

driven ground, shall be capable of conducting the anticipated fault current and shall have a minimum conductance of No. 2 AWG copper.

**§ 1926.955 Overhead lines.**

(a) *Overhead lines.* (1) When working on or with overhead lines the provisions of paragraphs (a) (2) through (8) of this section shall be complied with in addition to other applicable provisions of this subpart.

(2) Prior to climbing poles, ladders, scaffolds, or other elevated structures, an inspection shall be made to determine that the structures are capable of sustaining the additional or unbalanced stresses to which they will be subjected.

(3) Where poles or structures may be unsafe for climbing, they shall not be climbed until made safe by guying, bracing, or other adequate means.

(4) Before installing or removing wire or cable, strains to which poles and structures will be subjected shall be considered and necessary action taken to prevent failure of supporting structures.

(5)(i) When setting, moving, or removing poles using cranes, derricks, gin poles, A-frames, or other mechanized equipment near energized lines or equipment, precautions shall be taken to avoid contact with energized lines or equipment, except in bare-hand live-line work, or where barriers or protective devices are used.

(ii) Equipment and machinery operating adjacent to energized lines or equipment shall comply with §1926.952(c)(2).

(6)(i) Unless using suitable protective equipment for the voltage involved, employees standing on the ground shall avoid contacting equipment or machinery working adjacent to energized lines or equipment.

(ii) Lifting equipment shall be bonded to an effective ground or it shall be considered energized and barricaded when utilized near energized equipment or lines.

(7) Pole holes shall not be left unattended or unguarded in areas where employees are currently working.

(8) Tag lines shall be of a nonconductive type when used near energized lines.

(b) *Metal tower construction.* (1) When working in unstable material the excavation for pad- or pile-type footings in excess of 5 feet deep shall be either sloped to the angle of repose as required in §1926.652 or shored if entry is required. Ladders shall be provided for access to pad- or pile-type footing excavations in excess of 4 feet.

(2) When working in unstable material provision shall be made for cleaning out auger-type footings without requiring an employee to enter the footing unless shoring is used to protect the employee.

(3)(i) A designated employee shall be used in directing mobile equipment adjacent to footing excavations.

(ii) No one shall be permitted to remain in the footing while equipment is being spotted for placement.

(iii) Where necessary to assure the stability of mobile equipment the location of use for such equipment shall be graded and leveled.

(4)(i) Tower assembly shall be carried out with a minimum exposure of employees to falling objects when working at two or more levels on a tower.

(ii) Guy lines shall be used as necessary to maintain sections or parts of sections in position and to reduce the possibility of tipping.

(iii) Members and sections being assembled shall be adequately supported.

(5) When assembling and erecting towers the provisions of paragraphs (b)(5) (i), (ii) and (iii) of this section shall be complied with:

(i) The construction of transmission towers and the erecting of poles, hoisting machinery, site preparation machinery, and other types of construction machinery shall conform to the applicable requirements of this part.

(ii) No one shall be permitted under a tower which is in the process of erection or assembly, except as may be required to guide and secure the section being set.

(iii) When erecting towers using hoisting equipment adjacent to energized transmission lines, the lines shall be deenergized when practical. If the lines are not deenergized, extraordinary caution shall be exercised to maintain the minimum clearance distances required by §1926.950(c), including Table V-1.

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(6)(i) Erection cranes shall be set on firm level foundations and when the cranes are so equipped outriggers shall be used.

(ii) Tag lines shall be utilized to maintain control of tower sections being raised and positioned, except where the use of such lines would create a greater hazard.

(iii) The loadline shall not be detached from a tower section until the section is adequately secured.

(iv) Except during emergency restoration procedures erection shall be discontinued in the event of high wind or other adverse weather conditions which would make the work hazardous.

(v) Equipment and rigging shall be regularly inspected and maintained in safe operating condition.

(7) Adequate traffic control shall be maintained when crossing highways and railways with equipment as required by the provisions of §1926.200(g) (1) and (2).

(8) A designated employee shall be utilized to determine that required clearance is maintained in moving equipment under or near energized lines.

