



T and D - Inspect, Use and Maintain Bond Mats

Standard
Operating
Procedure

Table of Contents

TABLE OF CONTENTS	1
1.0 PURPOSE	2
2.0 ROLES AND PREREQUISITES	2
3.0 TOOLS AND EQUIPMENT	2
4.0 PROCEDURE	2
5.0 COMPONENTS	8
6.0 ACRONYMS, DEFINITIONS AND SYMBOLS	9
7.0 POLICIES AND REGULATORY REQUIREMENTS	10
8.0 REFERENCES	11



T and D - Inspect, Use and Maintain Bond Mats

Standard Operating Procedure

1.0 Purpose

This SOP provides:

- A standard for the proper way to inspect, use and maintain bond mats in the field

2.0 Roles and Prerequisites

Role(s)	Quantity Required	Prerequisites
Qualified Electrical Worker	1 or more	1. Bonding & Grounding Training 2. Clear understanding of the information contained within this SOP

3.0 Tools and Equipment

Minimum Tools and Equipment Required:

- Bond Mat(s)
- Mild Soap and Water
- Rag(s) for cleaning
- Wire brush
- Bonding Leads
- 4 way lug connector (for connecting multiple bond mats)

4.0 Procedure

The Procedure

NOTE: The following requirements shall be met prior to the start of the procedure:

- Complete Hazard/Aspect and Risk Assessment (HARA)
- Applicable Personal Protective Equipment (PPE) is available and in good condition
- Consider Environmental Best Management Practices

1.0 Characteristics of a Bond Mat

1.1 Important Considerations when using a Bond Mat

- *Bond Mat is **NOT** to be installed as part of a trip circuit*
- *Bond Mat is **NOT** to be used as a current carrying jumper*
- *Bond Mat is a tool to be used in conjunction with bonding and grounding procedures to create equipotential zones*
- *Bond Mat may become slippery when wet or snow covered*
- *Bond Mat to be used as per manufacturer's instructions*
- *Bond Mat must be visually inspected before every use*

- While accessing and exiting the Bond Mat the Worker must understand the dangers involved. You are bridging 2 zones. If a Worker must enter or exit the Bond Mat, while it is in use, it is recommended to use an insulating mat. If an insulating mat is not available this must be done as quickly as possible to limit the time of exposure to possible step potential or take other steps to reduce the risk.
- While working on the Mat all Workers, Equipment and Tools MUST be completely on the Mat and MUST remain on the Bond Mat while work is being done
- If the ground is uneven you may place the Bond Mat on top of plywood but ensure the Mat extends beyond the plywood surface so no one gets confused about where the Bond Mat ends.
- A worker on the mat must not exchange tools or material with someone not on the mat as this violates the Equipotential Zone

WARNING - Where it is known that induction is a serious problem, consideration should be given to the erection of a double barrier around the Bond Mat, with restricted access to the inner bond mat area over an insulating mat. The double barrier prevents contact between a person or object inside the mat area with outside the mat area. (reference 6.1.9 Earth Mat – IEC TR61328)

2.0 Explanation of the Benefit of Using a Bond Mat

2.1 Bond Mat Use

- In Figure 1 below, the worker (2) stands directly on the ground and in effect completes the circuit. Current flow from the source (1) flowing directly through the worker to ground, creates a potentially fatal situation

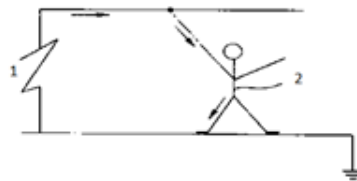


Figure 1

- In Figure 2 below, however, the worker (2) is standing on the bonding mat (3) installed according to the approved work methods, which is connected in the circuit with the power source (1). The current flow is therefore mostly through the ground lead and mat, notwithstanding the fact that the body of the worker is at full potential
- In this situation, however, the worker is safe from harm

