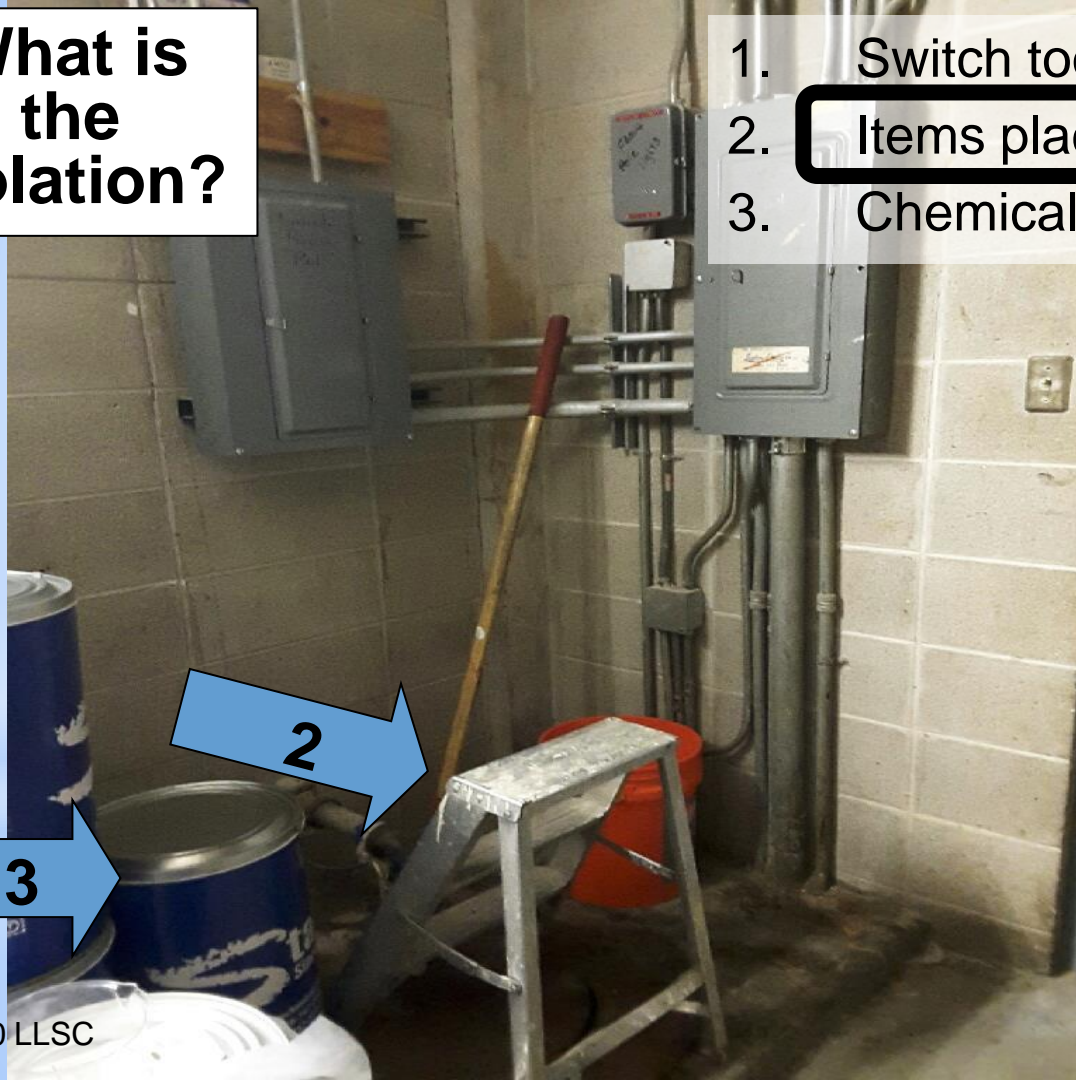
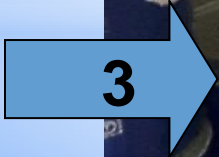
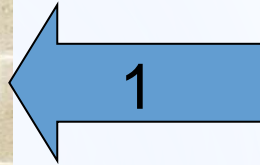


1. Clearance for electrical panel is blocked
2. Recycle container is too large
3. Copy machine obstructs corridor

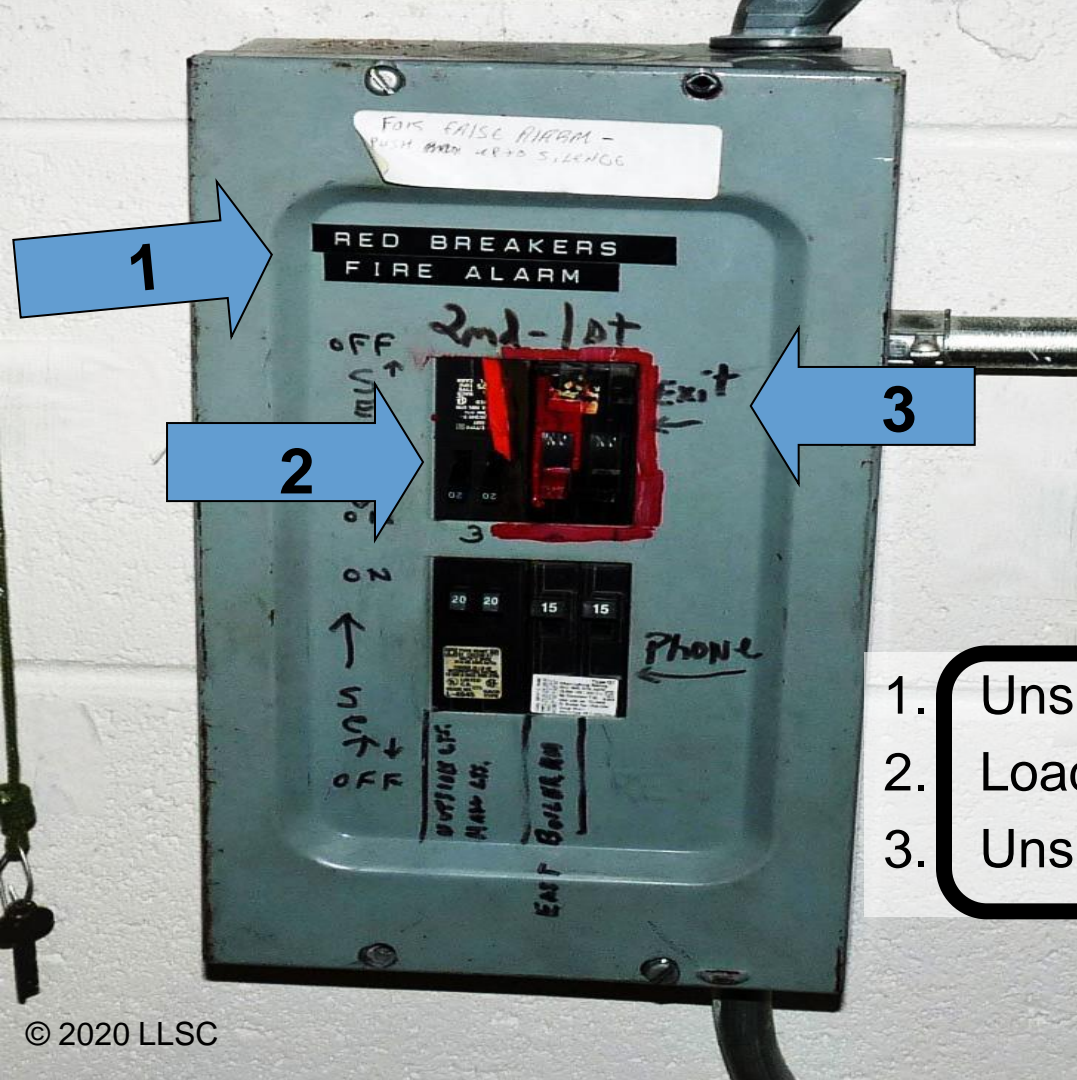


What is the violation?

1. Switch too close to panel
2. Items place in clearance space
3. Chemicals stored in electrical room

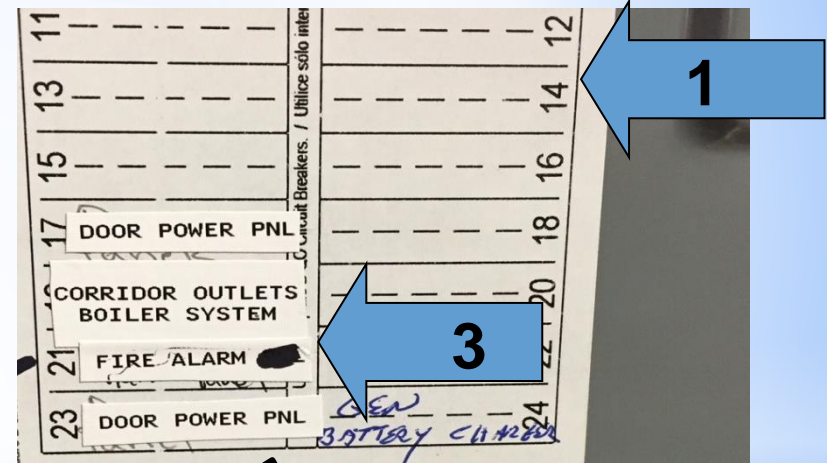
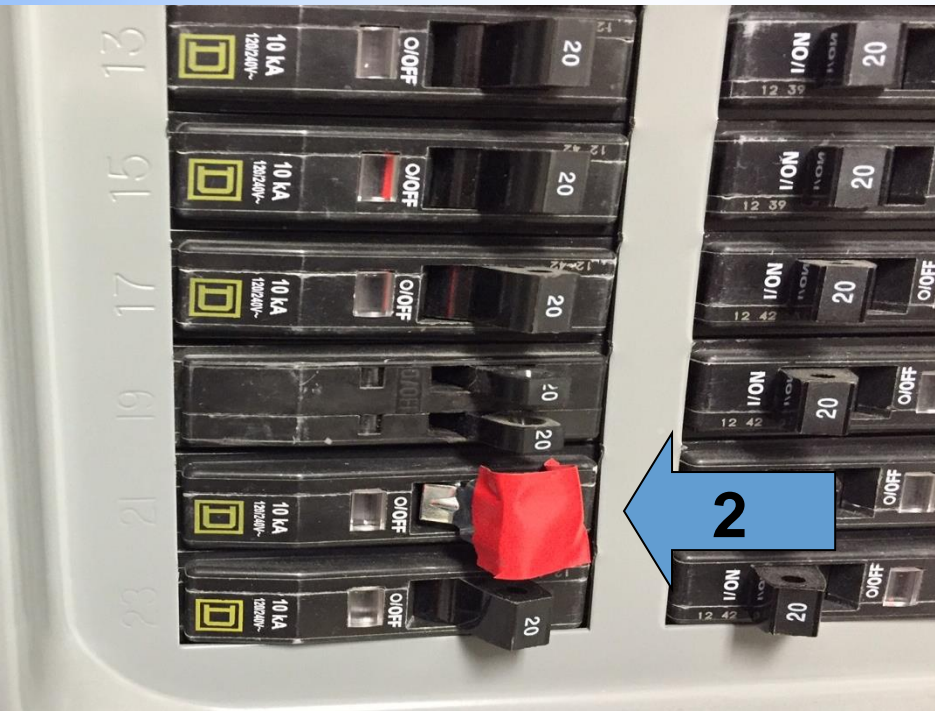


What is the violation?



1. Unsure which breakers are Fire Alarm
2. Load of 2 breakers not labeled ✓
3. Unsure what "exit" means

What is the violation?



1. Ckts not labeled ✓
2. FA breaker is not painted red
3. Ckt 21 not labeled "Fire Alarm Control Circuit" ✓

What is the violation?

