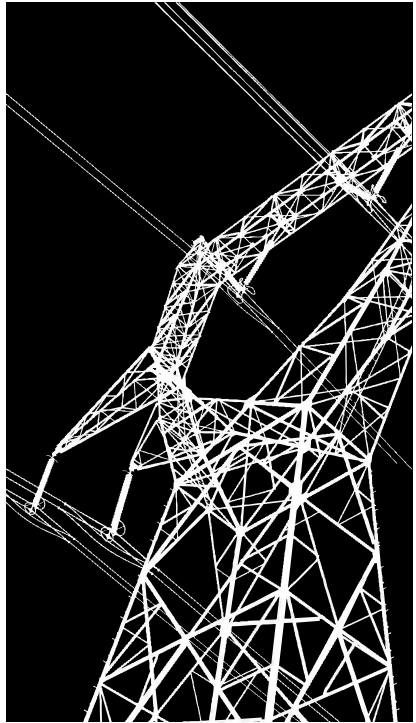
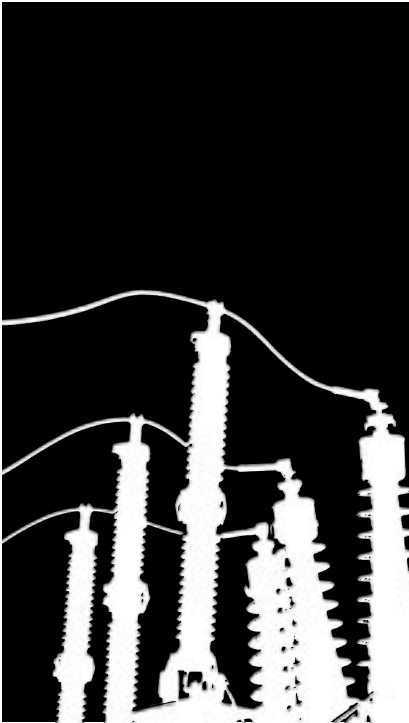


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**2004**

# **POWER SYSTEM SAFETY MANUAL**

**WESTERN AREA POWER ADMINISTRATION**





# **POWER SYSTEM SAFETY MANUAL**



UNITED STATES  
DEPARTMENT OF ENERGY

Western Area Power Administration  
Lakewood, Colorado

January 2004



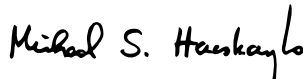
# INTRODUCTION

## To All Employees

Nothing is more important in our day-to-day activities, whether on the job or at home, than making a concerted effort to incorporate a safety ethic into everything we do. Safety is an obligation, a personal commitment, an individual responsibility. Safety begins and ends with each of us.

Western will provide you with the knowledge to work safely, the tools to accomplish your job safely, and will eliminate, where possible, potential hazards in the work environment. I ask each of you to accept your role in the safety arena. Despite what Western provides in the way of education, tools, and safety procedures, ultimately you decide whether your work is accomplished safely for not only you, but for your fellow employees.

Together we can, and must, be committed to a safe work environment. Our success will be measured by the silence associated with no accidents, no injuries, no personal pain or tragedy. I know I can count on your commitment to making our safety program the best ever.



Michael S. HacsKaylo  
Administrator

January 2004



This document will be updated and reprinted each year. Please submit all revisions and proposed changes on WAPA Form 5400.17 to Corporate Services Office, Attention A7700.

The contents of this publication are subject to continuous review and revision. To ascertain the current status of any individual copy and/or obtain insert copies of revised pages, please write to:

SAFETY AND SECURITY MANAGER A7700  
Western Area Power Administration  
P.O. Box 281213  
Lakewood, Colorado 80228-8213  
(720) 962-7292

WAPA 5400.17  
(1/02)

**DEPARTMENT OF ENERGY  
WESTERN AREA POWER ADMINISTRATION  
PROPOSED REVISION  
POWER SYSTEM SAFETY MANUAL**

Type of suggested revision, addition, deletion, rewording, other revision.  
(Circle appropriate description)

Section Number \_\_\_\_\_ Paragraph Number \_\_\_\_\_ Subparagraph \_\_\_\_\_

OLD WORDING OF AFFECTED PART

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SUGGESTED NEW WORDING

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JUSTIFICATION FOR NEW WORDING

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Revision recommended by

\_\_\_\_\_  
Name

\_\_\_\_\_  
Mail Code

\_\_\_\_\_  
Date

(If additional space is needed, attach necessary pages)

Please return to regional Safety Manager with copy to:

Safety Manager A7700  
Western Area Power administration  
P.O. Box 281213  
Lakewood, Colorado 80228-8213

Thank you for submitting this suggestion. We will consider it and let you know, as soon as possible, of its resolution.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Western safety Manager





# POWER SYSTEM SAFETY MANUAL

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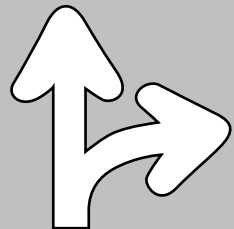
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# Purpose and Scope

- 1.1 Purpose
- 1.2 Scope
- 1.3 Format
- 1.4 Variances

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## SECTION 1

# PURPOSE AND SCOPE

### 1.1 PURPOSE.

The purpose of this Power System Safety Manual (PSSM) is to provide direction and guidance necessary for you as a Western Area Power Administration (Western) employee to perform your work without injury or occupational illness to yourself or to others, and to prevent accidents which result in personal injury, illness, property damage, or work interruption.

### 1.2 SCOPE.

- a. This PSSM establishes rules and assigns responsibilities for official operations and activities performed by Western employees, and contract employees except as adopted by reference in their contract. The Safety Programs described in this PSSM are found in WAPA O 440 (latest revision). The requirements found in the PSSM take precedence over rules, procedures or guidance found in other Western documents.
- b. Accident prevention is to be an integral part of the planning, training, and performing of all Western activities. If confronted with a situation not covered in this manual, seek your supervisor's help, consider all the potential hazards, and take appropriate corrective action.
- c. Compliance with the requirements of this manual and other accident prevention measures shall take precedence over immediate job production.

### 1.3 FORMAT.

- a. Herein are rules, which under normal conditions must not be violated.
- b. The following interpretations shall also apply:
  - (1) "May" - Permissive choice
  - (2) "Shall" or "Must" - Mandatory under normal conditions.
  - (3) "Will" - Mandatory, but allowing the responsible employee or party some discretion as to when, where, and how.

(4) “Should” - Advisory. These statements represent the best advice available at the time of printing.

(5) Male pronouns and related terms are used to reference both males and females.

## **1.4 VARIANCES.**

- a. Variances from the requirements of the PSSM which are not required by DOE or OSHA shall be handled as follows:

Under emergency conditions the supervisor may alter PSSM rules; however, before he alters a rule he must complete a careful analysis and discuss the alternatives with his crew to ensure that protection will be provided.

Under normal conditions, he must secure the concurrence of the Safety Manager and approval of higher management (see page 4) before the work is started, and in all cases after the work is done he must submit to his supervisor a written statement which includes:

- (1) Why the variation was necessary;
- (2) What alternative method was used;
- (3) How protection was provided; and
- (4) The time frame in which this variance is valid.

- b. Requests for variances from DOE or OSHA requirements must be documented and submitted to the Western Safety Manager for DOE processing.
- c. A Region may establish more stringent rules which shall prevail.

## Variance Request

Submitted by \_\_\_\_\_ Date \_\_\_\_\_

A variance to Western requirement \_\_\_\_\_ is requested.

(1) The quoted requirement needs to be varied because \_\_\_\_\_  
\_\_\_\_\_

(2) The following work method will be used.  
(use extra space to explain fully) (include JHA)

(3) How is protection provided (describe).

(4) This variance will remain effective from from \_\_\_\_\_ to \_\_\_\_\_

### Concurrence by:

Regional Safety Manager \_\_\_\_\_ Date: \_\_\_\_\_

### Approval by:

Regional Manager \_\_\_\_\_ Date: \_\_\_\_\_

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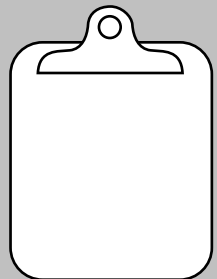
Corporate Services Office of Safety, A7700

# **Basic Responsibilities**

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2.1 Employees

2.2 Supervisors/Foreman



**BASIC RESPONSIBILITIES****2.1 EMPLOYEES.**

You are responsible and accountable for your actions as they affect your own safety, the safety of your fellow workers and the public, and for preventing accidents that can result in property damage and/or work interruption. Some of your basic responsibilities are as follows:

- a. Comply with all Western safety rules contained herein.
- b. Promptly correct and report unsafe/unhealthful working conditions to your supervisor.
- c. Promptly report Near Miss events to your supervisor.
- d. Immediately report all on-the-job accidents, injuries, and illnesses to your supervisor.
- e. Do not use intoxicants or drugs, including prescription and over the counter medications, that adversely influence normal decisions or actions while on duty.
- f. Use the specified personal protective equipment and visually inspect it prior to use. If defective, have it repaired or replaced prior to use.
- g Visually inspect tools and protective devices prior to use and have defective items repaired or replaced prior to use. Keep the guards and other safety features in place when using tools and equipment.
- h. Leave the job site in a safe condition. Before leaving a job, correct or give appropriate warning of any hazardous condition to others unfamiliar with existing conditions.
- i. Wear clothing and use barriers appropriate for the job and environment (See Subsection 8.7).
- j. No scuffling, horseplay, or fighting is permitted.
- k. Request a material safety data sheet (MSDS) from the manufacturer, warehouse or Safety Office for any chemical you use and follow the precautions included therein. Also read and adhere to the instructions on the label.



## **2.2 SUPERVISORS/FOREMAN.**

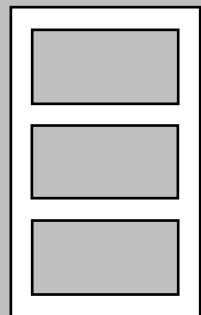
The person directly in charge of the work is considered the supervisor for the purposes of these requirements. Except in cases of insubordination or events beyond his control, the supervisor shall be responsible and accountable for unsafe acts and conditions that occur on work under his direction. Some of his basic responsibilities include the following:

- a. Observe all personnel to determine whether their work is being performed in a proper, safe, and healthful manner; and provide additional instruction and training if needed.
- b. Ensure employees inspect their tools, protective devices, and equipment and have defective items immediately removed from service, and repaired or replaced prior to use.
- c. Permit only the use of safe equipment, tools, or devices.
- d. Ensure that employees are trained and familiar with safe work practices, procedures for the tasks being performed.
- e. Permit only employees trained in the safe operation of equipment or apparatus to operate it except during training or instruction periods carried out under direct supervision.
- f. Prohibit employees from working when their ability or alertness is impaired.
- g. Outline specific methods and procedures for safely performing the work and verify that instructions are understood.
- h. Conduct onsite “tailgate” job planning meetings daily for crew-type work to ensure employees understand:
  - (1) What is to be done and in what sequence.
  - (2) How it is to be done and by whom.
  - (3) Possible hazards and how they are to be addressed.
  - (4) Status of energy sources.
  - (5) Personal protective equipment
  - (6) Changes in procedure and scope of the work
- i. When applicable conduct and document weekly safety meetings where past and future jobs are reviewed to identify safe and efficient procedures. Review appropriate paragraphs of the PSSM as part of these meetings.

- j. Conduct and document a job hazard analysis (JHA) on potentially hazardous work (see Section 17).
- k. Ensure good housekeeping in the work area.
- l. Regulate the work so the public is isolated or protected from injury or accident. Use adequate danger signs or barriers so placed that they effectively warn or prevent the public from entering dangerous areas.
- m. Enforce the safety rules and work practices herein provided.
- n. Ensure, bloodborne pathogen kits, first aid, medical care, rescue procedures and emergency telephone numbers are available and ensure injured employees and public receive immediate medical attention when needed.
- o. Notify your supervisor immediately of any accidents or near misses.
- p. In event of an accident, complete initial report, secure the accident scene, and preserve evidence.

# **Office, Building and Warehouse Safety**

► **CONTENTS**



## **SECTION 3**

# **OFFICE, BUILDING, and WAREHOUSE SAFETY**

### **3.1 GENERAL.**

Employees shall:

- a. Use the handrail when walking up or down stairs.
- b. Exercise caution when approaching blind corners.
- c. Keep desk and file drawers closed when not in use, and open only one at a time.
- d. Load files with heavy material in bottom drawers to prevent tipping.
- e. Use ladders or step stools for climbing.
- f. Maintain good housekeeping – wipe up spills; pick up foreign objects from floor; dispose of trash in proper containers, keep desks and tables free of hazards.
- g. Keep walkways clear of cords, boxes, and other tripping hazards.
- h. Correct unsafe condition(s); if this is beyond the worker's capability, report condition(s) to the supervisor.
- i. Smoke only in designated areas and use ashtrays or other appropriate receptacles to dispose of butts and matches.
- j. Request a material safety data sheet (MSDS) from the manufacturer, warehouse or Safety Office for any chemical you use and follow the precautions included therein. Also read and adhere to the instructions on the label.
- k. Use Underwriters Laboratory (UL) approved portable fans and heaters authorized by the facility manager for use at individual workstations.
- l. Not overload electrical circuits.
- m. Inspect electrical cords and receptacles annually and have defective items corrected.

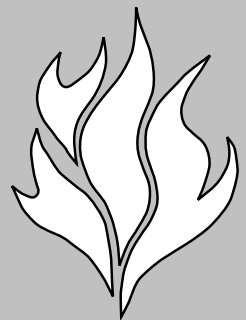
- n. Obtain help or use a cart when lifting or moving heavy or bulky objects.
- o. Not lean too far back in a chair.
- p. Get first aid or medical attention immediately for injuries. Notify supervisor of injury.
- q. Remove staples from cartons and envelopes that have been opened.
- r. Exercise caution when using cutting tools. Cut so the sharp point or edge is directed away from the body.
- s. Review the facility "Emergency Evacuation Plan" annually.
- t Turn off coffee pots and other appliances that are not being used.



# Fire Protection

- 4.1 General
- 4.2 Fire Prevention
- 4.3 Emergency Evacuation

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# FIRE PROTECTION

This section includes some general precautions to be taken to prevent and extinguish accidental fires in the workplace.

## 4.1 GENERAL.

Fires are divided into classes according to the types of combustible materials involved. Each requires a different class of fire extinguisher, as follows:

- a. Class A fires are fires involving ordinary materials, such as wood, paper, excelsior, rags, and rubbish. To extinguish them, use water, dry chemical, or fire retardant gas extinguishers marked for Classes A, B, and C.
- b. Class B fires are fires involving flammable liquids, such as gasoline, oil, and grease. Use CO<sub>2</sub>, dry chemical, or fire retardant gas extinguishers to extinguish these fires.
- c. Class C fires are fires involving energized electrical circuits or equipment. The power must be shut off or non-conductive extinguishing agents, such as CO<sub>2</sub>, dry chemical, or fire retardant gas are to be used.

## 4.2 FIRE PREVENTION.

- a. Smoke only in designated or unrestricted areas, away from flammable and explosive materials.
- b. Store dirty rags and other combustible waste in closed metal containers, and dispose of it regularly to minimize its fire potential.
- c. Do not start fires with gasoline or other highly volatile material.
- d. Inspect and keep fire safety equipment (extinguishers, alarms, fire doors, etc.) in good operating order and accessible for emergency use.

**NOTE:** Inspect portable fire extinguishers monthly at manned facilities. Inspect fire extinguishers each time a remote facility (microwave, substation) is visited. All portable fire extinguishers must be subjected to an annual maintenance check.



- e. Store and transport flammable liquids in approved containers. Containers that emit vapors shall not be stored or transported in the vehicle's passenger compartment.
- f. When transferring flammable liquids and gases, bond the nozzle and the receiving container.

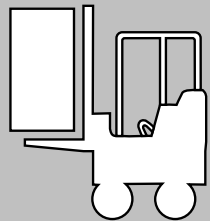
## **4.3 EMERGENCY EVACUATION**

- a. Facilities occupied by 10 or more employees shall have a written evacuation plan.
- b. A written evacuation plan shall include, at a minimum:
  - (1) emergency escape procedures and emergency escape route assignments including specific emergency evacuation procedures for each physically challenged employee located at the facility;
  - (2) procedures for designated "critical employees" who remain in the building;
  - (3) procedures to account for employees after the evacuation;
  - (4) rescue and medical responsibilities for designated employees;
  - (5) instructions on how to report a fire or an emergency; and
  - (6) identification of person(s), by name or job title, who can provide information or explanation of duties under the plan.
- c. Evacuation drills will be conducted at least annually for facilities of 30 or more employees.



# **Equipment and Motor Vehicles**

- 5.1 General
- 5.2 Operation of Equipment Near High-Voltage Facilities
- 5.3 Cranes, Derricks, Line Trucks and Hoists
- 5.4 Forklifts
- 5.5 Trailers
- 5.6 Farm-Type Tractors and Earthmoving Vehicles
- 5.7 ATV and Snowmobiles
- 5.8 Vehicle Repair and Maintenance
- 5.9 Vehicle and Equipment Fire Protection



## SECTION 5

# EQUIPMENT AND MOTOR VEHICLES

This section includes precautions to be taken when operating and maintaining motorized equipment.

## 5.1 GENERAL.

- a. In order to operate any over-the-road type motor vehicle for Western, you must:
  - (1) Have a current state driver's license valid for the class(s) of vehicles you may operate. (Federal law prohibits an individual from having more than one state driver's license.)
  - (2) Have an original or photographic copy of a medical examiners certificate on his/her person that he/she is physically qualified to drive a Commercial Motor Vehicle (CMV).
  - (3) Have your supervisor's approval.
- b. Notify your supervisor by the next workday if your state license is revoked or suspended.
- c. Obey all state and local traffic laws.
- d. All vehicle occupants must wear the safety belts that are provided at all times when the vehicle is in motion.
- e. Inspect the vehicle before use each day and have unsafe conditions corrected. Do not operate an unsafe vehicle. Refer to WAPA O440.1, Motor Vehicle Safety Chapter. Post trip inspection forms must be filled out and kept on file for 30 days on all commercial motor vehicles.
- f. When the vehicle is left in an unprotected area, lock all doors and cabinets.
- g. To prevent backing accidents:
  - (1) Park so backing is unnecessary.
  - (2) When your view is obstructed; designate a person to guide you or walk completely around vehicle prior to backing.
  - (3) Avoid parking at corners.
  - (4) Back slowly.

- h. The operator is to ensure the safe loading of the vehicle and the continual securement of the load during travel.
- i. Report immediately to your supervisor all accidents and moving violations involving any vehicle (including personal or rental vehicles) being used for Western business.

## **5.2 OPERATION OF EQUIPMENT NEAR HIGH-VOLTAGE FACILITIES.**

- a. To maintain the distances specified in Appendix B the non-electrical worker may:
  - (1) Install adequate guards or barriers, or
  - (2) Use a full-time signalman to warn the operator when approaching minimum distances.
- b. Electrical workers may operate equipment within the distances specified in Appendix A Table A-2 if all of the following conditions are met:

**EXAMPLE:** With a Hot Line Order (HLO) at 115 kV, electrical workers may operate vehicles or equipment between 10'8" and 3'2" (Appendix A, Table A-2).

- (1) A job hazard analysis has been done.
  - (2) A hot line order has been obtained.
  - (3) The activity is being performed under the direct supervision of a designated person who is trained and competent in this type of work. This person shall remain at the worksite in a non-work status and shall be positioned to observe all work performed under the HLO.
  - (4) The distances between energized parts and the equipment or load is monitored while the equipment or load is being moved and/or repositioned.
  - (5) The equipment is grounded.
  - (6) No one, other than necessary workers, is within 10 feet of the equipment during its operation. Workers are to perform their work while on the equipment or on insulated or bonded conductive mats, not while operating from a position on the ground.
- c. When vehicles or equipment are in transit with it's boom stored or no means of expansion, the vehicle or equipment may be moved within the distances specified in Appendix A, Table A-3 if all the following conditions are met:

**EXAMPLE:** With a Hot Line Order (HLO) at 115 kV, electrical workers may drive vehicles or equipment between 4'8" and 3'2" (Appendix A, Table A-3).

- (1) A job hazard analysis has been done.
  - (2) A hot line order has been obtained.
  - (3) The activity is being performed under the direct supervision of a designated person who is trained and competent in this type of work. This person shall remain at the worksite in non-work status and shall be positioned to observe all work performed under the HLO.
  - (4) The distances between energized parts and the equipment or load is monitored while the equipment or load is being moved and/or repositioned.
- d. At least 2 employees must be present for work involving the use of mechanical equipment in close proximity to energized parts as listed Appendix A, Table A-2.

### **5.3 CRANES, DERRICKS, LINE TRUCKS, AND HOISTS.**

- a. Operate only if authorized.
- b. Inspect the vehicle before use each day and have defects corrected. Also have the equipment tested and certified annually.
- c. Follow the manufacturer's recommendations and never overload the vehicle or side load the boom.
- d. Alterations and modifications are to be made only by authorized persons.
- e. Load line suspended work platforms are to be used to position employees only when built and used in accordance with applicable ANSI standards and OSHA regulations (1926.550). Never ride the load, block, or hook of a crane, derrick, or hoist.
- f. A designated employee is to signal for each lift.
- g. Tag lines are to be used to control loads when practical.
- h. The operator may not leave his or her position at the controls while a load is suspended.
- i. The accessible areas within the swing radius of the rear of the rotating superstructure of the crane shall be barricaded so as to prevent an employee from being struck or crushed by the crane.

j. Outriggers

- (1) Vehicular equipment, if provided with outriggers, shall be operated with the outriggers extended and firmly set as necessary for the stability of the specific configuration of the equipment. Outriggers may not be extended or retracted outside of clear view of the operator unless all employees are outside the range of possible equipment motion.
- (2) If the work area or the terrain precludes the use of outriggers, the equipment may be operated only within its maximum load ratings for the particular configuration of the equipment without outriggers.

k. Keep suspended loads clear of obstructions.

l. Keep people clear of suspended loads and loads about to be lifted.

m. Use the crane hand signals listed in Appendix C.

## **5.4 FORKLIFTS.**

- a. Operate only if authorized.
- b. Factory installed safety belts shall be worn.
- c. Inspect the vehicle before use each day and have hazardous conditions corrected prior to use.
- d. When approved work platforms are used on forklifts, secure them firmly to the forks, use toe boards and guard-rails where required, and use fall protection equipment.
- e. Ground the forklift, like any other vehicle, if it is to be used for work near energized circuits and maintain the required minimum approach distances.

## **5.5 TRAILERS.**

- a. All loads must be firmly immobilized or secured on or within a vehicle by structures of adequate strength dunnage, chocks, wedges, or tie downs, or a combination of these and check as required.
- b. Mark oversized loads with red flags by day and lights by night as well as signs required by State law.

- c. All trailers rated at 3000 GVW and larger shall be equipped with a DOT approved breakaway brake system. All other trailers shall be secured with a DOT approved safety chain (rated for capacity of the trailer). Safety chains should be crossed to provide stability in case the hitch fails.
- d. Comply with State requirements for movement of oversized loads; i.e., routing, permits, escorts, etc.

## **5.6 FARM-TYPE TRACTORS AND EARTHMOVING VEHICLES.**

- a. Operate only if authorized.
- b. Inspect the vehicle before use each day and have hazardous conditions corrected.
- c. Where roll-over protective structures are provided, safety belts shall be worn.

## **5.7 ATV and SNOWMOBILES.**

- a. Operate only if authorized
- b. Follow manufactures guidelines for safe operation and equipment limitation.
- c. DOT approved helmets shall be utilized for the operation of ATV's during periods of prolonged usage such as line patrol or traveling over relatively long distances of rough and uneven terrain. ATV's with rollover protection and seatbelts would not require helmet use but the operator would be required to have their seatbelts fastened during operation of the unit and wear suitable eye protection (i.e. safety glasses).

## **5.8 VEHICLE REPAIR AND MAINTENANCE.**

- a. Shut down the vehicle during repairs unless operation is required.
- b. Keep all guards in place during vehicle operation.
- c. During fueling operations:
  - (1) Shut off the engine.
  - (2) Do not smoke or use open flames within 50 feet.
- d. Tire Pressure and Load Limits. Tire information placards and vehicle certification labels contain information on tires and load limits. These labels indicate the vehicle manufacturer's information including:



- Recommended tire size
- Recommended tire inflation pressure
- Vehicle capacity weight (VCW)
- Front and rear gross axle weight ratings (GAWR)

Both placards and certification labels are permanently attached to the vehicle door edge, door post, glove-box door, or inside of the trunk lid. Recommended tire pressure and load limits for each vehicle can also be found in the vehicle owner's manual.

- (1) Use tire pressure gauges that will ensure accurate tire pressure readings are obtained.
  - (2) Ensure overweight axle conditions do not exist.
  - (3) Use a safety tire rack, tire inflation cage, or other protection when inflating unmounted tires on wheels with locking rings. Lock the ring in place before removing the wheel from the cage. If a tire on a vehicle is underinflated but has more than 80% of recommended pressure the tire may be inflated while the rim wheel is on the vehicle provided remote control inflation equipment is used, and no employee remain in trajectory during inflation. When split rim tire has been driven underinflated at 80% or less of the recommended pressure the tire and rim shall be deflated and removed from the axle for repair.
- e. Vent vehicle exhaust(s) directly to the outside whenever engines have to be run inside an enclosed garage.
  - f. Before walking or working under suspended vehicles or parts thereof, block them from falling with suitable safety stands or equivalent material, if appropriate.
  - g. Ensure that heavy equipment and vehicles have anti-skid (abrasive) walking surfaces and that they are maintained as such.

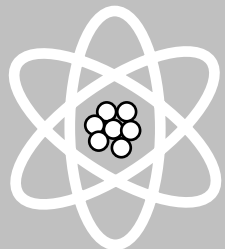
## **5.9 VEHICLE AND EQUIPMENT FIRE PROTECTION**

- a. All designated motorized vehicles used for maintenance activities shall be equipped with a portable fire extinguisher.
- b. Inspect fire extinguishers (pressure, secure pin, etc.) at least monthly. All portable fire extinguishers must be subjected to an annual maintenance check.



# **Material Handling and Storage**

- 6.1 Manual Material Handling
- 6.2 Hand Trucks
- 6.3 Material Storage
- 6.4 Hazardous Materials



## SECTION 6

# MATERIAL HANDLING and STORAGE

See Section 5 for rules related to cranes, forklifts, and other motorized material handling equipment.

