

## Bonding and Grounding

### What is bonding and grounding?

Grounding is the process of bonding one or more conductive objects to the ground, so that all objects are at the same static potential as earth; also referred to as “earthing.”

Bonding is the process of connecting two or more conductive objects together by means of a conductor so that they are at the same static potential, but not necessarily at the same potential as the earth.

### Why is bonding and grounding important?

Transferring a liquid from one metal container to another may result in static electrical sparks. Bonding and grounding is the process of providing an electrically conductive path between a dispensing container, a receiving container, and an earth ground, which eliminates the potential buildup of static electricity and possible spark that can cause a flash fire if there is a flammable mixture of fuel and air.



### Is bonding and grounding required?

Bonding and grounding are needed when dispensing flammable liquids from storage drums to smaller electrically conductive containers. Similarly, whenever you transfer these liquids between conductive containers in any work areas, for example, when filling or draining dip tanks, mixers, rinse tanks or other equipment, bond both containers together and ground one of them.

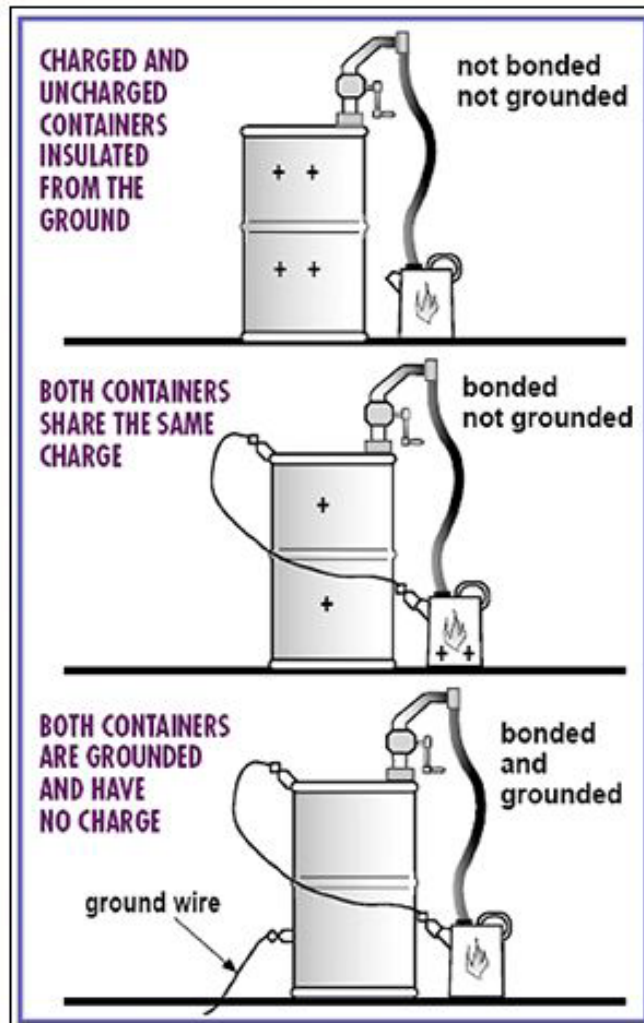
Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 °F (37.8 °C) must be bonded and grounded when transferring liquids in accordance with Code of Federal Regulations, 29 CFR 1910.106(e)(6)(ii) which states: “Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 °F (37.8 °C), shall not be dispensed into containers unless the nozzle and container are electrically interconnected. Where the metallic floorplate on which the container stands while filling is electrically connected to the fill stem or where the fill stem is bonded to the container during filling operations by means of a bond wire, the provisions of this section shall be deemed to have been complied with. “

## How to bond and ground?

- Assess and identify a safe location. Avoid poorly ventilated spaces, open flames or heat sources, such as hot plates or Bunsen burners, and electrically charged equipment.
- Transfer flammable liquids within a fume hood whenever possible and in a proper dispensing location such as a well-ventilated lab space or a high hazard/flammable room.
- Use proper bonding and grounding cables: plastic coated 10' coiled grounding cable (see picture on the left) with clamps on both ends or braided 3' bonding cable with alligator clips on both ends work well.
- Find an earth ground (copper water lines work well) and label it for future reference.
- Remove dirt, debris, paint, etc., to ensure a good metal to metal connection.
- Connect the dispensing vessel to the earth ground.
- Place receiving vessel in secondary containment or on a bonding metallic floorplate.
- Connect the bonding cable from the receiving vessel to the dispensing vessel or floorplate (from metal to metal). You may use a grounding rod if the receiving container is too small, doesn't have a metal connection or metal floorplate is not available.
- Please check if properly connected, then proceed with your transfer.
- When transfer is completed, disconnect all bonding and grounding cables. If applicable, remove the grounding rod as well.
- Clean all equipment and properly transport the material to another location if applicable.
- The bonding and grounding equipment should be readily available for the next person.



