

Bonding and Grounding of Flammable Liquid Containers

The terms "Bonding" and "Grounding" are sometimes used interchangeably because of a poor understanding of the terms. The terms are defined below:

Bonding - The process of connecting two or more conductive objects together by means of a conductor.

Grounding (Earthing) - The process of connecting one or more conducting objects to the ground, and is a specific form of bonding.

The words Bonded or Grounded must be understood to mean either that a bond or ground as defined has been deliberately applied, or that an electrically conductive path having a resistance adequately low for the intended purpose is inherently present by the nature of the installation.

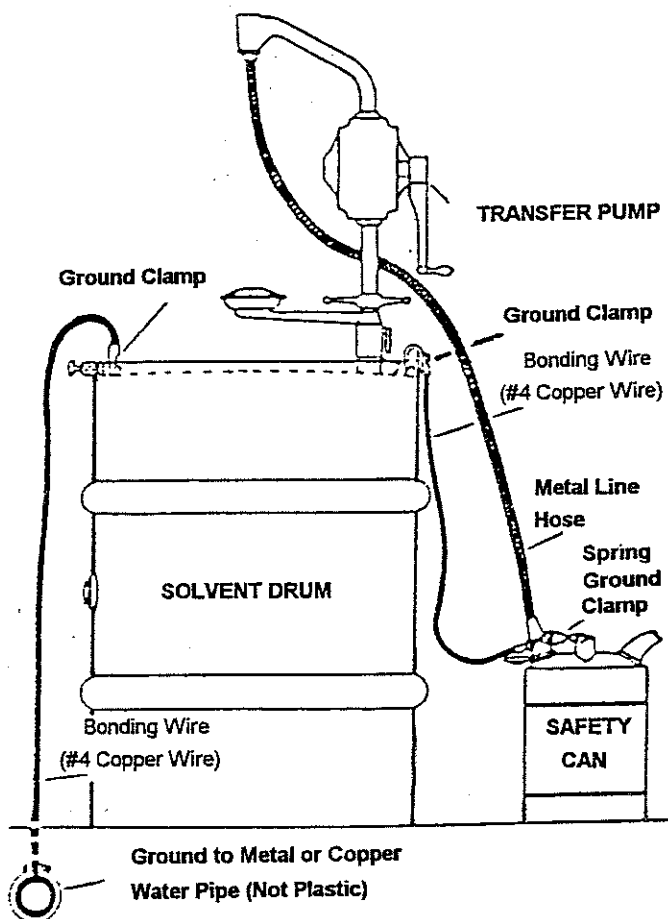
STATIC ELECTRICITY

Static electricity is generated by the contact and separation of dissimilar material. For example, static electricity is generated when a fluid flows through a pipe or from an orifice into a tank. The principal hazards of static electricity are fire and explosion caused by spark discharges containing enough energy to ignite flammable or explosive vapors, gases, or dust particles. Also, a worker could be injured because of an involuntary reaction caused by static spark shock.

There is great danger from a static spark where a flammable vapor may be present in the air, such as the outlet of a flammable liquid fill pipe, at a delivery hose nozzle, near an open flammable liquid container, and around a tank truck fill opening or barrel bung hole. When the potential for static charge is present, a spark between two bodies can occur because there is not a good electrical conductive path between them.

Hence, grounding or bonding of flammable liquid containers is necessary to prevent static electricity from causing a spark. The connections must be precisely made after consulting *NFPA 77, Recommended Practice on Static Electricity*, for details.

Where dangerous static conditions exist, measures appropriate to bring the hazard under reasonable control are humidification, bonding, grounding, ionization, or a combination of these methods. This reference material only addresses bonding and grounding.



If a good electrical connection is known to exist from the drum to the can through a metal lining and nozzle of the hose, the bonding cable between the drum and the container is not needed.

