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1. General

Wherever practicable it is intended that poles be jointly used with other utilities. To effectively do this some of the more important provisions in the National Electric Safety Code (NESC) pertaining to Joint Use are outlined below.

2. Scope

Communication company (Communication Co.) circuits in this DCS include Telephone, Telegraph, CATV, Railroad Signal, Messenger Call, Clock, Control, Fire and Police, and other alarm circuits.

3. NESC Requirements

The National Electric Safety Code forms the basis for construction specifications under our joint use agreements.

All new construction shall conform to the NESC in effect at the time of construction. Where conductors or equipment are added, altered, or replaced on an existing structure, the installation should be brought into conformance with the NESC in effect at that time except as mutually agreed not to do so. This mutual agreement is allowed provided that the resulting installation will be in compliance with either (a) the NESC rules in effect at original installation, or (b) NESC rules in effect in a subsequent edition to which the structure has been previously brought into compliance. Exception: On these existing structures, clearances between luminaire brackets and communications equipment must comply with the NESC rules in effect at the time the structure is replaced. These provisions shall not be so applied as to require any then existing cables carried on one side of a joint pole to be rearranged to occupy the other side of the pole.

3.1 Setting Depth of Poles

Ameren poles shall be set in accordance with DCS 02 20 03 01. Variations in depth setting for self-sustaining shall be considered in arriving at the height of pole required for joint use.

3.2 Minimum "Clearance Space to Ground" Requirements

The "Clearance Space to Ground" for a conductor is the NESC minimum clearance between ground or rail and the conductor. For equipment such as transformers hung low on a pole it is the minimum clearance between ground and the bottom of the transformer case or hanger.

In Table 1 are listed the clearances for Communications Co. conductors (usually the lowest on the pole).

TABLE 1

Clearance to Ground or Rail of Communications Co. Cables or Conductors

Nature of Object Crossed Over or Along	Clearance Above Ground or Rail
Communications Co. Cables or Conductors Crossing Over:	
Track Rails of Railroads	23.5 ft.
Public streets or roads	15.5 ft.
Public alleys	15.5 ft.
Driveways to residence garages (No vehicles greater than 8 ft. anticipated)	11.5 ft.
Spaces or ways accessible to pedestrians only	9.5 ft.
Communications Co. Cables Running Along and Within Limits of:	
Public Streets, Roads or Alleys	15.5 ft.
Where no part of line overhangs any part of the highway and where it is unlikely loaded vehicles will cross under the line	13.5 ft.
Spaces or ways accessible to pedestrians only	9.5 ft.

NOTE: The clearances given are for the lowest point in the span. The point of attachment on the pole must, therefore, be higher to compensate for conductor sag or ground irregularities. Clearances are per the 2017 NESC.

3.3 Neutral Space

The neutral space shall be an equipment free vertical space (except as noted below) between Ameren attachments and equipment and Communications Co. attachments and equipment. It shall measure not less than 40" for Ameren attachments and equipment of circuits up to 600 volts to ground and 72" for circuits exceeding 600 volts to ground.

Exceptions

1. Where non-current carrying parts of equipment are effectively grounded consistently throughout well-defined areas, and where communications circuits are at lower levels, the neutral space may be reduced to 30".

2. For street light span wires and brackets, see Section 3.5, and for vertical runs, see Section 3.6.

3.4 Ground Connections

On all structures where a pole ground is installed by either Ameren or the Communication Co., the electric supply neutral and communication metallic messengers shall be bonded together with a minimum #6 covered copper or equivalent bond wire.

The same grounding wire or artificial ground may be used for Ameren and Communications Co. attachments, where mutually agreed upon. If separate Ameren and communication grounds are installed on the same pole, they must be bonded together with a minimum #6 covered copper or equivalent bond wire to the same ground rod or at the base of the pole, and at the Communication Co. attachment level.

3.5 Minimum Clearances between Street Light Equipment and Communications Equipment

Table 2 gives the minimum clearances that shall be maintained between Ameren and Communications Co. facilities under various conditions.

TABLE 2

Vertical Clearance of Luminaire Brackets and Span Wires to Communication Lines

Location of Luminaire Bracket or Span Wire Supporting Luminaire	Minimun Vertical Clearance (in)
Above communication support arms (not allowed by Ameren)	40[1]
Below communication support arms (not allowed by Ameren)	40[2]
Above messengers carrying communication cables	40[3]
Below messengers carrying communication cables	40[3]
From terminal box of communication cable	40[3]
From communication brackets, bridle wire rings, or drive hooks	40[3]

NOTES:

Ref. 2017 NESC Section 23 Table 238–2

(1) This may be reduced to 20 inches for grounded luminaire brackets, or 12 inches for either span wires or metal parts of brackets at points 40 inches or more from the pole surface.

(2) This may be reduced to 24 inches for grounded luminaire brackets.

(3) This may be reduced to 20 inches for grounded luminaire brackets. (Note that this is greater than the NESC allowed 4".)

3.6 Vertical Runs on Pole Surface

In general Ameren and Communications Co. vertical runs shall not be placed on the same pole if it is practicable to place them on separate poles.

If vertical runs of both companies must be placed on the same pole, the runs shall be placed in adjacent quadrants, or on standoff brackets if more than half the pole surface is needed.

3.6.1 Clearance Between Vertical Runs and Pole Equipment

Vertical runs, risers, ground wires and hardware supporting such runs belonging to Ameren shall have a clearance of 1/8 the pole circumference but in no case less than 2" from communications equipment.

Vertical runs, risers, ground wires and hardware supporting such runs shall be so located that they do not interfere with the free use of pole steps.

3.6.2 Coverings for Vertical Runs on Poles

Ameren ground wires fastened directly to the pole shall in general only be covered with plastic moulding where within 8 feet of the ground.

Ameren non–leaded cables shall be covered with plastic conduit from the ground to a point not less than 40 inches above the highest Communications Co. attachments.

3.6.3 Vertical Runs Supported Between Crossarms

Lamp leads for street lights may be run from an Ameren crossarm directly to the lamp bracket provided the luminaire bracket is 40 inches or more above all communication attachments.

3.7 Other Attachments

3.7.1 Longitudinal Cable

All attachments in the communication space by a third party shall be bolted directly to the pole. In order to maintain climbing space, extension arms for means of attaching are prohibited.

3.7.2 Aerial Supply Service Cables

The point where such cables leave the pole shall be not less than 40 inches above the highest or 40 inches below the lowest Communication Co. attachments.

3.7.3 Requirements for Joint Use/Third Party Power Supply Equipment on Ameren Poles

All power supply equipment and associated facilities attachments (including but not limited to wires, conduits, brackets, and ground wires) are subject to Ameren approval.
Climbing space on any Ameren pole will be maintained at all times. This requires one side of the pole (180 degrees /the same face of the pole) to be open from the ground to the top of the communication space. Any power supplies or similar facilities shall be mounted on the same side of the pole as any risers and cables. Under no circumstances is power supply equipment allowed above the communications space.
Risers and cables shall be installed in accordance with Ameren Standard 14 00 01 02. No exceptions allowed.
Ameren's wireless antenna location policy addresses the proper placement of any risers and cables above the communications space.
If climbing space cannot be maintained, the cabinet equipment shall be installed on the ground and shall be a minimum of 5' horizontally, in any direction, from the base of the pole.

3.8 Guys & Anchors

In Tables 3 and 4 are listed minimum clearances that shall be maintained between guys of either the Ameren or the Communications Co. to the equipment listed and under the particular circumstances shown.

TABLE 3

Clearance to Grounded Guys when Crossing Over or Under Cables,
Conductors or Guys of Another Line

Equipment Guy Crosses over or under	Clearance Required
Communications Co. cable or conductors	2 feet
Ameren triplex or quad cables	2 feet
Ameren open conductors up to 750 volts	(3) 2 feet
Ameren open conductors above 750 volts	(2) (4) 2 feet
Other guys or street light span wires	(1) 2 feet

NOTE: Ref. 2017 NESC, Section 23, Table 233-1.

(1) This clearance may be reduced where both guys are electrically interconnected.

(2) For voltages above 22,000 volts consult the Standards Group.

(3) 4 feet is required to communication guy.

(4) 5 feet is required to communication guy.

TABLE 4

Clearance in Any Direction between Guys and Line Conductors or Cables Attached to the Same Structure

Equipment Guy Shall Clear	Parallel to Line	Not Parallel to Line
Communications Co. cables or conductors	(1) 6 Inch	(1) 6 Inch
Ameren conductors up to 8700 volts phase to phase	(1) 12 Inch	6 Inch
Ameren conductors (7.2/12.47 kV to14.4 kV)	15 Inch	9 Inch
Ameren 34.5 kV conductors	30 Inch	30 Inch

NOTE: Ref. 2017 NESC, Section 23, Table 235-6.

(1) If guy passes within 12 inches of Ameren conductors and also passes within 12 inches of communication cables, the guy must be insulated with a strain insulator at a point below the lowest supply conductor and above the highest communication cable.

Anchors shall have a minimum of 5 foot separation from the pole face and to other anchors. Communication guys shall not be attached to Ameren anchors (see DCS 29 00 01 01 sheet 10).

3.9 Miscellaneous Requirements

Street lamp span wires shall not encircle the pole but shall be attached by means of a through bolt.

Street lamp brackets and their metal parts shall be confined to the half of the pole circumference nearest the lamp, except that where attachment by means of lag screws is impracticable the metal parts may be secured with through bolts. Lamp leads supported along a span wire or lamp bracket shall be so attached that insulation will not be injured.

Span wires shall have at least one strain insulator of specified flash-over value.

3.10 Communication Co. Antennas

General

Communication Co. Antennas shall not be installed on any jointly used poles until reviewed by and approval is granted by Ameren. Communication Co. antennas shall not be installed on Ameren transformer poles, terminal poles, switch poles, capacitor poles, voltage regulator poles, recloser poles, deadend poles, or corner poles.

Exception: An installation on a transformer pole may be considered by Ameren to provide power to antenna where secondary does not exist.

Sections 3.3, 3.4, 3.5, 3.6, and 3.7 of this DCS shall also apply to Communication Co. Antennas except where the clearances in this Section are more stringent.

3.10.1 Communication Co. Antennas Located in the Communication Space

Communication Co. Antennas located in the communication space are considered equipment for the purpose of determining minimum clearance requirements.

Clearance from Communication Co. Antennas to Ameren secondary shall be 40” (see DCS 29 00 01 01 sheet 14). See Section 3.3 of this DCS for minimum required clearance to higher voltage conductors when Ameren secondary is not present.

3.10.2 Communication Co. Antennas Located in the Supply Space

Communication Co. Antennas located in the supply space shall be installed on the pole top only, and maintained only by personnel authorized and qualified to work in the supply space. Pole-top antennas shall only be allowed on poles that are truck accessible.

Minimum required clearances for Communication Co. Antennas installed in the supply space above Ameren conductors shall be as shown in DCS 29 00 01 01 sheet 15.

Pole top extensions are not permitted for providing antenna clearance above Ameren conductors.

All exposed Communication Co. Cable or wiring shall be covered or insulated. Antenna brackets shall be non-metallic or ungrounded.

Communication Co. Antenna cable must extend down the pole in non-metallic conduit or U-guard from the antenna to below the communication worker safety zone. The non-metallic conduit or U-guard shall be located so that it does not obstruct climbing spaces or lateral working spaces between line conductors at different levels, or interfere with the safe use of pole steps.

3.10.3 Antenna Disconnect

Communication Co. shall provide a disconnect switch accessible to Ameren so that the antenna can be de-energized to prevent exposure to radiation at any time work is required in or near the space (Supply or Communication) where the antenna is installed.

3.11 Overhead Aerial Construction

DCS 29 00 01 01 sheets 7 thru 13 include drawings for compliance to NESC joint construction requirements.
DCS 29 00 01 01 sheets 14 thru 16 include drawings showing Ameren requirements for location of communication antennas.

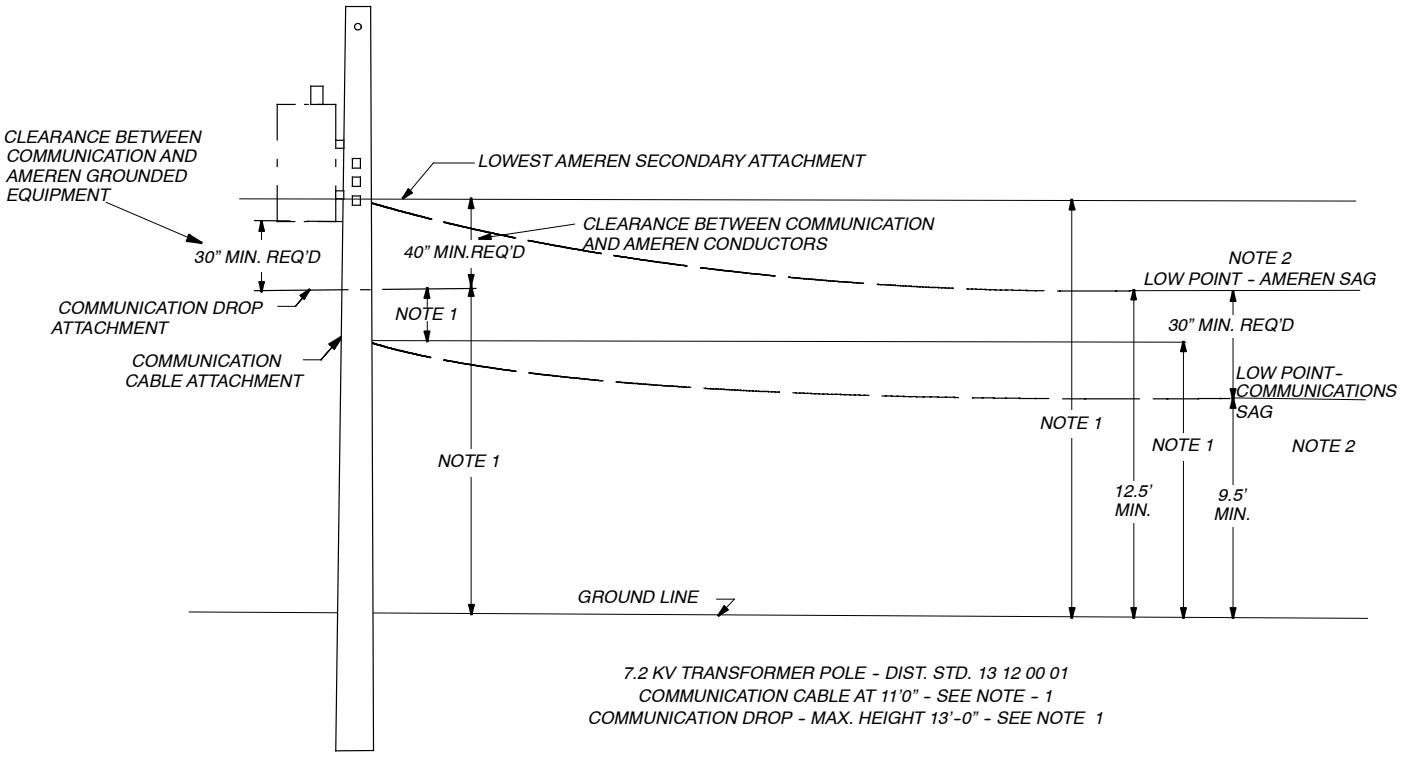
4. Communication Attachments to Poles

4.1 Wood Poles
Holes for through-bolts shall be no closer than 4" apart to avoid compromising pole strength.

4.2 Composite Poles

All communication attachments to Ameren composite poles shall be made using pole-band attachment hardware. Drilling holes in Ameren composite poles shall not be allowed for any communication facilities attachment. All attachment hardware shall be free of any cleats or protrusions that will compress into the pole. Ameren has approved the use of an Aluma-Form pole-band kit rated for 3,000lbs of vertical load for this purpose. This kit consists of a 60" stainless steel pole-band, a mounting block for the Communication Co. attachment, and fastening hardware for tensioning the band. The Aluma-Form part number is 3-CSO-3HB. Any alternate hardware must be approved by Ameren prior to use.

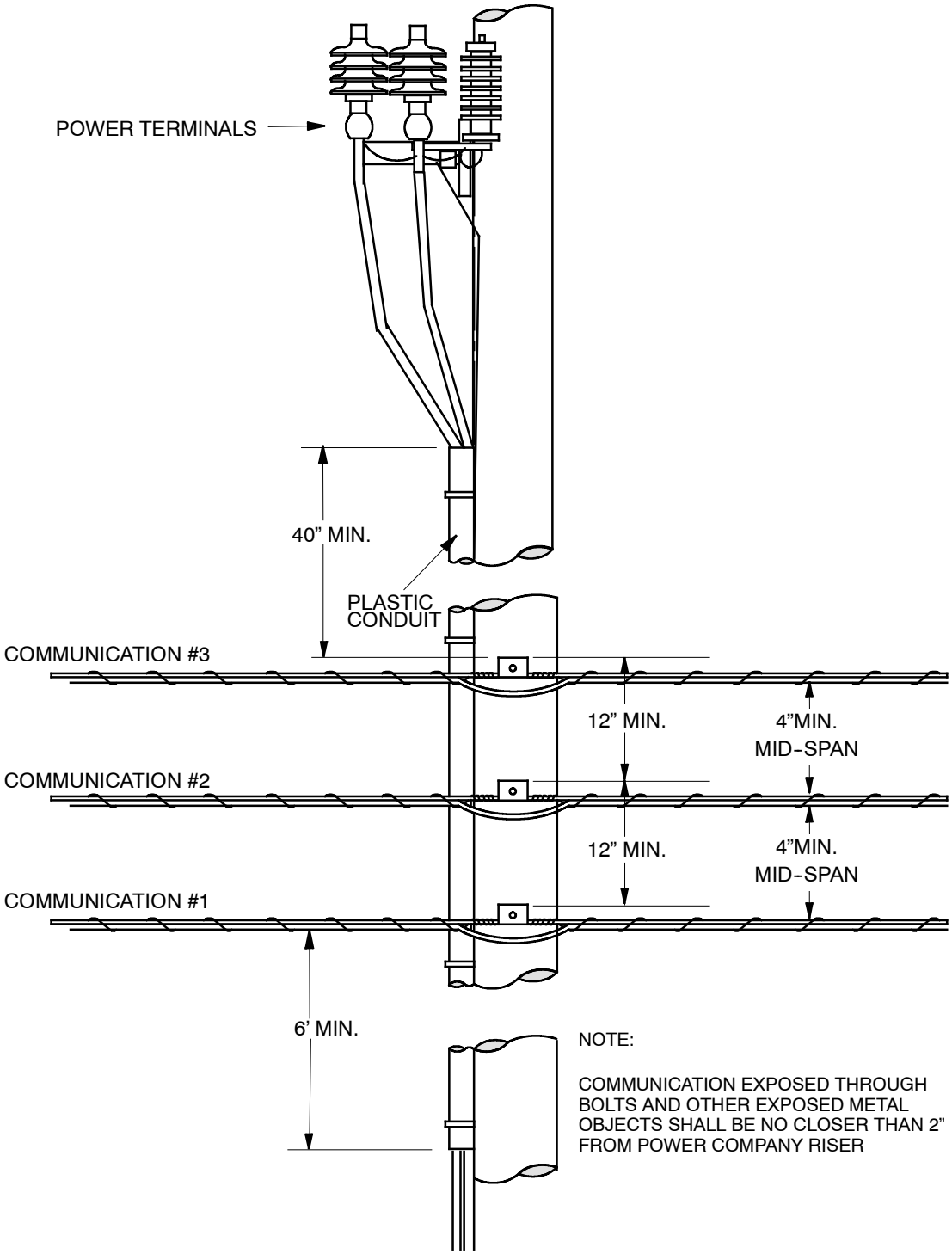
Typical Pole Set on Private Property



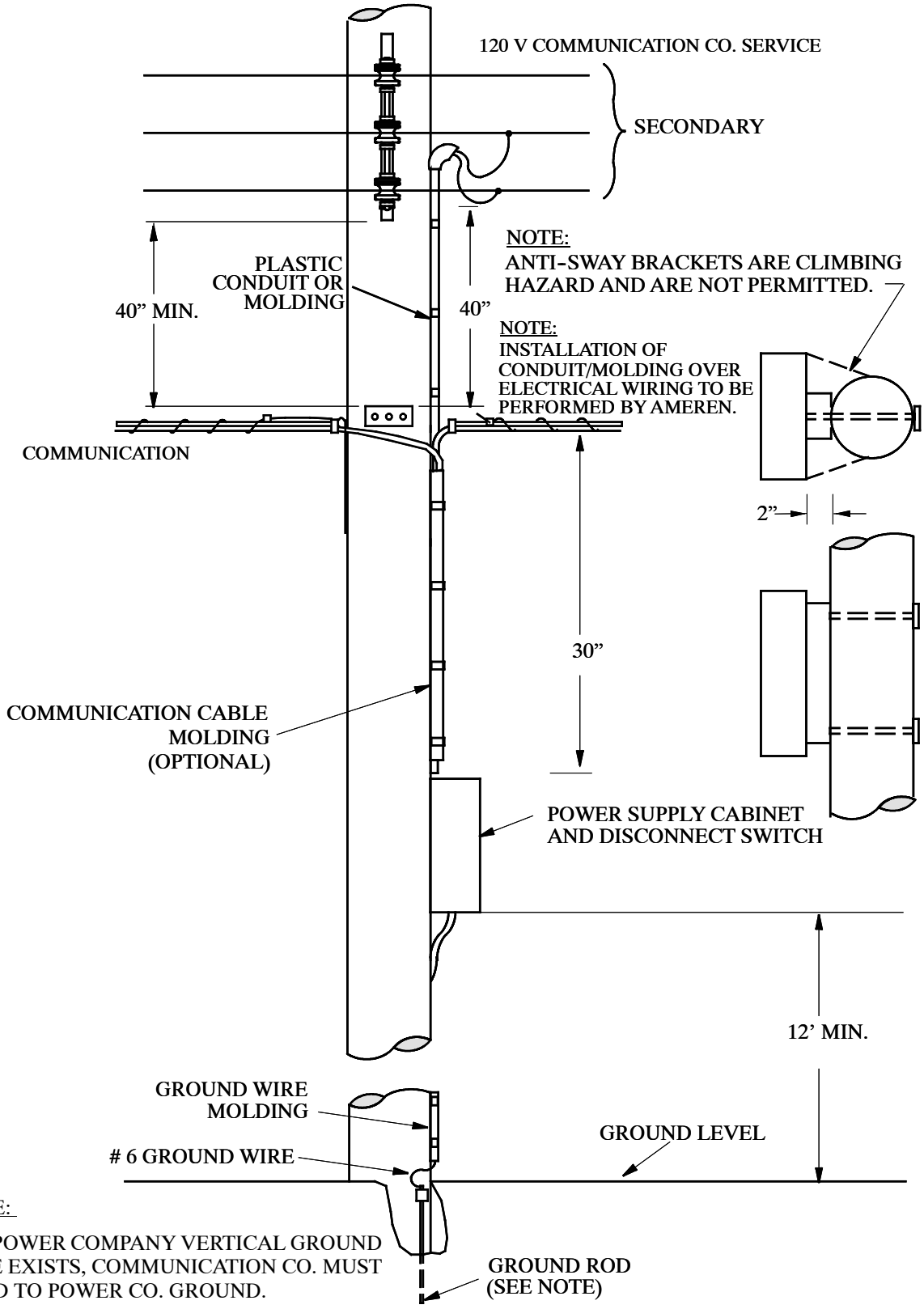
NOTE:

1. These mounting heights will vary in individual cases according to span lengths, conductor size, terrain and mounting height of customer drop attachment.
2. These minimum ground clearances are applicable in spaces or ways accessible to pedestrians only.