(c) *Stringing or removing deenergized conductors.* (1) When stringing or removing deenergized conductors, the provisions of paragraphs (c) (2) through (12) of this section shall be complied with.

(2) Prior to stringing operations a briefing shall be held setting forth the plan of operation and specifying the type of equipment to be used, grounding devices and procedures to be followed, crossover methods to be employed, and the clearance authorization required.

(3) Where there is a possibility of the conductor accidentally contacting an energized circuit or receiving a dangerous induced voltage buildup, to further protect the employee from the hazards of the conductor, the conductor being installed or removed shall be grounded or provisions made to insulate or isolate the employee.

(4)(i) If the existing line is deenergized, proper clearance authorization shall be secured and the line grounded on both sides of the crossover or, the line being strung or removed shall be considered and worked as energized.

(ii) When crossing over energized conductors in excess of 600 volts, rope nets or guard structures shall be installed unless provision is made to isolate or insulate the workman or the energized conductor. Where practical the automatic reclosing feature of the circuit interrupting device shall be made inoperative. In addition, the line being strung shall be grounded on either side of the crossover or considered and worked as energized.

(5) Conductors being strung in or removed shall be kept under positive control by the use of adequate tension reels, guard structures, tielines, or other means to prevent accidental contact with energized circuits.

(6) Guard structure members shall be sound and of adequate dimension and strength, and adequately supported.

(7)(i) Catch-off anchors, rigging, and hoists shall be of ample capacity to prevent loss of the lines.

(ii) The manufacturer's load rating shall not be exceeded for stringing lines, pulling lines, sock connections, and all load-bearing hardware and accessories.

(iii) Pulling lines and accessories shall be inspected regularly and replaced or repaired when damaged or when dependability is doubtful. The provisions of §1926.251(c)(4)(ii) (concerning splices) shall not apply.

(8) Conductor grips shall not be used on wire rope unless designed for this application.

(9) While the conductor or pulling line is being pulled (in motion) employees shall not be permitted directly under overhead operations, nor shall any employee be permitted on the crossarm.

(10) A transmission clipping crew shall have a minimum of two structures clipped in between the crew and the conductor being sagged. When working on bare conductors, clipping and tying crews shall work between grounds at all times. The grounds shall remain intact until the conductors are clipped in, except on dead end structures.

(11)(i) Except during emergency restoration procedures, work from structures shall be discontinued when adverse weather (such as high wind or ice

on structures) makes the work hazardous.

(ii) Stringing and clipping operations shall be discontinued during the progress of an electrical storm in the immediate vicinity.

(12)(i) Reel handling equipment, including pulling and braking machines, shall have ample capacity, operate smoothly, and be leveled and aligned in accordance with the manufacturer's operating instructions.

(ii) Reliable communications between the reel tender and pulling rig operator shall be provided.

(iii) Each pull shall be snubbed or dead ended at both ends before subsequent pulls.

(d) *Stringing adjacent to energized lines.* (1) Prior to stringing parallel to an existing energized transmission line a competent determination shall be made to ascertain whether dangerous induced voltage buildups will occur, particularly during switching and ground fault conditions. When there is a possibility that such dangerous induced voltage may exist the employer shall comply with the provisions of paragraphs (d) (2) through (9) of this section in addition to the provisions of paragraph (c) of this §1926.955, unless the line is worked as energized.

(2) When stringing adjacent to energized lines the tension stringing method or other methods which preclude unintentional contact between the lines being pulled and any employee shall be used.

(3) All pulling and tensioning equipment shall be isolated, insulated, or effectively grounded.

(4) A ground shall be installed between the tensioning reel setup and the first structure in order to ground each bare conductor, subconductor, and overhead ground conductor during stringing operations.

(5) During stringing operations, each bare conductor, subconductor, and overhead ground conductor shall be grounded at the first tower adjacent to both the tensioning and pulling setup and in increments so that no point is more than 2 miles from a ground.

(i) The grounds shall be left in place until conductor installation is completed.

(ii) Such grounds shall be removed as the last phase of aerial cleanup.

(iii) Except for moving type grounds, the grounds shall be placed and removed with a hot stick.

