Marne and Associates, Inc.
Experts in Electrical Code

National Electrical Safety Code (NESC) Rules for Joint-Use Construction

(OJUA NESC 201 – OJUA 2023 Spring Training)

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IMPORTANT NOTE: The information and diagrams contained in this document attempt to show common situations where the 2023 NESC Code applies. They are intended to be used as visual aids to the reader of the Code and are not intended to be a replacement for the comprehensive nature of the Code as it is written. If there are any discrepancies between the information in this presentation and the NESC document, the NESC document shall govern.

The figures and/or photos in this document were derived from McGraw Hill's NESC® Handbook by David J. Marne and John A. Palmer, and are used with the permission of the publisher, McGraw Hill LLC.

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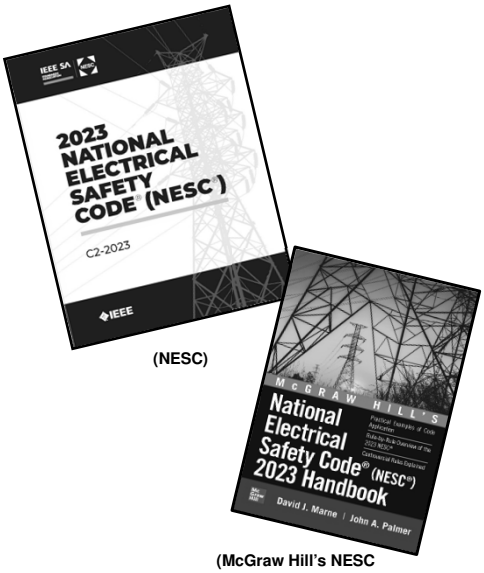
Differences between the NESC and the McGraw Hill's NESC Handbook



(NESC)

(McGraw Hill's NESC Handbook)

NESC

- Published by the Institute of Electrical and Electronic Engineers (IEEE).
- The electrical codebook for utilities.
- Used by engineers and utility lineworkers.
- Published on a 5-year cycle.

McGraw Hill's NESC Handbook

- Published by McGraw Hill LLC.
- Used as a reference for applying the rules in the NESC.
- Used by engineers and utility lineworkers.
- Contains over 500 figures, photos and examples.

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OJUA NESC 201

OJUA NESC 201 In Depth Discussion Topics

- NESC Organization and Dave's Favorite Joint-Use Numbers (refresher)
- NESC Joint-Use Changes
- More About Sag and Tension Charts
- More about applying the Communication Worker Safety Zone
- More About Street Lights (attached and not attached)
- More About Communication Antennas
- More about Strength and Loading
- More About Pole Climbing and Pre-Climb Inspections and Tests
- More about Underground Lines
- More about Applying MAD to a Joint-Use Pole
- David's Favorite Scenarios (Draw J-U Pole and Draw J-U Trench Exercise)
- David's Top 10 NESC Violations
- Industry Hot Topics and Q and A Session

4

Dave's Favorite Joint-Use Numbers

(All values are "not less than" values and adders, exceptions, and footnotes may apply.)

- **Part 2 – Overhead Lines**
  - ✓ **18.5 Feet (Power 12.47/7.2 kV phase wire above a roadway)**
  - ✓ **15.5 Feet (Communications line above a roadway)**
  - ✓ **40 Inches Plus or Minus (Between Power and Communications)**
- **Part 3 – Underground Lines**
  - ✓ **30 inches (Power 12.47/7.2 kV burial depth)**
  - ✓ **Sufficient Distance (Communications burial depth)**
  - ✓ **12 inches (Between Power and Communications)**
- **Part 4 – Work Rules**
  - ✓ **2 feet, 3 inches (Power worker minimum approach distance to 12.47/7.2 kV)**
  - ✓ **2 feet, 3 inches (Qualified Communication worker minimum approach distance to 12.47/7.2 kV)**

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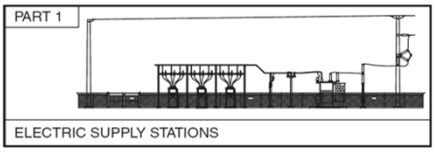
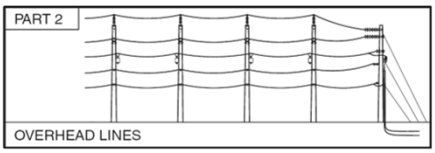
Part	1 - 4
Section	
Rule	

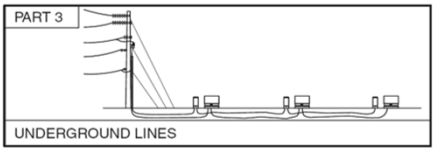
Parts 1 – 4



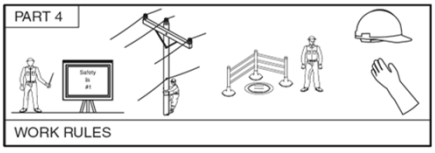
- Part 1. Electric Supply Stations



- Part 2. Overhead Lines



- Part 3. Underground Lines



- Part 4. Work Rules

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2023 National Electrical Safety Code® (NESC®) Changes

- National Electrical Safety Code® (NESC®) Changes
  - No changes – General Overview
  - Level 1  – Minor Change
  - Level 2  – Moderate Change
  - Level 3  – Major Change

Note: This presentation has a Joint-Use focus. Not every change will be discussed in this presentation. Please reference the NESC document for all changes which are marked with vertical change bars.

7

Part	**0**
Section	**02 and 03**
Rule	

Definitions of special terms and References

General Sections

- **01 Introduction**
- **02 Definitions**
- **03 References**
- **09 Grounding Methods**

Changes:

- ***Section 01 Introduction: Minor edits to the Purpose, Scope and other Rules. The customary inch-foot-pound system (English units) are now the primary units and the Metric tables have been moved to the back of the book (Annex 1).***
- ***Section 02 Definitions: Definition changes range from minor edits to new terms. The section heading clarified the use of the IEEE Standards Dictionary and a traditional dictionary.***
- ***Section 03 References: Updates to list of referenced documents.***

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Part	0
Section	09
Rule	

Grounding Methods

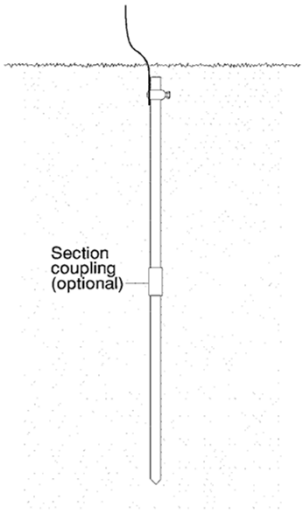
General Sections

01 Introduction
02 Definitions
03 References
09 Grounding Methods

9

Part	0
Section	09
Rule	094C2

Made electrodes – Driven rods, buried wire, strips, or plates



- **Driven ground rod:**
  - May be in sections.
  - Total length not less than 8’.
  - Longer rods or multiple rods can be used to reduce ground resistance.
  - Spacing between rods not less than 6’.
  - Exception: Other rod diameters and configurations may be used to reduce ground resistance if supported by a qualified engineering study.
  - Driven depth must be 8’ or more and the top end must be flush with or below grade or suitably protected.
  - Exception: If rock is encountered, then driven depth may be less than 8’ or another type of electrode may be used.
  - Exception: 7.5’ of driven depth may be used in pad-mounted enclosures, vaults, etc.

Change: Renumbered the rule and added / modified wording to clarify the rule.

10

Part	0
Section	09
Rule	094C2

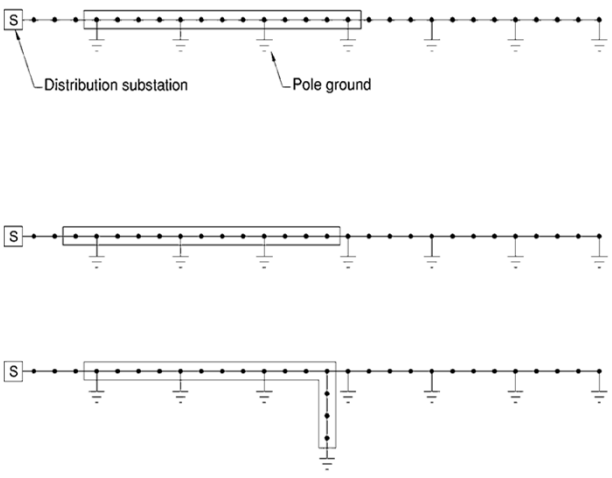
Driven ground rods

Violation!

11

Part	0
Section	09
Rule	096C

Example of checking "four grounds in each mile"



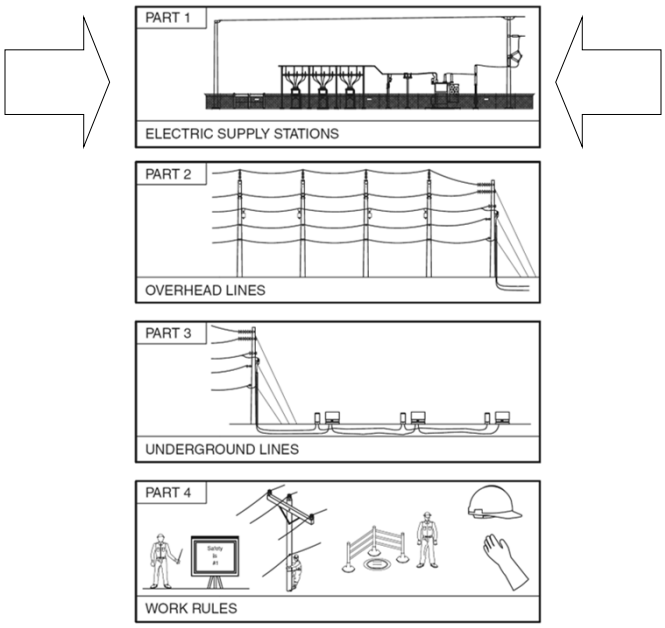
- One-mile window has 4 grounds.
- **VIOLATION!** When the one-mile window is moved, only 3 grounds exist. Additional grounding is required as 4 grounds are required IN EACH MILE (two exceptions apply).
- The one-mile window can also be bent to check taps.

Change: Added / modified wording for the exceptions to the 4 grounds in each mile requirement. The exceptions apply to underwater or underground installations and overhead installations with special terrain features.

12

Part	1
Section	
Rule	

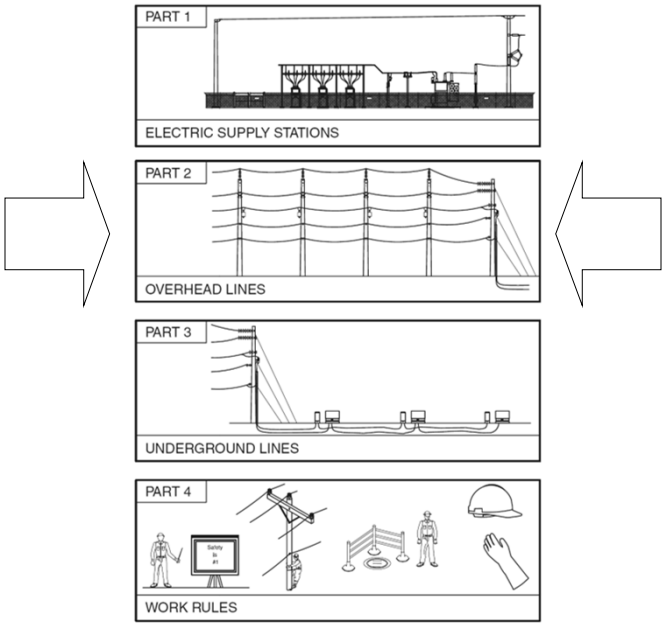
Part 1 – Electric Supply Stations



13

Part	2
Section	
Rule	

Part 2 – Overhead Lines



14

Part	2
Section	21
Rule	214

Inspection and tests of lines and equipment when in- and out-of-service

- Inspect- At intervals as experience has shown necessary. (As a separate duty or while performing other duties.)
- Lines and equipment with recorded conditions or defects that would reasonably be expected to endanger persons or property shall be promptly corrected, disconnected, or isolated.
- Other conditions or defects shall be designated for correction.

Change: The word "human life" was changed to "persons." The wording "permanently abandoned" was changed to "permanently out of service." Rule 313 added a note about performing inspections while performing other duties.