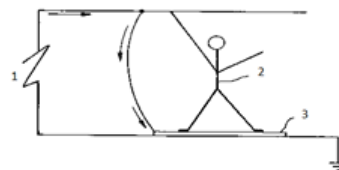


Figure 2

3.0 Care and Maintain Bond Mats

3.1 Proper Care and Maintenance of Bond Mats

- *Bond mats are subject to all kinds of dirt and moisture during the use in the field. It is important to clean after each use to be able to see if there is any obvious damage or wear to the mat or the conductive grids*
- *Clean with a mild soap and water (No harsh chemicals to be used. Dish soap is acceptable)*
- *Clean the bond connection points with a wire brush*
- *Store in a clean dry location or container*
- *It is best to roll up the bond mat for storage when possible. This reduces the wear that can happen when they are folded the same way repetitively (Can cause creases and possibly break the conductive grid within the mat)*

4.0 Bond Mat Use in Stations

4.1 Examples for possible use in stations

- *Operating the Insulated/Non-Insulated power mobile equipment in the station*
- *Depending on the integrity of the station grid and operating the boom from the ground the operator should be on a bond mat. Operator's feet must be at the same potential as his hands*
- *Degassifier or Mobile Substation outside the station fence in order to touch the vehicle a bond mat should be used or surround the degassifier with an insulating material*
- *Tool trailer (Accessible from station but parked outside station). Trailer powered by station power*
- *Hydro-Vac Operations. If using excavating equipment in the station - Operator's feet must be at the same potential as his hands. Refer to the Hydro-Vacuum SOP for full details*
- *Craning from outside to inside the station. (See figure #3 below)*
- *Splicing or repairing a cut grid conductor*
- *Working beneath or in proximity of the station grid*
- *Installing piles and other civil work*
- *When Station Grid Assessments have deemed a Station High Risk the Station will have a danger sign and Bond Mats will be used.*
- *Welding in a station - Welder should be using a bond mat when working on apparatus that is temporarily grounded and the insulating gravel is removed. If gravel is in place no bond mat is required. Protection for the Bond Mat can be utilized (plywood), making sure that the plywood*

protective cover is smaller than the mat to avoid Worker coming off of mat (Step Potential)

- *Drilling and working on ground wells - Bond mats must be used when working outside of the station grid.*

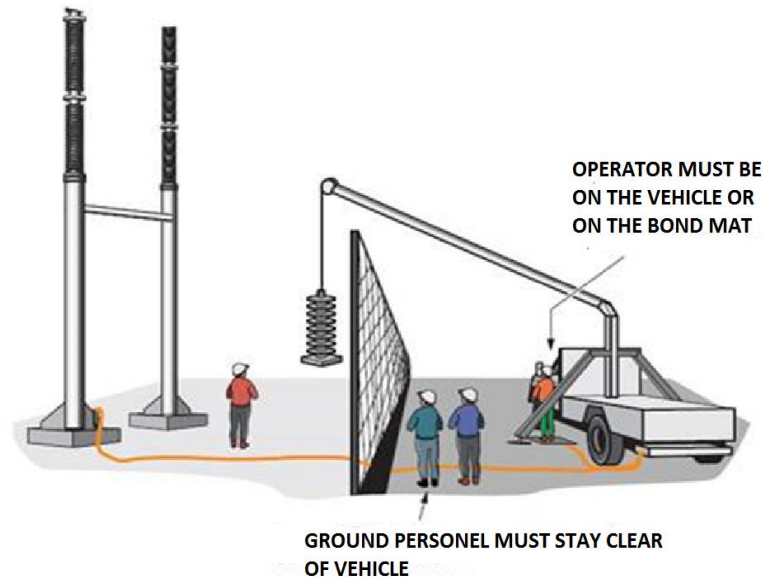


Figure #3 - Example - Moving Material From Outside Station to Inside

5.0 Bond Mat Use - Transmission & Distribution

5.1 Examples for possible use in the field:

- *U/G Switching Operations on Transformers and Switching Cubicles*
- *Opening or closing overhead switches*
- *Protecting workers with booms around power lines*
- *Bringing the PLT into the equipotential zone while performing ground duties*
- *On the ground overhead line splice*
- *Overhead conductor stringing operations*
- *Hydro Vac operations*



- The proper use of Bond Mat in these applications creates an equipotential zone just as a cluster bar does in overhead grounding practices.
- The mat can be utilized when repair work is to be done on the apparatus components in the **de-energized** state.
- Examples: Replacement of insulators , cleaning apparatus after a flashover etc.



