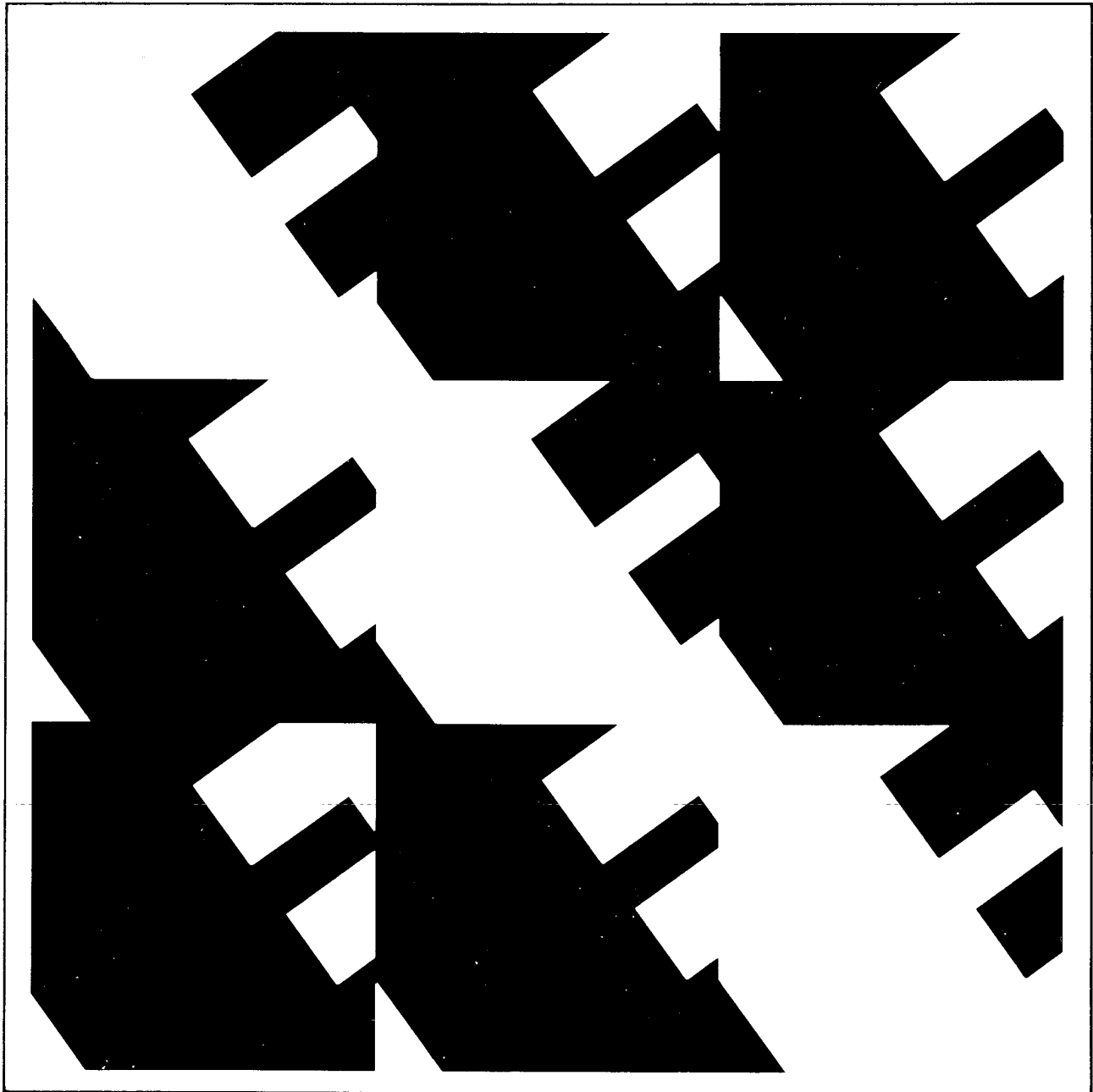


IEEE Guide to the Installation of Overhead Transmission Line Conductors

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Foreword

(This Foreword is not a part of IEEE Std 524-1980, IEEE Guide to the Installation of Overhead Transmission Line Conductors.)

This guide was compiled and written by Kenneth L. Griffing, D. H. Gilliam, William J. Bellerby and James W. Reilly. It includes contributions by persons from many electric utility companies and suppliers. However, because of the diversity of methods employed by different companies, only those methods most commonly used are discussed. Brief examination of the guide will serve to familiarize one with the range and completeness of the information. Terms unique to overhead transmission line construction have been defined. Every effort has been made to plan and write a guide that will serve as a useful reference.

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IEEE Guide to the Installation of Overhead Transmission Line Conductors

1. Introduction

1.1 Scope. This guide provides general recommendations for the selection of methods, equipment and tools that have been found practical for the stringing of overhead transmission line conductors and overhead groundwires. The guide also includes a comprehensive list of definitions for equipment and tools used in stringing and for stringing terms commonly employed.