(6) Conductors, subconductors, and overhead ground conductors shall be grounded at all dead-end or catch-off points.

(7) A ground shall be located at each side and within 10 feet of working areas where conductors, subconductors, or overhead ground conductors are being spliced at ground level. The two ends to be spliced shall be bonded to each other. It is recommended that splicing be carried out on either an insulated platform or on a conductive metallic grounding mat bonded to both grounds. When a grounding mat is used, it is recommended that the grounding mat be roped off and an insulated walkway provided for access to the mat.

(8)(i) All conductors, subconductors, and overhead ground conductors shall be bonded to the tower at any isolated tower where it may be necessary to complete work on the transmission line.

(ii) Work on dead-end towers shall require grounding on all deenergized lines.

(iii) Grounds may be removed as soon as the work is completed: *Provided*, That the line is not left open circuited at the isolated tower at which work is being completed.

(9) When performing work from the structures, clipping crews and all others working on conductors, subconductors, or overhead ground conductors shall be protected by individual grounds installed at every work location.

(e) *Live-line bare-hand work.* In addition to any other applicable standards contained elsewhere in this subpart all live-line bare-hand work shall be performed in accordance with the following requirements:

(1) Employees shall be instructed and trained in the live-line bare-hand technique and the safety requirements pertinent thereto before being permitted to use the technique on energized circuits.

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(2) Before using the live-line bare-hand technique on energized high-voltage conductors or parts, a check shall be made of:

(i) The voltage rating of the circuit on which the work is to be performed;

(ii) The clearances to ground of lines and other energized parts on which work is to be performed; and

(iii) The voltage limitations of the aerial-lift equipment intended to be used.

(3) Only equipment designed, tested, and intended for live-line bare-hand work shall be used.

(4) All work shall be personally supervised by a person trained and qualified to perform live-line bare-hand work.

(5) The automatic reclosing feature of circuit interrupting devices shall be made inoperative where practical before working on any energized line or equipment.

(6) Work shall not be performed during the progress of an electrical storm in the immediate vicinity.

(7) A conductive bucket liner or other suitable conductive device shall be provided for bonding the insulated aerial device to the energized line or equipment.

(i) The employee shall be connected to the bucket liner by use of conductive shoes, leg clips, or other suitable means.

(ii) Where necessary, adequate electrostatic shielding for the voltage being worked or conductive clothing shall be provided.

(8) Only tools and equipment intended for live-line bare-hand work shall be used, and such tools and equipment shall be kept clean and dry.

(9) Before the boom is elevated, the outriggers on the aerial truck shall be extended and adjusted to stabilize the truck and the body of the truck shall be bonded to an effective ground, or barricaded and considered as energized equipment.

(10) Before moving the aerial lift into the work position, all controls (ground level and bucket) shall be checked and tested to determine that they are in proper working condition.

(11) Arm current tests shall be made before starting work each day, each time during the day when higher volt-

age is going to be worked and when changed conditions indicate a need for additional tests. Aerial buckets used for bare-hand live-line work shall be subjected to an arm current test. This test shall consist of placing the bucket in contact with an energized source equal to the voltage to be worked upon for a minimum time of three (3) minutes. The leakage current shall not exceed 1 microampere per kilo-volt of nominal line-to-line voltage. Work operations shall be suspended immediately upon any indication of a malfunction in the equipment.

(12) All aerial lifts to be used for live-line bare-hand work shall have dual controls (lower and upper) as required by paragraph (e)(12) (i) and (ii) of this section.

(i) The upper controls shall be within easy reach of the employee in the basket. If a two basket type lift is used access to the controls shall be within easy reach from either basket.

(ii) The lower set of controls shall be located near base of the boom that will permit over-ride operation of equipment at any time.

(13) Ground level lift control shall not be operated unless permission has been obtained from the employee in lift, except in case of emergency.

(14) Before the employee contacts the energized part to be worked on, the conductive bucket liner shall be bonded to the energized conductor by means of a positive connection which shall remain attached to the energized conductor until the work on the energized circuit is completed.