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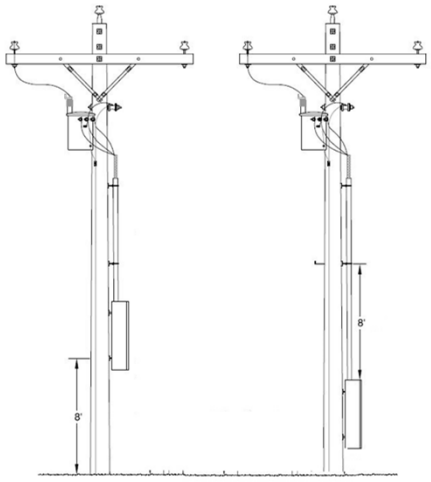
Part	2
Section	21
Rule	214

Inspection and tests of lines and equipment when in- and out-of-service

16

Part	2
Section	21
Rule	217A2d

Equipment and associated support brackets



- Either one of these arrangements is acceptable:
  - Not less than 8' between the lowest support bracket and ground or other surface that is permanently installed and accessible
  - Not less than 8' from the top surface or highest support bracket and the lowest handhold

Change: New rule 217A2d addresses equipment and associated support brackets.

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Part	2
Section	21
Rule	217C

Protection and marking of guys

- The ground end of EACH anchor guy exposed to pedestrian traffic must have a substantial and conspicuous guy marker.
- When an anchor guy is located in an established parking area, the guy must be protected from vehicle contact or marked. (The photo shows both.)
- Note that it is not practical to protect guys from out-of-control vehicles operating outside of established parking areas.

Change: Added / modified wording to clarify the rule. Added the word "each" to require a guy marker on each guy wire. A change is Rule 264B requires the guy wire strength rating to be based on the "minimum", not "nominal" breaking strength.

18

Part	2
Section	21
Rule	217C

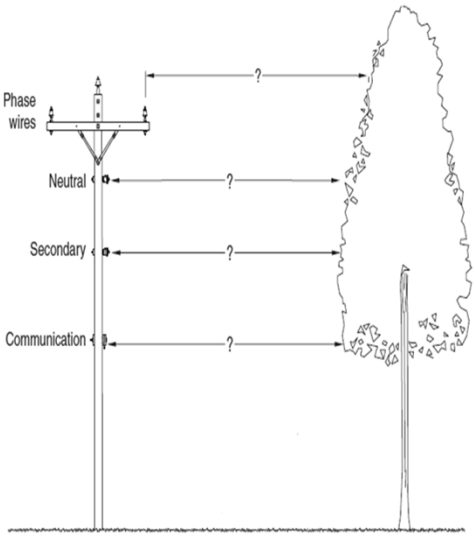
Protection and marking of guys

Violation!

19

Part	2
Section	21
Rule	218A

General vegetation management requirements



- Vegetation management should be performed around supply and communication lines as experience has shown necessary.
- No distance or tree trimming cycle (time period) is specified. Consider the following factors:
  - Line voltage
  - Species growth and failure
  - Right-of-way limitations
  - Relative locations
  - Movement during routine wind
  - Conductor sag

  Note that it is not practical to prevent all tree-conductor contact.

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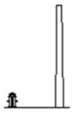
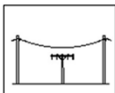
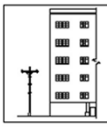
Part	2
Section	23
Rule	

Summary of overhead line clearance rules

INFO	RULE 230	General	Sag chart needed to check clearance? ☐ YES ☒ NO
	RULE 231	Clearances of supporting structures from other objects	☐ YES ☒ NO
	RULE 232	Vertical clearances of wires, conductors, cables, and equipment above ground, roadway, rail, or water surfaces	☒ YES ☐ NO
	RULE 233	Clearances between wires, conductors, and cables carried on different supporting structures	☒ YES ☐ NO
	RULE 234	Clearance of wires, conductors, cables, and equipment from buildings, bridges, rail cars, swimming pools, supporting structures, and other installations	☒ YES ☐ NO

Change: Minor wording change to the title of Rule 234.

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Part	2
Section	23
Rule	

Summary of overhead line clearance rules

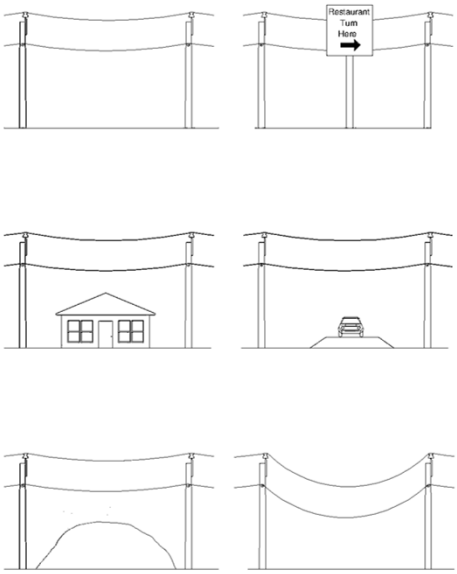
	RULE 235	Clearance for wires, conductors, or cables carried on the same supporting structure	☒ YES ☐ NO
	RULE 236	Climbing space	☐ YES ☒ NO
	RULE 237	Working space	☐ YES ☒ NO
	RULE 238	Clearances at the support between specified communications and supply facilities located on the same structure	☐ YES ☒ NO
	RULE 239	Clearance of vertical and lateral facilities from other facilities and surfaces on the same supporting structure	☐ YES ☒ NO

Change: Minor wording change to the title of Rule 238.

22

Part	2
Section	23
Rule	230I

Examples of maintenance of clearances and spacings

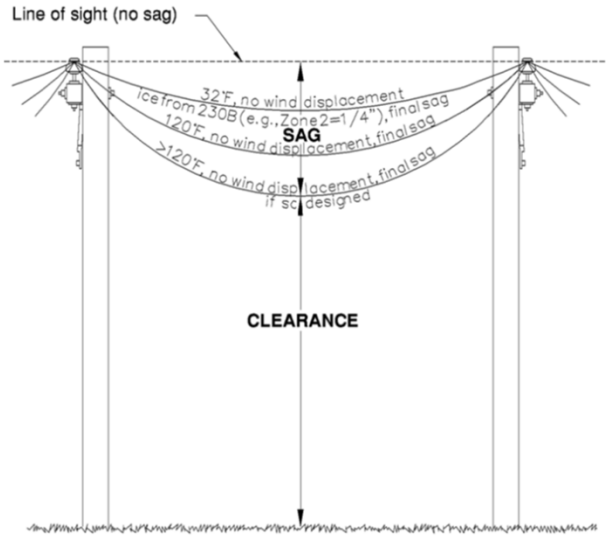


- Original Installation. Code clearance is met.
- Sign is built adjacent to the existing line. Code clearance now in **VIOLATION.** Utility must correct.
- Building is built or moved under the existing line. Code clearance now in **VIOLATION.** Utility must correct.
- Fill is brought in for the road under the existing line. Code clearance now in **VIOLATION.** Utility must correct.
- Snow is plowed under the existing line. No reductions exist for temporary clearance. Code clearance now in **VIOLATION.** Utility must correct.
- Existing conductor was excessively stretched due to a major ice or wind storm. Code clearance now in **VIOLATION.** Utility must correct.

23

Part	2
Section	23
Rule	232A

Conductor temperature and loading conditions for measuring vertical clearance



- Clearance must be measured to the **LARGEST FINAL SAG** of these conditions.
- Clearance required in NESC Table 232-1.

Change: The indention of the exception and the note were moved to apply to all of Paragraph A.

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Part	2
Section	23
Rule	

Sample sag and tension chart

Sample Sag and Tension Chart

Conductor: #1/0 AWG 6/ 1 Stranding ACSR "RAVEN"

Area = 0.0968 Sq. in Diameter = 0.398 in Weight = 0.145 lb/ft RTS = 4380 lb
Data from Chart No. 1-938
English Units
Limits and Outputs in Average Tensions.
Span = 300.0 Feet Special Load Zone
Creep is NOT a Factor Rolled Rod

Design Points				Final				Initial		
Temp	Ice	Wind	K	Weight	Sag	Tension	RTS	Sag	Tension	RTS
°F	in	psf	lb/ft	lb/ft	Ft	lb	%	Ft	lb	%
15.0	0.25	4.00	0.20	0.658	5.43	1366	31.2	5.43	1366	31.2
15.0	0.25	2.30	0.00	0.387	4.31	1012	23.1	4.07	1070	24.4
32.0	0.25	0.00	0.00	0.346	4.49	868	19.8	4.13	945	21.6
60.0	0.00	17.76	0.00	0.607	6.14	1114	25.4	5.92	1154	26.4
60.0	0.00	6.00	0.00	0.246	4.66	595	13.6	4.03	688	15.7
-20.0	0.00	0.00	0.00	0.145	1.78	916	20.9	1.61	1015	23.2
-10.0	0.00	0.00	0.00	0.145	1.98	825	18.8	1.73	945	21.6
0.0	0.00	0.00	0.00	0.145	2.20	740	16.9	1.86	876	20.0*
10.0	0.00	0.00	0.00	0.145	2.46	663	15.1	2.02	808	18.5
15.0	0.00	0.00	0.00	0.145	2.60	628	14.3	2.10	775	17.7
20.0	0.00	0.00	0.00	0.145	2.74	595	13.6	2.20	743	17.0
30.0	0.00	0.00	0.00	0.145	3.04	536	12.2	2.40	680	15.5
32.0	0.00	0.00	0.00	0.145	3.11	526	12.0	2.44	668	15.3
40.0	0.00	0.00	0.00	0.145	3.36	486	11.1	2.62	622	14.2
50.0	0.00	0.00	0.00	0.145	3.68	444	10.1	2.87	569	13.0
60.0	0.00	0.00	0.00	0.145	4.00	408	9.3	3.14	520	11.9
70.0	0.00	0.00	0.00	0.145	4.32	378	8.6	3.42	478	10.9
80.0	0.00	0.00	0.00	0.145	4.63	353	8.1	3.70	441	10.1
90.0	0.00	0.00	0.00	0.145	4.93	331	7.6	4.00	408	9.3
100.0	0.00	0.00	0.00	0.145	5.22	313	7.1	4.29	380	8.7
104.0	0.00	0.00	0.00	0.145	5.34	306	7.0	4.41	370	8.5
110.0	0.00	0.00	0.00	0.145	5.47	299	6.8	4.58	356	8.1
120.0	0.00	0.00	0.00	0.145	5.61	291	6.7	4.87	335	7.7
167.0	0.00	0.00	0.00	0.145	6.25	262	6.0	6.14	266	6.1
212.0	0.00	0.00	0.00	0.145	6.84	239	5.5	6.76	242	5.5

* Design Condition

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Part	2
Section	23
Rule	

CommScope Spanmaster

CommScope®

Spanmaster ® Release 3.1 Sag / Tension Computations

SSR Joint Use Presentation

Cables	X-SECT AREA (sq.in)	EFF MODULUS (psi)	NOMINAL DIAM (in)	EFF.EXP. COEFF. (1/F)	CABLE WEIGHT (lb/ft)	E*A LOAD BEARING CAPACITY (lbs)	MAX. RATED LOAD (lbs)
5/16" EHS	0.0595	2.60E+07	0.313	5.60E-06	0.2050	1545960	11200
P3-500CA	0.1963	2.44E+06	0.500	1.35E-05	0.0720	478264	300
P3-750CA	0.4418	2.39E+06	0.750	1.35E-05	0.1610	1053941	675
Bundle			1.250		0.4380		

NESC RESULTS

Loading Condition	Temp. (F)	Ice Load lb/ft	Ice Thick in	Wind Constant lb/ft	Horz Wind Load lb/sq ft	Result Load + Const lb/ft	Sag ft	Tension lb	% Len Chg From Input Conditions
Rule 251	15.0	0.466	.25	.2	4.0	1.276	5.85	2453	0.05
232A1	120.0	0.000	.00	.0	0.0	0.438	4.79	1029	0.02
User Loading1	32.0	0.466	.25	.0	0.0	0.904	5.17	1965	0.03
User Loading2	32.0	0.000	.00	.0	0.0	0.438	3.65	1350	-0.01

Span Length = 300.00 ft
Span Sag = 4.00 ft (48.0 in)
Span Tension = 1,232 lb
Max Load = 11,200 lb
Usable load (60%) = 6,720 lb
Catenary Length = 300.142 ft
Stress Free Length @
Installed Temperature = 299.903 ft

Unloaded Strand
Sag = 2.74 ft (32.9 in) 0.91 %
Tension = 842 lb

Temp (F)	Midspan Sag (ft)	Tension (lb)	% Length Change	Clearance 18 ft
-40.0	2.84	1,732	-0.02	19.16
-30.0	2.94	1,673	-0.02	19.06
-20.0	3.05	1,615	-0.02	18.95
-10.0	3.16	1,559	-0.02	18.84
.0	3.27	1,506	-0.02	18.73
10.0	3.38	1,455	-0.01	18.62
20.0	3.50	1,406	-0.01	18.50
30.0	3.62	1,359	-0.01	18.38
40.0	3.75	1,314	-0.01	18.25
50.0	3.87	1,272	0.00	18.13
60.0	4.00	1,231	0.00	18.00
70.0	4.13	1,193	0.00	17.87
80.0	4.26	1,156	0.01	17.74
90.0	4.39	1,122	0.01	17.61
100.0	4.52	1,089	0.01	17.48
110.0	4.66	1,058	0.02	17.34
120.0	4.79	1,029	0.02	17.21
130.0	4.92	1,002	0.02	17.08
140.0	5.05	976	0.03	16.95

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Part	2
Section	23
Rule	232B

NESC Table 232-1

Table 232-1—
Vertical clearance of wires, conductors, and cables above ground, roadway, rail, or water surfaces

(Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. See the definitions section for voltages of other systems.
See Rules 232A, 232B1, 232C1a, and 232D4.)