- **Bond Mats can help eliminate step and touch potential.**
- **When operating a switch without a grounding platform connect it to the handle of an overhead switch and stand on it when opening or closing the switch.**

- *Figure # 4 below - If we were to splice this conductor on the ground it would involve placing a bond mat under the worker's feet that is bonded to the conductor that may become energized.*
- *This method eliminates the step or touch potential because the bond mat rises uniformly to nearly the same voltage as the line to which it is connected. This minimizes the voltage developed on the worker's body using a low resistance parallel path.*
- *A hidden hazard of this method is that the maximum step voltage is transferred from the Earth contact point to the edge of the bond mat. The worker must remain on the mat during a fault condition. If he steps off, he bridges the same 3 feet of voltage drop creating hazardous step potential.*
- *Where it is known that induction is a serious problem, the worker must take proper precautions such as using an insulated access point such as an insulated mat, rubber blanket or steps.*

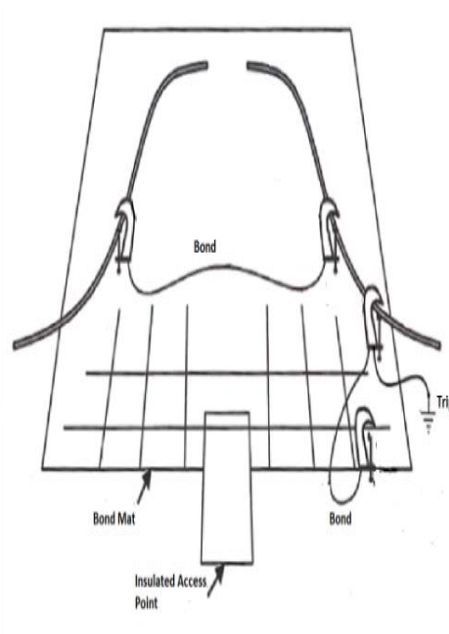


Figure #4 - Splicing overhead conductor on the ground

6.0 Inspection of the Bond Mat

6.1 Before Use Visual Inspection

- *Prior to every use perform a complete visual inspection of the bond mat.*
- *Any bond mats that do not pass the visual inspection as outlined below are to be tagged out and removed from service immediately.*

- *Inspection Procedure*
 - Visually inspect all exposed grid elements for signs of damage. (See Figure #5 below)
 - If any of the grid is completely severed, burned or scorched – replace with a new mat.
 - Normal signs of wear is acceptable, fraying but not severed
 - Visually inspect the carrier material and perimeter
 - Punctures or rips in the carrier material is not acceptable
 - Send to Apparatus Repair. They will repair if possible.
 - Normal signs of wear is acceptable
 - Visually inspect the thread around the perimeter of the bond mat.
 - Normal signs of wear is acceptable (1-2 missing threads caused by wear is acceptable)
 - If stitching comes loose and is a tripping hazard get mat repaired
- Note: if Bond mat has been subjected to a fault, whether or not there is noticeable burn marks, tag and remove mat from service immediately



• Normal signs of wear is acceptable



• Punctured, severed or missing braid elements are **not acceptable**

Figure #5 Types of Wear

7.0 Larger Equipotential Zone Required

7.1 How to create a larger zone for the worker(s)

- *First choice would be to get a larger mat, second choice, connect each mat to the conductor. If this is impossible, cascading (or joining together) two or more mats is easy with the connecting tab and hardware furnished with each mat.*



T and D - Inspect, Use and Maintain Bond Mats

Standard Operating Procedure

8.0 Testing

8.1 Requirements for Testing of Bond Mat

- *All testing of bond mats is to done by a Competent Worker who is trained in the criteria for testing bond mats*
- *Low Resistance Test*
 - *Checking the bond mat's integrity through a low resistance test*
 - *The values of which need to fall inside the manufacturer's specifications*
 - *See the applicable SOP*