1.2 Purpose. The purpose of this guide is to present in one document sufficient details of present day methods, materials and equipment to outline the basic considerations necessary to maintain safe and adequate control of conductors during stringing operations. References are given in Section 3 for those desiring more detailed information. Because the terminology used for many hardware items and for many stringing terms varies from place to place, the list of definitions is included to provide correlation and clarification of the terms most commonly employed.

1.3. Application. This guide is broad enough yet specific enough to be applicable to the stringing of overhead transmission conductors of all sizes. Since stringing practices for different projects will be strongly influenced by the magnitude and nature of each project and by local circumstances, alternate methods that have been successfully employed are presented. The practices that are described provide for continuous control of the conductor from the initial setup to the *ready for service* condition. Any legal requirements of national, state or local regulations must, of course, be observed.

The approach used within this guide is first to describe in general terms the stringing methods most commonly employed, then the

specific requirements of the various tools and equipment used. Finally, the application of the methods and equipment to the process of stringing is described.

2. Definitions and Cross Reference

Terminology for equipment and procedures associated with the installation of overhead transmission line conductors varies widely throughout the utility industry. Therefore, the table of definitions (2.1) and cross reference (2.2) have been included to provide a correlation between the terminology used in this guide and industry synonyms. Note that the synonyms are terms commonly used, although many are not necessarily good usage and should not be taken as equivalents to the guide terminology.

Many of the terms have additional meanings and usages which are defined in ANSI/IEEE Std 100-1977, Dictionary of Electrical and Electronics Terms.

2.1 Definitions and Terminology for Conductor Stringing Equipment

anchor. A device that serves as a reliable support to hold an object firmly in place. The term anchor is normally associated with cone, plate, screw or concrete anchors, but the terms *snub*, *deadman* and *anchor log* are usually associated with pole stubs or logs set or buried in the ground to serve as temporary anchors. The latter are often used at pull and tension sites. (See *anchor log*, ANSI/IEEE Std 100-1977.) Synonyms: anchor log, deadman, snub.

angle, roll over. For tangent stringing, the sum of the vertical angles between the conductor and the horizontal on both sides of the

traveler. Resultants of these angles must be considered when stringing through line angles. Under some stringing conditions, such as stringing large diameter conductor, excessive roll over angles can cause premature failure of a conductor splice if it is allowed to pass over the travelers.

block. A device designed with one or more single sheaves, a wood or metal shell, and an attachment hook or shackle. When rope is reeved through two of these devices, the assembly is commonly referred to as a *block and tackle*. A *set of 4s* refers to a block and tackle arrangement utilizing two 4 inch double sheave blocks to obtain four load bearing lines. Similarly, a *set of 5s* or a *set of 6s* refers to the same number of load bearing lines obtained using two 5 inch or two 6 inch double sheave blocks, respectively. Synonyms: set of 4s, set of 5s, set of 6s.

block, hold down. A device designed with one or more single groove sheaves to be placed on the conductor and used as a means of holding it down. This device functions essentially as a traveler used in an inverted position. It is normally used in midspan to control conductor uplift caused by stringing tensions, or at splicing locations to control the conductor as it is allowed to rise after splicing is completed. Synonyms: hold down roller, hold down traveler, splice release block.

block, snatch. A device normally designed with a single sheave, wood or metal shell and hook. One side of the shell usually opens to eliminate the need for threading of the line. Commonly used for lifting loads on a single line, or as a device to control the position or direction, or both, of a fall line or pulling line. Synonyms: Skookum, Washington, Western.

boatswain's chair. A seat designed to be suspended on a line reeved through a block and attached to a pulling device to hoist a workman to an elevated position. Synonym: bosun's chair.

bonded. The mechanical interconnection of conductive parts to maintain a common electrical potential. (See **bonding**, ANSI/IEEE Std 100-1977.) Synonym: connected.

bucket. A device designed to be attached to the boom tip of a line truck, crane or aerial

lift and support workmen in an elevated working position. It is normally constructed of fiberglass to reduce its physical weight, maintain strength and obtain good dielectric characteristics. Synonym: basket.

bullwheel. A wheel incorporated as an integral part of a bullwheel puller or tensioner to generate pulling or braking tension on conductors or pulling lines, or both, through friction. A puller or tensioner normally has one or more pairs arranged in tandem incorporated in its design. The physical size of the wheels will vary for different designs, but 17 in (43 cm) face widths and diameters of 5 ft (150 cm) are common. The wheels are power driven or retarded and lined with single or multiple groove neoprene or urethane linings. Friction is accomplished by reeving the pulling line or conductor around the groove of each pair.