Nature of surface underneath wires, conductors, or cables	Insulated communication conductors and cable; messengers; overhead shield/surge-protection wires; guys; [6,11] neutral conductors meeting Rule 230E1; supply cables meeting Rule 230C1 (ft)	Noninsulated communication conductors; supply cables of 0 to 750 V meeting Rule 230C2 or 230C3 (ft)	Supply cables over 750 V meeting Rule 230C2 or 230C3; open supply conductors, 0 to 750 V [3] (ft)	Open supply conductors, over 750 V to 22 kV [25] (ft)	Trolley and electrified railroad contact conductors and associated span or messenger wires [1]	
					0 to 750 V to ground (ft)	Over 750 V to 22 kV [25] to ground (ft)
Where wires, conductors, or cables cross over or overhang						
1. Track rails of railroads (except electrified railroads using overhead trolley conductors) [2, 16, 22]	23.5	24.0	24.5	26.5	22.0 [4]	22.0 [4]
2. Roads, streets, and other areas subject to truck traffic [23]	15.5	16.0	16.5	18.5	18.0 [5]	20.0 [5]

Change: Guys were removed from the Table in two columns. Similar guy edits were done to other NESC Clearance Tables. The footnotes to sailboating areas were modified. A note was added to Rule 232B1 addressing irrigation equipment.

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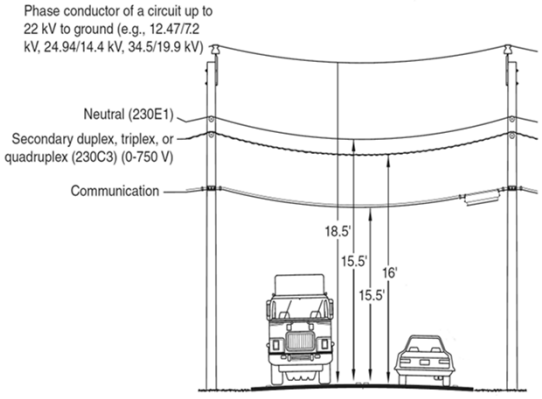
Part	2
Section	23
Rule	232B1

Common clearance values from NESC Table 232-1



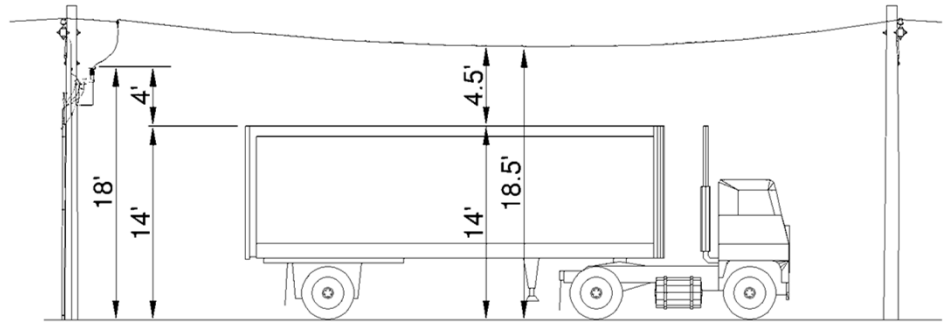
- All conductors at the largest final sag condition per Rule 232A.
- NESC Table 232-1, Row 2: Roads, streets, and other areas subject to truck traffic
- Code clearances are "not less than" values at the largest final sag conditions per Rule 232A. Footnotes to NESC Table 232-1 may apply to the clearances shown.
- Note: The values shown (from Rule 232) are for clearances of conductors to the surface below. Rule 235 must be referenced to determine clearance between the conductors which may dictate additional clearance above the surface below.

Change: Guys were removed from the Table in two columns. Similar guy edits were done to other NESC Clearance Tables. The footnotes to sailboating areas were modified. A note was added to Rule 232B1 addressing irrigation equipment.

28

Part	2
Section	23
Rule	232B

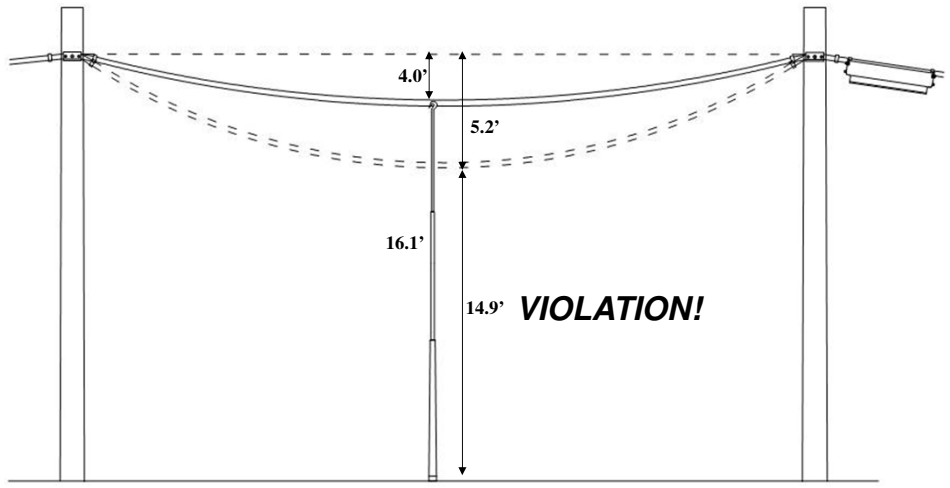
Example of how clearance values are determined



29

Part	2
Section	23
Rule	232B

Finding the minimum clearance



30

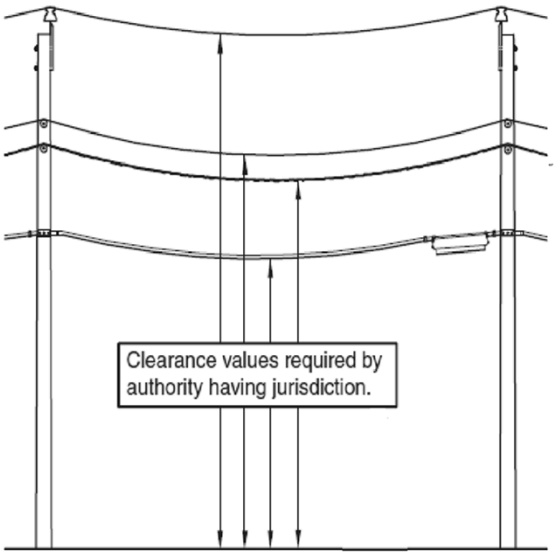
Part	2
Section	23
Rule	232B

Example of how clearance values are determined

31

Part	2
Section	23
Rule	232B

Authority having jurisdiction



State Highway Department, Railroad Company, U.S Army Corps of Engineers (water areas) and other agencies may require greater clearances than the NESC.

32

Part	2
Section	23
Rule	232

Table 232-2

- Table 232-2
  - Equipment cases, support arms, platforms, and braces must have
    - 15 feet of clearance to ground in areas subject to truck traffic.
    - 9 feet in pedestrian only areas. Footnote 7 allows less clearance for pedestrian areas if the walkway is not obstructed.

33

Part	2
Section	23
Rule	233C

Example of vertical clearance between wires carried on different supporting structures.

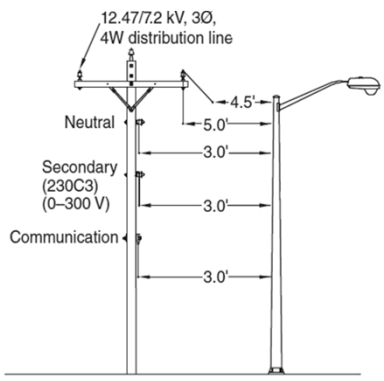
- Rule 233C applies to vertical clearance.
- 1st sentence of Rule 233A: Crossings should be made on a common supporting structure, where practical.
- Clearance values depend on the voltages involved and must be checked at specific sag conditions for the top and bottom circuits.

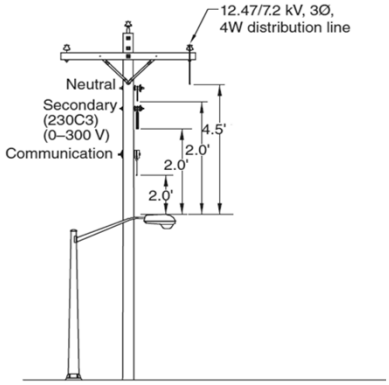
Change: The calculation for vertical clearance above 22 kV was changed from the phasor difference method to a simple clearance adder method for individual circuits. This change of wording reverts to the method used in the 2012 NESC.

34

Part	2
Section	23
Rule	234B

Clearance of wires, conductors, and cables from other supporting structures.





- Rule 234B1 applies to horizontal clearance.
- Rule 234B2 applies to vertical clearance.

Change: Added / modified the wording to clarify the rule. Added antenna supports to lighting supports and traffic signal supports.

35

Part	2
Section	23
Rule	234B

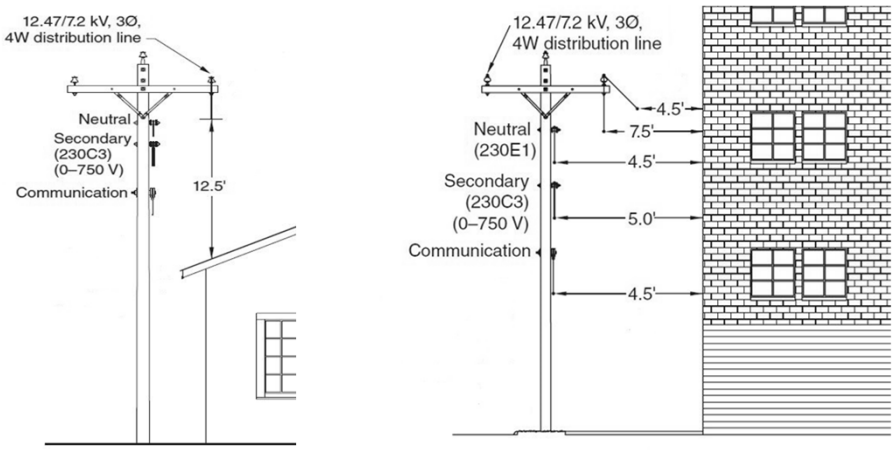
Clearance of wires, conductors, and cables from other supporting structures.

Change: Added / modified the wording to clarify the rule. Added antenna supports to lighting supports and traffic signal supports.

36

Part	2
Section	23
Rule	234C1

Example of horizontal clearance of a conductor to a building

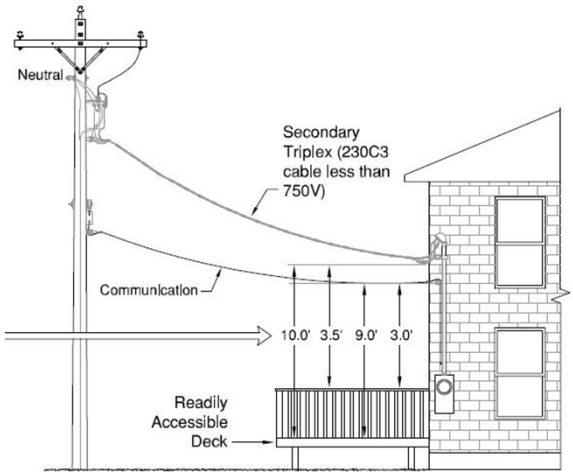


Change: Multiple wind Tables (not numbered) were combined and moved to new Table 234-7. Some secondary voltage vertical clearances were reduced and some primary voltage clearances were increased. Footnote 5 to Table 234-1 was modified to clarify how to apply clearances to chimneys and antennas.

