Electrical Task Analysis Document

Grounding

CPWR THE CENTER FOR CONSTRUCTION RESEARCH AND TRAINING

Grounding

What is this document for?

This document contains task-specific conditions and recommendations compiled from onsite observations and interviews with electrical workers and industry practitioners. It addresses safety and health hazards as well as production challenges associated with the task. This document can be used for training, hazard analysis, and pre-task planning. This information was gathered from new construction projects including a data center, a commercial distribution warehouse, and a gas-insulated substation.

Task Description:

Grounding involves connecting a circuit to ground or to a conductive body that extends the ground connection. Grounding is a way to prevent electrical shock and arc flash in an electrical system by providing an alternate pathway for voltage to travel when there is a fault, or unexpected current, within the system. Copper grounding wire is attached to a panel, hung inside and outside the structure, and crimped on to a thick copper grounding rod that is driven into the earth. Unexpected current, which may be caused by lightning or a short circuit due to physical damage, travels safely through the wire and grounding rod into the ground.

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CONDITIONS	RECOMMENDATIONS
Handling wire crimper: Holding a 10-15 lb. crimper tool overhead and bending repeatedly to get dies for the crimper can raise the risk of ergonomic injury.	• Use hydraulic crimping tools when possible • Best Built Plans for safe material handling
Cutting grounding wire to size: Cutting wire off a wire reel into specific lengths for grounding can be repetitive and can raise the risk of ergonomic injuries.	• Break the task down into two steps. Designate one worker to focus on measuring and cutting the right length of wire and another worker to focus on grounding • Use a hydraulic or mechanical wire cutter
Crimping grounding wire on the wrong side: Crimping the grounding wire on the wrong side may impact its performance. To fix this, the crimp must be ground off and replaced. 	• Designate a second person to double-check the wire crimp before tightening

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Working with grounding rods: Lifting, carrying, driving, and cad welding grounding rods can raise the risk of ergonomic injury, especially when working with large rods (e.g., 10-foot). 	• Mechanical ground driver • Use a two-person approach to lifting and carrying material • Remote ignition for exothermic cad welds • Best Built Plans for safe material handling
Bending heavy wires: Bending heavy copper wires can raise the risk of ergonomic injury (e.g., 250 lb. wires).	• Hickey • Ratcheted cable bender
Determining wire pathway: Running bare copper wire through and around structures can require advanced planning and consultation with foremen, especially when unmarked underground pipes block the pathway and delay work. 	• Maintain as-builts for all project site utilities • Cable locating device • Detectable underground warning tape

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Extreme temperatures: Freezing temperatures in winter and early spring can lead to a loss of manual dexterity and frostbite when handling grounding wires outdoors. Conversely, high temperatures in the summer can lead to heat-related illness.	• Arm immersion cooling system • Cold stress prevention program • Heat illness prevention resources • Heat stress program • Fans, misters, and air conditioning units • Real-time physiological monitoring for heat strain in workers • Resources for working in cold weather • Space heaters, shelters, and hand warmers • Tents and shade canopies
Damaged underground cables: Other trades can cause damage to underground cables during utility work, resulting in delays. 	• Maintain as-builts for all project site utilities • Cable locating device • Detectable underground warning tape • Geospatial augmented reality system

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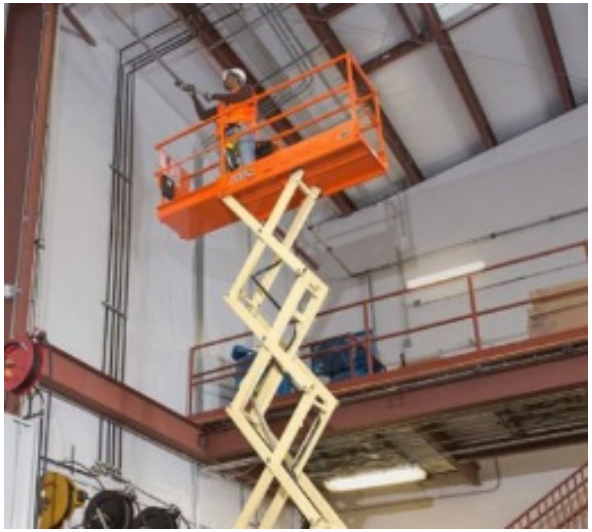
CONDITIONS	RECOMMENDATIONS
Handling grounding wire at heights: Grounding in certain projects (e.g., substations) involves taking heavy copper wire off the spool while working on a platform and handing it over to a coworker in a lift basket without dropping it. 	• To avoid dropping the wire, have one person on the platform whose only job is to hold the wire steady while the person in the lift pulls it into the basket • Use a wire reel dispenser to manage long lengths of wire for extended pulls
Wire bender availability: When there are not enough wire benders onsite, workers must bend heavy copper grounding wires by nonstandard methods. For example, by using railings and other structural elements as leverage.	• Hickey • Ratcheted cable bender

CONDITIONS	RECOMMENDATIONS
Handling smaller hardware while wearing gloves: Working with safety gloves can make it difficult to grip small hardware (e.g., 1/4” screws), which can lead to dropped and lost items. 	• Use thinner gloves with enhanced grip where feasible

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