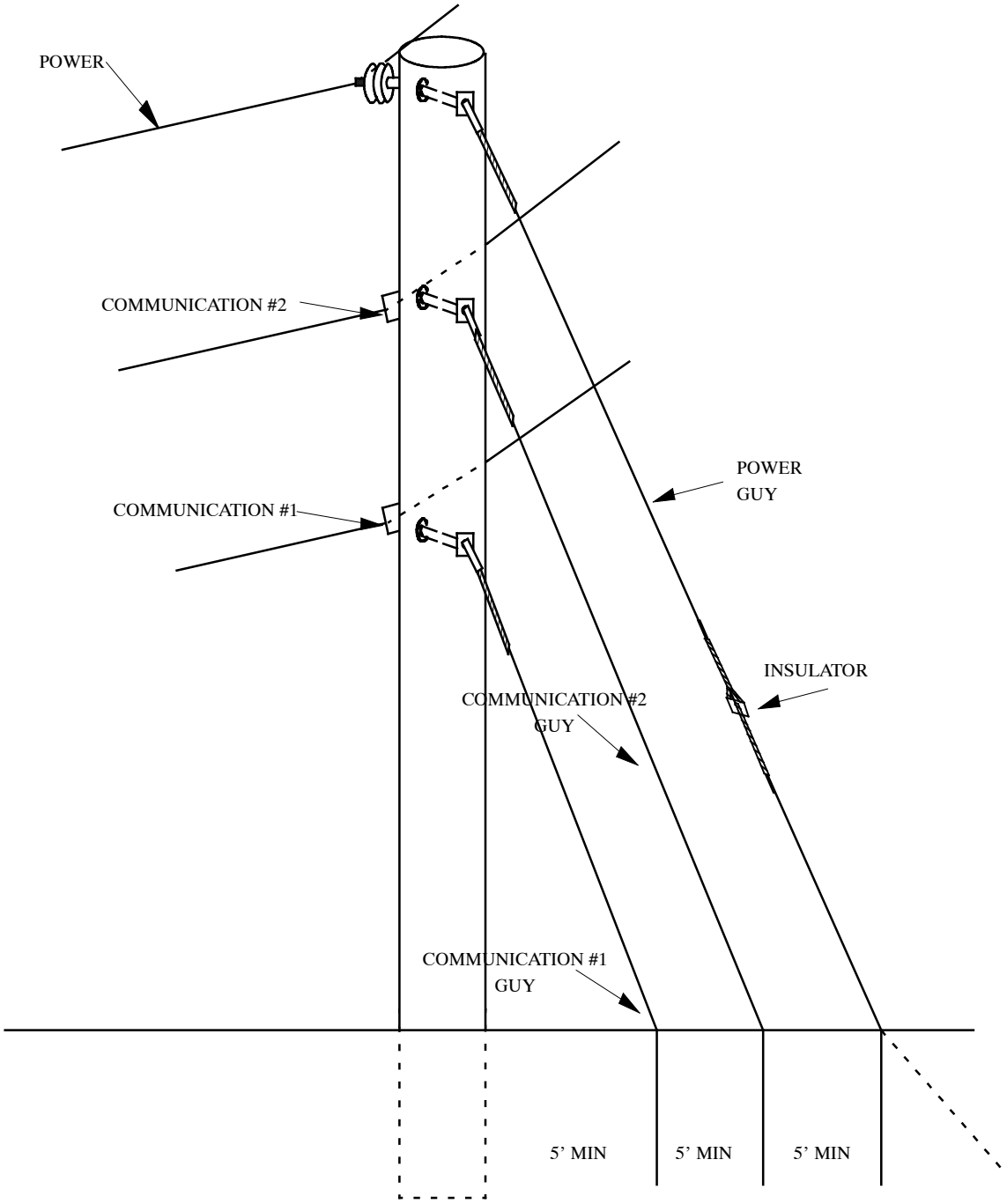
Vertical Clearance to Power Lines



Communication Co. Power Supplies



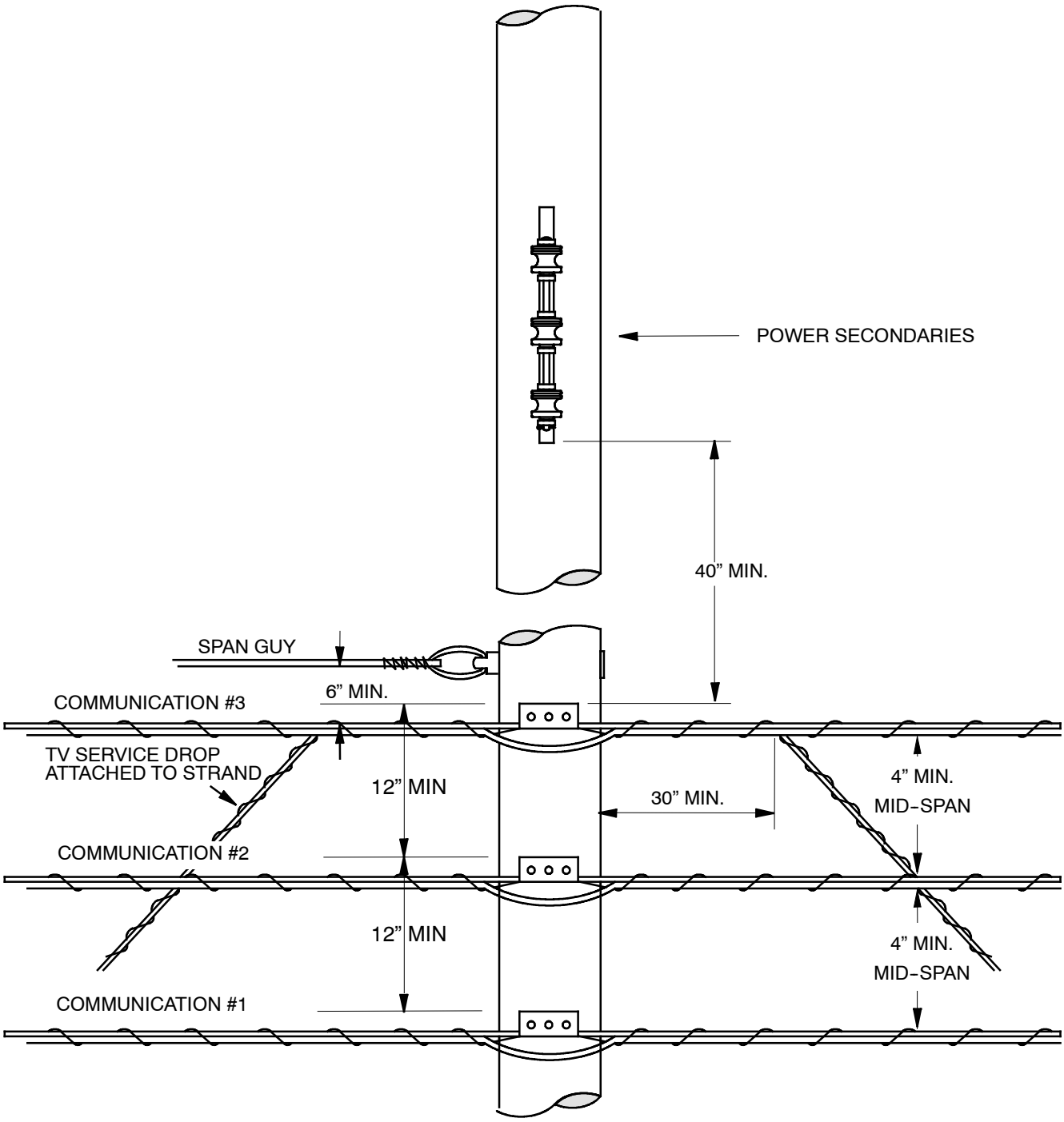
Guy Anchor Clearance



NOTES:

1. This guide is applicable to new guys only.
2. This guide is only to show minimum anchor separation at the ground.
3. Communication guys shall not be attached to Power (Ameren) anchors.

Vertical Clearance at the Pole

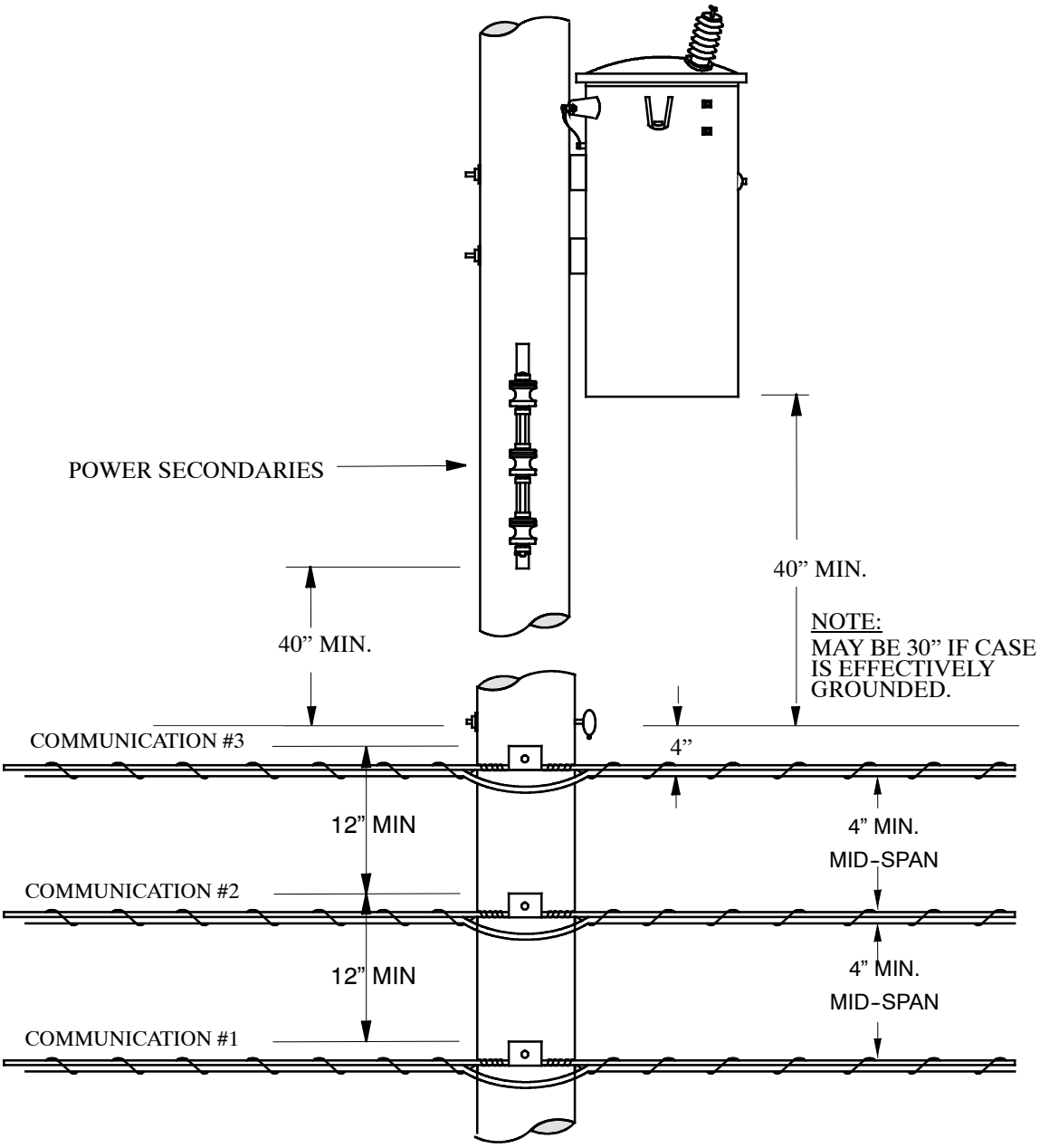


NOTE:

(1) ANY ADDITIONAL LICENSEE'S MUST ADHERE TO CLEARANCES SHOWN.

(2) SPACING BETWEEN ATTACHMENT LICENSEES AND JOINT USERS MUST CONSIDER EQUIPMENT WHICH MAY BE BELOW STRAND AND CABLE. SEPERATION IS DEFINED BY NESC AND OPERATING REQUIREMENTS.

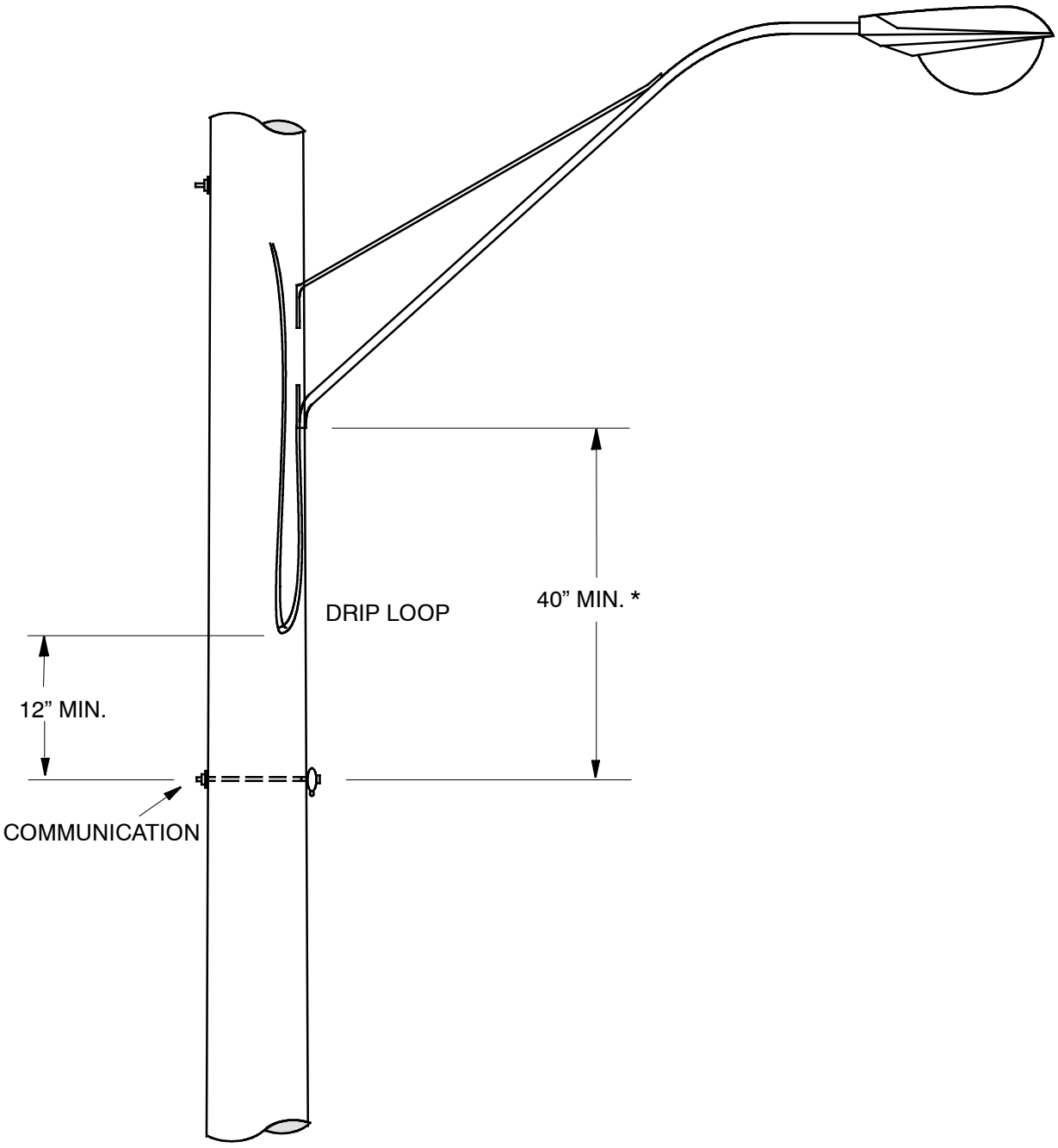
Vertical Clearance to Power Equipment



NOTE:

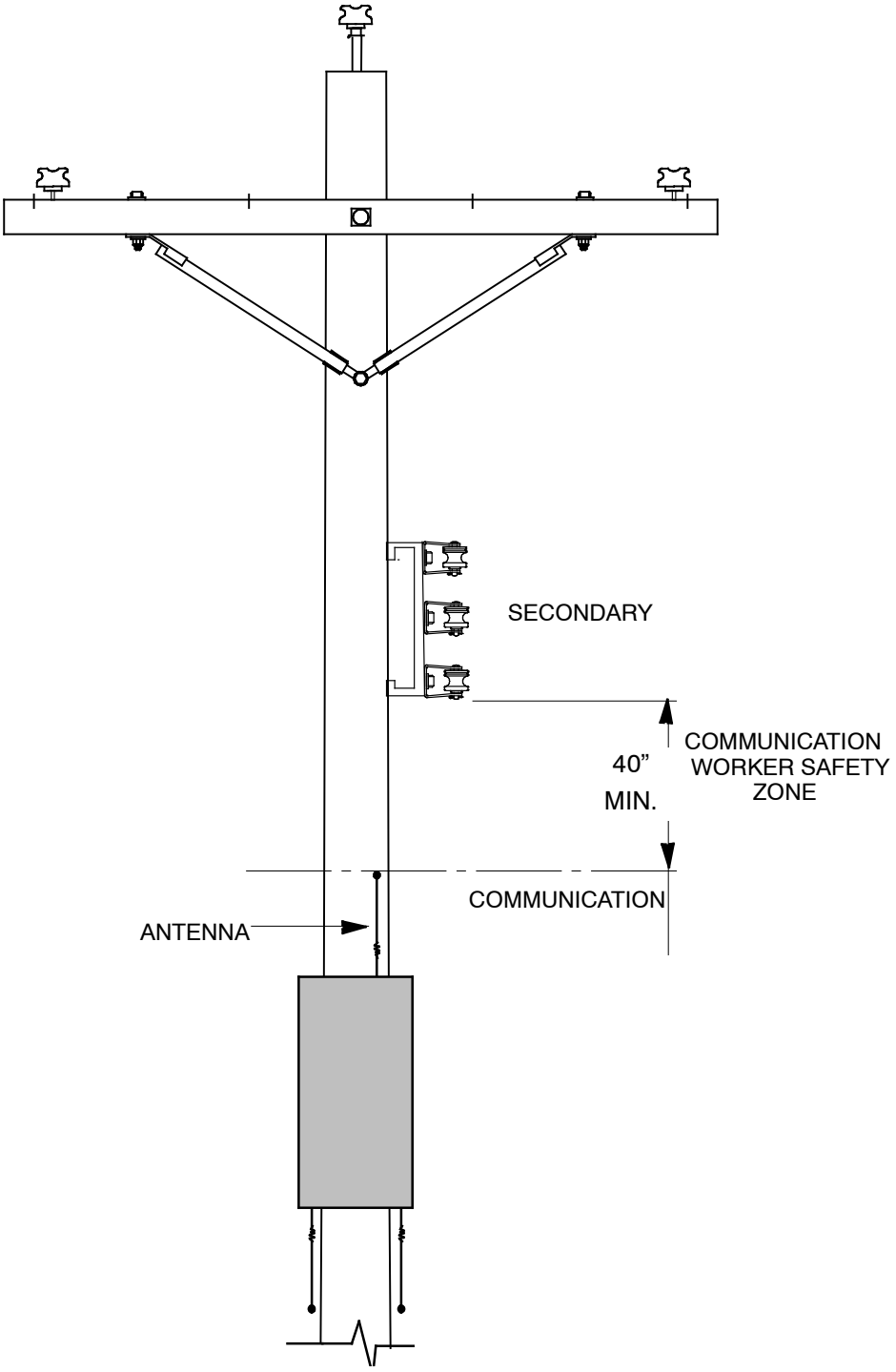
(1) NO COMMUNICATION EQUIPMENT IN CABINET SHALL BE INSTALLED ON A TRANSFORMER POLE.