## 6.1 MANUAL MATERIAL HANDLING.

When manually lifting and handling materials, you should:

- a. Consider the probable weight of an object before attempting to lift it, and get help if needed to ensure a safe lift and/or carry.
- b. Inspect objects for slivers, jagged edges, burrs, slippery surfaces, etc., and wear gloves when needed to protect your hands.
- c. Keep hands and gloves free of oil, grease, etc., and get a firm grip on the object before lifting it.
- d. Use recommended lifting procedures to prevent back injuries.
- e. Avoid carrying a load that you cannot see over or around.

## 6.2 HAND TRUCKS.

When using hand trucks, you should observe the following:

- a. Keep the center of gravity of the load as low as possible.
- b. Place the load so the weight is over the axle and not the handles, and so it will not slip, shift, or fall off.
- c. Keep the truck downhill from you when going up or down an incline.
- d. Move the truck at a safe speed which allows you to keep it under control.

## 6.3 MATERIAL STORAGE.

- a. Stack materials so they can be safely accessed and removed.
- b. Place materials so they are clear of walkways and traffic lanes. If this is not practical, place warning devices or barricades to alert others.
- c. Determine and mark the safe load limit of floors, balconies, and shelves and do not overload them.

- d. Materials which require the use of cranes, etc., should not be stored under powerlines.
- e. Nails should be removed from used lumber before stacking.
- f. Stack poles and pipe on racks or sills and block them to prevent them from spreading or rolling. Tag lines should be used to control poles while handling them with a crane or hoist. Work from the ground, and keep everyone clear while poles are being lifted from the pile or trailer, whenever possible.
- g. Stack structural steel and poles so they will not slide, roll, or tip over. Approach and work on them from the uphill side.
- h. Do not stack material within 6-feet of perimeter fence.
- i. Materials shall not be stored or moved within the distances to energized equipment specified in Appendix B.

## **6.4 HAZARDOUS MATERIALS.**

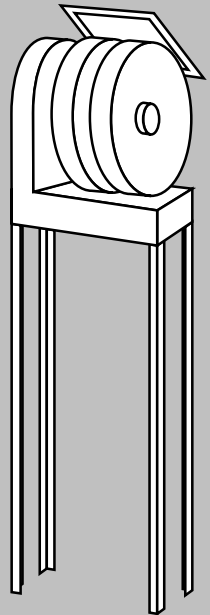
- a. Refer to the material safety data sheet (MSDS) on each chemical you use and follow the manufacturer's instructions for use, storage, labeling, disposal, and for dealing with emergencies arising from its use.
- b. Use solvents, cleaners, and degreasers only in well-ventilated areas, and keep smoking and other ignition sources away from flammable materials.
- c. Material Safety Data Sheet(s) (MSDS) must be readily available to every employee.



# Field and Shop Safety

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- 7.1 Good Housekeeping
- 7.2 Sanitation
- 7.3 Tools - General
- 7.4 Grinding Tools
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- 7.6 Powder-Actuated Tools
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- 7.15 Test Procedures and Facilities



## **FIELD AND SHOP SAFETY**

### **7.1 GOOD HOUSEKEEPING.**

Keep rooms, storage areas and passageways free from accumulation of materials that constitute hazards from tripping, fire, explosion or pest harborage. Vegetation control shall be performed as necessary.

### **7.2 SANITATION**

#### **a. Potable water**

- (1) An adequate supply of potable water shall be provided in all places of employment.
- (2) Any containers used to dispense drinking water shall be capable of being tightly closed, and equipped with a tap. Water shall not be dipped from container.
- (3) Any container used to distribute drinking water shall be clearly marked as to the nature of its contents and not used for any other purpose.
- (4) The common drinking cup is prohibited.
- (5) Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

#### **b. Toilets**

- (1) The requirements of this paragraph for sanitation facilities shall not apply to mobile crews having transportation readily available to nearby toilet facilities.
- (2) Toilets shall be provided for employees
- (3) Under temporary field conditions, provision shall be made to assure not less than one toilet facility is available.
- (4) Job sites, not provided with sanitary sewer, shall be provided with one of the following toilet facilities unless prohibited by local codes;
  - (a) Privies (where their use will not contaminate ground or surface water)
  - (b) Chemical toilets



- (c) Recirculating toilets
- (d) Combustion toilets

## 7.3 TOOLS - GENERAL.

- a. Keep tools in good repair and use only for the purpose for which designed. Inspect them before use each day.
- b. Tag defective tools and remove them from use. Note defect on the tag.
- c. Do not place tools on scaffolds, ladders, or overhead working spaces where they can fall on someone. Use containers to hold tools to prevent them from falling.
- d. Keep unguarded sharp-edged or pointed tools out of pockets.
- e. Use containers and hand lines for transporting tools (except those carried in tool belts) from one level to another. Tools and materials shall not be thrown to or from workers on structures, elevated surfaces or aerial devices.
- f. Follow the safe practices outlined by the manufacturer.
- g. Use electric-powered tools that are either battery-operated, double-insulated, or effectively grounded.
- h. In conductive areas, use hand, air, hydraulic, or double insulated, battery-powered tools; or use tools that are protected by a ground fault circuit interrupter (GFCI).

**EXCEPTION:** Special designed electrical test equipment which prevents the use of a GFCI protected circuit.

- i. Keep tool guards in place when tool is in use. Remove the power source before removing the guard.

## 7.4 GRINDING TOOLS.

- a. Keep the work rests on grinding machines adjusted to a maximum opening of 1/8-inch from the wheel, and tongue guards adjusted to within 1/4-inch of the wheel.
- b. Pedestal and bench grinders are to be firmly secured.
- c. Visually inspect and ring test the grinding wheel before mounting it. Also check the label to be sure it's the right speed rating for the machine.
- d. Use grinding wheels for material(s) as recommended by the manufacturer.

- e. Prior to operation of a grinder, stand to the side and let it get up to full speed before starting to grind.
- f. Store spare grinding wheels vertically, unless otherwise indicated by the manufacturer, and in an area where they will not be damaged.

## **7.5 HYDRAULIC AND PNEUMATIC TOOLS.**

- a. Securely install and maintain safety clips and retainers on pneumatic impact tools to prevent attachments from being accidentally ejected.
- b. If the compressor uses a hose exceeding 1/2-inch ID, be sure it has a safety device that will reduce the airflow if the hose fails.
- c. Safe operating pressures for hydraulic and pneumatic tools, hoses, valves, pipes, filters, and fittings shall not be exceeded.

**NOTE:** If any hazardous defects are present, no operating pressure would be safe, and the hydraulic or pneumatic equipment involved may not be used. In the absence of defects, the maximum rated operating pressure is the maximum safe pressure.

- d. A hydraulic or pneumatic tool used where it may contact exposed live parts shall be designed and maintained for such use.
- e. The hydraulic system supplying a hydraulic tool used where it may contact exposed live parts shall provide protection against loss of insulating value for the voltage involved due to the formation of a partial vacuum in the hydraulic line.

**NOTE:** Hydraulic lines without check valves having a separation of more than 35 feet between the oil reservoir and the upper end of the hydraulic system promote the formation of a partial vacuum.

- f. A pneumatic tool used on energized electrical lines or equipment or used where it may contact exposed live parts shall provide protection against the accumulation of moisture in the air supply.
- g. Pressure shall be released before connections are broken, unless quick acting, self-closing connectors are used. Hoses shall not be kinked.
- h. Employees shall not use any part of their bodies to locate or attempt to stop a hydraulic leak.

## **7.6 POWDER-ACTUATED TOOLS.**

- a. Use powder-actuated fastening tools or devices only if certified.
- b. Follow the manufacturer's instructions.

## **7.7 CLEANING OPERATIONS.**

- a. Use only approved cleaning solvents for which material safety data sheets (MSDS) are available. Follow the precautions listed on the MSDS.
- b. Wear suitable clothing to protect all skin areas when sandblasting. Also, use supplied air respirators.
- c. Compressed air used for blowing and/or cleaning parts is to be reduced down to a pressure of no more than 30 pounds per square inch (psi). It is not to be directed on the skin which could result in air being injected into the blood stream.

## **7.8 PORTABLE LADDERS.**

- a. Place straight ladders on a firm foundation and have ladders held, when possible, while being climbed unless they are tied off.
- b. Place straight ladders at a slope of 4:1, if possible. Also have the ladder extend at least 3 feet above the landing for dismounting, unless handholds or grabs are available.
- c. Use fiberglass-reinforced plastic (FRP) portable ladders in substation yards.
- d. Protect ladders from being struck by swinging doors, traffic, etc.

## **7.9 WELDING AND CUTTING.**

- a. Use welding equipment only if authorized.
- b. Have a portable fire extinguisher of the appropriate rating available.
- c. Use adequate local exhaust ventilation and/or respiratory protection plus other personal protective equipment as needed. Proper respiratory protection shall be used when cutting or welding on galvanized steel.
- d. Remove the electrode from the holder or otherwise protect it before leaving it unattended.

- e. Protect combustibles and flammables in the work area and on the other side of the item being worked on from sparks, slag, and heat produced by the operation. Also take precautions to protect other persons from the sparks and slag. Make a fire check of the area about 1/2 hour after work is stopped.
- f. Protect electrical cables and gas hoses from physical damage, and from being a tripping hazard.
- g. Use gas cylinders whose contents are clearly labeled on them and protect them from excessive heat and accumulations of snow and ice.
- h. Keep valve protection caps on cylinders except when the cylinders are secured in place on a welding cart or connected to a manifold.
- i. Store oxygen cylinders at least 20 feet away from fuel gas cylinders and flammable materials. Store cylinders in an upright position and secure them to prevent them from falling over.
- j. Keep grease and oil away from oxygen system valves, fittings, regulators, and gauges.
- k. Use only properly marked hoses for oxyacetylene service and equip them with backflow protective valves at the nozzle end of the hoses.
- l. Use friction lighters or stationary pilot flames, not matches or cigarette lighters, to light the torch. Remove matches and butane cigarette lighters from your pockets and keep them away from welding and cutting operations.
- m. Use a cradle or suitable platform to lift cylinders by a crane or hoist. Do not lift them by the cylinder valve cap or neck.
- n. When cylinders, containing gases used for welding and cutting, are transported by powered vehicles, they must be securely restrained in a vertical position.
- o. When cylinders, containing nonfuel gases, are transported by powered vehicles, they must be securely lashed in an upright position, loaded into racks securely attached to the vehicle, packed in boxes or crates of such dimensions to prevent their overturning, or securely loaded in a horizontal position.

## **7.10 PAINTING.**

- a. Review the MSDS for the material being used and follow the precautions.
- b. Mix and apply paint in adequately ventilated areas or use appropriate respiratory protection.
- c. Keep flammable paint away from heat, open flames, smoking, and other ignition sources.
- d. When using airless paint spraying equipment:
  - (1) Follow the manufacturer's instructions.
  - (2) Keep the spray gun pointed away from yourself and others.
  - (3) Electrically bond the spray gun, supply pump, power supply, object to be painted, and all conductive objects within 10 feet of the spray gun when using electrostatic equipment.

## **7.11 CHAIN SAWS.**

- a. Operate only if authorized.
- b. The following personal protective equipment is required: chaps, leather or ballistic gloves, hard hat, safety glasses, hearing protection, and protective-toed safety boots. Cut resistant foot protection meeting ASTM standard F1818 shall be used during tree felling operations (tree felling, limbing, and bucking) while on the ground (i.e. not from inside a bucket truck). The use of cut-resistant foot protection during chain saw operations outside the scope of tree cutting should be handled on a case by case basis through the JHA process.
- c. Keep both hands on the saw when cutting.
- d. The chain saw shall not be used to cut directly overhead.
- e. When felling trees, clear a path of retreat.
- f. When felling, limbing, or bucking trees, follow the safe practices provided by the industry experts and Western's PSMM Chapter 11, "Trimming and Felling of Trees and Brush Near Power Lines" (latest revision) and have another person in a safe position at the worksite.

## **7.12 BRUSH CHIPPERS.**

- a. Operate only if authorized.
- b. Wear personal protective equipment: Hearing protection, eye protection, gloves, hard hat, shirt with full length sleeves, full leg length pants, and protective-toed safety boots. Wear appropriate full face protection meeting ANSI Z87.1 whenever exposed to eye and face hazards.
- c. You should stand to the side of the chipper chute while feeding brush.
- d. Feed the butt end of brush into the chipper first.
- e. Use the automatic shut-off/stop control at the operator's station in times of an emergency.
- f. Access panels for maintenance and adjustment of the chipper blades and associated drive train shall be in place and secure during operation of the equipment.
- g. Trailer chippers detached from trucks shall be chocked or otherwise secured.

## **7.13 PORTABLE AND VEHICLE-MOUNTED GENERATORS.**

Portable and vehicle-mounted generators and inverters used to supply cord- and plug-connected equipment shall meet the following requirements:

- a. The generator may only supply equipment located on the generator or the vehicle and cord- and plug-connected equipment through receptacles mounted on the generator or the vehicle.
- b. The non-current-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles shall be bonded to the generator frame.
- c. In the case of vehicle-mounted generators, the frame of the generator shall be bonded to the vehicle frame.
- d. Any neutral conductor shall be bonded to the generator frame.

## **7.14 BACKPACK POWER UNITS FOR USE IN PRUNING AND CLEARING.**

- a. While a backpack power unit is running, no one other than the operator may be within 10 feet of the cutting head of a brush saw.

- b. A backpack power unit shall be equipped with a quick shutoff switch readily accessible to the operator.
- c. Backpack power unit engines shall be stopped for all cleaning, refueling, adjustments, and repairs to the saw or motor, except as the manufacturer's servicing procedures require otherwise.

## **7.15 TEST PROCEDURES AND FACILITIES.**

The following requirements apply to testing involving temporary measurements using high voltage, high power, or a combination of both types of test equipment. Testing involving continuous measurements such as routine metering, relaying, or normal linework is excluded from these requirements.

- a. Only qualified personnel who have been trained in the safe testing practices are to operate the test equipment.
- b. A minimum of two people shall be required to perform tests.
- c. When testing equipment such as transformers, circuit breakers, etc., under a Clearance, the person holding the Clearance shall be responsible for overseeing the safe testing activities.

**NOTE:** When working near adjacent energized equipment see section 11.1.2.

- d. Where a Clearance is not required, the person performing the testing will be responsible for the safe testing activities.
- e. When performing field testing one of the following means shall be used to prevent unauthorized personnel from entering the test area:
  - (1) The test area shall be guarded by the use of distinctly colored safety tape that is supported approximately waist high and to which safety signs may be attached.
  - (2) The test area shall be guarded by a barrier or barricade that limits access to the test area to a degree equivalent to e(1) above.
  - (3) The test area shall be guarded by one or more test observers stationed so that the entire area can be monitored.
  - (4) The barriers required by e (1) and e (2) above shall be removed when the protection they provide is no longer needed.





# Personal Protective Equipment

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- 8.1 General
- 8.2 Head Protection
- 8.3 Eye and Face Protection
- 8.4 Foot Protection
- 8.5 Respiratory Protection
- 8.6 Hearing Protection
- 8.7 Protective Clothing
- 8.8 Skin Protection
- 8.9 Fall Protection Equipment and Hardware
- 8.10 Inspection and Maintenance
- 8.11 Personal Flotation Devices (PFD)



## SECTION 8

# PERSONAL PROTECTIVE EQUIPMENT

This section includes personal protective equipment basic requirements (summarized in Table 8.1) for Western employees. More specific requirements are described in other sections of the PSSM, and may be further defined in Regional policy. PPE/Safety equipment must be ANSI or ASTM approved.

## 8.1 GENERAL.

- a. Personal protective equipment shall be worn as required.
- b. Observers shall not enter the work area unless authorized by the work area supervisor and equipped with personal protective equipment dictated by the hazards present.
- c. You shall remove rings, watches and other jewelry before working on batteries; engaging in other work where exposed energized parts are within reaching distance or where the possibility of being pinched, caught or hooked is a hazard.

## 8.2 HEAD PROTECTION.

DOT approved helmets shall be utilized for the operation of ATV's during periods of prolonged usage such as line patrol or traveling over relatively long distances of rough and uneven terrain. ATV's with rollover protection and seatbelts would not require helmet use but the operator would be required to have their seatbelts fastened during operation of the unit and wear suitable eye protection (i.e. safety glasses).

All substation yards and storage yards shall be designated "hard hat" areas and posted as such. In addition, wear an approved hard hat when there is a risk of a head injury and as follows:

- a. While doing substation maintenance and inspections, except in vehicles or office and control buildings when overhead hazards do not exist.
- b. While doing transmission line work.
- c. While on construction projects.
- d. While working on communication towers.

## 8.3 EYE AND FACE PROTECTION.

- a. Wear appropriate eye and face protection whenever exposed to eye or face hazards.
- b. Contact lenses are not to be considered as eye protection, nor are they to be worn in industrial environments where toxic or irritant substances could be trapped by the lenses.
- c. When working around caustic, toxic or irritant substances, an emergency-type water fountain for flushing the eyes must be available. Water purity is to be maintained.

## 8.4 FOOT PROTECTION.

- a. When engaged in field, shop, or other industrial activities sturdy work footwear shall be worn.
- b. Wear safety-toed footwear or toe guards when performing (or in proximity to) activities that present inherent danger to the toes, including but not limited to operating chain saws, jack hammers and tamps, powered post-hole diggers, and riding or walk-behind lawnmowers.
- c. Conductive footwear is recommended when and where static discharges cause discomfort. Conductive boots shall not be worn as a conventional work boot.
- d. Cut resistant foot protection meeting ASTM standard F1818 shall be used during tree felling operations (tree felling, limbing, and bucking) while on the ground (i.e. not from inside a bucket truck). The use of cut resistant foot protection during chain saw operations outside the scope of tree cutting should be handled on a case by case basis through the JHA process.

## 8.5 RESPIRATORY PROTECTION.

- a. Employees are not to enter locations with hazardous atmospheric conditions without adequate protection. The area should be brought within OSHA limits by ventilation or filtration rather than relying on use of respirators.

**EXAMPLE:** Oxygen below 19.5%, gas vapor, or mist above 10% of the LEL. See MSDS of material for LEL.

- b. When entering or working in an confined or enclosed space (tank, pit, vault, etc.) refer to WAPA O 440.1(latest revision) for Confined or Enclosed Space.

- c. Before using a respirator, you must be medically qualified by a physician; trained annually or prior to use; and fitted for the type of respirator to be used.
- d. If your work requires the use of a respirator, you must be able to pass the respirator fit test.
- e. During cleanup operations where there is a potential exposure to the Hantavirus, a high efficiency air-purifying respirator, at a minimum, is required.
- f. Proper respiratory protection shall be used when cutting or welding galvanized steel.

## **8.6 HEARING PROTECTION.**

The following activities/exposures require the use of hearing protectors (ear muffs or ear plugs):

- a. When exposed to noise levels that exceed the limits stated in table G-16 found in WAPA Order 440.1 latest revision, Hearing Conservation Program Chapter.
- b. In posted areas or when operating noisy equipment (e.g. chain saws, brush chippers, jack hammers, powered post hole diggers, impact wrenches, etc.).
- c. By employees exposed to excessive noise levels who have experienced a standard threshold shift.

## **8.7 PROTECTIVE CLOTHING.**

- a. Wear clothing appropriate for the type of work being performed and the environment. As a minimum, when engaged in field or shop work or other industrial activities, wear full-length pants and short-sleeved-shirt or t-shirt. Cutoffs, tank tops, or modified shirts are not acceptable.
- b. When working in the close proximity to energized equipment (Appendix A, Table A-2) you shall wear clothing that, when exposed to flames or electric arcs will not increase the extent of injury that could be sustained. In these situations wearing either alone or in blends is prohibited. When Engineering and Administrative Controls do not sufficiently minimize an arc flash exposure, personal protective equipment shall be worn. When employing PPE, there shall be no exposed body parts of the worker (including hands and face). All parts of the body must be protected to sufficiently withstand the arc exposure to a level below 1.2 calories/cm<sup>2</sup>. When choosing FR rated clothing

use clothing that will protect the worker under the conditions that he/she could be exposed. For jobs requiring FR rated clothing, the exposure must be less than or equal to the APTV of the garment. If the worker uses clothing that is not flame resistant, the clothing that is worn must match the hazard ( ie., made from natural fabrics). Until Region's conduct arc flash studies, interim procedures will be established.

- c. Wear welders gloves, chaps, and coat; or a combination of coat, sleeves, and pants which provide appropriate protection when doing overhead welding or cutting. When engaged in bench-type welding and cutting, wear welders gloves and apron as minimum protection.
- d. Wear leather-palm gloves when performing tasks such as handling steel plates, steel cables, barbed wire, rough-hewn timber, or other material with sharp edges or abrasive surfaces.
- e. If electrical rubber gloves, line hose, or blankets are used when performing work on energized circuits, they must have passed the ASTM electrical test within the last six months for the involved circuit voltage. Inspect them before each use.
- f. When working on or near public thoroughfares or flagging vehicle movements, wear safety color fluorescent clothing with a reflective area of at least 500 square inches above the waist.
- g. Wear industry approved protective chaps constructed of a minimum of four layers of Kevlar or ballistic material when operating chain saws.
- h. When engaged in aerial line patrol, wear the protective clothing outlined in the Flight Operations Manual.

## **8.8 SKIN PROTECTION.**

- a. Where caustic, toxic, or irritant substances may come in contact with the skin, use one or more of the following to prevent injury:
  - (1) Protective gloves, clothing, overshoes, and other necessary apparel appropriate for the substance.
  - (2) Appropriate protective ointment (barrier creams) for exposed skin areas.
  - (3) Appropriate solvents or soap and water for the removal of accumulated material and protective ointments.

- b. To lessen the injury from accidental contact with caustic, toxic, or irritant substances, use one or more of the following:
  - (1) Appropriate first-aid remedies.
  - (2) An emergency-type deluge shower.
- c. Use appropriate sunscreen to provide protection against harmful exposure to sun.

## **8.9 FALL PROTECTION EQUIPMENT AND HARDWARE.**

See Section 16.

## **8.10 INSPECTION AND MAINTENANCE.**

- a. Inspect personal protective equipment each day before it is used and remove defective items from service until they are repaired by a competent person or replaced.
- b. Fall arrest equipment receiving an impact from a fall shall be removed from service. The equipment shall be returned to the manufacturer for repair, shall be repaired by a competent person using a qualified facility, or shall be destroyed.
- c. If applicable, test personal protective equipment to ensure it is safe to use.

**Table 8.1**  
**Table of Requirements for Personal Protective Equipment**  
(Western provides equipment as needed)

Type of Equipment	Condition/Use
1. Protective headgear (hard hats and helmets)	Designated hard hat areas - Do not substitute bump caps - Do not alter by drilling holes, trimming brims, etc. Work in energized facilities; riding snowmobiles and ATV; or flying aerial patrol
2. Protective eyewear/facewear  - Industrial safety glasses, plain or prescription; flexible fitting plastic goggles - Face shield, plastic face shield, metal face shield	Duties requiring use of safety glasses in designated "eye hazard" area or operation in varying light conditions (i.e., indoors, outdoors, night, etc.) Designated eye/face hazard Duties requiring full-face protection Face shields to be used with goggles/protective glasses
3. Safety belts, body belts, and life lines	Use when job or procedures require PSSM, Section 16
4. Vehicle occupant restraint system - Lap belts/shoulder straps, or shoulder harnesses	Aircraft, motor vehicles, and other special equipment
5. Protective footwear (toeguards, instep metatarsal guards, rubber boots, or safety shoes) - Conductive footwear - Cut Resistant footwear - Rubber footwear	Use when foot hazard identified  Use where occupation involves barehand (i.e., live-line maintenance) Use when performing tree cutting operations (felling, limbing, and bucking) on the ground Use where wet conditions cause hazards(s)
6. Hearing Protection	Noise hazard areas – working or entering
7. Conductive clothing/boots	All employees working barehand, liveline maintenance; static electric potential
8. Special protective clothing	Use for following types of situations; aviation; chain saw use; welding; handling toxic substances; cryogenics
9. Respiratory protection	As required by manufacturers of chemicals as noted on the Material Safety Data Sheets (MSDS); e.g., pesticides, herbicides, insulating materials, (SF6) oils, solvents, etc., or where the Permissible Exposure Limit (PEL)
10. Other Personal Protective Equipment - Protective skin creams - Face shields - Protective gloves - Personal flotation devices	As determined

## **8.11 PERSONAL FLOTATION DEVICES (PFD).**

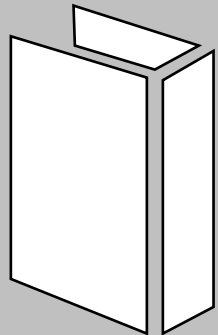
Wear a US Coast Guard approved personal flotation device (PFD) of Type III or Type V at all times when on rafts, in skiffs or small boats, or working over or near water where the danger of drowning exists. PFDs are not required when fall arresting devices or adequate guardrails are used.



# **Switching and Operational Requirements**

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- 9.2 Protection
- 9.3 Six Basic Steps of Switching



## **SWITCHING AND OPERATIONAL REQUIREMENTS**

### **9.1 GENERAL**

Work performed on or near transmission lines or high voltage substation equipment shall be done in compliance with the applicable requirements set forth in the Chapter 1 “Power System Switching Procedure,” Power System Operations Manual (PSOM).

### **9.2 PROTECTION**

Only qualified employees may work on exposed energized lines, parts or equipment. Electrical lines and equipment over 600V fall under the requirements of the PSOM, Chapter 1. Lines and equipment between 50V and 600V which cannot be de-energized and isolated through Lockout-Tagout procedures will be insulated from employee contact through the use of rated insulated tools.

### **9.3 THE SIX BASIC STEPS OF SWITCHING**

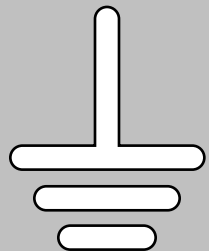
Follow the steps below

1. Carry the switching program with you while switching
2. Touch or point to the device identification name plate to verify its/your location.
3. Recheck the switching program for right location and right sequence.
4. Verify anticipated device position.
5. Perform requested action on the device.
6. Verify desired device position.

# Personal Protective Grounding

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- 10.3 Personal Protective Grounding on Metal Structures
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- 10.13 Grounding for Stringing and Removing Conductors
- 10.14 Care, Inspection, and Testing of Grounding Equipment



# PERSONAL PROTECTIVE GROUNDING

This section includes precautions to be taken when grounding vehicles and using personal protective grounds to protect employees should the circuit be energized from any source. More specific procedures on how grounds are to be maintained and tested are set forth in Chapter 1, “Personal Protective Grounding,” of the Power System Maintenance Manual (PSMM).