(15) The minimum clearance distances for live-line bare-hand work shall be as specified in Table V-2. These minimum clearance distances shall be maintained from all grounded objects and from lines and equipment at a different potential than that to which the insulated aerial device is bonded unless such grounded objects or other lines and equipment are covered by insulated guards. These distances shall be maintained when approaching, leaving, and when bonded to the energized circuit.

TABLE V-2—MINIMUM CLEARANCE DISTANCES FOR LIVE-LINE BARE-HAND WORK (ALTERNATING CURRENT)

Voltage range (phase-to-phase) kilovolts	Distance in feet and inches for maximum voltage	
	Phase to ground	Phase to phase
2.1 to 15 .....	2'0"	2'0"
15.1 to 35 .....	2'4"	2'4"
35.1 to 46 .....	2'6"	2'6"
46.1 to 72.5 .....	3'0"	3'0"
72.6 to 121 .....	3'4"	4'6"
138 to 145 .....	3'6"	5'0"
161 to 169 .....	3'8"	5'6"
230 to 242 .....	5'0"	8'4"
345 to 362 .....	1'7'0"	1'13'4"
500 to 552 .....	1'11'0"	1'20'0"
700 to 765 .....	1'15'0"	1'31'0"

<sup>1</sup>For 345–362kv., 500–552kv., and 700–765kv., the minimum clearance distance may be reduced provided the distances are not made less than the shortest distance between the energized part and a grounded surface.

(16) When approaching, leaving, or bonding to an energized circuit the minimum distances in Table V-2 shall be maintained between all parts of the insulated boom assembly and any grounded parts (including the lower arm or portions of the truck).

(17) When positioning the bucket alongside an energized bushing or insulator string, the minimum line-to-ground clearances of Table V-2 must be maintained between all parts of the bucket and the grounded end of the bushing or insulator string.

(18)(i) The use of handlines between buckets, booms, and the ground is prohibited.

(ii) No conductive materials over 36 inches long shall be placed in the bucket, except for appropriate length jumpers, armor rods, and tools.

(iii) Nonconductive-type handlines may be used from line to ground when not supported from the bucket.

(19) The bucket and upper insulated boom shall not be overstressed by attempting to lift or support weights in excess of the manufacturer's rating.

(20)(i) A minimum clearance table (as shown in table V-2) shall be printed on a plate of durable nonconductive material, and mounted in the buckets or its vicinity so as to be visible to the operator of the boom.

(ii) It is recommended that insulated measuring sticks be used to verify clearance distances.

### § 1926.956 Underground lines.

(a) *Guarding and ventilating street opening used for access to underground lines or equipment.* (1) Appropriate warning signs shall be promptly placed when covers of manholes, handholes, or vaults are removed. What is an appropriate warning sign is dependent upon the nature and location of the hazards involved.

(2) Before an employee enters a street opening, such as a manhole or an unvented vault, it shall be promptly protected with a barrier, temporary cover, or other suitable guard.

(3) When work is to be performed in a manhole or unvented vault:

(i) No entry shall be permitted unless forced ventilation is provided or the atmosphere is found to be safe by testing for oxygen deficiency and the presence of explosive gases or fumes;

(ii) Where unsafe conditions are detected, by testing or other means, the work area shall be ventilated and otherwise made safe before entry;

(iii) Provisions shall be made for an adequate continuous supply of air.

(b) *Work in manholes.* (1) While work is being performed in manholes, an employee shall be available in the immediate vicinity to render emergency assistance as may be required. This shall not preclude the employee in the immediate vicinity from occasionally entering a manhole to provide assistance, other than emergency. This requirement does not preclude a qualified employee, working alone, from entering for brief periods of time, a manhole where energized cables or equipment are in service, for the purpose of inspection, housekeeping, taking readings, or similar work if such work can be performed safely.

(2) When open flames must be used or smoking is permitted in manholes, extra precautions shall be taken to provide adequate ventilation.

(3) Before using open flames in a manhole or excavation in an area where combustible gases or liquids may be present, such as near a gasoline service station, the atmosphere of the manhole or excavation shall be tested and found safe or cleared of the combustible gases or liquids.

(c) *Trenching and excavating.* (1) During excavation or trenching, in order to