37

Part	2
Section	23
Rule	234C3 & C4

Supply conductors attached to buildings or other installations



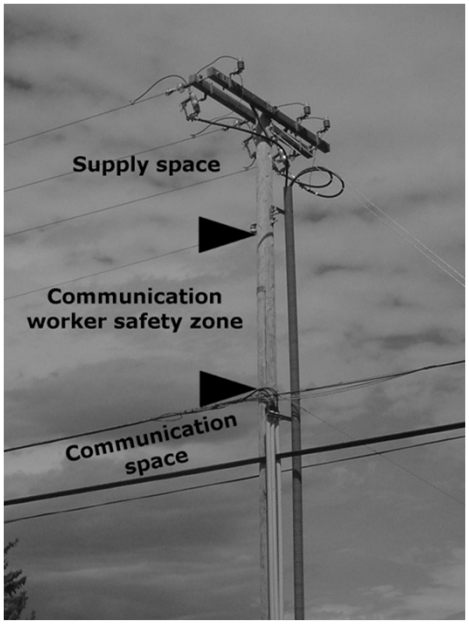
Changes:

- ***Rule 234C3d for supply service drops was modified.***
- ***Rule 234C4 for communication service drops had clearance values added to the rule.***
- ***New NESC Figures 234-2(a) and 234-2(b) were added for supply service drops.***

38

Part	2
Section	23
Rule	235C4

Communication worker safety zone



- The communication worker safety zone is the space on the pole where nothing is located (with some exceptions). Rule 238 and Rule 235C are used to define the space.
- Exceptions that are permitted in the communication worker safety zone are as follows:
  - Span wires or brackets carrying luminaires, traffic signals, or trolley conductors (Rule 238C).
  - Drip loops associated with light fixtures or traffic signals (Rule 238D).
  - Vertical risers (Rule 239).

39

Part	2
Section	23
Rule	235

NESC Table 235-5

Table 235-5—
Vertical clearance between conductors at supports

(When using column and row headings, voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. When calculating clearance values within the table, all voltages are between the conductors involved. See the definitions section for voltages of other systems. See also Rules 235A, 235C1, 235C2, and 235F.)

Conductors and cables usually at lower levels	Conductors and cables usually at upper levels		
	Open supply conductors 0 to 8.7 kV;[11] supply cables meeting Rule 230C1, 230C2, or 230C3; fiber-optic cables meeting Rule 230F1a or 230F1b; neutral conductors meeting Rule 230E1; communications cables located in the supply space meeting Rule 224A2 (in)	Open supply conductors Over 8.7 kV to 50 kV	
		Same utility [7] (in)	Different utilities [7, 12] (in)
1. Communication conductors and cables			
a. Located in the communication space	40[1, 5]	40	40 plus 0.4 per kV [6] in excess of 8.7 kV
b. Located in the supply space	16[9, 10]	40[10]	40 plus 0.4 per kV [6] in excess of 8.7 kV

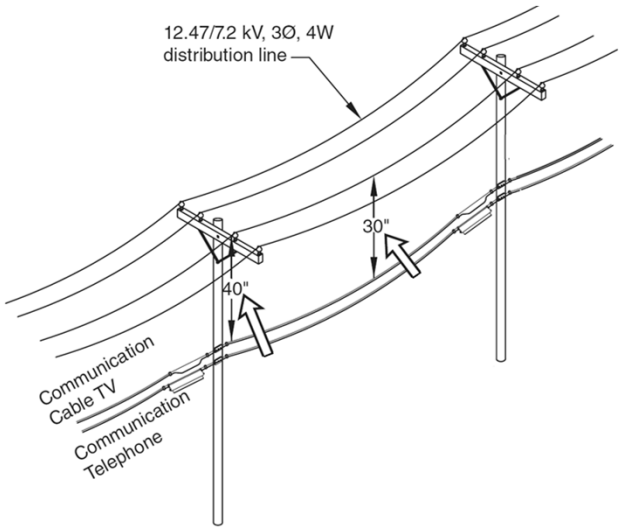
Change:

- ***Table 235-5 was reorganized including the Footnotes. Footnote 12 now allows the "same utility" column to be used for different utilities provided the parties agree.***

40

Part	2
Section	23
Rule	235C

Example of vertical clearance between joint use (supply and communication) conductors



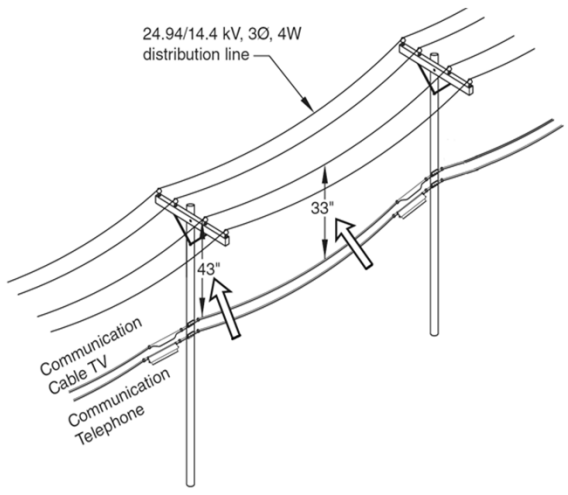
- Per NESC Table 235-5, not less than 40" of vertical clearance between the 7.2 kV to ground phase conductor and the communication cable.
- Not less than 75% of the value required at the structure is required in the span per Rule 235C2b(1)(a) at the specified conductor temperature and loading conditions in Rule 235C2b(1)(c).

  0.75 x 40" = 30"
- No hardware in the communication worker safety zone; see Rule 238.

41

Part	2
Section	23
Rule	235C

Example of vertical clearance between joint use (supply and communication) conductors



- Per NESC Table 235-5, not less than 43" of vertical clearance between the14.4 kV to ground phase conductor and the communication cable.

  40"+[(14.4 kV - 8.7 kV) X 0.4"/kV = 42.3"

  Round to 43"
- Not less than 75% of the value required at the structure is required in the span per Rule 235C2b(1)(a) at the specified conductor temperature and loading conditions in Rule 235C2b(1)(c).

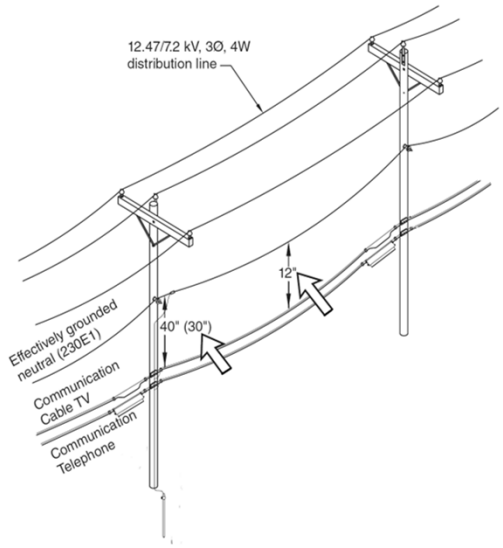
  0.75 x 43" = 32.3"

  Round to 33"
- No hardware in the communication worker safety zone; see Rule 238.

42

Part	2
Section	23
Rule	235C

Example of vertical clearance between joint use (supply and communication) conductors



- Per NESC Table 235-5 not less than 40". Per NESC Table 235-5, Footnote 5, not less than 30" of vertical clearance between the effectively grounded neutral and the communication cable if the neutral and the communication messenger are bonded. This footnote also applies to fiber optic cables in the supply space.
- Not less than 12" in the span at the specified conductor temperature and loading conditions per Rule 235C2b(1)(a), Exception 1.
- No hardware in the communication worker safety zone; see Rule 238

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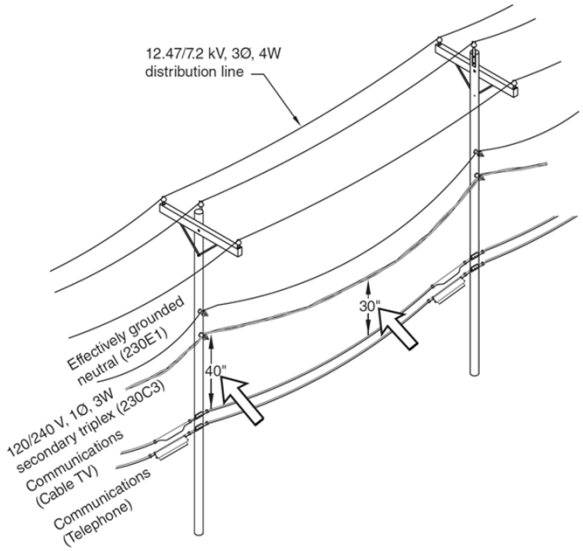
Part	2
Section	23
Rule	235C

Example of vertical clearance between joint use (supply and communication) conductors



- Per NESC Table 235-5, not less than 40" of vertical clearance between the 120/240V, 1ø, 3W secondary triplex (230C3) and the communication cable.
- Not less than 75% of the value required at the structure is required in the span per Rule 235C2b(1)(a) at the specified conductor temperature and loading conditions in Rule 235C2b(1)(c).
  0.75 x 40" = 30"
- No hardware in the communication worker safety zone; see Rule 238

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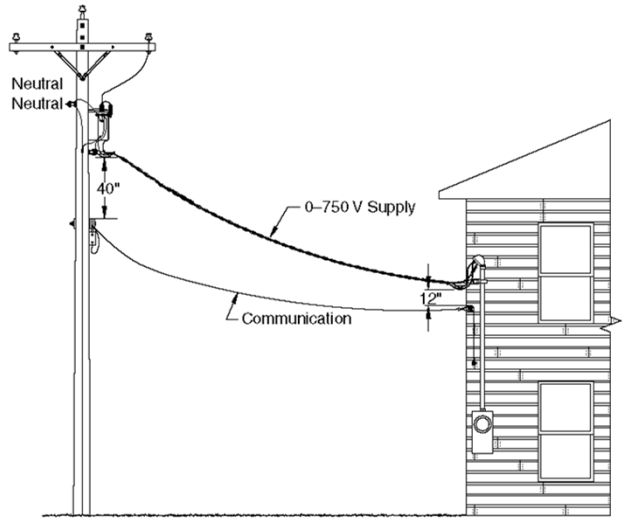
Part	2
Section	23
Rule	235C1

Exceptions to vertical clearance requirements for joint-use (supply and communication) construction



- Exception 3: Supply service conductors of 0–750 V running above and parallel to the communication service drop may have clearance anywhere in the span including the building attachment (or structure being served) of not less than 12“ to the communication conductor provided the phase conductors of the service drop are insulated and the required clearance is maintained at the pole.

45

Part	2
Section	23
Rule	235C1

Exceptions to vertical clearance requirements for joint-use (supply and communication) construction

46

Part	2
Section	23
Rule	235H

Clearance and spacing between communication lines

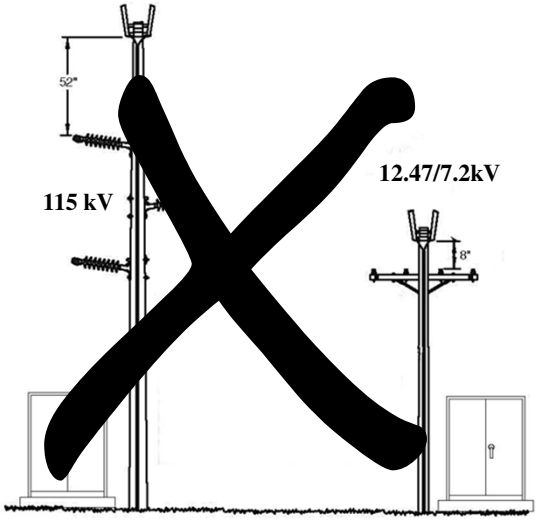
- Communication messengers should be spaced not less than 12" apart.
- Communication cables and equipment of different communication utilities must have not less than 4" of clearance anywhere in the span. An ambient temperature of 60 Degrees F without wind is used to determine the 4" clearance.
- Both the 12" spacing and the 4" clearance may be reduced (or eliminated) by agreement between the parties involved including the pole owner(s).

Change: An ambient temperature of 60 Degrees F without wind was added to the rule.

47

Part	**2**
Section	**23**
Rule	**235I**

Examples of clearance between supply lines and communication antennas in the supply space



Change: Rule 235I was deleted and the requirements were moved to Rule 238F.