Vertical Clearance to Streetlights



→ * 40” MINIMUM FROM BOTTOM OF UNGROUNDED BRACKET
→ * 20” MINIMUM FROM BOTTOM OF GROUNDED BRACKET

Antenna Clearance in Communication Space

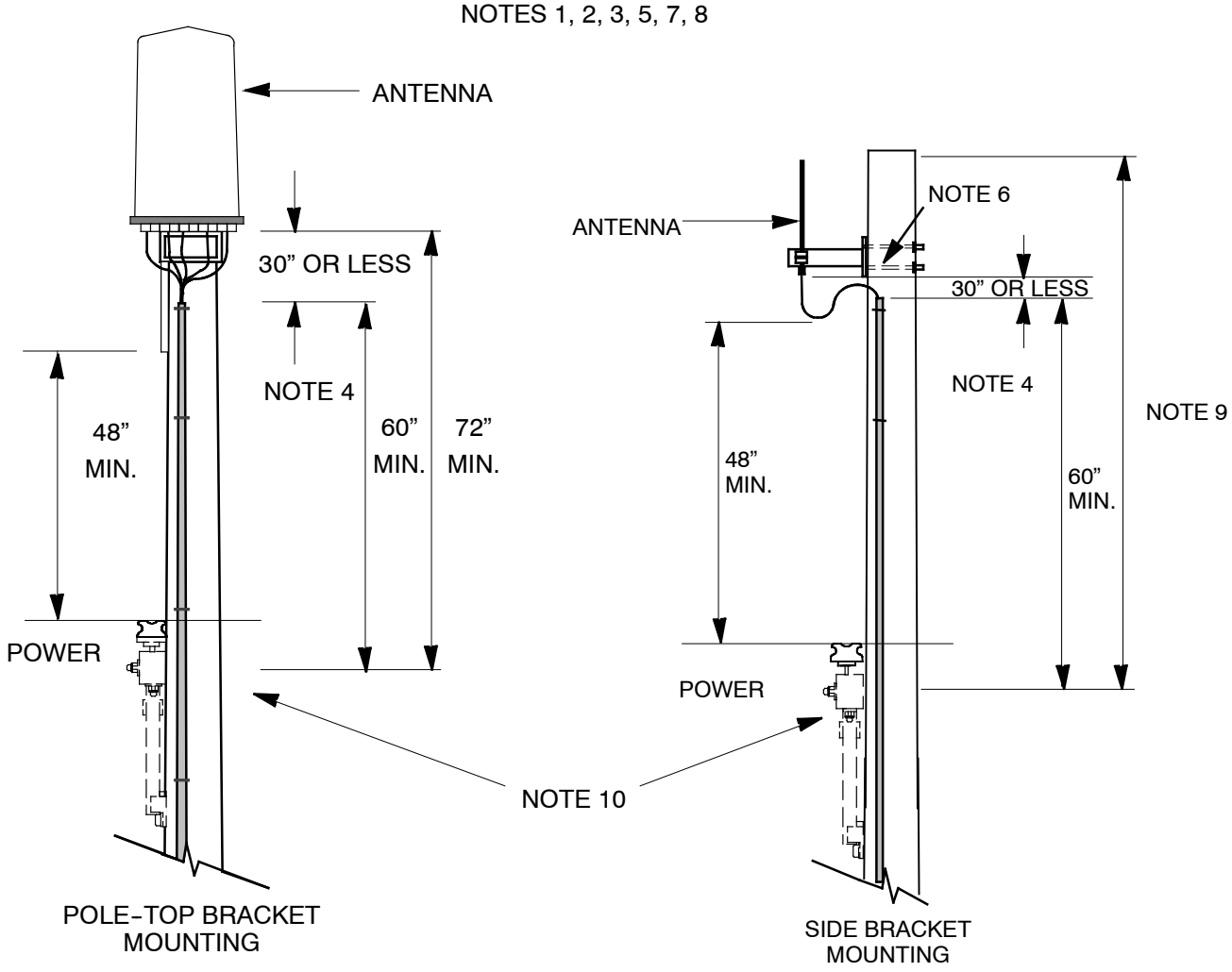


NOTES:

1. Refer to sections 3.7, 3.10 General, 3.10.1, 3.10.3, and 4 for specific requirements.

Antenna Clearance Above Ameren Conductors

NOTES 1, 2, 3, 5, 7, 8



NOTES:

1. Pole-top antennas shall only be allowed on poles that are truck accessible. Refer to sections 3.7, 3.10 General, 3.10.2, 3.10.3, and 4 for other specific requirements.
2. Communication Co. Antenna and Antenna cable must be installed and maintained by Ameren approved persons qualified to work in the electric supply space.
3. Pole top extensions are not permitted for providing antenna clearance above Ameren conductors.
4. Communication Co. Antenna cable must extend down the pole in non-metallic conduit or U-Guard from the antenna to below the communication worker safety zone. Length of antenna cable antenna to top of conduit or U-Guard opening, must be 30" or less.
5. All Communication Co. Wiring must be covered or insulated.
6. Antenna brackets must be non-metallic or ungrounded.
7. Ameren configuration changes required to accommodate the Communication Co. Antenna must meet Ameren avian design standard requirements. Conductor cover must be installed on center phase.
8. Ameren configuration changes required to accommodate the Communication Co. Antenna may require modification to adjacent poles to prevent conductor contact during galloping conditions.
9. 72" minimum from the crossarm mounting bolt (or center of the crossarm) to the top of the pole is required for antennas mounted on the pole top. For antennas mounted on side-brackets as shown in this drawing, the top of the pole must extend above the top of the antenna.

10. Tangent cross-arm construction is shown. For other single- or three-phase configurations, a minimum of 48" must be maintained from the lowest portion of the Communication Co. antenna mounting bracket or antenna cable drip-loop to the highest Ameren Power conductor.

General

Working clearances, electrical insulation levels and mechanical strength have been coordinated in the crossarm standards, Dist. Stds. 04 00 20 thru 04 00 41. To utilize properly these designs requires data on the strength of the configuration to withstand Vertical (V), Horizontal (H), and Transverse (T) loads during ”Continuous” and ”Intermittent” conditions.

Type of Loadings

”Continuous” loading, normally the 60^{o}F loadings, are those applied day in and day out for years at a time. This compares to the ”Intermittent” loadings or short time loadings as experienced during NESC Heavy Loading conditions due to ice, winds, plus at times, a lineman’s weight on the extremity of the crossarm.

Due to the inherent characteristics of wood, it behaves differently under the various types of loads. With a continuous load applied to the arm, deflection will occur and in time, a permanent set takes place. The degree of set is dependent upon the amount of applied load. It is from this condition, that as intermittent loads are applied, further arm deflections or bending take place. However, as the intermittent loads reduce and return to the normal continuous loading the arm deflections also return to normal.

Both of these conditions must be checked and this instruction has been prepared to simplify this task. To illustrate the use of the tables in this standard, the following problems have been worked out.

Problem 1 − Vertical (”V”) Loadings

Given a straight and level (4.16kV) line with 150 ft. spans and 3−556.5 kcmil bare AA conductors carried on crossarms in the top pole gain. Neutral is attached on body of pole.

The bare weight of the conductor (without ice) is .5224 lbs. per ft. The load on the pin is 78 lbs. Assume the conductors are placed on two end pins and a pin 29 inches in from one of the end pins. On an 8’−0” arm, the Equivalent Continuous Vertical Load ”VCont” located 4 inches in from the end of the arm is obtained by taking moments about the crossarm through bolt for the heavier loaded half of the crossarm.

VCont x 44” = 78 lbs. x 44 inches + 78 lbs. x 15 inches
VCont = 105 lbs.

The portion of NESC ”Heavy Loading” contributed by the conductor (with ice) is 1.366 lbs. per ft. or 205 lbs. per pin. This gives a partial Equivalent Intermittent Loading (VPint).

VPint x 44” = 205 lbs. x 44 inches + 205 lbs. x 15 inches
VPint = 275 lbs.

All braced crossarms except for the top gain arms shall be capable of supporting a vertical load of 300 pounds (Lineman’s weight, plus harness, tools, and equipment supported by the lineman) at either extremity in addition to the weight of the conductor. Thus, the total Equivalent Intermittent Vertical Load (VInt) is:

VInt = 275 lbs. + 300 lbs. = 575 lbs.

From Table 1 of this construction standard, an 8’−0” single arm, Std. 04 00 20 02, is good for 300 lbs. ”Continuous Loading” and 900 lbs. ”Intermittent Loading” which is adequate for the calculated loads in both conditions. Overload capacity factors are built into the loading tables in this standard.

Problem 2 − Horizontal ("H") Loadings

Given a 12.47 kV, 3 wire, 336 ACSR conductor, with 150 ft. spans strung to the Short Span sag table, grade "C" construction, to be deadended directly on the crossarm unit.

For "Continuous Loading" the initial 60^{o}F tension found in Dist. Std. 07 00 07 03 should be used. The initial tension for 336 ACSR, using the Short Span Sag table is 392 lbs. per conductor.

For "Intermittent Loading" the deadend tension found in Dist. Std. 07 00 07 03 should be used. The actual conductor deadend tension for 336 ACSR, using the Short Span Final Sag table is 1800 lbs. per conductor.

Assume that the line is to be deadended on 8'−0" double arms, Std. 04 00 20 07. Two conductors will be in deadend on one side and one conductor on the other side of the 8'−0" arms. The Equivalent Horizontal "Continuous Load" (HCont) is located 6" from the end of the arm and is obtained by taking moments about the through bolt of the cross-arm for the heaviest loaded half of the arm.

HCont x 42" = 392 x 42" + 392 x 19"
HCont = 570 lbs.

The Equivalent Horizontal Intermittent Load is:

HInt x 42" = 1800 x 42" + 1800 x 19"
HInt = 2615 lbs.

The strength of unit 04 00 20 07 from Table 1 is 800 lbs. continuous load and 1600 lbs. intermittent load. Therefore, because the calculated intermittent load is too high and because of unbalance, arm guys would be necessary.

Even if one of the conductors were deadended at the pole, the equivalent intermittent loading "HInt" would be 1800 lbs. Under these conditions, unit 04 00 20 07 would still not be strong enough. The 8' fiberglass deadend arm with B−phase deadended on the pole would be needed.

Problem 3 − Transverse ("T") Loadings

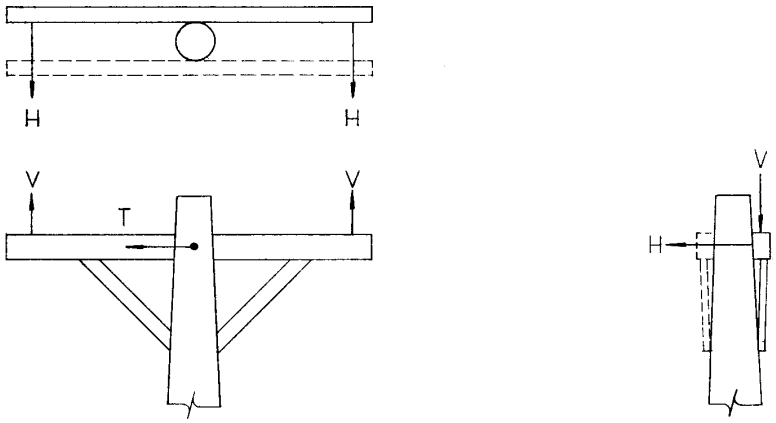
Given a pole with a 12.47kV, 3 wire 556.5 AA bare circuit strung to the Medium Span sag table turning a line angle of 15^{o}. Determine if crossarms can be used for this construction.

Going to Dist. Std. 03 00 03 00, an 18^{o} line angle can be turned using a double crossarm assembly with grid gains, provided the conductors are deadended on the arms. (See Note 5 Dist. Std. 03 00 03 00 Sh. 3.)

However, if one conductor can be carried on double pole top pins, the other two conductors could be carried on pins using double crossarms without grid gains. With this combination, a line angle of 17^{o} can be turned.

NOTES FOR TABLE 1 (ON NEXT SHEET):

1. The "Allowable Continuous Loading" for one insulator pin is 170 lbs. with 500 lbs. the "Allowable Intermittent Loading". These values to be doubled for two pins (340 lbs. and 1000 lbs.) as on a double arm.
2. The loadings shown are based on arm strength. Where more than two conductors are used per arm the total of pin loadings must not exceed the loadings given.
3. The loadings shown are based on double arm strength with grid gains.



V = Equivalent Vertical Load on Crossarm 4” From End of Arm
H = Equivalent Horizontal Load on Crossarm 6” From End of Arm
T = Transverse Load on Crossarm Due to Line Angles or Wind Loads

TABLE 1

Dist. Std. No.	Cross-arm Length	Crossarm Section	No. of Arms	Type Braces (Wood)	Allowable Continuous (60○F Initial)Loadings				Allowable Intermittent (NESC Heavy Final)Loadings			
					V	H(1)	T(2)	T(3)	V	H(1)	T(2)	T(3)
Crossarm Units − 13.8 kV and Below												
04002001	6’−0”	3−1/2x4−1/2	Single	V	300	400	400	–	900	800	1200	–
04002006	6’−0”	3−1/2x4−1/2	Double	V	600	1050	800	1400	1800	2100	2400	4000
04002002	8’−0”	3−1/2x4−1/2	Single	V	300	310	400	-	900	620	1200	-
04002007	8’−0”	3−1/2x4−1/2	Double	V	600	800	800	1400	1800	1600	2400	4000
04002003	10’−0”	3−1/2x4−1/2	Single	V	225	250	400	-	675	500	1200	-
04002008	10’−0”	3−1/2x4−1/2	Double	V	450	625	800	1400	1350	1250	2400	4000
Side Arm Units 7.2/12.47 kV and Below												
04002401	6’−0”	3−1/2x4−1/2	Single	Heel	350	-	400	-	1050	-	1200	-
04002403	6’−0”	3−1/2x4−1/2	Double	Heel	350	-	800	1400	1050	-	2400	4000
04002601	6’−0”	3−1/2x4−1/2	Single	Heel	350	-	400	-	1050	-	1200	-
04002603	6’−0”	3−1/2x4−1/2	Double	Heel	350	-	800	1400	1050	-	2400	4000
04002402	8’−0”	3−1/2x4−1/2	Single	Heel	250	-	400	-	750	-	1200	-
04002405	8’−0”	3−1/2x4−1/2	Double	Heel	250	-	800	1400	750	-	2400	4000
Crossarm Units − 34kV												
04002010	10’−0”	3−3/4x4−3/4	Double	V	500	900	750	1400	1500	1800	2250	4000

1. General

This instruction covers the type, care, and use of pneumatic tools carried on each portable air compressor of the Overhead Construction Division.

2. Standard Compressor Tools

Each compressor shall be equipped with the following tools:

a. Two paving breakers, heavy duty, 70 lb. class, 1−1/8" x 6" hex chuck, with the following accessories:

2 Ea.	Digging chisel with 3" x 12" blade 2'−0" Overall	Stock #85 07 055
3 Ea.	3" Chisel edge with round shank 5'−6" Overall	Stock #85 07 056
3 Ea.	Moil Point with hex shank 3'−6" Overall	Stock #86 02 123
3 Ea.	Moil Point with hex shank 6'−6" Overall	Stock #86 02 128

b. One rock drill, heavy duty, 55 lb. class, 7/8" x 3−1/4" hex chuck, blower type, with the following accessories:

2 Ea.	2' Drill Steel For detachable bit	Stock #85 32 135
2 Ea.	4' Drill Steel For detachable bit	Stock #85 32 136
2 Ea.	6' Drill Steel For detachable bit	Stock #85 32 137
3 Ea.	2" Drill bit, 4 Point	Stock #85 04 105
3 Ea.	1−1/2" Drill bit, 4 Point	Stock #85 04 156

c. One backfill tamper, 35lb. class, with 5" diameter butt.

d. Hoses and Fittings:

4 Ea.	50' length 3/4" heavy duty air hose complete with Thor #2072 fittings.
2 Ea.	12−1/2' length 3/4" heavy duty air hose complete with Thor #2072 fittings.
2 Ea.	25' length 1/2" air hose complete with Thor #2071 fittings (for backfill tamper).

3. Use

The paving breaker with its accessories is normally used for the following work:

Use	Accessory
Cutting through asphalt	Digging chisel
Breaking concrete	Moil point or chisel edge
Digging in rock or boulders	Moil point or chisel edge
Digging in hard−pan	Digging chisel or chisel edge
Starting rock anchor holes	Digging chisel or chisel edgel

The rock drill with drill rod and either 2−1/4" or 1−1/2" detachable bit is normally used as follows:

Use	Bit Size
Drilling holes for rock anchor	2"
All other drilling	2" or 1−1/2"*

*1−1/2" drill cuts much faster and should be used in most cases.

The backfill tamper is normally used for backfilling either dirt or rock.

Either the rock drill or the paving breaker may be operated separately from each compressor but not simultaneously.

The backfill tamper may be used separately or with the paving breaker.

Excessive air hose length reduces the operating efficiency of air tools, therefore, where practicable the compressor should be located so that only one section of the hose is necessary for the operation of a tool.

The 1/2" air hose should be used only on the backfill tamper.

4. Care

a. Lubrication

Pneumatic Air Tools require a special type of lubricating oil. This oil is available in one gallon cans under Stock #3159051.

Each compressor is equipped with a line oiler and this oiler should be full at the beginning of each shift. The oil chamber on each tool should also be full at the beginning of each shift. When the line oiler is functioning properly no oil will be required from the chamber on the tool. The chamber will remain full, adding insurance of proper lubrication.

b. Hose

The air hose should be kept on the reel when not in use. Each 50' section should have its turn at regular use and not be left on the reel for long intervals.

c. Sharpening

The paving breaker steels should be sent in to the Utility Shop for sharpening.

All broken steels should be sent to the Salvage shop.

d. Bits

The detachable bits should be sent to the Salvage Shop when broken or dulled beyond their usefulness.

1. General

This instruction specifies procedures, care and precautions to be used in handling and installing 5000 volt insulated wire. This type of wire is used for primary voltage installations on the 4160 and 4800 volt systems where open wire would be hazardous. These installations include primary transformer leads, switch leads and primary taps.

2. Care In Handling And Installing

It is essential that the utmost care and precaution be exercised in handling and installing 5000 volt insulated wire. A flexible insulation is inherently weak to mechanical damage. Even the best insulated wires or cables presently available have certain limitations and require care during handling and installation. The care exercised in storing and handling 5000 volt wire should be similar to that which is given to the storage, handling and use of rubber protective equipment.

2.1 Handling Before Installation

Care shall be taken to avoid cutting and abrading the insulation on 5000 volt wire before installation. The wire shall be supported in the truck on a smooth flat surface and shall be kept free of dirt, grease or other foreign substances. It shall not be thrown into the truck or onto the ground at any time. Throwing the wire on sharp objects will result in possible damage to the insulation. Similarly, objects shall not be thrown on the wire. Dragging the wire from the truck or along the ground will result in abrasion of the wire and shall be avoided.

2.2 Care And Precautions While Installing

2.2.1 Clearance

5000 volt wire shall be installed in such a manner that the insulation will not be damaged by rubbing against other objects nor be pressed against any projection which will cause an indentation in the insulation.

2.2.2 Bending

5000 volt insulated wire shall never be bent at a radius less than 10 times the outside diameter of the wire. (Diameter includes the insulation.) Excessive stretching by too sharp a bend will weaken the insulation.

2.2.3 Corona

5000 volt insulated wire shall be installed as far as possible from grounded objects or other conducting surfaces. Objects with sharp edges, such as bolts, brackets and transformer tanks, when in contact with the insulation cause a concentration of the corona at these edges and will accelerate the destruc tion of the insulation.

2.2.4 Splices

5000 volt insulated wire shall not be spliced where the splice will be inside conduit or within 6 inches of the point of entry of the insulated wire into the conduit. All splices shall be insulated with two layers of H.V. rubber tape (Stock #25 53 070) half lapped, two layers of friction tape (Stock #25 53 003) half lapped and the splice completed with a single layer of vinyl plastic tape (Stock #25 53 055) half lapped. See Dist. Std. 41 24 30 ** for a cold−shrinkable 5kV splice.

2.2.5 Taps

Joints where 5000 volt insulated wire tap a second 5000 volt insulated wire shall be insulated in the same manner as a splice. The joint shall be insulated with two layers of H.V. rubber tape half lapped, two layers of friction tape half lapped and the joint completed with a single layer of vinyl plastic tape half lapped.

MO ONLY **MO ONLY** **MO ONLY**

1. General

This instruction covers the inspection, testing, care and maintenance of all live line tools used in construction and maintenance of overhead lines.

2. Scope

The tools covered by this instruction include all live line tools as well as rope and other associated equipment used with these tools.

3. Storage

All live line tools shall be kept dry when not in use. When carried on a truck, they shall be placed in canvas bags and stored in assigned compartments. If special compartments and canvas bags are not available, the tools shall be transported in such a manner as to reduce to a minimum the possibility of damage and exposure to weather.

When live line tools are stored in a storeroom or at a works headquarters, they shall be placed in a well ventilated cabinet or trailer designed for this purpose. All precautions should be taken to insure that live line equipment is not subject to moisture or dampness while being stored.

4. Care of Live Line Equipment on the Job

Live line tools shall be wiped clean with silicone treated wiping clothes and visually inspected before being used. The inspection should include such items as condition of finish, cracks or gouges in the fiberglass and condition of hardware. The surface of the tool should be smooth, free of dust and have a shiny finish. If any defect or contamination that could adversely affect the insulating qualities or mechanical integrity of the live line tool is present the tool should be removed from service and returned to the Stores Department.

When live line tools are temporarily laid aside on the job, they should be laid on waterproof canvas drop clothes to keep them clean and free of moisture.

All rope used in live line work shall be the standard treated rope used for other line work, but the lengths when required shall be issued from new rope and kept separate for this purpose only. Special care shall be exercised to keep this rope clean and dry and stored on the truck so that it will not be subject to moisture, dirt, oil, or grease.

5. Two Year Inspection

Live line tools used for primary employee protection shall be cleaned waxed and inspected every two years. All live line tools which satisfactorily pass the two year inspection shall be marked with the date of the inspection. All live line tools having any defects or contamination that could adversely affect the insulating qualities or mechanical integrity of the live line tool shall be returned to the Stores Department.

6. Return of Live Line Equipment

All surplus live line equipment and live line equipment which is defective in any manner shall be returned to the Stores Department. All wood hot sticks should be retired and returned to the Stores Department. All live line equipment which is returned to the Stores Department for any reason shall have a Tool Repair Ticket, Form #5074, firmly attached. These tags shall be filled out in detail and the specific reason the tool is being returned shall be carefully noted on the tag.

7. Inspection and Maintenance by Meter Department

All live line equipment which is returned to the Stores Department from the field shall be sent to the Meter Shop for inspection. All returned equipment shall be carefully cleaned, inspected, and tested for current leakage by personnel of the Meter Shop and Meter Laboratory before being returned to stock. The inspection procedure will be as follows:

a. Thoroughly clean the equipment using an approved hot stick cleaner.

b. Check each tool for indications that the tool may have been mechanically over stressed. This type of damage is evidenced by bent or cracked parts, bent rivets or bolts, signs that ferrules have been pulled away from their original positions and obviously damaged fiberglass members. Check metal parts of the tool for excessive wear and other visible damage and repair or replace as needed.

MO ONLY **MO ONLY** **MO ONLY**

c. Minor parts such as end caps, tool hangers, tie wire assistants, hand guards, and machine screws shall be replaced by the Meter Shop.

d. Hot Sticks which have been cleaned and inspected shall then be tested for current leakage with an approved Hot Stick Tester. Detailed instructions for use of the Hot Stick Tester are contained in Standard Work Practice Section IX–C–1–1 through IX–C–1–8. All live line tools which fail to pass the current leakage test shall be dried out in a drying cabinet. After drying out, the tools shall be retested for current leakage with the Hot Stick Tester.

e. All hot line equipment which satisfactorily passes the inspection and testing by the Meter Shop and Laboratory shall be marked with the date of the test, appropriately packaged, marked with an identifying U.E. stock number and returned to the storeroom to be placed in stock.

f. Non–stock live line tools which pass inspection and testing by the Meter Shop and Laboratory shall be returned directly to the original user, if known. Otherwise, these tools shall be accumulated by the T&D Meter Shop and listed in T&E Newsletter as available live line tools.

1. General

This instruction prescribes procedures to be followed on group operated airbreak and load−break switches on 13.8kV thru 69kV lines and in customer substations. It does not apply to switches installed in company substations.