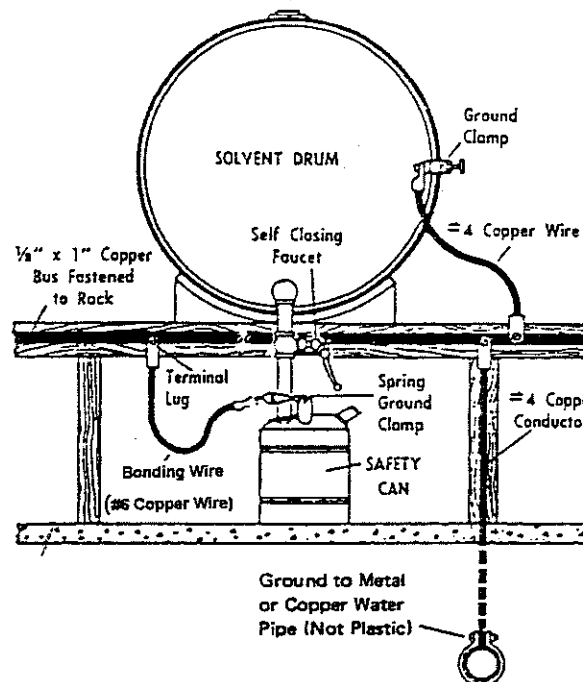
BONDING AND GROUNDING

When two objects are bonded, the charges flow freely between the bodies and there is no difference in their charge.

Although bonding will eliminate a difference in potential between the objects that are bonded, it will not eliminate a difference in potential between these objects and the earth unless one of the objects possesses an adequate conductive path to earth. Therefore, bonding will not eliminate the static charge, but will equalize the potential between the objects bonded so that a spark will not occur between them.

An adequate ground will always continuously discharge a charged conductive body and is recommended as a safety measure when any doubt exists concerning a situation or when a governing authority requires it.

To avoid a spark from discharge of static electricity during flammable liquid filling operations, a wire bond should be provided between the storage container and the container being filled, unless a metallic path between the two containers is otherwise present.



BOND AND GROUND CONDUCTORS

Bond wires and ground wires should have adequate capacity to carry the largest currents that may be anticipated for any particular installation. When currents to be handled are small, the minimum size of wire is dictated by mechanical strength rather than current carrying capacity. The currents encountered in the procession against accumulations of static electricity are in the order of microamperes (one millionth part of an ampere).

The acceptable resistance in a ground connection depends upon the type of hazard for which it is intended to give protection. To protect electrical power circuits, the resistance must be low enough to ensure operation of the fuse or circuit breaker under fault conditions. Any ground that is adequate for power circuits or lightning protection is more than adequate for protection against static electricity.

A bond or ground should be composed of suitable conductive materials having adequate mechanical strength, corrosion resistance, and flexibility for the service intended. Since the bond or ground does not need to have low resistance, nearly any conductor size will be satisfactory from an electrical standpoint. Solid conductors are satisfactory for fixed connections. Flexible conductors are used for bonds that are to be connected and disconnected frequently. Conductors may be insulated or uninsulated. Some prefer uninsulated conductors so that defects can be easily spotted by visual inspections. If insulated for mechanical protection, the concealed conductor should be checked for continuity at regular intervals, depending on the inspector's experience. Connections may be made with pressure type ground clamps, brazing, or welding. Battery clamps, magnetic, or other special clamps provide metal to metal contact.

GROUND ALL CONTAINERS FOR EXTRA SAFETY

In the handling of containers of flammable liquids having high electrical resistance and low flash points, possible loss of life, loss of property and interruption to business can be greatly minimized by effective grounding and bonding of the containers.

The two illustrations show an effective method of preventing static accumulation by grounding drums to a water pipe or other low resistance ground, and bonding the drums to small containers during filling operations.

NOTE: NFPA 77 is the definitive reference on this subject. This information is intended only to advance the basic concepts of Bonding and Grounding.