1988–1990

National Electrial Safety Code

Interpretations

1988—1990 inclusive

National Electrical Safety Code Committee, ANSI C2

National Electrical Safety Code Interpretations 1988–1990 inclusive

A companion volume to

National Electrical Safety Code Interpretations
1961–1977 inclusive

National Electrical Safety Code Interpretations
1978–1980 inclusive
with interpretations prior to the 6th Edition, 1961

National Electrical Safety Code Interpretations
1981–1984 inclusive

National Electrical Safety Code Interpretations
1984–1987 inclusive

Abstract: This edition includes official interpretations of the National Electrical Safety Code as made by the Interpretations Subcommittee of the National Electrical Safety Code Committee, ANSI C2.

Keywords: electric supply stations, overhead electric supply and communication lines, underground electric supply and communication lines, clearances to electric supply and communication lines, strength requirements for electric supply and communication structures.

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Contents

Foreword

In response to repeated public inquiries and requests from C2 Cormmittee members, the IEEE C2 Secretariat arranged for publication of Interpretation Requests received and Interpretations made by the National Electrical Safety Code Subcommittee on Interpretations. The original requests have been lightly edited to remove extraneous matter and focus on the C2 problem presented. Some illustrations have been redrawn for publication. With these exceptions, requests are in the form received.

The first volume, INTERPRETATIONS 1961–1977, published in 1978 included the first interpretation request received for the 6th Edition of Part 2 (IR 92, May 1961) and ended with the last interpretation issued in 1977 (IR 212). The second volume, INTERPRETATIONS 1978–1980, continued with IR 213 issued in 1978 and ended with the last interpretation issued in 1980 (IR 283). It also includes all interpretations found in the archives and applying to the 5th and prior editions of the Code (IR 11 through IR 90). Where no copy of an interpretation request or an interpretation could be found in the archives, this fact is noted. The third volume, INTERPRETATIONS 1981–1984, continued with interpretation IR 284 issued in 1981 and ended with IR 361 issued in 1984. It also contained requests IR 362 to IR 366, but did not include their interpretations, as the Interpretations Subcommittee still had them under consideration at press time. INTERPRETATIONS 1984–1987 incorporated IR 362 to IR 366 with their interpretations, continued with IR 367, issued in 1984, and ended with IR 415, which was requested in 1987. This new volume, INTERPRETATIONS 1987–1990, incorporates interpretations for IR 407, IR 413, and IR 414, which were not included in the last volume, and includes interpretation requests to IR 443. Interpretations have not yet been provided for IR 442 and IR 443.

The Secretariat hopes that the publication of all interpretations will prove helpful to those concerned with the National Electrical Safety Code.

National Electrical Safety Code Interpretations
Introduction

General: Interpretations are prepared by the National Electrical Safety Code Interpretations Subcommittee in response to formal requests received by the National Electrical Safety Code Committee Secretariat.

This volume contains all interpretations issued on the National Electrical Safety Code 1988 through 1990.

Arrangement: This compilation includes a numerical index for all issued interpretations arranged in order of interpretation number, showing the rule number and topic covered. This will be convenient for location of the text if the user has only the interpretation request number available.

Interpretation requests and interpretations quoted in full are arranged according to the primary rule number. Applicable cross references are inserted appropriately if a request covers several rules. If illustrations were provided, they follow the Interpretation Request text. In the 1977 Edition some changes were made in the rule numbers. Exact correspondence of Rule numbers between other editions does not exist in some cases. Interpretations published in the 1977, 1981, 1984, 1987, and 1990 Editions are identified to show the Edition in which they were published.

The request data refers to the date on the original letter request. The Interpretation date is the date of the response letter.

Procedure for Requesting an Interpretation: Requests for interpretation should be addressed to:

Secretary
National Electrical Safety Code Committee, ANSI C2
IEEE Standards Office
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331

Requests for interpretations should include:

1 The rule number in question.
2. The applicable conditions for the case in question.

Line drawings should be black ink or excellent black pencil originals. Photos should be black and white glossy prints. These illustrations must be reproduced for committee circulation and eventually will be used to supplement the text of our next edition. Clear diagrams and pictures will make the work of interpretation easier and more valuable to C2 users.