48

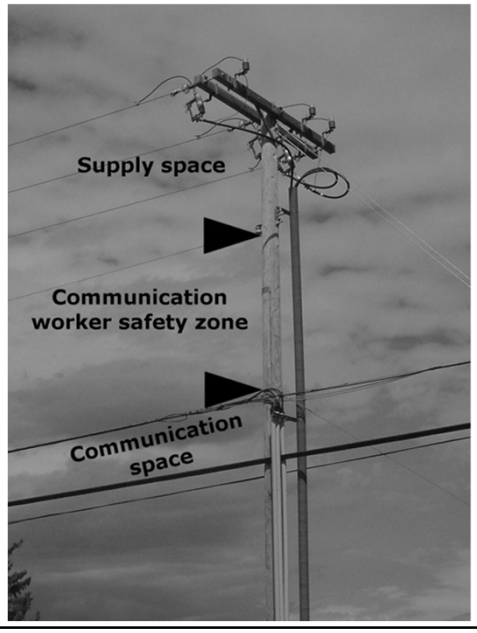
Part	2
Section	23
Rule	236

Climbing Space Issues

49

Part	2
Section	23
Rule	238E

Communication worker safety zone



- The communication worker safety zone is the space on the pole where nothing is located (with some exceptions). Rule 238 and Rule 235C are used to define the space.
- Exceptions that are permitted in the communication worker safety zone are as follows:
  - Span wires or brackets carrying luminaires, traffic signals, or trolley conductors (Rule 238C).
  - Drip loops associated with light fixtures or traffic signals (Rule 238D).
  - Vertical risers (Rule 239).

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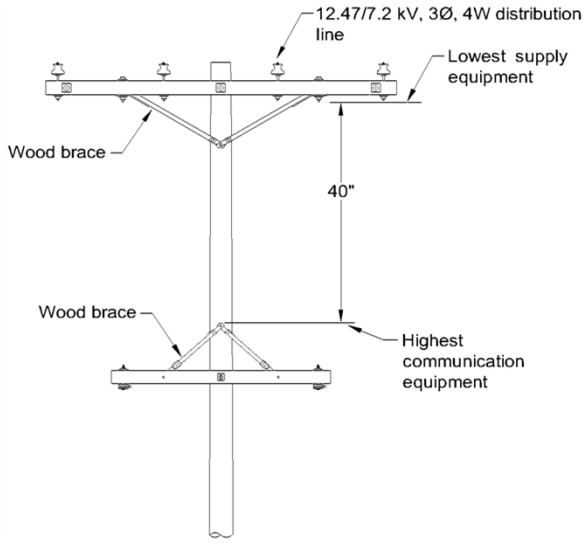
Part	2
Section	23
Rule	238A & 238B

Example of vertical clearance between supply and communication equipment on the same structure

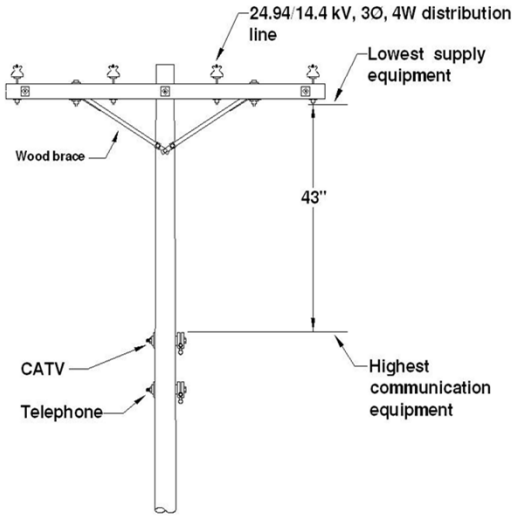


- Per Rule 238A, wood crossarm brace for supply (power) is not considered equipment but wood crossarm brace for communications is considered equipment.
- Vertical clearance per NESC Table 238-1.

51

Part	2
Section	23
Rule	238B

Example of vertical clearance between supply and communications equipment on the same structure

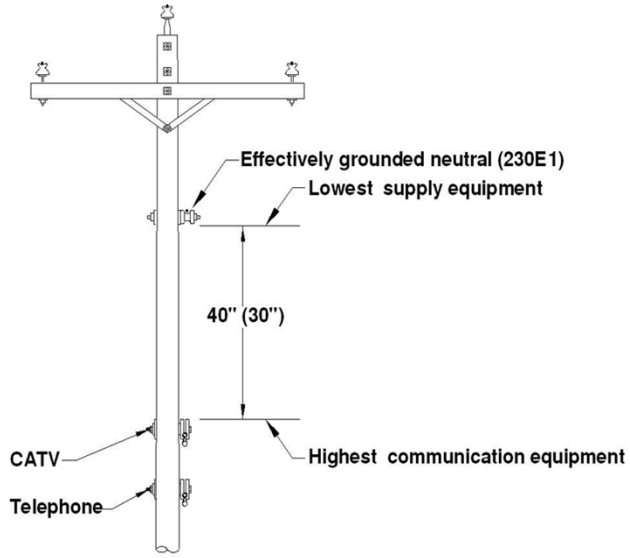


- Per NESC Table 238-1, not less than 43" of vertical clearance between 14.4 kV phase to ground supply circuit equipment and communication equipment.
- 40"+[(14.4 kV - 8.7 kV) x 0.4"/kV] = 42.3“ Round to 43”.

52

Part	2
Section	23
Rule	238B

Example of vertical clearance between supply and communication equipment on the same structure

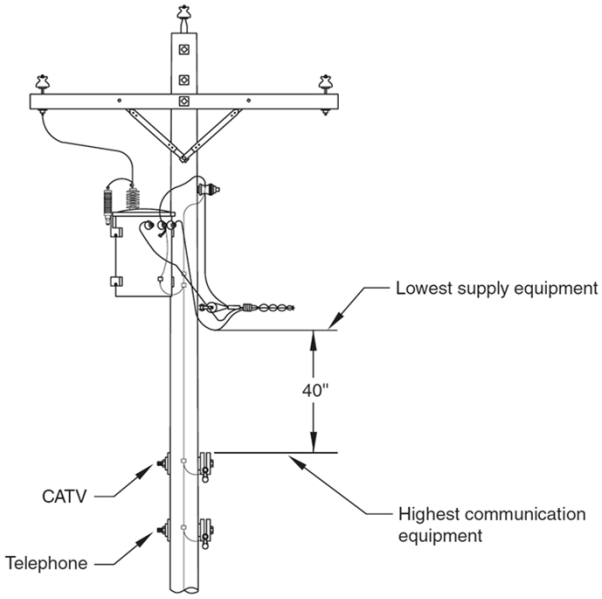


- Not less than 40”. Not less than 30" (per NESC Table 238-1, Footnote 1) of vertical clearance between the effectively grounded neutral hardware and communication equipment.

53

Part	2
Section	23
Rule	238B

Example of vertical clearance between supply and communication equipment on the same structure



- 120/240 V, 1ø, 3W secondary triplex (230C3) below bottom of transformer tank.
- Not less than 40" of vertical clearance between a 120/240 V, 1ø, 3W secondary triplex (230C3) and communications equipment (30" exception does not apply to secondary cable).

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Part	2
Section	23
Rule	238B

Example of vertical clearance between supply and communication equipment on the same structure

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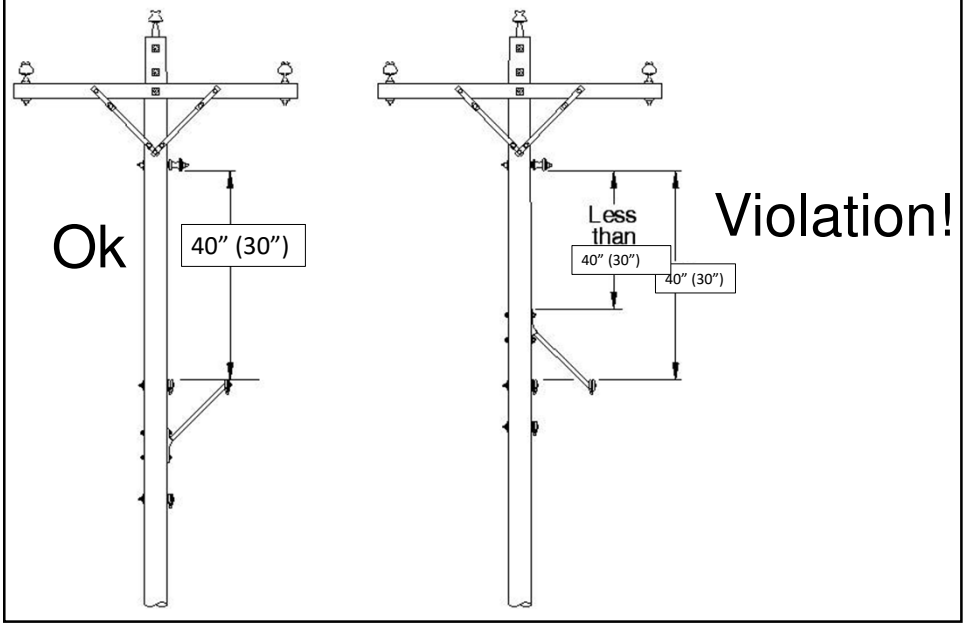
Part	2
Section	23
Rule	238B

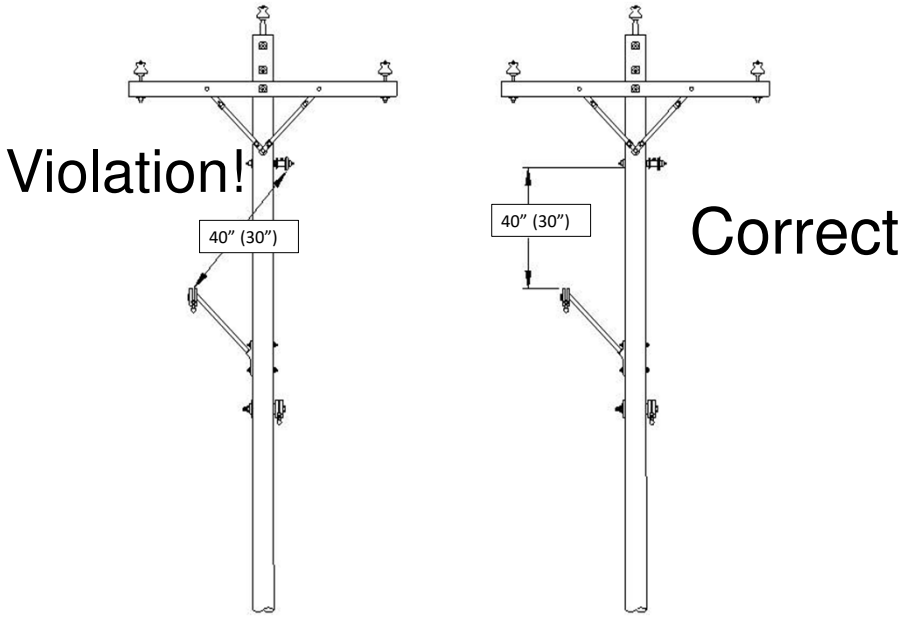
Example of vertical clearance between supply and communication equipment on the same structure



56

Part	2
Section	23
Rule	238B

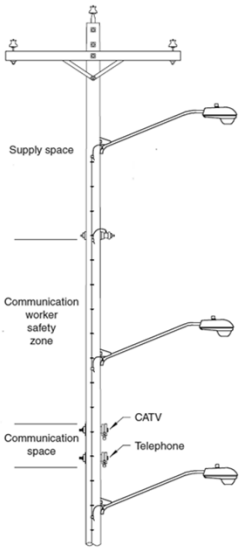
Example of vertical clearance between supply and communication equipment on the same structure



57

Part	2
Section	23
Rule	238C

Clearances for span wires or brackets



Per NESC Table 238-2, a streetlight bracket located in the communication worker safety zone and a streetlight bracket located below the communications space must be effectively grounded.

Change: A <u>not</u> effectively grounded streetlight bracket is no longer allowed below the communication space.

