	<p align="center"><b>OFFICE OF STATE FIRE MARSHAL</b></p> <p align="center"><i>EMERGENCY RESPONSE UNIT</i> <i>Regional Hazardous Materials</i> <i>Emergency Response Teams</i></p> <p align="center"><b>STANDARD OPERATING GUIDELINES</b></p>	<p><b>Number: SOG-T023</b></p> <p><b>Adoption Date:</b> January 12, 2005</p> <p><b>Review/Revision Date:</b> February 27, 2018</p>
<p>OSFM Approved: <u>Michael D. Hoff</u> Date <u>4/2/18</u> Michael Heffner, Emergency Response Manager</p>		<p><u>Jamie Kometz</u> Date <u>4/2/18</u> Jamie Kometz, RHMERT Program Coordinator</p>
<p><b>SUBJECT:            Grounding and Bonding</b></p> <p><b>OBJECTIVE:        Determine the need for, and properly apply, grounding and bonding of containers and equipment in a hazardous materials incident.</b></p>		

**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.

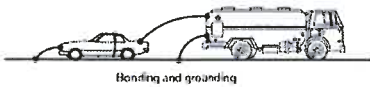
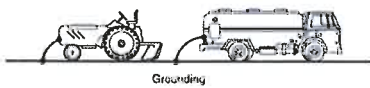
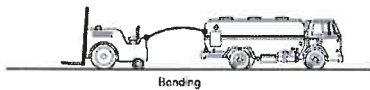
**II.    General**

Grounding and bonding should be used to control the hazardous effects of the materials involved and is used to control the likelihood of a static ignition. More than one procedure or technique for grounding or bonding may be needed depending on the dynamics of the call.

**III.   Definitions**

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

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



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

Ohmmeter – A tool used to measure the electrical resistance and confirm the electrical continuity of grounding and bonding connections.

Grounding Rod – Four to six feet of copper or auger-type t-handle rod

Grounding and Bonding Cable – Minimum (10) 1/8-inch stainless steel cables of varying lengths are suggested. Cables should have a clamp that has hardened steel points that will penetrate paint, corrosion products, and accumulated material using either screw force or a strong spring.

#### **IV. Grounding and Bonding Considerations**

The safest way to establish an earth ground is to find an existing structure that has a low resistance to ground, like a fence or guardrail. Be aware that driving a six-foot rod into the ground may come in contact with buried utilities. If you must drive a rod, make every effort to identify a location with no buried utilities.

The generation and accumulation of static charges in a flammable environment must always be considered before beginning operations.

During the transfer of class 1 flammable liquids, Grounding and Bonding is required.

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 or 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 limit (LEL) of the product involved, corrective action will be required prior to transfer operations commencing.
- 2) Establish and test an earth ground utilizing an existing path (i.e. guardrail or chain link fence) or by use of a grounding rod(s) document that an earth ground has been established and the measured resistance. (See VII on how to establish an earth ground.)

- 3) Ground all containers and equipment. Grounding cables should initially be connected to the damaged container and then moved outward away from the flammable environment. The final connection should be at the earth ground.
- 4) Test all paths to ground utilizing an Ohmmeter. Total resistance must be less than 25 Ohms (earth ground + highest resistance to the earth ground).
- 5) Bond all containers and equipment together. Bonding cables must be placed on a clean, grease-free, paint-free surface.
- 6) 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 grounding field can be improved with water and rock salt. If high resistance is encountered, first try adding water to the field. If this does not improve the field, add rock salt and retest.

## **VII. How to Check the Grounding Field**

This is done using an instrument called an earth resistance tester. Oregon State Teams use a “Megger.” Be aware that the “Megger” is not intrinsically safe, and that it actually generates electricity when it is used for checking the ground. An existing earth ground is identified or the rod being tested is placed in the earth. The “Megger” is then connected to the ground rod, as well as a separate field at specified distances from the “Megger” by wires connected to the terminals on the back of the “Megger” (Fig. 1). Without crossing, the RED and YELLOW wires should fall in a straight line from the meter parallel to each other, approximately one foot apart. When the “Megger’s” generator is activated, it measures a resistance value for the earth ground being tested.

