

## Static Electricity, Bonding and Grounding

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# Safety Tips from the WorkSafe People

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## Static Electricity

- Electricity is the flow of free electrons
- Electrons are one of the basic components of all matter
- A buildup of electrons on objects insulated from their environment and each other results in a positive or negative charge
  - Objects with extra electrons are given a negative charge
  - Objects that have lost electrons are given a positive charge
- Static electricity is formed when the electricity is trapped or prevented from escaping the surface of a nonconductive body and is usually generated by friction through the physical contact and separation of dissimilar materials
- Electricity on a conducting body — in contact with only nonconductors — can also be classified as static electricity

## Types of Static Charge Transfer

- There are two processes involved with static charge transferred from one surface to another:
  - **Induction** — physical contact is not necessary between objects to transfer electrical charge
  - **Conduction** — physical contact is necessary between objects to transfer electrical charge
- Examples of placing a charge on a surface include:
  - Collecting a falling stream of pulverized material or liquid poured from a faucet — the stream is charged by separation
  - Bombardment of a surface with air molecules — charged from exposure to a high-voltage electrode
  - Charge injection results when an object or fluid is exposed to an electron beam or it moves around a high-voltage electrode
- Static electricity is present at every interface, and therefore cannot be absolutely prevented
- Static correction provides a means for separate charges to recombine harmlessly before the sparking potential is reached

## Generators of Static Electricity

- Static electricity is produced as the result of motion — involving the pulling apart of contacting surfaces that are made up of different types of material.
- Common industrial examples of this separation movement include:
  - Motion resulting in friction between contacting surfaces made up of unlike materials (usually dissimilar liquids or solids)
  - Air and gas streams containing particulate matter, as well as steam containing moisture (coming from a pipe or hose opening)
  - When a stream of liquid is separated from contact with a hose, faucet, or pouring spout
  - Pulverized material moving through chutes or pneumatic conveyors
  - The motion of nonconductive power or conveyor belts
  - Vehicles in motion

## Static Electricity Ignition Sources

- Potential fire or explosion hazards exist when the following four conditions are met:
  - Static electricity is generated
  - There exists a way to accumulate and maintain separate positive and negative electrical charge potential
  - An adequate discharge of energy has occurred
  - The discharge occurred in an ignitable mixture
- The ability to ignite a flammable mixture depends on the amount of energy transferred to the mixture, which will be only a part of the total stored energy available

## Reduction of Static Electricity Ignition Sources

- Eliminate ignitable mixtures from the area where sparks of static electricity may occur
- Relative humidity of 50% or higher may minimize static problems when objects are made up of substances like paper or wood, which can reach equilibrium with the atmosphere
- High relative humidity will not eliminate static charges for objects that have heated surfaces, or are made up of oils
- Properly bond and ground to balance and dissipate the static charge

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## **Bonding**

Bonding wires are used to connect objects together. The same effect may be achieved through direct contact between the two objects, as long as nothing interferes with the contact, such as paint or coating.

- Bonding is the process of joining two or more conductive objects together by a conductor
- Bonding minimizes the potential charge differences between two or more objects
- Bonded objects must also be grounded to dissipate the static charge
- Bond the container before opening, and close the container before disconnecting the bonding wire

## **Grounding**

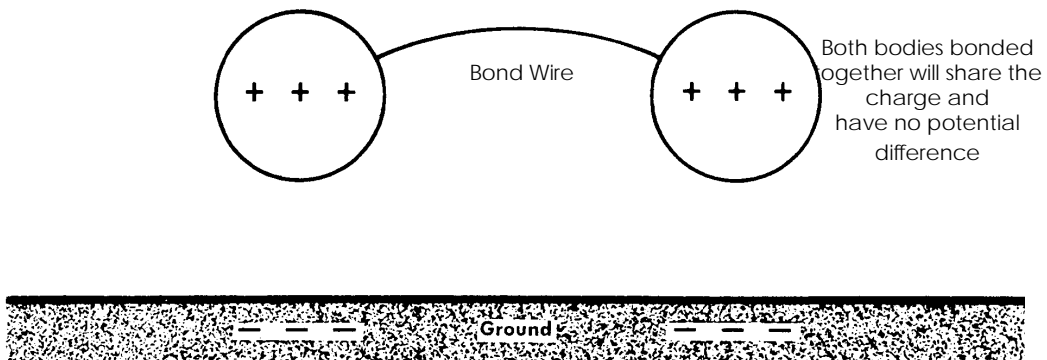
Grounding or “earthing” is a special bonding process — connecting one or more conductive objects to the earth or any large metal structure associated with a building.