bundle, two conductor, three conductor, four conductor, multiconductor. A circuit phase consisting of more than one conductor. Each conductor of the phase is referred to as a *subconductor*. A two conductor bundle has two subconductors per phase. These may be arranged in a vertical or horizontal configuration. Similarly, a three conductor bundle has three subconductors per phase. These are usually arranged in a triangular configuration with the vertex of the triangle up or down. A four conductor bundle has four subconductors per phase. These are normally arranged in a square configuration. Although other configurations are possible, those listed are the most common. Synonyms: twin-bundle, tri-bundle, quad-bundle.

cable car. A seat or basket shaped device designed to be suspended by a framework and two or more sheaves arranged in tandem to enable a workman to ride a single conductor, wire or cable. Synonym: cable trolley.

clamp, cable. A device designed to clamp cables together. It consists of a *U* bolt threaded on both ends, two nuts and a base and is commonly used to make temporary *bend back* eyes on wire rope. Synonyms: clip, Crosby, Crosby clip.

clamp, strand restraining. An adjustable circular clamp commonly used to keep the individual strands of a conductor in place and prevent them from spreading when the conductor is cut.

Synonyms: cable binding block, hose clamp, vise grip plier clamp.

clearance. (1) The condition where a circuit has been deenergized to enable work to be performed more safely. A clearance is normally obtained on a circuit presenting a source of hazard prior to starting work. Synonyms: outage, permit, restriction.

(2) The minimum separation between two conductors, between conductors and supports or other objects, or between conductors and ground (ANSI/IEEE Std 100-1977), or the clear space between any objects.

clipping-in. The transferring of sagged conductors from the travelers to their permanent suspension positions and the installing of the permanent suspension clamps. Synonyms: clamping-in, clipping.

clipping offset. A calculated distance, measured along the conductor from the plumb mark to a point on the conductor at which the center of the suspension clamp is to be placed. When stringing in rough terrain, clipping offsets may be required to balance the horizontal forces on each suspension structure.

conductor. A wire or combination of wires not insulated from one another, suitable for carrying an electric current. It may be, however, bare or insulated (ANSI/IEEE Std 100-1977). Synonyms: cable, wire.

conductor car. A device designed to carry workmen and ride on sagged bundle conductors, thus enabling them to inspect the conductors for damage and install spacers and dampers where required. These devices may be manual or powered. Synonyms: cable buggy, cable car, spacer buggy, spacer cart.

crossing structure. A structure built of poles and, sometimes, rope nets. It is used whenever conductors are being strung over roads, power lines, communications circuits, highways or railroads and normally constructed in such a way that it will prevent the conductor from falling onto or into any of these facilities in the event of equipment failure, broken pulling lines, loss of tension, etc. Synonyms: guard structure, H-frame, rider structure, temporary structure.

deenergized. Free from any electric connection to a source of potential difference and from

electric charge; not having a potential different from that of the ground. The term is used only with reference to current-carrying parts that are sometimes alive (energized). (See **dead**, ANSI/IEEE Std 100-1977.) To state that a circuit has been deenergized means that the circuit has been disconnected from all intended electrical sources. However, it could be electrically charged through induction from energized circuits in proximity to it, particularly if the circuits are parallel. Synonym: dead.

dynamometer. A device designed to measure loads or tension on conductors. Various models of these devices are used to tension guys or sag conductors. Synonyms: clock, load cell.

energized. Electrically connected to a source of potential difference, or electrically charged so as to have a potential different from that of the ground. (See **alive**, ANSI/IEEE Std 100-1977.) Synonyms: alive, current carrying, hot, live.

equipotential. An identical state of electrical potential for two or more items.

explosives. Mixtures of solids, liquids or a combination of the two which, upon detonation, transform almost instantaneously into other products which are mostly gaseous and which occupy much greater volume than the original mixtures. This transformation generates heat which rapidly expands the gases, causing them to exert enormous pressure. Dynamite and Primacord are explosives as manufactured. Aerex, Triex and Quadrex are manufactured in two components and are not true explosives until mixed. Explosives are commonly used to build construction roads, blast holes for anchors, structure footings, etc. Synonyms: Aerex, dynamite, fertilizer, powder, Primacord, Quadrex, Triex.

grip, conductor. A device designed to permit the pulling of conductor without splicing on fittings, eyes, etc. It permits the pulling of a *continuous* conductor where threading is not possible. The designs of these grips vary considerably. Grips such as the Klein (Chicago) and Crescent utilize an open sided rigid body with opposing jaws and swing latch. In addition to pulling conductors, this type is commonly used to tension guys and, in some cases, pull wire rope. The design of the come-along (pocket-book, suitcase, four bolt, etc) incorporates a

bail attached to the body of a clamp which folds to completely surround and envelope the conductor. Bolts are then used to close the clamp and obtain a grip. Synonyms: buffalo, Chicago grip, come-along, Crescent, four bolt, grip, Klein, pocketbook, seven bolt, six bolt, slip-grip, suitcase.