Requests, including all supplementary material, must be in a form that is easily reproduced. If suitable for Subcommittee consideration, requests will be sent to the Interpretations Subcommittee. After consideration by the Subcommittee, which may involve many exchanges of correspondence, the inquirer will be notified of the Subcommittee's decision. Decisions will be published from time to time in cumulative form and may be ordered from IEEE.

Interpretations are issued to explain and clarify the intent of specific rules and are not intended to supply consulting information on the application of the Code. The Interpretations Subcommittee does not make new rules to fit situations not yet covered.

Numerical Listing by Interpretation Request (IR) Numbers

(The volume in which the Interpretation appears is listed in italics below the IR number.)

Request Date	*IR Number*	*Subject*	*Rule*
(Dec 23, 43)	11 *78/80*	Will use of Lamicoid marker on cross-arms of 550V power supply circuits comply with marking rule	220B3b
(Jan 18, 44)	12 *78/80*	Avoiding fatigue failure in conductors under tension	233A, Table 3
(Aug 4, 44)	13 *78/80*	Clearance over farmland	232A, Table 1
(Nov 16, 44)	14 *78/80*	a) Transverse wind loading b) Definition of "grades" of construction	251
(Nov 13, 44)	15 *78/80*	Climbing space minimum clearance	235A3, Table 9
(Nov 14, 44)	16 *78/80*	Clearance of primary neutral conductor over communication conductor	233A, Table 3
(Nov 11, 44)	17 *78/80*	Allowable stress in members of steel structure	261, Table 16
(Dec 18, 44)	18 *78/80*	For special construction supply circuits is 550 the minimum allowable voltage or the nominal?	220B3
	19	*No record*	
(Feb 15, 45)	20 *78/80*	Do words "containing steel" describe composite conductor or merely any wire of such a stranded conductor?	261F2

Numerical Listing by Interpretation Request (IR) Numbers

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	21 *through* 23	*No record*	
(May 26, 45)	24 *78/80*	Change of districting from heavy to medium loading	250
(Oct 23, 45)	25 *78/80*	Increased clearances for excess span length	232B
(Dec 15, 45)	26 *78/80*	a) Vertical and transverse loadings;	261A4a
		b) Strength requirements for dead-end and transverse guys	261C5a
	27	*No record*	
(Apr 24, 46)	28 *78/80*	Insertion of choke coil in ground lead	Section 9, No Rule
	29 30	*No record*	
(Mar 28, 47)	31 *78/80*	Clearance over farm fields for voltages of 50kV	232, Table 1
	32 *through* 36	*No record*	
(June 8, 47)	37 *78/80*	High voltage transmission lines; excessive clearance requirements	235A, Table 9
	38 *through* 41	*No record*	
(June 30, 49)	42 *78/80*	Deflection data on tubular steel poles	260
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Numerical Listing by Interpretation Request (IR) Numbers

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(Oct 31, 49)	46 *78/80*	Thickness of metal used for metal poles	261A3e
(Dec 2, 49)	47 *78/80*	Clearances from building	234C4
	48	*No record*	
(May 10, 50)	49 *78/80*	Classification of jumper wires at poles	235A3, Table 9
(May 26, 50)	50 *78/80*	Guys attached to wood poles	283B4b
(Aug 25, 50)	51 *78/80*	Double crossarm over railroad tracks in suspension insulator type of construction	261D5
(Aug 30, 50)	52 *78/80*	Clearance for communications conductors used exclusively in the operation of supply lines	238B, 238E
	53, 54	*No record*	
(Jan 31, 51)	55 *78/80*	Ground resistance: a) limit, b) measurement requirement	96A,B
	56	*No record*	
(Aug 21, 51)	57 *78/80*	Horizontal or vertical clearances from buildings	234C4, Table 4
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(Mar 10, 52)	59 *78/80*	Clearance from buildings	234C4a(1) and (2)
(Mar 27, 52)	60 *78/80*	Clearance with suspension insulators	232A, Table 1; 232B1a(1); 232B3