58

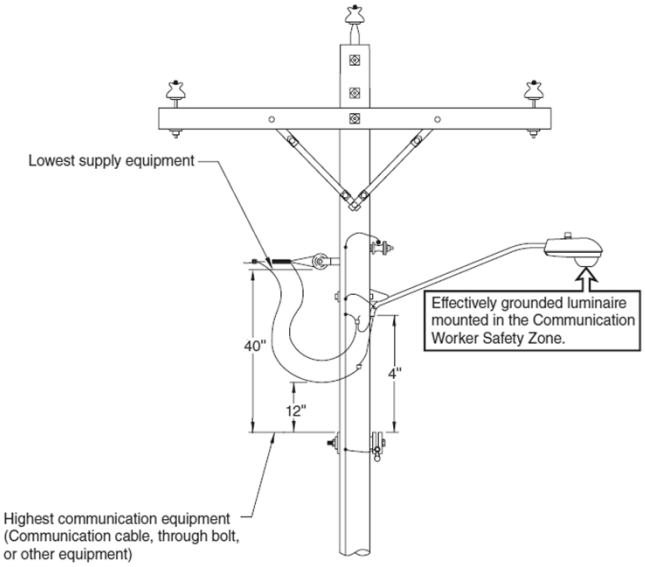
Part	2
Section	23
Rule	238C

Clearances for span wires or brackets

59

Part	2
Section	23
Rule	238C&D

Example of vertical clearance between a drip loop feeding a luminaire and communication equipment

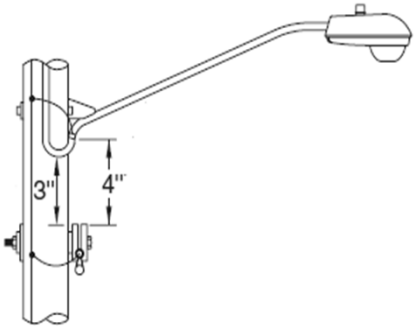


Effectively grounded luminaire mounted in the communication worker safety zone.

60

Part	2
Section	23
Rule	238C&D

Exception to vertical clearance between a drip loop feeding a luminaire and communication equipment



- The exception to Rule 238D permits the drip loop clearance to be 3" if the loop is covered by a suitable nonmetallic covering that extends 2‟ beyond the loop.
- Effectively grounded luminaire mounted in the communication worker safety zone.

61

Part	2
Section	23
Rule	238C & D

Clearances for span wires or brackets

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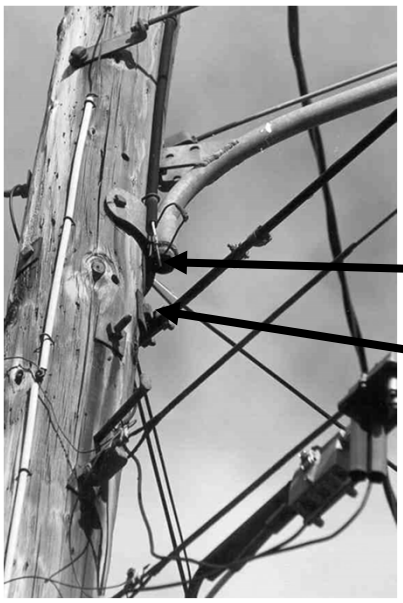
Part	2
Section	23
Rule	238C&D

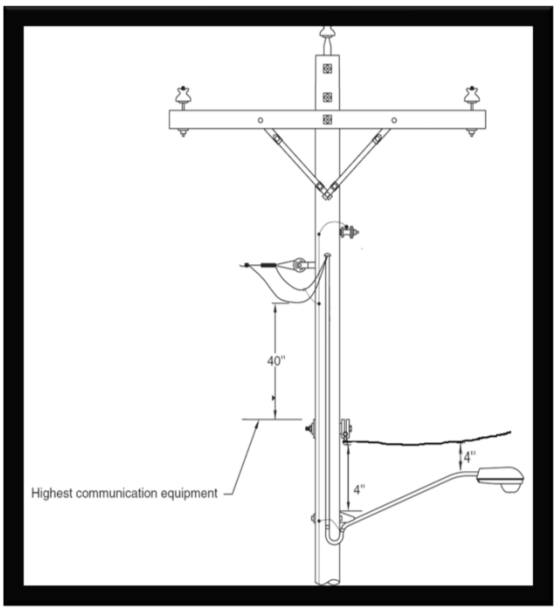
Violation! Vertical clearance between a drip loop feeding a luminaire and communication equipment



63

Part	2
Section	23
Rule	238C&D and 239G

Example of vertical clearance between a communications cable and a luminaire mounted below the communications space

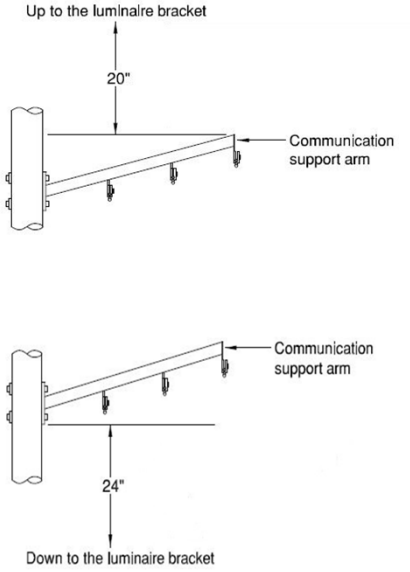


- A clearance of not less than 4” must be maintained between the messengers supporting communication cables and the luminaire bracket.
- Per NESC Table 238-2, Footnote 3, the clearance can be measured in all directions to all portions of the luminaire bracket and luminaire.
- Effectively grounded luminaire mounted below the Communication Worker Safety Zone below the communication space.

64

Part	2
Section	23
Rule	238C

Examples of vertical clearance between a communication support arm and a luminaire bracket

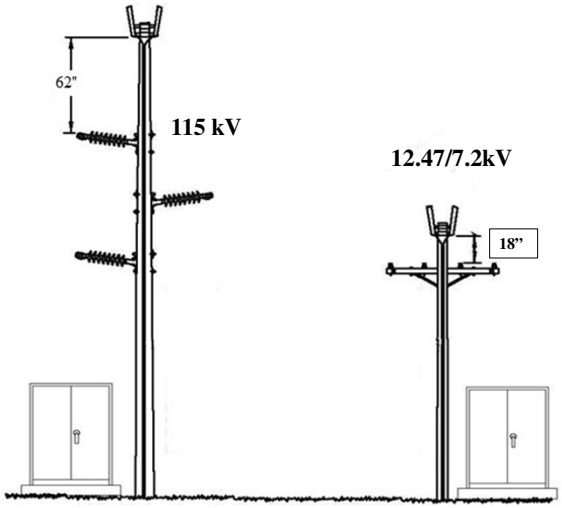


- Per NESC Table 238-2, the clearance between a communication support arm and a luminaire bracket is greater than the clearance between a luminaire bracket and messengers supporting communication cables.

65

Part	2
Section	23
Rule	238F2a

Examples of clearance between supply lines and antennas in the supply space



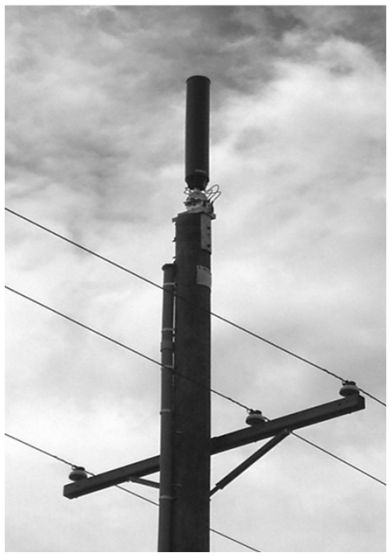
- Not less than 62" of vertical clearance per the formula in NESC Table 238-3. This clearance may be reduced per Footnote 6.
- Not less than 18" of vertical clearance per the formula in NESC Table 238-3. This clearance may be reduced per Footnote 5.
- Communication antennas in the supply space must be installed by qualified supply workers.
- Risers must conform to Rule 239 .
- Rule 420Q is referenced for radio frequency emission limits.

Change: New Rule 238F replaces old Rule 235I.

66

Part	2
Section	23
Rule	238F

Examples of clearance between supply lines and antennas in the supply space and the communication space



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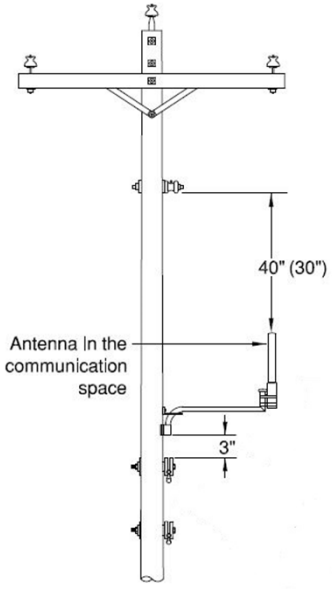
Part	2
Section	23
Rule	238F2b

Examples of clearance between supply lines and antennas in the communication space



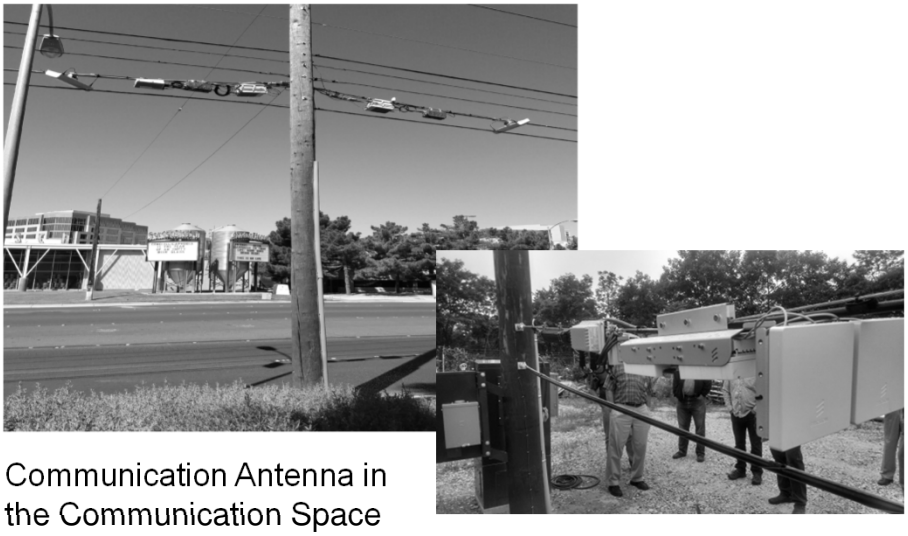
- Rule 238F2b references NESC Table 238-1 (vertical clearances).
- The 3” value is a clearance in any direction per Rule 238F2b.
- The exception to Rule 238F2b recognizes the installation of span mount antennas. (Not shown in the figure.)
- Rule 235H2 requires 4” of vertical clearance between communication cables of different utilities.
- Communication antennas in the communication space can be installed by qualified communication workers.

Change: New Rule to address communication antennas in the communication space.

68

Part	2
Section	23
Rule	238F

Example of a strand mount antenna



Communication Antenna in the Communication Space (Strand Mount)

69

Part	2
Section	23
Rule	238 Tables

NESC Tables 238-1, 238-2, and 238-3

It is important to note the differences between NESC Tables 238-1, 238-2, and 238-3. Some of the major differences are outlined below:

- **NESC** Table 238-1 is a phase-to-ground voltage table per the wording in parentheses under the table title.
- **NESC** Table 238-1 specifies vertical clearances per the title of the table.
- **NESC** Table 238-2 does not specify any voltages as the table applies to span wires and brackets supporting luminaires, traffic signals, or trolley conductors.
- **NESC** Table 238-2 specifies vertical clearances per the title of the table, but Footnote 3 addresses clearance in all directions.
- **NESC** Table 238-3 is a phase-to-phase voltage table per the wording under the heading "Supply lines."
- **NESC** Table 238-3 specifies vertical clearances per the wording in the first column of the table, but Footnotes 3, 4, 5, and 6 address reduced clearances in any direction.

