	OFFICE OF STATE FIRE MARSHAL *REGIONAL HAZARDOUS MATERIAL EMERGENCY RESPONSE TEAMS* **STANDARD OPERATING GUIDELINES**	**Number: T023** **Adoption Date:** January 12,2005 **Review/Revision Date:** April 5, 2005

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SUBJECT: **Grounding and Bonding**

OBJECTIVE: **Determine the need for, and properly apply, grounding and bonding of containers in a hazardous materials incident.**

I. Scope

This guideline address procedures, techniques, and methods used in the mitigation of hazardous materials situations. It is expected that grounding and bonding methods will be used by qualified personnel with full observance of established safety procedures.

II. General

Grounding and bonding should be used in control of the hazardous effects of the materials involved.
More than one procedure or technique for grounding or bonding may be needed depending on the dynamic of the call.

III Definitions

Grounding - the process of connecting one or more conductive objects to the ground through an earthing electrode (i.e., grounding rod); it is done to minimize potential differences between objects and the ground.

Bonding -the process of connecting two or more conductive objects together by means of a conductor; it is done to minimize potential differences between conductive objects, thereby minimizing or eliminating the chance of sparking.

Resistance - the difficulty an electrical current encounters in passing through an electrical circuit or conductor.

Ohmmeter - used to measure the electrical resistance and ensure the electrical continuity of grounding and bonding operations.

IV Grounding and Bonding Considerations

The generation and accumulation of static charges during the transfer operation must always be considered. In order for static electricity to be a source of ignition, four conditions must be satisfied:

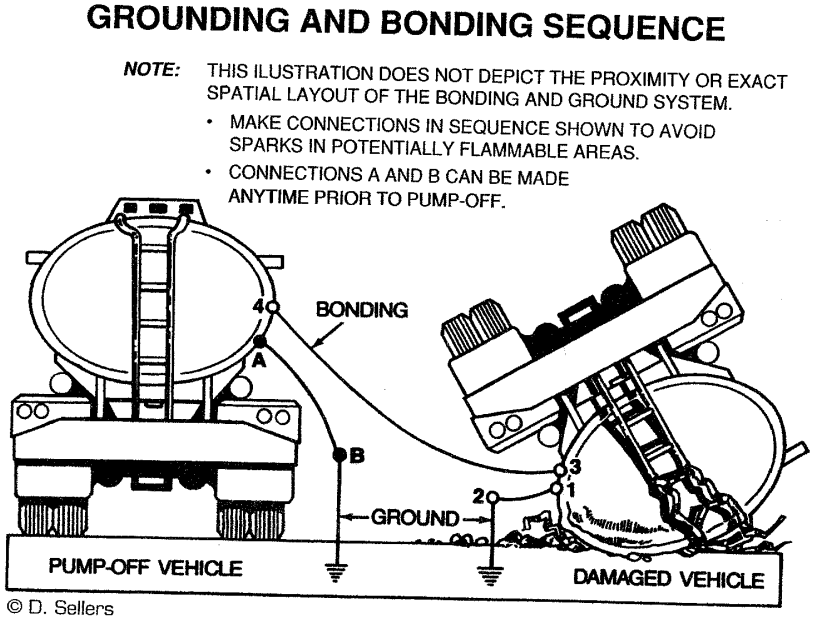
1) There must be an effective means of static generation, such as when flammable and combustible liquids are pumped through hose lines, are agitated, or fall freely through the air;
2) There must be a means of accumulating the separate charges and maintaining a suitable difference of electrical potential;
3) There must be a spark discharge of adequate energy; and
4) The spark must occur in an ignitable mixture.

To minimize the potential of a flash or explosion during transfer operations, this static build-up must be controlled through grounding and bonding.

V. Grounding and Bonding Sequence

The container must be grounded and bonded before product removal and transfer operations begin. Consider the following operational guidelines:

1) The area should be monitored to determine the concentration of flammable vapors. If the concentration is at or near the lower explosive (LEL), corrective action will required prior to transfer operations commencing.
2) The pump and all pump-off appliances, such as hose couplings, downspouts, and recovery pans and "stingers" should all be bonded by connecting a bonding cable from the container to the appliance. In all appliance bonding operations, the first connection must always start at the damaged unit.
3) Bonding cables must be placed on a clean, grease-free, paint-free surface. Cables with C-clamps are preferable to cables with "alligator" because they make better connections. At least five (5) 50-foot sections of 1/8-inch stainless steel grounding cables are suggested.
4) Grounding cables should initially be connected to the damaged container,



and then moved outward away from the overturned vehicles. The final connection can be made to a guardrail post, telephone or electrical pole support rod, providing it's deep enough to carry away the charge. Fire hydrants should not be used due to coating on the ductile iron pipe.

5) Grounding rod options include auger-type t-handle grounding rods or a 4-6 foot copper grounding rods.
6) The ohmmeter should be used to check the resistance to all connections. Readings should be 25 ohms or less.
7) Periodically monitor all bonding and grounding cable connections to ensure that they remain in-place and connected. To enhance operational safety, some response teams will sometimes provide double connections from the damaged container to ground.

VI. How to Improve the Grounding Field

The condition of the grounding field can be "assisted" by doing certain things to the soil. However, these enhancements should be discussed with environmental authorities first because they involve use of chemicals.

1) Use water while inserting the rod into the ground. This will lower the resistance to the earth.
2) Use a salt to decrease the amount of resistance. Two salts that are used are copper sulfate and sodium carbonate.
3) Use common "rock" salt. This probably the most readily available chemical. Remember- check with the environmental authorities first!

VII. How to Check the Grounding Field

This is done using an instrument called an earth resistance tester. The one we use is called a "Megger", manufactured by the James G. Biddle Company. Be aware that the "Megger" is not intrinsically safe, and that it actually generates electricity when it is used for checking the grounding grid. This particular instrument operates by sending electrical current out to the electrodes placed in the earth and then reads the resistance on an ohmmeter. The method used at the Transportation Test Center (TTC) is the "Three terminal" earth resistance test (also called the "Fall of Potential" test). The rod being tested is placed in the earth at the depth wished. The "Megger" is then connected to the ground rod, as well as a separate field at specified distances from the Megger by wires to the terminals on the Megger. There are three or four terminals on the instrument, depending on Megger model. C represents current and P represents Potential. In straight lines from the earth rod being tested, additional rods included with the tester are driven into the ground at 45 and 90 feet from the instrument. The Megger should be approximately 10 feet from the ground field being tested, thus the field being tested is 55 and 100 feet from the two reference rods. The cable going to the rod 90 feet away is connected to the P2 terminal. The C1 and P1 terminals are jumpered together and the ground field cable is then attached to the jumpered C1P1 terminal. When the Megger's generator is activated, we then measure amps and volts and then the meter will measure the resistance (ohms). The distances are based on Ohm's Law.

Credits:
Gasoline Tank Truck Emergencies, guidelines and procedures 2nd Edition

Grounding and Bonding, manual Association of American Railroads
1. Bonding Cable from Leaking vehicle/vessel to Receiving vehicle/vessel.