- Grounding minimizes the potential charge difference between two or more objects and the ground
- The conductive materials suitable for bonding and grounding must have:
  - Adequate mechanical strength
  - Corrosion resistance
  - Flexibility for the intended use
- Solid conductors may be used for fixed connections
- Flexible conductors may be used when connecting and disconnecting happens frequently
- Connections may be made with pressure-type ground clamps, brazing, or welding to ensure metal-to-metal contact
- Check electrical continuity in all bonding and grounding systems regularly
- Metal-to-metal connection must be maintained between the bonding and grounding cables and the containers
- Remove all paint, dirt, and rust from the connecting area

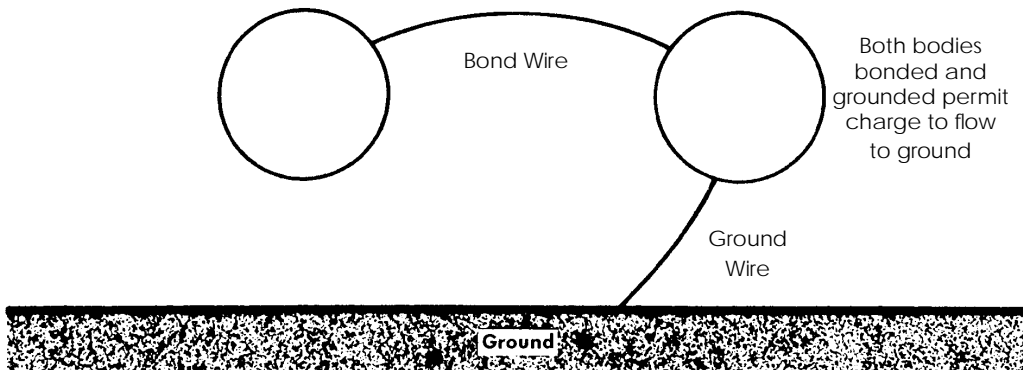
**Charged and Uncharged Bodies Insulated from Environment**



**Both Insulated Bodies Share the Same Charge**



**Both Bodies Are Grounded and Have No Charge**



## **Types of Bonding and Grounding Connections**

- There are two basic types of connections:
  - **Permanent connection** — solid or braided wires with either a screw-type clamp or welding
  - **Temporary connection** — only braided wires with spring-type or magnetic clamps
- Solid wire — a single complete strand of wire that is not very durable and should be used where handling is limited
- Braided wire — is made up of several strands of wire wrapped together which provides greater strength and flexibility

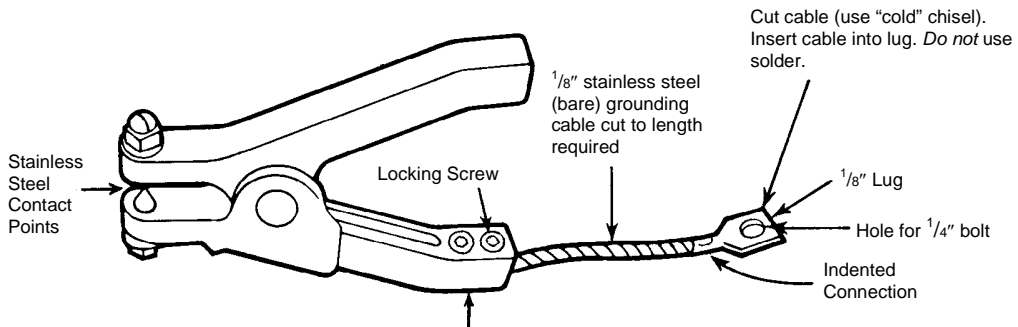
## **Dust and Powder Handling**

- Ground all conductive parts of equipment
- Ground all personnel — require them to wear proper clothing and footwear
- Use grounded equipment if powders are handled or processed in the presence of flammable gas or vapors

## **Liquid Handling**

- Transport liquid slowly from one container to another
  - When material is moved static, charge is generated
  - Permitting the liquid to come to rest equalizes the static charge
- Reduce the amount of spraying and splashing of the liquid
- Keep pumps, containers, and filters free of rust, dirt, and metal

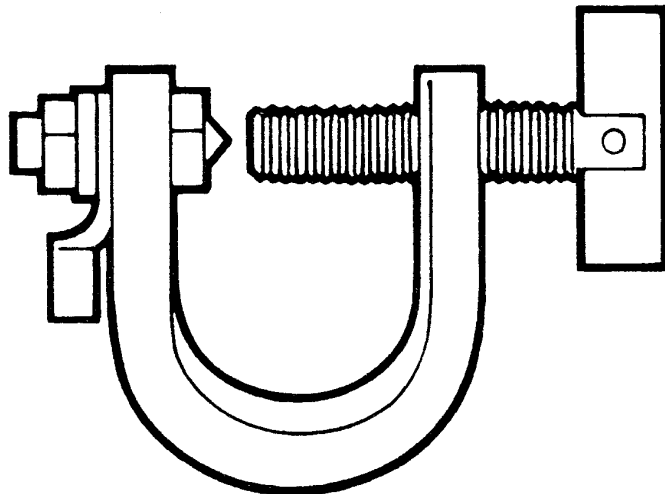
**Small Ground Clamp Standard Assembly**



Cut cable to length required (use "cold" chisel). Insert cable end into clamp and tighten locking screw until cable and clamp are securely locked together. *Do not* use solder or heat for this connection.