## 10.1 GENERAL.

- a. Treat electrical circuits and equipment, normally energized at 600 volts or more, as energized unless they are de-energized, isolated, a clearance is secured, they are properly grounded, and a worksite grounding system has been established and maintained for the duration of the de-energized work procedure.
- b. Before selecting grounds, determine the following:
  - (1) Maximum anticipated fault current for the circuit. (See Regional/District Fault Current charts)
  - (2) Proper size and number of grounds to be used.
  - (3) Where grounds are to be placed.
- c. Grounding cables are to be:
  - (1) Of adequate size (minimum 1/0 AWG copper) to withstand maximum fault current for the facility at 15 cycles relay for substation and 30 cycles relay for transmission line. The cables shall be sized in accordance with Table 10.1.
  - (2) Of adequate length. However, excessive lengths should be avoided since additional length increases the resistance, and thus increases the voltage drop across the grounding cable.

**NOTE:** Ground cable splices equal to or greater than the cable rating may be used to obtain minimum cable lengths.
- d. If multiple ground cables are paralleled in order to carry the fault current, the cables shall be the same size and length, installed at the same location and each cable must be derated by a factor of 10%.

- e. If ground cables are placed at the worksite on both sides of the employee, the cable(s) on each side shall be capable of handling the maximum fault current.
- f. When physically checking ground clamps for tightness, use a hotstick.

## **10.2 APPLICATION OF PERSONAL PROTECTIVE GROUNDS**

- a. Secure a clearance on the circuit or equipment before work is started. The line or equipment shall be tested and found absent of nominal voltage before any personal protective grounds are installed. The required method of testing circuits to be sure they are de-energized before protective grounds are installed is using a high-voltage detector. This method of testing the circuit shall be performed before starting work each day and each time during the day when changed conditions indicate a need for additional tests, such as changing lines or circuits.
- b. Install proper size three phase personal protective grounds as close as practical to the work site. EXCEPTION: See Paragraphs 10.2.c and 10.2.d.
- c. When working on one phase only, single phase personal protective grounding may be used in lieu of three phase personal protective grounding on transmission lines 115kV and greater and 500kV single pole substation equipment. The Minimum live-work approach distances (phase-to-phase and phase-to ground) listed in Appendix A, shall be maintained for the ungrounded phases.
- d. When another crew is working on the same circuit, (except between bracket grounds; ie., storm damage, and construction stringing activities) each supervisor is to secure a clearance, have personal protective grounds placed at his worksite, and let the other supervisor know what work is to be done. If the grounded circuit parallels an energized circuit, high circulating ground currents may exist between remote grounds, therefore necessary precautions shall be taken. (See section 10.12.)
- e. The person holding the clearance is responsible for ensuring that grounds are properly placed and maintained during the job; and for their proper removal prior to releasing the clearance.
- f. Clean the surfaces where ground clamps are to be placed to ensure a low resistance connection.

- g. Install the ground-end clamp of a grounding cable first and remove it last. On metal structures, tighten the clamp and then, if provided, the set screw until it penetrates the surface. EXCEPTION: See Paragraph 10.8.a, 10.9.c.
- h. Install and remove the conductor-end clamps of grounding cables with hot sticks of adequate length and capacity. Do not hold onto grounding cables.
- i. After attaching the ground end, apply grounds, in turn, to the nearest conductor or bus first, proceeding outward and upward until all phases and overhead ground wires (OGW) that are to be grounded have been bonded. Reverse this order when removing grounding cables.
- j. After making the ground-end connection, bond all phases and structure ground wires in a multiphase short at the worksite on wood pole structures. EXCEPTION: See Paragraph 10.2.c.
- k. When the hardware connecting a subconductor is separated from the bundle or when the bonding of the subconductors is suspect, the subconductors shall be bonded together.
- l. Maintain at least 2 feet and 2 inches clearance from insulated OGW unless they are grounded.

### **10.3 PERSONAL PROTECTIVE GROUNDING ON METAL STRUCTURES.**

Connect personal protective grounds to any convenient metal structure member. See Figures 10.1 - 10.2 for the preferred methods.

### **10.4 PERSONAL PROTECTIVE GROUNDING ON WOOD POLE STRUCTURES.**

- a. Inspect and clean pole ground wires to determine that they have not been cut, damaged, or removed prior to attachment.
- b. Mount grounding cluster bars on the grounded-structure pole(s) no higher than conductor level and below the worker's feet as shown in Figures 10.3, 10.4 and 10.6, as the preferred methods.
- c. Bond grounding cluster bars to the pole ground wire(s). Cluster bars may also be bonded to the OGW and/or to ground rod(s).
- d. On structures without OGW, pole ground wires or with defective pole ground wire(s), bond the grounding cluster bars to ground rods, as shown in Figures 10.3 and 10.4, as the preferred method.

- e. A driven ground rod may be used in lieu of clusters bars PROVIDED that the pole grounds are tied to the ground rod prior to attaching to the conductors, as shown in figure 10.7.
- f. When the OGWs are used in place of cluster bars, as shown in Figure 10.5, a personal ground cable must be placed between the OGW and the structure ground IF the OGW connecting hardware is to be removed.
- g. When grounding to the pole grounds, wood structure grounds shall be visibly electrically bonded.

## **10.5 GROUND ROD INSTALLATIONS.**

- a. When a ground rod is required, install it to a depth of at least 5 feet to ensure good soil contact. If a rod cannot be installed to a depth of 5 feet, install additional rods such that a total of at least 5 feet of rod is buried. Bond these rods together with grounding cables of adequate size based on the maximum anticipated fault current. Also, bond the installed ground rod(s) to any existing grounding system to establish an effective worksite grounding system.
- b. If ground rods cannot be installed at all, such as in a concrete parking lot or frozen ground, the structure ground or OGW shall be used.

## **10.6 APPROACH DISTANCE FROM GROUNDS.**

Persons on the ground should stay clear (at least 10 feet where feasible) of down guys, ground rods, vehicles that are bonded to the conductor grounding system and its grounds, structure ground wires while personal protective grounds are in place to reduce the hazard of step, touch, and transferred touch voltages. When it is necessary to work on or near these features, protective measures, such as insulated platforms, should be used to minimize the hazard.

## **10.7 GROUNDING IN SUBSTATIONS AND SWITCHYARDS.**

- a. The noncurrent-carrying conductive parts of electrical equipment, such as transformer cases, circuit breaker tanks, oil storage tanks, rails, piping, screens, metal fences, and guards shall be permanently grounded by copper conductor(s) to the station ground mat. Physically inspect these grounds periodically to ensure that a good bond exists. These grounds are not to be removed while the equipment is in service.

- b. Request and receive a clearance and ground current-carrying components of substation equipment before approaching them within the minimum approach distances specified in Appendix A, Table A-1. Personal protective grounds should be placed as close to the equipment as practical to minimize the inductive voltage loop formed by the ground cable and the employee. (See Figure 10.9).
- c. Request and receive a clearance and ground transformer and circuit breaker bushings before oil or gas is drained from their tanks. This does not apply to oil or gas sampling.
- d. Bond personal protective grounds to a grounded metal structure member, or to a common copper equipment or structure grounding lead, and then to each bushing lead of the equipment.
- e. In performing certain tests which require the circuit breaker terminals to be ungrounded, such as power factor or oscillographic contact (motion analyzer) tests, the bushing leads may be temporarily ungrounded (using a hotstick) as long as the ground is reestablished (using a hotstick) as soon as the test is completed.
- f. After capacitor banks (series and shunt) have been de-energized and isolated, wait at least 5 minutes to permit the capacitors to drain through their internal discharge resistor. Close the bank grounding switch, if available, and apply personal protective grounds. Then short the capacitors to be contacted from terminal-to-terminal and from terminal-to case by approved means. (Caution. If possible, allow several hours after the failure of a capacitor before the shunting, grounding, and handling of bulged units to allow cooling and relieving of internal pressure.)
- g. When working in an area of a substation under a clearance where there are one or more physical breaks in the electrical circuit, install personal protective grounds on each section of the circuit if a hazard exists.
- h. Grounding through a device shall not be permitted as part of the personal protective grounding system.
- i. Where a substation, switchyard, or transmission line tap is under a clearance, is not influenced by induction from nearby facilities, and has all line terminals and back feeds such as station service transformers grounded, it may not be necessary to provide additional protective grounds within that station, yard, or tap.



**NOTE:** Energy storage devices shall be discharged in accordance with this section, PSMM Chapter 1, Personal Protective Grounding, and the manufacturer's recommendations.

- j. When working on an insulated high-voltage cable, install personal protective grounds on the terminal end of the cable. The cable shall be spiked before it is opened, if there is any possibility of opening the wrong cable. Use insulated tools to cut the cable.
- k. Do not attach personal protective grounds to the transformer neutral grounds. Use other nearby ground mat risers.

## **10.8 BONDING OF EQUIPMENT DURING OIL AND SF<sub>6</sub> HANDLING.**

- a. During oil handling operations on oil-filled equipment, observe the following precautions to prevent the buildup of a hazardous electrical charge.
  - (1) Bond apparatus tanks, conductive hoses, pumping or filtering equipment, drums, tank cars, trucks, and portable storage tanks to the station ground mat. Connect the vehicle end first and disconnect it last to prevent possible arcs near the vehicle. Conductive hoses should be tested for continuity before use.
  - (2) Bond exposed conductors, such as transformer or circuit breaker bushings, or coil ends of transformers where bushings have been physically removed, to the same grounding point.
- b. Bond SF<sub>6</sub> equipment in accordance with manufacture recommendations and Western work procedures.

## **10.9 GROUNDING VEHICLES.**

- a. Vehicles, whether with an insulated or uninsulated boom used to bring workers into contact with a grounded system, shall be grounded with a ground cable rated for the maximum anticipated fault current. The vehicle shall be grounded to the structure ground system where practicable. Platforms and metal-lined buckets on insulated booms shall be bonded with the live-line barehand-type bonding lead to the ground system before hand or body contact. When grounding to the structure is not practicable, such as during in-span repair work, the vehicle shall be bonded to a ground rod driven near midpoint of vehicle.

- b. Ground parked vehicles that are involved in substation maintenance activities to the station ground mat, using a grounding cable(s) of adequate size, if the vehicle is in close proximity to energized parts as defined in Appendix A, Table A-2. Vehicles in transit shall comply with section 5.2.c.
- c. When grounding trucks with permanently mounted reel-type ground cables, it is permissible to bond the ground cable to the structure ground or ground rod. If there is a potential for hazardous induced voltages to be present on the vehicle, such as in substations, a hotstick should be used to attach the ground cable.
- d. No part of a vehicle may be used as a means to complete or lengthen a personal protective grounding circuit unless the vehicle has been designed, tested, and rated, for carrying the maximum available fault current at the worksite.

## **10.10 OPENING OR SPLICING DE-ENERGIZED CONDUCTORS OR OVERHEAD GROUND WIRES.**

- a. Before separating and/or splicing a conductor or OGW (while under a clearance), at ground level take the following precautions:
    - (1) Bond all conductors together, including OGWs when applicable, and bond them to ground as near to the worksite as practicable.
    - (2) Install a ground on the damaged conductor or OGW at each structure from which it is to be lowered. Continuous grounding must be in place until the conductor or OGW is reinstalled.
    - (3) Install a ground rod and bond it to the metallic work platform if one is used. Also install ground cables from the ground rod (using a hotstick) to each side of where the conductor or OGW is to be cut or spliced. (See Figure 10.10.)
- NOTE:** If an insulated work platform is used, it must be kept clean and dry.
- (4) Bond any other conductive objects in the work area to the same ground rod if a worker could bridge between them and the conductor or OGW being worked.

(5) The use of insulated or bonded conductive work platforms should be considered and they should be accessed quickly to minimize the possibility of hazardous step, touch, and transferred touch voltages.

(6) Bond equipment used to pull and hold tension on the conductor or OGW to a structure ground or a temporary ground rod.

**NOTE:** All workers should stay on the equipment or at least 10 feet away from it. When necessary to access or get off the equipment, it should be done quickly.

b. Before separating and/or splicing a conductor or OGW at an in-span location above ground level from an insulated or uninsulated aerial device, take the following precautions:

(1) Bond all conductors together, including OGW when applicable, and bond them to a ground as near the worksite as practical.

(2) Ground the vehicle as specified in Subsection 10.9.

(3) Persons on the ground should stay at least 10 feet away from the vehicle, ground rods, down guys, etc., during this operation to reduce exposure to hazardous step, touch, and transferred touch voltages.

(4) Install a jumper or bond (and/or section of conductor) rated for the maximum continuous current to maintain the continuity of the conductor or OGW before cutting. Use a hotstick when installing a jumper to restore continuity to a severed conductor or OGW.

c. Before separating and/or splicing an optical ground wire (OPGW) at ground level for wood structures, whether under a clearance or while the line is energized, take the following precautions:

(1) Install a ground rod near the work location and bond the structure ground to the ground rod.

(2) If splicing operations are performed outdoors, install a conductive ground mat at the work location and bond the mat to the ground rod.

(3) If the splicing operations are performed from inside a vehicle, bond the vehicle to the ground rod.

- (4) Before removing the splicing box from the structure, bond together both sections of the OPGW above the splice box and attach a personal protective ground from the OPGW to the ground rod.
- (5) All splicing operations shall be performed from the conductive mat or from inside the vehicle.
- d. Before separating and/or splicing an optical ground wire (OPGW) at ground level for metal structures, whether under clearance or while the line is energized, take the following precautions:
  - (1) If splicing operations are performed outdoors, install a conductive ground mat at the work location and bond the mat to the structure.
  - (2) If the splicing operations are performed from inside a vehicle, bond the vehicle to the structure.
  - (3) Before removing the splice box from the structure, bond together both sections of the OPGW above the splice box and attach a personal protective ground from the OPGW to the structure.
  - (4) All splicing operations shall be performed from the conductive mat or from inside the vehicle.

## **10.11 USE OF TERMINAL GROUND SWITCHES.**

Ground switches may be used in conjunction with personal protective grounds. They must not be used as or in place of personal protective grounds.

## **10.12 GROUNDING OF CIRCUITS ENERGIZED BY INDUCTION FROM PARALLEL CIRCUITS.**

When the arc drawn between the circuit and the ground cable being installed is too great to allow installation of the ground cable, a Job Hazard Analysis shall be performed to determine which one of the following methods shall be used:

- a. Close terminal ground switches until application of the grounding cables is completed. Transmission line terminal ground switches may be opened to reduce circulating ground current at the worksite.
- b. Use ground cables with in-line interrupters.

- c. Live-line hotstick methods in accordance with Section 13
- d. Remove the energized line from service and use normal grounding methods.

## **10.13 GROUNDING FOR STRINGING AND REMOVING CONDUCTORS.**

See Section 12.5 of this manual.

## **10.14 CARE, INSPECTION & TESTING OF GROUNDING EQUIPMENT.**

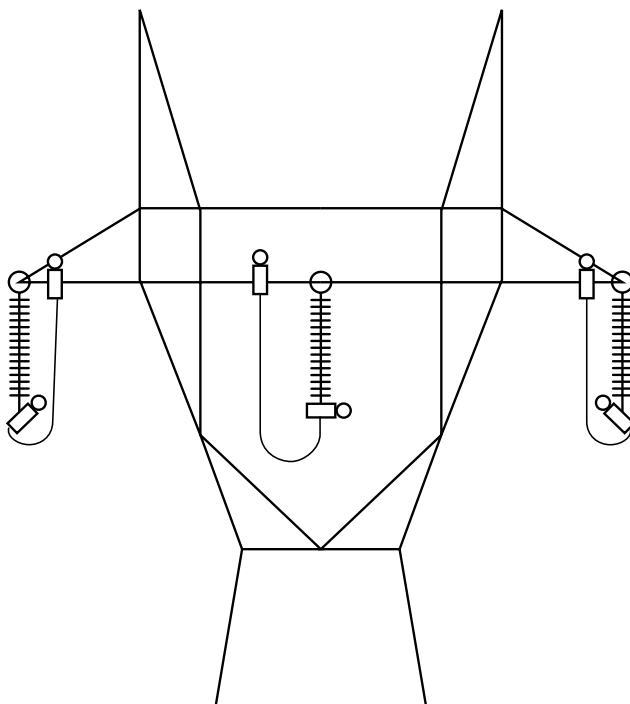
Maintain grounding equipment in good electrical and mechanical condition by:

- a. Visually inspecting grounding equipment before each use for tight connections, cleanliness, and physical damage.
- b. Electrically testing grounding cables every two years, after modification, or after sustaining an electric fault. An electrical acceptance test shall be performed on new grounding cables prior to use.
- c. Identifying each grounding cable (or grounding cable set) when it has passed the test, and destroying those which fail the test unless they can be repaired.
- d. Maintaining records of the electrical tests.

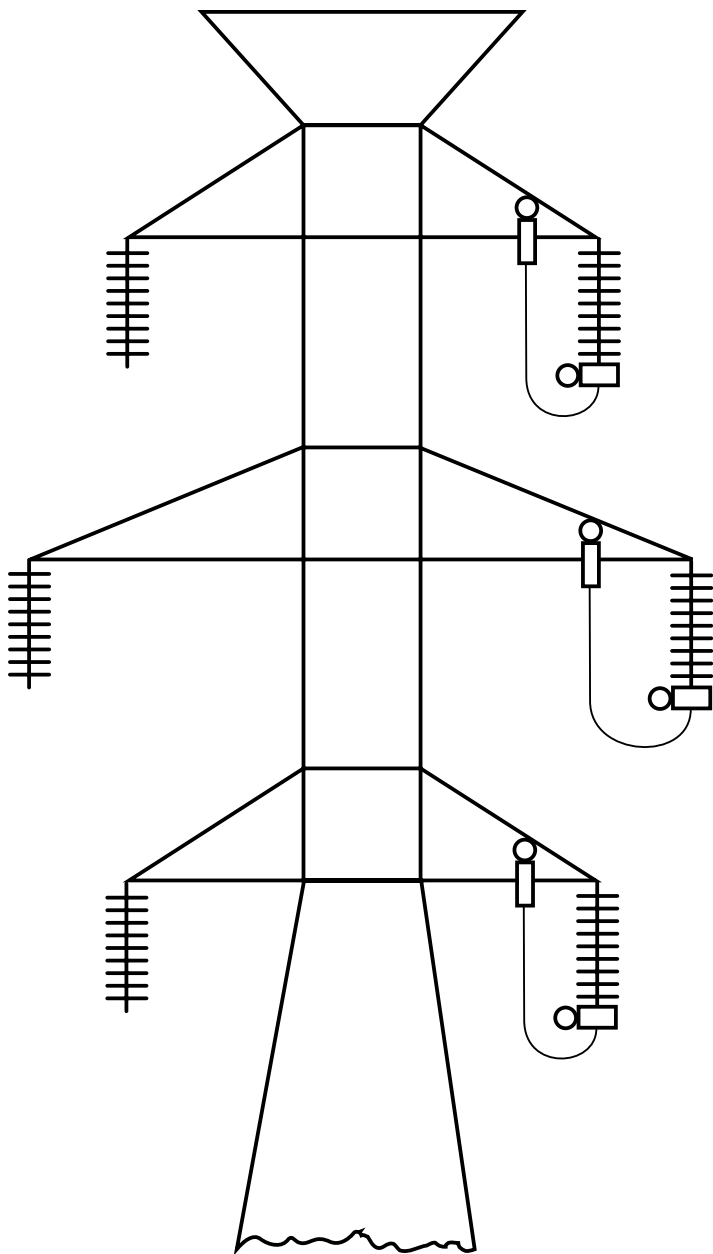
**NOTE:** (See Table 10.1 next page) If the continuous current anticipated at the jobsite exceeds the continuous current rating of the grounding cable, an aluminum conductor of equal or greater capacity shall be used as a jumper, including properly rated clamps. Ground cables shall be capable of handling the continuous current available. In areas where induced voltages may be a hazard, calculations shall be made to determine the magnitude and time characteristics of continuous current for cables to be left in place for more than one day. If multiple ground cables are paralleled in order to carry the fault current, the cables shall be the same size and length, and each cable must be derated by a factor of 10%.

**TABLE 10.1**  
**MAXIMUM FAULT CURRENT CAPABILITY AND**  
**CONTINUOUS CURRENT RATING FOR**  
**GROUNDING CABLES**

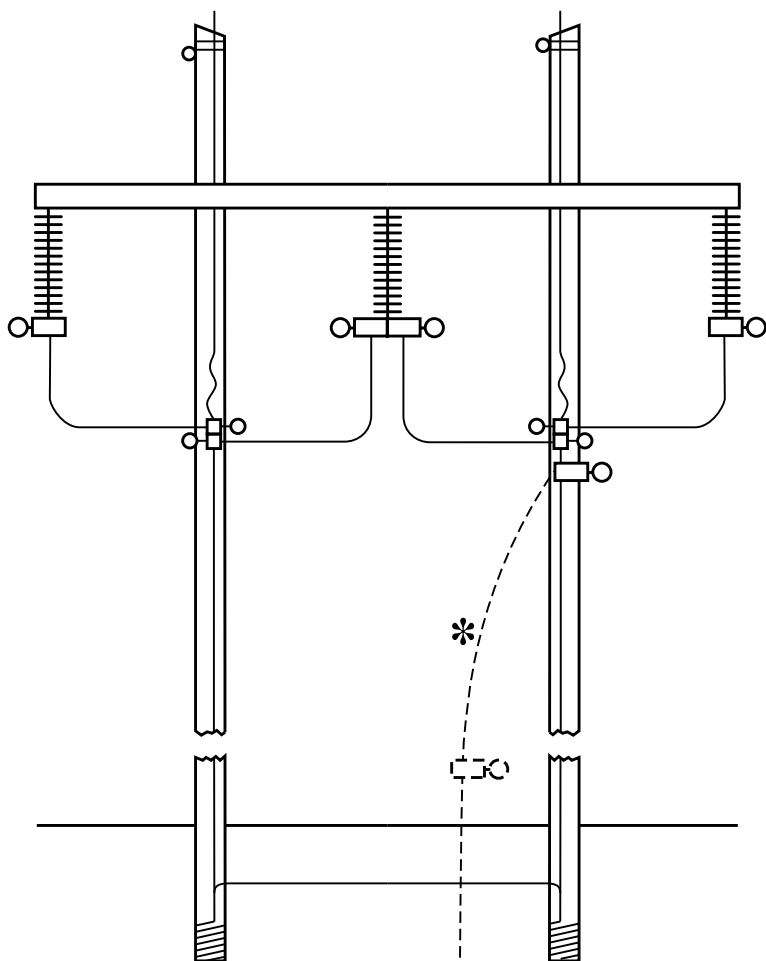
Cable Size (AWG)	Continuous Current (RMS)	Fault Time (cycles)	Fault Current Capability RMS
1/0	250	15	21,000
		30	15,000
2/0	300	15	27,000
		30	20,000
3/0	350	15	34,000
		30	25,000
4/0	400	15	43,000
		30	30,000



**FIGURE 10.1**  
**PREFERRED PERSONAL PROTECTIVE GROUNDING**  
**INSTALLATION FOR SUSPENSION, DEAD-END,**  
**OR ANGLE TOWER**



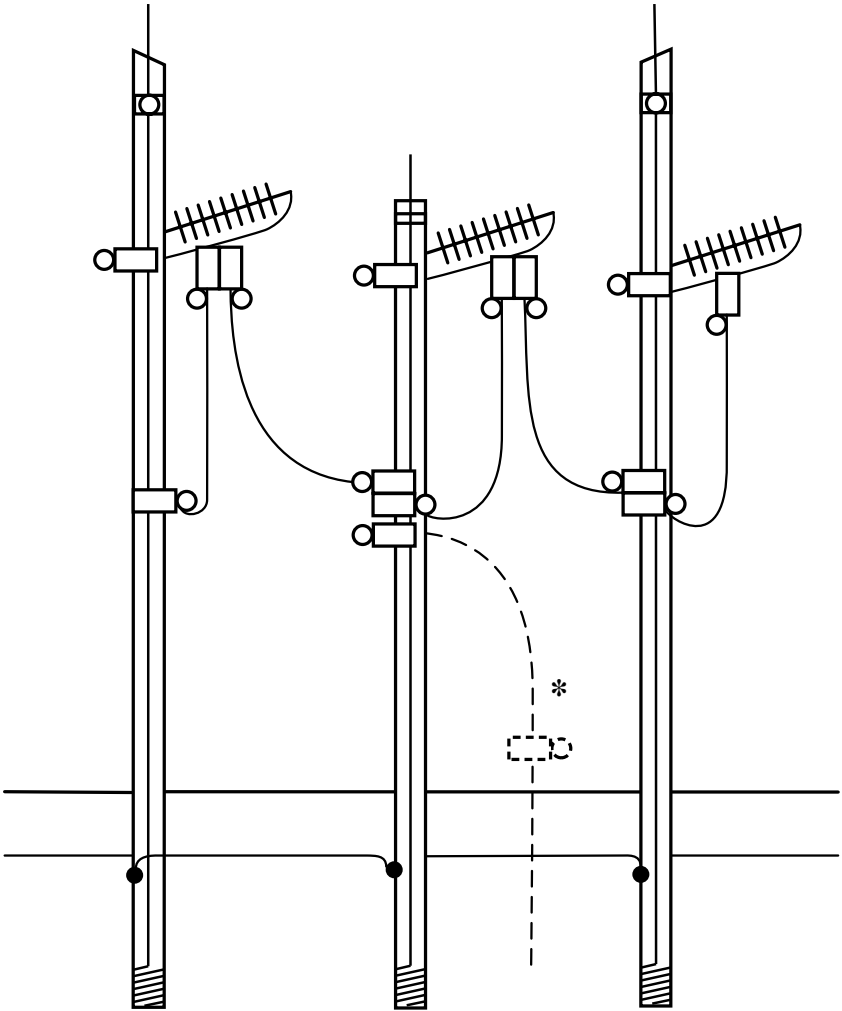
**FIGURE 10.2**  
**PREFERRED PERSONAL PROTECTIVE GROUNDING**  
**INSTALLATION FOR DOUBLE-CIRCUIT**  
**TOWER**



**FIGURE 10.3**  
**PREFERRED PERSONAL PROTECTIVE GROUNDING**  
**INSTALLATION FOR TWO-POLE**  
**GROUNDING STRUCTURE**

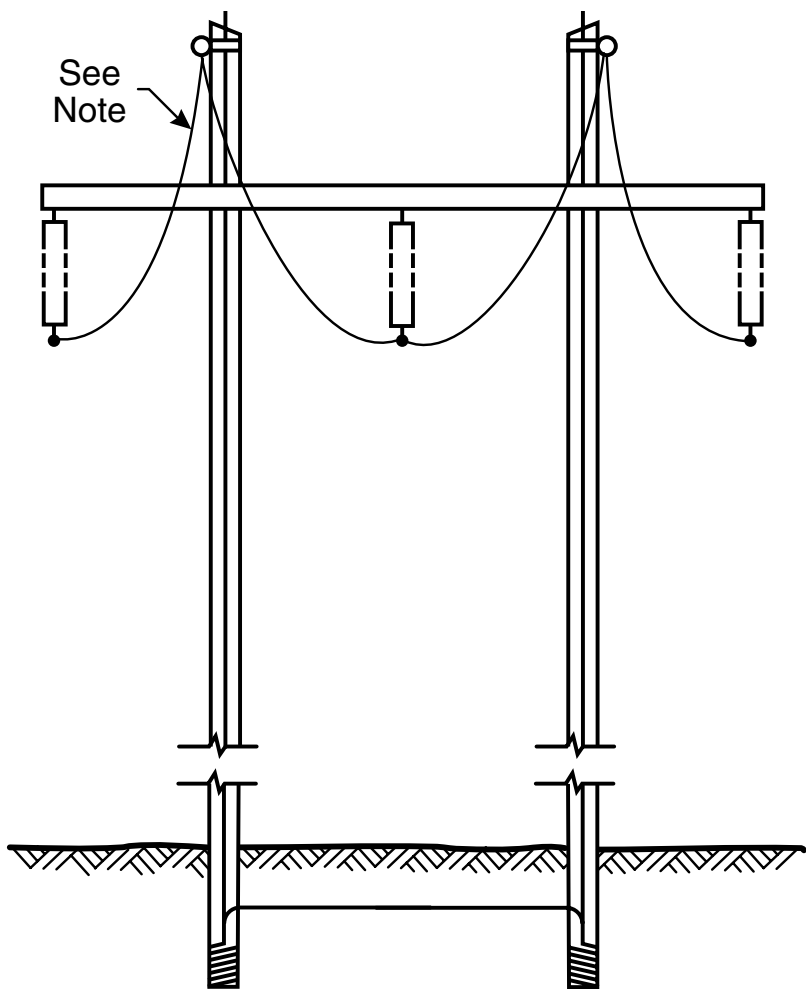
\*Add ground rod & cable for structures without OGW.





