Public Safety in the Healthcare Facility

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Public Safety: 15% of CBET Exam
- Electrical
- Chemical
- Radiation
- Biological
- Fire
- Codes and Standards

Electrical
Microshock and Electrical Safety Testing

Ground Conductor Resistance
- NFPA 99 (2005) 8.4.1.3.2
  - Ground Conductor Resistance < 0.5 Ω
- NFPA 99 (2012) 10.3.2.1
- Protective Earth Impedance < 0.3 Ω
- AAMI ES60601-1:2005 8.6.4
  - Ground Conductor Resistance < 0.5 Ω
- ESM 2015: A practical limit for identifying ground conductor problems is 0.5 Ω

Ground Conductor Resistance
- NFPA 99 (2012) 10.3.1
  - Confirm by visual inspection physical integrity of the power cord, attachment plug, cord strain relief
- NFPA 99 (2012) 10.3.2.1
  - Cord flexed at attachment plug or connector
  - Cord flexed at chassis strain relief
Chassis Leakage Current

- NFPA 99 (2005) 8.4.1.3.5: Chassis Leakage Current
  New equipment < 500 μA
  Existing and special equipment < 500 μA

- NFPA 99 (2012) 8.4.1.3.5: Touch Current
  Ground wire intact / normal polarity < 100 μA
  Ground wire disconnected < 500 μA

- AAMI ES60601-1:2005 8.7.3: Touch Current
  Normal Condition < 100 μA
  Single Fault Condition < 500 μA

- ESM 2015: A practical limit for identifying chassis leakage current problems is 500 μA (normal polarity, power switch on and off, ground closed and open)
AAMI ES60601-1:2005 Test Load

Test Load – Low Frequency

Test Load – High Frequency

Electrical Safety References

- AAMI ES60601-1:2005: Medical Electrical Equipment – Part 1: General Requirements for Basic Safety and Essential Performance
- Electrical Safety Q&A. Health Devices (February 2005).

Electrical Power Systems
Joint Commission: Emergency Power
EC.02.05.03 and EC.02.05.07

- Alarm systems*
- Exit Route and exit sign illumination*
- Emergency communication systems*
- Elevators (at least one)

*As required by the Life Safety Code

Joint Commission: Emergency Power
EC.02.05.03 and EC.02.05.07

- Critical equipment, including:
  - Blood, bone, and tissue storage systems
  - Medical air compressors
  - Medical and surgical vacuum systems

- Critical areas, including:
  - Operating and recovery rooms
  - Obstetrical delivery rooms and nurseries
  - Urgent care areas

Joint Commission: Emergency Power
EC.02.05.03 and EC.02.05.07

- Monthly testing of generators and transfer switches (30 minutes, adequate load)
- Additional testing of generators every 36 months (4 hours, adequate load)

Schematic Diagram

IPS Panel

From NFPA Health Care Facilities Handbook
Line Isolation Monitor (LIM)

LIM Alarms

- Total Hazard Current: Current that would flow through a low impedance if it were connected between either isolated conductor and ground
  - Old LIM alarms: “Total Hazard Current” < 2 mA
  - New LIM alarms: “Total Hazard Current” < 5 mA

IPS Risk Assessment

Is the area designated as a wet procedure location?
Note: In NFPA 99 (2012) ORs are regarded as wet procedure locations unless a formal risk assessment determines otherwise.
- No ⇒ Conventional (grounded) power system
- Yes ⇒ Can power loss be tolerated?
  - No ⇒ Isolated (ungrounded) power system
  - Yes ⇒ Ground Fault Circuit Interrupters (GFCIs)
**Power Wiring Color Codes**

**120 VAC Grounded (United States)**
- Ground = Green
- Neutral = White
- Hot = Black

**120 VAC Grounded (European)**
- Ground = Green (solid or yellow stripe)
- Neutral = Blue
- Hot = Brown

**120 VAC Isolated Power System**
- Ground = Green
- Line 1 = Orange (to “neutral” terminal)
- Line 2 = Brown (to “hot” terminal)

**OSHA**

Chemical & Biological Hazards

Infection Control
Workplace Safety Pointers

- OSHA: Occupational Safety and Health Administration (www.osha.gov)
- OSHA is exclusively concerned with the safety of employees

OSHA Bloodborne Pathogens: Infectious microorganisms in human blood that can cause disease in humans, including hepatitis B (HBV), hepatitis C (HCV), and human immunodeficiency virus (HIV)
- Universal Precautions: an approach to infection control to treat all human blood and certain human body fluids as if they were known to be infectious
- Personal Protective Equipment (PPE): barrier gowns, gloves, eyewear (goggles or glasses), face shields

OSHA Hazard Communication Standard

HCS 1994 → HCS 2012
- Employees have a Right to Know
  - Inventory of hazardous materials
  - Information and training
  - Access to MSDS SDS information
- Material Safety Data Sheets ◀ Global Harmonization
  - Hazards of using the material
  - How to use the material safely (including PPE)
  - What to do if exposed (including First Aid)
  - How to clean up spills
  - How to dispose of the material

See also: “Avoiding Sticker Shock” Environment of Care News (February 2015) and “Staying in Compliance with OSHA’s Hazard Communication Standard” Inside ASHE (Summer 2014)

Airborne Infection Control

- Airborne Infection Isolation (AII) room:
  - Protects people in surrounding areas from airborne pathogens
  - Negative pressure; external exhaust
- Protective Environment (PE) room:
  - Protects patient from airborne pathogens in surrounding areas.
  - Positive pressure; HEPA filtration
Radiation Hazards

