MSA FACILITIES SAFETY AND HEALTH INSPECTION PROGRAM

Electrical – Wiring Methods, Components and Equipment for General Use

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Further Dissemination Unlimited
At the completion of this unit you shall be able to:

1. Utilize section Z of the Safety and Health Hazard Inspection Program Checklist to identify compliant and non-compliant safety behaviors.

2. Identify areas of concern requiring immediate action to mitigate or prevent a possible injury.

Please use “Slide Show” to properly view this presentation!
Let’s start with a discussion of Electrical Safety.
Whenever you work with electrical devices there is a risk of electrical hazards, especially electrical shock. Risks are increased at maintenance and construction sites because many jobs involve electric power tools.

Coming in contact with an electrical voltage can cause current to flow through the body, resulting in electrical shock and burns. Serious injury or even death may occur.

Electricity has long been recognized as a serious workplace hazard, exposing employees to electric shock, electrocution, burns, fires, and explosions. In 1999, for example, 278 workers died from electrocutions at work, accounting for almost 5 percent of all on-the-job fatalities that year, according to the Bureau of Labor Statistics. What makes these statistics more tragic is that most of these fatalities could have been easily avoided.
• When an electrical shock enters the body it may produce different types of injuries. Electrocution results in internal and external injury to body parts or the entire body – often resulting in death. After receiving a “jolt” of electricity all or part of the body may be temporarily paralyzed and this may cause loss of grip or stability. A person may also involuntarily move as a result of receiving an electrical shock, resulting in a fall. Internal or external burns may result from contact with electricity.
For this reason we inspect and verify the safety of our electrical equipment in our offices, shops, and posts.
Section Z deals with the Electrical wiring methods, components and equipment for general use.
• This section consists of up to 13 items.
• Let’s look at these more closely.
1. Junction, switch, and outlet boxes have all openings covered.
2. Extension cords are not used as a substitute for permanent, fixed wiring.
3. Flexible cords and cables are in good condition and properly routed to prevent physical damage and eliminate tripping hazards.
4. Multi-outlet power strips/surge protectors properly connected (no daisy chain).
5. 36-inch working space is maintained in front of electrical panels. Panel schedules are clearly legible and up-to-date.*
6. Electrical disconnects are labeled to identify the equipment it controls, or so located that its purpose is evident.*
7. Insulation on wiring is in good condition.
8. Electrical equipment installed or used in wet or hazard class locations is approved for such use. *
9. Space heaters are approved by a Nationally Recognized Testing Laboratory (NRTL). *
10. Warning signs and/or physical barriers are used to keep unauthorized employees a safe distance from exposed energized electrical equipment/parts above 50 volts. *
11. Electrical rooms or enclosures containing live parts/conductors operating at greater than 600 volts are locked and labeled “Danger High Voltage”. *
12. Holes through which conductors pass will not cause damage to conductor.
Electrical – Wiring Methods, Components and Equipment for General Use

1. Junction, switch, and outlet boxes have all openings covered.

• Junction, switch, and outlet boxes are designed to have their covers on them and any other holes that could allow a finger to contact live electrical parts guarded.
1. Junction, switch, and outlet boxes have all openings covered.

- Junction, switch, and outlet boxes are designed to have their covers on them and any other holes that could allow a finger to contact live electrical parts guarded.
- Underneath these covers are live electrical parts that can cause injury.
1. Junction, switch, and outlet boxes have all openings covered.

- A compliant rating would indicate that all holes were sealed and all covers in place.
1. Junction, switch, and outlet boxes have all openings covered.

- A non compliant rating would indicate that the covers were missing, broken, or that cable holes (“knockouts”) were missing that could allow contact with exposed electrical parts.
2. Extension cords are not used as a substitute for permanent, fixed wiring.

- Extension cords are found in many work locations at this project. Using an extension cord is convenient, but if misused, can create unsafe conditions. Potential hazards include fires from overloaded cords, electrical shock from worn or damaged cords, and trip and fall accidents from unsecured cords. According to the National Electrical Safety Foundation, extension cords should be used only on a temporary basis.
2. Extension cords are not used as a substitute for permanent, fixed wiring.

• Generally, if an extension cord is plugged in for >90 days it is considered “permanent wiring” and as such is a violation of the electrical code and Project Policy.
2. Extension cords are not used as a substitute for permanent, fixed wiring.