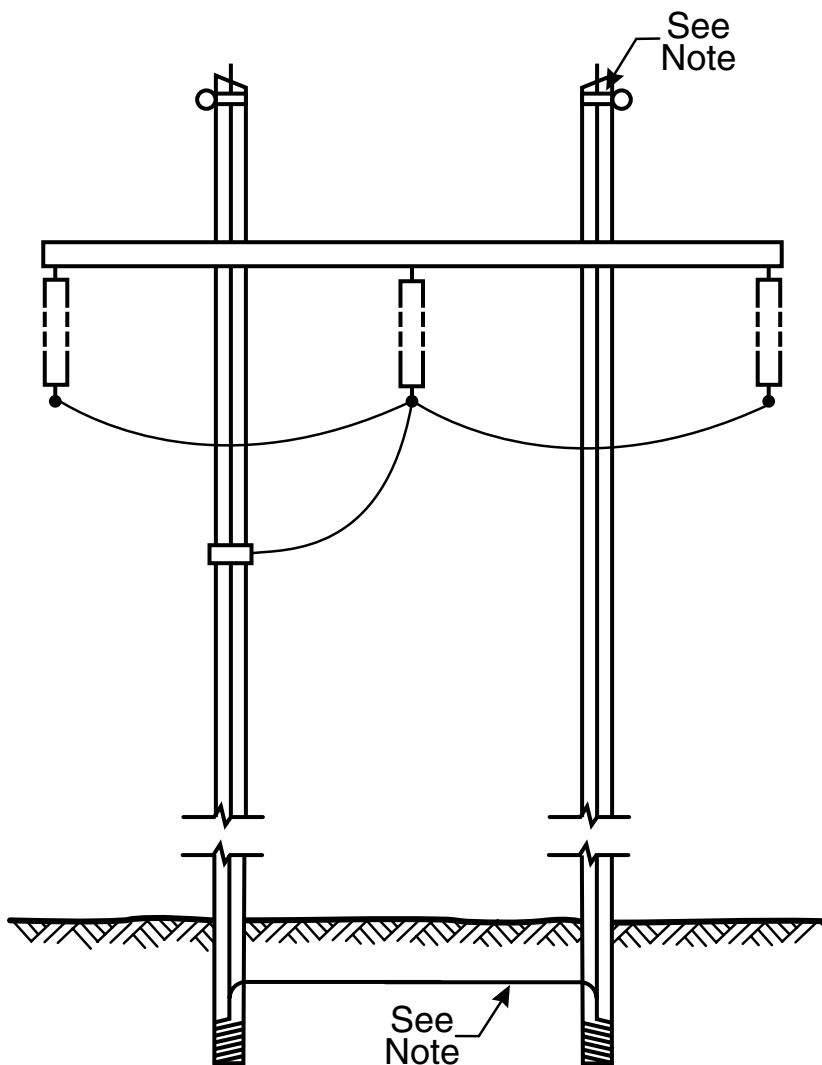
**FIGURE 10.4**  
**PREFERRED PERSONAL PROTECTIVE GROUNDING**  
**INSTALLATION FOR THREE-POLE**  
**GROUNDING STRUCTURE**

\*Add ground rod & cable for structures without OGW



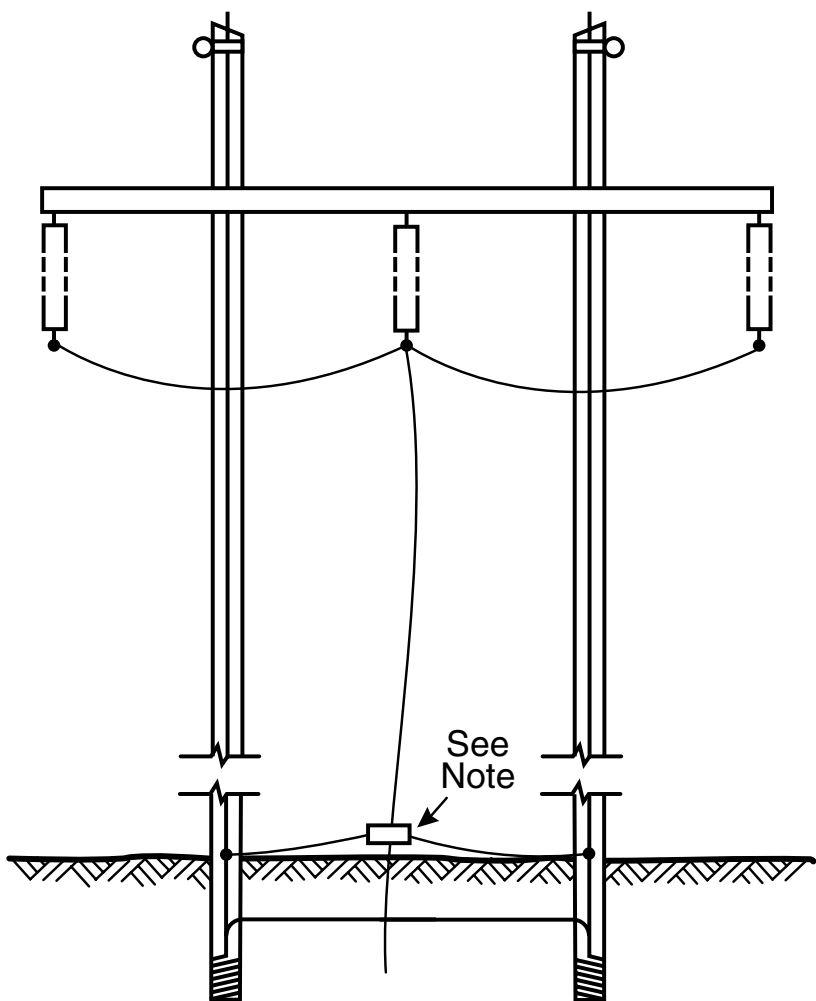
**FIGURE 10.5**  
**PERSONAL PROTECTIVE GROUNDING**  
**WITH BUCKET TRUCK (ALTERNATE)**

NOTE: When the OGWs are used in place of cluster bars, a personal ground cable must be placed between the OGW and the structure ground IF the OGW connecting hardware is to be removed.



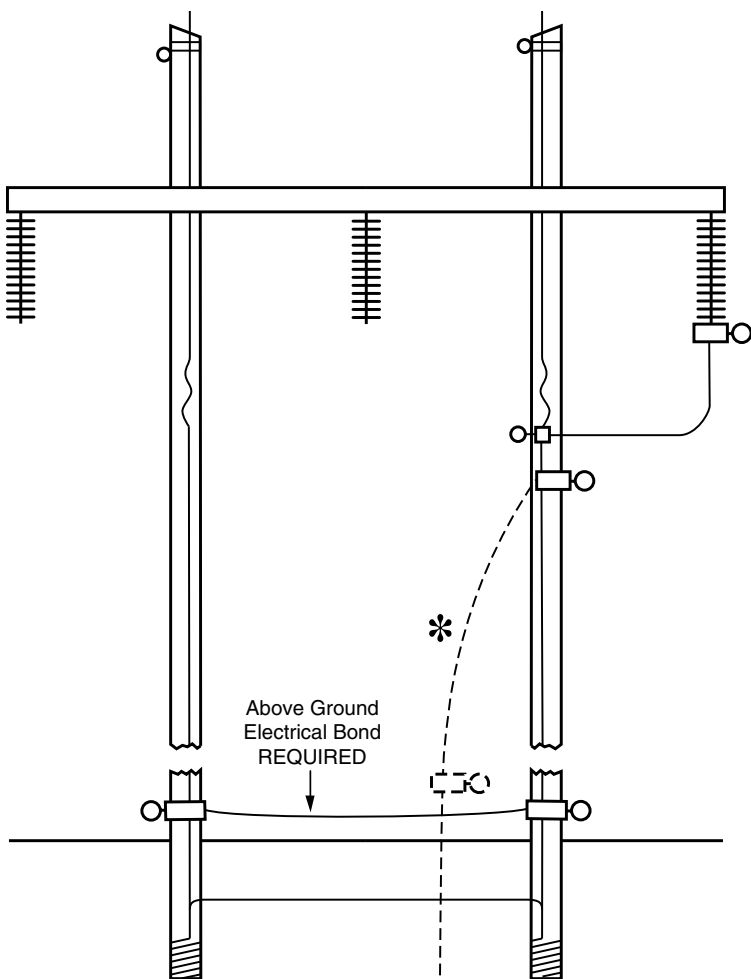
**FIGURE 10.6**  
**PERSONAL PROTECTIVE GROUNDING WITH SINGLE**  
**CLUSTER BAR (POLE REMOVAL)**

**NOTE:** To minimize step, touch, and transferred touch voltages around the pole to be removed, isolate the underground pole-to-pole tie and the OGW from the pole ground wire prior to placing the personal protective grounds on the conductors. Do not become a path to ground by letting your body bridge the gap between the pole grounding wire and the underground pole-to-pole tie on the OGW.



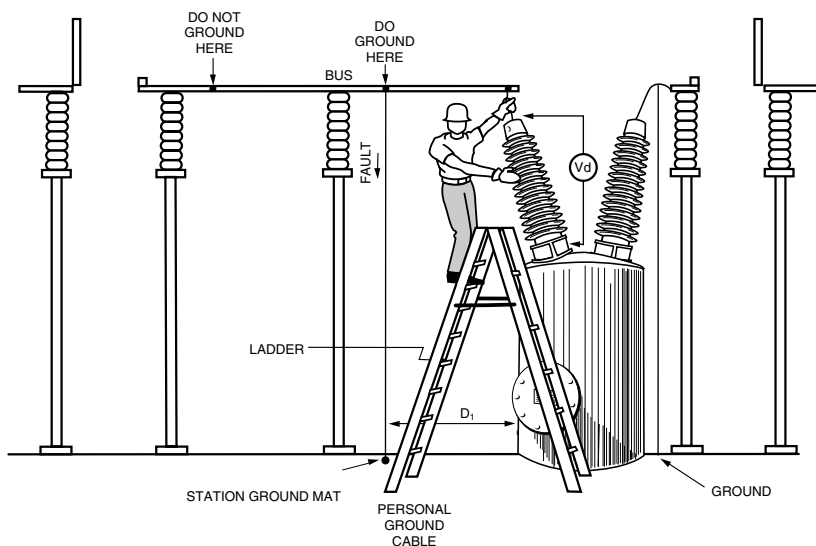
**FIGURE 10.7**  
**PERSONAL PROTECTIVE GROUNDING WITH**  
**DRIVEN GROUND ROD (ALTERNATE)**

NOTE: A driven ground rod may be used in lieu of clusters bars PROVIDED that the pole grounds are tied to the ground rod prior to attaching to the conductors.



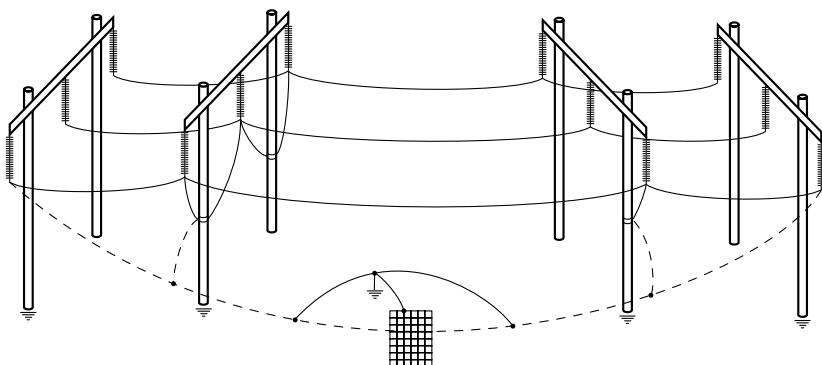
**FIGURE 10.8**  
**PREFERRED PERSONAL PROTECTIVE**  
**SINGLE PHASE GROUNDING**  
**INSTALLATION FOR TWO-POLE GROUNDING STRUCTURE**

\* Add ground rod & cable for structures without OGW.



**FIGURE 10.9**  
**PREFERRED SUBSTATION**  
**PERSONAL PROTECTIVE GROUNDING**

**NOTE:**  $D_1$  should be kept as small as reasonable.

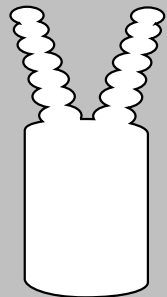
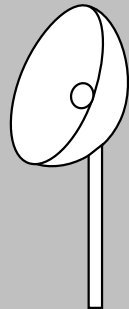


**FIGURE 10.10**  
**PREFERRED PROCEDURE FOR SPLICING A**  
**CONDUCTOR FROM A METALLIC GROUND MAT**

# Substation and Communication Facility Work

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- 11.1 Substation
  - 11.1.1 General
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  - 11.1.4 Insulating Oil-Handling Operations
  - 11.1.5 Insulating Gas Handling Operations
- 11.2 Communication Facilities



## **SECTION 11**

# **SUBSTATION AND COMMUNICATION FACILITY WORK**

## **11.1 SUBSTATION.**

This section addresses precautions to be taken when working on substation equipment and facilities.

### **11.1.1 GENERAL.**

- a. Before starting substation work, the supervisor shall conduct a tailgate briefing with the crew and develop a job hazard analysis (JHA) if needed.
- b. Follow the local rules for substation entry and exit notification.
- c. Maintain neatness, orderliness, and good housekeeping in and around the substation.
- d. Trench and excavation work - refer to 29 CFR 1926 subpart P for safe work rules.
- e. At least 2 employees must be present for work in proximity to energized parts (Appendix A, Table A-2) energized at more than 600 volts. The following types of work are excepted when they can be performed safely by one person:
  - (1) switching (routine) of circuits.
  - (2) work performed with live-line tools if the employee is positioned so that he or she is neither within reach of, nor otherwise exposed to contact with energized parts.
  - (3) emergency repairs to the extent necessary to safeguard the general public.
  - (4) normal routine maintenance that does not require a clearance or HLO.
- f. Do not park vehicles under energized circuits except when essential for the work being performed.



## 11.1.2 WORK NEAR ENERGIZED EQUIPMENT BY ELECTRICAL WORKERS.

- a. When working in a substation without a clearance, maintain at least the minimum approach distance shown in Appendix A, Table A-1 from exposed energized high-voltage (600 volts and above) components of substation equipment.
- b. When working in a substation with a clearance on station equipment, the Clearance Supervisor is responsible for preventing encroaching the MAD (Appendix A, Table A-1) to adjacent energized equipment. The JHA shall address close proximity to energized equipment when work is performed in close proximity to energized equipment (distances in Appendix A, Table A-2), or there is potential encroachment by unauthorized personnel.

**NOTE:** When work is performed in close proximity to energized equipment (distances in appendix A, A2) or there is a potential encroachment by unauthorized personnel, one of the following methods shall be used:

- (1) Use visible warning devices, such as cones, tape, rope, or portable fence sections with minimum ground-to-top height of 42 inches. Warning signs shall be placed at intervals of not more than 20 feet. Barricades can be placed at any location that would sufficiently warn workers from encroaching the MAD.
- (2) For work above ground on bus sections and associated equipment, use distinctive flags on hooks or similar warning devices placed near the energized circuits by hotsticks or other appropriate means to indicate the hazard.
- (3) Using a designated person to be a “safety observer” while work is in progress. The “safety observer” shall not perform any other work.

**Exception:** The 3 precautionary methods above are not required when working in a substation with a clearance on substation equipment and no grounds are required, such as work only in the cabinet, and there is no possibility of unauthorized personnel encroachment.

c. When performing field testing one of the following means shall be used to prevent unauthorized personnel from entering the test area: (Any person not directly involved with the high voltage testing is considered unauthorized for this paragraph.)

- (1) The test area shall be guarded by the use of distinctly colored safety tape that is supported approximately waist high and to which safety signs may be attached.
- (2) The test area shall be guarded by a barrier or barricade that limits access to the test area to a degree equivalent to (1) above.

**NOTE:** If you have a properly placed work barricade around the equipment it can serve double duty as the test area guard. In this case the barricade would not have to be removed after high-voltage testing is completed. If you are testing in an area such as a shop, etc., the barricade would need to be removed when the testing is completed.

- (3) The test area shall be guarded by one or more test observers stationed so that the entire area can be monitored. The operator of the safety switch, while Doble Testing meets the intent of this requirement if they can monitor the entire area.
- (4) The barriers required by c (1) and c (2) above shall be removed when the protection they provide is no longer needed.

### **11.1.3 WORK ON STATION EQUIPMENT BY ELECTRICAL WORKERS.**

- a. Ground circuits/equipment that are under a clearance at the worksite using the appropriate personal protective grounding cables prior to commencing work.
- b. Short the secondary terminals of energized current transformers (CT) before opening their secondary circuits. Also verify that the CT tank is bonded to ground.
- c. After de-energizing and isolating a capacitor bank (series or shunt), wait at least 5 minutes to permit the capacitors to drain through their internal discharge resistor. Close the bank grounding switch if available and apply personal protective grounds. Then short the capacitors to be contacted from terminal-to-terminal and from terminal-to-case by approved means. (Caution. If possible, allow several hours after the failure of a capacitor before the shunting, grounding, and

handling of bulged units to allow cooling and relieving of internal pressure.)

- d. Ground surge arresters before touching them.
- e. Before working inside the base housing of a coupling capacitor, use a hotstick to close the unit's grounding switch and visually inspect the ground switch and ground wire to ensure they are intact.
- f. Use fuse tongs or other approved rated tools to install or remove fuses on energized circuits.
- g. Use non-metallic measuring devices in substations and other locations where they are subject to contacting energized circuits.
- h. Wear a face shield, rubber apron, and rubber gloves when testing or maintaining station batteries.
- i. When it is necessary to enter transformers, tanks, or other confined/enclosed spaces, Refer to WAPA Order 3790.1, latest revision, for Confined or Enclosed Spaces. Also use hand, air, hydraulic, or battery powered tools; or use electrical tools that are supplied through a circuit that is protected by a ground-fault circuit interrupter (GFCI). Only specially guarded low temperature lights are to be used inside the confined/ enclosed space.
- j. When switching, the switchman shall stand on the provided switch-operating platform to safeguard against any hazardous voltage gradients that may exist during fault conditions.

### **11.1.4 INSULATING OIL-HANDLING OPERATIONS.**

Observe the following additional precautions during oil-filtering, oil-reclaiming, and other oil-handling operations:

- a. Secure a clearance and ground potential and current transformers before taking oil samples from them.
- b. Have appropriate fire extinguisher(s) readily available.
- c. If necessary to process oil in an energized transformer, conduct a job hazard analysis, prepare a written work procedure, and take appropriate precautions.

### **11.1.5 INSULATING GAS HANDLING OPERATIONS.**

Refer to Power System Maintenance Manual (PSMM) Chapter 4  
“Maintenance and Handling of Insulating Gas.”

## **11.2 COMMUNICATION FACILITIES.**

### **a. MICROWAVE TRANSMISSION**

- (1) No employee shall look into an open waveguide or antenna that is connected to an energized microwave source.
- (2) If the electromagnetic radiation level within an accessible area associated with microwave communication system exceeds the radiation protection guide given in §1910.97 (a)(2) the area shall be posted with the warning symbol described in §1910.97 (a)(3). The lower half of the warning symbol shall include the following statements or ones that the employer can demonstrate are equivalent:

Radiation in this area may exceed hazard limitations and special precautions are required. Obtain specific instruction before entering.

- (3) When an employee works in an area where the electromagnetic radiation could exceed the radiation protection guide, the employer shall institute measures that ensure that the employee's exposure is not greater than that permitted by that guide. Such measures may include administrative and engineering controls and personal protective equipment.

### **b. POWER LINE CARRIER INCLUDING FIBER OPTICS.**

Power line carrier work, including work on equipment used for coupling carrier current to power line conductors, shall be performed in accordance with the requirements pertaining to Sections 13 and 14.

### **11.2.1 RF EXPOSURE**

This section addresses the worker safety issues for Radio Frequency Exposure (RF) from RF communication facilities utilizing antenna systems installed on Western towers. It provides guidelines regarding safe working distances from energized antennas and time limits for worker exposure. All affected employees shall have received RF occupational/controlled exposure training and follow this general criteria.

- (1) **CRITERIA 1:** For work activity that would result in personal exposure exceeding six (6) minutes, the minimum safe working distances (MSWD) for antennas is:

**Directional Panel Antennas (see Figure 11.1)**

MSWD = 2 feet, unless marked otherwise by appropriate signage.

**Omni-directional Whip Antennas (see Figure 11.1)**

MSWD = 2 feet, unless marked otherwise by appropriate signage.

**Microwave Antennas**

MSWD = No MSWD is specified unless marked otherwise by appropriate signage.

**NOTE:** The MSWD based upon the technical parameters of each antenna will be determined. For towers with antennas where the MSWD is greater than 2 feet, warning signs will be posted so as to be visible to a climber or worker from the climbing leg and in the structure near the antenna.

- (2) **CRITERIA 2:** Work activity that would normally violate the MSWD's BUT would result in a time averaged personal exposure less than or equal to six (6) minutes times the maximum permissible exposure (MPE) in any 6-minute period is considered safe and de-energization of the antennas is not required.

**EXAMPLE:** A worker climbing past an antenna may move within the MSWD of that antenna in order to get to a work site located outside the MSWD. The worker may return within the MSWD after remaining well beyond the MSWD, provided that the total time-averaged exposure does not exceed the equivalent of 6 minutes of exposure at the MSWD rate in any 6-minute period.

- (3) **CRITERIA 3:** In situations where a worker must remain within the specified MSWD resulting in a time-averaged exposure which exceeds six minutes times the MPE in any six minute period, arrangements must be made for the facility operator to de-energize the antenna during the period of the worker exposure

**NOTE:** A portable, hand-held personal RF radiation monitor should be used to verify that an antenna has been de-energized prior to entering the MSWD.

(4) **CRITERIA 4:** General population/uncontrolled exposure limits will apply to any Western employee which may be exposed to RF radiation as a consequence of their employment but may not be fully aware of the potential for exposure or cannot exercise control over their exposure. Occupational/controlled exposure limits will only apply to those employees who have been trained, or have specific knowledge, such that they are fully aware of the exposure and can exercise control over their exposure.

**11.2.2 FIBER OPTIC/LASER SAFETY**

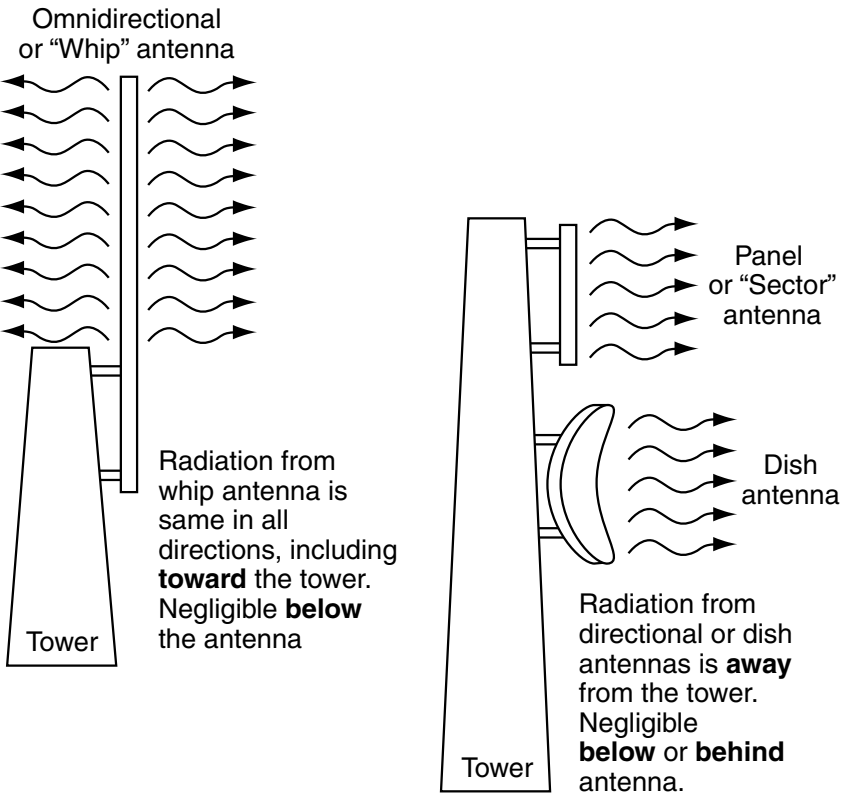
Employees installing, modifying, and servicing LASER/LED optical fiber communication systems (OFCS) shall utilize the following:

- (1) Only personnel trained in use of LASER/LED equipment shall perform the installation, modification, and maintenance of LASER/LED OFCS.
- (2) Do not view the end of fibers without proper eye protection. Note: OFCS emissions are often not in the visible range, i.e. hazards are not easily detected.
- (3) All fiber splicing, fiber modification, fiber installation and removal shall be done with the LASER/LED source de-energized.
- (4) If viewing fiber ends is necessary for work while LASER/LED sources are energized, only indirect image converters or filtered optical instruments sufficient to reduce eye exposure to safe levels shall be used.
- (5) All terminated fiber ends shall be covered by tape or end caps.
- (6) Fiber splicing and cleaving shall be performed using PPE that prevents injury to eyes and skin from fiber particles.