grip, woven wire. A device designed to permit the temporary joining or pulling of conductors without the need of special eyes, links or grips. Synonyms: basket, chinese finger, Kellem, sock, wire mesh grip.

grounded. Connected to earth or to some extended conducting body that serves instead of the earth, whether the connection is intentional or accidental (ANSI/IEEE Std 100-1977).

ground grid. A system of interconnected bare conductors arranged in a pattern over a specified area and on or buried below the surface of the earth. Normally, it is bonded to ground rods driven around and within its perimeter to increase its grounding capabilities and provide convenient connection points for grounding devices. The primary purpose of the grid is to provide safety for workmen by limiting potential differences within its perimeter to safe levels in case of high currents which could flow if the circuit being worked became energized for any reason or if an adjacent energized circuit faulted. Metallic surface mats and gratings are sometimes utilized for this same purpose. When used, these grids are employed at pull, tension and midspan splice sites. (See **counterpoise**, **ground grid**, **ground mat**, ANSI/IEEE Std 100-1977.) Synonyms: counterpoise, ground gradient mat, ground mat.

ground, master. A portable device designed to short circuit and connect (bond) a deenergized circuit or piece of equipment, or both, to an electrical ground. Normally located remote from, and on both sides of, the immediate work site. Primarily used to provide safety for personnel during construction, reconstruction or maintenance operations. Synonyms: ground set, ground stick.

ground, personal. A portable device designed to connect (bond) a deenergized conductor or piece of equipment, or both, to an electrical

ground. Distinguished from a master ground in that it is utilized at the immediate site when work is to be performed on a conductor or piece of equipment which could accidentally become energized. Synonyms: ground stick, red head, working ground.

ground rod. A rod that is driven into the ground to serve as a ground terminal, such as a copper-clad rod, solid copper rod, galvanized iron rod or galvanized iron pipe (ANSI/IEEE Std 100-1977). Copper-clad steel rods are commonly used during conductor stringing operations to provide a means of obtaining an electrical ground using portable grounding devices. Synonym: ground electrode.

ground, running. A portable device designed to connect a moving conductor or wire rope, or both, to an electrical ground. These devices are normally placed on the conductor or wire rope adjacent to the pulling and tensioning equipment located at either end of a sag section. Primarily used to provide safety for personnel during construction or reconstruction operations. Synonyms: ground roller, moving ground, rolling ground, traveling ground.

ground, structure base. A portable device designed to connect (bond) a metal structure to an electrical ground. Primarily used to provide safety for personnel during construction, reconstruction or maintenance operations. Synonyms: butt ground, ground chain, structure ground, tower ground.

ground, traveler. A portable device designed to connect a moving conductor or wire rope, or both, to an electrical ground. Primarily used to provide safety for personnel during construction or reconstruction operations. This device is placed on the traveler (sheave, block, etc) at a strategic location where an electrical ground is required. Synonyms: block ground, rolling ground, sheave ground.

hoist. An apparatus for moving a load by the application of a pulling force and not including a car or platform running in guides (ANSI/IEEE Std 100-1977). These devices are normally designed using roller or link chain and built-in leverage to enable heavy loads to be lifted or pulled. They are often used to deadend a conductor during sagging and clipping-in operations and when tensioning guys. Synonyms: chain

hoist, chain tugger, Coffing, Coffing hoist.

hook, conductor lifting. A device resembling an open boxing glove designed to permit the lifting of conductors from a position above them. Normally used during clipping-in operations. Suspension clamps are sometimes used for this purpose. Synonyms: boxing glove, conductor hook, lifting shoe, lip.

hub. A reference point established through a land survey. A hub or POT (point on tangent) is a reference point for use during construction of a line. The number of such points established will vary with the job requirements. Monuments, however, are usually associated with state or federal surveys and are intended to be permanent reference points. Any of these points may be used as a reference point for transit sagging operations, provided all necessary data pertaining to them is known. It is quite common to establish additional temporary hubs as required for this purpose. Synonyms: monument, POT.

isolated. (1) Physically separated, electrically and mechanically, from all sources of electrical energy. Such separation may not eliminate the effects of electrical induction.

(2) An object not readily accessible to persons unless special means for access are used (ANSI/IEEE Std 100-1977).

joint, compression. A tubular compression fitting designed and fabricated from aluminum, copper or steel to join conductors or overhead ground wires. It is usually applied through the use of hydraulic or mechanical presses. However, in some cases, automatic, wedge, and explosive type joints are utilized. Synonyms: conductor splice, sleeve, splice.

jumper. (1) The conductor that connects the conductors on opposite sides of a deadend structure. Synonym: deadend loop.