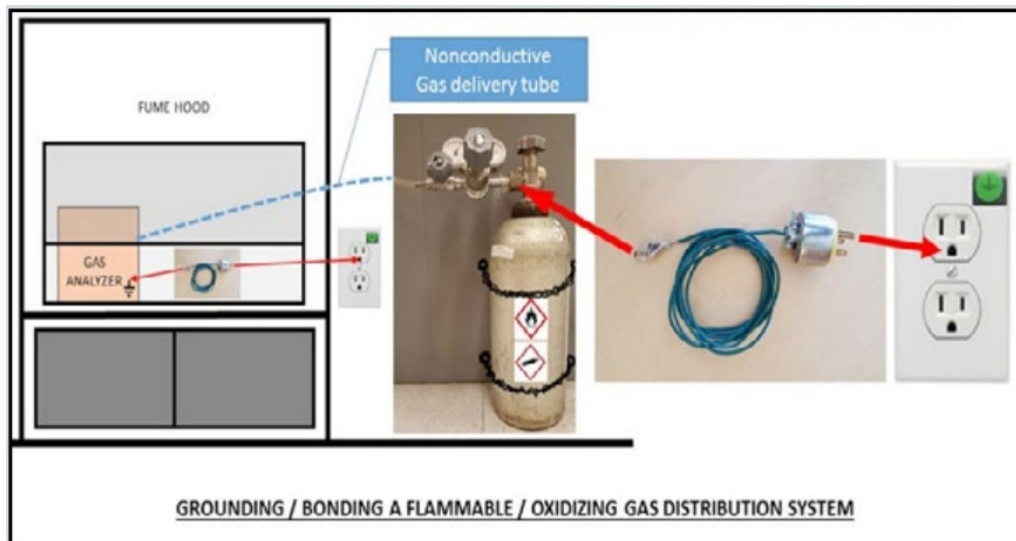
### Bonding and Grounding configuration for transferring flammable liquid



### Should flammable gas systems be grounded and bonded?

Yes, flammable gas systems should be grounded and bonded. Piping and gas bottles should be protected from static charge buildup. Bonding and grounding could also be done with grounding cable and bonding jumpers. Please find the picture below as the example for bonding and grounding for flammable gas distribution within a fume hood.

OSHA 1910.103(c)(1)(x) also requires that the liquefied hydrogen container and associated piping shall be electrically bonded and grounded.



Source: [https://www.ucop.edu/safety-and-loss-prevention/\\_files/safety-spotlight/August-2017-Safety-Spotlight-Poster.pdf](https://www.ucop.edu/safety-and-loss-prevention/_files/safety-spotlight/August-2017-Safety-Spotlight-Poster.pdf)

### Do all containers have to be bonded or grounded?

Only those containers that conduct electricity, such as those made from metal or conductive plastics, need to be bonded. If a container is made from a material that does not conduct electricity, such as polyethylene plastic or glass, bonding or grounding may not be necessary.

#### References and more information:

1. OSHA, 1910.106 - Flammable liquids. <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.106>
2. Canadian Centre for Occupational Health and Safety, How to work safely with – Static Electricity.

[https://www.ccohs.ca/oshanswers/prevention/howto/flammable\\_static.html](https://www.ccohs.ca/oshanswers/prevention/howto/flammable_static.html)

3. UC San Diego, Flammable and Combustible Liquids Storage Requirements. <https://blink.ucsd.edu/safety/research-lab/chemical/liquids/storage/>
4. University of Washington, EH&S, Grounding and Bonding. <https://www.ehs.washington.edu/system/files/resources/grounding-bonding-focus-sheet.pdf>
5. UCOP, Safe Flammable Liquid and Gas Transfers in Lab-Scale Quantities. [https://www.ucop.edu/safety-and-loss-prevention/\\_files/safety-spotlight/August-2017-Safety-Spotlight-Poster.pdf](https://www.ucop.edu/safety-and-loss-prevention/_files/safety-spotlight/August-2017-Safety-Spotlight-Poster.pdf)