**Potential Risks Associated with LASER/LED OFCS**

Service Group/Class	Hazard to Eye	Hazard with optical aids	Warning Labels Required
I	No	No	No
II	Yes*	Yes*	Yes*
III	Yes*	Yes*	Yes*
IIII	Yes*	Yes*	Yes*

**\*Note:** OFCS systems incorporate Class 1, Class 2 and Class 3 lasers. Under normal operating conditions OFCS are shielded by enclosures, fiber sheaths and connectors. Under these conditions there are no accessible radiant energy emissions, and no subsequent safety or health hazards. For this reason end to end OFCS are inherently Class I systems. However, OFSC can be compromised deliberately or accidentally, requiring the use of the above work rules and precautions.



**FIGURE 11.1**  
**RF EXPOSURE ACCORDING TO**  
**TYPE OF ANTENNA**

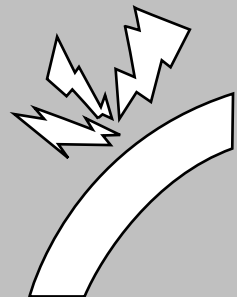




# Deenergized Line Work

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- 12.1 General
- 12.2 Pole Holes
- 12.3 Erection and Removal of Poles
- 12.4 Adjacent Energized Conductors
- 12.5 Stringing Transmission Line  
Conductors and Overhead Ground  
Wires
  - 12.5.1 General
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Removing Conductors
  - 12.5.3 Crossing Circuits, Highways,  
Railroads, and Telephone Lines



## SECTION 12

# DE-ENERGIZED LINE WORK

This section includes precautions to be taken when working on transmission lines that are de-energized, isolated, a clearance is secured, and the lines are properly grounded.

## 12.1 GENERAL.

- a. Treat all circuits normally energized at 600 volts or more as energized unless they are properly grounded.
- b. Treat all overhead ground wires, static lines, and guy wires as energized unless they are bonded/grounded properly.
- c. Keep yourself and conductive objects away from ungrounded circuits and parts by at least the minimum approach distances specified in Appendix A, Table A-1.
- d. Use a nonconductive measuring device to verify the distance from adjacent energized circuits, if necessary.
- e. Obtain a hot line order on adjacent energized circuits or equipment when the work may require being in proximity to energized parts specified in Appendix A, Table A-2. The JHA shall address close proximity to energized equipment. The person who obtains the HLO shall remain at the worksite while work is being performed. When the work may require being in proximity to energized parts, this person shall remain in a non-working status and shall be positioned to observe all aspects of the work performed.
- f. Before starting new work, conduct a job hazard analysis (JHA) as indicated in Section 17 and a tailgate briefing.
- g. Use a tool bag to raise, carry and hold tools that are not carried in a tool belt while working from a structure.
- h. Discontinue aerial work while there is any indication of lightning in the surrounding area.

## 12.2 POLE HOLES.

- a. Cover or otherwise protect holes to prevent persons or animals from falling into them.

- b. Personnel descending into augered holes are to be protected by removable-type casing from the top of the hole to within 24 inches of the bottom when total depth exceeds 5 feet. Refer to WAPA Order 3790.1, latest revision, for Confined or Enclosed Spaces.

## **12.3 ERECTION AND REMOVAL OF POLES.**

- a. Inspect poles before climbing them to ensure they are safe to climb.
- b. Assure the butt is free before raising a pole. A pole clamping device (pole-grabber), mounted on the hydraulic boom of a truck, may be used to control but not lift the pole during installation or removal.
- c. Guy or tag lines are not to be wrapped around any part of the body.
- d. Climbing a defective pole or one being plumbed is prohibited unless it is supported.
- e. Support the pole while backfilling to keep it from falling.

## **12.4 ADJACENT ENERGIZED CONDUCTORS.**

When poles or crossarms being installed or removed could contact an adjacent energized conductor, do the following:

- a. Obtain a hot line order in accordance with PSOM chapter 1 (latest revision).
- b. Maintain at least the minimum approach distance specified in Appendix A, Table A-1, from the energized conductors.
- c. Monitor the clear distance from the energized conductors using an insulated measuring device if necessary.
- d. Use nonconductive rope and insulated cant hooks to control and orient the pole. Employee shall not contact the pole.

## **12.5 STRINGING TRANSMISSION LINE CONDUCTORS AND OVERHEAD GROUND WIRES.**

### **12.5.1 GENERAL.**

Throughout this Subsection, consider overhead ground wires (OGW) and conductive pulling lines the same as conductors in terms of required safety precautions during installation.

- a. Inspect reel trailers and stands to ensure they have ample capacity, operate smoothly, and are equipped with adjustable brakes to control the reels while pulling.

**NOTE:** The reel operator's station shall provide approved protection for the operator in case of wire failure.

- b. Secure reels to the reel stands and anchor the reel stands, and align and level them to prevent displacement or overturning in the event of a fouled reel or brake lockup while pulling.
- c. Load ratings of stringing lines, pulling lines, conductor grips, load-bearing hardware and accessories, rigging, and hoists shall not be exceeded.
- d. Inspect attachments between pulling lines and the conductor for adequate capacity and construction to allow the lines to flow freely through the stringing blocks. Conductor grips shall not be used. Clamp the conductor end of the sock to prevent slippage.
- e. Make no attempt to free the conductor if it should catch under a firm object until the pulling has been stopped and the tension slacked off.
- f. Discontinue stringing operations while there is any indication of lightning in the surrounding area.
- g. Maintain reliable communications between both ends of a stringing operation.
- h. While the conductor or pulling line is being pulled (in motion) with a power-driven device, employees are not permitted directly under overhead operations or on the cross arm, except as necessary to guide the stringing sock or board over or through the stringing sheave.
- i. In lieu of the following requirements for grounded travelers at energized crossings and at first structures adjacent to both pullers, the conductor must be treated as energized until personal grounds are applied in their place.

## **12.5.2 GROUNDING FOR STRINGING AND REMOVING CONDUCTORS.**

- a. While stringing or removing conductors that are under a clearance place bonds and grounds as follows:
  - (1) Bond and ground the stringing equipment (reel stands, trailers, pullers or tensioners) at the worksite. Install a

barricade or barrier around the equipment when stringing parallel to or crossing energized lines.

(2) Install a rolling ground between the tensioning reel setup and the first structure for each conductor being pulled.

(3) Install grounded stringing blocks at the first structure adjacent to both the tensioning and pulling setups and at least every four miles in between grounds.

(4) At all open dead-ends or catch-off points.

b. After the conductor has been pulled in, place bonds and grounds as follows:

(1) If employees are working on or near conductors, grounds shall be installed at each location where these employees are working.

(2) At all open dead-ends and catch-off points or at the adjacent structure.

c. Remove the grounds from the ends of the pulled-in conductor only after all work on or near the conductor has been completed.

### **12.5.3 CROSSING CIRCUITS, HIGHWAYS, WATERWAYS, RAILROADS, AND TELEPHONE LINES.**

In addition to the items in Subsection 12.5.1, and 12.5.2 when stringing across circuits, highways, railroads, navigable waters, and telephone lines, do the following:

a. Except in an emergency, coordinate with the proper utility, highway department or railroad before crossing their facilities.

b. Install protective guard structures or other supporting elevated devices at all crossings to ensure that adequate distances are maintained between the pulling lines or conductors and the facility being crossed.

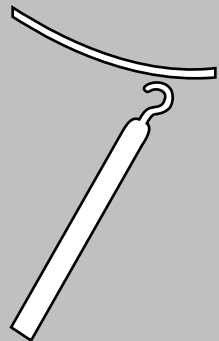
c. When the conductors are being pulled across (over or under) an energized circuit, install grounded stringing blocks at the structures on both sides of the crossing.

- d. Obtain a clearance or hot line order on the powerline being crossed, in accordance with PSOM chapter 1 (latest version). The person who obtains the HLO shall remain at the worksite while work is being performed. When the work may require approaching the minimum approach distances, the person shall remain in a non-work status and shall be positioned to observe all aspects of work performed.
- e. Use nonconductive ropes as lead lines at energized crossings.
- f. Station a safety observer with verbal communication with the pulling machine operator within sight of each powerline, highway, railroad, and navigable water crossings when lines or conductors are being pulled.

# **Live-line Hotstick Work**

## **► CONTENTS**

- 13.1 General
- 13.2 Inspecting, Testing, and  
Maintenance of Hotsticks
- 13.3 Other Tools
- 13.4 Hotstick Techniques
- 13.5 Erection and Removal of Poles



## SECTION 13

# LIVE-LINE HOTSTICK WORK

This section includes precautions that are to be taken when performing maintenance or associated training using hotstick methods on energized transmission lines. Further guidelines are provided in Western's Power System Maintenance Manual (PSMM), Chapter 3, "Live-line Maintenance" (latest revision). This section does not apply to general switching or fuse replacement.

## 13.1 GENERAL.

- a. An agency certification must be obtained in order for workers to perform or supervise hotstick work, except during training sessions when working under constant supervision.
- b. Hotstick work is to be personally supervised by a supervisor who is trained and certified to direct that specific type of live-line work.
- c. Specific written job procedures are to be reviewed, updated as necessary, and discussed with the crew before work begins.
- d. The supervisor shall receive a HLO on the involved circuit(s) and shall remain at the jobsite in non-work status while procedural live-line work is in progress. He shall be positioned to observe and direct all aspects of the live-line work. Maintain communication with the Operations Supervisor while work is performed under a Hot Line Order. The HLO Supervisor shall inform the Operations Supervisor ahead of time if communications cannot be maintained.
- e. Use only equipment and tools that are rated for the voltage of the line/equipment.
- f. Use electrically tested and visually inspected fiberglassreinforced plastic (FRP) hotsticks.
- g. Discontinue hotstick work while there is any indication of lightning or other inclement weather in the surrounding area.
- h. Do not park vehicles under conductors except when essential for the work being performed.
- i. Vehicles, with an uninsulated or insulated boom, shall be grounded with a ground cable rated for the maximum anticipated fault current. The vehicle shall be grounded to the



structure ground system where practicable. When grounding to the structure is not practicable, such as during in-span repair work, the vehicle shall be bonded to a ground rod installed near the center of the vehicle. If grounding during in-span repairs is not possible, the operator shall remain on the vehicle or on insulated or bonded conductive mat and no one shall approach within 10 feet of the vehicle or a clearance shall be taken and the vehicle shall be grounded in accordance with 10.9.a..

## **13.2 INSPECTION, TESTING, & MAINTENANCE OF HOTSTICKS.**

a. Visually inspect and clean hotsticks and associated equipment before use. Tag defective or damaged items and remove them from service. Look for the following types of defects:

- (1) A loss or deterioration of the glossy surface on hotsticks.
- (2) Deep cuts, scratches, nicks, gouges, dents, or delamination in the surface.
- (3) Bent, worn, cracked components, or other damage.
- (4) Dirt, paint, creosote, grease, or other foreign material.
- (5) Known or suspected physical or electrical overloading, as evidenced by elongated or damaged rivets or electrical tracking respectively.
- (6) Inspect the bronze trunnion assembly using a trunnion gauge. Visually inspect the internal acme thread for signs of wear. Make sure the ball thrust bearings are smooth and free running.
- (7) Inspect the steel jackscrew for crookedness, rust, wear, nicks, or burns. Perform a thread wear gauge test if it is available from the manufacturer.

b. Clean hotsticks with manufacturer's approved cleaning cloth and solution only.

**WARNING:** Do not use soap or liquid detergents such as 409, Fantastic, Ajax, etc., to clean hotsticks as they can leave a conductive coating.

c. Use the manufacturer's gloss-restorer products on hotsticks after cleaning only as necessary to maintain their glossy surface.

- d. Dielectrically test fiberglass-reinforced plastic live-line tools at least every 2 years in accordance with PSMM, Chapter 3, Live-Line Maintenance (latest revision).
- e. Transport and store hotsticks in weatherproof boxes or bags, or in tool trailers.
- f. Mark hotsticks (work sticks) to identify the minimum phase-to-ground minimum approach distance listed in Appendix A for the circuit being worked.

### **13.3 OTHER TOOLS.**

- a. Use high-quality, properly maintained synthetic rope for handlines and taglines (not natural-fiber rope) for live-line work. Keep it stored in a clean, dry location and protected from damage and contamination.
- b. Wear clean gloves when handling these lines to avoid contaminating them and remove wet, dirty, or damaged lines from service.
- c. Maintain the minimum approach distances from energized parts listed in Appendix A when using handlines and taglines.
- d. Use a tool bag to raise, carry and hold tools that are not carried in a tool belt while working from a structure or aerial device.

### **13.4 HOTSTICK TECHNIQUES.**

- a. Use metal wire or braid, as detailed in PSMM Chapter 3, “Live-line Maintenance” (latest revision), to jumper across ropes or nylon straps that are used as part of the hotstick support system of energized conductors, if the system is to be left in place overnight or longer.
- b. Electrically test each porcelain or glass insulator in the insulator string(s) on tension structures (dead-ends and angles) prior to replacing insulators, wood poles, or crossarms . If any insulator string has less than the following number of good insulators listed in the following table, it is only to be replaced under de-energized conditions. Insulator units to be shunted with a static ground or that are effectively spanned by conductive parts of live-line tools are to be treated as defective.

**TABLE 13.1**  
**MINIMUM INSULATION**

Phase-to-Phase Voltage – kV	Minimum Required Number of Electrically Good Insulators for Live-Line Replacement (see note 1)	
	Porcelain	Glass
34.5 - 72.5	2	De-energize
72.6 - 121	3	5
138 - 145	4	6
161 - 169	6	8
230 - 242	7	9
345 - 362	8	10
500 - 550	12 (see note 2) 15 (see note 3)	— —

**NOTES:**

- (1) The values listed are the per string numbers. A vee string requires the given number in each string.
- (2) This number can only be used when a 41 inch portable protective gap is in place.
- (3) This number is based on known transient over-voltages for the COTP. (Applicable only to COTP).
- (4) The minimum number of good insulator units is zero for de-energized and ungrounded circuits after a study has been performed to determine the voltage level on the line and that there is sufficient insulation to perform the work method safely. Minimum approach distances for the voltage of the circuit being worked shall be maintained.

c. Maintain the minimum approach distances listed in Appendix A, Table A-1 in addition to the above restrictions. Also, electrically test each porcelain or glass replacement insulator before it is installed and discard defective units.

d. Visually inspect polymer fiberglass insulator assemblies for carbon tracking on the skirts. If tracking is found, the circuit is to be de-energized before work is done. Assemblies with visible damage are to be worked de-energized.

## **13.5 ERECTION AND REMOVAL OF POLES.**

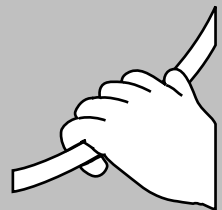
Follow the precautions listed in Subsection 12.3 and 12.4, as appropriate, while erecting or removing a pole in an energized line. When setting new poles that could come in contact with an energized conductor, cut and peel back the pole ground.



# **Live-line Barehand Work**

## **► CONTENTS**

- 14.1 General
- 14.2 Barehand Techniques
- 14.3 Insulated Aerial Devices  
(Vehicle-Mounted)
- 14.4 Insulated Hook Ladders



## **LIVE-LINE BAREHAND WORK**

This section includes precautions to be taken when performing maintenance or associated training using the live-line barehand (barehand) methods on energized transmission lines and equipment rated at 69-kV or higher. Further guidelines are provided in Western's Power System Maintenance Manual (PSMM), Chapter 3, "Live-line Maintenance" (latest version).

### **14.1 GENERAL.**

- a. An agency certification must be obtained in order for workers to perform or supervise barehand work, except during training sessions when under constant supervision.

**NOTE:** When it is necessary that an engineer or other specialist participate in a specific test or inspection program involving the use of insulated personnel-support equipment, the engineer or specialist need not be certified, but must have received sufficient instruction to perform the inspections and/or tests safely under supervision.

- b. Barehand work is to be personally supervised by a supervisor who is trained and certified to direct that specific type of live-line work.
- c. Specific written job procedures are to be reviewed, updated as necessary, and discussed with the crew prior to starting the work.
- d. The supervisor shall receive a HLO on the involved circuit(s) and shall remain at the jobsite in non-work status while procedural live-line work is being done. He is to position himself so he can observe and direct all aspects of the live-line work.
- e. Use only equipment and tools that are designed, tested, and/or approved for barehand work. Inspect them in accordance with manufacturers' and/or Western's instructions.
- f. Before performing barehand work on energized electrical conductors or equipment:
  - (1) Check the voltage rating of the circuit on which the work is proposed,

- (2) Measure the distances from energized parts to ground and to other energized phases using an insulated measuring stick or other approved device, and
- (3) Check the voltage and load limitations of the tools and equipment intended to be used.
- (4) Electrically test each porcelain or glass insulator in the insulator string(s) prior to replacing insulators. Broken or chipped insulators shall be considered electrically defective and may be tested. Those passing the test may be considered good. The number of good insulators shall not be less than that listed in the following table. Insulator units to be shunted with a static ground or that are effectively spanned by conducting parts of live-line tools are to be treated as defective. Multiple (parallel) strings of insulators (dead-end) shall be considered as a single string for determining minimum insulation.

**TABLE 14.1**  
**MINIMUM INSULATION**

Phase-to-Phase Voltage – kV	Minimum Required Number of Electrically Good Insulators for Live-Line Replacement (see note 1)	
	Porcelain	Glass
34.5 - 72.5	2	De-energize
72.6 - 121	3	5
138 - 145	4	6
161 - 169	6	8
230 - 242	7	9
345 - 362	8	10
500 - 550	12 (see note 2) 15 (see note 3)	— —

**NOTES:**

- (1) The values listed are the per string numbers. A vee string requires the given number in each string.
- (2) This number can only be used when a 41 inch portable protective gap is in place.
- (3) This number is based on known transient over-voltages for the COTP. (Applicable only to COTP).

- (5) Maintain the minimum approach distances listed in Appendix A, Table A-1, in addition to the above restrictions. Also, electrically test each non-polymer replacement insulator before it is installed and discard defective units.

- (6) Non-ceramic insulators (NCI) shall not be removed under energized conditions. Replacing glass or ceramic insulators with non-ceramic insulators (NCI) may be installed under energized conditions. (See PSMM Chapter 3 latest revision)
- g. Discontinue aerial work while there is any indication of lightning or other inclement weather in the surrounding area.
  - h. Consider all wood members on wood pole lines to be at ground potential.
  - i. Wear approved conductive clothing as follows:
    - (1) Barehand procedures below 200 kV nominal phase-to-phase voltage from:
      - Aerial device/metal-lined bucket – Footwear
      - Aerial device/open metal platform – Footwear
      - Insulated ladder – Parka, pants, socks, and gloves (footwear if mounting from steel structure)
    - (2) Barehand procedures above 200 kV nominal phase-to-phase voltage from:
      - Aerial device/metal-lined bucket – Footwear, parka, or jacket
      - Aerial device/open metal platform – Footwear, parka, pants, and socks
      - Insulated ladder, tower boom-supported platform, or conductor cart – parka, pants, socks, and gloves (footwear if mounting from steel structures).
  - j. Do not park vehicles under conductors except when essential for the work being performed.
  - k. Wear clean gloves when handling live-line ropes to avoid contaminating rope. Remove wet, dirty, or damaged ropes from service.
  - l. A minimum approach distance table reflecting the minimum approach distances listed in Appendix A, Table A-1 for the specific jobsite shall be printed on a plate of durable nonconductive material. This table shall be mounted so as to be visible to the operator of the boom.
  - m. A non-conductive measuring device shall be readily accessible to assist employees in maintaining the required minimum approach distance.



## 14.2 BAREHAND TECHNIQUES.

- a. Prior to suspending a work platform from overhead ground wires or phase conductors, verify the physical integrity of the wire/conductor by visual inspection for apparent physical damage such as worn suspension fittings, gunfire damage, ice load damage, etc.

**NOTE:** Personnel work platforms which support the worker while actually performing barehand work, includes fiberglass bucket(s), or metal platform of vehicular-mounted insulated aerial-lift equipment; vertical or horizontal insulated ladder; “Baker board;” boatswain’s chair, basket, bucket, or tree-trimmer’s saddle supported by an insulated tower boom or nonconductive rope; conductor cart; or such other worker support device as may be developed to safely and properly support the energized worker.

- b. Maintain the phase-to-phase and phase-to-ground minimum approach distances specified in Appendix A, Table A-1. When approaching, bonded to, and leaving the energized part, the additional requirements of paragraph 14.3.i for aerial devices and paragraph 14.4.c for insulated ladders shall be applied.
- c. The use of hand lines between personnel-support equipment and the ground is prohibited. Approved clean, dry, non-conductive hand lines may be used from phase to ground when not supported by the work platform.
- d. Keep conductive materials over 3 feet long off the work platform, except for appropriate-length jumpers, armor rods, and approved tools; and do not allow metal objects to shunt insulators or lessen the distances listed in Appendix A, Table A-1.
- e. Keep static grounds and bonding leads as short as possible, with excess leads taped or knotted, or otherwise restrained to prevent them from contacting a conductor or ground if accidentally dropped.

## 14.3 INSULATED AERIAL DEVICES (VEHICLE-MOUNTED).

- a. Do not overstress the work platform and insulated section of the insulated aerial device equipment by attempting to lift or support weights in excess of the manufacturer’s rating.

Avoid using the fiberglass parts, the work platform, or the insulated section of the insulated aerial device equipment as a

fulcrum for prying or lifting. Where a short auxiliary insulated boom is provided, it may be used for lifting or supporting features within the manufacturer's load rating.

- b. Vehicles with an insulated boom used to bring workers into contact with energized parts shall be grounded with a ground cable rated for the maximum anticipated fault current. The vehicle shall be grounded to the structure ground system where practicable. Platforms and metal-lined buckets on insulated booms shall be bonded with the live-line barehand type bonding lead to the energized system before hand or body contact.

When grounding to the structure is not practicable, such as during in-span repair work, the vehicle shall be grounded to a ground rod installed near the center of the vehicle and as close to the center of the vehicle as practicable. If grounding during in-span repairs is not possible due to rock or soil conditions, the vehicle shall be grounded in accordance with 13.1i if the hotstick method is to be used or a clearance shall be taken and the vehicle shall be grounded in accordance with 10.9.a.

- c. Before moving the insulated aerial device equipment into the work position (Only authorized persons are to operate or maintain aerial device equipment):
  - (1) All controls (ground level and bucket or platform) shall be checked. In addition, for insulated aerial device equipment with hydraulic lines, the support platform shall be raised to its maximum height and left in the raised position for 5 minutes.
  - (2) Take the dielectric arm-current reading before starting work each day, each time during the day when a higher voltage is going to be worked, and when changed conditions indicate a need for additional tests.

**NOTE:** A fused and protected ammeter shall be placed at the meter receptacle on the boom. If the dielectric arm-current, after 3 minutes, is less than 1 micro-ampere for each kilovolt of nominal phase-to-ground voltage (refer to table below), and relatively the same as previous dielectric arm-current readings from tests on the same voltage and under similar conditions, the work platform may be used for barehand live-line work. Written records of these tests shall be kept with the equipment and at the responsible maintenance facility.

**TABLE 14.2**

<b>Voltage (kV) Phase-to-Phase</b>	<b>Voltage (kV) Phase-to-Ground</b>	<b>Acceptable Dielectric Current (Microamps) <math>\mu</math> = 10-6</b>
46.1 - 72.5	40	less than 40
72.6 - 121	67	less than 70
138 - 145	80	less than 80
161 - 169	93	less than 100
230 - 242	133	less than 140
345 - 362	200	less than 200
500 - 550	318	less than 320

- (3) Keep all but essential persons off the platform while making the initial contact of an energized circuit so that the dielectric arm-current may be measured.
  - (4) Keep everyone at least 10 feet away from the vehicle while dielectric arm-current tests are being made, except the person(s) on the vehicle conducting the test.
  - (5) Suspend work operations immediately upon indication of a malfunction in the equipment. Tag faulty equipment and prohibit its use until repaired and/or retested satisfactorily.
- d. While in contact with the conductor or when barehand work is in progress, at no time is the vehicle engine to be shut off unless the engine can be started from the bucket or platform.
  - e. Clean the bottom of conductive footwear before entering the bucket or work platform. Inspect the floor of the bucket or work platform for dirt or other material, which might prevent good contact between the floor and conductive footwear, and remove foreign materials.
  - f. One worker, capable of operating all the controls, is to be stationed on the vehicle at the control panel or on the ground near the vehicle (not closer than 10 feet) when worker(s) are in the bucket or platform. The employee stationed on the ground is to keep other persons from walking under the work area and clear of the vehicle when the bucket or platform is elevated.

No one on the ground is to be in contact with the vehicle ground cable while the bucket or platform is in an energized condition unless they are standing on a bonded-conductive or insulated surface.

**NOTE:** When worker(s) are in the bucket or work platform, all movements of the lift assembly are to be controlled by the worker(s) aloft, except under emergency conditions. Under such emergency conditions, the ground operator is to mount the vehicle by means of an insulated device or by means such that he does not simultaneously contact the vehicle and ground.

- g. Make contact with the energized electrical conductor or equipment by the bonding strap(s) from the bucket or platform to the energized electrical conductor before making bodily contact.