2. Procedure

a. The switch should be disconnected from all electric power sources before service. Ground leads or their equivalent should be attached to both sides of the switch. Local and applicable OSHA regulations, including all safety precautions should be followed. Switch leads that may have been removed shall be re−connected and all switch terminals shall be checked for tightness before the switch is released for normal service.

b. Look for evidence of burning, pitting or overheating of the blade and stationary contacts. Inspect all live pats for scarring, gouging, or sharp points that could contribute to excessive radio noise and corona. Check corona balls and rings for damage that could impair their effectiveness.

c. Inspect the flexible braids or slip−ring contacts used for grounding the operating handle. Replace braids showing signs of corrosion, wear, or having broken strands.

d. Switches having silver contacts shall be cleaned and those having copper contacts may be lightly dressed with sandpaper.

e. A preliminary check on the operation of all moving parts shall be made to determine if any bushings, bearings, pins, etc., are missing or worn and replacement shall be made as required.

f. The mounting bolts that fasten the base of each switch to the crossarms shall be checked for tightness and tightened as needed. Also, the mounting bolts and lag screws that fasten all guide bearings and the operating handle assembly to the pole shall be checked and tightened. All other supporting members of the switch structure that may become loose through weathering should also be checked and tightened.

g. After all necessary repairs have been made and all mounting bolts, hardware, etc., has been tightened, the overall operation of the switch shall be carefully checked and adjusted.

h. Inspect interphase linkages, operating rods, levers, bearings, etc., to assure that adjustments are correct, all joints are tight, and pipes are not bent. Clean and lubricate the switch parts only when recommended by the manufacturer. The length of the interphase rods should be adjusted as needed so that all units open and close simultaneously. It is important that all switches operate to the fully closed position. The shortening or lengthening of the interphase rods may have to be repeated several times to assure proper operation. The travel of the operating handle should be set so that a slight effort is required to lock it in either the open or closed position. Check gear boxes for moisture that could cause damage due to corrosion or ice formation.

i. Inspect the insulators for breaks, cracks, burns, or cement deterioration. Clean the insulators particularly where abnormal conditions such as salt deposits, cement dust, or acid fumes exist. This is important to minimize the possibility of flashover as a result of the accumulation of foreign substances on the insulator surfaces.

j. Check the switch for alignment, contact pressure, eroded contacts, corrosion, and mechanical malfunction. Replace damaged or badly eroded components. If contact pitting is of a minor nature, smooth the surface with clean, fine sandpaper (not emery) or as the manufacturer recommends. If recommended by the manufacturer, lubricate the contacts. Inspect arcing horns for signs of excessive arc damage and replace if necessary.

k. Power−operating mechanisms for switches are usually of the motor−driven, spring, hydraulic, or pneumatic type. The particular manufacturer's instructions for each mechanism should be followed. Check the limit switch adjustment and associated relay equipment for poor contacts, burned out coils, adequacy of supply voltage, and any other conditions that might prevent the proper functioning of the complete switch assembly.

l. Inspect and check all safety interlocks while testing for proper operation for Turner D Switch.

3. Interrupters

Vacuum interrupters (bottles) shall be checked for proper operation. Check the fiberglass housing. If there is evidence of burning from the inside showing or if there are cracks which appear to go through the housing, replace the bottle.

The bottle is designed to interrupt 2000 amps of load current (1200A capacitive). It is not able to carry load current for more than a few seconds.

The actuating arm on the bottle trips the vacuum interrupter internally. Check that the arm operates smoothly and there is a click for tripping and for resetting (when the arm is released). Be sure the actuating arm springs back to its reset or rest position. Check electrical continuity in the reset position and for open in the trip position.

3.1 Turner D Switches:

Check for proper switch blade –– actuating arm operating. The actuating arm on the bottle should be contacted by the opening switch blade pick up hardware before the quick whips separate from the stationary contact. As the blade keeps moving the current is carried through the actuating arm until it trips. As the blade keeps moving it clears the bottle actuating arm (minimum 3/4”). The actuating arm then springs back to reset. When the switch is closed again, momentary contact will be made with the bottle actuating arm.

3.2 SEECO Switches:

Switches supplied with high–speed, snap–out arcing horns for the interruption of limited amounts of line charging and transforming magnetizing currents. Horn shall be tapered design to provide maximum tip speed and shall include a mechanical stop (snubber) to prevent return/rebound of the horn and possible re–strike.

Inspect the arcing horn assemblies to insure that no whips are burned and that no snubber rubbers are broken. Insure that the arcing horn whips engage the hooks and are held as the switch opens. Insure that all jaw assemblies open completely, so that the blade closing in will hit inside the jaw rather than on the outside. Insure that the blade closing in will hit the center of the jaw contact finger assemblies equally.

The switch has vacuum interrupters installed, inspect to insure that interrupter operating arm is engaged correctly by the opening blade and visually inspect the auxiliary contacts to insure that they are not burned and they engage in the proper sequence.

4. Application of Silicone Compound

Silicone compound shall be applied to 13.8kV and 34.5kV airbreak switches to minimize the adhesion of ice toswitches and operating mechanisms.

4.1 Areas of Application

Silicone compound shall be applied to the following switch parts.

a. All bearings, pivot points and pins.

b. Contact Areas

1. The stationary contact assembly.

2. The switch contact area.

3. Arcing horns.

c. Any location where ice may form between a moving part and a stationary member. For example: On interphase rods where the clearance between the interphase rods and switch base is small.

4.2 Method of Application

Stock No. 31 51 048 – "Compound – Insulating, Silicone, in 12 oz. Pressurized Cans" – This silicone compound is combined with a solvent in a liquid form and is packaged in an aerosol bomb. Upon application the solvent quickly evaporates leaving the silicone compound. A sufficient amount of spray should be applied to leave a thin film of silicone compound on the area sprayed.

CAUTION: The solvent will attack rubber; do not spray on rubber equipment.

1. **General**

This standard and the Clearance Standards that follow cover minimum clearances to be used in the design and construction of overhead lines on the Ameren System. The clearances specified meet or exceed the NESC requirements as required by the amended 83 IL. Admin. Code 305 and the MO 4CSR 240–18.010 Safety Standards. These clearances also meet the requirements of the 2017 Edition of the NESC.

2. **Horizontal Clearances of Supporting Structures**

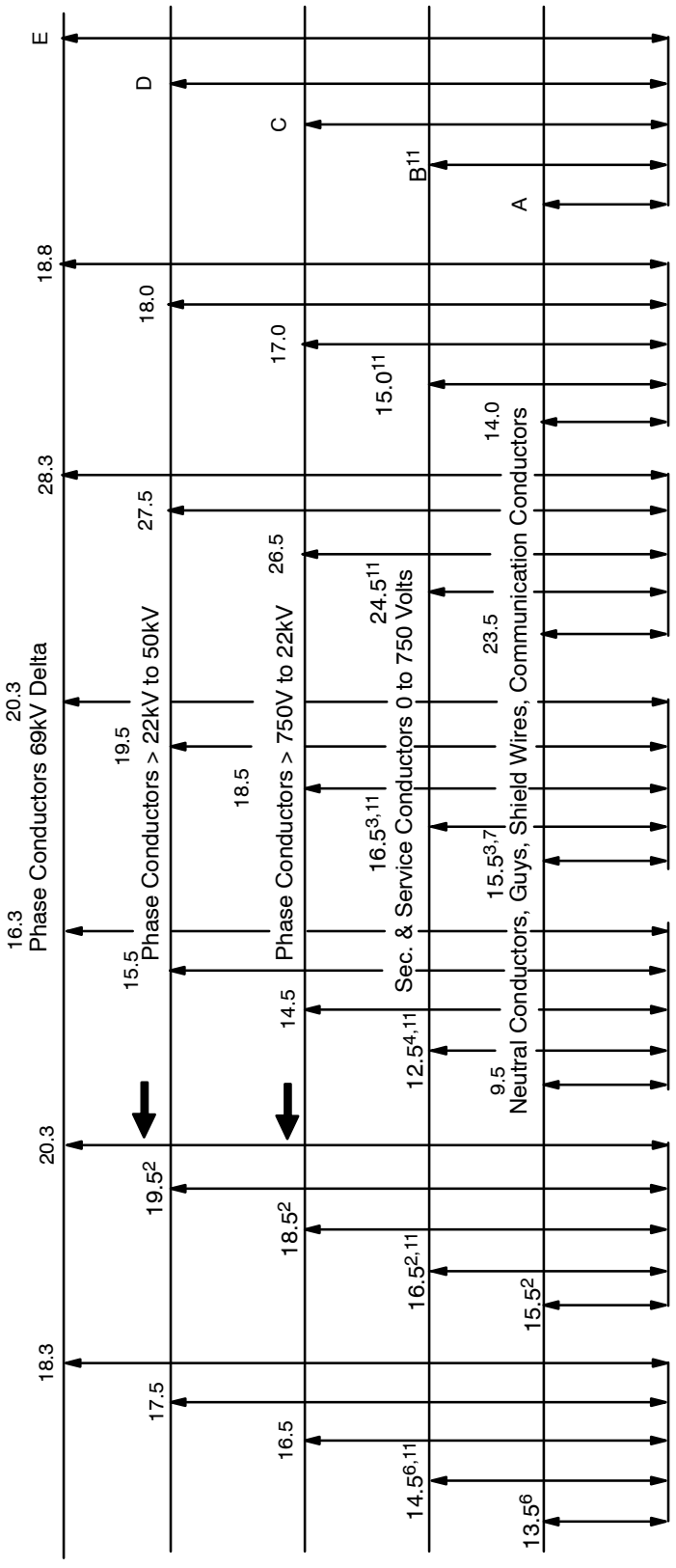
Supporting structures, support arms, anchor guys, and attached equipment shall have the following minimum clearances, measured between the nearest parts of the objects concerned:

OBJECTS	MINIMUM	RECOMMENDED
A. Fire Hydrants	3 ft. [3]	4 ft.
B. Streets, Roads, & Highways[4]	Horizontal Clearance for First 15 Ft. Above Ground[5]	
1. With street curbs (clearance measured from street side of the curb).	See Note 1.[4]	2 ft.[1,4]
2. With no curbs.		As close as practical to R.O.W. Line[4]
C. All Railroad Tracks	Horizontal Clearance for First 22 ft. Above the Nearest Track Rail	
	12 ft. [2]	12 ft.

NOTES:

Reference: 2017 NESC, Rule 231.

1. Supporting structures should be placed as far as practical behind the curb within the road right–of–way and shall be located a sufficient distance behind the curb to avoid contact by ordinary vehicles using and located on the traveled way. Some ordinary trucks and delivery vehicles overhang the curb by more than 6 in. Superelevated curves and heavily crowned roads further increase this overhang.
2. This may be reduced to 7 feet where the supporting structure is not the controlling obstruction, provided sufficient space for a driveway is left where the cars are loaded and unloaded.
3. 3 feet is allowed only if conditions do not allow 4 feet clearance.
4. For Illinois and Missouri State and Federal highways, location of structures shall be as required by each individual permit. In Illinois, 92 IL Admin. Code 530 provides requirements for location of support structures. In Missouri, MO 7CSR 10–3.010 provides requirements for location of support structures.
5. Specified clearance is to the support structure or the closest support arm, anchor guy, or attached equipment on that structure up to 15 feet above the road surface.



Water Areas[8,9,10,13]	Reference Height[9]	A	B[11]	C	D	E
less than 20 acres	16	17.5	18.5	20.5	21.5	22.3
20 to 200 acres	24	25.5	26.5	28.5	29.5	30.3
200 to 2000 acres	30	31.5	32.5	34.5	35.5	36.3
over 2000 acres	36	37.5	38.5	40.5	41.5	42.3

All Distance in Feet

NOTES:

(Based on maximum calculated sag for span; see Note 1.)

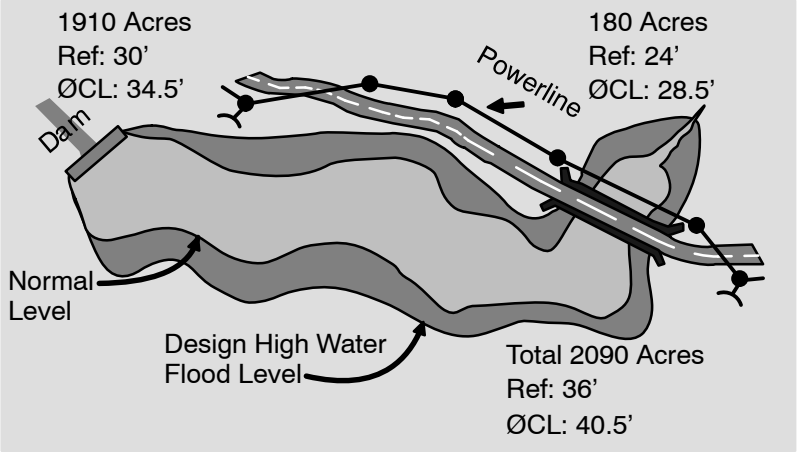
(All voltages are phase−to−ground unless otherwise indicated.)

Reference: 2017 NESC, Rule 232, Table 232−1

1. The vertical clearances apply under the following conductor temperature and loading conditions, whichever produces the largest final sag.
   a. 120ºF (50ºC), no wind displacement.
   b. The maximum conductor temperature for which the line is designed to operate, if greater than 120ºF (50ºC), with no wind displacement.
   c. 32ºF (0ºC), no wind displacement with 1/2 inch of ice.
2. Where this construction crosses over state and federal commercial highways, this clearance shall be no less than 18 ft. per MO Title 7 CSR 10−3.010 and 92 Il. Admin. Code 530. For Illinois limited access highway crossings, this clearance shall be no less than 20 ft.
3. Where vehicles exceeding 8 ft in height are not normally encountered nor reasonably anticipated, service drop(s) clearances over residential driveways only may be reduced to the following:
   a. Insulated supply service drops limited to 300V to ground 12.5 ft.
   b. Insulated drip loops of supply service drops limited to 300 V to ground 10.5 ft.
   c. Triplex supply service drops limited to 150V to ground 12.0 ft.
   d. Drip loops only of triplex service drops limited to 150V to ground 10.0 ft.
   e. Insulated communication service drops 11.5 ft.
4. Clearance values for service drops to residential buildings only may be reduced to the following:
   a. Insulated supply service drops limited to 300V to ground 10.5 ft.
   b. Insulated drip loops of supply service drops limited to 300V to ground 10.5 ft.
   c. Triplex supply service drops limited to 150V to ground 10.0 ft.
   d. Drip loops only of triplex supply service drops limited to 150V to ground 10.0 ft.
5. Spaces and ways subject to pedestrians or restricted traffic only are those areas where riders on horseback or other large animals, vehicles, or other mobile units exceeding 8 ft in height, are prohibited by regulation or permanent terrain configurations or are otherwise not normally encountered nor reasonably anticipated.
6. Where a line along a road is located relative to fences, ditches, embankments, etc. so that the ground under the line would not be expected to be traveled except by, pedestrians, this clearance may be reduced to the following values:
   a. Triplex and quadruplex 120V to ground 10.0 ft.
   b. Insulated conductors 0 to 300V to ground 12.5 ft.
   c. Guys, neutrals, insulated communication cables 9.5 ft.
7. Where this construction crosses over and runs along alleys, driveways, or parking lots not subject to truck traffic, this clearance may be reduced to 15 ft.
8. The surface area and corresponding clearance shall be based upon the normal flood level or, for controlled impoundments, upon the design high water level. The clearance over rivers, streams, and canals shall be based upon the largest surface of any one−mile long segment which includes the crossing. The clearance over a canal or similar waterway providing access for sailboats to a larger body of water shall be the same as that required for the larger body of water.
9. Where an over water obstruction restricts vessel height, the required clearance may be reduced by the difference between the Reference Height from the 'Water Areas' table above (for the overall area of the body water that the line crosses), and the over water obstruction height. Exception: The reduced clearance shall not be less than that required for the water surface area on the line−crossing side of the obstruction.

Example: A 12.47 kV line will cross over a portion of a 2090 acre lake adjacent to a bridge. For this is size lake, the normally required clearance for a 12.47 kV line is 40.5 ft. (the Reference Height = 36 ft.). The area of the lake on one side of the bridge is 1910 acres. For a 1910 acre lake, the normally required clearance for a 12.47kV line is 34.5ft. The area of the lake on the other side of the bridge is 180 acres. For a 180 acre lake, the normally

required clearance for a 12.47 kV line is 28.5 ft. The height of the bridge above the water is 25 ft. The Reference Height for the overall area of the lake minus the bridge height is 11ft. (36 ft. – 25 ft.).



If the 12.47 kV line is installed on the 1910 acre side of the bridge, an 11 ft. reduction in the clearance over the 2090 acre lake would be 29.5 ft. (40.5ft. – 11ft.). However, 29.5 ft. is less than the 34.5 ft. required for a 12.47 kV line over a 1910 acre lake. Therefore, if the 12.47 kV line crossing is done over the 1910 acre side of the bridge, the full 34.5 ft. clearance of the 12.47 kV line over the lake must be maintained.

If the 12.47 kV line is installed on the 180 acre side of the bridge, an 11 ft. reduction in the clearance over the 2090 acre lake would be 29.5 ft. (40.5 ft. – 11 ft.). 29.5 ft. is more than the 28.5 ft. required for a 12.47 kV line over a 180 acre lake. Therefore, if the 12.47 kV line crossing is done over the 180 acre side of the bridge, the clearance of the 12.47 kV line over the lake can be reduced to 29.5 ft.

10. Where the US Army Corps of Engineers, or the State, or surrogate thereof has issued a crossing permit, clearances of that permit shall govern.
11. Clearance can be reduced by 6 inches for triplex and quadruplex conductor.
12. When designing to accommodate oversized vehicles, these clearance values shall be increased by the difference in the known height of the oversized vehicle and 14 ft.
13. Add 5 ft to the water area clearance values for ground clearance at established boat ramp and rigging areas, or areas posted with sign(s) for rigging or launching sail boats.

General

These vertical clearances above ground are for unguarded rigid live parts such as potheads, transformer bushings, lightning arresters, and short lengths of connecting supply conductors which are not subject to variations in sag and effectively grounded equipment cases.

(All voltages are phase–to–ground unless otherwise indicated)

NATURE OF SURFACE BELOW LIVE PARTS		MINIMUM VERTICAL CLEARANCE IN FEET				
		Effectively Grounded Cases	0 to 750 Volts	Over 750V to 22kV	Over 22 kV to 50kV	69kV Delta
1.	Where live parts overhang:					
a.	Roads, streets, alleys; nonresidential driveways; parking lots and other areas subject to truck traffic[3]	15.0	16.0	18.0	19.0	19.8
b.	Residential driveways; commercial areas not subject to truck traffic.	15.0	16.0[1]	18.0	19.0	19.8
c.	Other land traversed by oversized vehicles such as cultivated land, grazing land, forest, orchard, industrial commercial etc.[7]	15.0[5]	16.0	18.0	19.0	19.8
d.	Spaces and ways accessible to pedestrians only.[4]	9.0[5]	12.0[1b]	14.0	15.0	15.8
2.	Where live parts are along and within the limits of high ways or other road rights–of–way but do not overhang the roadway:					
a.	Roads, streets, and alleys.	15.0[5]	16.0	18.0	19.0	19.8
b.	Roads where it is unlikely that vehicles will be crossing under the line.	13.0[5]	14.0[2]	16.0	17.0	17.8
3.	Water areas not suitable for sailboating or where sailboating is prohibited.[6]	13.5	14.5	16.5	17.5	18.3
4.	Water areas suitable for sail boating including lakes, ponds, reservoirs, tidal waters, rivers, streams, and canals with an unobstructed surface area.	Use clearances over Water Areas in DCS 29 00 17 02 reduced by 6 inches.				

Reference: NESC, 2017 Edition, Rule 232, Table 232–2

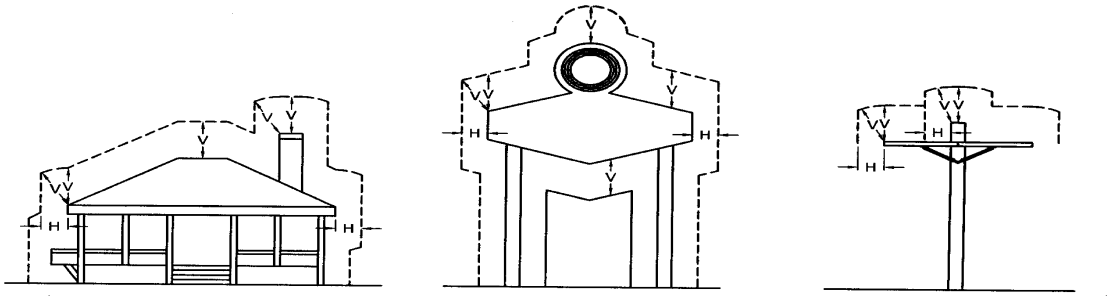
NOTES:

1. This clearance may be reduced to the following values(feet):
   a. Insulated live parts limited to 300V to ground 12
   b. Insulated live parts limited to 150V to ground 10
2. Where a supply line along a road is limited to 300V to ground and is located relative to fences, ditches, embankments, etc., so that the ground under the line would not be expected to be traveled except by pedestrains, this clearance may be reduced to 12 ft.
3. For the purpose of this rule, trucks are defined as any vehicle exceeding 8 ft. in height. Areas not subject to truck traffic are areas where truck traffic is not normally encountered nor reasonably anticipated.
4. Spaces and ways subject to pedestrains or restricted traffic only are those areas where riders on horseback, vehicles, or other mobile units exceeding 8 ft. in height, are prohibited by regulation or permanent terrain configurations or are otherwise not normally encountered nor reasonably anticipated.

5. Effectively grounded switch handles and supply or communication equipment cases (such as fire alarm boxes, control boxes, communication terminals, meters, or similar equipment cases) may be mounted at a lower level for accessibility, provided such cases do not unduly obstruct a walkway.
6. Where the US Army Corps of Engineers, or the state, or surrogate thereof has issued a crossing permit, clearances of that permit shall govern.
7. These clearances shall be increased by the difference between the known height of the oversized vehicle and 14ft.