**Always Test for Ground Continuity**

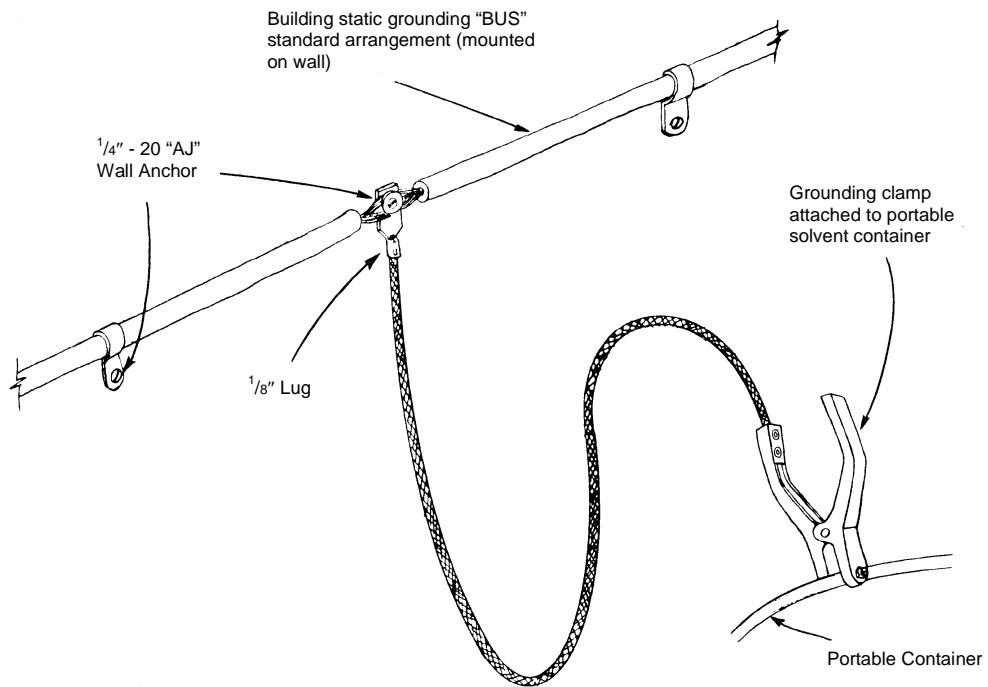
**Bronze Grounding Clamp**



Used for grounding solvent containers and drums.