Keep at least one bonding strap attached to the energized electrical conductor or equipment at all times while work is being performed. Inspect and maintain bonding straps, including anchors and clamps, in good condition and their length confined to that necessary to permit free working conditions. Restrain wand and bonding straps so as to prevent them from falling below the bottom of the bucket or platform or being blown near grounded objects.

- h. Before an energized electrical conductor is opened, use an approved jumper cable(s) as a shunt.
- i. When approaching, bonding to, or leaving an energized part:
  - (1) Follow requirements of PSMM Chapter 3, (latest version).
  - (2) For work at the energized terminal end of a bushing on a circuit with a phase-to-phase voltage of less than 200 kV, the work platform is to be positioned so that none of the bushing insulation is shunted by the work platform, with distances from grounded parts and other phases not less than specified in Appendix A, Table A-1. For work at the energized terminal of a bushing on a circuit with a phase-to-phase voltage of 200 kV or more, the bucket or platform is to be positioned so that no more than 10 percent of the bushing insulation is shunted by the bucket or platform with distances from grounded parts and other phases not less than Appendix A, Table A-1.
- j. In addition to the preoperative tests required in paragraph 14.3.c, periodically inspect and test insulated aerial device equipment in accordance with PSMM Chapter 3, Live-line Maintenance, Appendix B.

- k. Hydraulic driven tools connected to dielectric oil systems shall be maintained as part of that system and are not to be used on non-dielectric oil systems. This is to prevent hydraulic oil cross-contamination.

## **14.4 INSULATED HOOK LADDERS.**

- a. Insulated hook ladders may be used as a work platform for barehand work on energized electrical conductors and with a phase-to-phase voltage rating exceeding 115 kV, provided minimum approach distances specified in Appendix A, Table A-1 are maintained.
- b. Make sure that all rigging is complete and secure before moving a worker on a ladder into an energized position.
- c. Before beginning work on an energized electrical conductor or equipment from an insulated ladder, bond the required conductive clothing to the energized electrical conductor or equipment by means of a spring-type breakaway bonding clip.
- d. Items being passed or raised to a worker on an insulated ladder are to be passed or raised using non-conductive rope only after bonded to the energized electrical conductor or equipment. These items should be touched first to the energized electrical conductor or equipment to bring them to equipotential.
- e. Secure the insulated ladder in a manner that stabilizes their movement.
- f. Dielectric current tests shall be conducted on insulated ladders used in barehand live-line maintenance each day, when a higher voltage is going to be worked, and when conditions indicate a need for additional tests.

**NOTE:** A fused and protected ammeter shall be used for testing the dielectric current through the ladder legs with each leg bonded together at the metering point. If the measured dielectric ladder-current, after 1 minute, is less than 1/3 microamperes for each kilovolt of nominal phase-to-ground voltage (refer to table below), the insulated ladder may be used for barehand live-line work. Written records of these tests shall be kept with the equipment and at the responsible maintenance facility.

**TABLE 14.3**

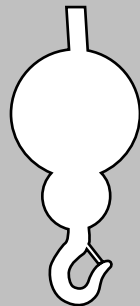
<b>Voltage (kV) Phase-to-Phase</b>	<b>Voltage (kV) Phase-to-Ground</b>	<b>Acceptable Dielectric Current (Microamperes) <math>\mu</math> = 10<sup>-6</sup></b>
46.1 - 72.5	40	less than 10
72.6 - 121	67	less than 30
138 - 145	80	less than 30
161 - 169	93	less than 40
230 - 242	133	less than 50
345 - 362	200	less than 70
500 - 550	318	less than 110

- g. Suspend barehand work immediately upon indication of a malfunction in the equipment.

# Rigging

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- 15.1 General
- 15.2 Wire Rope
- 15.3 Fiber and Synthetic-Fiber Rope
- 15.4 Chains
- 15.5 Slings
- 15.6 Rigging Hardware



## SECTION 15

# RIGGING

This section includes only a few basic requirements and precautions that are to be taken when rigging for lifts of material or equipment.

### 15.1 GENERAL.

- a. The “Rigging Manual,” published by the Construction Safety Association of Ontario, Canada, the DOE “Hoisting and Rigging Manual” and others are used as guidance for Western.
- b. Determine the capacity rating of wire rope, fiber rope, chains, rigging hardware, or combinations thereof before using them to lift loads.

**NOTE:** Where the manufacturer does not provide the capacity rating for wire rope, it may have to be calculated by applying the appropriate safety (overload capacity) factor(s) listed in Table 15.2 to the manufacturer’s specified ultimate (breaking) strength. For individual items used in combination, the safety (overload capacity) factors are not cumulative, and the overall capacity rating of the combination is the capacity of the weakest item. The particular application or service factors may further reduce the capacity rating.

- c. Efficiency factors listed in Tables 15.1 - 15.2 are to be used to determine the safe workload rating of ropes, chains, rigging hardware, or combinations thereof.

**NOTE:** The safe workload rating differs from the capacity rating of equipment alone in that nonequipment associated efficiency factors which reduce the strength of the overall installation are considered.

- d. Install, maintain, and/or repair ropes and chains, only if qualified by training. Commercial slings and rigging hardware are to be repaired only by the manufacturer, or repaired in accordance with manufacturer’s instructions; and tested and certified by an engineer competent in this field.
- e. All slings (other than wire rope) shall be tagged identifying the type of sling and its capacity. Non-wire rope slings shall not be used without that identification tag. Wire rope slings shall not be used in loads in excess of the rated capacities shown in Figure 15.3.



## 15.2 WIRE ROPE.

- a. Choose wire rope carefully to meet expected service conditions. Consider the strength, flexibility, abrasion resistance, and resistance to crushing. Seek the manufacturer's guidance as needed.
- b. Use only commercial wire rope fittings that are properly applied to develop maximum strength.
- c. Spool wire rope in the proper direction to avoid rope twist, spreading of coils, and crossing or overlapping on wench drums.
- d. Use sheaves and drums with grooves slightly larger than the wire rope to avoid pinching and binding the strands and to permit the rope to adjust itself to the curvature; but not so much larger that the rope will flatten.
- e. Inspect drums, sheaves, and pulleys to ensure they are free from surface defects that might damage the rope.
- f. Lubricate wire rope as needed and never remove the rope's internal lubricant. Use a jet of air or steam, or wire brush the rope's exterior prior to applying manufacturer's approved lubricant.
- g. Remove wire rope immediately from service if it has one or more of the following defects:
  - (1) Corrosion resulting from acids or alkalis. (Rust film which has not resulted in pitting or loss of more than one third of the original wire diameter can be removed, and the wire cleaned, relubricated, and reused.)
  - (2) One or more broken wires in the valley between two adjacent strands, or six randomly distributed broken wires in one rope lay.
  - (3) Abrasion, scrubbing, flattening or peening causing loss of more than one-third of the original diameter of the outside wires.
  - (4) Severe kinking, crushing, birdcaging, or other damage resulting in distortion of the rope's structure.
  - (5) Heat damage resulting from a torch or electrical contact.
  - (6) Reduction from nominal diameter of more than:

3/64 inch for sizes up to 3/4 inch

1/16 inch for sizes 7/8 to 1-1/8 inches

3/32 inch for sizes 1-1/4 to 1-1/2 inches

**NOTE:** Any marked reduction may indicate deterioration of the core.

h. Discard defective hoisting and load-carrying cables.

i. Keep out of the bight of running lines.

## 15.3 FIBER AND SYNTHETIC-FIBER ROPE.

a. Use only synthetic-fiber rope, and only nonconductive ropes near energized conductors. “Hot” ropes currently used for live-line work are not to be used for other purposes.

b. Keep ropes clean and dry, and store them in loose coils.

c. Discard ropes that are contaminated with acids or alkalis.

d. Use sheaves when necessary to prevent chaffing ropes while lifting or lowering loads.

e. Knots and hitches as shown in Figures 15.2 reduce the safe working load of rope by a minimum of 50 percent. See the “Rigging Manual” for details.

f. Be aware of elongation at 20 percent of the rated breaking strength:

**EXAMPLE:** Nylon rope will elongate 23% when the load reaches 20% of breaking strength. A 10 foot piece of Nylon rope rated at 5,000 pound breaking strength loaded with 1,000 pounds will become 12.3 feet long. Manila stretches 3 percent; Polyester, 9 percent; and Polypropylene, 14 percent.

## 15.4 CHAINS.

a. Avoid subjecting chains to impact loads or jerking.

b. Chains are to be repaired by the manufacturer or in strict accordance with the manufacturer’s recommendations.

c. Do not splice chain together by inserting a bolt between two links or by passing one link through another and inserting a bolt, nail, or other unapproved object to hold it.

d. Use only alloy steel chains for rigging that have been marked and maintained in conformance with the manufacturer’s guidelines. Do not use these chains for tying down equipment.

## 15.5 SLINGS.

This section applies to wire rope, synthetic rope, and synthetic webs.

- a. Store slings so they will not be damaged.
- b. Protect in-use slings from being damaged by sharp, rough, or square corners.
- c. Remove damaged slings from use and destroy them.
- d. To prevent sling-related accidents, do the following:

- (1) Keep slings free of knots or other devices used to shorten them.
- (2) Keep sling legs free of kinks.
- (3) Keep load within the sling's capacity.

**NOTE:** Table 15.2 identifies the effects of the sling angle on the sling's capacity.

- (4) Balance loads supported by basket hitches to prevent slippage.
  - (5) Securely attach the slings to the load.
  - (6) Keep hands and fingers from between the sling and load while the sling is being tightened around the load.
  - (7) Place blocks under the load so slings may be removed without damaging them.
- e. All new synthetic slings must have a minimum safety (overload capacity) factor of 7:1. All existing synthetic slings rated at 5:1 shall be re-rated and marked accordingly or discarded.

**EXAMPLE:** Sling rating is 1,000 pounds, multiply by 5, divide by 7, and mark sling for 714 pounds.

## 15.6 RIGGING HARDWARE.

- a. Use forged-alloy or stainless steel hoisting hooks (excluding sling and choker hooks) that are stamped with their safe working load and are equipped with safety keepers. They should also be equipped with swivels and headache balls.

- b. Use forged-alloy or stainless steel shackles of the locking or secured-pin type for hoisting. Shackles designed for having bolts, nuts, and self locking steel cotter keys (BNKs) shall only be used with the BNKs properly secured. Inspect them before use and discard any that are worn in the crown or pin by more than 10 percent of the original diameter. Do not replace shackle pins with bolts.
- c. Follow the application data on eyebolts, turn-buckles, blocks, and other rigging hardware as presented in the referenced Rigging Manual.
- d. Do not use job-fabricated rigging hardware unless it has been tested and certified by an engineer competent in this field.

**EXCEPT:** Use Figure 15.1 to determine the safe working load of wire rope eye splice or wire rope sling.

## FIGURE 15.1 WIRE SPLICE TEST FORM

Date: \_\_\_\_\_

Field Location: \_\_\_\_\_

Test Personnel: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Type of Splice: \_\_\_\_\_

Size and Type of Wire Rope: \_\_\_\_\_

Ultimate Breaking Strength of Wire Rope: \_\_\_\_\_

Overload Capacity Factor: \_\_\_\_\_ Working Load: \_\_\_\_\_

Test Load: \_\_\_\_\_

(Tested at 110% minimum of Working Load for 5 minutes.)

Application Splice is Used For: \_\_\_\_\_

Vehicle License Plate Number: \_\_\_\_\_

Winch Type: \_\_\_\_\_ Winch Ultimate Strength: \_\_\_\_\_

Shear Pin: \_\_\_\_\_ Yes \_\_\_\_\_ No

**NOTE:** Splices made for the purpose of fabricating eyes for winch line shall be stamped with the working load of the wire rope. (straight line pull)

**Formula:** Rope strength divided by Overload Capacity Factor times factor for eye (if Molly and sleeve .9) = Working Load

Test Load: (110% of working load for 5 minutes)

Sign: \_\_\_\_\_ Date: \_\_\_\_\_

### EXAMPLE:

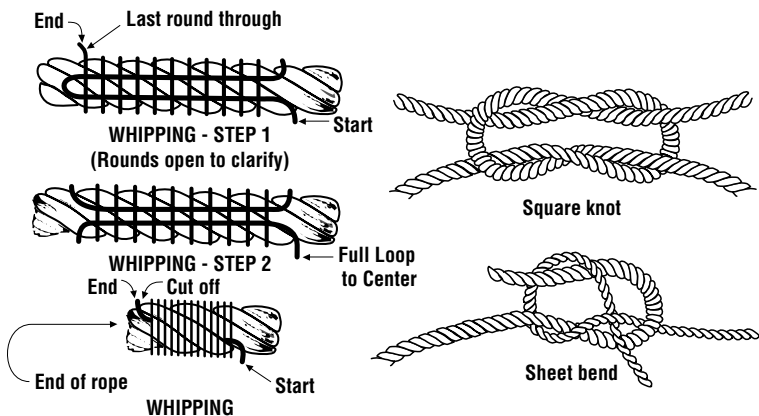
Breaking strength of wire rope:	20400 lb.
Overload Capacity Factor:	3.5 to 1
Loss for eye (Molly)	.9 This could change on type of eye.
Tested: (5 minutes)	110%

Divide 3.5 into 20400 = 5828.57 lb.

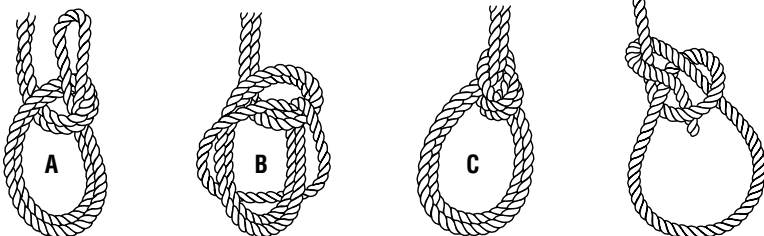
5828.57 x .9 = 5245.7 or 5246 lb. (This is the working load)

5246 x 110% = 5771 lb. (This is the load used for dynamometer testing)

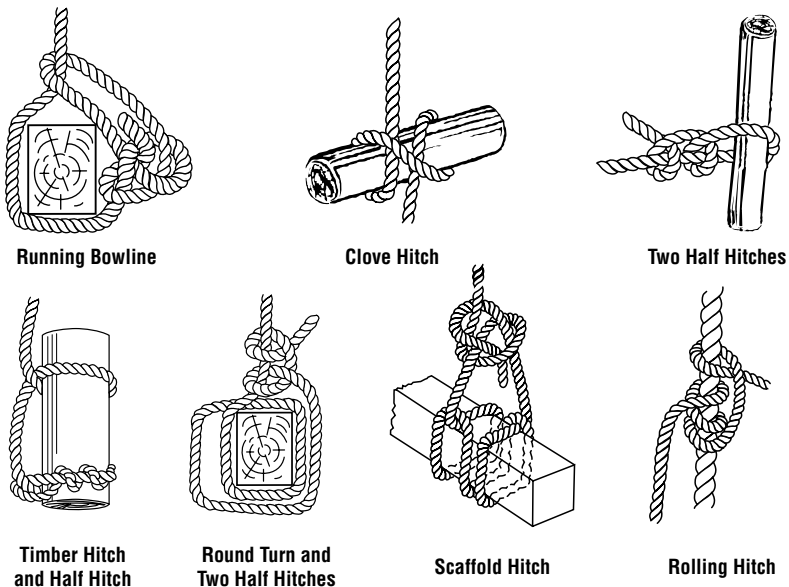
## FIGURE 15.2 KNOTS AND HITCHES



### Bowline on the bight



This knot is used in emergency to lift an injured man off a building or out of a hole, this is done by sitting in one loop, and putting the other loop around the back and under the arms. Also to tie bowline in middle of line.



**TABLE 15.1**  
**EFFICIENCY OF WIRE ROPE AS COMPARED TO**  
**SAFE LOADS ON WIRE ROPES**

Figure	Type of connection	Efficiency (percent)
1	Sockets - zinc type - properly attached	100
2	Wedge sockets	70
3	Plate Clamp - three-bolt type	80
4	Cable clips	80
5	Spliced eye and thimble: 1/4 inch and smaller diameter 5/16 to 7/16 inch 1/2 inch 5/8 inch 3/4 inch 7/8 inch	90 88 86 84 82 80



Figure 1



Figure 2

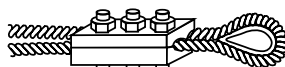


Figure 3

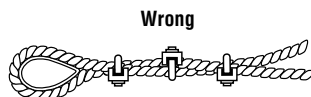
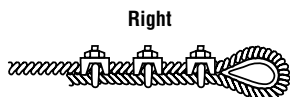
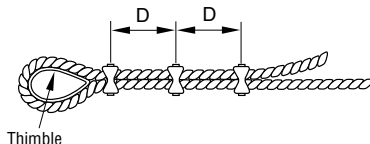
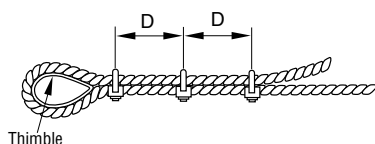


Figure 4



Figure 5

The spacing of clips should be six times the diameter of the wire rope. To assemble a satisfactory end-to-end connection, the number of clips indicated in rigging tables should be increased by two.



U-bolt of all clips on dead end of rope. Never stagger clips. Never put U-bolt of clip on live end of rope.

## INSTALLATION OF CABLE CLIPS ON WIRE ROPE

Number of clips and the proper torque necessary to assemble wire rope eye loop connections with a probable efficiency not more than 80 percent

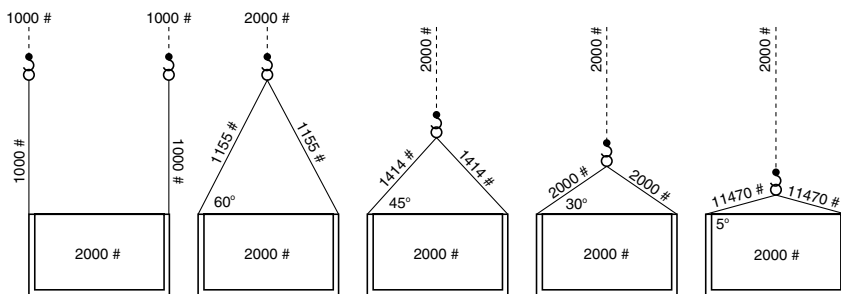
Rope diameter (in.)	Nominal size of clips	Number of clips	Torque to be applied to nuts of clips (ft.-lbs.)	Spacing of clips (in.)
5/16	3/8	3	25	1 7/8
3/8	3/8	3	25	2 1/4
7/16	1/2	4	40	2 5/8
1/2	1/2	4	40	3
5/8	5/8	4	65	3 3/4
3/4	3/4	4	100	4 1/2
7/8	1	5	165	5 1/4
1	1	5	165	6
1 1/4	1 1/4	5	250	7 1/2
1 3/8	1 1/2	6	375	8 1/4
1 1/2	1 1/2	6	375	9
1 3/4	1 3/4	6	560	10 1/2

**TABLE 15.2**  
**MINIMUM SAFETY (OVERLOAD CAPACITY) FACTORS FOR WIRE ROPE**

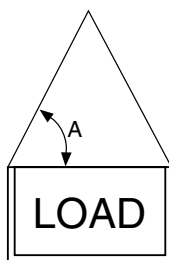
Type of Service	Safety Factor
Portal, tower and pillar, crawler locomotive, truck, and floating cranes; derricks; A-frames; and base-mounted hoisting drums: Standing and guy lines Running and hoisting lines	3.0 3.5
Overhead, gantry, and hammerhead 5.0 cranes; slings; small hoists (including chain falls); and truck mounted winch	5.0
Material hoists	7.0
Overhead hoists, manskips, and personnel hoists	As specified by equipment manufacturer's or ANSI standards.



## How angle of sling affects the capacity of each leg:








Angle Efficiency (A)	Angle (percent)	Efficiency (A)	(percent)
90 degrees	100	50 degrees	76
80 degrees	98	45 degrees	71
70 degrees	94	40 degrees	64
65 degrees	91	35 degrees	57
60 degrees	87	30 degrees	50
55 degrees	82	5 degrees	8.5



**NOTE:** To determine safe load for a single line, divide the breaking strength of the line by the applicable safety factor and multiply the result by the percentage factor indicated in the above table. Slings shall not be attached in such a manner as to provide an angle of less than 30 degrees between the sling leg and the horizontal.

**FIGURE 15.3**  
**LOAD CAPACITY OF WIRE ROPE SLINGS**

Construction (Class)		RATED CAPACITY — IN LBS.*					Eye Dimensions (approximate)	
	size (in.)	Vertical 	Choker 	Basket Hitch**			Width (in.)	Length (in.)
				Vertical 	30° 	45° 		
6 X 19 IWRC	1/4	1,120	820	2,200	1,940	1,580	2	4
	5/16	1,740	1,280	3,400	3,000	2,400	2 1/2	5
	3/8	2,400	1,860	4,800	4,200	3,400	3	6
	7/16	3,400	2,400	6,800	5,800	4,800	3 1/2	7
	1/2	4,400	3,200	8,800	7,600	6,200	4	8
	9/16	5,600	4,000	11,200	9,600	8,000	4 1/2	9
	5/8	6,800	5,000	13,600	11,800	9,600	5	10
	3/4	9,800	7,200	19,600	16,800	13,800	6	12
	7/8	13,200	9,600	26,000	22,000	18,600	7	14
	1	17,000	12,800	34,000	30,000	24,000	8	16
1 1/8	20,000	15,800	40,000	34,000	28,000	9	18	
6 X 37 IWRC	1 1/4	26,000	19,400	52,000	46,000	36,000	10	20
	1 3/8	30,000	24,000	60,000	52,000	42,000	11	22
	1 1/2	36,000	28,000	72,000	62,000	50,000	12	24
	1 5/8	42,000	32,000	84,000	72,000	60,000	13	26
	1 3/4	50,000	38,000	100,000	86,000	70,000	14	28
	2	64,000	48,000	128,000	110,000	90,000	16	32
	2 1/4	78,000	60,000	156,000	136,000	110,000	18	36
	2 1/2	94,000	74,000	188,000	162,000	132,000	20	40

\*Rated capacities apply only when attachment of the eye is made over an object not wider than the natural width of the eye.

\*\*For basket hitches, these values apply only when the ratio (D/d) of the diameter of the bend (where the sling contacts the load) to the diameter of the component rope is 20 or more. For angles greater than 45 degrees, contact the manufacturer.

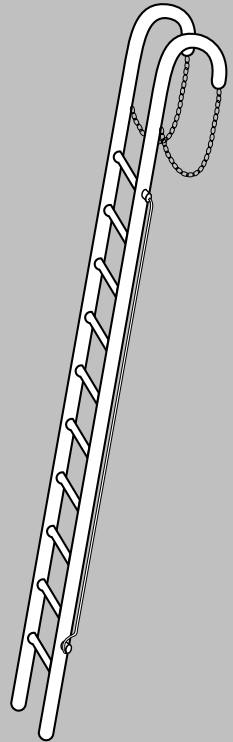
# Fall Protection

16.1 General

16.2 Hook Ladders

16.3 Equipment

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## **FALL PROTECTION**

This section includes precautions that are to be taken when performing maintenance or associated training using fall protection at elevated locations. Further guidelines are provided in Western's Power System Maintenance Manual (PSMM), Chapter 2 "Fall Protection" (latest revision).

### **16.1 GENERAL.**

Western's fall protection program includes all of the elements required to prevent a climber from falling, or should a fall occur, to arrest the forces on the worker's body to prescribed limits.

The following statements summarize the major elements of Western's Fall Protection Policy.

- a. Attachment is required to an appropriate anchorage:
  - (1) When working more than 4 feet above the ground while climbing, moving, and working on structures.
  - (2) While moving or working more than 4 feet above a lower level on fixed electrical substation equipment without an approved railing.
    - (a) For working, inspecting, testing, etc, on substation equipment:
      - (i) Perform all tasks using an aerial manlift, if possible, or
      - (ii) Perform all tasks using a portable ladder properly secured.
    - (b) If 2 (a) (i) or (ii) above cannot be accomplished, all attempts shall be made to use some type of temporary fall protection system. Examples of temporary fall protection systems are, but not limited to the following:
      - (i) A lifeline capable of arresting a fall shall be attached between two adjacent structures and crossing directly over the substation equipment to be worked. NOTE: Refer to the PSMM, Chapter 2, and the PSSM, Section 15.

- (ii) Attachment of a lanyard to an overhead boom or other approved anchorage point. (Crane hooks are not an approved anchorage point.)
- (iii) Erect scaffolding under the supervision of a competent person.
- (iv) Using bushings on substation equipment for anchorage is acceptable only if all other options are not feasible. Climbing or using SF-6 breaker bushings as an anchorage is not permitted.

**NOTE:** All attachment points shall be at waist level or above.

- (c) If all attempts have been looked at to provide a positive fall protection system and one still cannot be used, a safety observer shall be positioned to observe and warn all workers of encroaching a potential fall hazard.

**NOTE: In cases where a positive fall protection system can not be achieved, it shall be addressed in a written Job Hazard Analysis and approved by each member involved in the work. In developing the JHA, the entire work to be performed shall be reviewed to ensure additional hazards are not introduced because of the implementation of the fall protection system.**

- (3) In an aerial device.
  - (4) At all elevated work or rest locations.
  - (5) When transferring to or from suspended work ladders, work platforms, and traveling carts suspended from conductors.
  - (6) When moving on suspended ladders as presently defined in Section 16.2.
  - (7) When climbing or moving on structures where anchorages and fall arrest systems are effective to reduce fall risk.
  - (8) When climbing during adverse weather.
  - (9) When fixed climbing safety devices on communication towers are available and operative.
- b. Attachment is optional for qualified climbers when adequate fall arrest systems or climbing safety devices are not available or operational and when:
- (1) Using step bolts and fixed ladders.