• A compliant rating on this item would indicate that all extension cords found were not being used as a “permanent wiring methods.”
2. Extension cords are not used as a substitute for permanent, fixed wiring.

- A non compliant rating would indicate that the extension cord had been there for some time and was being used in lieu of permanent wiring methods.
Flexible cords and cables are in good condition and properly routed to prevent physical damage and eliminate tripping hazards.

- Extension cords allow us to provide power to the tools and equipment that have cords that are too short. Unfortunately cords on the ground can create tripping hazards as well as create an opportunity for failure of the electrical sheathing (insulation) of the cord.
- For this reason we require that cords be routed properly.
Flexible cords and cables are in good condition and properly routed to prevent physical damage and eliminate tripping hazards.

- A compliant rating would indicate that the extension cords were protected from damage and were not creating a tripping hazard.
3. Flexible cords and cables are in good condition and properly routed to prevent physical damage and eliminate tripping hazards.

- Non compliant rating would indicate that the cords were located where they could be damaged or they could trip someone.
4. Multi-outlet power strips/surge protectors properly connected (no daisy chain).

• The supply of readily available electrical outlets is inadequate in some buildings, especially older ones. To meet power supply needs, extension cords or surge protected power strips are often interconnected, or “daisy chained,” to readily provide more outlets and/or to reach greater distances.
4. Multi-outlet power strips/surge protectors properly connected (no daisy chain).

- Another common solution is to create a “mixed daisy chain,” interconnecting extension cords and power strips. However, interconnecting these devices is a violation of Occupational Safety and Health Administration (OSHA) regulations and the National Electrical Code because doing so can cause them to become overloaded, leading to their failure and a possible fire.
4. Multi-outlet power strips/surge protectors properly connected (no daisy chain).

- A compliant rating would indicate that the power strips in use were plugged directly into an permanently wired receptacle, did not connect to another strip or surge suppressors or use an extension cord.
Electrical – Wiring Methods, Components and Equipment for General Use

4. Multi-outlet power strips/surge protectors properly connected (no daisy chain).

• A non compliant rating would indicate that the power strips/suppressors were daisy chained.
4. Multi-outlet power strips/surge protectors properly connected (no daisy chain).

- A non compliant rating would indicate that the power strips/suppressors were daisy chained.

- Also, it would indicate that the power strips weren’t being used correctly in other ways as well.

Multiple issues here, but the strips are not being used iaw with the manufacturers instructions!
5. 36-inch working space is maintained in front of electrical panels. Panel schedules are clearly legible and up-to-date.

- The minimum requirements for both access and working space for electrical equipment used on circuits 600 volts nominal or less are 30 inches wide and 3 feet deep.
- Equipment examples include panelboards, switches, circuit breakers, controllers, and controls on heating and air-conditioning equipment.
- This area cannot be used for storage.
5. 36-inch working space is maintained in front of electrical panels. Panel schedules are clearly legible and up-to-date.

- Also included in this item is the requirement that each panel clearly state what circuits are fed by each breaker. This is called the “schedule”. 
Electrical – Wiring Methods, Components and Equipment for General Use

5. 36-inch working space is maintained in front of electrical panels. Panel schedules are clearly legible and up-to-date.

- A compliant rating would indicate that the access to these disconnects, panel boards, and breaker boxes were clear of “non-electrical” equipment.
- These would include boxes, brooms, garbage cans, chairs, etc.
- Also the schedule was legible and up to date showing the loads that were served by each breaker.
5. 36-inch working space is maintained in front of electrical panels. Panel schedules are clearly legible and up-to-date.

- A non compliant rating would indicate that the access to these disconnects, panel boards, and breaker boxes were not clear of “non-electrical” equipment or the schedule was missing or was illegible.
6. Electrical disconnects are labeled to identify the equipment it controls, or so located that its purpose is evident.

• The purpose of this item is to ensure that equipment disconnects are either clearly marked as to the equipment they serve or it is obvious which equipment they serve. An example of obvious would be a disconnect for a machine that is mounted on the machine or the cable connecting the disconnect is obviously going into only that machine.
6. Electrical disconnects are labeled to identify the equipment it controls, or so located that its purpose is evident.

- A compliant rating would indicate that the disconnects were either marked for the equipment they served or they were obvious in their location and function.
6. Electrical disconnects are labeled to identify the equipment it controls, or so located that its purpose is evident.

- A non compliant rating would indicate that the disconnects were either marked for the equipment they served or they were obvious in their location and function.
7. Insulation on wiring is in good condition.