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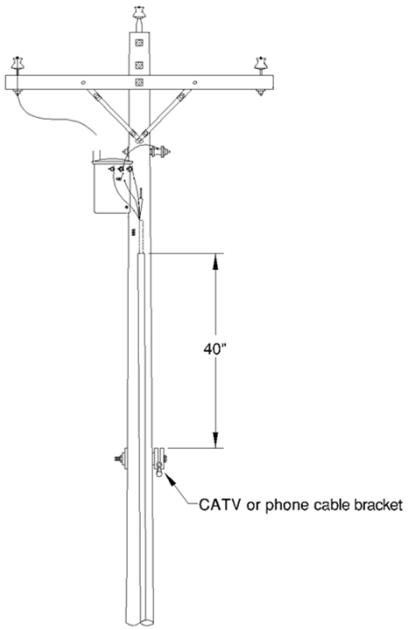
Part	**2**
Section	**23**
Rule	**239G1**

Example of vertical supply conductors on a joint use pole



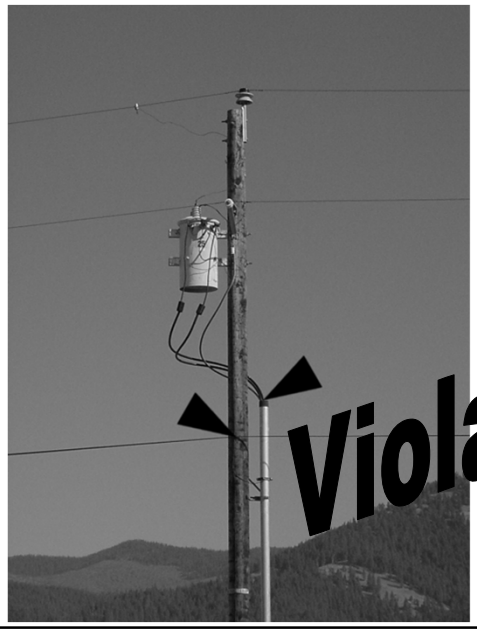
- Vertical supply conductor passing through communication space
- 40" of conduit above the highest communication attachment applies to typical secondary (low voltage) conductors as well as typical primary (high voltage) conductors.

Change: Added / modified wording to clarify the rule. Added the word "duct."

71

Part	2
Section	23
Rule	239G1

Example of vertical supply conductors on a joint use pole



72

Part	2
Section	24 - 27
Rule	

Sections 24 through 27

- Section 24 – Grades of Construction
- Section 25 – Loadings for Grades B and C
- Section 26 – Strength Requirements
- Section 27 – Line Insulation

73

Part	2
Section	24-26
Rule	

Examples of pole loading software

O-Calc Pro

SOFTWARE

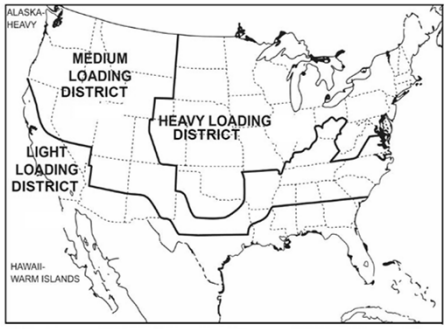
PowerLine Technology, Inc.
PoleForeman

- Typical pole loading calculations include:
  - Pole loading based on wind span and weight span
  - Pole Buckling
  - Guy Tension

74

Part	2
Section	25
Rule	250B, 250C, 250D

Loading districts (250B) extreme wind loading (250C) and extreme ice with concurrent wind loading (250D)



The Warm Island Loading District includes American Samoa, Guam, Hawaii, Puerto Rico, Virgin Islands, and other islands located from latitude 25 degrees south through 25 degrees north.

Figure 250-1—General loading map of United States with respect to loading of overhead lines

Rule 250B (Loading Districts):
- Applies to all poles.

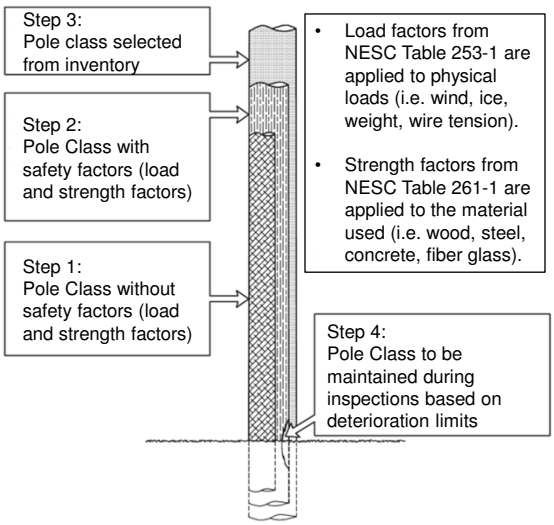
Rule 250C (Extreme Wind) and Rule 250D (Extreme Ice w/ Wind):
- Where a structure or its supported facilities exceeds 60 feet above ground or water level, Rules 250C and 250D apply.
- **Per Rules 261A1c, 261A2e, and 261A3d, extreme wind must be applied to all structures without conductors.**

Changes:
- ***Rule 250B: "Loading zone" was changed to "loading district." The weight of ice changed from 57 lb/ft^3 to 56 lb/ft^3.***
- ***Rule 250C minor wording change to address the 60' exemption, but the exemption still applies. New 100-year extreme wind maps for Grade B and new 50-year extreme wind maps for Grade C. New formulas and tables for the Gust Response Factor. The weight of ice changed from 57 lb/ft^3 to 56 lb/ft^3.***
- ***Rule 250D minor wording change to address the 60' exemption, but the exemption still applies. Rule 250D has new maps with shaded areas for mountainous terrain (50-year maps).***

75

Part	2
Section	25 & 26
Rule	253, 261

Load and strength factors



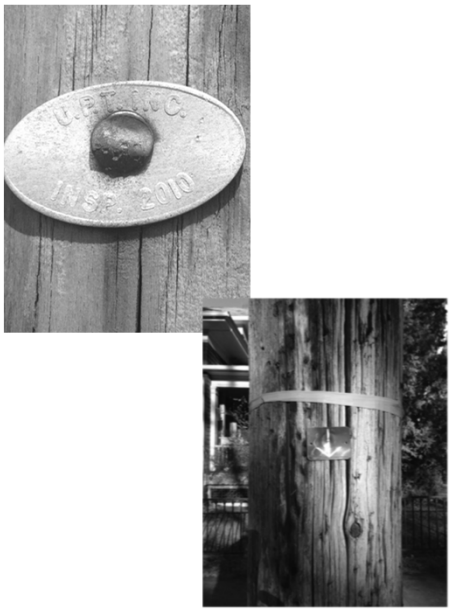
- Load factors from NESC Table 253-1 are applied to physical loads (i.e. wind, ice, weight, wire tension).
- Strength factors from NESC Table 261-1 are applied to the material used (i.e. wood, steel, concrete, fiber glass).

Change:
- ***Table 253-1 changed the load factor for Grade C Extreme Wind Loads from 0.87 to 1.0. Fiber-reinforced polymer materials were added to Footnotes 4 and 5.***
- ***Table 261-1 added a reference for Footnote 6 to support hardware. Footnote 7 was added to replace the wording at the heading of the Table.***
- ***Rule 260A added additional information for deformation, deflection, and displacement.***

76

Part	2
Section	26
Rule	260B

Pole strength and OSHA pre-climb inspections and tests

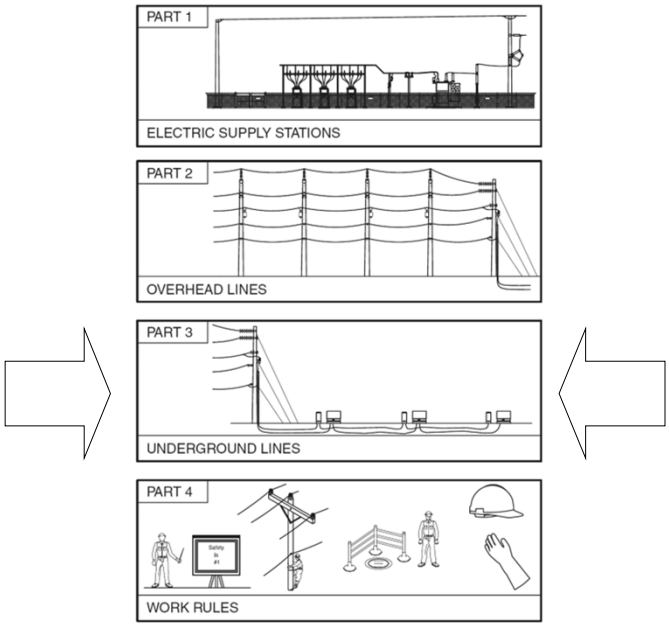


- Communications Test Requirements for Strand
  OSHA 1910.268(n)(5)
- Communications Methods for Testing Wood Poles
  OSHA 1910.268(n)(3)
- Power Methods of Inspecting and Testing Wood Poles
  OSHA 1910.269
  Appendix D

77

Part	3
Section	
Rule	

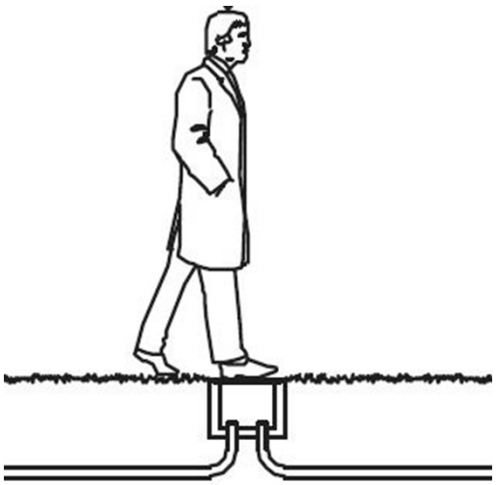
Part 3 – Underground Lines



78

Part	3
Section	32
Rule	323D4

Covers and gratings



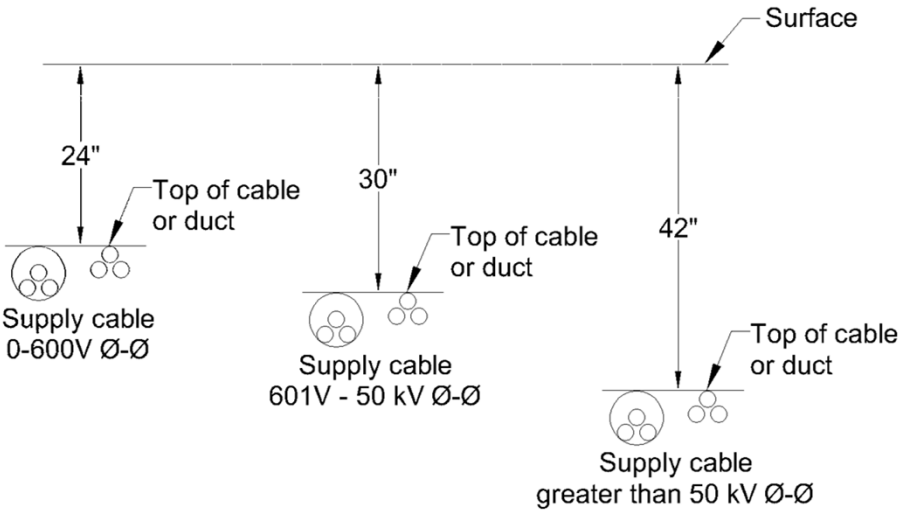
Covers and gratings should be designed to limit the likelihood of tripping by pedestrians.

Change: New paragraph added to the rule to address tripping by pedestrians.

79

Part	3
Section	35
Rule	352D2

Supply cable, conductor, or duct burial depth

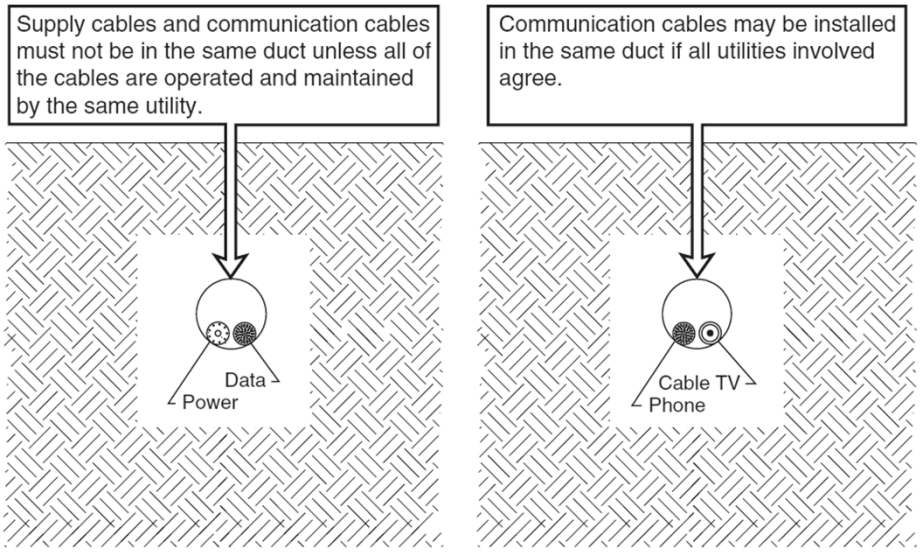


- Rule 352
  - The Rule starts with “Sufficient Distance” wording, this wording applies to communication cables as Table 352-1 is for supply cables.

