NEW

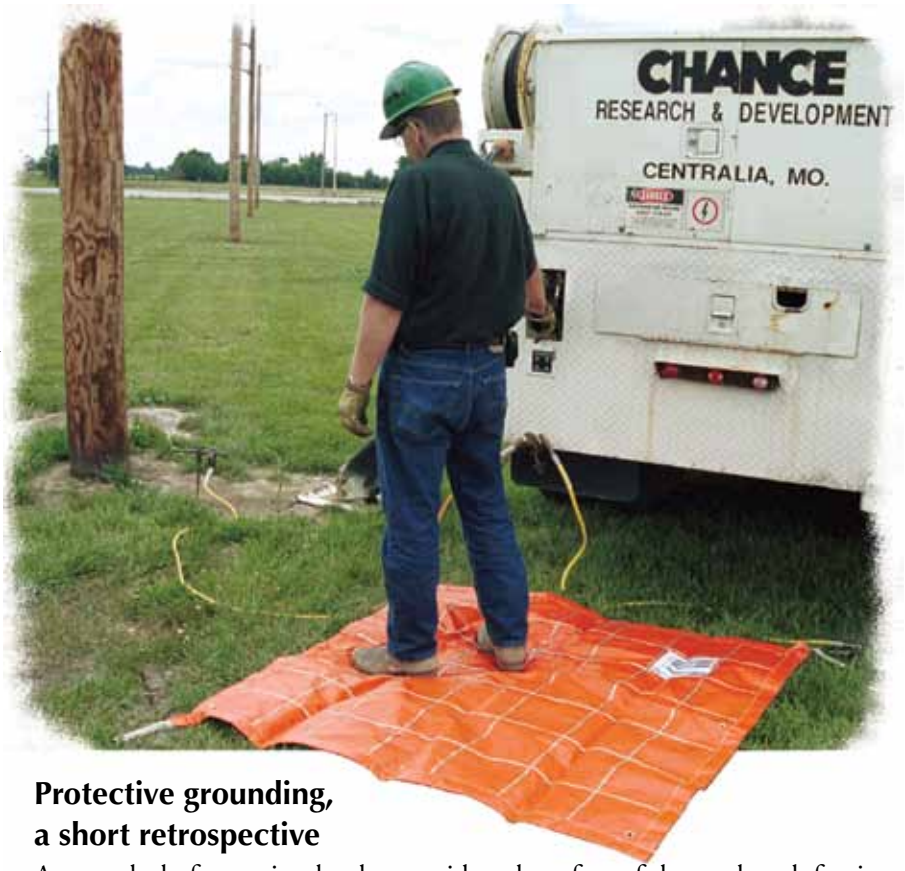
Equi-Mat™ Personal Protective Ground Grid

• Protective grounding for workers on ground level

Chance has a long history of successful products used for personal protective grounding. Now, Hubbell Power Systems is continuing that tradition. This introduction of another new product will further improve safe working conditions for line workers.

To establish a common ground for all readers, consider first a short review of the principles of worker protection using personal protective grounding, then the application of these principles to the worker at ground level and, finally, a device that provides protection to the worker on the ground.

Protection for the ground worker has long been missing in many cases. Now we have a product that addresses these workers.



Protective grounding, a short retrospective

A great deal of attention has been paid to the safety of the worker aloft, either on the pole or structure, or in the basket of a bucket truck. Over the years several different protection schemes have been used, and some have been found to be less than satisfactory. The latest method, single point or worksite grounding has had a lot of study and testing. Chance has been promoting this method since the 1970s. It now has been accepted by most utilities and also has been written into the OSHA guidelines.

The key to this method is the extremely low resistance path that is placed in parallel with the worker's body. One grounding jumper is the primary source of protection. Its purpose is to shunt the high level of fault current around the worker. It works because it keeps both the current through and the voltage across the body at a low level. That is, the hands and feet are at nearly the same voltage, i.e., an equipotential zone. Other jumpers in this method are used to protect the electrical system. Their purpose is to insure that the system sees a low resistance return path for the current back to its source. This forces the flow of a fault current so that it will be interrupted by the breakers or fuses that protect the system. For this reason, connections are made to a driven earth ground and/or the

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neutral, if one is present.

Protection overhead versus on-the-ground

Understanding the foregoing factors and the effects of electricity on the human body makes grounding protection somewhat straightforward for workers on overhead lines. To do so, we must know something about available fault current, worker resistance and the speed of operation of protective devices.

But what about workers at ground level? How do we protect them? And from what are we protecting them? Step potential and touch potential are the primary hazards.

Step potential is created when a fault current flows into the earth. The earth has resistance. Current flowing through a resistance creates a voltage drop. The worker's feet can span a voltage drop.

Touch potential is created when an energized element is connected to something near a remote worker by something conductive. It spans the distance between the energized part and the worker. For example, a digger-derrick boom gets into an energized line and a worker standing on the ground touches the truck. The truck now is at the line voltage. The worker's feet are near voltage zero and his hand touches the truck. He is the path to ground. This type of accident often is fatal.

Workers can be protected in both of these cases by using the same principle we discussed for the worker aloft: Maintain a low voltage drop across the body by keeping the hands and feet at nearly the same voltage. That is, by establishing an equipotential zone.