1. “?” Denotes inaccurate directory
2. Spare & name of load inconsistent
3. Changes written, not typed



PANELBOARD / PANNEAU / TABLERO
DATE: 11/11/99
LOAD / CHARGE / CARGA
1 1302, 1308, 1311, 1306, 1309 Rec(5)
3 1324, 1329, 1326 Rec(4)
4 1306, 1312, 1309, 1302 Rec
5 1323 Bath GFI (1) ?
6 1304, 1313, 1307 Bath GFI
7 1329 GFI (1)
8 1316, 1318 Reg Rec(#)
9 1329 GFI (1)
10 1316 GFI (1)
11 1331, 1339, 1332, 1338 Rec (4)
12 1321, 1322 Hall/Vest Rec(4)
13 1331, 1338, 1332, 1339 Rec(4)
14 1321 Vest Rec(3)
15 1336, 1333, 1337 GFI Rec(3)
16 1322 Corridor nurse sta. Rec(4)
17 1337, 1334, 1336 GFI & Rec(3)
18 1232 CuH-1&2
19 1341, 1334 Hall Rec(2)
20 Revised art glass Rec(4)
21 Outside GFI (2)
22 ~~Spare~~ 1291 Treadmill
23 1303 Unit Cab Heater (CUH-5)
24 ~~Spare~~ 1291 Treadmill
25 spare Double Duplex Rm 1208
26 ~~Spare~~ 1339 Recept
27 Spare Double Duplex Rm 1208

1

2

3



Heather
Lauzon Werner



Electrical Requirements

1. **Electrical Panel Requirements**
(Labeling, Clearances, Protection)
2. **Other Electrical Code Citations**
(Extension Cords & Power Strips, Open Boxes, Fire Stopping, Arc Flash)



Boxes

Typical Issues with Electrical Boxes

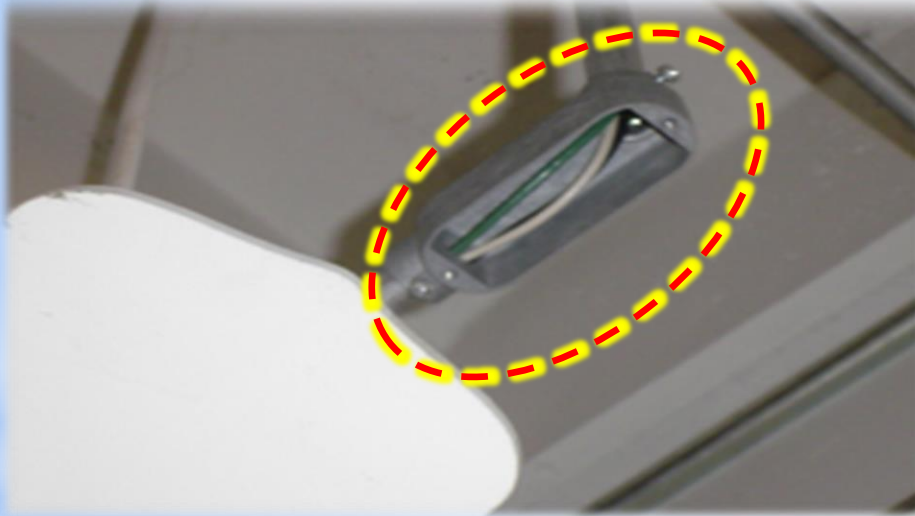
Missing Cover
Open Elec Box
Open Knock Out space
Open Wire Nuts
Broken Face Plate

Cabinets, Boxes and Fittings

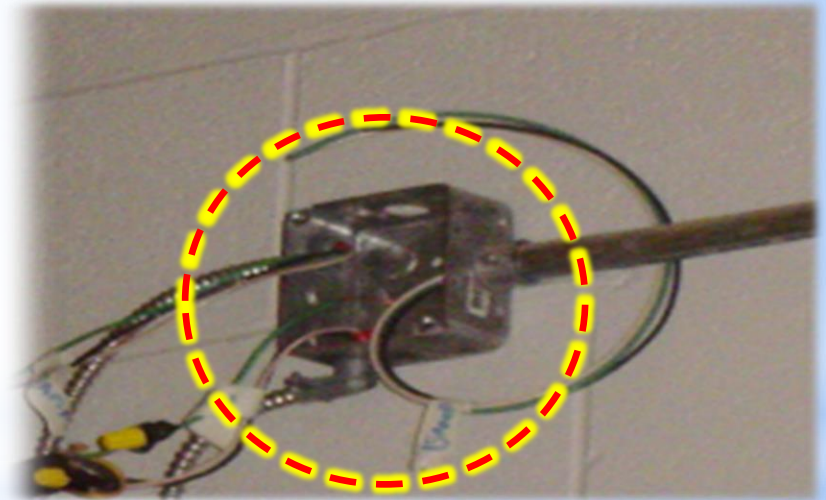
1910.305(b)(1)(i)

- Openings shall be effectively closed

No cover on “LB” fitting



No cover on “4x4” box

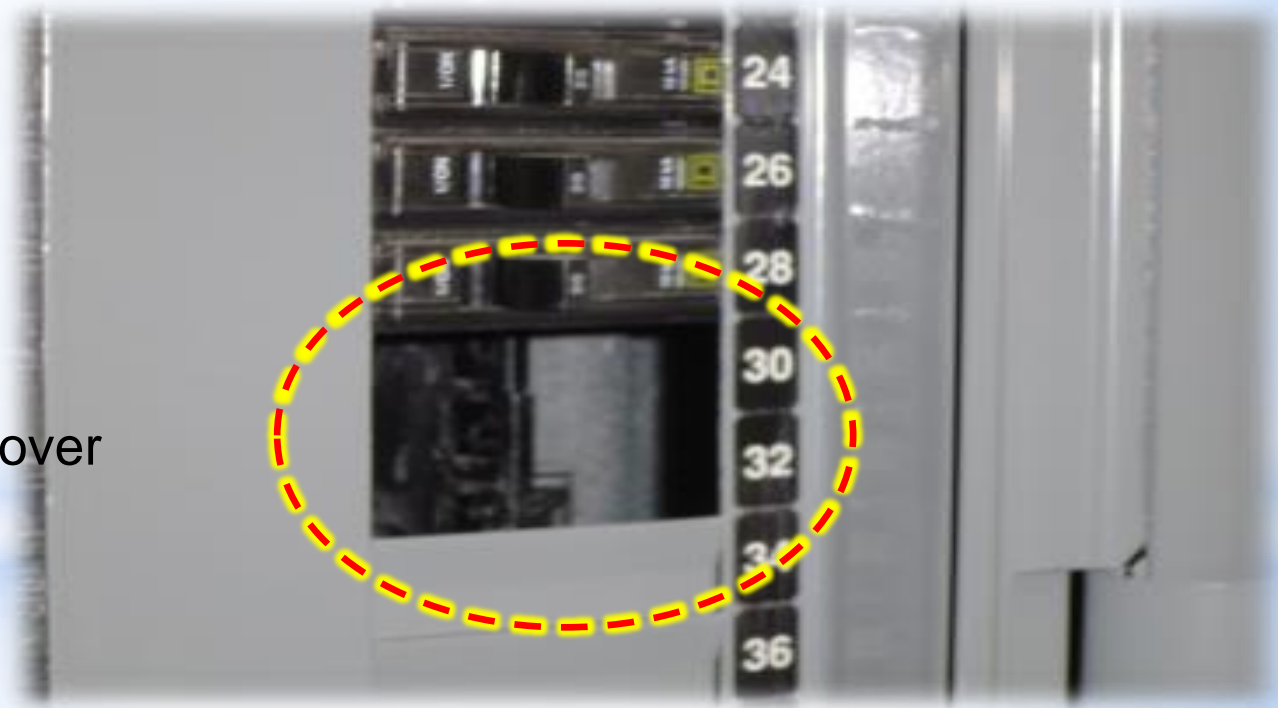


Cabinets, Boxes and Fittings

1910.305(b)(1)(i)

- Openings shall be effectively closed

No breaker
No blank on cover



Cabinets, Boxes and Fittings

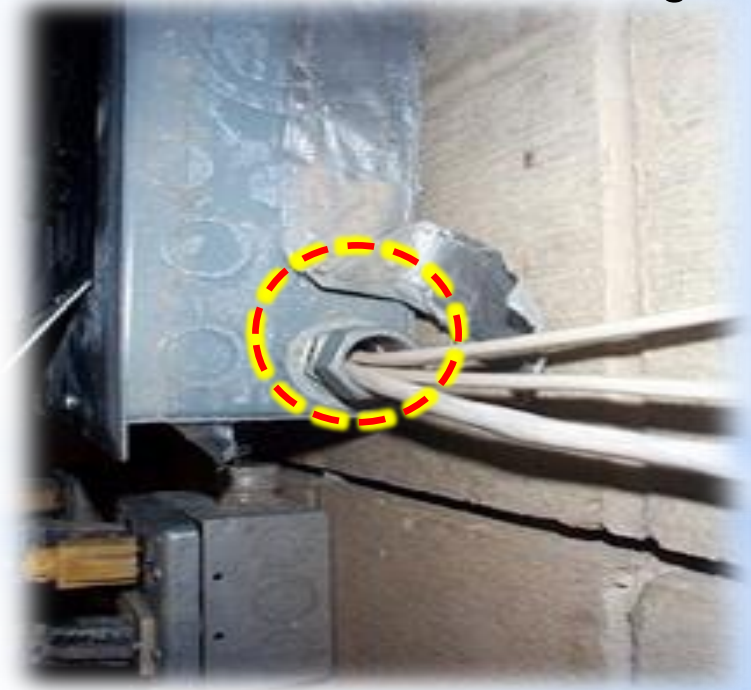
1910.305(b)(1)(i)

- Openings shall be effectively closed

No plug on “knock-out”



No conduit on fitting



Cabinets, Boxes and Fittings

1910.305(b)(1)(i)

- Openings shall be effectively closed

No nut on “connector”



No device to fill hole in cover

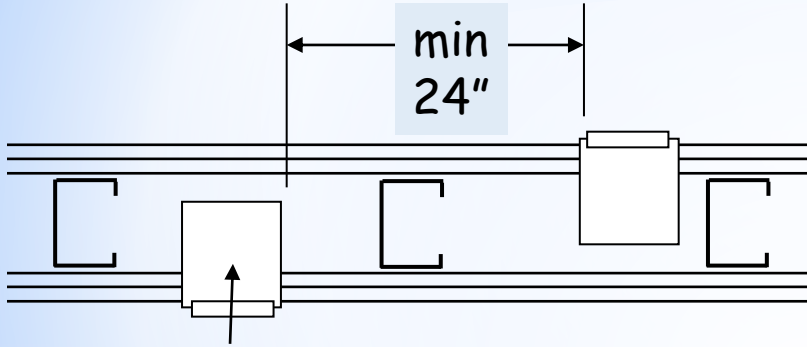


Box Locations

In Rated Walls

- Must have a rated box, or
- Must maintain wall rating behind back box. or
- Must follow box spacing rules

Box Spacing Rules in Rated Walls



- Elec Boxes must be $> 24''$ apart (unless using “putty pads”); never acceptable back-to-back [IBC 711.3.2(3)]

- Max 16 sq.inch box [IBC 711.3.2]
- Max 100 sq.in./100 sq. ft.

Cabinets, Boxes and Fittings

1910.305(b)(1)(i)

- Conductors entering shall be protected
- Cable is fastened within 12” from box or raceway

Main Oxygen Storage

(NFPA 99-2012, 11.3.)

>3,000, but ≤ 20,000 cf (~80 H-size cylinders, 100's of E)

- * 1-hr Rated Enclosure
- * Mechanical or Natural Ventilation
- * Switch & Outlets > 60"
- * Tanks Secured & Separated
- * Room Signage



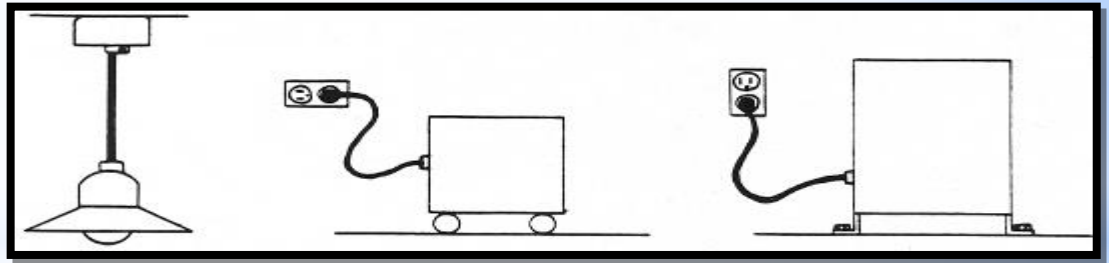


Electrical Requirements

Cords

Flexible Cords – Permitted Use 1910.305(g)(1)(ii)(A)-(L)

- Pendants;
- Wiring of fixtures;
- Connection of portable lamps or appliances;
- Portable and mobile signs;
- Elevator cables;
- Wiring of cranes and hoists;
- Appliances to permit removal for maintenance



Pendant,
or
Fixture
Wiring

Portable
lamps,
tools or
appliances

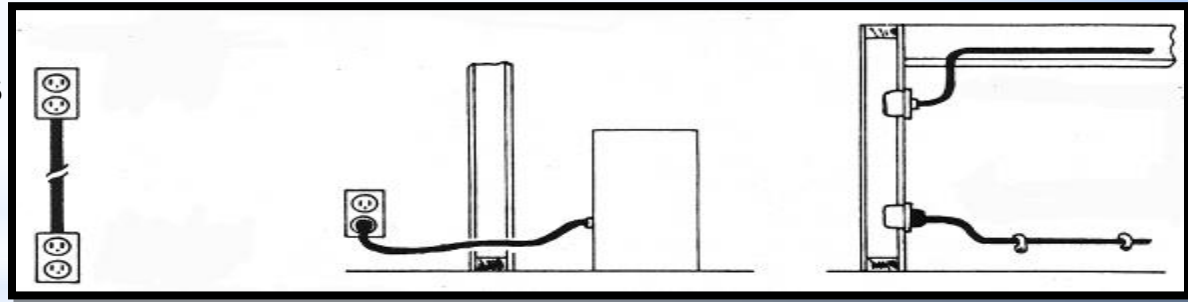
Stationary equip.
to
facilitate
interchange

Flexible Cords – Permitted Use 1910.305(g)(1)(ii)(A)-(L)

- Connection of stationary equipment to facilitate their frequent interchange;
- Prevention of the transmission of noise or vibration;
- Appliances where the fastening means and mechanical connections are designed to permit removal for maintenance and repair;
- Data processing cables approved as a part of the data processing system;
- Connection of moving parts; and
- Temporary wiring as permitted in paragraph (a)(2) of this section.