Numerical Listing by Interpretation Request (IR) Numbers

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(July 16, 52)	61 *78/80*	Grade B construction, conductor size; does Exception 2 apply to railroad crossings?	261F2
(Nov 27, 52)	62 *78/80*	Are clearance increases cumulative in 1, 2, and 3 as indicated in the text on page 52?	233A, B
(Apr 10, 53)	63 *78/80*	Vertical separation at supports	238A, Table 11
(June 15, 53)	64 *78/80*	a) Definition: Communication Lines	Definition 45
		b) Classification of CATV cable as a communication circuit	238
(June 4, 53)	65 *78/80*	Interpretation of footnote "c" appearing in Table 14, allowing Grade C construction	242; 243
(May 14, 53)	66 *78/80*	Clearance to building or similar structure	234C4
(Aug 5, 53)	67 *78/80*	Clearances from buildings	234C4, Table 4
(Oct 1, 53)	68 *78/80*	Does the word "spliced" also refer to pole top extensions?	261A4g
(Dec 30, 53)	69 *78/80*	Clearance between conductors and supporting structures of another line	234B2
(Mar 2, 54)	70 *78/80*	Are galvanized steel ground rods regarded as approved equivalent of rods of nonferrous materials?	95D
	71	*Interpretation was withdrawn*	

Numerical Listing by Interpretation Request (IR) Numbers

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(May 31, 55)	72 *78/80*	Minimum size of conductors in a crossing span of 215 feet over a railroad track	262I2b, Table 24
(July 29, 55)	73 *78/80*	Grounding of guys	283B4
(Aug 1, 55)	74 *78/80*	Horizontal and vertical clearances from a steel windmill tower	234Ca, Table 4
(Aug 29, 55)	75 *78/80*	Guy insulators; acceptability of fiberglass as insulating material	283A1a
(Sept 13, 55)	76 *78/80*	Clearance requirements for telephone lines which pass over driveways into farmer's fields in strictly rural areas	232A, Table 1
(Nov 15, 55)	77 *78/80*	Clearance requirements for conductors passing by or over buildings	234C4a
(Nov 16, 55)	78 *78/80*	Clearance requirements for conductors passing by or over buildings	234C4
(Jan 4, 55)	79 *78/80*	Clearance for cabled service drop, 150 V max to ground	232A Table 1
(Aug 14, 56)	80 *78/80*	Clearance between 8.7-15 kV line and grounded neutral or secondary conductors	237B3
(Apr 18, 56) (Aug 24, 56)	81 *78/80*	Horizontal clearance of supply conductors (300V to 8.7 kV) from buildings	234C4 Table 4
(Sept 15, 56)	82 *78/80*	a) Clearances between conductors on adjacent crossarms	238B1

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		b) Service brackets at end of crossarms	238D
		c) Clearance to buildings	234C3, 4
(Nov 1, 56)	83 *78/80*	a) Increase in clearance, V 50 kV	232B2, 233B2
		b) Clearance for basic and longer spans	234C4
		c) Clearance to building corner	
(Sept 20, 56) (Nov 7, 56)	84 *78/80*	a) Clearance between power and signal conductors on same crossarm	238A Table 11
		b) Clearance between signal conductors and multiple light system circuit	238E
		c) Clearance of vertical supply conductors from communication crossarm	239F
		d) Dead ending or guying of communication messenger	
		e) Spacing between crossarms	
(Feb 26, 57)	85 *78/80*	a) Classification of specific cable construction	230C
		b) Clearance requirements	234D
(May 1, 57)	86 *78/80*	a) Requirements for a fence to prevent unauthorized entry	102
		b) What is practicable limit for reduction of hazards. Does rule apply to employee or public?	110