OVERHEAD LINES INSTRUCTION

Clearances of Wires from Buildings and Other Installations



Clearance in Feet

Voltages Are Phase- to- Ground Unless Otherwise Indicated

STRUCTURES	SHIELD WIRES; NEUTRAL CONDUCTORS; GUYS[10]	TRIPLEX OR QUAD CABLES	UNGUARDED RIGID LIVE PARTS 0 TO 750V	PHASE CONDUCTORS 0 TO 750V; SHIELDED & NON- SHIELDED CABLES W/ MESSENGER OVER 750V[18]	UNGUARDED RIGID LIVE PARTS OVER 750VTO 22kV	PHASE CONDUCTORS AT XX KV (PHASE TO PHASE)			
						2.4 12	34	69Y	69Δ
Buildings [2,3,19]									
1. Horizontal Clearances, with wind [20]	--	--	--	3.5	--	4.5	5.0	5.2	6.2
2. Horizontal Clearances, no wind [20]									
a. To walls, projections and guarded windows	4.5 [5,11]	5.0 [5]	5.0 [5]	5.5 [5]	7.0 [5]	7.5 [5]	8.0 [5]	8.2	9.2
b. To unguarded windows [13]	4.5	5.0	5.0	5.5	7.0	7.5	8.0	8.2	9.2
c. To balconies and areas accessible to pedestrians [7]	4.5	5.0	5.0	5.5	7.0	7.5	8.0	8.2	9.2
3. Vertical Clearances[8]									
a. Above or below roofs or projections NOT accessible to pedestrians	3.0	3.5 [12]	10.0	10.5 [12]	12.0	12.5	13.0	13.2	14.2
b. Above or below balconies or roofs accessible to pedestrians[7]	10.5	11.0 [12]	11.0	11.5 [12]	13.0	13.5	14.0	14.2	15.2
c. Above roofs accessible to vehicles but NOT subject to truck traffic [16]	10.5	11.0	11.0	11.5	13.0	13.5	14.0	14.2	15.2
d. Above roofs accessible to truck traffic [16]	15.5	16.0	16.0	16.5	18.0	18.5	19.0	19.2	20.2
Signs, chimneys, radio and T.V. antennas, tanks and other installations NOT classified as buildings or bridges [6,9,19]									
1. Horizontal clearances, with wind [20]	--	--	--	3.5	--	4.5	5.0	5.2	6.2
2. Horizontal clearances, no wind [20]									
a. To portions that are NOT readily accessible to pedestrians	3.0	3.5	5.0 [5]	5.5 [5]	7.0 [5]	7.5 [5]	8.0	8.2	9.2
b. To portions that ARE readily accessible to pedestrians[7]	4.5	5.0	5.0 [5]	5.5	7.0 [5]	7.5	8.0	8.2	9.2
3. Vertical Clearances									
a. Over or under catwalks and other surfaces upon which personnel walk	10.5	11.0	11.0	11.5	13.0	13.5	14.0	14.2	15.2
b. Over or under other portions of such installations	3.0	3.5	5.5	6.0	7.5	8.0	8.5	8.7	9.7
Support Structures [14, 19]	Guys, messengers, neutrals, triplex 0- 300V			Phase conductors & cables 0- 750V					
1. Horizontal clearances, with wind [20]			--	3.5	--	4.5	5.0	5.2	6.2
2. Horizontal clearances, no wind [20]	3.0	3.0	--	5.0	--	5.0	5.5	5.7	6.7
3. Vertical Clearances [15]	2.0	2.0	--	4.5	--	4.5	5.0	5.2	6.2
Crane, derricks, etc. [17]									
1. Vertical clearances	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	15.0
Storage facilities for hazardous materials (oxygen, hydrogen, gasoline, etc.)	Contact the Electric Distribution Standards group before locating any electric line within 50 feet of such a storage facility (Reference is OSHA, 1910 Subpart H)								

NOTES:

Reference: NESC, 2017 Edition, Rules 234 A,B,C, and G.

1. Not used in this revision.
2. The construction of electric distribution primary lines over buildings is to be avoided whenever possible. When avoidance is not practical, these clearances shall be provided.
3. Where buildings or other installations exceed three stories (or 50 feet) in height, overhead lines should be arranged, where practical, so that a clear space or zone at least 6 feet wide will be left either adjacent to the building or beginning not over 8 feet from the building, to facilitate the raising of ladders where necessary for fire fighting.
4. Not used in this revision.
5. Where available space will not permit this value, it may be reduced by 2 feet if the conductors, including splices and taps, have covering which provides sufficient insulation to prevent a short circuit in case of a momentary contact with a structure or building.
6. Clearance to flags and banners shall assume no deflection of the flag pole but maximum displacement of the flag or banner towards the at rest (no displacement) utility facility.
7. A roof, balcony, or similar structure is considered readily accessible to pedestrians if it can be casually accessed through a doorway, window, ramp, stairway, or permanently mounted ladder by a person on foot who neither exerts extra ordinary physical effort nor employs tools or devices to gain entry. A permanently mounted ladder is not considered a means of access if its bottom rung is 8 ft. or more from the ground or other permanently installed accessible surface, or is otherwise equipped with barriers to inhibit climbing by unauthorized persons.
8. For clearances above railings, walls, or parapets around balconies, decks, or roofs, use the clearances required for roofs not accessible to pedestrians.
9. The required clearance shall be increased to allow for the movement of motorized signs and other moveable attachments to any installation covered by this table.
10. Ungrounded guys and ungrounded portion of guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed to a slack conductor or guy.
11. This clearance may be reduced to 3 in. for the effectively grounded portion of guys.
12. Service Conductors Attached to Installation for Service Entrance:
    a. Service drop conductors including drip loops not in excess of 750 volts, shall have a clearance of not less than 10 ft. from the highest point of roofs over which they pass with the following exceptions.

    Exception 1: Where the voltage between open-wire conductors does not exceed 300 volts or the voltage between triplex or quadruplex conductors does not exceed 750 volts and the roof or balcony is not readily accessible, the clearance may be not less than 3 feet.

    Exception 2: Where service-drop conductors of 0 to 300V, or triplex or quadruplex cable 0 to 750V pass over a roof or a balcony that is not readily accessible to terminate at a (through the roof) raceway or approved support located not more than 4 feet horizontally from the nearest edge of the roof, it may be maintained at a minimum of 18 inches for a horizontal distance of 6 ft. from the raceway or support, and may be maintained at a minimum of 3 feet for the remainder of the horizontal distance that the conductor or cable passes over the roof.

    b. Service drop conductors not in excess of 750 volts shall have a clearance of not less than 3 ft. in any direction from windows designed to open.

    Exception 1: This does not apply to triplex or quadruplex conductors above the top level of a window.

    c. Service drop conductors of 300 volts or less may be run along side the installation provided the clearance from the surface of the installation is not less than 3 inches.

    d. Service drop conductors not in excess of 750 volts shall have a clearance of not less than 5 ft. horizontally from porches, decks, fire escapes, or other similarly attached structures.

    e. Service drop conductors not in excess of 750 volts shall have a clearance of not less than 3 ft. vertically below porches, decks, fire escapes, or other similarly attached structures.

13. Windows not designed to open may have the clearance permitted for walls and projections.
14. Support structures include those to which the conductor is not attached, such as a lighting support, a traffic signal support, and a supporting structure of another line.
15. These clearances may be reduced by 2 ft. (with 2 ft. as minimum) if both of the following conditions are met:
    a. The wires, conductors, or cables above and the supporting structure of another line below are operated and maintained by the same utility.
    b. Employees do not work above the top of the supporting structure unless:
        1. The upper circuit is de- energized and grounded, or temporarily insulated or repositioned, or
        2. Other equivalent measures are taken.
16. For purpose of these clearances, trucks are defined as any vehicle exceeding 8.0 ft. in height. When designing for oversized vehicles, increase clearances by the difference between the known height of the oversized vehicle and 14 ft.
17. The clearances specified in the table are minimum clearances allowed between any part of the equipment, load line, or load and the energized conductors if the 20ft zone of clearance cannot be maintained. THE CRANE, DERRICK, ETC. OPERATOR MUST COMPLY WITH OSHA 1926.1408 WHICH SPECIFIES SAFETY REQUIREMENTS IF ANY PART OF THE EQUIPMENT, LOAD LINE, OR LOAD COULD GET CLOSER THAN 20FT TO A POWER LINE.
18. “Shielded & Non- Shielded Cables w/Messenger Over 750V” does NOT include spacer type cable. Spacer cable clearances are the same as open phase conductors in this DCS.
19. The clearances specified in the table are NESC minimum clearances. If workers must access these structures for installation or maintenance when the conductors are energized, then minimum approach distances (MAD) for un qualified workers as specified by OSHA in section 1910.333 (c) (3) (i) must be maintained (10 feet for 69kVY and below and 11 feet for 69kV∆). These MADs are to the longest conductive tool or object the worker may contact.
20. The following table lists NESC wind displacement for some of Ameren’s higher use conductors. These values are added to the ’Horizontal Clearances with wind’ values in the clearance table. If this sum is greater than the ’no wind’ clearance, the ’no wind’ clearance must be increased to this value.

    Example: 12kv, 1/0 AAAC Long Span - Wind displacement is 3.9 ft. The ’with wind’ value from clearance table is 4.5 ft. The sum of the two is 8.4 ft. The ’no wind’ value from clearance table is 7.5 ft. which is less than the ’with wind’ sum. Therefore, the ’no wind’ clearance must be increased to 8.4 ft.

HORIZONTAL LINE DISPLACEMENT

60F, 6psf of WIND, FINAL SAG*

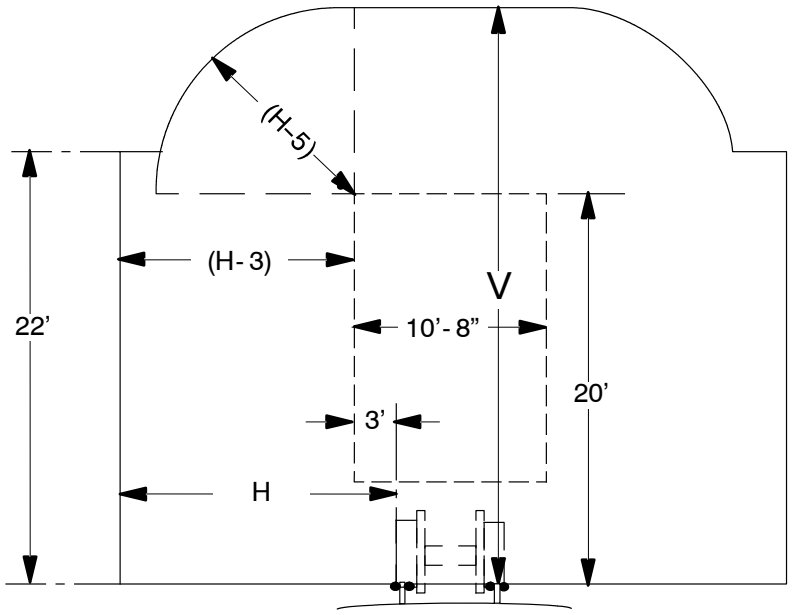
(In Feet)

TABLE 1

SAG TABLE

CONDUCTOR	Short Span	Medium Span	Long Span	Extra Long Span
1/0 AAAC	2.2	3.2	3.9	4.8
110.8 (12/7) ACSR	2.5	3.0	3.3	3.5
336.4 (18/1) ACSR	2.9	3.7	4.5	5.0
556.5 (19) AAC	2.7	3.2	4.2	5.1
954 (45/7) ACSR	3.1	4.1	5.0	5.9
1272 (45/7) ACSR	3.5	4.3	5.0	5.8
4/0 (6/1) ACSR T2	3.2	3.6	4.0	4.1
336.4 (18/1) ACSR T2	2.8	3.5	4.1	4.6
556.5 (19) AAC T2	2.8	3.8	4.8	5.7
954 (45/7) ACSR T2	3.6	4.7	5.8	6.6

*Per NESC Rule 234 A2



Overhead Wires, Conductors, or Cables	Minimum Clearance in Feet[1]	
	V[4]	H[3]
Phase Conductors 69 kV △[2]	28.3	13.3
Phase Conductors > 22 kV to 50 kV	27.5	12.5
Phase Conductors 751 V to 22 kV	26.5	11.5
Phase Conductors 0- 750V, Unshielded Cables with messenger over 750V	24.5	9.5
Triplex, Quad, Unshielded Cable with Messenger 0- 750V	24.0	9.0
Grounded Guys, Neutrals, Shielded Cables With Messenger	23.5	8.5

NOTES:

Reference: NESC, 2017 Edition, Rules 234A and I.

1. Clearances shown are NESC minimums. Where the railroad authority issues a crossing permit, clearances of that permit shall govern.
2. This voltage is phase- to- phase. All others are phase- to- ground.
3. Where conductors run along mine, logging, and similar railways that handle only cars smaller than standard freight cars, the value of H may be reduced by one- half the difference between the width of a standard rail car (10 ft. 8 in.) and the width of the narrower car.
4. The vertical clearance V is per DCS 29 00 17 02 (NESC Rule 232).

P = Probe clearance (18 ft.) (1)
H = Horizontal clearance (15 ft.) (1)
T = Transition clearance
V_1 = Vertical clearance above a building, see 29 00 17 04
V_2 = Vertical clearance above land, see 29 00 17 02

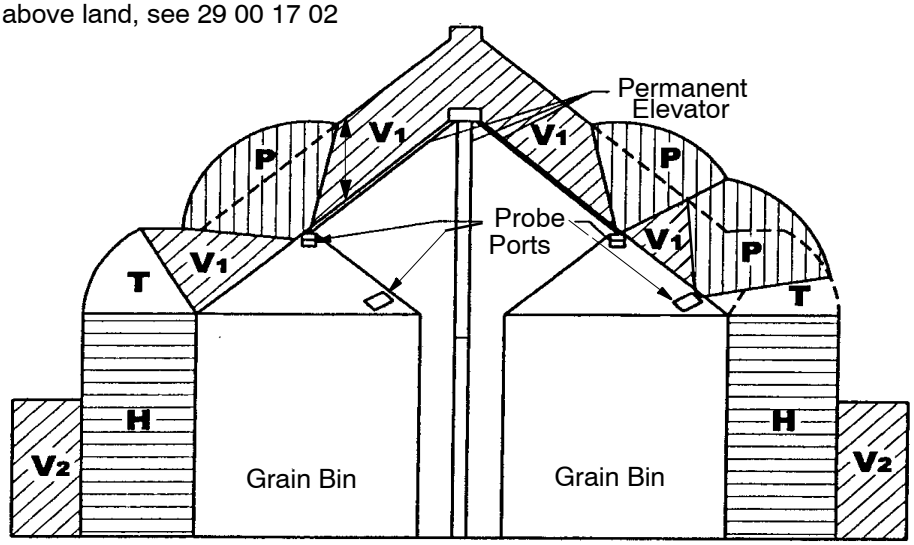


Figure 1 - Clearance Envelope for Grain Bins Filled by Permanently Installed Augers, Conveyors or Elevators

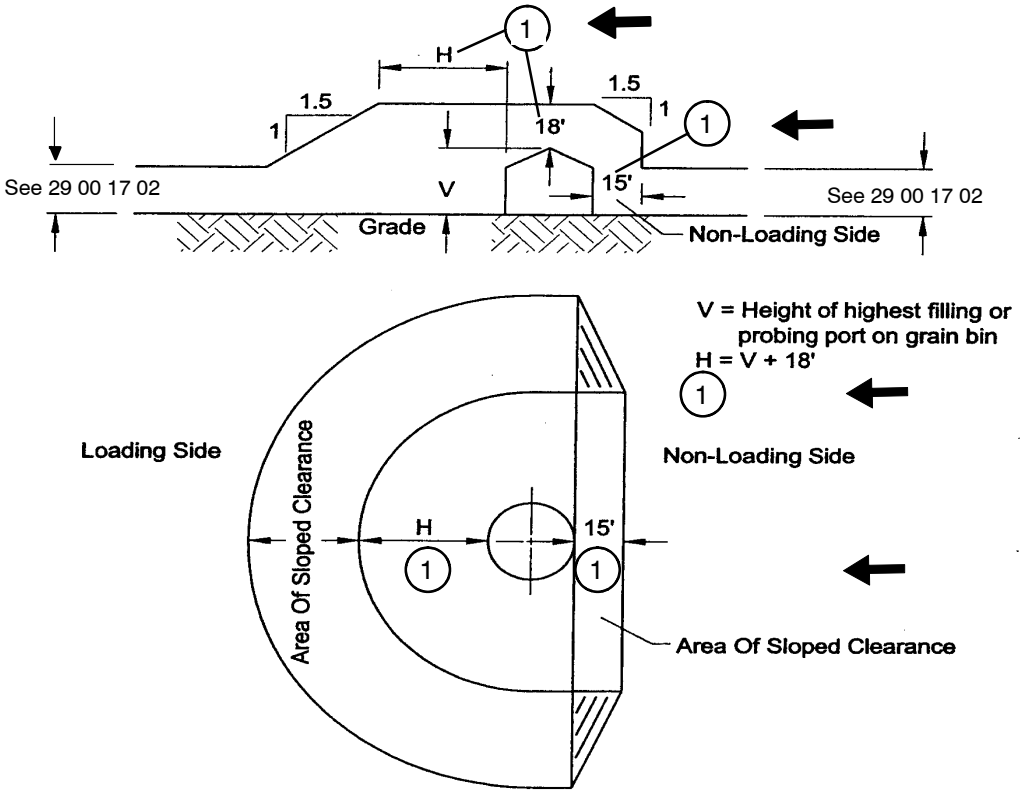


Figure 2 - Clearance Envelope for Grain Bins Filled by Portable Augers, Conveyors, or Elevators

NOTES:

References: NESC 2017 Edition, Rules 234A, F, and G.

1. The clearances on this page are the minimums permitted for up to 34.5kV- Y. Increase dimensions by 0.5 ft. for 34.5 kV- Delta, 0.7 ft. for 69 kV- Y, and 1.7 ft. for 69 kV- Delta.
2. All portions of grain bins that are expected to be loaded by use of a permanently installed auger, conveyer, or elevator system shall be considered as a building or other installation for the purpose of determining clearances, except that for voltages of 0 to 34.5 kV- Y a radial clearance above the bin of not less than 18 ft. shall be maintained above each port and a horizontal clearance of not less than 15 ft. shall be maintained between an open supply conductor and a grain bin.
3. The clearance on the non- loading side of grain bins may be reduced to those required for buildings (see DCS 29 00 17 04) if the cable or equipment is in one of the following categories:

   (a) Support arms and effectively grounded equipment cases
   (b) Messengers, guys, neutrals, and shielded cables
   (c) Triplex and quadruplex unshielded cable with messenger 0- 750 volts
4. Any side of a grain bin is considered to be a non- loading side if it is so designated, or if it is so closely abutting another structure or obstruction, or so close to a public road or other right of way that a portable auger, conveyer, or elevator is not reasonably anticipated to be used over that side or portion to fill the grain bin.
5. Where an agreement excludes the use of portable augers, conveyers, or elevators from a designated portion of a grain bin, such portion is considered to be a non- loading side.

Clearance in Feet[1,9]
Voltages Are Phase-to-Ground Unless Otherwise Indicated

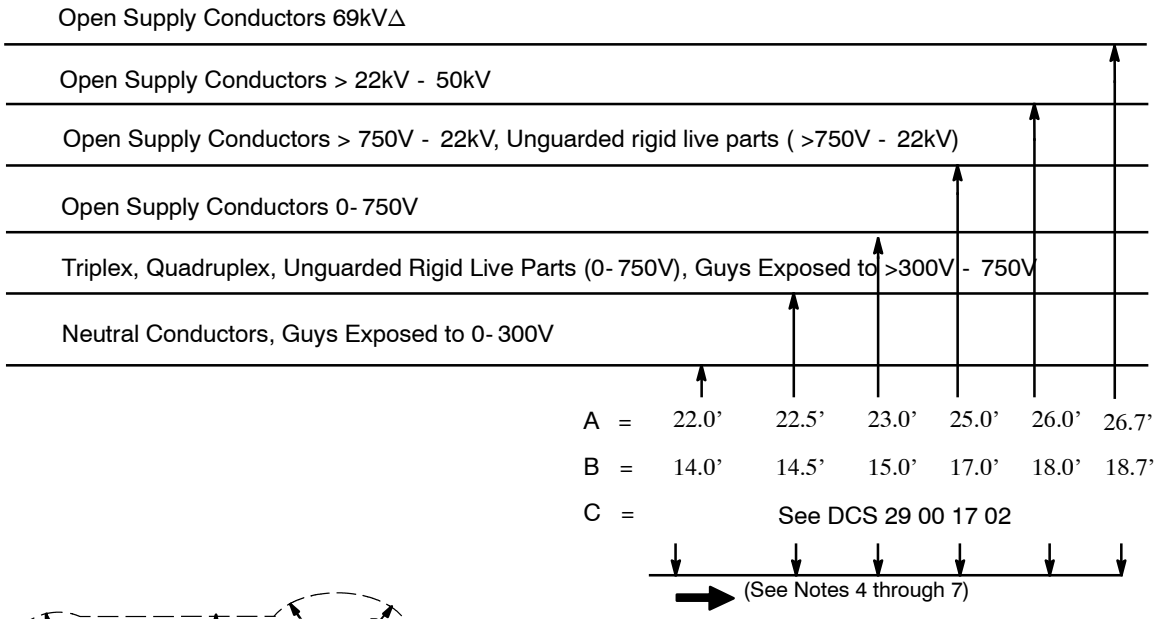
	Unguarded rigid live parts and ungrounded equipment cases 0-750V, triplex, quad, shielded & non-shielded cables with messenger 0-750V; ungrounded guys[8]	Unshielded Cable with Messenger Over 750V Phase Conductors 0-750V	Unguarded rigid live parts and un-grounded equipment cases over 750V to 22kV	Phase Conductors at XX kV (Phase-to-Phase)			
				2.4 12	34	69Y	69Δ
1. Over Bridges [2,4]							
a. Attached[3]	3.0	3.5	5.0	5.5	6.0	6.2	7.2
b. Not attached	10.0	10.5	12.0	12.5	13.0	13,2	14.2
2. Clearances beside, under or within bridge structure[4]							
a. Readily accessible portions of any bridge including wing wall and bridge attachments[2]							
1. Attached[3]	3.0	3.5	5.0	5.5	6.0	6.2	7.2
2. Not attached, no wind	5.0	5.5	7.0	7.5	8.0	8.2	9.2
3. Not attached, with wind[7]	- -	3.5	- -	4.5	5.0	5.2	6.2
b. Ordinarily inaccessible portions of bridges (other than brick, concrete or masonry) and from abutments[5]							
1. Attached[3,6]	3.0	3.5	5.0	5.5	6.0	6.2	7.2
2. Not attached, no wind[6,8]	4.0	4.5	6.0	6.5	7.0	7.2	8.2
3. Not attached, with wind[6,7,8]	- -	3.5	- -	4.5	5.0	5.2	6.2

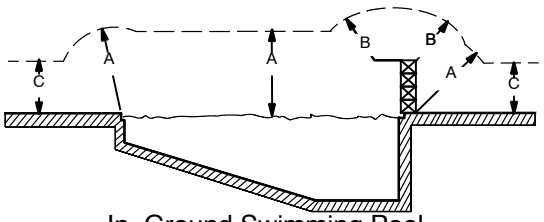
NOTES:

Reference: NESC 2017 Edition, Rules 234A, D, and G.