- (2) Moving between work locations while on structures such as poles, communication towers, transmission towers, or similar structures.
- (3) Moving on a double wood crossarm.
- (4) Transitioning obstructions on wood poles.
- (5) Appropriate anchorages are not available.
- c. Employees, will use fall protection equipment and aerial devices to reduce exposure to falls and the possibility of serious injury should a fall occur. Western will continue to evaluate equipment and structure enhancements.
- d. Training is required on fall prevention and arrest principles, rescue, and equipment usage. A climber must demonstrate proficiency of fall protection principles, climbing skills, and on the care and use of fall protection equipment prior to being considered a qualified climber. Rescue shall be practiced by qualified climbers and others involved in climbing activities on a regular basis (at least annually). The supervisor will “qualify” climbers based on established criteria.
- e. Walking and climbing surfaces on heavy equipment, substation equipment, and ladder rungs shall have a nonskid surface and be free of clutter.
- f. Gaffs shall not be worn while working from an aerial device, unless used as part of an access system incidental to work activity. If used for this type of activity gaffs shall be protected while in the aerial device.
- g. A qualified climber may transfer between a single or multiple occupancy aerial device and a structure, conductor, aerial ladder, cablecart, or electrical equipment in accordance with the following:
  - (1) Buckets and platforms shall be positioned to remain stable during a transfer. The platform or bucket shall have a fixed-pin or a locking mechanism to provide stability during transfer.
  - (2) The transfer shall be made from the aerial device by a door, step, or secured ladder designed solely for the purpose of assisting the worker over the rim of the bucket or platform. Portable ladders shall not extend beyond the rim of the bucket. Portable ladders shall be removed from the bucket after the worker returns to the bucket. Platform guardrail systems must meet the design requirements of ANSI/SIA A92.2.

- (3) The aerial device shall be attended at all times when employees are transferring from or to the aerial device. The aerial device shall be considered to be attended as long as a qualified operator remains at the controls either in the bucket or at ground level. The climber and the operator shall remain in voice and/or visual contact at all times when a climber is aloft. While a climber is working aloft and not transferring, the operator may work on other jobs at the site provided the operator is available when needed at the controls.
- (4) A climber transferring between an aerial device and a structure shall be attached to the structure with both feet on the floor of the bucket or platform prior to making the transfer. The employee shall not be connected to the aerial device while attaching to the structure. The unattached time shall be kept to a minimum.
- (5) There shall be a second qualified climber present at the location at any time this procedure is performed. The second qualified climber requirement does not apply while working on substation equipment at heights of less than 4 feet.
- h. The body belt and safety strap will continue to be standard equipment for all journeymen employees and apprentices. As vendors develop acceptable designs, the use of the full body harness will be evaluated. See PSMM chapter 2, Section 6.3 (latest revision).
- i. When working from an aerial device, bucket, or platform, a full body harness in conjunction with a shock absorbing or retractable lanyard must be used. A lineman's body belt may be worn with a full body harness.
- j. Using bushings on substation equipment for anchorages or climbing is not recommended. The use of SF6 breaker bushings as an anchorage is not permitted.
- k. Unqualified climbers must remain 100 percent attached and shall climb under the direction and observation of a qualified climber.
- l. Crossarms shall not be walked unless attached to an engineered anchorage system.
- m. During climbing activities above 4 feet, at least two qualified climbers shall be present. Exception: employees working in substations may use a ladder to inspect equipment or read gauges as long as the employee does not encroach minimum

approach distances to live parts (Appendix A, Table A-1) or get off the ladder above the ground level.

## **16.2 HOOK LADDERS.**

- a. Equip hook ladders both insulated and non-insulated with nonconductive safety ropes along both outside rails.
- b. Secure the safety chains on both hooks.
- c. Place your safety strap around the ladder ensuring that it goes between at least one of the ropes and rail. Secure safety strap to a ladder rung when in a working position and when the ladder is being moved. Any alternate approved fall arrest system is acceptable as protection.

**NOTE:** Provide non-skid materials on suspended ladder rungs. Ladders without abrasive material on the rungs shall not be used.

## **16.3 EQUIPMENT.**

- a. Emergency rescue equipment shall be available prior to ascending structure/equipment.
- b. Climbing equipment is to be properly stored and protected according to the manufacturer's standards when not in use.
- c. Synthetic materials and hardware of fall protection equipment shall be inspected prior to use. Defective equipment shall immediately be removed from service.
- d. 100 percent leather positioning straps and line-worker's body belt buckle straps (without wear indicators) shall not be used.
- e. Lanyards shall not be knotted while in use.
- f. Lanyards shall not be attached back onto themselves unless a carabiner or ladder hook is used.
- g. Snaphooks or carabiners on all lanyards and positioning straps shall be of the double action locking type.
- h. Pole climbers may not be used if the gaffs are less than 1-1/4 inches in length as measured on the underside of the gaff. The gaffs of pole climbers shall be covered with gaff protectors when not being used.
- i. Fall arrest equipment shall be attached at a location that limits the free fall distance to six feet or less with a shock absorbing lanyard.



- j. Fall arrest equipment receiving an impact from a fall shall be removed from service. The equipment shall be returned to the manufacturer for repair, repaired by a competent person using a qualified facility, or shall be destroyed.
- k. Full body harnesses shall be designed to distribute a majority of the load across the buttocks.
- l. Only energy absorbers with shock force indicators shall be used.
- m. Self retracting lifelines shall be permanently marked with the manufacturers name, model number, rating, and date of manufacture.
- n. The connection between the slider and the attachment point on a body belt or full body harness on fixed ladder safety climbing systems shall not exceed 9 inches.
- o. Boom straps used for fall protection shall be of sufficient design to withstand a static load of 5,000 pounds or twice the maximum anticipated impact load and meet ANSI Z359.1 requirements.



- 17.1 Written Work Procedures
- 17.2 Job Hazard Analysis
- 17.3 Special Work Permits

[illegible]

## **WRITTEN WORK PROCEDURES, JOB HAZARD ANALYSIS AND SPECIAL WORK PERMITS**

### **17.1 WRITTEN WORK PROCEDURES**

- a. Written work procedures shall be prepared for unusual, unique, or complicated work activities where a step-by-step process is essential for the worker(s). These written work procedures may be prepared by the supervisor in consultation with the employees involved as a part of and included with a Job Hazard Analysis (JHA). Alternatively, they may be written as a separate document for repetitive type tasks or incorporated into the JHA. Second line or higher supervisors may participate in the preparation or review of the written work procedures as deemed necessary to help ensure safe performance of the task.

While development of a written work procedure is encouraged wherever it will enhance safety or efficiency, written work procedures for the following tasks are mandatory:

- (1) Live-line maintenance activities where energized parts are handled by barehand methods or supported by insulated tools, or aircraft.
  - (2) Use of materials classified by their material safety data sheet (MSDS) as highly toxic or extremely hazardous.
  - (3) Work in confined or enclosed spaces requiring use of breathing apparatus, testing for toxic atmospheres, or continuous monitoring of oxygen supply.
  - (4) Work in excavations more than four feet deep in which a collapsing wall may trap employees within or cause vehicles or buildings to collapse into the excavation.
  - (5) For high voltage and high power testing performed in shops, substations, and field on electrical transmission and distribution equipment. Does not apply to hot sticks and personal grounds.
  - (6) Other activities as required by the Region.
- b. Written work procedures prepared as a separate document shall contain as a minimum the following information:

- (1) Title to identify the specific activity to be performed. Clearly state the intended objective.
- (2) Date prepared or date of last revision.
- (3) A complete list of the separate tasks listed in the specific order of their accomplishment.
- (4) A list of special equipment and tools required.
- (5) Signature of preparer.
- (6) Signature of reviewer, if applicable.

## **17.2 JOB HAZARD ANALYSIS**

These are the basic JHA requirements. Further guidelines are provided in Western's PSMM Chapter 12 (latest version).

- a. A JHA is a study of a job or activity to (1) identify hazards or potential accidents associated with each step or task and (2) develop solutions that will eliminate, modify, or prevent such hazards or accidents. For simple tasks, the JHA may be a thought process for a single employee task; it may be an oral discussion as part of a tailgate safety meeting; (see Section 2.2) or it may be an oral discussion among a supervisor and employees when work is assigned at the shop prior to departure.

While an oral JHA may suffice for simple tasks, a written document is strongly encouraged for all crew type work. The written JHA should be prepared by the Supervisor in consultation with the employees. It also may involve second level or higher supervision as in the case of a separate written work procedure. In all cases the analysis shall include those participating in the task. A written JHA shall be prepared for the following tasks.

- (1) Tasks which require a written work procedure.
  - (2) Tasks which involve safety rule modifications as allowed under paragraph 1.4.a.
  - (3) Other activities as required by the Region.
  - (4) Tasks which a positive fall protection system can not be achieved.
- b. The written JHA shall be documented on a suitable form and shall contain as a minimum the following information.
    - (1) Date.

- (2) Identification of Employee Group(s).
- (3) Identification of work site.
- (4) Narrative description of work to be accomplished.
- (5) List of identified hazards and how to minimize or eliminate, including specific personal protective equipment.
- (6) Special instructions or limitations.
- (7) List of all special equipment and tools.
- (8) Sequence of steps or, when required, a detailed step-by-step work procedure.
- (9) Signature or initials of all participants.

## **17.3 SPECIAL WORK PERMITS**

Special Work permits provide a means of communication and tracking conditions affecting contractor and/or non-Western forces working on or near Western's facilities and equipment. The permit identifies the limits and conditions of the safe working area by documenting points of protection and using sketches and/or single-line diagrams as necessary. The permit identifies and documents potential hazards that could affect the working area.

Special Work Permits are required any time a contractor or non-Western organization performs construction or maintenance activities on or near Western equipment, where contact with equipment or violation of established minimum approach distances (See Appendix B) could occur. Western's Authorized Representative will determine if switching procedures are required, based on the needs of the Contractor's Authorized Representative. When switching procedures are necessary, Western's Authorized Representative will request and hold the Clearance or HLO.

Work shall not proceed until Western's Authorized Representative has issued a Special Work Permit. Nor shall any work be conducted in any area not specifically covered by the Special Work Permit.

### **17.3.1 The Contractor's Authorized Representative Shall:**

- (a) Know and understand the procedures of this section (Special Work Permits) of PSSM Chapter 17 or Western's Guide Specifications/Western Standard Paragraph.
- (b) Communicate his needs to Western's Authorized Representative, including a detailed plan for accomplishing work.

- (c) Initiate the request for Western's Authorized Representative to arrange necessary switching.
- (d) Obtain appropriate Clearances or Hot Line Orders from non-Western entities when working in proximity to those Non-Western facilities and equipment. In some cases Non-Western Entities may require Western to obtain the Clearance or Hot Line Order.
- (e) Remain on the job site while work is being performed under Special Work Permit.
- (f) Report any unusual conditions to Western's Authorized Representative and record them on the Special Work Permit.
- (g) Ensure that all contractor personnel abide by the boundaries and conditions of the Special Work Permit

### **17.3.2 Western's Authorize Representative Shall:**

- (a) Obtain Clearance and Hot Line Orders as appropriate, in coordination with the Contractor's Authorized Representative.
- (b) Prepare the Special Work Permit for inspection and signature by Western's and Contractor's Authorized Representative.

### **17.3.3 Procedures For Establishing A Special Work Permit**

- (a) The Contractor's Authorized Representative shall communicate a plan for accomplishing work to Western's Authorized Representative.
- (b) Western's Authorized Representative shall determine the need for and obtain the Clearance or Hot Line Order in accordance with PSOM Chapter 1.
- (c) Western's Authorized Representative shall prepare a Special Work Permit in duplicate. (Appendix F)
- (d) Western's Authorized Representative shall review the Special Work Permit, including the limits of the switching procedure, any proposed location and placement of personal protective grounds, and any unusual conditions, with the Contractor's Authorized Representative.
- (e) Western's and the Contractor's Authorized Representative shall inspect the work site together, to verify the adequacy of the information on the Special Work Permit and associated switching procedures.

- (f) Western's and the Contractor's Authorized Representative shall sign both copies of the Special Work Permit at the work site, thereby authorizing the Contractor to proceed with work. Both parties shall retain a copy of the Special Work Permit.

**NOTE:** If Western's Authorized Representative observes that the contractor is not sufficiently knowledgeable or equipped to apply grounds properly, he may request that competent Western Personnel install the required grounding.

### **17.3.4 Release Of A Special Work Permit And Switching Procedures**

- (a) Contractors Authorized Representative shall sign all copies of the Special Work Permit, certifying that all personnel have been informed of the intent to release and are in the clear, that all protective grounds, if applicable, and barricades have been removed.
- (b) Western's Authorized Representative shall ensure that the equipment installed or modified is satisfactory for service or energization or is in safe condition for the action to be released.
- (c) Western's Authorized Representative shall report the condition of the equipment to the Operations Supervisor and inform him that the Special Work Permit has been released.
- (d) Western's Authorized Representative shall release the switching order in accordance with PSOM Chapter 1.

### **17.3.5 Transfer Of Responsibility For Work Performed Under A Special Work Permit**

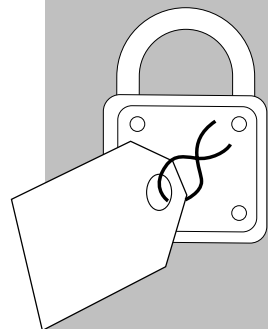
Should it be necessary to transfer the responsibility for the work under a Special Work Permit from one Western's or the Contractor's Authorized Representative to another, a new Special Work Permit shall be issued to the new representative before the existing permit is released. If the previous representative is not available to release the previous permit, the new Authorized Representative shall sign the release of the previous Special Work Permit.



# Lockout/ Tagout

## ► CONTENTS

- 18.1 General
- 18.2 Covered Equipment
- 18.3 Sequence of LOTO



## **LOCKOUT/TAGOUT**

### **18.1 GENERAL**

This section establishes the minimum requirements for lockout and tagout (LOTO) of energy isolating devices whenever maintenance or servicing is done on machines, equipment, or systems operated at less than 600 volts.

It shall be used to ensure the machine, equipment, or systems are stopped; are isolated from all potentially hazardous energy sources; are locked/tagged-out before employees perform any servicing or maintenance where the unexpected energization or start-up of the machine, equipment, or systems or the release of stored energy could cause injury. Further guidance on LOTO procedures, training requirements and LOTO equipment can be found in Chapter XI of WAPA Order 3790.1, latest revision.

### **18.2 COVERED EQUIPMENT**

a. This LOTO section DOES apply to the following:

- (1) All equipment, electrical circuits, and machines (including hydraulics, pneumatics, and stored energy) located in manned facilities, shops, and garages, including equipment directly associated with the transmission or distribution of electrical power at 600 volts or less.
- (2) All equipment and machines located in substations and switch yards which are supplied by the station service transformer or alternate power supplies, such as but not limited to lighting, HVAC systems and ventilation equipment.
- (3) All construction and contractor activities at Western owned sites and facilities.

b. This LOTO section DOES NOT cover the following:

- (1) Equipment and circuits with voltage levels below 50 volts to ground, if there is no increased exposure to electrical burns or explosions due to electrical arcs.

- (2) Equipment (greater than 600 volts) directly associated with electrical power generation, transmission, distribution installations and metering equipment located in buildings or outdoors. For this equipment, refer to Chapter 1 of the PSOM.

## **18.3 SEQUENCE OF LOTO**

- a. The following requirements shall be met in the order given:
  - (1) Notify affected individuals that maintenance work is to be performed on a machine, equipment and/or system.
  - (2) Identify the type and magnitude of the energy, understand the hazards and know the methods to control the energy.
  - (3) Shutdown the machine, equipment and/or system.
  - (4) Switch-off or deactivate the energy isolating device(s) at the energy source.
  - (5) Dissipate and restrain stored or residual energy such as that in capacitors; inductors; spring-charged equipment; elevated machine members; rotating flywheels; or hydraulic, pneumatic, steam, or water pressure systems; by methods such as grounding, repositioning, blocking, bleeding-down, etc.
  - (6) Lock and tag the energy isolating device(s).
  - (7) Verify that the machine, equipment and /or system is at a zero-energy state.
- b. The following verification steps shall be taken before work can begin:
  - (1) Check that other personnel are safely positioned and not exposed.
  - (2) Operate the control(s) to verify isolation of equipment.
  - (3) Return operating control(s) to a “neutral” or “off” position after verifying isolation of equipment.
  - (4) Test equipment shall be used to ensure that electrical parts and circuit elements are deenergized.
    - a. Test instruments and equipment shall be visually inspected for external defects or damage before being used to determine deenergization.

b. Test equipment shall be checked for proper operation immediately before the test. Voltage testing equipment must be capable of reading “0” volts. (A “WIGGINS” TYPE VOLTAGE TESTER IS NOT ACCEPTABLE FOR THIS VERIFICATION).

(5) The machine, equipment and /or system is now locked/ tagged out.

c. The following steps shall be taken to restore equipment to service even temporarily:

- (1) The employee shall conduct tests and visual inspections, as necessary, to verify that all tools, electrical jumpers, shorts, grounds, and other devices, such as blocks, wedges, etc., have been removed so the circuits, equipment, or machine can be safely energized or placed in service.
- (2) The removal of some forms of blocking may require reenergizing of the machine before safe removal
- (3) Check work area to ensure that all employees have been safely positioned or removed from the area.
- (4) Potentially exposed employees shall be warned to stay clear of circuits and equipment prior to reenergizing.
- (5) Verify, at the equipment, that controls are in the “NEUTRAL” or “OFF” position.
- (6) Remove the lock and tag at the energy source(s) and proceed to energize the circuit, electrical equipment, or machine at the energy source. (main breakers, branch breaker, etc.)
- (7) Ensure that equipment or machine is functioning satisfactorily.
- (8) Notify affected individuals that the servicing or maintenance is completed and the machine or equipment is ready for use or in service.

## APPENDIX A

**Table A-1, Minimum Approach Distance to Live Parts for Electrical Workers**

Columns (a) = Phase-to-ground (ft - in)      Columns (b) = Phase-to-phase (ft - in)

Altitude		Voltage in kilovolts phase-to-phase										Altitude adjustment negligible for voltages below 72.6 kV	
(ft)	(m)	.301 to .750		.751 to 15.0		15.1 to 36.0		36.1 to 46.0		46.1 to 72.5			
		(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)		
		1'0"	1'0"	2'2"	2'3"	2'7"	2'10"	2'9"	3'2"	3'3"	3'11"		
All		72.6 to 121		138 to 145		161 to 169		230 to 242		345 to 362		500 to 550	
3,000	900	3'2"	4'3"	3'7"	4'11"	4'0"	5'8"	5'3"	7'6"	8'6"	12'6"	11'3"	18'1"
4,000	1,200	3'3"	4'4"	3'8"	5'0"	4'1"	5'10"	5'4"	7'8"	8'8"	12'9"	11'6"	18'5"
5,000	1,500	3'3"	4'5"	3'9"	5'2"	4'2"	5'11"	5'6"	7'10"	8'11"	13'1"	11'10"	19'0"
6,000	1,800	3'4"	4'7"	3'10"	5'3"	4'3"	6'1"	5'7"	8'1"	9'2"	13'5"	12'1"	19'6"
7,000	2,100	3'5"	4'8"	3'11"	5'5"	4'4"	6'2"	5'9"	8'3"	9'4"	13'10"	12'5"	20'0"
8,000	2,400	3'6"	4'9"	4'0"	5'6"	4'5"	6'4"	5'11"	8'5"	9'7"	14'2"	12'9"	20'6"
9,000	2,700	3'7"	4'10"	4'1"	5'7"	4'7"	6'6"	6'0"	8'8"	9'10"	14'6"	13'0"	21'0"
10,000	3,000	3'8"	4'11"	4'2"	5'9"	4'8"	6'8"	6'2"	8'10"	10'0"	14'10"	13'4"	21'6"
12,000	3,600	3'9"	5'1"	4'3"	5'11"	4'9"	6'10"	6'4"	9'2"	10'5"	15'5"	13'10"	22'5"
14,000	4,200	3'10"	5'3"	4'5"	6'1"	4'11"	7'1"	6'7"	9'6"	10'9"	16'0"	14'4"	23'3"
												*7'6"	*11'6"

**NOTE:** If there is a need for reduced minimum approach distances (values less than those stated above), an engineering study shall be conducted and documented stating the maximum transient overvoltage, the reduced minimum approach distance, and the required operating conditions of the line, for the line being worked on. Maintain at least 2'2" from insulated OGW unless they are grounded.

\* These values are specific to the COTP transmission line with portable protection gaps properly installed. Altitude correction is not required with portable protective gaps in

## APPENDIX A

**Table A-2**  
**Close Proximity Distances to Live Parts for Electrical Workers**

Voltage in kV Phase to Phase	Distance (Phase to Ground) to Energized Equipment	
	Closer than this Distance	Up to this Distance*
.751 to 15	10'	2'2"
15.1 to 36	10'	2'7"
36.1 to 46	10'	2'9"
46.1 to 72.5	10'	3'3"
72.6 to 121	10'8"	3'2"
138 to 145	11'4"	3'7"
161 to 169	11'8"	4'
230 to 242	13'	5'3"
345 to 362	15'4"	8'6"
500 to 550	19'	11'3"

\* Distances in this column are subject to altitude adjustment corrections. For altitude correction, refer to Table A-1

**Table A-3**  
**Minimum Approach Distance to Live Parts for Vehicles and Mechanical Equipment in Transit for Electrical Workers**

Voltage in kV Phase to Phase	Distance (Phase to Ground) to Energized Equipment	
	Closer than this Distance	Up to this Distance*
.751 to 15	4'	2'2"
15.1 to 36	4'	2'7"
36.1 to 46	4'	2'9"
46.1 to 72.5	4'	3'3"
72.6 to 121	4'8"	3'2"
138 to 145	5'4"	3'7"
161 to 169	5'8"	4'
230 to 242	7'	5'3"
345 to 362	9'4"	8'6"
500 to 550	13'	11'3"

**NOTE:** The use of this table is only allowed under section 5.2.c.

\*Distances in this column are subject to altitude adjustment corrections. For altitude correction, refer to Table A-1. Where distances in this column are greater than those in the first column (due to altitude correction), the distance in this column cannot be violated.

## APPENDIX B

# MINIMUM APPROACH DISTANCES TO LIVE PARTS FOR NON-ELECTRICAL WORKERS

**TABLE B-1**  
**MINIMUM APPROACH DISTANCE TO LIVE PARTS**  
**FOR NON-ELECTRICAL WORKERS**

Voltage in kilovolts Phase-to-Phase	Electrical Distance Phase-to-Ground (ft-in)
0 to 90	10 - 0
91 to 121	10 – 8
138 to 145	11 – 4
161 to 169	11 – 8
230 to 242	13 – 0
345 to 362	15 – 4
500 to 550	19 - 0

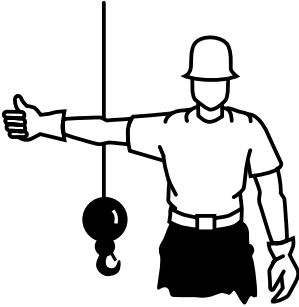
**TABLE B-2**  
**MINIMUM APPROACH DISTANCE TO LIVE PARTS FOR VEHICLES AND**  
**MECHANICAL EQUIPMENT IN TRANSIT**

Voltage in kilovolts Phase-to-Phase	Electrical Distance Phase-to-Ground (ft-in)
0 to 90	4 - 0
91 to 121	4 – 8
138 to 145	5 – 4
161 to 169	5 – 8
230 to 242	7 – 0
345 to 362	9 – 4
500 to 550	13 - 0

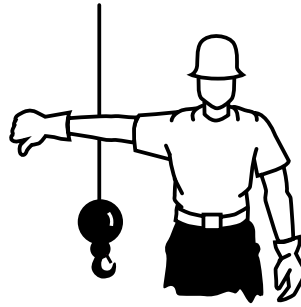
**NOTE:** Table B-2 is derived from OSHA standard 1910.333 (C) (3) (iii) and is only to be used for a vehicle in transit with its structure lowered.

## APPENDIX C

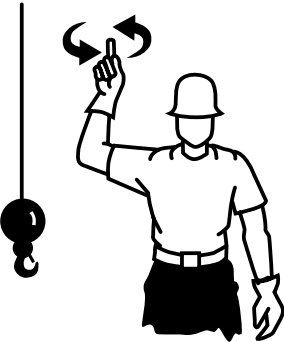
# RECOMMENDED CRANE HAND SIGNALS



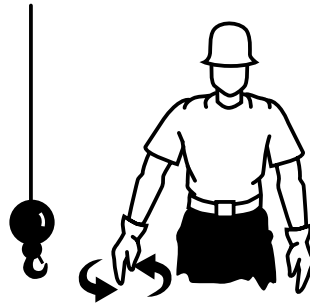
**RAISE BOOM.** Arm extended, fingers closed, thumb pointing upward.



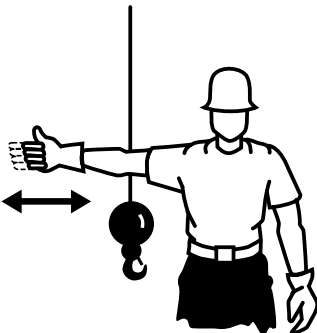
**LOWER BOOM.** Arm extended, fingers closed, thumb pointing downward.



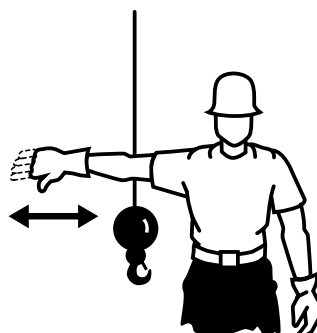
**HOIST.** With forearm vertical, forefinger pointing up, move hand in small horizontal circle.



**LOWER.** With arm extended downward, forefinger pointing down, move hand in small horizontal circles.

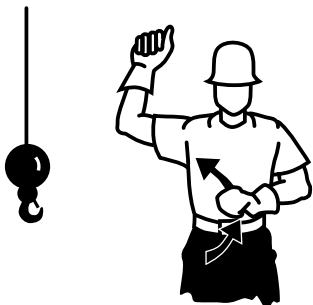


**RAISE THE BOOM AND LOWER THE LOAD.** With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.

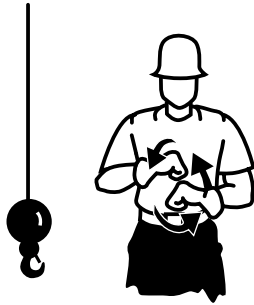


**LOWER THE BOOM AND RAISE THE LOAD.** With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.

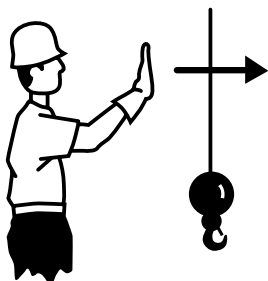




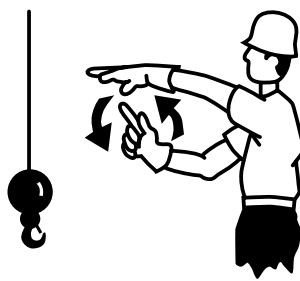
TRAVEL. (One Track) Lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body. (For crawler cranes only)



TRAVEL. (Both Tracks) Use both fists, in front of body, making a circular motion, about each other, indicating direction of travel; forward or backward. (For crawler cranes only)



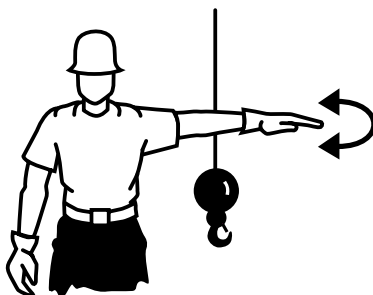
TRAVEL. Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.