See also: [www.epa.gov/radiation/understand/ionize_nonionize.htm](http://www.epa.gov/radiation/understand/ionize_nonionize.htm)

Laser Safety

See also: "Laser Beam Safety Scheme" Environment of Care News (February 2015)

Fire Safety

Classes of Fires & Extinguishers

Wikipedia: “Fire Triangle”
Fire Tetrahedron

Fire Types

- **Class A**: Ordinary combustibles such as wood, paper, cloth, trash plastics.
- **Class B**: Flammable liquids such as gasoline and paint. Also propane and butane. Not cooking oils and grease.
- **Class C**: Energized electrical equipment such as motors and appliances. If power is removed, fire becomes another class.

  \[
  \begin{align*}
  A &= \text{Ash (burns to ash)} \\
  B &= \text{Barrel (gas/liquids come in barrels/cylinders)} \\
  C &= \text{Current (electrical current)} \\
  \text{TRASH} &\text{ LUBRICANTS} \\
  \text{ELECTRICAL} &\text{ KITCHEN}
  \end{align*}
  \]

- **Class D**: Combustible metals such as potassium, sodium, aluminum, and magnesium.
- **Class K**: Cooking oils and greases.

See also: [www.hanford.gov/files.cfm/ExtBrochure.pdf](http://www.hanford.gov/files.cfm/ExtBrochure.pdf)

Extinguisher Types

- **Dry Chemical**: Class ABC fires
- **Water and Foam**: Class A only.
- **Carbon Dioxide**: Class BC fires.
- **Wet Chemical**: Class K fires.
- **Halogenated or Clean Agent**: Class ABC fires.
- **Dry Powder**: Class D fires only.
- **Water Mist**: Primarily Class A fires.

Fire Safety

**Principles of Life Safety**

- Patients **incapable of self-preservation**
- **Defend in place versus evacuation**
- **Building compartmentation**
Building compartments
- Patient room
- Smoke compartment
- Floor assembly
- Building separation
- Exits and methods of egress

Fire Safety Pointers
- Current edition: 2015
- CMS (and TJC): 2000 → 2012

Codes & Standards
Joint Commission
Joint Commission Management Plans

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<th>2008</th>
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<tbody>
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<td>Fire Safety (Note 2)</td>
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<td>Medical Equipment</td>
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<tr>
<td>Utility Systems</td>
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(Note 1) All moved to new EM chapter. Emergency Operations Plan
(Note 2) ILSM and SOC standards moved to new chapter.

Medical Equipment Management

- Management plan
- Selection and acquisition of equipment
- Equipment inventory
- Inspection and maintenance strategies
- Inspection and maintenance schedule
- Hazard notices and recalls
- FDA Medical Device Reporting
- Emergency procedures

Performance Monitoring & Improvement

- Performance monitoring
- Annual evaluation:
  - Scope
  - Objectives
  - Performance
  - Effectiveness
- Performance improvement

Joint Commission References

- Hospital Accreditation Manual $$$$$
- Environment of Care Essentials for Health Care $$
- EC News $$$
- Joint Commission E-Alerts $

Codes & Standards

NFPA

NFPA Codes and Standards

- NFPA 70: National Electrical Code (NEC)
- NFPA 99: Healthcare Facilities Code
  - Electrical Equipment
  - Medical Gas Systems
Joint Commission: Medical Gas Systems EC.02.05.09
- Inspect, test, maintain critical components (time frames defined by the hospital)
- Master signal panels
- Area alarms
- Automatic pressure switches
- Shutoff valves
- Flexible connectors
- Outlets

Joint Commission: Medical Gas Systems EC.02.05.09
- Test for...
  - Purity
  - Correct gas
  - Proper pressure
- Whenever systems are...
  - Installed
  - Modified
  - Repaired

Storage and Handling of Gas Cylinders
- Compressed Gas Association poster (www.cganet.com)
- Maintaining Medical Gas Safety. *Environment of Care News* (February 2014)

Medical Gas Color Codes

<table>
<thead>
<tr>
<th>Gas</th>
<th>Color</th>
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<tbody>
<tr>
<td>Air</td>
<td>Yellow</td>
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<tr>
<td>Carbon Dioxide</td>
<td>Gray</td>
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<tr>
<td>Helium</td>
<td>Brown</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>Black</td>
</tr>
<tr>
<td>Nitrous Oxide</td>
<td>Blue</td>
</tr>
<tr>
<td>Oxygen</td>
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Codes & Standards

FDA

FDA Medical Device Reporting
- Safe Medical Devices Act (SMDA): Requires medical device reporting by Device User Facilities
- Referenced by Joint Commission (EC.02.04.01).
- FDA: www.fda.gov/cdrh/mdr
**FDA Medical Device Reporting**

- When the facility has information that reasonably suggests a device has or may have caused or contributed to a patient’s death, report to the manufacturer and FDA.
- File FDA Form 3500A within 10 work days.

**Accreditation**

- CMS: Centers for Medicare and Medicaid Services
- The Joint Commission (not JCAHO)
- Healthcare Facilities Accreditation Program (HFAP) — American Osteopathic Association (AOA)
- National Integrated Accreditation for Healthcare Organizations (NIAHO) — DNV GL Healthcare
- Center for Improvement of Healthcare Quality (CIHQ)

**Codes & Standards**

**Other**

**Other Organizations**

- AABB: American Association of Blood Banks
- ACR: American College of Radiology
- ANSI: American National Standards Institute
- IEC: International Electrotechnical Commission
- FCC: Federal Communications Commission
- ASHE: American Society for Healthcare Engineering
- IEEE: Institute of Electrical & Electronics Engineers