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		c) Is exterior of porcelain arrester a live part?	114 Table 2,C
		d) Clearance to ground in substation; measured from earth or concrete supporting base for arresters	
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		f) Does locked fence constitute guarding by isolation?	114C
(Jun 12, 57)	87 *78/80*	a) Clearance to building b) Is clearance (in a specific case) in accordance with the NESC?	234C4
(July 15, 57)	88 *78/80*	Can grounding conductor of primary spark gap be solidly interconnected with the secondary neutral on an otherwise ungrounded system?	97
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		b) Insulator swing considerations	236A2a(1) 236A2b
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(Aug 12, 57)	89X *78/80*	a) Clearance for lines 70kV	422C1

Numerical Listing by Interpretation Request (IR) Numbers

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		b) Clearance for hot line work	
		c) Clearance for climbing	
(Oct 24, 58)	90 *78/80*	Systematic inspection—time interval between inspections	213A2
	91	*No record*	
(May 19, 61)	92 *61/77*	Meaning of "supply cables having an effectively grounded continuous metal sheath, or insulated conductors supported on and cabled together with an effectively grounded messenger." Spacer cable	230C
(Apr 13, 62)	93 *61/77*	Clearance between multigrounded neutral and communication service drop	238D
(Mar 5, 62) (Mar 27, 62) (Aug 6, 62) (Aug 8, 62)	94 *61/77*	Plastic guy guards	282E
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(Feb 14, 63)	97 *61/77*	Guy grounding; upper end effectively grounded vs. anchor end ground	282H
(Feb 21, 63)	98 *61/77*	Clearance—horizontal and vertical—from buildings	234C4

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(Apr 22, 63)	100 *61/77*	Insulators in guys	283B2
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(Feb 24, 64)	107 *61/77*	Grounding of transformer tank with tank grounded arrester, via a sparkgap, etc.	97C 93A, B
(Apr 2, 64)	108 *61/77*	Longitudinal strength of towers-Grade B construction.	261A3(b)
(Apr 24, 64)	109 *61/77*	Joint use 7.2 kV/communications-cable joint use poles; insulated strand, self-supporting communications cable.	242

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(Nov 12, 64)	113 *61/77*	Clearance of conductor from building.	234C4(a)
(Aug 2, 66)	114 *61/77*	Clearance of HV conductors around circuit breakers.	114
(Aug 4, 64)	116 *61/77*	13.8 kV distribution clearance with horizontal post insulators without crossarms.	238 Table 11
(Aug 31, 65)	116 *61/77*	Guy guard—on guys to ground anchors—in areas where stock runs.	282E
(Sept 17, 65)	117 *61/77*	(a) Clearance between supply conductors and signs (b) Clearance between pad-mounted transformers and gas metering equipment	23
(Sept 8, 65)	118 *61/77*	Nine questions concerning grounding conductor (1) Mechanical protection for interconnected (arrester and neutral) grounding lead	239C 97C1(b) and(c)

Request Date	*IR Number*	*Subject*	*Rule*
		(2) Required number of grounding connections	97C1(c)
		(3) Allowable omission of mechanical protection	239C and 97C1(b)
		(4) Allowable omission of protective covering	and (c)
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		(6) Method of grounding nonmagnetic mechanical protection	239C
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		(9) Allowable interconnection of grounding neutrals	97C
(Sept 2, 65)	119 *61/77*	Insulator electrical strength	272
(Dec 3, 65)	120 *61/77*	Clearance between highway lighting standards and transmission lines	243B
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		(c) Crossing of power and communications lines	261D5
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(Feb 22, 67)	124 *61/77*	Substation conductor clearance to building	114A1 and 234C4(a)
(Dec 23, 66)	125 *61/77*	Distinction between urban and rural	232A
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		(b) Ground neutral clearance to building	230D 234C4
		(c) Spaces and ways accessible to pedestrians	232A, Table 1
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(Apr 16, 68)	128 *61/77*	Meaning of "closely latticed poles or towers"	280A2(b)
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	152	Number not assigned	
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(Feb 5, 74)	155 *61/77*	Cable burial depth	353D