80

Part	3
Section	35
Rule	352E1, E2

Supply in communication cables and duct

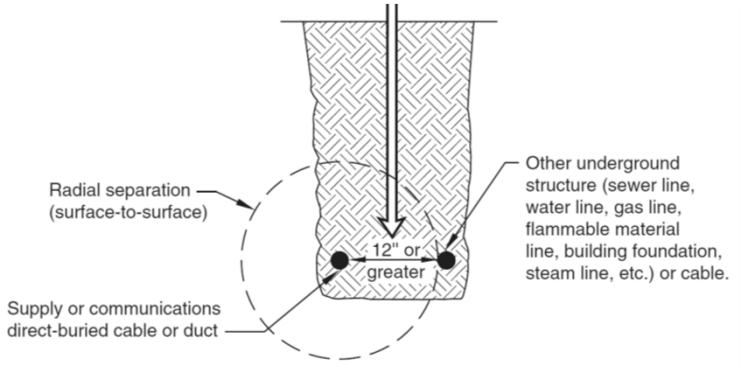


Change: Renumbered the Rule.

81

Part	3
Section	35
Rule	353 &354

Rule 353: Deliberate separations – equal to or greater than 12"
Rule 354: Random separation – separation less than 12"



Rule 353: Deliberate separations – equal to or greater than 12" (This is the basic rule.)
Rule 354: Random Separation – separation less than 12" (Additional rules must be met to install power and communication conductors less than 12" apart.)

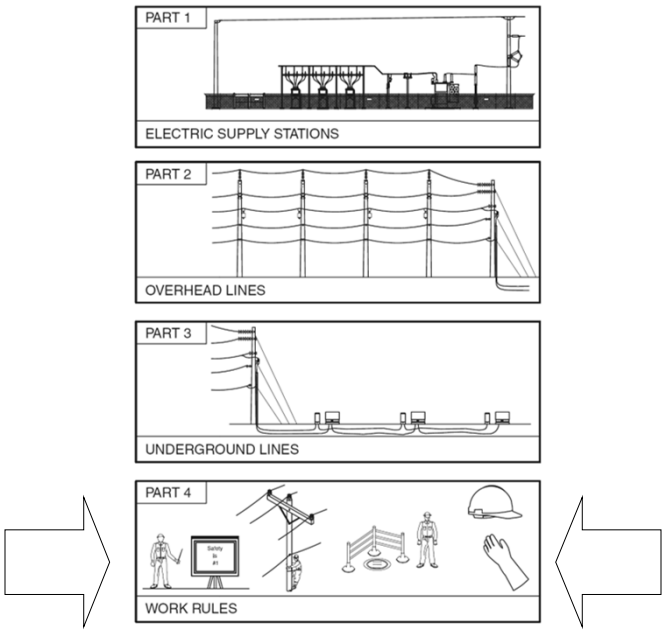
Change:

- ***An exception was added to Rule 354D1g to increase the 1,000' bonding requirement between supply and communication conductors if the parties agree.***
- ***An exception was added to Rule 354G3 to decrease the 8 grounds in each mile for certain installations.***

82

Part	4
Section	
Rule	

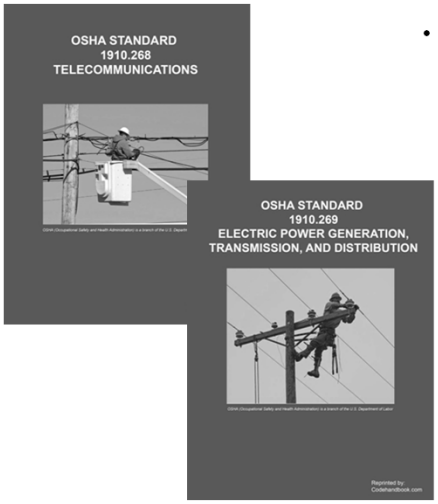
Part 4 – Work Rules



83

Part	4
Section	40
Rule	

Related OSHA Standards

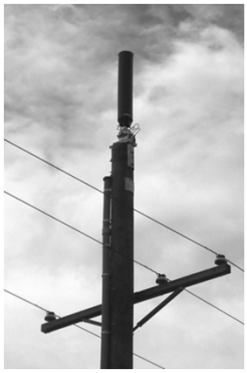


- OSHA Standards related to the NESC Work Rules:
  - 1910.268 – Telecommunications (Operations and Maintenance)
  - 1910.269 – Electric Power Generation, Transmission, and Distribution (Operation and Maintenance) Revised 2014

84

Part	4
Section	41
Rule	410A6

Supply and communication systems – rules for employers



- Rule 410A6
  - The employer shall provide radio-frequency (RF) safety training to all employees who work in the vicinity of antennas.

Change: Added / modified wording to clarify the Rule.

85

Part	4
Section	42
Rule	420K

Fall protection

- Rule 420K
  - Fall protection is required while climbing, transferring, or transitioning across obstacles.
  - Wood-pole fall-restriction devices meeting ASTM Standards are deemed to meet anchorage strength requirements.

86

Part	4
Section	42
Rule	421A6

Job briefing

A job briefing should include the following items:

- Work procedures
- Personal protective equipment requirements
- Energy source controls
- Hazards associated with the job
- Special precautions
- Information necessary to respond to emergencies.

An employee working alone does not need to conduct a job briefing. However, the tasks performed should be planned as if a briefing was required.

Change: Added the wording " information necessary to respond to emergencies" to the list of job briefing items. Also added wording about working alone.

87

Part	4
Section	42
Rule	423B

Testing for Gas in Manholes

- The atmosphere must be tested for combustible or flammable gases before entry.
- When detected, the work area must be ventilated.
- Unless continuous ventilation is used, a test must also be made for oxygen deficiency.
- Provisions must be made for adequate, continuous air supply.

88

Part	4
Section	43
Rule	431

NESC Table 431-1 – Communication work minimum approach distances

Table 431-1—Communication work minimum approach distances [3, 4]
(See Rule 431 in its entirety.)

Voltage range phase-to-phase (rms) [1]	Distance to employee at altitudes from sea level to 12 000 ft		
0 to 50 V [2]	Not specified		
51 to 300 V [2]	Avoid contact		
301 to 750 V [2]	1 ft-1 in		
751 V to 15 kV	2 ft-3 in		
15.1 kV to 36 kV	3 ft-0 in		
36.1 kV to 46 kV	3 ft-6 in		
46.1 kV to 72.5 kV	4 ft-0 in		
Voltage range phase-to-phase (rms) [1]	At altitudes from		
	Sea level to 3000 ft	3001 ft to 6000 ft	6001 ft to 12 000 ft
72.6 kV to 121.0 kV	4 ft-9 in	5 ft-0 in	5 ft-10 in
121.1 kV to 145.0 kV	5 ft-4 in	5 ft-8 in	6 ft-8 in
145.1 kV to 169 kV	5 ft-10 in	6 ft-3 in	7 ft-3 in
169.1 kV to 242 kV	7 ft-8 in	8 ft-2 in	9 ft-8 in
242.1 kV to 362 kV	12 ft-3 in	13 ft-2 in	15 ft-8 in
362.1 kV to 420 kV	14 ft-11 in	16 ft-2 in	19 ft-2 in
420.1 kV to 550 kV	17 ft-8 in	19 ft-0 in	22 ft-8 in
550.1 kV to 800 kV	23 ft-8 in	25 ft-5 in	30 ft-4 in

89

Part	4
Section	44
Rule	441

NESC Table 441-1 – AC live work minimum approach distance

Table 441-1—AC live work minimum approach distance [4]
(See Rule 441 in its entirety.)

Voltage in kilovolts phase-to- phase [1, 2, 3]	Distance to employee [4]			
	Phase-to-ground		Phase-to-phase	
	(ft-in)	(m)	(ft-in)	(m)
0 to 0.050	Not specified		Not specified	
0.051 to 0.300	Avoid contact		Avoid contact	
0.301 to 0.750	1-1	0.33	1-1	0.33
0.751 to 5.0	2-1	0.63	2-1	0.63
5.1 to 15.0	2-2	0.65	2-3	0.68
15.1 to 36.0	2-7	0.77	3-0	0.89
36.1 to 46.0	2-10	0.84	3-3	0.98
46.1 to 72.5	3-4	1.00	4-0	1.20

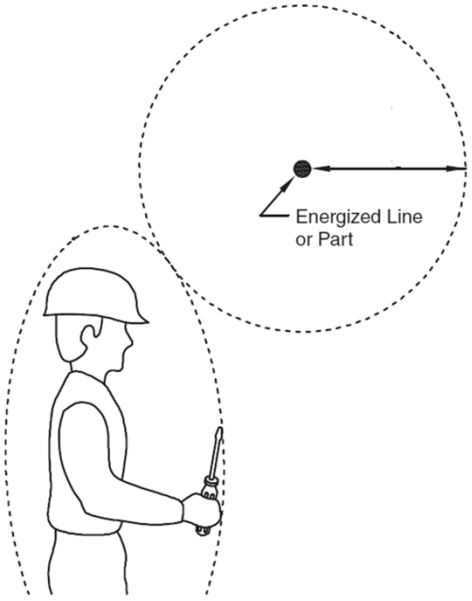
Voltage in kilovolts phase-to-phase	Distance to employee from energized part [4, 5, 6, 10]					
	Without live-line tools phase-to-ground		With live-line tools phase-to-ground [7, 9]		Without live-line tools phase-to-phase [8]	
	(ft-in)	(m)	(ft-in)	(m)	(ft-in)	(m)
72.6 to 121	3-6	1.06	3-9	1.13	4-8	1.42
121.1 to 145	4.0	1.21	4-4	1.30	5-5	1.64
145.1 to 169	4-6	1.36	4-10	1.46	6-5	1.94
169.1 to 242	6-2	1.87	6-8	2.01	10-2	3.08
242.1 to 362	10-6	3.19	11-3	3.41	18-2	5.52
362.1 to 420	13.2	3.99	14-0	4.25	22-5	6.81
420.1 to 550	15-9	4.78	16-8	5.07	27-1	8.24
550.1 to 800	21-6	6.53	22-7	6.88	37-5	11.38

Change: The Table was updated to clarify that tools are live-line tools.

90

Part	4
Section	44
Rule	441

Minimum approach distance



- Minimum Approach Distance (MAD)
  - Reach is defined as the range of anticipated motion of an employee while performing a task.
  - Extended reach is defined as the range of anticipated motion of a conductive object being held by an employee while performing a task.

91

Summary from OSHA 1910.332 and OSHA 1910.333

- **Unqualified persons.**
  - For voltages to ground 50kV or below - 10 feet.
  - For voltages to ground over 50kV - 10 feet plus 4 inches for every 10kV over 50kV.
- **Additional requirements for qualified persons.**

  Trained and familiar with:
  1. The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.
  2. The skills and techniques necessary to determine the nominal voltage of exposed live parts, and
  3. The Minimum Approach Distance to which the qualified person will be exposed.

92

Selected OSHA Standards

- Selected OSHA 1910.268 standards related to the NESC Part 4 Work Rules (for communication workers)
  - Insulated gloves
    - 1910.268(m)(5): Attaching and removing temporary bonds
    - 1910.268(n)(1)(i): When handling cable suspension strand which is being installed on poles carrying exposed energized power conductors
    - 1910.268(n)(11)(iv): When handling the pole with either hands or tools, when there exists a possibility that the pole may contact a power conductor
  - Hard hats (Class E, Electrical)
  - Voltage test
  - No metal tapes and ropes
  - Pre-climb testing of wood poles and strand

93

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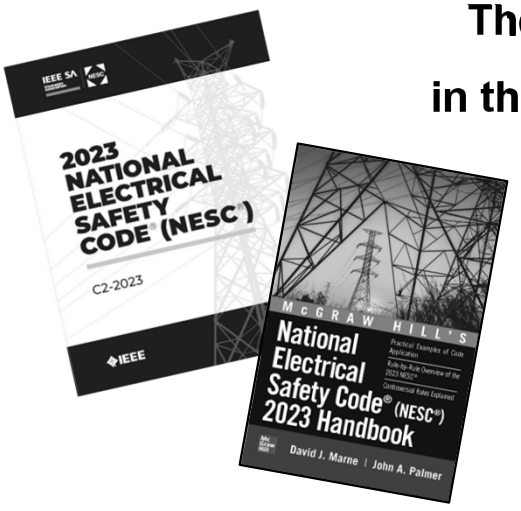

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