(2) A conductor placed across the clear space between the ends of two conductors or metal pulling lines which are being spliced together. Its purpose then is to act as a shunt to prevent workmen from accidentally placing themselves in series between the two conductors.

ladder, rope. A ladder having vertical synthetic or manila suspension members and wood, fiberglass or metal rungs. The ladder is suspended

from the arm or bridge of a structure to enable workmen to work at the conductor level, hang travelers, perform clipping-in operations, etc. Synonym: Jacobs ladder.

ladder, tower. A ladder complete with hooks and safety chains attached to one end of the side rails. These units are normally fabricated from fiberglass, wood or metal. The ladder is suspended from the arm or bridge of a structure to enable workmen to work at the conductor level, to hang travelers, perform clipping-in operations, etc. In some cases, these ladders are also used as linemen's platforms. Synonym: hook ladder.

leader cone. A tapered cone made of rubber, neoprene or polyurethane that is used to lead a conductor splice through the travelers, thus making a smooth transition from the smaller diameter conductor to the larger diameter splice. It is also used at the connection point of the pulling line and running board to assist in a smooth transition of the running board over the travelers, thus significantly reducing the shock loads. Synonyms: nose cone, tapered hose.

lifter, insulator. A device designed to permit insulators to be lifted in a *string* to their intended position on a structure. Synonyms: insulator saddle, potty seat.

line, bull. A high strength line, normally synthetic fiber rope, used for pulling and hoisting large loads.

line, finger. A lightweight line, normally sisal, manila or synthetic fiber rope, which is placed over the traveler when it is hung. It usually extends from the ground, passes through the traveler and back to the ground. It is used to thread the end of the pilot line or pulling line over the traveler and eliminates the need for workmen on the structure. These lines are not required if pilot lines are installed when the travelers are hung.

line, pilot. A lightweight line, normally synthetic fiber rope, used to pull heavier pulling lines which in turn are used to pull the conductor. Pilot lines may be installed with the aid of finger lines or by helicopter when the insulators and travelers are hung. Synonyms: lead line, leader, P-line, straw line.

line, pulling. A high strength line, normally

synthetic fiber rope or wire rope, used to pull the conductor. However, on reconstruction jobs where a conductor is being replaced, the old conductor often serves as the pulling line for the new conductor. In such cases, the old conductor must be closely examined for any damage prior to the pulling operations. Synonyms: bull line, hard line, light line, sock line.

line, safety life. A safety device normally constructed from synthetic fiber rope and designed to be connected between a fixed object and the body belt of a workman working in an elevated position when his regular safety strap cannot be utilized. Synonyms: life line, safety line, scare rope.

line, tag. A control line, normally manila or synthetic fiber rope, attached to a suspended load to enable a workman to control its movement.

line, threading. A lightweight flexible line, normally manila or synthetic fiber rope, used to lead a conductor through the bullwheels of a tensioner or pulling line through a bullwheel puller. Synonym: bull line.

link, connector. A rigid link designed to connect pulling lines and conductors together in series. It will not spin and relieve torsional forces. Synonyms: bullet, connector, link, slug.

link, swivel. A swivel device designed to connect pulling lines and conductors together in series or connect one pulling line to the drawbar of a pulling vehicle. The device will spin and help relieve the torsional forces which build up in the line or conductor under tension. Synonym: swivel.

load binder. A toggle device designed to secure loads in a desired position. Normally used to secure loads on mobile equipment. Synonyms: binder, chain binder.

off road vehicle. A vehicle specifically designed and equipped to traverse sand, swamps, muddy tundra or rough mountainous terrain. Vehicles falling into this category are usually all wheel drive or tracked units. In some cases, units equipped with special air bag rollers having a soft footprint are utilized. Synonyms: all terrain vehicle (ATV), swamp buggy.

overhead groundwire (lightning protection).

Multiple grounded wire or wires placed above phase conductors for the purpose of intercepting direct strokes in order to protect the phase conductors from the direct strokes (ANSI/IEEE Std 100-1977). Synonyms: earth wire, shield wire, skywire, static wire.

platform, aerial. A device designed to be attached to the boom tip of a crane or aerial lift and support a workman in an elevated working position. Platforms may be constructed with surrounding railings, fabricated from aluminum, steel or fiber reinforced plastic. Occasionally, a platform is suspended from the load line of a large crane. Synonyms: cage, platform.

platform, lineman's. A device designed to be attached to a wood pole or metal structure, or both, to serve as a supporting surface for workmen engaged in deadending operations, clipping-in, insulator work, etc. The designs of these devices vary considerably. Some resemble short cantilever beams, others resemble swimming pool diving boards, and still others as long as 40 ft (12 m) are truss structures resembling bridges. Materials commonly used for fabrication are wood, fiberglass and metal. Synonyms: Baker board, D-board, deadend board, deadend platform, diving board.

