Bonding and Grounding of Flammable Liquids

LENGTH: 14 MINUTES **Production Year: 2024**

PROGRAM SYNOPSIS:
Every day, flammable liquids are safely used, transported, and transferred in a wide variety of industries, vehicles, and applications. In order to do so, all personnel involved in flammable liquid operations must be aware of the potential hazards presented by flammable liquids and understand the safe work practices that must be followed to prevent fires or explosions. This program demonstrates how to prevent electrostatic discharge while transferring flammable liquids by using the proper equipment and PPE.

PROGRAM OBJECTIVES:
After watching the program, the participant should be able to explain the following:
- What is static electricity;
- Why it is important to know the flashpoint of a flammable liquid;
- How bonding and grounding works;
- The equipment and PPE needed for safe bonding and grounding.

PROGRAM OUTLINE:
INTRODUCTION
- Every day, flammable liquids are safely used, transported, and transferred in a wide variety of industries, vehicles, and applications.
- In order to do so, all personnel involved in flammable liquid operations must be aware of the potential hazards presented by flammable liquids and understand the safe work practices that must be followed to prevent fires or explosions.
- During this program you will learn how to prevent electrostatic discharge while transferring flammable liquids. But first, we need to have a good understanding of static electricity.

STATIC ELECTRICITY
- All matter is made up of atoms. Atoms are often called “the building blocks of matter.” Anything that has mass or takes up space is made up of atoms. This includes all solids, liquids, and gasses.
- Atoms consist of other small particles: protons, neutrons, and the smallest of particles – electrons. The nucleus, or center, of an atom consists of some combination of protons and neutrons while the smaller electrons orbit around the nucleus.
- It is these electrons that we are concerned about when it comes to flammable liquid safety because each electron carries a small, negative electrical charge.
- The movement of two materials against each other, such as shoes across carpet, can forcibly transfer negatively charged electrons from one material to another. When this occurs, one material becomes more negatively charged than the other. This is often called a “charge imbalance” and can also be referred to as “electrical potential.”
- It is the imbalance of negatively charged particles that creates static electricity. The presence of static electricity in and of itself is not a problem. However, the spark that can be produced by the discharge of static electricity? Now ***that*** can be an explosive problem that must be controlled.

FLASHPOINT
- One of the primary hazards of flammable liquids are their vapors.
- When conditions are right, these vapors can ignite when any type of ignition source is introduced. This includes a spark caused by the discharge of static electricity, also known as “electrostatic discharge.”
- The risk of creating a build-up of static electricity increases when flammable liquids are transferred from one container to another. This is because liquid moving through a pipe or hose, or even being poured from one container to another, is forcibly moving electrons from one place to another.

- This transfer of electrons via the flowing liquid can create a charge imbalance in the various items or materials involved in the transfer. Drums, containers, vehicles, tanks, vessels, even airplanes can become negatively or positively charged relative to other objects.
- And when materials with this type of a charge imbalance are brought close together, an electrostatic discharge can occur and potentially ignite any nearby vapors from flammable liquids.
- By definition, a flammable liquid is any liquid with a flashpoint equal to or below 93 degrees Celsius or 199.4 degrees Fahrenheit. The term "flashpoint" refers to the minimum temperature at which a liquid gives off vapor within a vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid. This is an important concept to understand because it is the ***vapor*** that ignites, not the ***liquid.***
- In general, flammable liquids with a lower flashpoint are ***more*** volatile, meaning they present a greater fire hazard, than flammable liquids with a higher flashpoint.

BONDING AND GROUNDING

- Due to their volatility, both OSHA and the NFPA have bonding and grounding requirements when transferring flammable liquids. Bonding and grounding is used to prevent the build-up of static electricity and help prevent the occurrence of a spark due to electrostatic discharge.
- This is why all containers of flammable liquids with a flashpoint of 100 degrees Fahrenheit or less must be bonded and grounded during the dispensing of the flammable liquid.
- The process of bonding and grounding can be defined as providing an electrically conductive pathway between a dispensing container, a receiving container, and an earth ground.
- By establishing this conductive pathway ***before*** the transfer of flammable liquid begins, any potential build-up of static electricity will safely dissipate into the ground and there will be no charge imbalance created between the containers, thus reducing the possibility of sparks from electrostatic discharge.
- Next, let's briefly explain the difference between bonding and grounding.
- When two items are ***bonded*** together with a conductive material, any charge imbalance between the items (also known as "electrical potential") is eliminated because excess electrons can easily move or "flow" through the bonding conductor as needed to correct any charge imbalance.
- In other words, bonding completes the "circuit" between two objects and places them at the same electrical potential.
- However, there is another large object that must also be considered, the Earth.
- Bonding the drum to a smaller container merely creates a bonded system that may also have a charge imbalance relative to the Earth. And any person or object in contact with the Earth may cause an electrostatic discharge (or spark) when contacting the bonded drum or small container.
- The solution to this problem is grounding.
- Grounding begins by driving a conductive grounding rod deep into the Earth and then attaching a conductive grounding wire to the grounding rod. This grounded connection can then be routed via other conductive objects and attached to the item being grounded.
- In addition to grounding wires and bus bars, conductive plumbing pipes are often used to provide a grounded connection to other points in a facility.
- Once an object is grounded in this manner, any build-up of static electricity in the grounded item or any item bonded to it will dissipate into the Earth. When a group of objects are properly bonded and grounded, there will be no charge imbalance between any of the bonded objects and the Earth.
- For example, let's say you want to pump a gallon of paint thinner from a 55-gallon drum into a metal safety can. First, the drum needs to be properly grounded, and then the transfer pump is bonded to it.
- In some cases, the pump is bonded to the drum by a metal-to-metal attachment point. In other cases, a bonding wire may be used.
- To complete the bonding circuit, the metal safety can will then need to be bonded to either the transfer pump or the drum.
- For bonding and grounding to be effective, a metal-to-metal connection must be maintained between the bonding and grounding wires and the objects to which they are connected. For this reason, paint and other coatings, grease, or dirt need to be removed from the area being connected.
- If grinding or other spark-producing activity is used to create a clean bonding or grounding connection, be sure no flammable vapors are present before beginning.