- The purpose of this item is to check on the condition of the insulation on wires of equipment being used.
- It is not intended as an full scope electrical inspection but rather a visual check on the condition of the electrical cordage being used.
7. Insulation on wiring is in good condition.

- Obviously if you observe a wiring system such as this you’ll want to let the facility manager and your safety professionals know as soon as possible.
7. Insulation on wiring is in good condition.

- Generally, you need to look for damaged cords;
7. Insulation on wiring is in good condition.

- Generally, you need to look for damaged cords;
- modified plugs
7. Insulation on wiring is in good condition.

- Generally, you need to look for damaged cords;
- modified plugs
- obvious improper wiring methods
Electrical – Wiring Methods, Components and Equipment for General Use

7. Insulation on wiring is in good condition.

- Generally, you need to look for damaged cords;
- modified plugs
- obvious improper wiring methods
- illegal 3 prong adaptors (suicide plugs).
Electrical – Wiring Methods, Components and Equipment for General Use

7. Insulation on wiring is in good condition.

- If you find that the cordage and electrical installations are in good condition then you would rate the item as compliant.
- Otherwise you would need to rate the item as non compliant or less, ensure that the comment section was filled out, and in all the examples given ensure that the facility manager was informed and took action immediately.
8. Electrical equipment installed or used in wet or hazard class locations is approved for such use.
Electrical – Wiring Methods, Components and Equipment for General Use

8. Electrical equipment installed or used in wet or hazard class locations is approved for such use. *

- Electrical equipment needs to be approved and rated for the environment it is located in.
- Major incidents have happened in facilities where the equipment was either not approved for use in that environment or had degraded to where it was not longer safe.
8. Electrical equipment installed or used in wet or hazard class locations is approved for such use.

• When we talk about electrical equipment in wet areas, we mean equipment that will not short to ground or if there is a problem with the device it is designed with safeguards to protect the operator of the equipment from shock. These protections include GFCI’s, double insulation, and water proof/weather proof installations.
8. Electrical equipment installed or used in wet or hazard class locations is approved for such use.

- We also are concerned that the electrical equipment is appropriate for any hazards that may be present. The Codes and Standards have requirements that electrical equipment in locations of explosive gas, dust, or liquids but be rated for that purpose.

Imperial Sugar Factory Georgia, after recent sugar dust explosion.
8. Electrical equipment installed or used in wet or hazard class locations is approved for such use.

- A compliant rating would indicate that the electrical equipment was installed correctly and was for the environment it was located in.
8. Electrical equipment installed or used in wet or hazard class locations is approved for such use.

- A compliant rating would indicate that the electrical equipment was installed correctly and was for the environment it was located in.
- A non compliant rating would indicate that the electrical equipment was not approved for that location.

An outside receptacle not protected from the weather.
9. Space heaters are approved by a Nationally Recognized Testing Laboratory (NRTL).

- Space heaters are used for augmentation of existing heating systems in many of our buildings. These heaters are of many different types and use many different types of energy to create heat. Of concern in this item are the safety of electric space heaters that are used by our personnel.
9. Space heaters are approved by a Nationally Recognized Testing Laboratory (NRTL).

- If these heaters are not used properly or are not of the correct and listed type then a fire can happen.
- The photo on the right shows a space heater that had combustible material placed too close to it. Subsequently a fatal fire occurred.
9. Space heaters are approved by a Nationally Recognized Testing Laboratory (NRTL).

- Must have a tip-over shutdown feature. If a space heater is knocked over, the unit must automatically shut off.
9. Space heaters are approved by a Nationally Recognized Testing Laboratory (NRTL).

• Must be UL (Underwriters Laboratory), or other Nationally recognized testing laboratory approval (NRTL), and must be labeled accordingly.
Space heaters are approved by a Nationally Recognized Testing Laboratory (NRTL).

- A compliant rating would indicate that the space heater had met these requirements and was being safely used.
9. Space heaters are approved by a Nationally Recognized Testing Laboratory (NRTL).

- **A non compliant rating would indicate that the heater was not listed or was not in a safe condition.**
Warning signs and/or physical barriers are used to keep unauthorized employees a safe distance from exposed energized electrical equipment/parts above 50 volts.

• The purpose of this item is to ensure that personnel are protected from hazards of exposed electrical parts (≥ 50 VAC to ground) during both maintenance and normal operations.