plumb mark. A mark placed on the conductor located vertically below the insulator point of support for steel structures and vertically above the pole center line at ground level for wood pole structures used as a reference to locate the center of the suspension clamp.

pole, plumb marker. A small diameter, lightweight pole with a marking device attached to one end, having sufficient length to enable a workman to mark the conductor directly below him from a position on the bridge or arm of the structure. This device is utilized to mark the conductor immediately after completion of sagging. Synonyms: marker, offset marker (pole).

puller, bullwheel. A device designed to pull pulling lines and conductors during stringing operations. It normally incorporates one or more pairs of urethane- or neoprene-lined, power driven, single or multiple groove bullwheels where each pair is arranged in tandem. Pulling is accomplished by friction generated against the pulling line which is reeved around

the grooves of a pair of the bullwheels. The puller is usually equipped with its own engine which drives the bullwheels mechanically, hydraulically or through a combination of both. Some of these devices function as either a puller or tensioner. Synonym: puller.

puller, drum. A device designed to pull a conductor during stringing operations. It is normally equipped with its own engine which drives the drum mechanically, hydraulically or through a combination of both. It may be equipped with synthetic fiber rope or wire rope to be used as the pulling line. The pulling line is payed out from the unit, pulled through the travelers in the sag section and attached to the conductor. The conductor is then pulled in by winding the pulling line back onto the drum. This unit is sometimes used with synthetic fiber rope acting as a pilot line to pull heavier pulling lines across canyons, rivers, etc. Synonyms: hoist, single drum hoist, single drum winch, tugger.

puller, two drum, three drum. The definition and application for this unit is essentially the same as that for the drum puller previously described. It differs in that this unit is equipped with three drums and thus can pull one, two or three conductors individually or simultaneously. Synonyms: two drum winch, double drum hoist, double drum winch, three drum winch, triple drum hoist, triple drum winch, tugger.

puller, reel. A device designed to pull a conductor during stringing operations. It is normally equipped with its own engine which drives the supporting shaft for the reel mechanically, hydraulically or through a combination of both. The shaft, in turn, drives the reel. The application of this unit is essentially the same as that for the drum puller previously described. Some of these devices function as either a puller or tensioner.

pulling vehicle. Any piece of mobile ground equipment capable of pulling pilot lines, pulling lines or conductors. However, helicopters may be considered as a pulling vehicle when utilized for the same purpose.

rack, traveler. A device designed to protect, store and transport travelers. It is normally designed to permit efficient use of transporting vehicles, spotting by helicopters on the line,

and stacking during storage to utilize space. The exact design of each rack is dependent upon the specific travelers to be stored. Synonym: dollie car.

reel stand. A device designed to support one or more reels and having the possibility of being skid, trailer or truck mounted. These devices may accommodate rope or conductor reels of varying sizes and are usually equipped with reel brakes to prevent the reels from turning when pulling is stopped. They are used for either slack or tension stringing. The designation of reel trailer or reel truck implies that the trailer or truck has been equipped with a reel stand (jacks) and may serve as a reel transport or *payout* unit, or both, for stringing operations. Depending upon the sizes of the reels to be carried, the transporting vehicles may range from single axle trailers to semitrucks with trailers having multiple axles. Synonyms: reel trailer, reel transporter, reel truck.

ruling span. A *calculated deadend span length* which will have the same changes in conductor tension due to changes of temperature and conductor loading as will be found in a series of spans of varying lengths between deadends.

running board. A pulling device designed to permit stringing more than one conductor simultaneously with a single pulling line. For distribution stringing, it is usually made of lightweight tubing with the forward end curved gently upward to provide smooth transition over pole crossarm rollers. For transmission stringing, the device is either made of sections hinged transversely to the direction of pull or of a hard nose rigid design, both having a flexible pendulum tail suspended from the rear. This configuration stops the conductors from twisting together and permits smooth transition over the sheaves of bundle travelers. Synonyms: alligator, bird, birdie, monkey tail, sled.

safety, conductor. A sling arranged in a vertical basket configuration, with both ends attached to the supporting structure and passed under the clipped-in conductor(s). These devices, when used, are normally utilized with bundled conductors to act as a safety device in case of insulator failure while workmen in conductor cars are installing spacers between the subconductors, or as an added safety measure when crossing above energized circuits.

These devices may be fabricated from synthetic fiber rope or wire rope.

sag section. The section of line between snub structures. More than one sag section may be required in order to sag properly the actual length of conductor which has been strung. Synonyms: pull, setting, stringing section.

sag span. A span selected within a sag section and used as a control to determine the proper sag of the conductor, thus establishing the proper conductor level and tension. A minimum of two, but normally three, sag spans are required within a sag section in order to sag properly. In mountainous terrain or where span lengths vary radically, more than three sag spans could be required within a sag section. Synonym: control span.

sheave. (1) The grooved wheel of a traveler or rigging block. Travelers are frequently referred to as sheaves. Synonyms: pulley, roller, wheel.