Flexible Cords – Prohibited Use 1910.305(g)(1)(iv)(A)-(F)

- As a substitute for the fixed wiring of a structure;
- Where run through holes in walls, ceilings, or floors;
- Where run through doorways, windows, or similar openings;
- Where attached to building surfaces;
- Where concealed behind building walls, ceilings, or floors
- Where installed in raceways, except as otherwise permitted in this subpart.



Substitute
for fixed
wiring

Run through walls,
ceilings, floors,
doors, or windows

Concealed
behind or attached
to building surfaces

Flexible Cords

1910.304(b)(3)(ii)(C)(3)

Extension cords must be visually inspected before each use on any shift (need policy, but doc not needed)

Examine the cord for

- Missing grounding pin
- Damaged outer jacket (tear in insulation)
- Possible internal damage (pinched cord)

Grounding Pin

1910.304(b)(3)(ii)(C)(4)(i) – (iii)

Ensure that grounding pin on extension cords is in place and operable

All equipment grounding conductors shall be tested for continuity:

- Before first use
- Before return to service (repairs)
- Before use after an incident that may have caused damaged and
- Intervals not to exceed three (3) months



Splices

1910.305(g)(2)(ii)

Flexible cords may be used only in continuous lengths without splice or tap.



Note: Black electrical tape does not provide suitable insulation and is not acceptable

Other

1910.305(g)(2)(i)

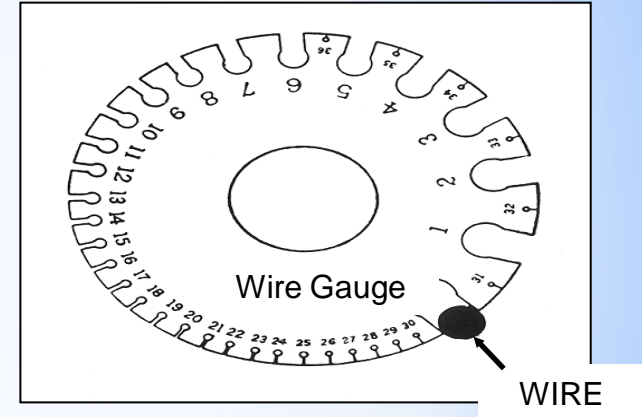
- Durably marked as to type, size, and number of conductors
- Strain relief must be provided



Portable Tools

Portable tool with an extension cord that has a wire too small for the tool:

- The tool will draw more current than the cord can handle, causing overheating and a possible fire without tripping the circuit breaker
- The circuit breaker could be the right size for the circuit but not for the smaller-wire extension cord



Wire gauge measures wires ranging in size from number 36 to 0 American wire gauge (AWG)



Alex Werner



Electrical Requirements

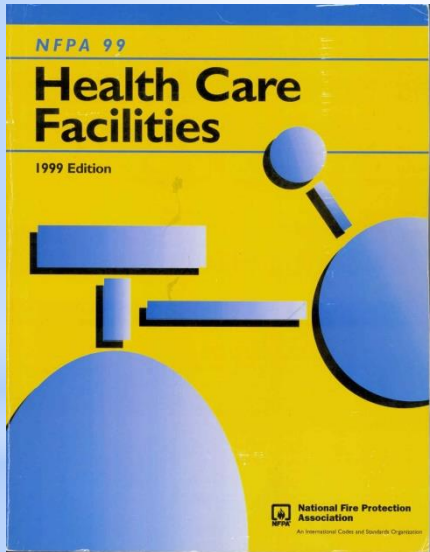
Receptacles

Quantity of Receptacles

Comply w/NFPA 99 in effect when built

Minimum quantity has changed over the years

2003-2016:



3-3.2.1.2 All Patient Care Areas.

2. *Minimum Number of Receptacles.* The number of receptacles shall be determined by the intended use of the patient care area. There shall be sufficient receptacles located so as to avoid the need for extension cords or multiple outlet adapters.
 - a. Receptacles for Patient Bed Locations in General Care Areas. Each patient bed location shall be provided with a minimum of four receptacles.
 - b. Receptacles for Patient Bed Locations in Critical Care Areas. Each patient bed location shall be provided with a minimum of six receptacles.

Exception No. 1: Receptacles shall not be required in bathrooms or toilet rooms.

General:

Min 4

ICU:

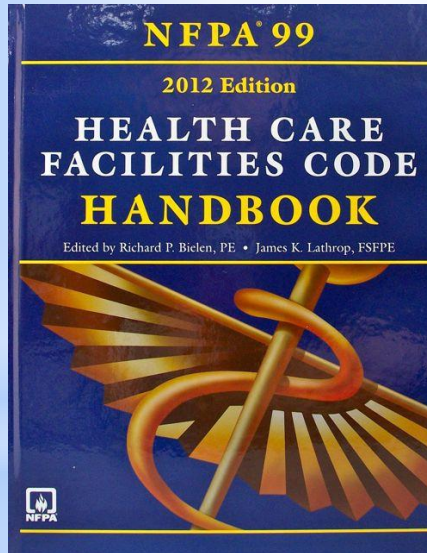
Min 6

Quantity of Receptacles

Comply w/NFPA 99 in effect when built

Minimum quantity has changed over the years

>2016:



6.3.2.2.6.2 Minimum Number of Receptacles. The number of receptacles shall be determined by the intended use of the patient care rooms in accordance with 6.3.2.2.6.2(A) through 6.3.2.2.6.2(E).

(A) **Receptacles for Patient Bed Locations in General Care Areas (Category 2).** Each patient bed location shall be provided with a minimum of eight receptacles.

(B) **Receptacles for Patient Bed Locations in Critical Care Areas (Category 1).** Each patient bed location shall be provided with a minimum of 14 receptacles.

(C) **Receptacles for Operating Rooms (Category 1).** Operating rooms shall be provided with a minimum of 36 receptacles.

(D) **Receptacles for Bathrooms or Toilets.** Receptacles shall not be required in bathrooms or toilet rooms.

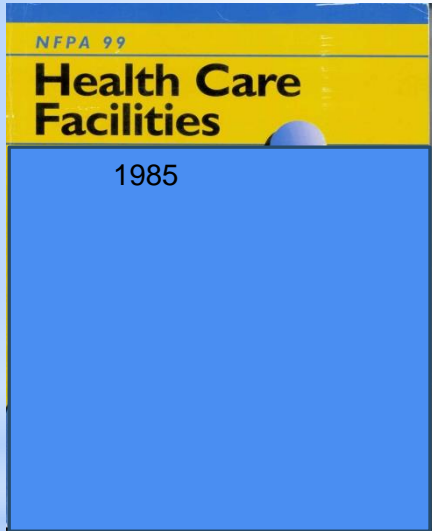
General:
Min 8

ICU:
Min 14

OR:
Min 36

Quantity of Receptacles

Comply w/NFPA 99 in effect when built



1971-1988:

Follow Wis ILHR/COMM codes

(I don't have a copy)

1988-2003:

Follow 1985 NFPA 99 (I don't have a copy)

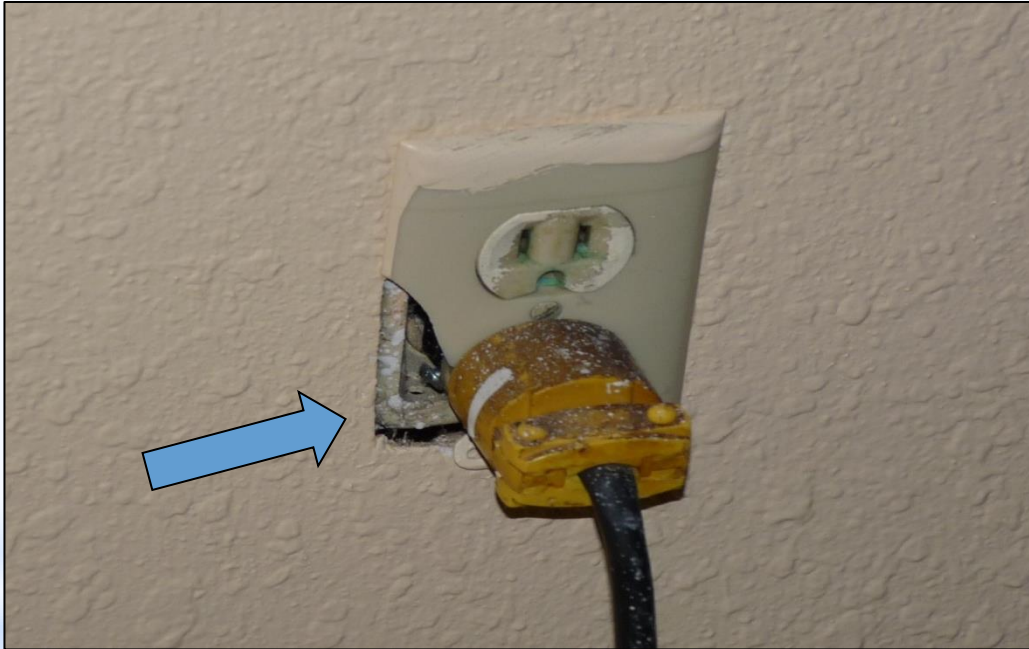
Cover Plates

1910.305(b)(2)(i)
NEC, Art 314.25

In completed installations, each outlet box shall have a cover or faceplate.



Cover plates must be in good condition



Testing

NFPA 99(2012)

6.3.3.2 Receptacle Testing in Patient Care Rooms.

6.3.3.2.1 The physical integrity of each receptacle shall be confirmed by visual inspection.

6.3.3.2.2 The continuity of the grounding circuit in each electrical receptacle shall be verified.

6.3.3.2.3 Correct polarity of the hot and neutral connections in each electrical receptacle shall be confirmed.

6.3.3.2.4 The retention force of the grounding blade of each electrical receptacle (except locking-type receptacles) shall be not less than 115 g (4 oz).

Typical Receptacle Test Form

File	No. C	Power	Room	Outlet	Wiring	Line <input type="checkbox"/> Volts	Ground Impedance	Polarity	Tension <input type="checkbox"/> Pwr Gnd	Tester's Note
1		EM	A420	1	OK	OK	N/A	OK	OK	GFCI
2		EM		2	OK	OK	N/A	OK	OK	GFCI
3		EM		3	OK	OK	N/A	OK	OK	GFCI
4		EM		4	OK	OK	N/A	OK	OK	GFCI
5		N	A413	1	OK	OK	OK	OK	OK	
6		N		2	OK	OK	OK	OK	OK	
7		EM		3	OK	OK	OK	OK	OK	
8		EM		4	OK	OK	OK	OK	OK	
9		N		5	OK	OK	OK	OK	OK	
10		N		6	OK	OK	OK	OK	OK	
11		EM		7	OK	OK	OK	OK	OK	
12		EM		8	OK	OK	OK	OK	OK	
13		EM		9	OK	OK	OK	OK	OK	
14		EM		10						
15				11						
16				12						
17				1						
18				2						
19				1						
20				2						
21				1						
22				2						
23				3						
24				4						
25		EM		5						
26		EM		6						

Should define how Outlets are "numbered" (Example: CW from door)

✓	◊ Doc Must List/Show Locations of Each
	◊ Test includes - Visual inspection of physical integrity
	◊ Test of Grounding continuity
	◊ Test of Correct Polarity of hot and neutral connections
	◊ Test of Ground Blade Retention Force (min 4oz)

Typical Receptacle Test Form

File No. C	Power	Room	Outlet	Wiring	Line Volts	Ground Impedance	Polarity	Tension Pwr Gnd	Tester's Note
1	EM	A420	1	OK	OK	N/A	OK	OK	GFCI
2	EM		2	OK	OK	N/A	OK	OK	GFCI
3	EM		3	OK	OK	N/A	OK	OK	GFCI
4	EM		4	OK	OK	N/A	OK	OK	GFCI
5	N	A413	1	OK	OK	OK	OK	OK	
6	N		2	OK	OK	OK	OK	OK	
7	EM		3	OK	OK	OK	OK	OK	
8	EM		4	OK	OK	OK	OK	OK	
9	N		5	OK	OK	OK	OK	OK	
10	N		6	OK	OK	OK	OK	OK	
11	EM		7	OK	OK	OK	OK	OK	
12	EM		8	OK	OK	OK	OK	OK	
13	EM		9	OK	OK	OK	OK	OK	
14	EM		10						
15	EM		11						
16	EM		12						
17	N	A413A	1						
18	N		2						
19	N	A414B	1						
20	N		2						
21	N	A414A	1						
22	N		2						
23	N		3						
24	N		4						
25	EM		5						
26	EM		6						