1. The clearances on this page are the minimums permitted. No clearances are specified for effectively grounded neutral conductors.
2. Where over traveled ways on or near bridges, the clearances specified in 29 00 17 02 also apply.
3. Clearances from supply conductors to supporting arms and brackets attached to bridges shall be the same as specified in 29 00 17 09 if the supporting arms and brackets are owned, operated, or maintained by the same utility.
4. Where the bridge has moving parts, such as a lift bridge, the required clearances shall be maintained throughout the full range of movement of the bridge or its attachments.
5. Bridge seats of steel bridges carried on masonry, brick, or concrete abutments that require frequent access for inspection shall be considered as readily accessible portions.
6. Where conductors passing under bridges are adequately guarded against contact by unauthorized persons and can be de-energized and grounded for maintenance of the bridge, clearances of the conductor from the bridge at any point may have clearances specified in 29 00 17 09 for clearances from surfaces of support arms plus one-half the final sag at 60 degrees F no wind of the conductor at that point.
7. Clearances with wind shall be determined with the conductor or cable displaced by a 6 lb. per sq. ft. wind at final sag at 60 degrees F. The wind may be reduced to 4 lbs. per sq. ft. in areas sheltered by buildings, terrain or other obstacles. The displacement shall include the deflection of suspension insulators and flexible structures.
8. Ungrounded guys and ungrounded portions of guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to a slack conductor or guy.
9. Where permitted by the bridge owner, supply cables may be run in rigid conduit attached directly to the bridge.

Clearances Over Swimming Pools[1,2]
And Waterways Restricted to Swimming[1,3]
Voltages Are Phase- to- Ground Unless Other wise Indicated



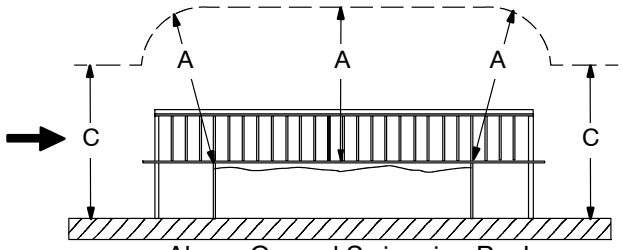


In- Ground Swimming Pool

A = Clearance in any direction to the water level, edge of water surface, base of diving platform or permanently anchored raft.

B = Clearance in any direction to the diving platform, tower, slide, or other fixed pool structure.

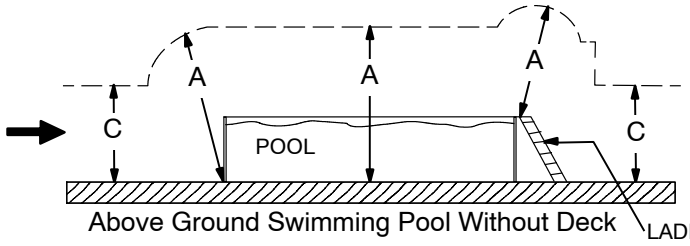
C = Vertical clearance over adjacent land as specified by DCS 29 00 17 02



Above Ground Swimming Pool

A = Clearance in any direction from the highest point of the installation upon which people can stand (typically the pool deck).

C = Vertical clearance over adjacent land as specified by DCS 29 00 17 02.



Above Ground Swimming Pool Without Deck

A = Clearance in any direction from the highest point of the installation upon which people can stand (typically the pool deck).

C = Vertical clearance over adjacent land as specified by DCS 29 00 17 02.

NOTES:

Reference: NESC, 2017 Edition, Rule 234A, E, and G.

1. Although the NESC allows conductors to be installed over swimming areas, this practice is discouraged and should only be done if there is no other practical alternative.
2. Where wires conductors or cables cross over a swimming pool or the surrounding area, the clearances in any direction shall be as shown in the diagrams above. This rule does not apply to a pool fully enclosed by a solid or screened permanent structure.
3. If rescue poles are not used by lifeguards in supervised swimming beaches, the clearances specified in DCS 29 00 17 02 for the appropriate water body shall be used.
4. Vertical clearances are determined with conductor at final sag, maximum design operating temperature, no wind.
5. This rule does not apply to neutrals, guys, triplex, and quadruplex (0 to 750 V) when these are 10 ft. or more horizontally from the edge of the pool, diving platform, diving tower, slide, or other fixed pool related structures.
6. For hot-tubs, jacuzzis, spas, etc. not suitable for swimming, vertical clearance is from the hightest point of the installation upon which a person can stand. See DCS 29 00 17 04 for this clearance.
7. For wading pools, see DCS 29 00 17 02, “space or ways accessible to pedestrians only”.

A. MINIMUM VERTICAL CLEARANCE BETWEEN LINE CONDUCTORS (INCHES) [1]

(All voltages are phase- to- ground unless otherwise indicated)

Conductors Usually at Upper Levels / Conductors Usually at Lower Levels	Neutral Conductors: Triplex & Quadruplex		Open Supply Line Conductors							
			0 to 8.7 kV		> 8.7 to 22 kV		> 22 to 50 kV		69 kV△	
	At Pole	Mid Span	At Pole	Mid Span	At Pole	Mid Span	At Pole	Mid Span	At Pole	Mid Span
Communication Conductors	40[6]	30	40	30	46	35	57	43	66	52
Neutral Conductors; Phase Conductors 0- 750 Volts; Triplex & Quadruplex	16[7]	12[7]	16[4,9]	12[4,9]	22[8]	17[8]	33[8]	25[8]	42[8]	34[8]
> 750 V to 8.7 kV	-	-	16[4]	12[4]	25[8]	19[8]	36[8]	27[8]	45[8]	37[8]
> 8.7 to 22 kV	-	-	-	-	31[8]	24[8]	42[8]	32[8]	51[8]	43[8]
> 22 to 50 kV	-	-	-	-	-	-	53[8]	40[8]	62[8]	54[8]

NOTES:

Reference: NESC, 2017 Edition, Rule 235 A,C, and G

1. **In Illinois, where conductors are mounted on crossarms, IL Adm Code 305 Table A takes precedent (See Sheet 2 of this DCS).**
2. The minimum vertical clearance at any point in the span shall be not less than the mid- span values in the table above with the upper conductor at its maximum design operating temperature or 32° F with ½ inch of ice (whichever produces the greatest final sag) and the lower conductor at its final sag at the same ambient temperature. The clearance "At Pole" means the clearance at the support on the supporting structure.
3. Communication service drops, crossing under neutral conductors on a common crossing structure, may have a minimum clearance of 4 inches to the neutral conductor.
4. Where conductors are operated by different utilities, the minimum vertical clearance of 40 inches at the pole and 30 inches mid- span are recommended.
5. Triplex and quadruplex cables, 0- 480 volts, running above and parallel to communication service drops, may have a minimum spacing of 12 inches at any point in the span, including the point of and at their attachment to a building, provided that a clearance of 40 inches is maintained between the two services at the pole.
6. May be reduced to 30 inches for effectively grounded supply neutrals where the communication messenger is bonded to the neutral.
7. No clearance is required between neutral conductors and triplex or quadruplex cables if owned by the same utility.
8. Where conductors are operated by different utilities, add 24 inches to the "At Pole" clearance. The new "Mid Span" clearance is then 75% of this new "At Pole" clearance.
9. Secondary conductors (0- 750V) on vertical racks are allowed to have only 8 inches separation at the pole for span lengths up to 250 feet and 12 inches separation up to 300 feet.

B. VERTICAL SEPARATION BETWEEN CROSSARMS

Reference: 83 Il. Adm. Code 305 Table A; **Applicable only to service area in Illinois**

(All voltages are nominal circuit voltages)

Conductors Usually at Upper Levels / Conductors Usually at Lower Levels	Neutral Conductors; Phase Conductors 0 to 480 Volts; Shielded & Non-Shielded Cables With Messenger	Phase Conductors				
		2.4 to 4 kV	7.2 to 13.8 kV	14.4 to 34 kV	69 kV Y	69 kV Δ
Communication Conductors	48 in.	48 in.	48 in.	72 in.	72 in.	81 in.
Communication Conductors Used in Operation of Power Lines	24	24	24	48[1]	48[1]	571
Neutral Conductors; Phase Conductors 0 to 480 Volts; Shielded & Non-Shielded Cables with Messenger	24	24[1]	24[1]	48[1]	48[1]	57[1]
Phase Conductors						
2.4 to 4kV	-	24[1]	24[1]	48[1]	48[1]	57[1]
7.2 to 13.8kV	-	-	24[1]	48[1]	481	57[1]
14.4 to 34kV	-	-	-	48[1,2]	48[1,2]	57[1,2]
69 kV Y	-	-	-	-	48[1,2]	62[1,2,3]
69 kV Δ	-	-	-	-	-	71[1,2,3]

NOTES:

1. Where conductors are operated by different utilities, the minimum vertical clearance shall be increased by 24 inches.
2. These values do not apply to adjacent crossarms carrying phases of the same circuit or circuits.
3. These values are calculated from the NESC. They exceed the 83 IL. Adm. Code 305 Table A values.

C. HORIZONTAL CLEARANCE BETWEEN LINE CONDUCTORS

Line conductors attached to fixed supports shall have horizontal clearances from each other not less than the larger value required by the following table or as calculated based on the sag of the conductors. For long spans, horizontal clearance requirements will in most cases be driven by the conductor sag calculation method.

(Voltage is between the two conductors for which the clearance is being determined)

Class of Circuit	Clearance (inches) [1,2,3]					
	0 to 8.7 kV	> 8.7 to 14.4 kV	> 14.4 to 22 kV	> 22 to 34.5 kV	> 34.5 to 50 kV	69 kV[4]
Supply Conductors of the Same or Different Circuit	12	15	18	23	29	38

Horizontal clearance based on conductor sag is calculated as follows:

a. For line conductors smaller than #2 -
Clearance (inches) = 0.3 x kV + 4.04 x sq rt (S- 24)

b. For #2 or larger line conductors -
Clearance (inches) = 0.3 x kV + 8 x sq rt (S/12)

S = the sag in inches of the conductor having the greater sag (60 degree F, final sag, no wind)

kV = the voltage between the conductors

Example: 69kV, 954 ACSR, 260 ft.spans.
S = 64 inches per DCS 07 00 07 03
kV = 69 x 1.05 = 72.45 kV
(Switching surge factor of 1.05 is applied because above 50 kV, the maximum possible operating voltage must be used instead of the nominal voltage)

Clearance = 0.3 x 72.45 + 8 x sq rt (64/12)
= 41 inches

Therefore; for this example, 41 inches of horizontal spacing at the support is required instead of the 38 inches as indicated in table.

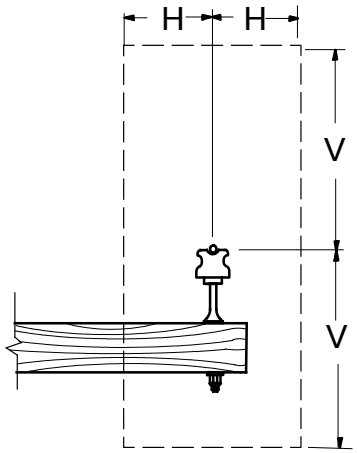
NOTES:

References: NESC, 2017 Edition, Rule 235 A and B

1. The pin spacing on buck- arm construction may be reduced to 7.25 inches for conductors 15 kV line- to- line and below provided that the span lengths do not exceed 150 feet; the 60 degree F sag does not exceed 15 inches (#2 or larger), or 30 inches(smaller than #2); each conductor on the end of every arm is tied to the same side of its insulator; and spacing on the next pole is not less than 14.5 inches.
2. These clearances do not apply to covered or insulated cables.
3. Where suspension insulators are used and not restrained from movement, the horizontal spacing shall be increased so that the clearances above will be maintained with one string of insulators at maximum swing angle with 6 lb/sq ft wind at 60 degree F final sag. This may be reduced to 4 lb/sq ft wind in sheltered areas.
4. For 69 kV conductors of the same circuit, no horizontal clearance is specified in the NESC.

D. DIAGONAL CLEARANCE BETWEEN LINE WIRES, CONDUCTORS, AND CABLES LOCATED AT DIFFER ENT LEVELS ON THE SAME SUPPORTING STRUCTURE

No wire, conductor, or cable may be closer to any other wire, conductor, or cable than defined by the dashed line in the figure below. V is determined by section A of this DCS and H is determined by section C of this DCS.



V = Vertical clearance

H = Horizontal clearance

E. CLEARANCES IN ANY DIRECTION FROM LINE CONDUCTORS TO SUPPORTS, AND TO VERTICAL OR LATERAL CONDUCTORS, SPAN OR GUY WIRES ATTACHED TO SAME SUPPORT.

a. Fixed Supports
Clearances shall not be less than those in Table below.

b. Suspension Insulators
Where suspension insulators are used and are not restrained from movement, the clearance shall be in creased so that the clearances in the following table are maintained with the string of insulators at maximum design swing angle with 6 lb/sq. ft. wind at 60 degree F final sag. This may be reduced to a 4 lb/sq. ft. wind in sheltered areas. The displacement of wires, conductors, and cables shall include deflections of flexible structures and fittings where such deflection would reduce the clearances.

(All voltages are phase- to- phase)

Clearance of Line Conductors From[1]	0 to 4.16kV	> 4.16kV - 14.4kV	>14.4kV - 34.5kV	69kV
Vertical and lateral conductors:[2,3]				
Of the same ckt.	3 in.	5 in.	10 in.	19 in.
Of other ckts.[11]	6 in.[7]	9 in.	17 in.	32 in.
Span or guy wires attached to same structure:[9]				
Span guy parallel to line	12 in.[5,8]	15 in.	30 in.[10]	38 in.
All other	6 in.[5]	9 in.[5]	30 in.[10]	32 in.
Surface of support arms	3 in.[4,6]	5 in.	9 in.	16 in.
Surface of structures	5 in.[4,6]	7 in.	11 in.	18 in.

NOTES:

Reference: NESC, 2017 Edition, Rule 235E

1. A line conductor is a wire or cable intended to carry electric currents between structures along the route of the line.
2. A lateral conductor is a wire or cable entirely supported on one structure and extending in a general horizontal, vertical, or diagonal direction to make connections to line conductors, service drops, equipment, or other facilities on the same structure. Lateral conductors may be attached directly to the structure or supported away from the structure.
3. A vertical conductor is either a wire or cable riser (not in non- metallic conduit or u- guard) attached to a pole, or the vertical portion of a lateral conductor.
4. A neutral conductor which is effectively grounded throughout its length and associated with circuits 0 to 22 kV to ground may be attached directly to the structure surface.
5. If a guy passes within 12 inches of Ameren's conductors and also passes within 12 inches of communication cables, the guy must be insulated with a strain insulator at a point below the lowest supply conductor and above the highest communication cable.
6. For supply circuits of 0 to 750V., this clearance may be reduced to 1 in.
7. For neutrals and supply circuits of 0 to 750V., this clearance may be reduced to 3 in.
8. For neutrals, this clearance may be reduced to 6 inches.
9. "Parallel" means in the same general direction as the line conductors. "All other" includes down guys and span guys that cross over or under line conductors. See DCS 11 00 02 03 for reduced clearances allowed to guy insulators.
10. 30" is based on Ameren's use of 500 kV BIL and is greater than NESC requirements.

11. These dimensions are based on the voltage of the vertical or lateral conductor being 8.7 kV or less. If voltage of vertical or lateral conductor is greater than 8.7 kV, then these dimensions need to be increased based on assumption that line and vertical or lateral conductor voltages are 180° out of phase.

Equipment here means non-current-carrying metal parts of equipment mounted on the same structure. Non-Current-Carrying metal parts of equipment include metal supports for cables or conductors, metal support braces which are attached to metal supports or are less than 1 inch from transformer cases or hangers which are not effectively grounded, and metal or non-metallic supports or braces associated with communication cables or conductors. Antennas, solar panels, power supplies, etc., are considered equipment for applying these clearances.

(All voltages are phase to ground unless otherwise indicated)

Vertical Clearance of Conductors to Non-Current-carrying metal parts of Equipment[2]		Vertical Clearance of span wires and luminaire brackets from communication lines		
Supply Voltage (kV)	Vertical Clearance (in)	Location of Span Wires and luminaire brackets	Not effectively grounded (in)	Effectively Grounded (in)
Grounded conductor and messenger hardware and supports	30	Above communication support arms	40	20[3]
0 to 8.7kV	40[1]	Above messengers carrying communication cables	40	4
>8.7 to 22kV	46[1]	From terminal box of communication cable	40	4
>22 to 50kV	57[1]	From communication brackets, bridle wire rings, or drive hooks	40	4
69kV DELTA	66[1]	Drip loop of conductor entering luminaire bracket above cummunication cable, through-bolt, or other equipment	12[4]	12[4]

NOTES:

Reference: NESC, 2017 Edition, Rule 238

1. Where non-current-carrying parts of supply equipment are effectively grounded, communication messenger is bonded to the neutral four times per mile, and communication lines are at lower levels, clearances may be reduced to 30 inches.
2. For vertical clearances which are between supply conductors and communication equipment, communication conductors and supply equipment, and supply and communication equipment.
3. Clearance may be reduced to 12 inches for span wires or metal parts of brackets which are 40 inches or more from the structure surface.
4. May be reduced to 3 inches if the loop is covered by a suitable non-metallic covering that extends at least 2 inches beyond the loop.

Table 1 Clearances of Open Vertical and Lateral Conductors (inches)[1,2]				
Phase- to- Phase Voltages (kV)	0 to 8.7 kV	> 8.7 to 22 kV	> 22kV to 50 kV	69kV
From surfaces of supports[4]	3[3]	6	12	16
From span guy and messenger wires	6[7]	12	23	32
Anchor Guys	6[7]	10	17	29

Table 2[4] Clearances Between Open Vertical Conductors and Pole Surface (Fig.1,2)		
Phase- to- Ground Voltages (kV) Unless otherwise indicated)	A. Zones Above and Below Conductor Where Clearances Apply (ft.)[5]	B. Min. Clearance Between Vertical Cond. & Pole Surface (in.)
0 to 22kV	6	19
>22 to 30kV	6	22
>30 to 50kV	6	30
69kV△	Note 6	Note 6

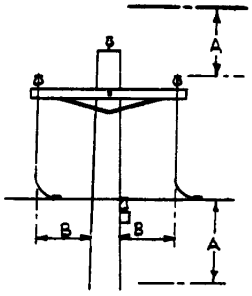


FIG. 1

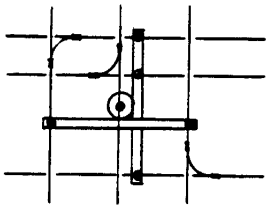


FIG. 2

NOTES:

Reference: NESC, 2017 Edition, Rule 239E.

1. A lateral conductor is a wire or cable entirely supported on one structure and extending in a general horizontal, vertical, or diagonal direction to make connections to line conductors, service drops, equipment, or other facilities on the same structure. Lateral conductors may be attached directly to the structure or supported away from the structure.
2. A vertical conductor is either a wire or cable riser (not in non- metallic conduit or u- guard) attached to a pole, or the vertical portion of a lateral conductor.
3. Clearance may be reduced to 1 inch for supply circuits of 0 to 750 volts. A neutral conductor may be attached directly to the structure surface.
4. If open wire conductors are within 4 feet of the pole, vertical conductors must conform to the zones and clearances in Table 2.

5. Within this zone above and below open supply conductors, vertical and lateral conductors may be enclosed in non- metallic conduit or protected by a non- metallic covering and may be run on the pole surface.
6. These distances are not specified in the NESC for voltages above 50kV phase- to- ground.
7. For effectively grounded neutrals, this clearance can be reduced to 3 inches.

Additional Requirements (per NESC, 2017 Edition, Rule 239)

1. CONDUCTORS ATTACHED DIRECTLY TO SUPPORTING STRUCTURES.
   Grounding and neutral conductors or conductors physically protected by conduit may be run directly on the support.
2. CLIMBING SPACE
   Location of vertical or lateral conductors shall not obstruct climbing spaces or lateral working spaces between line conductors at different levels.
3. CONDUCTORS NOT IN CONDUIT
   All conductors which are not enclosed in a conduit must maintain the same clearances from conduits as from other structure surfaces.
4. MECHANICAL PROTECTION NEAR GROUND
   All vertical conductors, cables, and grounding wires shall have a suitable mechanical protective covering when within 8 feet of the ground. This protective covering may be omitted from grounding conductors used to ground multi- grounded circuits.
5. SUPPLY GROUNDING CONDUCTORS
   Supply grounding conductors may be run bare through communication spaces provided no supply equipment is located between the ground rod and the neutral and the grounding conductor is bonded to grounded communication facilities at that structure. All other grounding conductors must be protected by a non- metallic covering for a distance of 40 inches above the highest communication attachment and 6 feet below the lowest communication attachment.
6. CLEARANCE FROM METAL PARTS
   Vertical runs of supply cables must have a clearance of at least 2 inches from through bolts or other metal parts associated with communication line equipment. Exception: Vertical runs of effectively grounded supply conductors may have a clearance of 1 inch.

A. General

Crossings should be made on a common supporting structure, where practical. When this is not practical, the clearance between any two crossing or adjacent wires, conductors, or cables carried on different supporting structures shall be not less than that required in this DCS.

B. Conductor Movement Envelope

The relevent positions of the conductors or cables on or within their respective conductor movement envelopes must be considered. The conductor movement envelope for each must be determined under the following general conditions, See Figure 1.

a. Both are simultaneously subjected to the same ambient air temperature and wind loading conditions, and

b. Each is subjected individually to the full range of its icing conditions and applicable design electrical loading.

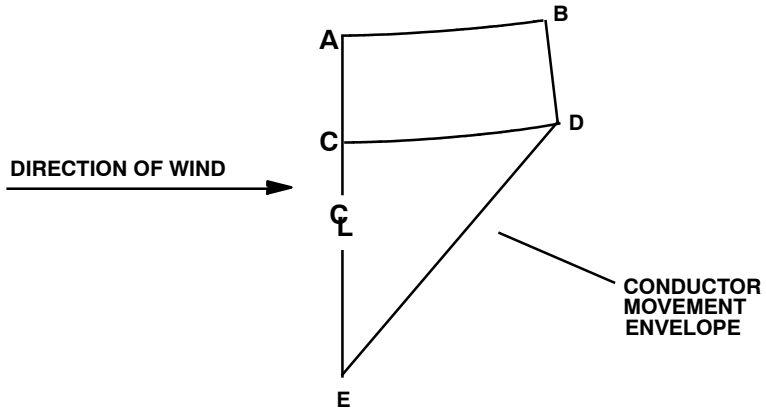
C. Conductor Clearance Envelope

The vertical and horizontal clearances in Table 1 are used to define a clearance envelope as shown in Figure 2. The clearance envelope defines the minimum required clearance to any other conductor or cable.