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(Oct 17, 73)	156 *61/77*	Clearances from buildings; Meaning of voltage	234C, Table
(Feb 25, 74)	157 *61/77*	Antenna conflicts	Def.
(Dec 18, 72)	158 *61/77*	Clearance for line	234
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(May 14, 74)	160 *61/77*	Clearances—Wires on different supports, voltages 50 kV; also above ground or rails	233B2 232B2
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(May 17, 74)	162 *61/77*	Definition of "constant potential" in grades of construction	242, Table 15
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(May 29, 74)	164 *61/77*	"Immediate vicinity of a fault" as applied to damage withstanding capability of underground cable	330D
(Aug 22, 74)	165 *61/77*	Basic clearance—Wires above ground; "Accessible to pedestrians only"	232A
(Nov 1, 74)	166 *61/77*	Grounded neutral; Definition of 4 grounds per mile	97C1(c)
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		when jacking for hot line maintenance is taken into account	
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(Mar 19, 75)	171 *61/77*	Communication cable burial depth	353D
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(May 29, 75)	173 *61/77*	Clearance, line to adjacent steel structure; Voltage definition	234B1 234C, Table 4
(Sept 29, 75)	174 *61/77*	Clearance to building and guarding	234C4
(Sept 30, 75)	175 *61/77*	Clearance between conductors in substations	235A, Table 6
(Dec 15, 75)	176 *61/77*	Climbing space	236
(Dec 18, 75)	177 *61/77*	Fence height	110A
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(Feb 5, 76)	179 *61/77*	Guy guards; meaning of "traffic"	282E
(Feb 3, 76)	180 *61/77*	Construction grade of line; Effect of additional loading	261A4
(Mar 8, 76)	181 *61/77*	Application of *K*-factors	251, 252
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(Feb 18, 77)	189 *61/77*	Clearance of neutral to building	234C4a(1) Table 4
(May 23, 77)	190 *61/77*	(a) Requirements for disconnect switch (b) Energized switch blade	173C, 170, 171
(Mar 23, 77)	191 *61/77*	Foundation strength for steel pole structure	261B
(Mar 24, 77)	192 *61/77*	Clearance to energized parts in substation	124
(Apr 18, 77)	193 *61/77*	Outside substation (a) vertical clearance to live parts (b) definition of voltage	114A; 114C1
(May 9, 77)	194 *61/77*	Intent of term "proximate facilities"	212
(May 10, 77)	195 *61/77*	Clearance required for communication conductors over roads	232A
(July 14, 77)	196 *61/77*	Neutral grounding for buried concentric neutral cable with semi-conducting sheath	350E

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(July 1, 77)	197 *61/77*	Clearance to roads; high temperature transmission lines	232B2d(2)
(July 12, 77)	198 *61/77*	Clearance to chimney; meaning of attachments	234C4(a)
(July 14, 77)	199 *61/77*	Meaning of "readily climbable"	280A1b
(July 8, 77)	200 *61/77*	Application of extreme wind loading	250C
(July 27, 77)	201 *61/77*	(a) Implication of retrofitting	102B
		(b) Fence height	110A
(Aug 23, 77)	202 *61/77*	Supply cable requirements, OR vs AND	230C
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(Sept 13, 77)	204 *61/77*	Grounding—pole butt plates	94B4b
(Sept 3, 77)	205 *61/77*	Electrostatic effects	234F1c
(Sept 15, 77)	206 *61/77*	CATV cable clearance	232A, Table 1
(Oct 3, 77)	207 *61/77*	Transmission line clearances	232B2d
		Meaning of "maximum conductor temperature for which the line is designed to operate" with respect to designed for, but unplanned contingencies	
(Oct 31, 77)	208 *61/77*	Neutral clearance to bridge	234D1, Table 234-2
(Oct 31, 77)	209 *61/77*	Vertical clearance at supports	235C1, Table 235-5