✓	◇ Doc Must List/Show Locations of Each
X	◇ Test includes - Visual inspection of physical integrity
	◇ Test of Grounding Continuity
	◇ Test of Correct Polarity of hot and neutral connections
	◇ Test of Ground Blade Retention Force (min 4oz)

Typical Receptacle Test Form

File No. C	Power	Room	Outlet	Wiring	Line Volts	Ground Impedance	Polarity	Tension Pwr Gnd	Tester's Note
1	EM	A420					OK	OK	GFCI
2	EM					N/A	OK	OK	GFCI
3	EM					N/A	OK	OK	GFCI
4	EM					N/A	OK	OK	GFCI
5	N	A413				OK	OK	OK	
6	N					OK	OK	OK	
7	EM					OK	OK	OK	
8	EM		4	OK	OK	OK	OK	OK	
9	N		5	OK	OK	OK	OK	OK	
10	N		6	OK	OK	OK	OK	OK	
11	EM		7	OK	OK	OK	OK	OK	
12	EM		8	OK	OK	OK	OK	OK	
13	EM		9	OK	OK	OK	OK	OK	
14	EM		10						
15	EM		11						
16	EM		12						
17	N	A413A	1						
18	N		2						
19	N	A414B	1						
20	N		2						
21	N	A414A	1						
22	N		2						
23	N		3						
24	N		4						
25	EM		5						
26	EM		6						

But...BEST to call heading "Ground Continuity"

✓	◊ Doc Must List/Show Locations of Each
X	◊ Test includes - Visual inspection of physical integrity
✓	◊ Test of Grounding continuity
	◊ Test of Correct Polarity of hot and neutral connections
	◊ Test of Ground Blade Retention Force (min 4oz)

Typical Receptacle Test Form

File No.	C	Power	Room	Outlet	Wiring	Line Volts	Ground Impedance	Polarity	Tension Pwr Gnd	Tester's Note
1		EM	A420	1	OK	OK	N/A	OK	OK	GFCI
2		EM		2	OK	OK	N/A	OK	OK	GFCI
3		EM		3	OK	OK	N/A	OK	OK	GFCI
4		EM		4	OK	OK	N/A	OK	OK	GFCI
5		N	A413	1	OK	OK	OK	OK	OK	
6		N		2	OK	OK	OK	OK	OK	
7		EM		3	OK	OK	OK	OK	OK	
8		EM		4	OK	OK	OK	OK	OK	
9		N		5	OK	OK	OK	OK	OK	
10		N		6	OK	OK	OK	OK	OK	
11		EM		7	OK	OK	OK	OK	OK	
12		EM		8	OK	OK	OK	OK	OK	
13		EM		9	OK	OK	OK	OK	OK	
14		EM		10						
15		EM		11						
16		EM		12						
17		N	A413A	1						
18		N		2						
19		N	A414B	1						
20		N		2						
21		N	A414A	1						
22		N		2						
23		N		3						
24		N		4						
25		EM		5						
26		EM		6						

✓	◊ Doc Must List/Show Locations of Each
X	◊ Test includes - Visual inspection of physical integrity
✓	◊ Test of Grounding continuity
✓	◊ Test of Correct Polarity of hot and neutral connections
	◊ Test of Ground Blade Retention Force (min 40z)

Typical Receptacle Test Form

File No. C	Power	Room	Outlet	Wiring	Line Volts	Ground Impedance	Polarity	Tension Pwr Gnd	Tester's Note
1	EM	A420	1	OK	OK	N/A	OK		GFCI
2	EM		2	OK	OK	N/A	OK	OK	GFCI
3	EM		3	OK	OK	N/A	OK	OK	
4	EM		4	OK	OK	N/A	OK	OK	
5	N	A413	1	OK	OK	OK	OK	OK	
6	N		2	OK	OK	OK	OK	OK	
7	EM		3	OK	OK	OK	OK	OK	
8	EM		4	OK	OK	OK	OK	OK	
9	N		5	OK	OK	OK	OK	OK	
10	N		6	OK	OK	OK	OK	OK	
11	EM		7	OK	OK	OK	OK	OK	
12	EM		8	OK	OK	OK	OK	OK	
13	EM		9	OK	OK	OK	OK	OK	
14	EM		10						
15	EM		11						
16	EM		12						
17	N	A413A	1						
18	N		2						
19	N	A414B	1						
20	N		2						
21	N	A414A	1						
22	N		2						
23	N		3						
24	N		4						
25	EM		5						
26	EM		6						

✓	◇ Doc Must List/Show Locations of Each
X	◇ Test includes - Visual inspection of physical integrity
✓	◇ Test of Grounding continuity
✓	◇ Test of Correct Polarity of hot and neutral connections
✓	◇ Test of Ground Blade Retention Force (min 4oz)

But...BEST to record the actual reading



Hospital Grade Outlets

What is Hospital Grade ?

= “HIGHER STANDARD OF QUALITY”

1. Must comply with the general outlet requirements
2. Must comply with additional requirements for:
 - additional grounding reliability,
 - assembly integrity,
 - strength and
 - durability

Identified by Green Dots

**Green Dot
on patient-use devices**



**Such Equip. Must ONLY
BE PLUGGED into H-G
Outlets**

**Green Dot
on Receptacle**





Ground Fault Outlets

Ground Fault Receptacles

1910.304(b)(3)(i)



Install Within
4' of any
Water Device



- Also: -- Garages
- Rooftops
 - Outdoors
 - Construction

GFCI Protection 1910.304(b)(3)(ii)(A)

Receptacle outlets (including cord sets) that are not part of the permanent wiring of the building shall have ground-fault circuit-interrupter protection for personnel.

Note: A cord connector on an extension cord set is considered to be a receptacle outlet if the cord set is used for temporary electric power.



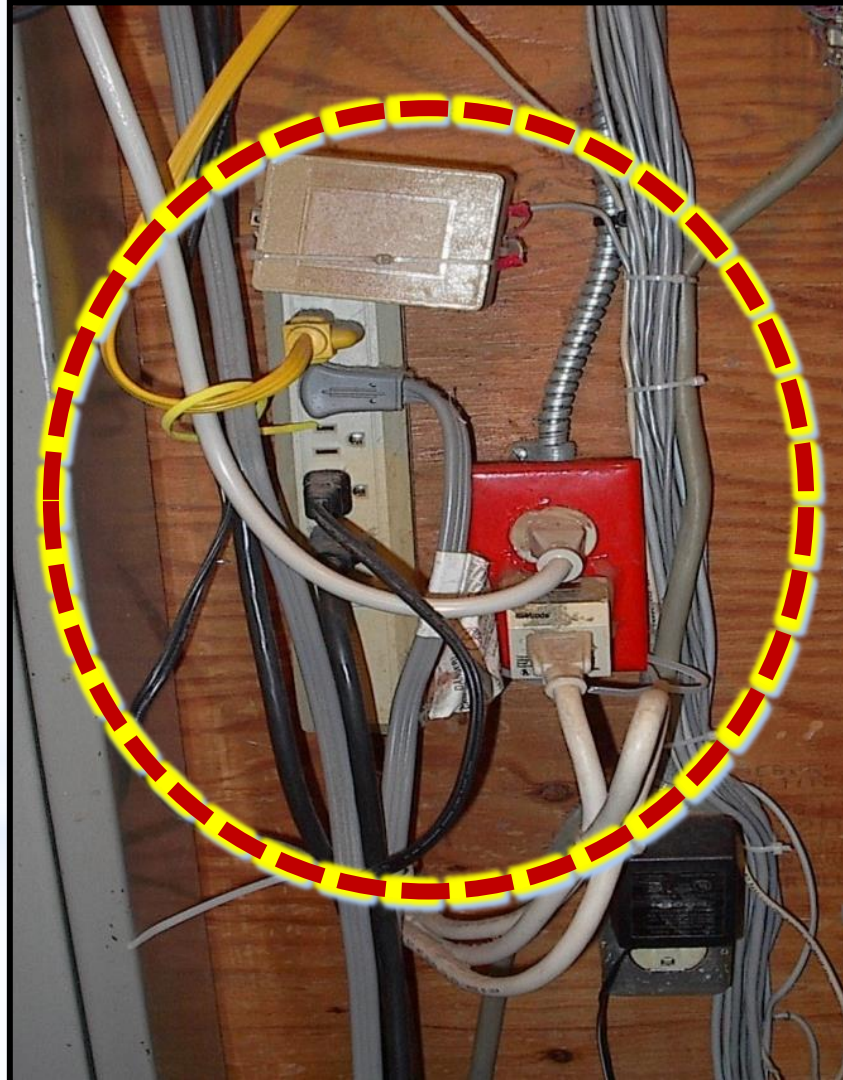


Electrical Requirements

Power Strips

Do You Have This?

This is what gives
power strips a bad
reputation



Power Strips

aka:
Relocatable Power Taps

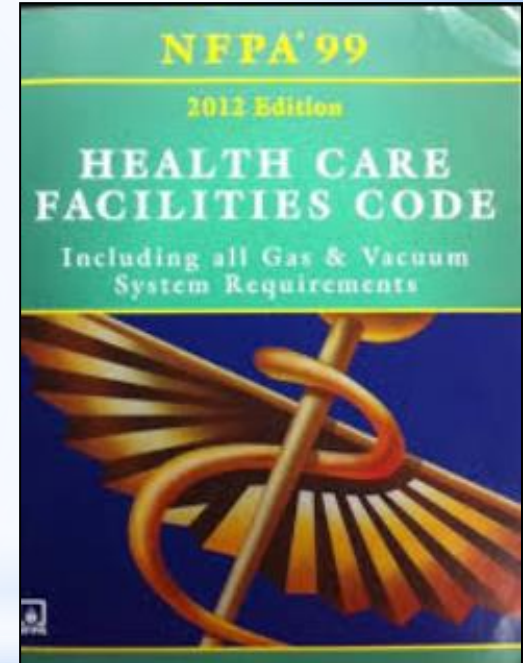
MANY TYPES & STYLES ON THE MARKET



Power Strips Requirements

Contained in
NFPA 99 (2012), Chap 10

- Power strips are permitted
- Follow all General Rules
- Follow Situation Rules



Power Strips Requirements

GENERAL

1. Have use & test policies on all equip.
2. Have policy on non-facility owned equip.
3. Have GFI & Power Strip Testing
4. Outlet is properly grounded
5. No daisy chains, no physical dangers
6. Comply with manufacturer instructions
7. Comply with NFPA 99-2012
8. Comply with all of NFPA 99 & 70

GENERAL REQUIREMENTS

- ☐ Facility has policy on use & testing of all electrical devices & cords
- ☐ Facility has policy for control of devices not supplied by the facility
- ☐ Strip plugs powered by a GFIC; or part of a documented testing program of the strip plug for physical integrity, polarity, and grounding.
- ☐ Outlets that provide power to the strip plug must be properly grounded per its listing.
- ☐ Cords cannot be a trip hazard; be 'daisy' chained together; have tension on plug; be walked on, be overloaded, or be near combustibles
- ☐ Strip plug must be installed & maintained per manufacturer instructions.
- ☐ Facility complies with all requirements of 2012 NFPA 99 on strip plugs (6.3.2.2.6, 10.2, 10.5, etc)
- ☐ Facility complies with all requirements of 1999 NFPA 99 and NFPA 70, including article 715.