D. Use of the Conductor Clearance and Conductor Movement Envelopes

The “conductor 1” clearance envelope is drawn with its center located at any point on the “conductor 1” movement envelope. At any point on its movement envelope, the “conductor 1” clearance envelope shall not contact “conductor 2” within its movement envelope with the same horizontal displacement. See Figure 3.

Figure 1 - Conductor Movement Envelope



Point	Conductor Temperature	Sag	Ice Loading	Wind Displacement[1]
A	60° F[4]	Initial	None	None
B	60° F[4]	Initial	None	6 psf
C	60° F[4]	Final	None	None
D	60° F[4]	Final	None	6 psf
E1[3]	The greater of 120°F or maximum operating temperature	Final	None	None
E2[3]	32°F	Final	½ in.	None

Figure 1 Notes:

1. The direction of the wind shall be that which produces the minimum distance between conductors including the deflection of suspension insulators and flexible structures.
2. Not used in this revision.
3. Point E shall be determined by whichever of the conditions described under E1 and E2 produces the greater sag.
4. When one conductor movement envelope is lower than that of the other conductor, the lower conductor envelope shall be developed with points A, B, C, and D at a conductor temperature equal to the ambient temperature used in determining E of the upper conductor movement envelope.

Figure 2 - Conductor Clearance Envelope

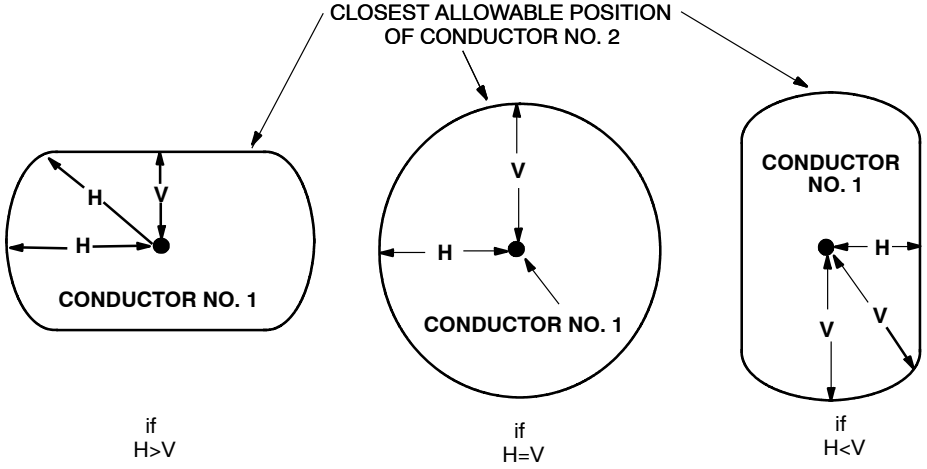


Table 1 - Vertical and Horizontal Clearances for Clearance Envelope

(All voltages are phase- to- ground unless otherwise indicated)

Vertical Clearances V in Feet - Used for Drawing Conductor Clearance Envelope						
Conductors at Upper Levels / Conductors at Lower Levels	Shield/Static Wire, Neutral, Guys[3]	Shielded Cables with Messenger; Triplex & Quadruplex	Phase Conductors			
			0 to 750V	>750V to 22kV	>22kV to 50kV	69kv△
Shield/static Wire, Neutral, Guys[3]	2.0[1]	2.0	2.0	2.0	3.0	3.7
Communication Conductors	2.0	2.0	4.0[4]	5.0[2]	6.0	6.7
Shielded Cables with Messenger; Triplex & Quadruplex	2.0	2.0	2.0	2.0	3.0	3.7
Phase Conductors 0 to 750Volts	2.0	2.0	2.0	2.0	3.0	3.7
Phase Conductors > 750 V to 22kV	2.0			3.0	3.7	5.0
Phase conductors > 22 kV to 50kV	3.0				4.6	5.4
Phase Conductors 69kV△	4.0					6.1

Horizontal Clearance H Used for Drawing the Clearance Envelope	
Vector Difference Between Voltage of Wires (kV)[5]	Horizontal Clearance H (ft.)
0 to 22 kV	5.0[6]
Over 22 kV	5.0 plus 0.4 inches / kV over 22 kV

Table 1 Notes:

Reference: NESC, 2017 Edition, Rule 233

1. No clearance is specified between guys or span wires that are electrically interconnected.
2. This clearance may be reduced to 4 feet where supply conductors of 750 V to 8.7 kV cross a communication line more than 6 feet horizontally from a communication structure.
3. These clearances may be reduced by not more than 25% to a guy insulator, provided that full clearance is maintained to its metallic end fittings and the guy wires. The clearance to an insulated section of a guy between two insulators may be reduced by not more than 25% provided that full clearance is maintained to the uninsulated portion of the guy.
4. This clearance may be reduced to 2 feet for supply service drops.
5. Vector Difference Between Voltage of Wires is equal to:
   1.05 X (kV Ø-Ø (Line1)) /√3 + 1.05 X (kV Ø-Ø (Line 2)) /√3
   The Factor of 1.05 is only applied if the kV Ø-Ø is greater than 50kV.
6. The horizontal clearance H between anchor guys of different supporting structures may be reduced to 6 inches and may be reduced to 2 feet between other guys and neutral conductors.

Figure 3 - Use of Conductor Movement and Clearance Envelopes

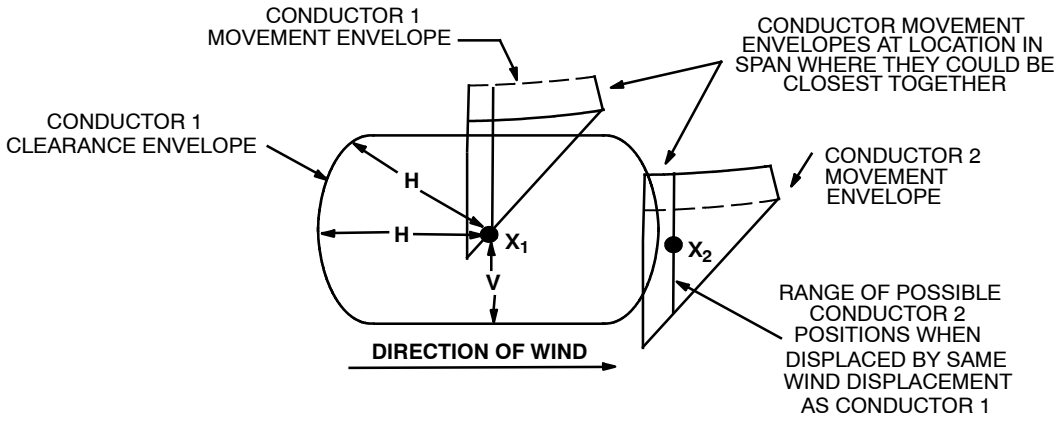


Figure 3 Notes:

1. In this illustration, Conductor 2 is closest at position X2 to Conductor 1 when Conductor 1 is at position X1.
2. Vertical lines intersecting X1 and X2 represent the equivalent horizontal wind displacements.

1. General

Climbing space shall be provided on poles past any conductors, crossarms, equipment or other parts. In addition, working space shall be provided on the climbing face of the pole at each side of the climbing space.

2. Climbing Space – Location and Dimensions (Reference NESC, 2017 Edition, Rule 236)

The climbing space need only be provided on one side or corner of the pole and shall extend vertically not less than 40 inches above or below the limiting conductors or other part, but may otherwise be shifted from any side or corner of the pole to any other side or corner per Figure 1.

TABLE 1
Minimum Horizontal Dimensions of Climbing Space
(All voltages are phase–to–phase)

Character of Conductors Adjacent to Climbing Space	Horizontal Dimension of Climbing Space
Communications Conductors	30” x 30”
Ameren Circuits	40” x 40” preferred generally but in no case less than 30” x 30” for 4.16kV; in no case less than 36” x 36” for 15kV; in no case less than 40” x 40” for 34.5kV; and in no case less than 54” x 54” for 69kV

a. Portions of Pole and Equipment in Climbing space

Portions of the pole or structure, including crossarms, when included in one side or corner of the climbing space, are not considered to obstruct the climbing space.

Longitudinal runs, such as secondaries on racks or brackets, are not considered as obstructing the climbing space if all wires concerned are covered by rubber protective equipment or otherwise guarded.

Where longitudinal runs such as secondaries on racks or brackets are not covered up, the climbing space shall be measured from the longitudinal run concerned and shall extend 40 inches above and below the limiting conductors. The normal method of meeting this requirement where there is less than 40 inches between limiting conductors and conductors are carried on arms, is to eliminate the conductor from the pole pin on the opposite side of the pole to which the longitudinal run is attached. This also includes buckarm construction.

Vertical runs encased in suitable conduit or other protective covering and securely attached to the pole surface are not considered to obstruct the climbing space.

With pole top pin construction, the climbing space shall be provided above the top crossarm to the pole top pin conductor but need not be carried past it.

Supply and communication apparatus including but not limited to transformers, regulators, capacitors, cable terminals (potheads), lightning arresters, antennas, and switches when located below conductors or other attachments shall be mounted outside the climbing space.

3. Working Space – Dimensions (Reference NESC, 2017 Edition, Rule 237)

The working space shall extend along the crossarm on each side of the climbing space to the outmost pin position on the crossarm.

At right angles to the crossarm, the working space shall preferably extend 40 inches but in no case less than the distances shown in Table 1 when measured from the face of the crossarm.

Vertically the working space shall have a height not less than shown in Table 2.

The working space shall not be obstructed by vertical or lateral conductors. Such conductors shall be located on the opposite side of the pole from the climbing side or on the climbing side of the pole at a distance from the crossarms at least as great as the width of the climbing space required for the highest voltage conductor concerned. See Table 1.

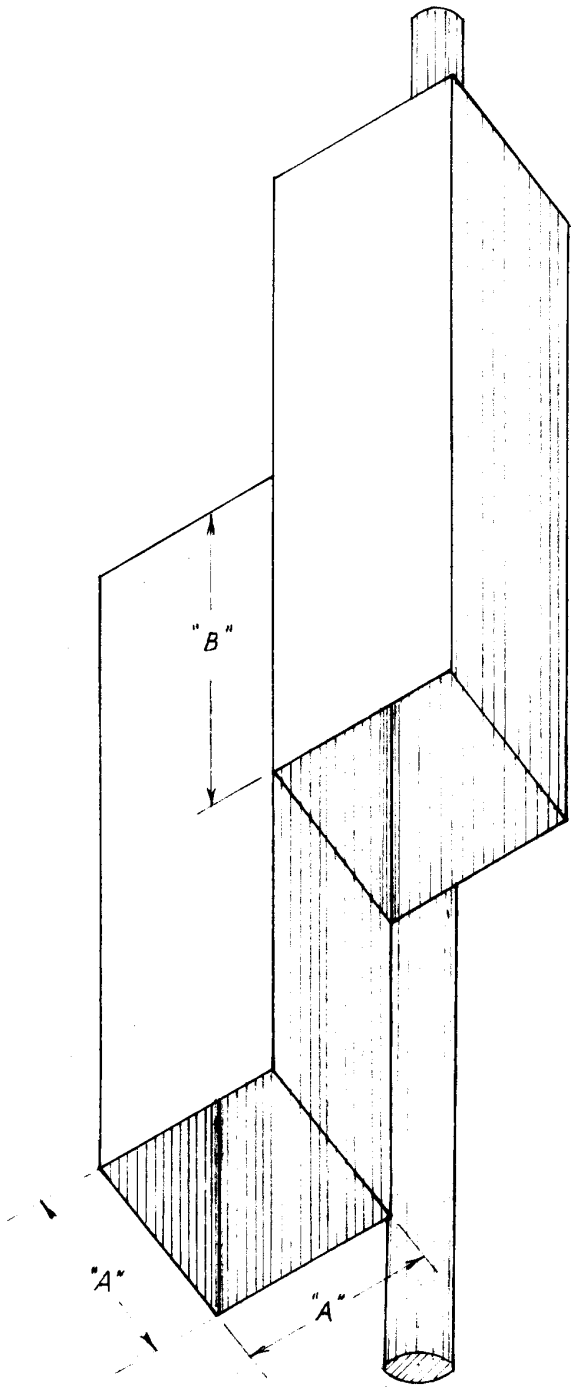
TABLE 2
Minimum Vertical Height of Working Space between Conductors on
Different Levels on The Same Pole or Structure

Voltage of Wire, Cable, or Conductor Concerned	Other Wire, Cable, or Conductor Concerned		
	A	B	C
	Secondaries 0–750 Volts Between Phases and Multi–grounded Neutral	2400 Volt 4160 Volt 4800 Volt Circuits	7.2/12.47 kV 13.2 kV 34.5 kV Circuits
Secondaries 0–750 Volts between phases and multi–grounded neutral	16 Inches[1]	24 Inches[2]	60 Inches[2]
2400 Volt, 4160 Volt 4800 Volt Circuits		24 Inches[2]	60 Inches[2]
7.2/12.47 kV, 13.2 kV and 34.5kV Circuits			60 Inches[2]

NOTES:

1. This applies to secondaries on crossarms. The clearance between secondary conductors on racks or clevises are allowed to have 8 inches separation for span lengths up to 250 feet and 12 inches up to 300 feet.

2. These clearances exceed NESC required minimums. For reduced clearances refer to NESC Table 235–5.



Climbing space shaft may be shifted from one side or corner of pole to another side or corner as required but shall in such instances provide the minimum vertical overlap shown by dimension ”B”.

Figure 1

	DIMENSION ”A”					DIMENSION ”B”
	AMEREN CIRCUIT VOLTAGE					
	0 to 300V	300V to 4800V	11kV to 15kV	34.5kV	69kV	
Min. Climbing Space	30”	30”	36”	40”	54”	40”

1. **General**

Sub Transmission- All sub transmission lines shall be numbered at each **1st structure** coming out of the substation with the circuit number at the top of the pole, on both sides. The **5th structure** shall be numbered with #5 then each 5th structure will be numbered in sequence starting at the normal source end of the line. Poles should be numbered on both sides at major road crossings

In the event a new pole or poles are added between any of the AP numbers, (Example between 301 and 302), add pole number designation 301A, 301B, 301C, etc.

Aerial Patrol Numbering – All sub transmission lines numbered for aerial patrolling shall be numbered in consecutive sequence on **both sides** of each structure that has a number divisible evenly by 5.

When sub transmission poles are either repaired or replaced a new AP number should be installed if the sequence is as mentioned in the above paragraph. If an AP number already exists on the pole, front and back side, no action would be required.

Note: When a structure that should be numbered is located at a major angle in the line and cannot be numbered, either of the adjacent structures shall be numbered with its own structure number. Example, if the major angle is on pole 95, the structure in front would be 94 and the structure behind would be 96; keeping in consecutive order with the other numbered poles.

Numbering shall be continuous from one major switching station to another.

Tap lines shall be numbered with number one on the first structure from the junction with the main line.

Aerial patrol numbers shall be located on structures as indicated by drawings in this bulletin. Typically numbers shall be installed below the first set of insulators (between 1st and 2nd set), if the pole is unshielded. If the pole is shielded, then the numbers can be installed at top of the top or as stated above, below the first set of insulators.

2. **Installation**

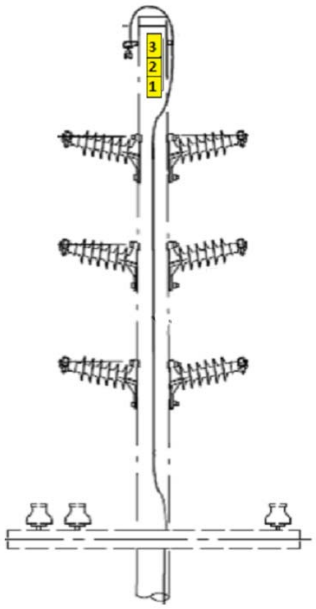
Wood Poles - The vertical holder shall be installed using two lag screws, 2” long with ¼” diameter (Stock # 23 60 027). An alternative to the vertical holder for a wood pole is to securely nail the plates directly to the pole (four holes in each plate).

Composite Poles / Fiberglass Poles - Composite / Fiberglass Poles - Use #10 hex head 3/4” long self-tapping screws (Stock # 21 76 679) in predrilled holes. If pole is not predrilled, use Stock # 86 04 289 to drill pilot hole. This length will work on all composite poles.

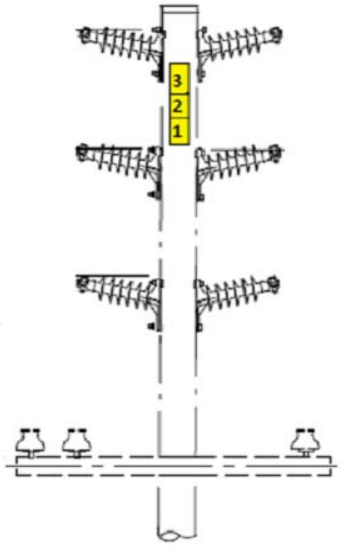
3.Tag Holder and Inserts

Material used in numbering sub transmission lines shall be Black on Yellow, Aluminum 5”W x 7”H w/6” Number Embossed with a Vertical Aluminum Number Plate 29” H x 5 ¼” W. Tags will be produced from following stock numbers.

Stock Number	Description
16 04 627	Numeral "0"
16 04 628	Numeral "1"
16 04 629	Numeral "2"
16 04 630	Numeral "3"
16 04 631	Numeral "4"
16 04 632	Numeral "5"
16 04 633	Numeral "6" or "9"
16 04 634	Numeral "7"
16 04 635	Numeral "8"
16 02 691	Letter "A"
16 02 689	Letter "B"
16 02 690	Letter "C"
16 06 272	Holder-Vertical



SHIELDED 34KV OR 69 KV



UNSHIELDED 34 KV OR 69 KV

Numbers shown on the following examples are NOT to scale

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1. Conductors and electrical apparatus shall be treated as energized unless they are properly grounded.
2. Any circuit de–energized for work clearance shall be tested prior to grounding to ascertain whether the circuit is actually de–energized.
3. Protective grounding cables shall be installed and connected to ground at one or more points as illustrated in pages 3–5.
4. The ground end of grounding cables shall always be connected first.
5. The grounding cables shall be installed and removed by means of hot sticks. If self–cleaning clamps are used, they should be installed in such a manner as to insure the effectiveness of the self–cleaning action. If self–cleaning clamps are not used, clamp jaws and conductors shall be wire brushed immediately before attachment. After the ground–end connection is secured, the grounding cables shall be applied in turn to the nearest conductor first, proceeding outward and upward until all phases have been connected. They shall be removed in reverse order, with the farthest ground removed first.
6. The cables shall be as short as possible, and shall be installed with minimum slack by placing the clamps as far out from the structure as possible in order to reduce violent mechanical reaction in the event of a fault.
7. Grounds shall be installed at the structure upon which the work is being performed. If it is not possible to place the grounds on the same structure, the work shall be done between two sets of visible grounds, preferably placed on the first structure either side of the work structure or span. When ground sets are not placed at the work structure, a personal ground shall be used as the work structure. The personal ground shall consist of a grounding cable connecting the phase upon which work is being performed to a grounding–cluster assembly located on the pole below the lineman's feet.
8. The grounding–cluster assembly shall always be placed on the structure just below the lineman's feet. When a system neutral is not present and a pole ground is present, the grounding–cluster assembly must be bonded to the pole ground. This may be accomplished by connecting a grounding jumper to the connection bar on the assembly and the pole ground. On metal structures, the grounding clamps may be attached to the structure below the lineman's feet in lieu of the gorunding–cluster assembly.
9. All phase conductors to be worked on must be electrically bonded together and connected to ground. Bonding one conductor of each bundled conductor assembly is adequate. To maintain continuity, a bonding jumper must be installed before opening a grounded conductor for any purpose.
10. Where feasible, groundmen should not approach within ten feet of ground wires while protective grounds are installed. They should avoid ground wires and grounding cables except where it is necessary to work on or near them while the grounding cables are in place.

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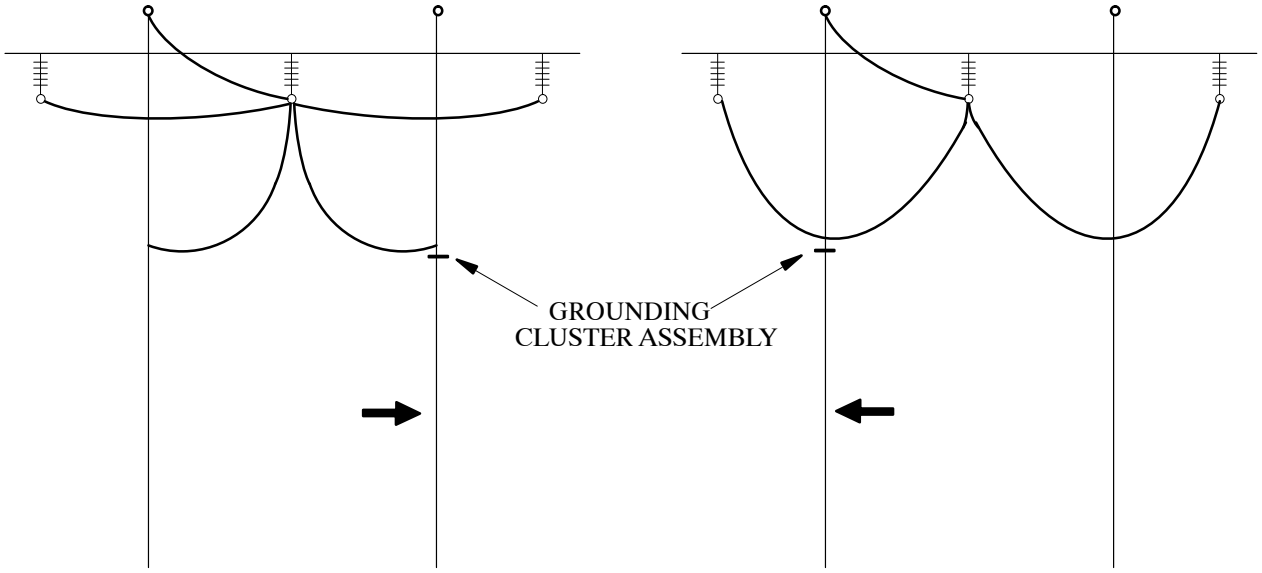

FIG. A
UNACCEPTABLE FOR 138KV–345KV

FIG. B
APPROPRIATE GROUNDING FOR 138KV–345KV

The following sheets show application of ground sets at various voltages.