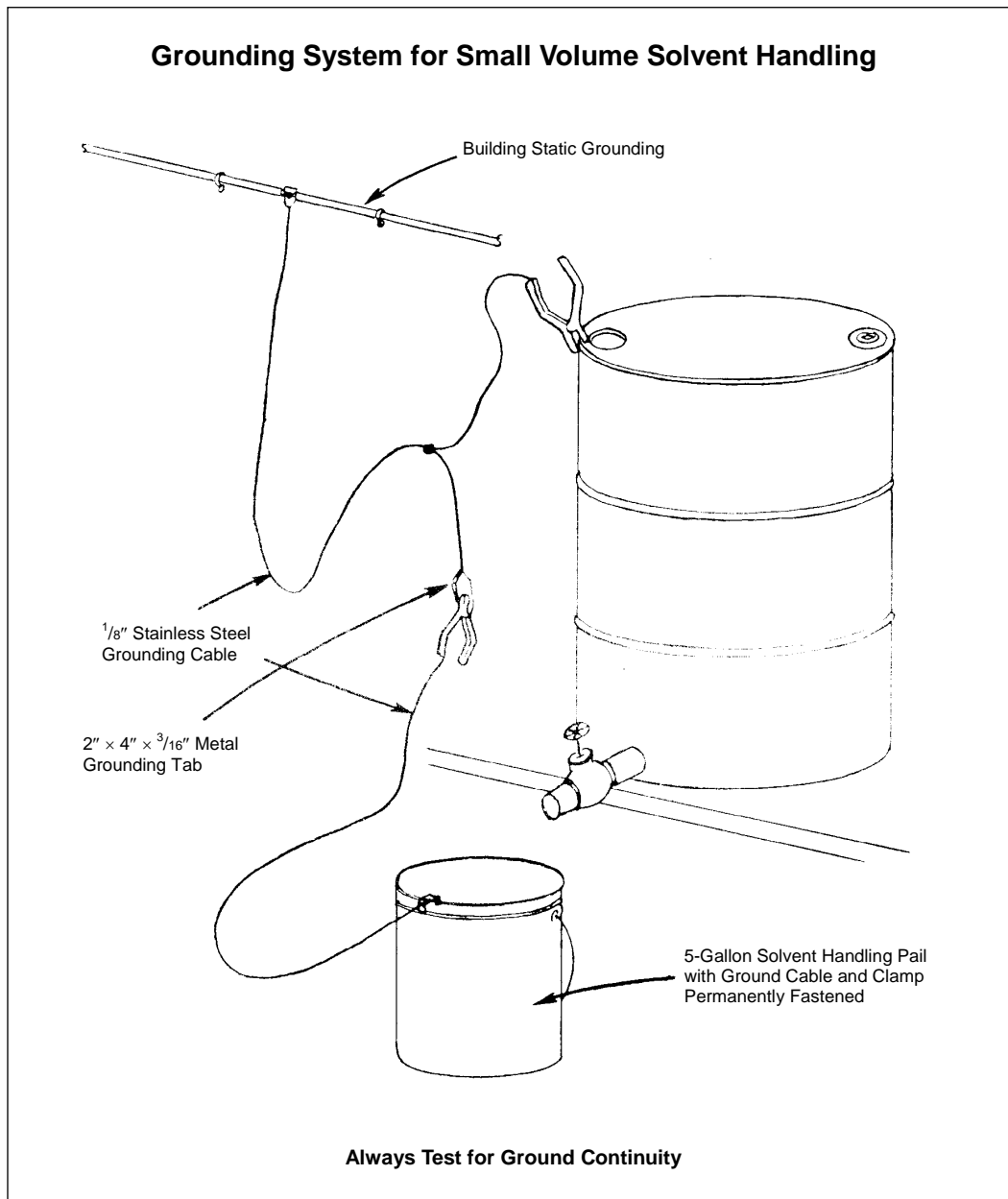
**Always Test for Ground Continuity**

## Extension to Portable Solvent Containers — Standard Assembly

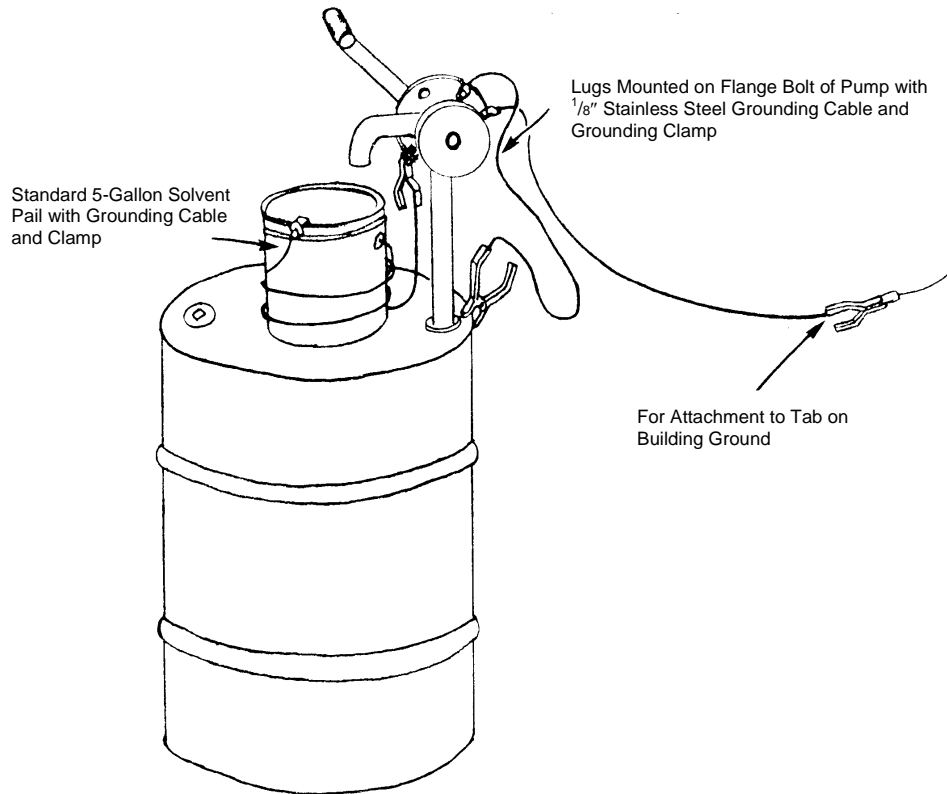


**Always Test for Ground Continuity**





**Grounding System for Small Volume Solvent Handling**



**Always Test for Ground Continuity**