• There are two types of hazards we guard against.
10. Warning signs and/or physical barriers are used to keep unauthorized employees a safe distance from exposed energized electrical equipment/parts above 50 volts.

- The first is to guard against the possibility of “arc flash” during maintenance/operations of the equipment with their covers off.
- **Flash Protection Boundary** - distance from an arc source within which an employee may receive a second-degree burn from an electrical arc flash
- The Flash Protection Boundary is 4 feet for energized electrical equipment up to 600 volts unless otherwise calculated.
10. Warning signs and/or physical barriers are used to keep unauthorized employees a safe distance from exposed energized electrical equipment/parts above 50 volts.

- Access into this barrier requires that only qualified persons wearing the prescribed arc flash PPE may approach.
- The perimeter of this area must be marked so that no unsuspecting employee may enter the area and be at risk.
10. Warning signs and/or physical barriers are used to keep unauthorized employees a safe distance from exposed energized electrical equipment/parts above 50 volts.

• The second type of electrical hazard we try to protect against is the possibility of electrical shock.
• Guarding is provided by locating the energized equipment in rooms, vaults, enclosures, etc, only accessible to qualified persons.
• We place components in enclosures (panels) that require tools to access the live parts.
10. Warning signs and/or physical barriers are used to keep unauthorized employees a safe distance from exposed energized electrical equipment/parts above 50 volts.

- We also can protect exposed live electrical equipment by location on a suitable balcony, gallery, or platform and arranged so as to exclude unqualified persons.
- We also can guard by elevation a minimum of 8 feet or more above the floor or other working surface.
- For exposed movable conductors (like on cranes) we require a minimum of 10 feet elevation to protect workers.
Warning signs and/or physical barriers are used to keep unauthorized employees a safe distance from exposed energized electrical equipment/parts above 50 volts.

• In order to protect personnel from accidental shock there is a 3 ½ foot approach distance from exposed (unguarded) electrical components. This area is restricted to only qualified persons or persons under the direct supervision of qualified person.

• This is called the “limited approach boundary (LAB)”.

• If the conductor is an exposed movable conductor then the LAB is 10 feet.
10. Warning signs and/or physical barriers are used to keep unauthorized employees a safe distance from exposed energized electrical equipment/parts above 50 volts.

- A compliant rating would indicate that either there were no exposed energized electrical wires, there were sufficient barriers, or there was sufficient boundaries in place to prevent accidental contact.
10. **Warning signs and/or physical barriers are used to keep unauthorized employees a safe distance from exposed energized electrical equipment/parts above 50 volts.**

- **A non compliant rating would indicate there were conditions that could lead to accidental contact with live electrical conductors.**
11. Electrical rooms or enclosures containing live parts/conductors operating at greater than 600 volts are locked and labeled “Danger High Voltage”.

• This item is to ensure that non qualified personnel do not have access to intermediate or high voltage equipment (>600 VAC)

• This is not a requirement for lower voltage systems (<600 VAC) where building occupants are expected to have access to low voltage disconnects.
11. Electrical rooms or enclosures containing live parts/conductors operating at greater than 600 volts are locked and labeled “Danger High Voltage”.

- A compliant rating would indicate that these locations were locked.
11. Electrical rooms or enclosures containing live parts/conductors operating at greater than 600 volts are locked and labeled “Danger High Voltage”.

• A compliant rating would indicate that these locations were locked.
• Note these locations also have to be marked as “DANGER High Voltage” as well.
11. Electrical rooms or enclosures containing live parts/conductors operating at greater than 600 volts are locked and labeled “Danger High Voltage”.

- A non compliant rating would indicate that these locations were not locked and were accessible to non qualified personnel.
12. Holes through which conductors pass will not cause damage to conductor.

- This item is to ensure that cords and wires going through holes in desks, walls, panels, etc. are protected from cutting and abrasion from sharp edges.
- Grommets (a desk grommet shown here), stuffing tubes and other devices are used to protect electrical conductors.
12. Holes through which conductors pass will not cause damage to conductor.

- A compliant rating would indicate that the conductors were protected from cutting and abrasion.
12. Holes through which conductors pass will not cause damage to conductor.

- A non compliant rating would indicate that the conductors were not protected from cutting and abrasion.
If at any time you have any questions about how to fill out the form or about the items on the form please contact your project OS&H group.
Thank you for your time and desire to help us have a safer workplace