Application of Ground Sets

Figures A and B above show two examples of the application of ground sets. In Figure A, jumpers are connected between phases and a single jumper is connected to the grounding cluster assembly below the lineman's feet on each structure. This allows less conductors below the lineman to congest the area; however, when working on an outside phase, his body is parallel with two jumpers in series, thus increasing the resistance and the voltage impressed across the lineman in case of a fault. Because of the lesser spacings and shorter jumper lengths on voltages 69 kV and below, this method will be used where possible on single pole structures at these voltages. At voltages of 138 kV to 345kV, the phase spacing requires longer jumpers than acceptable, thus impressing hazardous voltages across the lineman if a fault should occur while working on one of the outside phases. Therefore, the ground sets shall be applied as shown in Figure B on these voltages.

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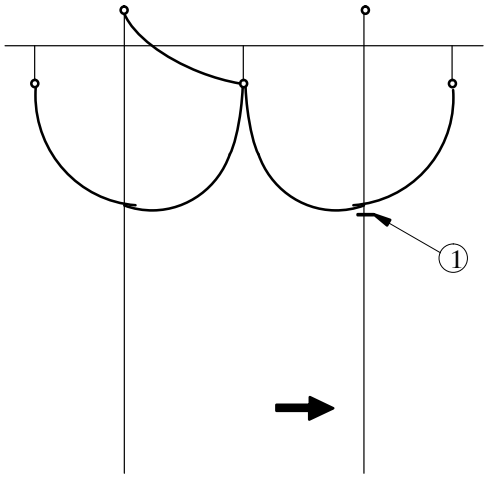
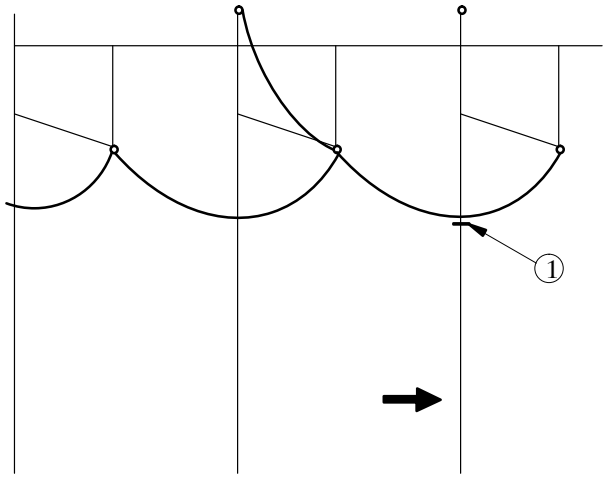
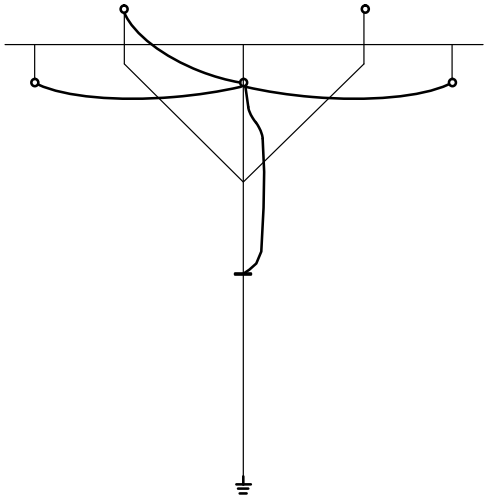
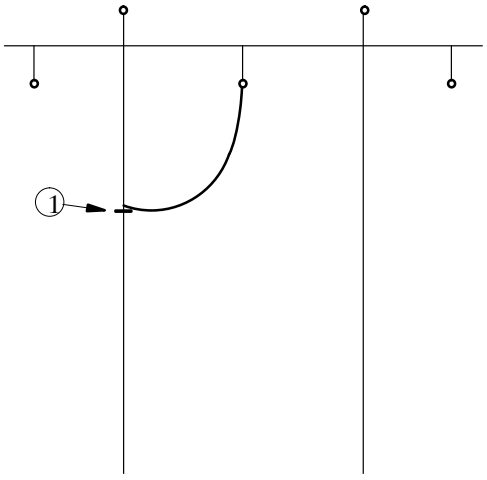
138 kV – 345 kV







METAL TOWER



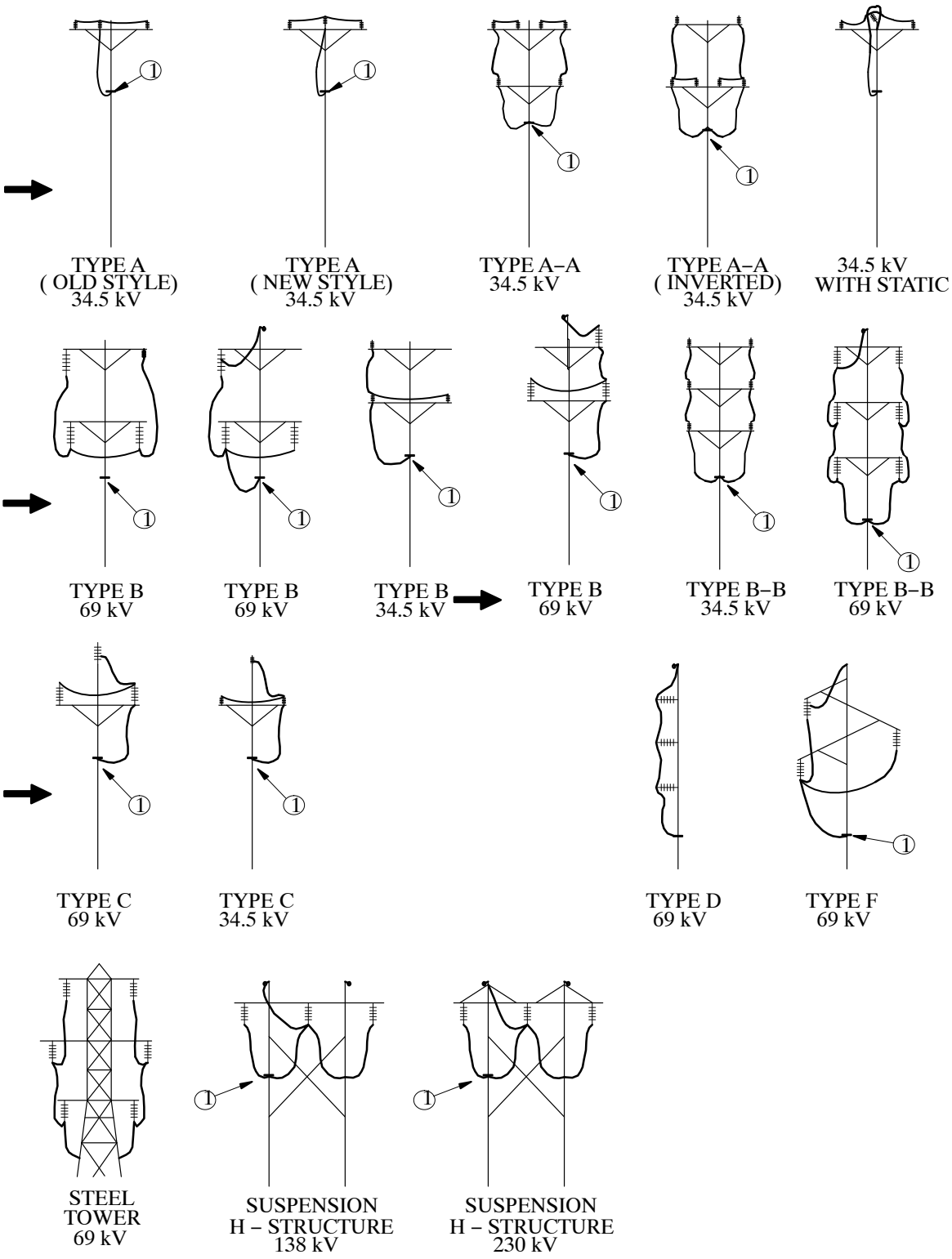
Personal ground – To be used when ground sets are placed as near as possible in all directions from structure being worked on. Apply to phase which is being worked.

NOTE:

1. Grounding cluster assembly.

ILLINOIS ONLY

34.5kV – 69 kV



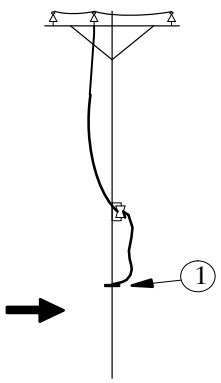
NOTE:

1. Grounding cluster assembly.

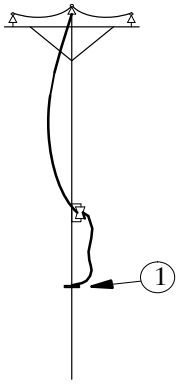
2. Where a low voltage system neutral is present, jumper should be installed from the system neutral to the temporary grounding system.

ILLINOIS ONLY

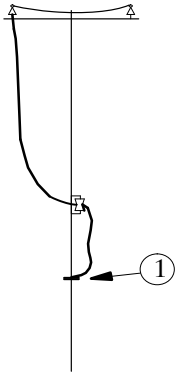
2.4 kV – 12.5 kV



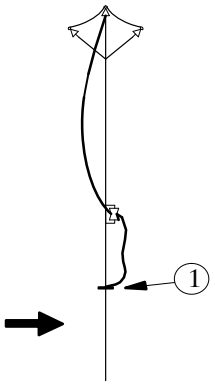
3∅ UNDERBUILD



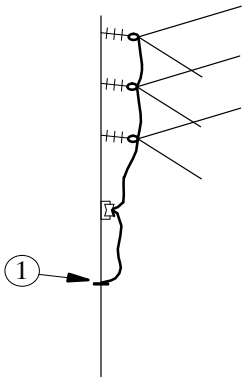
3∅ TANGENT



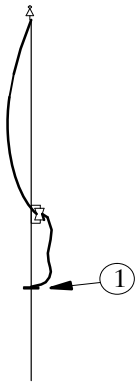
2∅ TANGENT



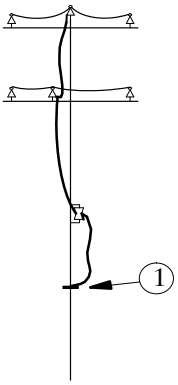
3∅ ARMLESS



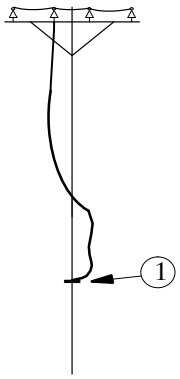
3∅ ANGLE OR CORNER



1∅ POLE TOP PIN



DOUBLE CIRCUIT BOTH CKTS. GROUNDED



3∅ WITH NEUTRAL ON ARM

NOTE:

1. Grounding cluster assembly.
2. When system neutral is shield wire on underbuild circuit, a jumper is required from underbuild phase to the shield wire or pole ground.

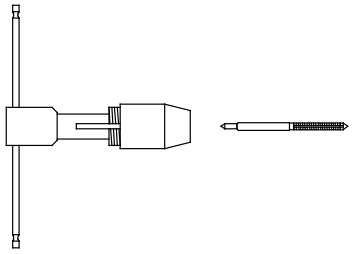
Purpose -

This DCS is for use by Ameren Illinois for EZRR corrective action projects. This DCS provides materials for:
1) Moving the arrester from the energize zone above the transformer to the transformer tank,
2) Replacing porcelain cutout with polymer cutout,
3) Lowering cutout from phase conductor crossarm to FG cutout bracket (refer to DCS 13 12 00 01), and
4) Conforming the transformer H2 grounding to current Ameren Standards (refer to DCS 13 00 06 02).

The variations in each standard within this DCS are as described below:
29 12 00 01 - Tank Mounting of Arrester, 7.2 kV thru 7.97 kV Transformer
29 12 00 02 - Tank Mounting of Arrester, 2.4 kV Transformer w/ Cover Mounted Primary Bushings
29 12 00 03 - Tank Mounting of Arrester, 2.4 kV Transformer w/ Side-Wall Mounted Primary Bushings
29 12 00 04 - Hanger Bracket Mounting of Arrester, 7.2 kV thru 7.97 kV Transformer
29 12 00 05 - Hanger Bracket Mounting of Arrester, 2.4 kV Transformer w/ Cover Mounted Primary Bushings

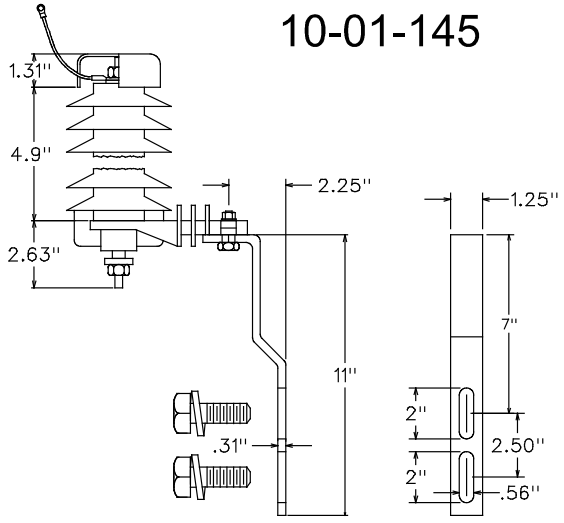
If transformer has existing lugs for mounting arresters adjacent to the H1 bushings:

1. **Clean the threads in the arrester mounting lugs.** Thread Tap stock number **85-37-166** with T-Wrench stock number **85-41-336** can be used to 'chase' the threads.

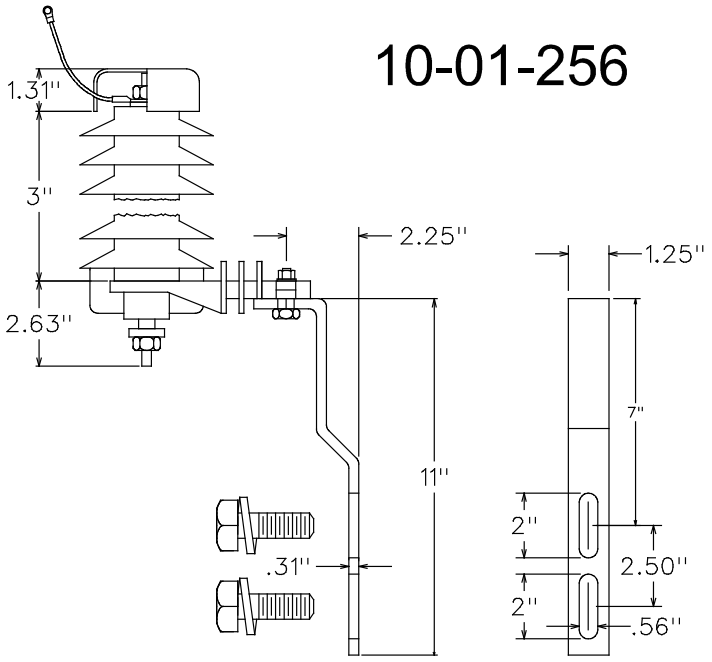


2. **Install arrester on transformer tank-**

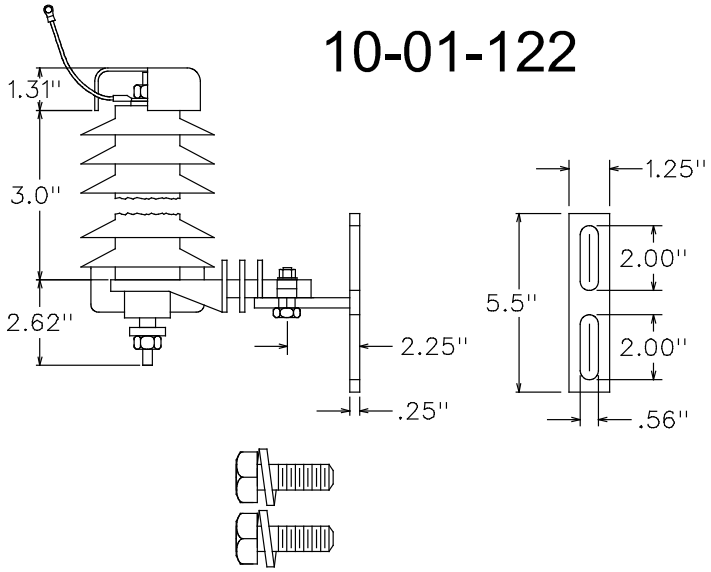
   a. If transformer is rated 7.2kV thru 7.97kV-29 12 00 01
   Use arrester kit stock number 10-01-145. This kit includes a 10kV arrester with cap, 600V insulated arrester lead-wire, L-shaped mounting bracket, copper ground strap, and two 1/2" bolts for mounting to the transformer tank.



b. If transformer is rated 2.4kV with cover mounted bushings-29 12 00 02
Use arrester kit stock number 10-01-256. This kit includes a 3kV arrester with cap, 600V insulated arrester lead-wire, L-shaped mounting bracket, copper ground strap, and two 1/2" bolts for mounting to the transformer tank.



c. If transformer is rated 2.4kV with side-wall mounted primary bushings-29 12 00 03
Use arrester kit stock number 10-01-122. This kit includes a 3kV arrester with cap, 600V insulated arrester lead-wire, T-shaped mounting bracket, copper ground strap, and two 1/2" bolts for mounting to the transformer tank.



If transformer does NOT have existing lugs for mounting adjacent to the H1 bushing:

1. **Transformer with Cover Mounted Primary Bushings–**

   29 12 00 04 – Hanger Bracket Mounting of Arrester, 7.2kV thru 7.97kV Transformer

   29 12 00 05 – Hanger Bracket Mounting of Arrester, 2.4kV Transformer w/ cover mounted primary Bushings

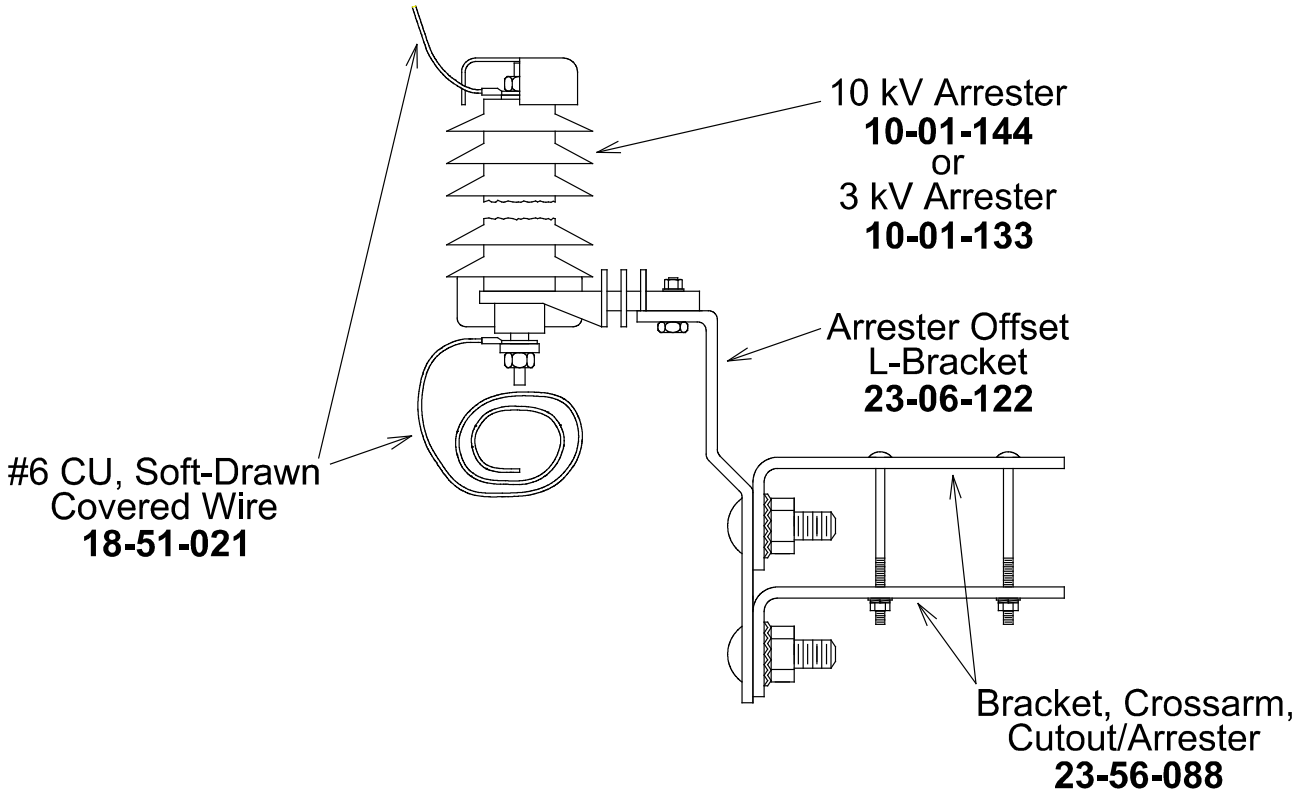
   Mount hardware and arrester to upper transformer hanger bracket as per DCS 12 12 05 **. DCS 12 12 05 ** contains the following materials needed for a transformer with cover mounted primary bushings:

   i. Cutout/Arrester Crossarm Bracket 23–56–088.

   ii. Arrester Offset L–Bracket 23–06–122.

   iii. 10kV Arrester 10–01–144 (for 7.2kV thru 7.97kV transformers) Or
   3kV Arrester 10–01–133 (for 2.4kV transformers).

   iv. #6 CU, Soft–Drawn, Covered Wire 18–51–021.



2. **2.4kV Transformer with Side–Wall Mounted Primary Bushings–**
   Replace with new transformer that is pre–kitted with tank mounted arrester.

		Stnd./Stk No	Description 29 12 00 **	01	02	03	04	05
	A	23 06 127	Bracket, Cutout	1	1	1	1	1
	B	23 52 065	Bolt, Mach, 5/8” x 12”	2	2	2	2	2
	C	23 66 027	Washer, Square, 5/8”	2	2	2	2	2
	D	54 07 208	Switch, Fused, Open Type	1	1	1	1	1
@	E		Link, Fuse (see DCS 10 00 01 01)	1	1	1	1	1
	F	18 51 025	Wire, Trans. Riser, #4, S.D. Poly covered (FT.)	15	15	15	15	15
	G	23 17 411	Cover–Cutout	1	1	1	1	1
	H	10 01 145	Arrester Kit, 10kV, w/ “L” Transformer Mtg. Brkt.	1				
		10 01 256	Arrester Kit, 3kV, w/ “L” Transformer Mtg. Brkt.		1			
		10 01 122	Arrester Kit, 3kV, w/ “T” Transformer Mtg. Brkt.			1		
	I	12 12 05 01	Arrester, 10kV				1	
		12 12 05 02	Arrester, 3kV					1
	M	23 64 001	Staple, Ground Wire, Serrated, CU Clad				3	3
	N	17 51 032	Clamp, PG. #6–1/0	1	1	1	2	2
	O	69 58 296	Guard, Wildlife, Clam–Shell, Short	1	1	1	1	1
	P	69 58 121	Ground, Transformer Tank, #8 Sol. To #2 Str. Cu.	1	1	1	1	1