5.0 Components

The following is a list of components for this SOP which can be accessed through the SOP System:

Component Name	Component Type	Component Description	Location of Component
N/A			

6.0 Acronyms, Definitions and Symbols

Acronyms and Abbreviations

PPE - Personal Protective Equipment

HARA - Hazard/Aspect and Risk Assessment

FRC - Fire Retardant Clothing

Definitions

Portable Bond Mat - A mat that creates an equipotential zone for the worker to stand on during various energized and de-energized work practices

Bond - Electrical connection which causes conductive parts to be at an equal potential

Grounding (Earthing) -

- Provision of a continuous path to the earth that has sufficient ampacity to carry any fault current that may be imposed on it.
- Has a sufficiently low impedance to limit the voltage rise above ground potential
- Facilitates the operation of the protective devices in the circuit as quickly as possible
- Bleeds any excess energies induced by electric and magnetic fields or static sources
- Equipotential Zone



T and D - Inspect, Use and Maintain Bond Mats

Standard
Operating
Procedure

- A work area, the bounds of which are set by the outermost point of conductive parts which are connected by an equipotential bonding or grounding system

Equipotential Zone - A work area, the bounds of which are set by the outermost point of conductive parts which are connected by an equipotential bonding or grounding system

Capacitive Coupling - Caused when isolated lines in parallel to or in close proximity to energized lines which act as a capacitor. Depending on the voltage and the phase orientation of the energized circuit a voltage can appear on an isolated line with no connection to ground.

Electromagnetic Induction - Caused by current flow in an energized line which produces current flow in a parallel isolated circuit.

When one ground is installed on an isolated power line that is in parallel to an energized power line carrying current, an open end voltage to ground is established on both sides of the ground point. This open-end voltage is determined by the current flow in the energized line, the separation between the two lines and the distance from the ground.

Note: when a single grounding point is used, there is no complete circuit in which the current can flow. In this situation, a worker touching the conductor may become the second grounding point. If two or more grounds are installed, circulating currents can be established.

Static Charge - Even in the absence of A.C. electric and magnetic fields, a charge can accumulate on isolated systems by such affects as D.C circuits, wind, cloud movement or solar flares. Grounding the isolated line or equipment will bleed off excess charge accumulation.

Step Potential - The difference in voltage level from one foot to the opposite foot. This can be felt when a worker steps across an energized path of earth. The worker forms a parallel path to the earth and current flows through the worker as well as the earth. This can result in harmful current levels in some situations.

- In the event of a fault to ground the voltage on the earth rises at the contact site but falls off sharply as the distance from the fault increases. This is because the resistance of the earth current path decreases as more of the earth is involved and the current can dissipate through a large cross section.

Touch Potential - The difference in voltage level between energized electric lines and the earth. This may be felt by a worker standing on the ground when the worker comes in contact with the electric lines or equipment and completes a parallel path to earth. The voltage may be supplied by a power system element such as a portable generator, or by unintentional energization or by induction, as noted previously.

Symbols

N/A



T and D - Inspect, Use and Maintain Bond Mats

Standard
Operating
Procedure

7.0 Policies and Regulatory Requirements

This SOP is a result of the following regulations, policies, industry standards, and corporate directives and standards:

Regulatory Requirement(s)

- Occupational Health and Safety Regulations 1996 - Section 465

Policies

- Hazard/Aspect and Risk Assessment Policy
- Personal Protective Equipment Policy
- Working Alone Policy

Standards

- Deviation from Safe Work Procedure Standard
- Personal Protective Equipment Standard
- Hazard/Aspect and Risk Assessment Standard

Other

- Safety and Environment Rulebook
- Environmental Best Management Practices

8.0 References

References

6.1.9 Earth Mat – IEC TR61328
CAN/ULC-S801-14
Field Inspection and Testing of Bond Mats SOP