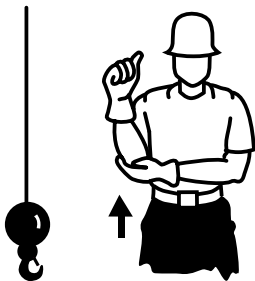
MOVE SLOWLY. Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist slowly shown as example)



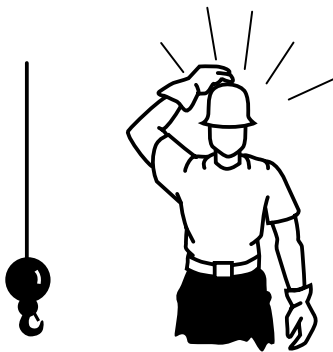
DOG EVERYTHING. Clasp hands in front of body.



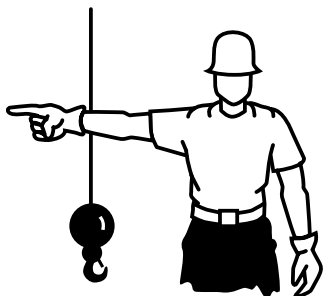
EMERGENCY STOP. Arm extended, palm down, move hand rapidly right and left.



USE WHIP LINE. (Auxilliary Hoist)  
Tap elbow with one hand; then use  
regular signals.



USE MAIN HOIST. Tap fist on head;  
then use regular signals.



SWING. Arm extended point with finger  
in direction of swing of boom.

#### ONE HAND SIGNALS



STOP all  
movement



EXTEND  
BOOM



RETRACT  
BOOM

#### TWO HAND SIGNALS



STOP all  
movement



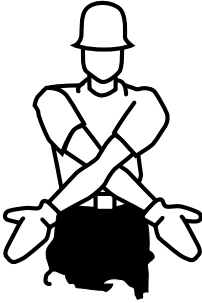
EXTEND  
BOOM



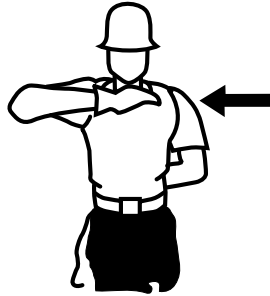
RETRACT  
BOOM

## APPENDIX D

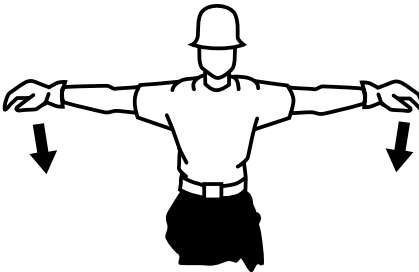
# HELICOPTER HAND SIGNALS



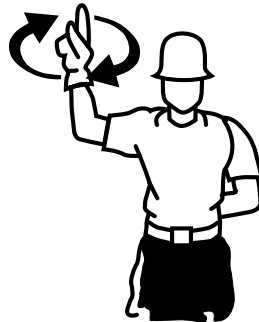
**LAND.** Arms crossed in front of body and pointing downward with back to prevailing wind.



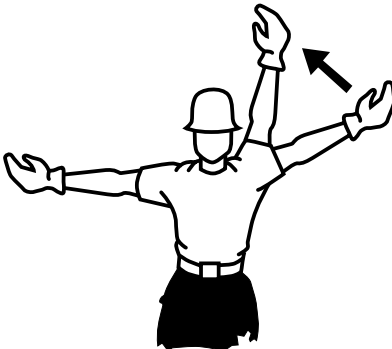
**SHUT OFF MACHINE.** Slash across throat.



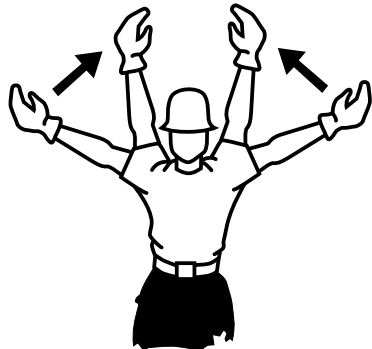
**MOVE DOWNWARD.** Arms extended, palms down, arms sweeping down.



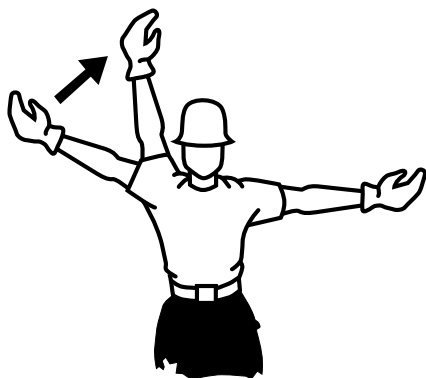
**CLEAR TO START ENGINE.** Left hand behind belt line in back. Right hand circles clockwise with forearm vertical.



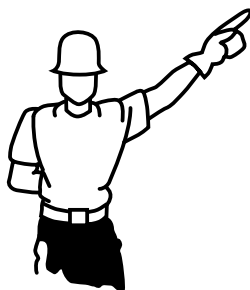
**MOVE LEFT.** Right arm horizontal, left arm sweeps upward to position over head.



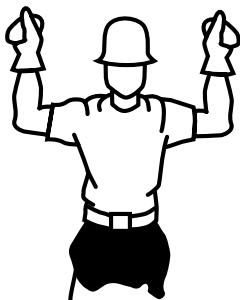
**MOVE FORWARD.** Combination of arm and hand movement in a collecting motion pulling toward body.



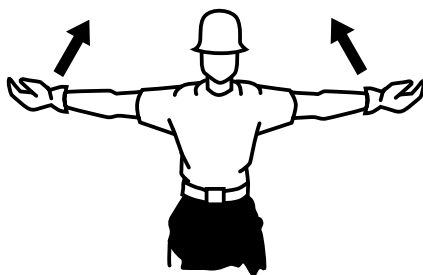
**MOVE RIGHT.** Left arm horizontal. Right arm sweeps upward to position over head.



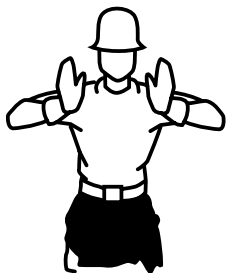
**TAKE OFF.** Right hand behind back, Left hand pointing up.



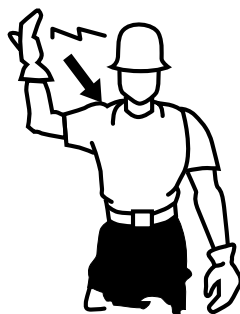
**HOLD - HOVER.** Place arms over head with clenched fists.



**MOVE UPWARD.** Palms up; arms sweeping up palms.



**MOVE REARWARD.** Hands above arm, palms out using a shoving motion.



**RELEASE SLING LOAD.** Left arm down away from body. Right arm cuts across left arm in a slashing movement from above.

## APPENDIX E

**METRIC CONVERSION FACTORS**

The following metric conversion factors are presented in International System of Units (SI) to facilitate conversion of the United States customary (inch-pound) units of measure.<sup>1,2</sup>

**Length:**

- 1 inch = 25.4 millimeters
- 1 foot = 304.8 millimeters
- 1 yard = 0.9144 meter

**Area:**

- 1 square inch = 6.45 square centimeters
- 1 square foot = 0.093 square meters

**Volume/Capacity:**

- 1 cubic inch = 16.39 cubic centimeters
- 1 quart = 0.946 liter
- 1 gallon = 3.785 liters

**Velocity:**

- 1 mile per hour = 1.61 kilometers per hour
- 1 foot per minute = 0.3048 meters per minute

**Mass:**

- 1 pound = 0.454 kilogram

**Force:**

- 1 pound = 4.45 newtons

<sup>1</sup>Nominal conversions: For noncritical dimensions, nominal conversion factors may be used. Examples of this are:

- 1 inch = 25 millimeters
- 1 foot = 300 millimeters
- 1 yard = 1 meter
- 1 pound/inch<sup>2</sup> = 7 kPa

<sup>2</sup>Converting maximum/minimum dimensions: To ensure exact compliance with slated maximum or minimum dimensions, dimensions converted to metric units shall be rounded in the conservative direction (i.e., maximum values should be rounded downward and minimum values should be rounded upward).

### **Light Intensity:**

1 footcandle = 10.76 lux

### **Flow:**

1 gallon per minute = 3.785 liters per minute

### **Power:**

1 horsepower = 746 watts

### **Temperature:**

Temp °F = 1.8 (Temp °C) + 32

Temp °C = (Temp °F - 32)/1.8

### **Pressure:**

1 pound per square inch = 6.895 kilopascals

1 pound per square foot = 48 pascals

### **Loadings, mass:**

lb/ft<sup>2</sup> = 4.88 kilograms per square meter

APPENDIX F SPECIAL WORK PERMIT

U.S. DEPARTMENT OF ENERGY  
WESTERN AREA POWER ADMINISTRATION  
SPECIAL WORK PERMIT

NUMBER \_\_\_\_\_

SOLICITATION NO. \_\_\_\_\_

A POWER SYSTEM ☐ (CLEARANCE) ☐ (HOT LINE ORDER) HAS BEEN ISSUED  
ON THE FOLLOWING FACILITY. (CHECK THE APPROPRIATE BOX)

TO PERMIT WORK BY CONTRACTOR FORCES. THE UNDERSIGNED HAVE DISCUSSED THE  
WORK TO BE DONE, REVIEWED THE DETAILS OF THE ABOVE LISTED PROTECTIVE ACTION FOR  
ADEQUACY, AND DEFINED THE LIMITS AND CONDITIONS OF THE SAFE WORKING AREA. THE  
LIMITS OF THE SAFE WORKING AREA ARE AS FOLLOWS:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

NOTE: Draw sketches and/or single line diagrams on reverse side showing safe working limits and  
hazards if applicable.

☐ CLEARANCE NO. \_\_\_\_\_ (Signature) \_\_\_\_\_

☐ HOT LINE ORDER DATE \_\_\_\_\_ TIME \_\_\_\_\_ AGENCY EMPLOYEE HOLDING ACTION \_\_\_\_\_

This Work Permit issued at the worksite Date \_\_\_\_\_ Time \_\_\_\_\_ and the  
contractor is authorized to proceed with the work in the area designated above.

\_\_\_\_\_  
(Signature)  
CONTRACTOR'S AUTHORIZED  
REPRESENTATIVE AT THE WORKSITE

\_\_\_\_\_  
(Signature)  
AGENCY REPRESENTATIVE  
IN CHARGE AT THE WORKSITE

RELEASE OF SPECIAL WORK PERMIT

I HEREBY CERTIFY THAT ALL PROTECTIVE GROUNDS AND BARRIERS HAVE BEEN  
REMOVED AND THAT ALL PERSONNEL ARE CLEAR OF THE AREA COVERED  
BY THIS WORK PERMIT.

\_\_\_\_\_  
CONTRACTOR'S AUTHORIZED REPRESENTATIVE (SIGNATURE)

\_\_\_\_\_  
DATE

\_\_\_\_\_  
TIME

O&M COPY	
CONSTRUCTION COPY	
CONTRACTOR COPY	
OTHER	

## APPENDIX G

## DEFINITIONS

**Accident** - An unplanned but not necessarily injurious or damaging event which interrupts the completion of an activity and is invariably preceded by an unsafe act and/or unsafe or unhealthful condition.

**Aerial Device** - Any piece of equipment utilizing a bucket or platform to place the worker(s) at an elevated worksite.

**Anchorage** - A secure means of attachment to which the fall protection system is connected.

**Approved** - A method, equipment, procedure, practice, tool, etc., which is sanctioned, consented to, confirmed, or accepted as good or satisfactory for a particular purpose or use by a person or organization authorized to make such a judgment.

**Authorized Individual** - A selected person who has been properly trained, tested, and certified to perform, and is currently involved in, the action being accomplished.

**Barricade** - A physical obstruction such as tapes, cones, or A-frame type wood or metal structures intended to provide a warning about and to limit access to a hazardous area.

**Barrier** - A physical obstruction which is intended to prevent contact with energized lines or equipment or to prevent unauthorized access to a work area.

**Bond** - The electrical interconnection of conductive parts designed to maintain a common electrical potential.

**Bracket Grounds** - Two sets of personal protective grounds placed apart from each other on a transmission line that allows a crew(s) to work a line section while it is physically on the ground without having personal protective grounds in place at the work site.

**Carabiner** - A connector component generally comprised of a trapezoidal or oval shaped body with a normally closed gate or similar arrangement which may be opened to permit the body to receive an object, and when released, automatically closes to retain the object.

**Certified** - A person who possesses a valid certificate, issued by a recognized authority, attesting that he has satisfactorily completed tests as to his knowledge and skill to safely perform in a specific field of endeavor.



**Clearance** - A statement with documentation from the Operations Supervisor to the Clearance Supervisor declaring that the equipment to be worked on has been deenergized and isolated from all sources of primary system energy.

**Clearance Supervisor** - An authorized individual who receives and releases a switching procedure and who is responsible for meeting the requirements of Chapter 1, PSOM, during the clearance. The Clearance Supervisor is responsible to ensure that the Clearance protection provided is adequate. The Clearance Supervisor is not required to be the supervisor in charge of the job.

**Close Proximity** - The distance as defined in Table A-2.

**Codes** - Rules and standards which have been adopted by a governmental agency as mandatory regulations having the force and effect of law. Also used to describe a body of standards.

**Commercial Motor Vehicle** - A vehicle with a gross vehicle weight rating (GVWR) or gross combination weight rating, (vehicle plus trailer), or gross vehicle weight or gross combination weight, (vehicle plus trailer) of 10,001 pounds or more whichever is greater: or is used in transporting hazardous material as defined under 49USC 5103 and transported in a quantity requiring placarding under regulations prescribed by the Secretary of Transportation under 49 CFR, subtitle B, chapter 1, subchapter C.

**Competent Person** - One who, because of training, experience, and authority is capable of identifying and correcting hazardous or dangerous conditions.

**Conductive Hose** - Fuel or oil handling hose with continuous metal braid from attachment to attachment.

**Contractor** - A non-Western construction or maintenance organization responsible to Western for the work.

**Contractor's Authorized Representative** - An employee of the contractor who is designated and authorized responsibility by the contractor to coordinate, receive and release Special Work Permits. The Contractor's Authorized Representative is responsible for the work covered by the Special Work Permit.

**Damage** - Loss in value, usefulness, etc., to property or things. Harm causing any material loss.

**Danger** - A general term denoting liability or potential of injury, illness, damage, loss or pain.

**Deenergized** - Removed from its primary electrical source of energy by opening load current interrupting devices.

**NOTE:** The circuit may have a static or induced charge and shall be considered energized until isolated and grounded.

**Defect** - An unsafe or unwanted physical condition of material or an inherent or created weakness.

**Electrical Worker** - A worker who has received, as part of a training program, formal instruction and training in the electrical systems and the associated hazards.

**Energy (shock) Absorber** - A component whose primary function is to dissipate energy and limit deceleration forces on the body during fall arrest.

**Engineer** - One who, by possession of a recognized degree or current engineering registration certificate, and who by knowledge, training, and expertise has successfully demonstrated the ability to design or analyze electrical, mechanical, hydraulic, or structural equipment and systems and their proper applications.

**Equipment** - Any machine, device, or apparatus (either electrical, mechanical, or hydraulic) including electrical circuits, transmission lines, piping systems, and waterways.

**Fall Arrest System** - The assemblage of equipment such as a full body harness in conjunction with a shock absorbing lanyard to limit the forces a worker experiences during a fall from one elevation to another.

**Fall Prevention System** - A system intended to prevent a worker from falling from one elevation to another. Fall Protection System - A fall prevention or arrest system consisting of three integral parts: an anchorage, a body attachment device, and a means of connecting a body attachment device to the anchorage.

**General Switching** - Switching performed for line sectionalization or system (electrical, mechanical, hydraulic, etc.) rearrangement for testing and/or changes in operating conditions. Such operations are not normally associated with clearances, HLOs or special conditions.

**Ground** - A conducting connection, whether intentional or accidental, between an electric circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

**Grounded** - Connected to earth or to some conducting body that serves in place of the earth.

**Grounded System** - Includes the deenergized and grounded conductor and all conductive items bonded to it, i.e. guy wires, structure and overhead ground wires, metal structure members, ground rods, vehicles, etc.

**Groundman** - A person working at ground level in support of a lineman or electrician working aloft.

**Guarded** - Covered, fenced, enclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, mats, or platforms, designed to minimize the possibility, under normal conditions, of dangerous approach or accidental contact by persons or objects.

**NOTE:** Wires which are insulated, but not otherwise protected, are not considered as guarded.

**Hazard** - That dangerous condition, potential or inherent, which can bring about an interruption or interference with the expected orderly progress of an activity.

**Hazard Analysis** - A study of a job or activity to (1) identify hazards or potential accidents associated with each step or task, and (2) develop solutions that will eliminate, nullify, or prevent such hazards or accidents. The job hazard analysis should be an integral part of the written procedures for specific work activities. May be an oral discussion when tasks allows.

**Hazardous Condition** - The physical condition or circumstance which is or could be casually related to an accident occurrence.

**Hazardous Materials** - Materials possessing a relatively high potential for harmful effects upon persons.

**High-power** - Tests in which fault currents, load currents, magnetizing currents, and line-dropping currents are used to test equipment, either at the equipment's rated voltage or at lower voltages.

**High-voltage** - Tests in which voltages of approximately 1000 volts are used as a practical minimum and in which the voltage source has sufficient energy to cause injury.

**Hot Line Order** - A statement with documentation from the Operations Supervisor to the HLO Supervisor that the automatic reclosing is turned off and that the equipment covered by the hot line order will not be intentionally reenergized until contact has been made with the HLO Supervisor.

**HLO Supervisor** - An authorized individual who receives and releases a switching procedure and who is responsible for meeting the requirements of Chapter 1, PSOM, during the HLO. The HLO Supervisor is responsible to ensure that the Hot Line Order perimeter provided is adequate. Injury (occupational) - Any hurt, harm, or impairment to the body which arises out of, or in the course of, employment.

**Isolated** - The circuit is isolated when all switches, disconnectors, jumpers, taps, or other means through which known sources of electrical energy may be supplied to the particular lines and equipment have been opened on a deenergized electrical circuit or equipment.

**NOTE:** the circuit may have a static or induced charge and shall be considered as energized until grounded.

**Job Hazard Analysis** - See section 17 or Hazard Analysis definition.

**Jobsite** - The assembly point at the structure or equipment where the workers, tools, and vehicles are assembled to perform the work activity.

**Jumper** - A conductive tool used to maintain electric continuity across equipment, or a conductor that shall be opened mechanically to enable various operations of live work to be performed.

**Lineman** - A payroll classification or title given a craftsperson whose duties include climbing wood poles or steel structures to perform work on electric power transmission and/or distribution circuits.

**Management** - Refers collectively to the operating office head and his staff and/or the Regional Manager and his staff.

**Minimum Approach Distance** - Minimum Approach Distance - The closest distance an employee is permitted to approach an energized or ungrounded object.

**Near Miss** - An incident that could have caused injury or damage but did not.

**Nominal Voltage** - The voltage that a line or equipment is designated to be energized at. The actual operating voltage can vary from the nominal within a range that permits satisfactory operation of equipment.

**Non-electrical Worker** - A worker that does not meet the requirements of an electrical worker.

**Personal Protective Equipment** - Any apparel or device worn or used to protect the worker from exposure to, or contact with, any harmful material, force, or environment.

**Personal Protective Ground** - A portable cable designed to connect a deenergized conductor, piece of equipment, or both to an electrical ground at the worksite.

**Personal Protective Grounding** - The installation of personal protective grounds (normally in a three phase short) at the worksite.

**Primary System Energy** - Electrical energy above 600 volts. Operating energy (pneumatic, hydraulic, spring or other stored energy), and control or annunciator power sources, are not considered primary system energy but are the responsibility of the supervisor to be aware of and provide protection against, if required, for the work to be accomplished.

**Procedure** - A course of action by which work is initiated, performed, controlled and completed. A procedure establishes what action is required, who is required to act, and when the action is to take place.

**Procedural Live-line Work** - Crew type maintenance activities for which formal hotstick and/or barehand written procedures have been established.

**Qualified Climber** - A worker who, by reason of training and experience, understands the methods and has routinely demonstrated proficiency in climbing and in knowledge of the hazards and equipment associated with climbing with respect to his profession based on supervisor's assessment in concurrence with the next higher level supervisor.

**Qualified Employee** - One knowledgeable in the construction and operation of the electric power generation, transmission, and distribution equipment involved, along with the associated hazards.

**NOTE 1:** An employee must have the training required by DOL/OSHA 1910.269 (a)(2)(ii) in order to be considered a qualified employee.

**NOTE 2:** Except under DOL/OSHA 1910.269 (g)(2)(v), an employee who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties.

**Regulation** - A rule, ordinance, law, or device by which conduct or performance is controlled.

**Safe** - Relatively free from danger, injury, or damage or from the risk of danger, etc.

**Safety** - The art of performing any activity in the most accident-free manner. Relatively free from hazard.

**Safety Observer** - A qualified electrical worker who knows and understands the safe rules, practices and procedures and the electrical hazards associated with the work being performed.

**Snaphook** - A connector comprised of a hook-shaped member with a normally closed keeper or similar arrangement, which may be opened to permit the hook to receive an object and, when released, automatically closes to retain the object.

**Spiking Cables** - The process of driving a grounded pin into an insulated electrical cable to assure it is deenergized before the insulation is opened.

**Step Voltage** - The potential difference between two points on the earth's surface separated by a distance of one pace (assumed to be one meter). This potential difference could be hazardous when current flows through the earth or material upon which a person is standing, particularly under fault conditions.

**Supervisor** - The person directly in charge of personnel at the worksite, regardless of payroll or operating title.

**System Ground** - May be the grounded structure, driven ground rod(s) or overhead ground wire(s) to which the de-energized circuit and other deenergized conductive items are bonded. (See Grounded System)

**Tailgate Meeting** - An on-the-job briefing, usually not documented, about the job to be done.

**Task** - A definite portion of a job assigned to or required of a person.

**TLV's (threshold limit values)** - The quantity below which the effects of airborne substances cease to be perceptible and dangerous to nearly all workers who may be repeatedly exposed, day after day.

**Touch Voltage** - The potential difference between a grounded metallic structure and a point on the earth's surface separated by a distance equal to the normal maximum horizontal reach (approximately one meter). This potential difference could be hazardous and could result from induction of fault conditions, or both.

**Transferred Voltage** - The potential difference between points on a surface connected by a conductive element which will greatly increase step and touch potentials as the distance from the source increases.

**Toxic** - Of, pertaining to, or caused by poison. Poisonous, harmful.

**Unauthorized Personnel** - Anyone not directly involved in the work or task being performed

**Unsafe Condition** - Any physical state which deviates from that which is acceptable or correct in terms of its past production or potential future production of personal injury and/or damage to property or things. Any physical state which results in a reduction in the degree of safety normally present.

**Weekly Job-Safety Planning Meeting** - A documented meeting that the supervisor holds with his employees to discuss safety and health issues. Also referred to as "Tool Box Meeting."

**Western's Authorized Representative** – A properly qualified Operations, Maintenance, or Construction person, employed or contracted by Western, who is knowledgeable of PSOM Chapter 1 and this document's procedures and certified by Western to switch, request, and receive Clearance and Hot line Orders and issue a Special Work Permit.

**Worksite** - The location on the structure or equipment where the worker is in position to perform the assigned work or task.

**Worksite Grounding System** - A worksite grounding system is one where all conductive objects that may be touched simultaneously, either by a person or conductive tool, shall be grounded and bonded together. This includes—but is not limited to—conductors, overhead ground wires, vehicles, equipment, structure grounds, guys (where isolated insulators are used, both sections shall be bonded to the system), and fences.

## APPENDIX H

# ACRONYMS AND INITIALISMS

<b>ACSR</b>	—	Aluminum Conductor Steel Reinforced
<b>ANSI</b>	—	American National Standards Institute
<b>ATPV</b>	—	Arc Thermal Performance Value
<b>AWG</b>	—	American Wire Gauge
<b>ASTM</b>	—	American Society for Testing and Materials
<b>COTP</b>	—	California-Oregon Transmission Project
<b>CT</b>	—	Current Transformer
<b>dBA</b>	—	Weighted Noise Power in Decibels
<b>DOE</b>	—	Department of Energy
<b>DOL</b>	—	Department of Labor
<b>DOT</b>	—	Department of Transportation
<b>FRP</b>	—	Fiberglass-Reinforced Plastic
<b>GFCI</b>	—	Ground Fault Circuit Interrupter
<b>GVW</b>	—	Gross Vehicle Weight
<b>HLO</b>	—	Hot Line Order
<b>ID</b>	—	Inside Diameter
<b>JHA</b>	—	Job Hazard Analysis
<b>LED</b>	—	Light Emitting Diode
<b>LEL</b>	—	Lower Explosive Limit
<b>LOTO</b>	—	Lock Out Tag Out
<b>MAD</b>	—	Minimum Approach Distance
<b>MSDS</b>	—	Material Safety Data Sheet
<b>NFPA</b>	—	National Fire Protection Association
<b>OFCS</b>	—	Optical Fiber Communications System
<b>OGW</b>	—	Overhead Ground Wire
<b>OSHA</b>	—	Occupational Safety and Health Administration
<b>PFD</b>	—	Personal Floatation Device
<b>psi</b>	—	pounds per square inch
<b>PSMM</b>	—	Power System Maintenance Manual
<b>PSOM</b>	—	Power System Operations Manual
<b>PSSM</b>	—	Power System Safety Manual
<b>SF6</b>	—	Sulfur Hexafluoride
<b>SI</b>	—	International System of Units (Le Système International d'Unités)
<b>TLV</b>	—	Threshold Limit Value
<b>TWA</b>	—	Time Weighted Average
<b>UL</b>	—	Underwriters Laboratory



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