This technique has been used by utilities for many years, as grids or grillages buried under substations and beneath overhead-switch operating handles. They work, but are permanently installed and can't be moved from worksite to worksite.

Extended protection zone 'To Go'

Previously, there wasn't a reasonable solution for this portable protection. However, a product now is available that duplicates the substation grid, is portable and can be used to improve safe work conditions in a variety of work situations. The product is the EQUI-MAT™ Personal Protective Ground Grid from Chance/Hubbell Power Systems.

EQUI-MAT™ Ground Grid consists of a grillwork of flexible copper braid, both criss-crossing and around the perimeter of a durable mat. It's placed on the ground at a work site and connected to the de-energized system component that could become accidentally re-energized. A separate connection must be made as a low resistance fault current return path. These two are in parallel because the mat is not meant to carry fault current, rather to keep voltage across the worker at a low value. The sizing of these connections is less critical than the parallel jumper used for the worker at pole top, whose protection depends upon the resistance of the parallel path. While connections at ground level are less critical, they must be sized so they will not fuse during the flow of a fault current.

Easy-to-use, three sizes may be coupled

The mat comes in 5x5, 5x10 and 10x10-feet sizes. Terminals on two diagonal corners provide the means to connect to the de-energized part using the ground-

Human limits to the effects of electricity

Remember that some current will flow through every possible path and that even small levels of body current are dangerous. That is why the total resistance in parallel with the worker must be kept at an extremely low resistance value. By determining the maximum fault current that may flow at every worksite a crew services, one set of protective grounds can be developed to provide the protection needed at all sites. This eliminates the need to carry multiple sizes of grounds on a single line truck.

With the approximate fault current at the worksite and the worker's body resistance known, we can calculate the maximum parallel resistance needed to protect the worker. It's basically a simple parallel circuit.

The least current an average man can feel is 1.1 milliamperes. The threshold for a painful shock is 9 milliamperes. The let-go threshold is 16 milliamperes and heart fibrillation begins at 25 milliamperes. Heart fibrillation is the main hazard. Once it starts, only high-voltage medical-rescue paddles can shock the heart back to its proper rhythm.

Heart fibrillation is a function of the length of time the current flows. That means a higher level of current can be tolerated for a shorter time, without going into fibrillation. Conversely, a lower current flowing for a longer time may cause fibrillation. This is why it is so important to have the protective devices operate as fast as possible.

ing jumpers normally carried on the line truck. Nothing special is required. These terminals also provide the means for connecting together multiple mats to enlarge the protected work area. This means they can be placed around a truck or stringing equipment to provide a place for workers to stand. They can be placed around pad-mounted transformers or switches during maintenance. They can be placed at dig-in sites for such underground-cable work as adding a tap or splicing.

Application range verified and defined

The EQUI-MAT™ Personal Protective Ground Grid has been tested up to 35kV using a 1,000-ohm resistor as the simulated worker. Fault currents varied from 100 to 1,000 amperes. In all cases, voltage across the "worker" was negligible.

However, it will **not** provide protection during the final part of a splicing operation if the worker is in contact with the center conductor of underground cable and a remote worker removes the cable's grounded elbow from the grounded parking stand and replaces it on the energized bushing. This energizes the center conductor, which by design is insulated from the ground. In this case, the worker is now a path to ground, with or without the mat.

In summary, the principles to protect workers up on structures now can be successfully applied at ground level. The portability of the EQUI-MAT™ Ground Grid and its ready use with equipment normally found on line trucks offers significant improvements in protection now available for workers at ground level.

Pre-Packaged Kits

Each Pre-Packaged Kit includes Ground Grid (size below with Long Ball Stud & illustrated instructions) plus Ground Set T600-2841 and Storage Bag C417-0147

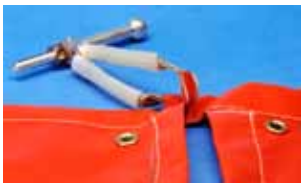
Kit Catalog No.	EQUI-MAT™ Personal Protective Ground Grid Size	Weight per Kit
C6002989	58" x 58"	11 lb. / 24.2 kg.
C6002990	58" x 120"	17 lb. / 37.4 kg.
C6002991	120" x 120"	29 lb. / 63.8 kg.

Basic EQUI-MAT™ Personal Protective Ground Grid

Each includes Long Ball Stud & illustrated instructions

Catalog No.	Size	Weight
Single ¼" Perimeter Braid		
C6002850	58" x 58"	5 lb. / 11 kg.
C6002851	58" x 120"	10 lb. / 22 kg.
C6002852	120" x 120"	20 lb. / 44 kg.

(At left) To join mats, the conductive grids simply connect at corner tabs with the bolt, washer and nut included with each mat. Tabs are fitted with shrink tube for stress relief. (Right) Ball stud can join mats and/or connect to grounding cable clamps.



Long ball stud accepts various grounding clamps as shown below: Duckbill, Ball/Socket, and C Type.

For more information, contact your Hubbell Power Systems representative, fax 573-682-8714 or e-mail hpsliterature@hps.hubbell.com.

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