(2) A shaft-mounted wheel used to transmit power by means of a belt, chain, band, etc (ANSI/IEEE Std 100-1977).

site, pull. The location on the line where the puller, reel winder and anchors (snubs) are located. This site may also serve as the pull or tension site for the next sag section. Synonyms: reel setup, tugger setup.

site, tension. The location on the line where the tensioner, reel stands and anchors (snubs) are located. This site may also serve as the pull or tension site for the next sag section. Synonyms: conductor payout station, payout site, reel setup.

snub structure. A structure located at one end of a sag section and considered as a *zero* point for sagging and clipping offset calculations. The section of line between two such structures is the sag section, but more than one sag section may be required in order to sag properly the actual length of conductor which has been strung. Synonyms: 0 structure, zero structure.

splice, wire rope. The point at which two wire ropes are joined together. The various methods of joining (splicing) wire ropes together include *hand tucked* woven splices, *compression* splices which utilize compression fittings but do not incorporate loops (eyes) in the ends of the ropes, and mechanical splices which are made

through the use of loops (eyes) in the ends of the ropes held in place by either compression fittings or wire rope clips. The latter are joined together with connector links or steel bobs and, in some cases, rigged *eye to eye*. Woven splices are often classified as short or long. A short splice varies in length from 7 to 17 ft (2 to 5m) for $\frac{1}{4}$ to $1\frac{1}{2}$ in diameter ropes, respectively, while a long splice varies from 15 to 45 ft (4 to 14m) for the same size ropes.

splicing cart. A unit which is equipped with a hydraulic compressor (press) and all other necessary equipment for performing splicing operations on conductor. Synonyms: sleeving trailer, splicing trailer, splicing truck.

step voltage. The potential difference between two points on the earth's surface separated by a distance of one pace (assumed to be 1 m) in the direction of maximum potential gradient (ANSI/IEEE Std 100-1977). This potential difference could be dangerous when current flows through the earth or material upon which a workman is standing, particularly under fault conditions. Synonym: step potential.

stringing. The pulling of pilot lines, pulling lines and conductors over travelers supported on structures of overhead transmission lines. Quite often, the entire job of stringing conductors is referred to as *stringing operations*, beginning with the planning phase and terminating after the conductors have been installed in the suspension clamps.

stringing, slack. The method of stringing conductor slack without the use of a tensioner. The conductor is pulled off the reel by a pulling vehicle and dragged along the ground, or the reel is carried along the line on a vehicle and the conductor deposited on the ground. As the conductor is dragged to, or past, each supporting structure, the conductor is placed in the travelers, normally with the aid of finger lines.

stringing, tension. The use of pullers and tensioners to keep the conductor under tension and positive control during the stringing phase, thus keeping it clear of the earth and other obstacles which could cause damage.

switching surge. A transient wave of overvoltage in an electrical circuit caused by a switching operation. When this occurs, a momentary voltage surge could be induced in a circuit adjacent and parallel to the switched circuit

in excess of the voltage induced normally during steady state conditions. If the adjacent circuit is under construction, switching operations should be minimized to reduce the possibility of hazards to the workmen.

target, sag. A device used as a reference point to sag conductors. It is placed on one structure of the sag span. The sagger, on the other structure of the sag span, can use it as his reference to determine the proper conductor sag. Synonyms: sag board, target.

tensioner, bullwheel. A device designed to hold tension against a pulling line or conductor during the stringing phase. Normally, it consists of one or more pairs of urethane- or neoprene-lined, power braked, single or multiple groove bullwheels where each pair is arranged in tandem. Tension is accomplished by friction generated against the conductor which is reeved around the grooves of a pair of the bullwheels. Some tensioners are equipped with their own engines which retard the bullwheels mechanically, hydraulically or through a combination of both. Some of these devices function as either a puller or tensioner. Other tensioners are only equipped with friction type retardation. Synonyms: retarder, tensioner.

tensioner, reel. A device designed to generate tension against a pulling line or conductor during the stringing phase. Some are equipped with their own engines which retard the supporting shaft for the reel mechanically, hydraulically or through a combination of both. The shaft, in turn, retards the reel. Some of these devices function as either a puller or tensioner. Other tensioners are only equipped with friction type retardation. Synonyms: retarder, tensioner.