Power Strips Requirements

SITUATION #1

PATIENT-CARE VICINITY

1. Follow all General Requirements
2. Applies within 6' of bed/care area

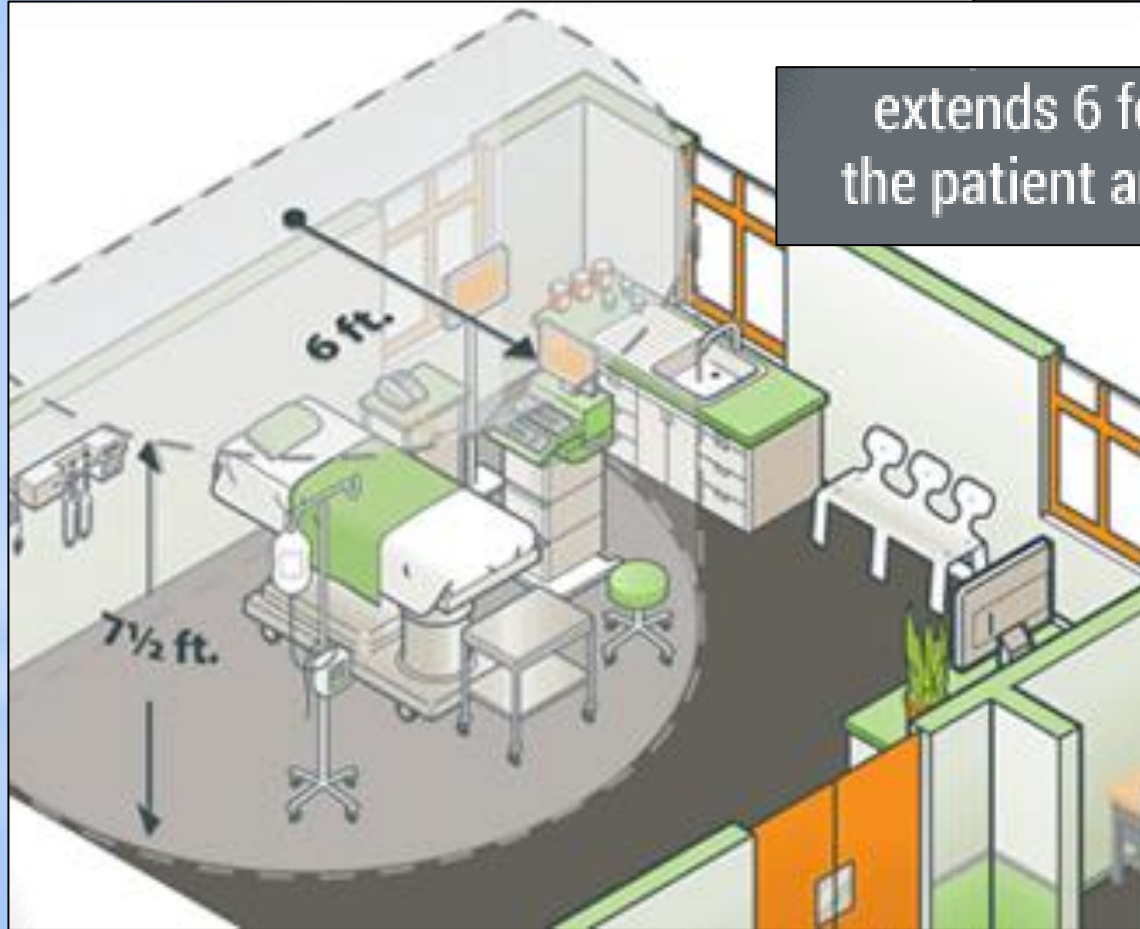
PATIENT CARE VICINITY

Strip plugs may be used hospitals or nursing homes in the patient care vicinity (within 6' of a bed/stretcher) for rack, table, pedestal, or cart mounted line-operated patient care equipment, provided all the following are satisfied:

- ☐ 1-Strip Plug must be UL listed 1363A or UL 60601-1, "Special Purpose Relocatable Power Tap"
- ☐ 2-Strip plug must be permanently attached to the equipment assembly
- ☐ 3-Mounting of the plug strip must be performed by qualified personnel
- ☐ 4-Sum of Amp rating of all attached devices adds up to less than 75% of the cord rating
- ☐ 5-Ampacity of the cord satisfied the current edition of the NFPA 70
- ☐ 6-A method is used to prevent added devices being plugged into the plug strip
- ☐ 7-Equip does not need to be an intraga component of a mfg assembly of equipment
- ☐ 8-Non-pt care equipment cannot be plugged into a power strip in the pt care vicinity.

Power Strips Requirements

PATIENT-CARE VICINITY



extends 6 feet beyond any portion of the patient and 7.5 feet above the floor.

Power Strips Requirements

SITUATION #1

PATIENT-CARE VICINITY

1. Follow all General Requirements
2. Applies within 6' of bed/care area
3. UL Listed 1363A or 60601-1
4. Mounted by qualified person
5. Permanently attached
6. Load less than 75% of rating
7. Cord per NFPA 70
8. Prevent adding equip
9. Prohibit non-patient care equipment

PATIENT CARE VICINITY

Strip plugs may be used hospitals or nursing homes in the patient care vicinity (within 6' of a bed/stretcher) for rack, table, pedestal, or cart mounted line-operated patient care equipment, provided all the following are satisfied:

- ☐ 1-Strip Plug must be UL listed 1363A or UL 60601-1, "Special Purpose Relocatable Power Tap"
- ☐ 2-Strip plug must be permanently attached to the equipment assembly
- ☐ 3-Mounting of the plug strip must be performed by qualified personnel
- ☐ 4-Sum of Amp rating of all attached devices adds up to less than 75% of the cord rating
- ☐ 5-Ampacity of the cord satisfied the current edition of the NFPA 70
- ☐ 6-A method is used to prevent added devices being plugged into the plug strip
- ☐ 7-Equip does not need to be an intraga component of a mfgr assembly of equipment
- ☐ 8-Non-pt care equipment cannot be plugged into a power strip in the pt care vicinity.

Power Strips Requirements

SITUATION #2:

NON-PATIENT-CARE VICINITY

1. Follow all General Requirements
2. Applies beyond 6' of bed/care area
3. UL Listed 1363
4. Can plug in non-medical equipment
5. Extension cords prohibited in lieu of permanent wiring (except for 90 days for construction or holidays)

NON-PT CARE VICINITY

Strip plugs may be used outside the patient care vicinity for both patient care and non-patient care equipment, provided all the following are satisfied:

- ☐ 1-Strip Plug used for non-patient care equipment must be UL listed 1363, "Relocatable Power Tap"
- ☐ Extension cords not used in lieu of permanent wiring, except for a 90 day period for construction or holiday decoration.

Power Strips Recommendations

1. MINIMIZE the use of power strips ... you will be required to monitor their use (including those for computers)
2. BUY ONLY UL Listed Power Strips 1363, 1363A or 60601-1 (or other equiv listed)
3. STANDARDIZE on a single brand & model for each type power strip (so they are readily identifiable)

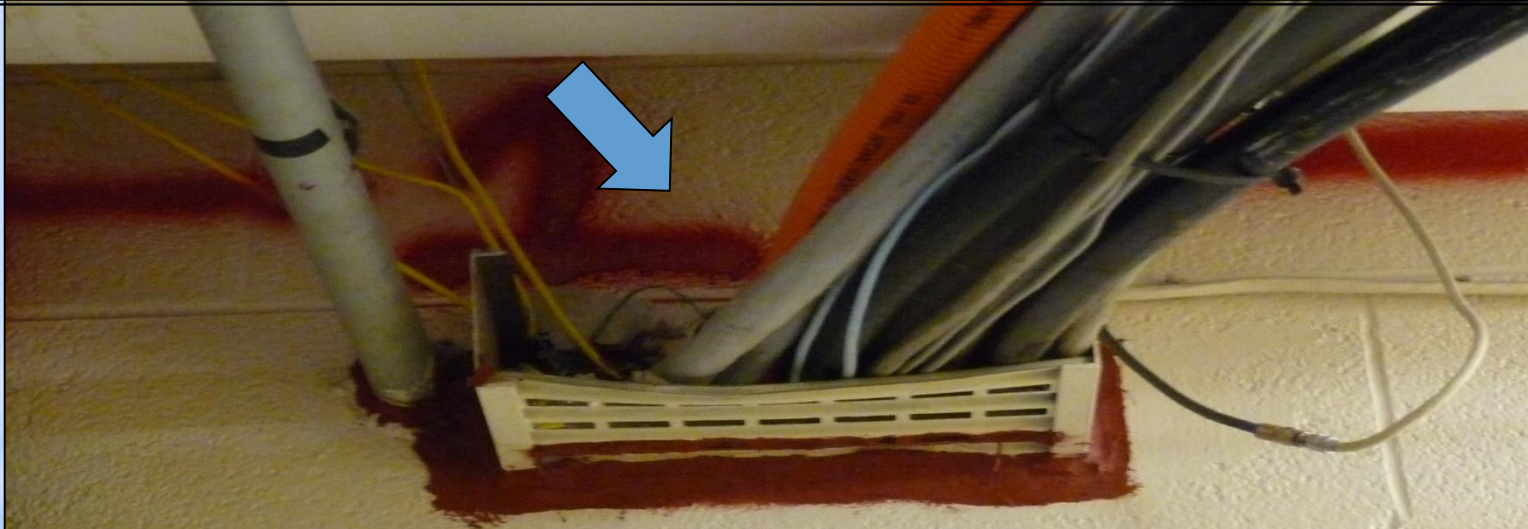




Fire Stopping

All penetrations of Rated Walls must be **FIRE STOPPED** according to a UL tested design

In & Outside of Cable tray must be fire stopped per UL design standard



Typically both sides of walls and the top side of floors must be stopped.

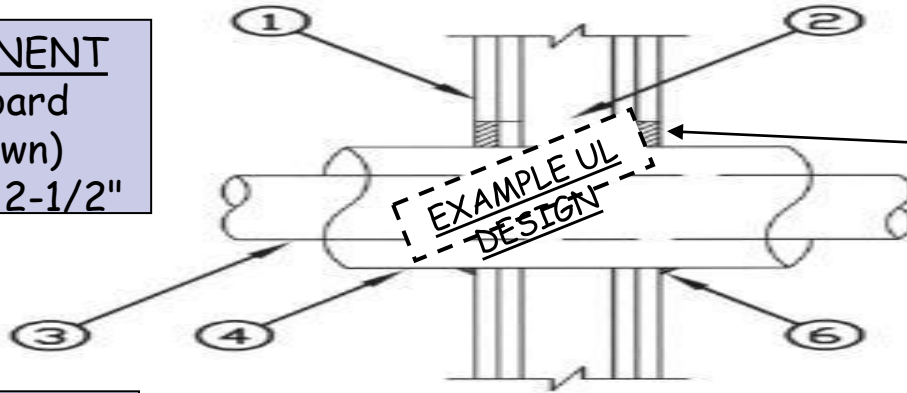
Fire Stop Design

[LSC 8.2.3.2.4; 8.3.6]

Always use the UL Design from your product vender for the precise method for each seal!

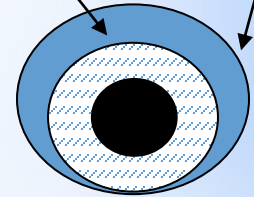
A-RATED COMPONENT

1. Gypsum wall board (2 hr shown)
2. Metal studs, min 2-1/2"



C-RESTRICTIONS

max 18" hole;
annular: 0" to 1-7/8"



B-PENETRANTS

3. Metal pipe, max: (NO sleeve) 12" steel (sch20); 6"cu, 4"emt

D-REQUIRED SEALANT

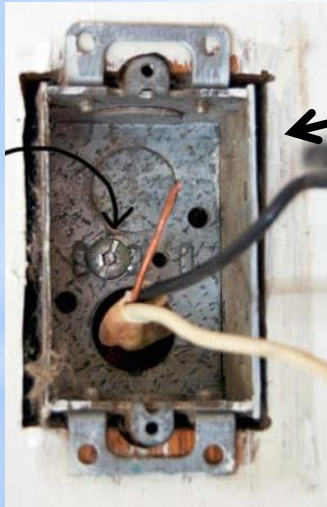
5. Min FS-1: 5/8" for 1 or 2 hr
6. Min 1/2" crown of FS-1



Electrical Fire Stop Exceptions

for Membrane Penetrations

Per WI Commercial Building Code & IBC



1. Steel electrical boxes

- Max 1/8" gap around box (w/o fire stop)

2. Non-Electrical boxes

- Annular space filled with approved membrane fire stop system with F & T ratings of the wall

3. Listed Electrical boxes of any material

- Max 1/8" gap around box



Fire Proofing

What is the violation?

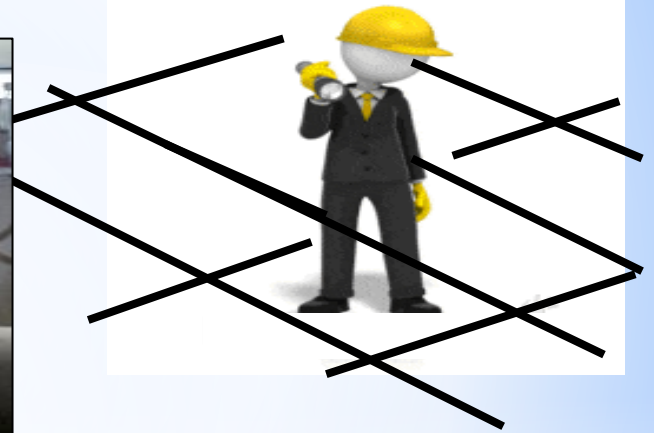
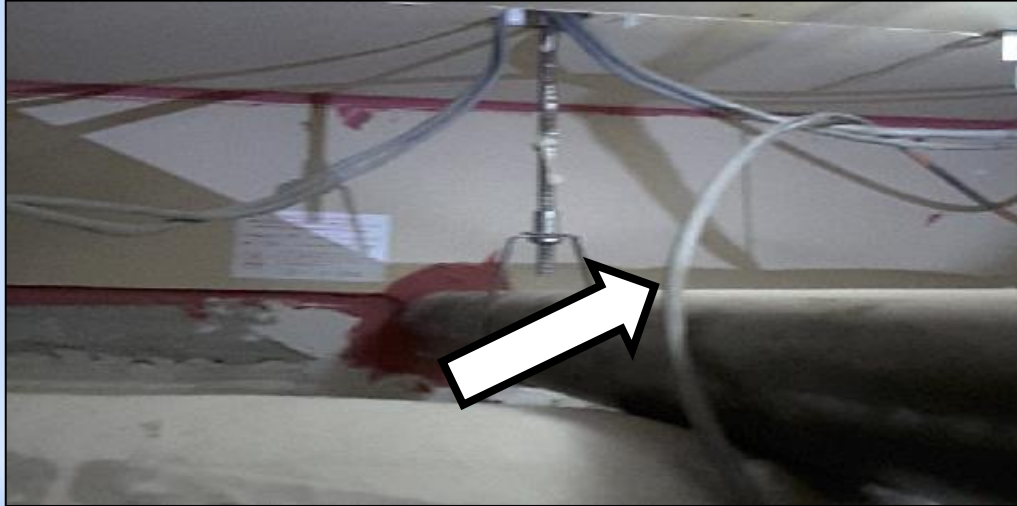
1. Fire proofing missing on beam
2. Can't fire proof beam under the box