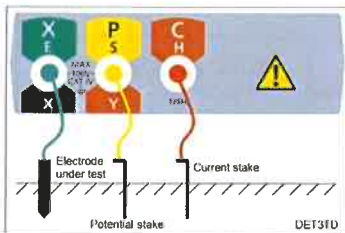


Figure 1

### **Credits:**

Gasoline Tank Truck Emergencies, guidelines and procedures 2<sup>nd</sup> Edition

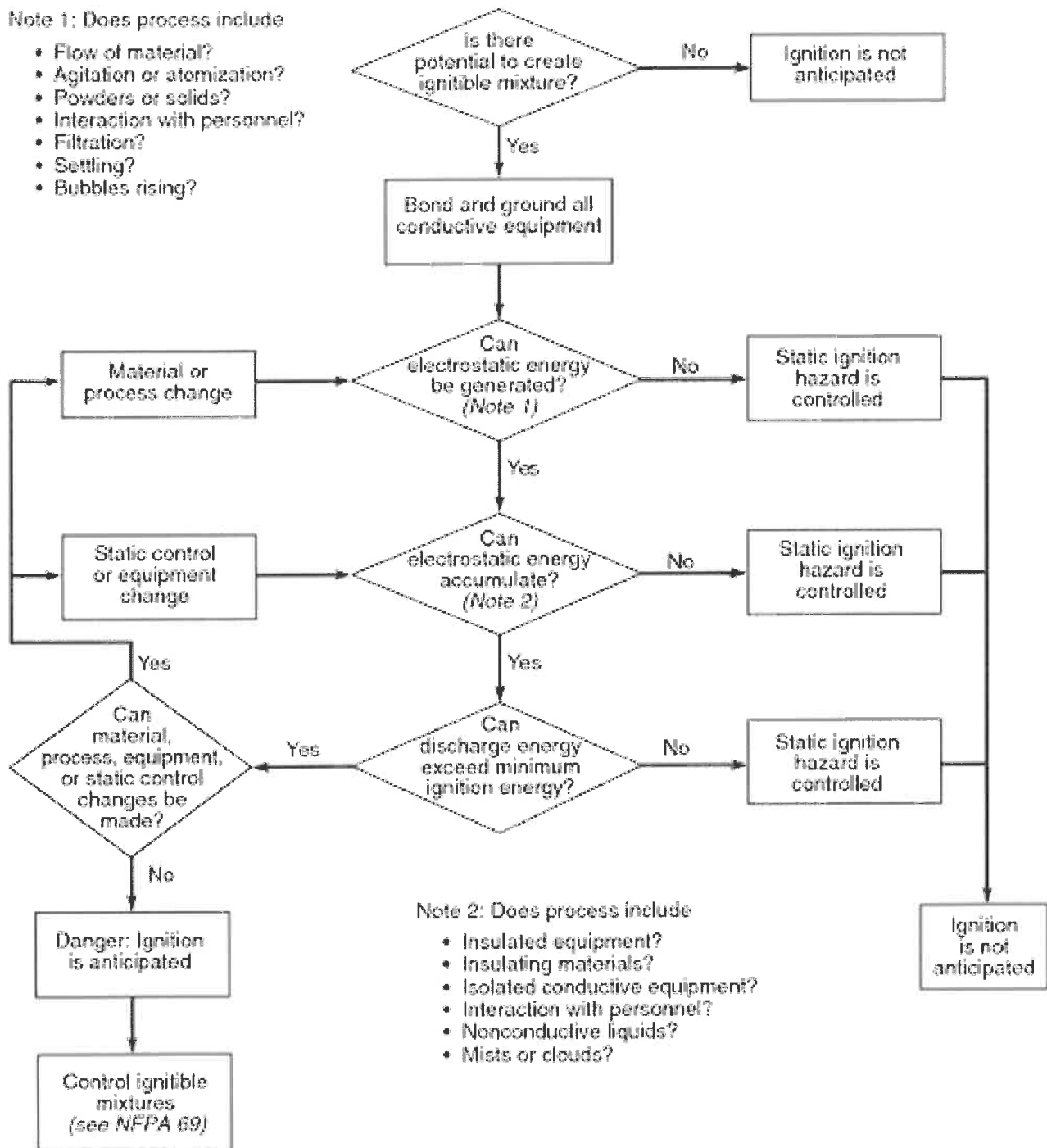
Grounding and Bonding, Manual Association of American Railroads

1. Bonding Cable from Leaking vehicle/vessel to Receiving vehicle/vessel

NFPA 77

Note 1: Does process include

- Flow of material?
- Agitation or atomization?
- Powders or solids?
- Interaction with personnel?
- Filtration?
- Settling?
- Bubbles rising?



Note 2: Does process include

- Insulated equipment?
- Insulating materials?
- Isolated conductive equipment?
- Interaction with personnel?
- Nonconductive liquids?
- Mists or clouds?