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 1 m (ANSI/IEEE Std 100-1977). This potential difference could be dangerous and could result from induction or fault conditions, or both. Synonym: touch potential.

tractor, crawler. A tracked unit employed to pull pulling lines, sag conductor, level or clear pull and tension sites, and miscellaneous other work. It is also frequently used as a temporary anchor. Sagging winches on this unit are usually

arranged in a vertical configuration. Synonyms: cat, crawler, tractor.

tractor, wheel. A wheeled unit employed to pull pulling lines, sag conductor, and miscellaneous other work. Sagging winches on this unit are usually arranged in horizontal configuration. It has some advantages over crawler tractors in that it has a softer footprint, travels faster, and is more maneuverable. Synonyms: logger, sagger, skidder, tractor.

transit. An instrument primarily used during construction of a line to survey the route, set hubs and POT locations, plumb structures, determine downstrain angles for locations of anchors at the pull and tension sites, and to sag conductors. Synonyms: level, scope, site marker.

traveler. A sheave complete with suspension arm or frame used separately or in groups and suspended from structures to permit the stringing of conductors. These devices are sometimes bundled with a center drum, or sheave and another traveler, and used to string more than one conductor simultaneously. For protection of conductors that should not be nicked or scratched, the sheaves are often lined with nonconductive or semiconductive neoprene or with nonconductive urethane. Any one of these materials acts as a padding or cushion for the conductor as it passes over the sheave. Traveler grounds must be used with lined travelers in order to establish an electrical ground. Synonyms: block, dolly, sheave, stringing block, stringing sheave, stringing traveler.

traveler sling. A sling of wire rope, sometimes utilized in place of insulators, to support the traveler during stringing operations. Normally, it is used when insulators are not readily available or when adverse stringing conditions might impose severe downstrains and cause damage or complete failure of the insulators. Synonym: choker.

uplift roller. A small single-grooved wheel designed to fit in or immediately above the throat of the traveler and keep the pulling line in the traveler groove when uplift occurs due to stringing tensions.

winder, pilot line. A device designed to payout and rewind pilot lines during stringing operations. It is normally equipped with its own engine which drives a drum or a supporting

shaft for a reel mechanically, hydraulically or through a combination of both. These units are usually equipped with multiple drums or reels, depending upon the number of pilot lines required. The pilot line is payed out from the drum or reel, pulled through the travelers in the sag section, and attached to the pulling line on the reel stand or drum puller. It is then rewound to pull the pulling line through the travelers.

winder, reel. A device designed to serve as a recovery unit for a pulling line. It is normally equipped with its own engine which drives a supporting shaft for a reel mechanically, hydraulically or through a combination of both. The shaft, in turn, drives the reel. It is normally used to rewind a pulling line as it leaves the bullwheel puller during stringing operations. This unit is not intended to serve as a puller, but sometimes serves this function where only low tensions are involved. Synonym: takeup reel.

2.2 Cross Reference

Synonyms	Guide Terminology	Synonyms	Guide Terminology
Aerex	explosives	cage	platform, aerial
alive	energized	cat	tractor, crawler
alligator	running board	chain binder	load binder
all terrain vehicle		chain hoist	hoist
(ATV)	off road vehicle	chain tugger	hoist
anchor log	anchor	Chicago grip	grip, conductor
Baker board	platform, lineman's	chinese finger	grip, woven wire
basket	bucket	choker	traveler sling
basket	grip, woven wire	clamping-in	clipping-in
binder	load binder	clip	clamp, cable
bird	running board	clipping	clipping-in
birdie	running board	clock	dynamometer
block	traveler	Coffing	hoist
block ground	ground, traveler	Coffing hoist	hoist
bosun's chair	boatswain's chair	come-along	grip, conductor
boxing glove	hook, conductor lifting	conductor hook	hook, conductor lifting
buffalo	grip, conductor	conductor payout	site, tension
bullet	link, connector	station	
bull line	line, pulling	conductor splice	joint, compression
bull line	line, threading	connected	bonded
butt ground	ground, structure base	connector	link, connector
cable	conductor	control span	sag span
cable binding block	clamp, strand restraining	counterpoise	ground grid
cable buggy	conductor car	crawler	tractor, crawler
cable car	conductor car	Crescent	grip, conductor
cable trolley	cable car	Crosby	clamp, cable
		Crosby clip	clamp, cable
		current carrying	energized
		D-board	platform, lineman's
		dead	deenergized
		deadend board	platform, lineman's
		deadend loop	jumper
		deadend platform	platform, lineman's
		deadman	anchor
		diving board	platform, lineman's
		dollie car	rack, traveler
		dolly	traveler
		double drum hoist	puller, two drum
		double drum winch	puller, two drum
		dynamite	explosives
		earthwire	overhead groundwire
		fertilizer	explosives
		four bolt	grip, conductor
		grip	grip, conductor
		ground chain	ground, structure base
		ground electrode	ground rod
		ground gradient mat	ground grid
		ground mat	ground grid
		ground roller	ground, running
		ground set	ground, master
		ground stick	ground, master