Do NOT mount
elect boxes directly
to beams/columns



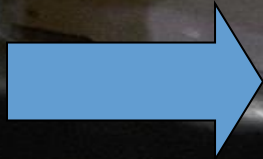
Sprinklers

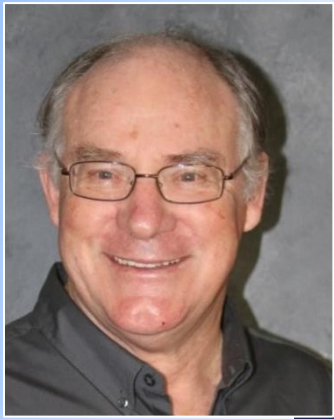
Violation: Anything touching a sprinkler pipe or its hanger



Make it a standard practice whenever looking in the ceiling to turn 360° to look for violations

Flex is laying on
the sprinkler pipe





Bill Lauzon



Electrical Requirements

Arc Flash

Arc Flash

A dangerous release of energy created by an electrical fault

Release will contain:

- ◆ Thermal energy
- ◆ Acoustical energy
- ◆ Pressure wave
- ◆ Debris



Arc Flash Intensity

The size & energy of an electric arc flash are determined by:

- ◆ Amperage
- ◆ Voltage
- ◆ Arc Gap
- ◆ Closure time
- ◆ Distance from arc
- ◆ Phase of power
- ◆ Confined space



Arc Flash Heat

- Can reach 35,000°F
- Fatal burns >10 feet
- Exposure to 203°F for 1/10 of a second will cause a 3rd degree skin burn



1st Degree Burn:
redness, pain – not
permanent

2nd Degree Burn:
blistering – skin
will regenerate

3rd Degree Burn: Total skin depth
destroyed. Will not regenerate –
requires grafting

Arc Flash Hospitalizations

- **30,000** arcs and **7,000** burns per year
- Majority of hospital admissions are arc flash burns, not shock
- Over **2,000** admitted to burn centers yearly with severe arc flash burns



Burn Survival

- 2nd and 3rd degree break skin, providing an infection pathway
- Most hospital deaths are caused by infection
- Odds of survival fall as age increases
- Burn % predicts survival, not severity
 - ✓ Odds of survival fall with total % burn
 - ✓ Odds of survival fall precipitously above 50% burn

Burn Costs

- Burn treatment requires approx. 1-1/2 days of hospitalization per % burn
- Average hospitalization is 19 days, at costs exceeding \$18,000/day
- Total hospitalization cost typically ranges from **\$200,000** to **\$750,000**, with many over **\$1,000,000**

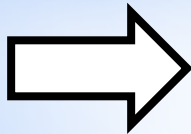


Safe Work Practices

Employers must develop and enforce safe work practices to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts.

Safe work practices could include:

- Written Safety Program
- Energized Electrical Work Permit
- Pre-work Job Briefing
- Insulated Tools
- Personal Protective Equipment
- *Flash Hazard Labeling*
- *Qualified Person Training*




Flash Hazard Label

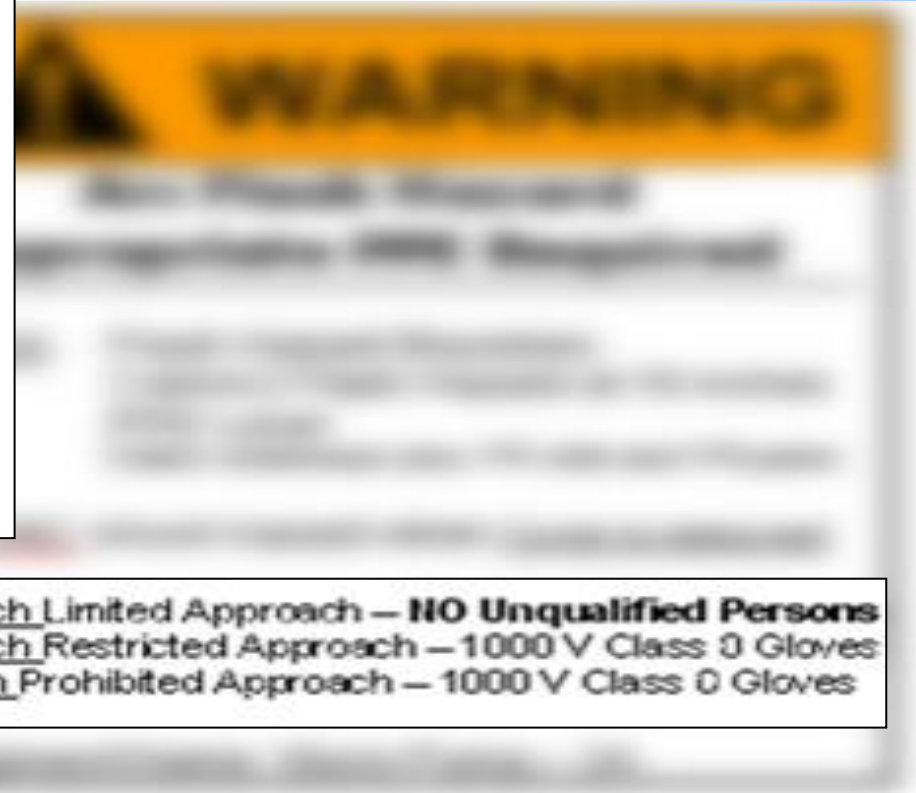
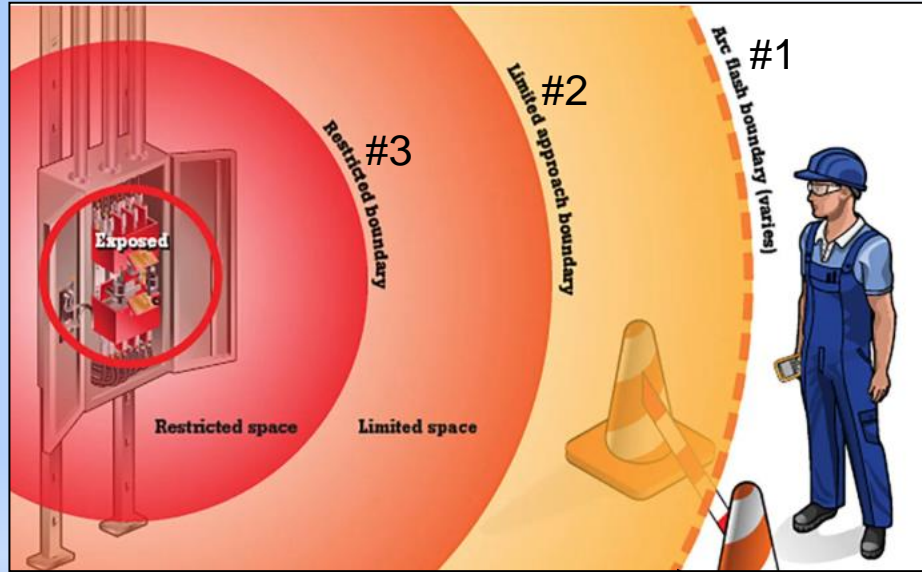
A Arc Flash Hazard label must be posted, which identifies:

• **Required PPE** →

• **Approach boundaries** → {

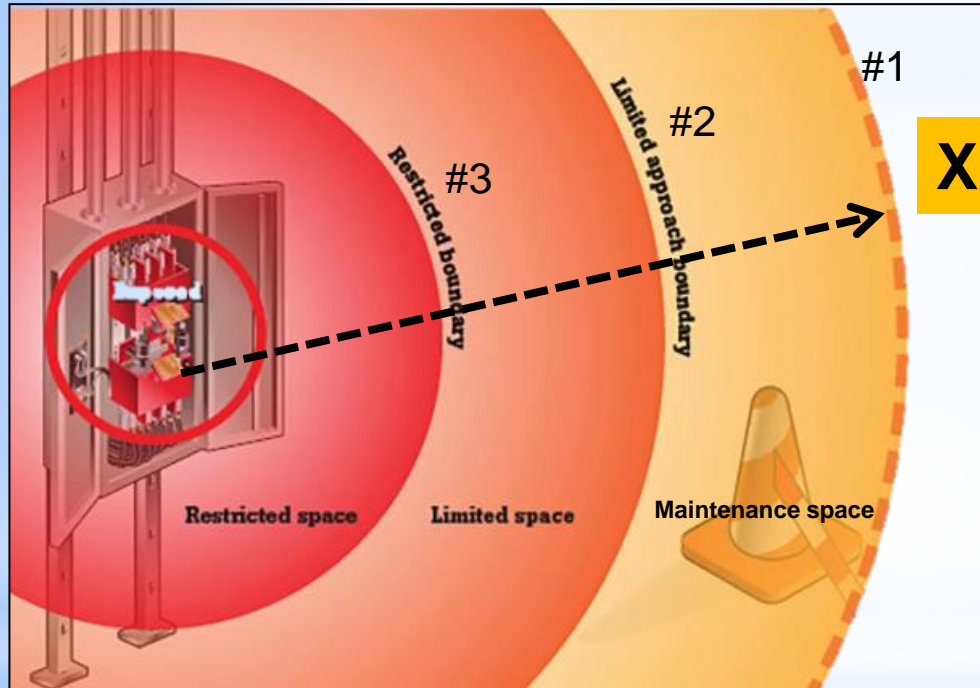
	
WARNING	
Arc Flash Hazard	
Appropriate PPE Required	
<u>40 inch</u>	Flash Hazard Boundary
<u>4.9</u>	Cal/cm ² Flash Hazard at 18 inches
<u>#2</u>	PPE Level
Cotton underwear plus FR shirt and FR pants	
<u>480 VAC</u> shock hazard when <u>Cover is removed</u>	
<u>42 inch</u> Limited Approach – NO Unqualified Persons	
<u>12 inch</u> Restricted Approach – 1000 V Class 0 Gloves	
<u>1 inch</u> Prohibited Approach – 1000 V Class 0 Gloves	
Equipment Name: Slurry Pump – 2A	

Approach Boundaries determines accessible spaces



DISTANCE from the possible arc flash point

Approach Boundaries determines accessible spaces



Safe Space

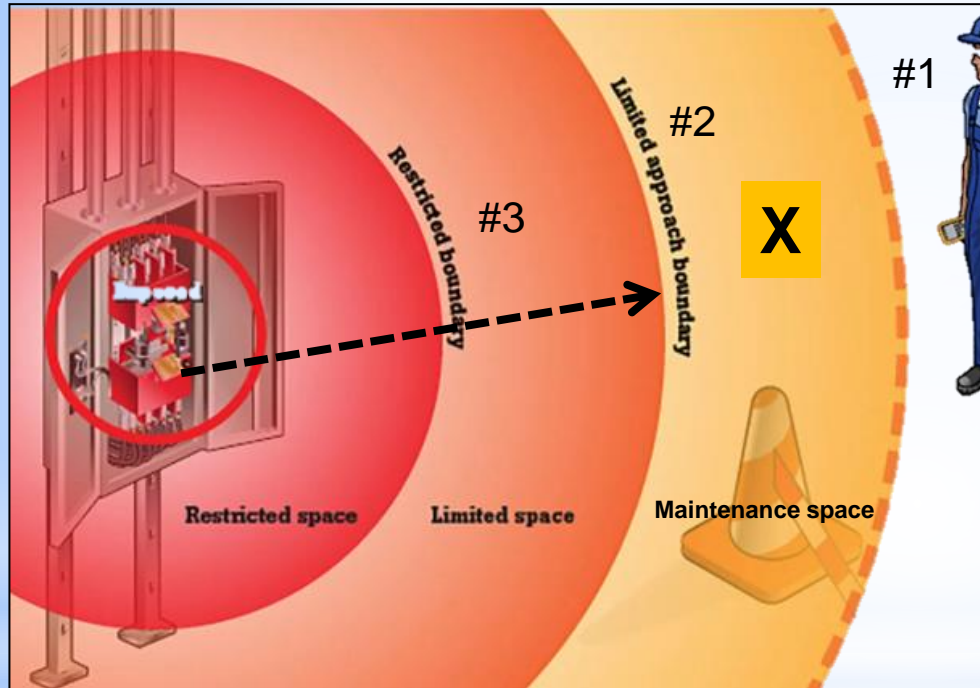
Are considered "safe" for general population



No closer than the
#1-Flash Protection Boundary:
If an arc flash occurred, an employee would be exposed to a curable 2nd degree burn