BONDING EQUIPMENT AND STORAGE

- Usually, bonding and grounding cables (or wires) are made of copper or another highly conductive metal. Each end has a clamp, clip, or eyelet to facilitate bonding or grounding. Jumper cables are not reliable as bonding/grounding assemblies and should not be used for bonding or grounding.
- As we mentioned earlier, bonding and grounding is required during the transfer or dispensing of flammable liquids with a flashpoint of 100 degrees Fahrenheit or less. However, there is no requirement that flammable liquid containers be bonded or grounded while stored and NOT involved in transfer operations; however, some organizations require it none the less.
- Also, flammable liquid storage cabinets are not required to be grounded, but if flammable liquids are being dispensed from *inside* the cabinet, the possibility of vapor accumulation combined with the large metal surface area of the cabinet make grounding the cabinet and bonding it to the transfer container a good idea.
- Many cabinet manufacturers provide a built-in grounding lug for this purpose. It is generally located on the bottom right-hand side.
- For bonding and grounding systems to be effective in preventing sparks from electrostatic discharge, each bonding and grounding cable must be in good condition and all connectors must be in solid contact with a conductive surface and free from excessive corrosion. This requires periodic inspection and testing by qualified personnel to ensure that a complete low-resistance circuit exists.
- Of course, the bonding wires used during each transfer should be visually inspected ***before*** each use. Look for broken strands, loose connections, corrosion, or the build-up of paint, grime, or other coatings that may prevent making a good connection.
- Also, make sure all transfer hoses and nozzles are clean, because rust, dirt, or other non-conductors in the flow can create additional electron flow and static electricity.
- Some bonding and grounding systems, such as those used on vacuum trucks or fuel dispensing vehicles, contain visual indicators that an adequate bond and/or ground has been achieved.
- Before using these systems, make sure you understand the meaning of the various indicators and make sure the equipment is properly bonded and grounded prior to beginning the transfer of flammable liquid.

NON-CONDUCTIVE CONTAINERS

- Non-conductive materials can still hold a static charge, and the flow of liquid between such containers can carry electrons and dissipate that charge, resulting in a spark.
- This is why OSHA issued a letter of interpretation addressing non-metallic containers and confirmed that any static charge between such containers be equalized and or eliminated, so that no potential for a static discharge exists. To achieve this, the liquid in the container itself must be in contact with a conductive material that completes the bonding and grounding circuit.
- Most modern plastic containers may have an embedded ground wire so it can be grounded and bonded as needed.
- Also, a pump with a metal draw tube can be used to ensure contact with the liquid. In laboratory settings, a copper tube is often inserted into a glass beaker for this purpose.

WHAT PPE IS NEEDED?

- Any time you're transferring flammable liquids, you should always be aware of your personal safety. Make sure to wear the proper personal protective equipment.
- At a minimum, safety glasses are needed; however, the extra protection of splash goggles and a face shield will provide more complete protection.
- Gloves should be worn to protect hands from contact with the flammable liquid. Of course, make sure they are rated for the type of flammable liquid being dispensed. Different liquids may require specific glove materials. Check the Safety Data Sheet if you are unsure.
- When liquid splashing is a possibility during the transfer, a chemical-resistant apron or protective coveralls should be used. Selecting the appropriate outwear can provide protection for your body against spills or splashes.

CONCLUSION

- Make sure you always use the bonding and grounding equipment provided by your organization any time you are involved in dispensing flammable liquids.
- After all, this simple act helps ensure your safety and all those working with you.

BONDING AND GROUNDING OF FLAMMABLE LIQUIDS

ANSWERS TO THE REVIEW QUIZ

1. a
2. a
3. a
4. b
5. a
6. a
7. a
8. b
9. a

BONDING AND GROUNDING OF FLAMMABLE LIQUIDS

REVIEW QUIZ

Name_____Date_____

The following questions are provided to determine how well you understand the information presented in this program.

1. Sparks that can be produced by the discharge of static electricity create an explosive problem that must be controlled when working with flammable liquids.

a. True
b. False

2. The risk of creating a build-up of static electricity increases when flammable liquids are transferred from one container to another.

a. True
b. False

3. The term "flashpoint" refers to the minimum temperature at which a liquid gives off vapor within a vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

a. True
b. False

4. Flammable liquids with a higher flashpoint are ***more*** volatile than flammable liquids with a lower flashpoint.

a. True
b. False

5. All containers of flammable liquids with a flashpoint of 100 degrees Fahrenheit or less must be bonded and grounded during the dispensing of the flammable liquid.

a. True
b. False

6. Bonding completes the "circuit" between two objects and places them at the same electrical potential.

a. True
b. False

7. Grounding begins by driving a conductive grounding rod deep into the Earth and then attaching a conductive grounding wire to the grounding rod.

a. True
b. False

8. Paint and other coatings, grease, or dirt do not need to be removed from the bonding area for an effective metal-to-metal connection to be maintained.

a. True
b. False

9. Proper personal protective equipment to be used when transferring flammable liquids can include safety glasses or goggles, a face shield, gloves rated for the liquid being transferred, and a chemical-resistant apron or coveralls.

a. True
b. False