Non-Trained persons must stay this far away

Approach Boundaries determines accessible spaces



Maintenance Space

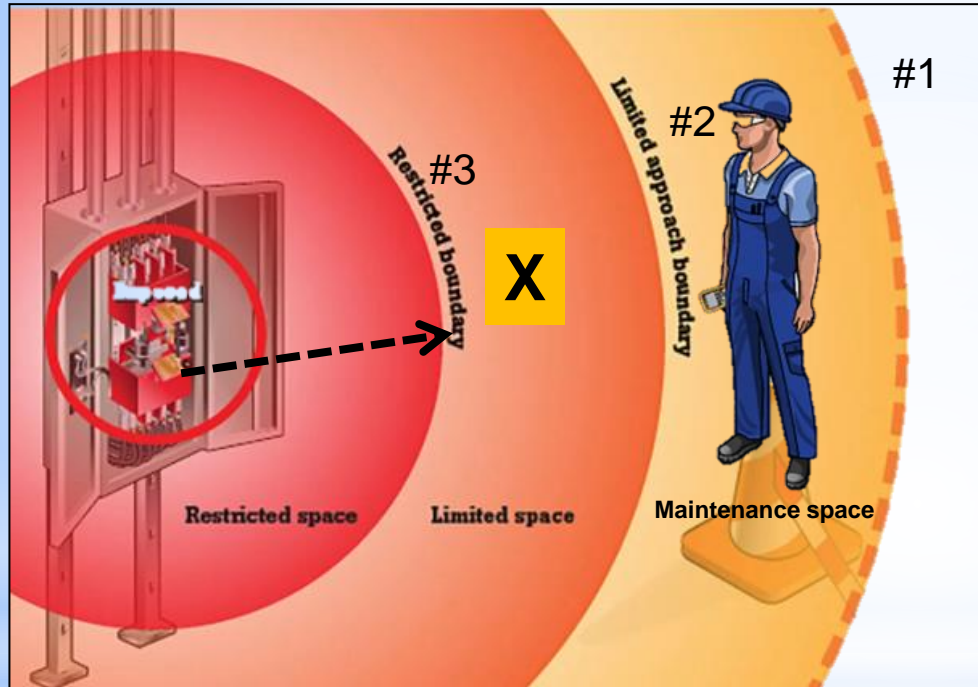
Must be minimally trained to enter this space

No closer than the
#2 – Limited Approach Boundary:

A distance from an exposed live part where a shock hazard exists if you were closer

NO UNQUALIFIED persons within this space

Approach Boundaries determines accessible spaces

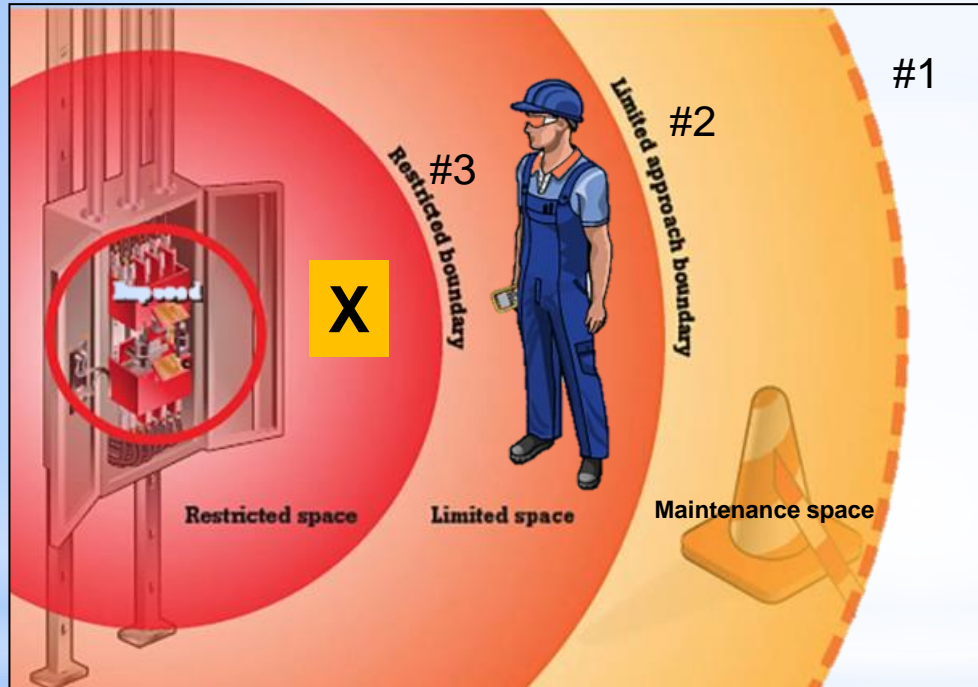


#3 – Limited Space Area Near Live Parts”

No closer than the
#3-Restricted Boundary:
A distance from an exposed live part where there is an increased risk of shock.

In this area, must be a qualified worker with additional training

Approach Boundaries determines accessible spaces



Restricted Space

Considered working on live parts

Determined by
Exposed Live Parts

Must be a qualified worker with the proper training, tools & PPE.
(May also require a work permit and documentation)

4 Ways to Determine Approach Boundaries

Method #1: NFPA 70E Tables:

- Pro: Easiest and quickest method
- Con: Provides the least amount of accuracy. Limited tasks are covered in tables



Method #2: NFPA 70E & IEEE 1584 Formulas:

- Pro: More accurate and all inclusive than NFPA tables
- Con: Is time consuming, requires an engineer level of expertise and is subject to human error.



4 Ways to Determine Approach Boundaries

Method #3: Approach Spread-Sheet Calculators:

- Pro: Quicker than formula method
- Con: Still requires detailed information about the equipment and circuit often requiring the use of an electrical engineer.



Method #4: Commercial Software:

- Pro: Creates one-line diagrams and arc flash labels based on data entered
- Con: Cost and equipment / circuit knowledge is still required, often requiring an engineer.

Qualified Person Training



Has received training and has

- knowledge of construction,
- knowledge of electric equipment,
- knowledge hazards involved, and
- demonstrated skills

Qualified Person Training 1910.332(b)(3)(i) – (iii)

Qualified persons shall be trained in at least the following areas:

- Ability to distinguish exposed live parts from other parts of electric equipment
- Ability to determine the nominal voltage of exposed live parts
- The clearance distances specified in 1910.333(c) and the corresponding voltages to which the qualified person will be exposed



Electrical Inspections

23 Required Electrical Inspections

W-Generator
M-Generator
A-Generator
A-Load Bank
3-Load Bank
A-Diesel Fuel
A-Natural Gas
A-Transfer Switch
S-Emergency Breakers
A-Emergency Breakers
2-Emergency Breakers

M-Exit Signs
M-Battery Lights
A-Battery Lights
M-Battery Bank Sys
Q-Battery Bank Sys
A-Battery Bank Sys
M-Isolated Power
A-Isolated Power
S-Wet Locations
A-Outlets
A-Plug Strips
A-Lab Cords

Required by NFPA
Codes if you have
the equipment

Beyond the scope of this
L&L to review. If you
want more training, enter
in your review comments



Electrical Equipment

K-TAG on ELECTRICAL EQUIPMENT

K921

Electrical Equipment – Testing and Maintenance Requirements

#1

The physical integrity, resistance, leakage current, and touch current tests for fixed and portable patient-care related electrical equipment (PCREE) is performed as required in 10.3. Testing intervals are established with policies and protocols. All PCREE used in patient care rooms is tested in accordance with 10.3.5.4 or 10.3.6 before being put into service and after any repair or modification. Any system consisting of several electrical appliances demonstrates compliance with NFPA 99 as a complete system. Service manuals, instructions, and procedures provided by the manufacturer include information as required by 10.5.3.1.1 and are considered in the development of a program for electrical equipment maintenance. Electrical equipment instructions and maintenance manuals are readily available, and safety labels and condensed operating instructions on the appliance are legible. A record of electrical equipment tests, repairs, and modifications is maintained for a period of time to demonstrate compliance in accordance with the facility's policy. Personnel responsible for the testing, maintenance and use of electrical appliances receive continuing training.

#2

#3

10.3, 10.5.2.1, 10.5.2.1.2, 10.5.2.5, 10.5.3, 10.5.6, 10.5.8

#1 - Patient Care Electrical Equip. Policies

Facility shall establish policies and protocols for the type of test and intervals for testing for patient care-related electrical equipment (10.5.2.1.1)

All patient care-related electrical equipment used in patient care rooms shall be tested in accordance with their policies (10.5.2.1.2)

- Before being put into service for the 1st time
- After any repair/modification
- Per the manufacturer's recommendations

#2 - Tests: Leakage Current

Insulation is not perfect. Leakage current “escapes” its intended path and travels to ground via metal parts. The ground conductor is intended to provide a safe path for this electrical energy

- **FIXED EQUIPMENT** – Max 10 mA in general and critical care areas (10.3.4.2)
- **PORTABLE EQUIPMENT** – Max 100 μ A touch current with ground wire; Max 500 μ A with ground disconnected (10.3.5.1)

#2 - Tests: Power Cords

- Must be grounded (10.2.3.2); unless double-insulated
- Must visually inspect physical integrity of cord when first installed (10.3.1)
- Must test grounding when first installed; max .5 ohm (10.3.2.1)

#2 - Tests: Extension Cords

- Permitted, when used per code (10.5.2.3.1)
- 3 to 2 prong adapters are not permitted (10.5.2.3.2)
- Must be tested for physical integrity, polarity, and grounding continuity (10.5.2.332)

#2 - Inspection: Non-Patient Electrical Equip

- All equipment used in the patient care vicinity (within 6' of a patient) must be visually inspected by staff prior to use (10.4.2.1)
- Office appliances without a ground wire are NOT permitted within the patient care vicinity, unless they are double-insulated (10.4.2.3)



#3 - Qualifications & Training



Users & maintainers of equipment must be trained on the risks of use (10.5.8.1)

- Facilities must provide continuing education (10.5.8.1)

- Equipment must be serviced by qualified personnel (10.5.8.3)





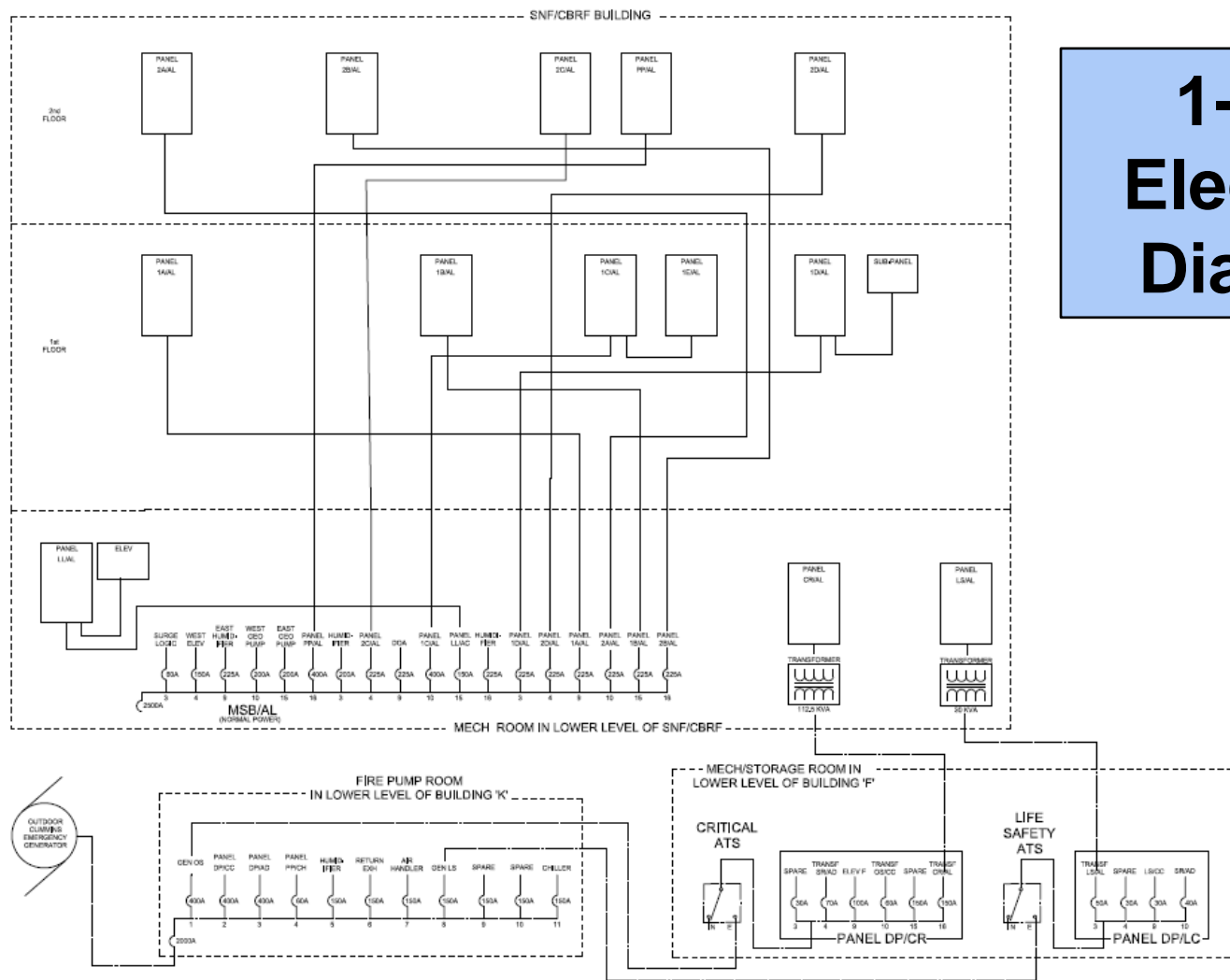
1-Line Diagrams

1-Line Electrical Diagrams

Shows how panels are powered

- **Normal Power**
- **Emergency Power**

Caution: 1-Lines are NOT normally kept up to date, especially if there's a lot of additions



1-Line Electrical Diagram

Type Sys



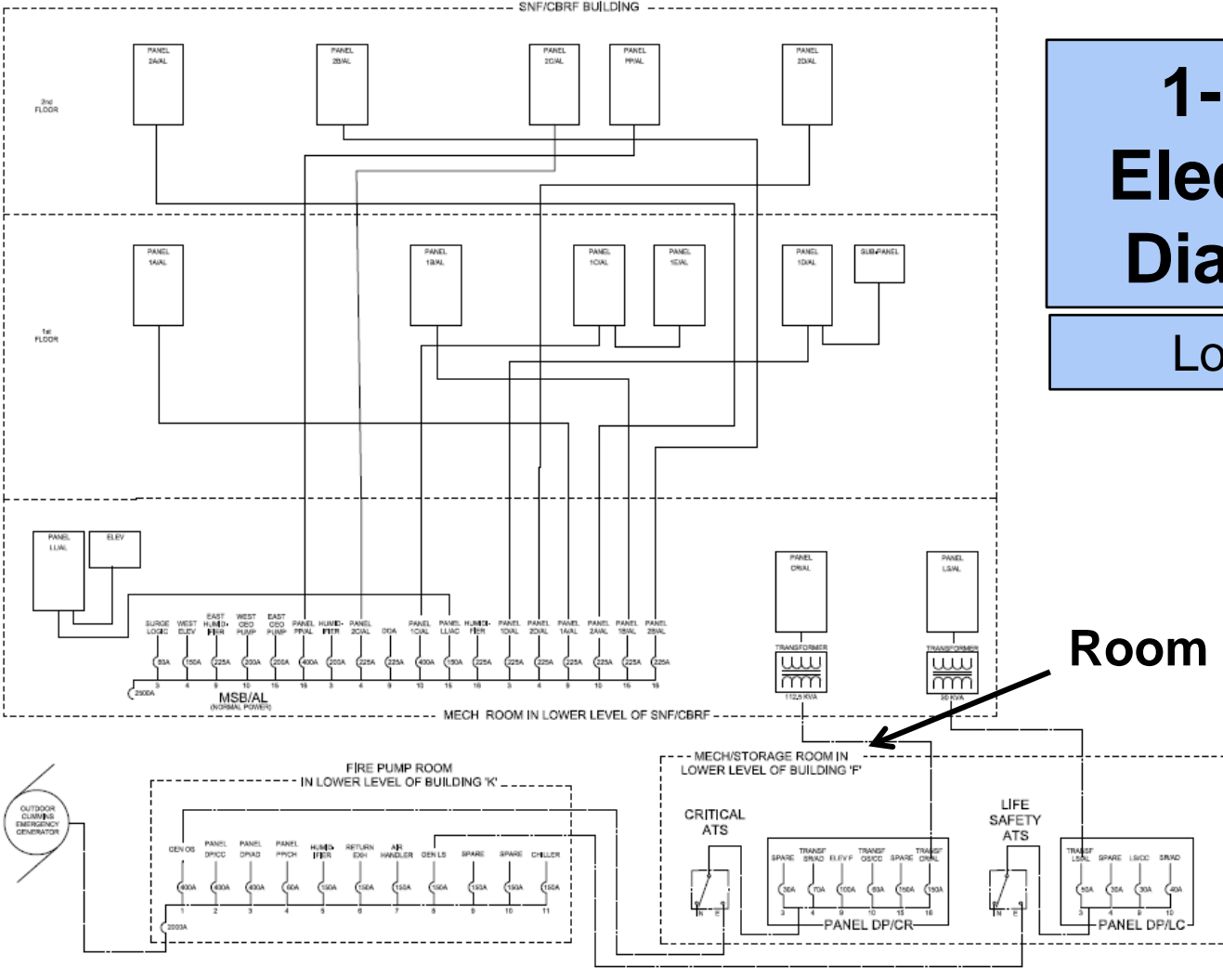
2nd Flr

1st Flr

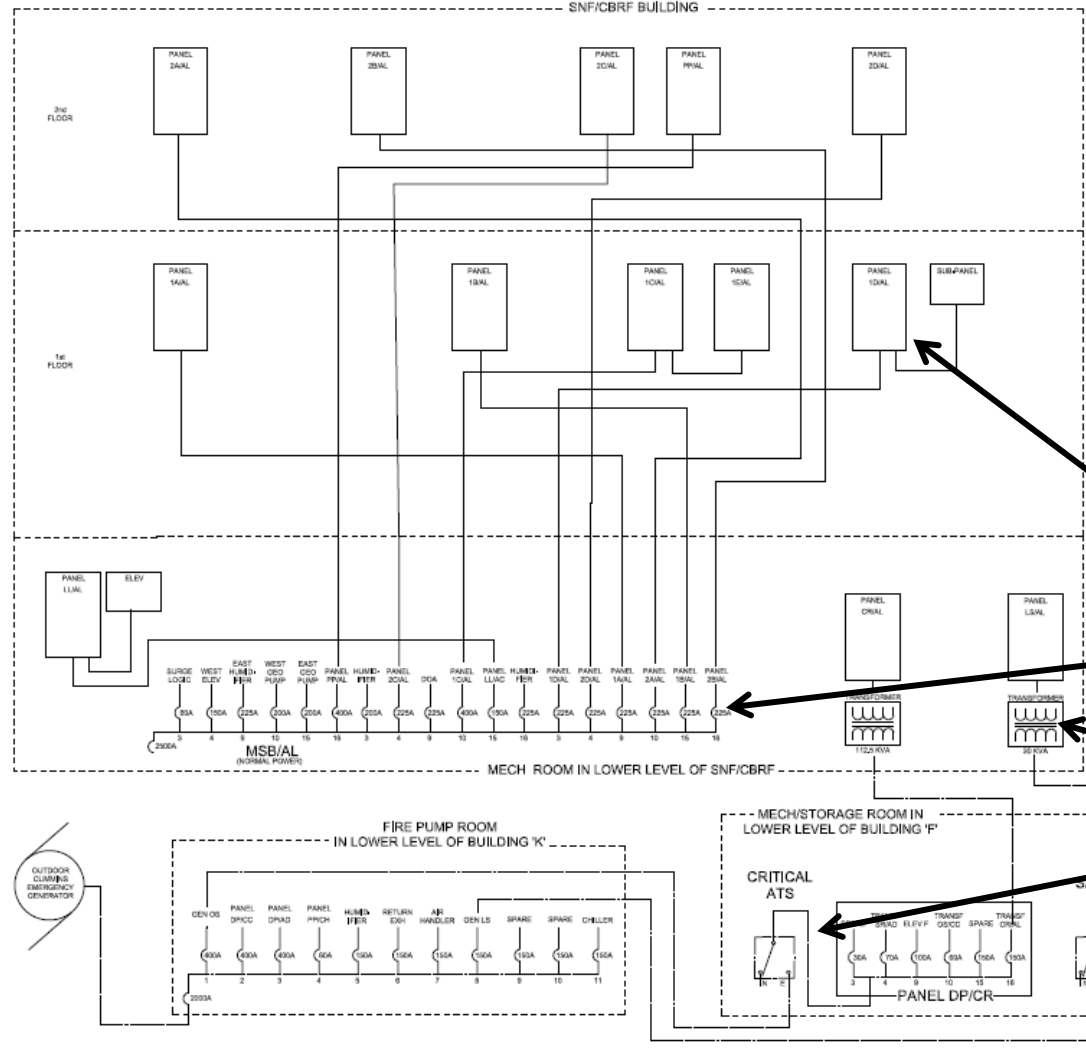
Bsmt

1-Line
Electrical
Diagram

Location




Room




1-Line Electrical Diagram


Symbols




Elect Panel



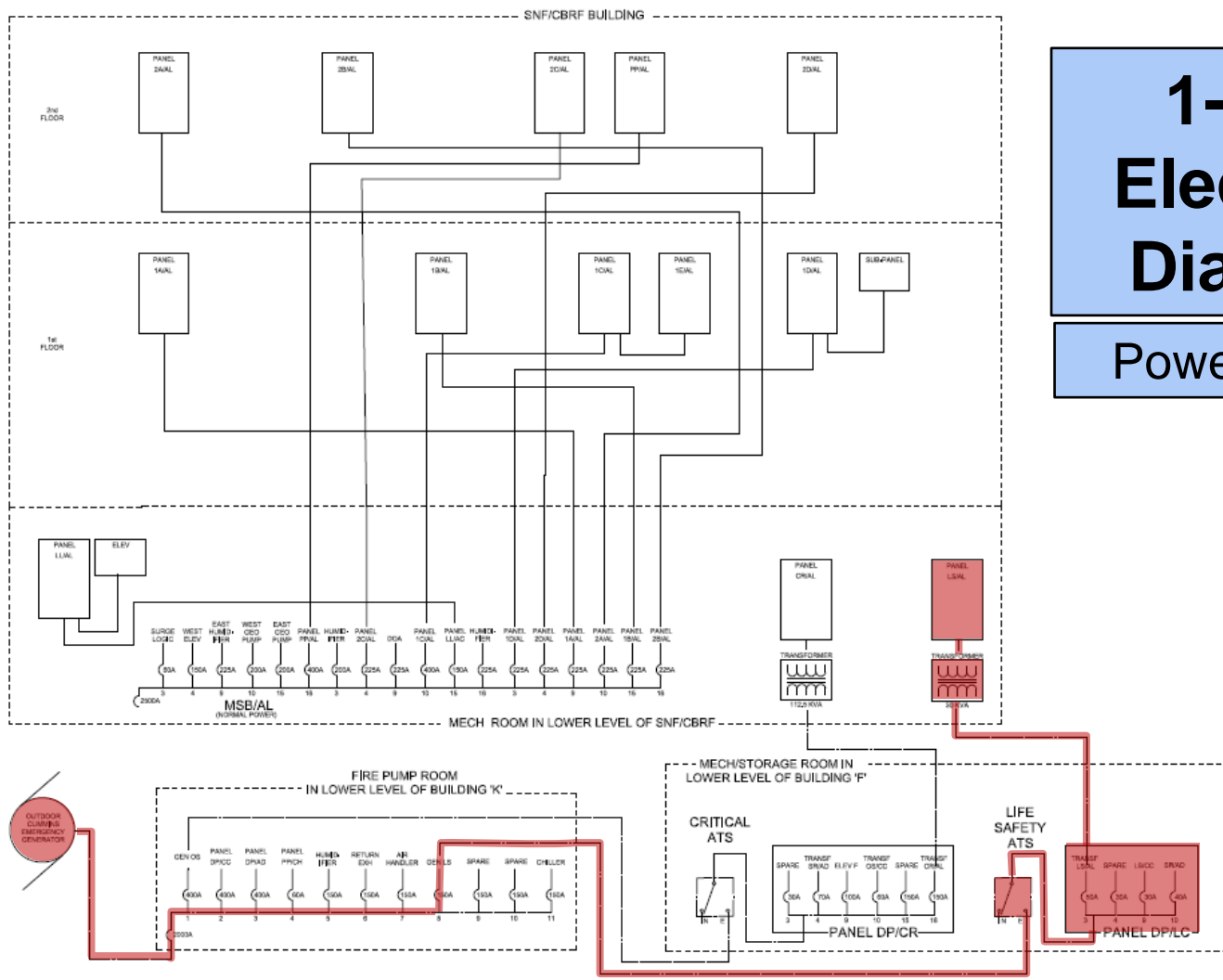
225A Breaker



Transformer



Auto Transfer Switch



1-Line Electrical Diagram

Power Tracing



Electrical Requirements

Last Topic of the Day

Lock Out Tag Out

De-energize = Safety

The most effective and fool-proof way to eliminate the risk of electrical shock or arc flash is to de-energize the equipment



Lockout / Tagout

A lock and a tag shall be placed on each disconnecting means used to de-energize equipment on work to be performed



Note: Electric equipment that have been de-energized, but have not been locked out or tagged, shall be treated as energized.

Working Live

OSHA allows not de-energizing electrical equipment when it would increase current hazards or create additional hazards, for example:

- Interruption of life support equipment,
- Deactivation of emergency alarm systems,
- Shutdown of hazardous location ventilation equip,
- Removal of illumination for an area.
- Infeasibility of deenergization (i.e. testing of electric circuits)



Electrical Panel Components



LAST chance to ask questions
Use the CHAT button