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Oct 31, 77)	210 *61/77*	Clearance from line conductors at supports (a) Meaning of minimum clearance (b) Clarification of "voltages are between conductors" (c) Reason for additional clearances on joint poles	235E1, Table 235-6
(Nov 4, 77)	211 *61/77*	(a) Omission of fiber stress calculation point formerly stated in 6th Edition, 261A4a,b	261A2b,c
		(b) Meaning of "other supported facilities"	260C
(Nov 11, 77)	212 *61/77*	Grounding of supporting structures	215C1
(Nov 26, 77)	213 *78/80*	Load on structure or foundation; application of overload capacity factors	260C
(Nov 28, 77)	214 *78/80*	Application of overload capacity factor unguyed and guyed angle factors	261A2d
(Dec 12, 77)	215 *78/80*	Meaning of "reconstructions"	202B1
(Dec 21, 77)	216 *78/80*	Load on foundation, application of overload capacity factors	261B
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Numerical Listing by Interpretation Request (IR) Numbers

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(Jan 18, 78)	220 *78/80*	Reconstruction definition. Does line voltage change from 7.2/12.5 kV to 14.4/24.9 kV require compliance with 1977 Edition clearances?	202B
(Jan 25, 78)	221 *78/80*	Horizontal clearance under wind loading. One or both conductors under maximum swing angle?	233B1; 233B1b
(Jan 25, 78)	222 *78/80*	Horizontal clearance between line conductors 2 circuits 115 kV and 230 kV on same support	235B1
(Feb 7,78)	223 *78/80*	Service drops—clearance to ground	232, Table 232-1
(Jan 26, 78)	224 *78/80*	Clearance over residential driveways	232, Table 232-1
(Feb 14, 78)	225 *78/80*	Clearance of primary riser termination from communication cable	Table 232-1 239F
(Feb 23, 78)	226 *78/80*	Clearance in pole to building spans between communication and electric supply service drops	235C2b
(Feb 23, 78)	227 *78/80*	(a) Magnitude limit of ground fault storage	215C1

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
		(b) Intent of "effectively grounded"	
(Feb 28, 78)	228 *78/80*	(a) Centerline spacing for adequate clearance between parallel lines on separate structures	233B1 235B2
		(b) Use of switching surge factor in above case	235B3
(Mar 6, 78)	229 *78/80*	Clearance to bridle guy	235E
(Apr 5, 78)	230 *78/80*	Definition of recontruction	202B
(Apr 6, 78)	231 *78/80*	Example requested	231B1a
(Apr 6, 78)	232 *78/80*	Horizontal and vertical clearances; effect of high temperature	234
(Apr 11, 78)	233 *78/80*	2: Does the exception apply to horizontal clearances or both	234B Table 235-5
		5: Vertical separation of conductors of same circuit	Table 235-5
(July 21, 78)	234 *78/80*	Use of line conductor as grounding point in place of common point on wye-connected secondary	92B1
(July 27, 78)	235 *78/80*	Use of double guy insulators in down guy	283B2b
(Sept 19, 78)	236 *78/80*	Insulator in down guy	283A3
(Sept 19, 78)	237 *78/80*	Rationale involved in calculating basic clearances shown in Table 234-3	234E1, Table 234-3

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Sept 25, 78)	238 *78/80*	Governing clearance to building—horizontal or vertical	234C4a
(Oct 31, 78)	239 *78/80*	Calculation of support load at angle in line	252B3
(May 24, 78)	240 *78/80*	Floor drains for transformer installations. Meaning of "outside the building"	153B1
(Nov 30, 78)	241 *78/80*	Definition of "large"; meaning of "segregated"	153A2
(Jan 2 & 11, 79)	242 *78/80*	Interpretation of clearance measurement; communication to power conductors	235C1; 238B Tables 235-5 and 238-1
(Jan 17, 79)	243 *78/80*	New installations, reconstruction extensions; status of existing installation if cable TV line is added	202B
(Jan 17, 79)	244 *78/80*	Definition of unsealed jars and tanks	141
(Feb 13, 79)	245 *78/80*	Overload capacity factors for composite components	261
(Feb 5, 79)	246 *78/80*	Frequency of inspection for service drops	214A2
(Mar 13, 79)	247 *78/80*	Service drop conductors (a) Minimum height in span (b) Minimum height of point of attachment	232, Table 232-1
(Mar 15, 79)	248 *78/80*	Grain bin clearance (building vs tank) 115 kV line	234C, Table 234-1

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Mar 23, 79)	249 *78/80*	Spaces or ways accessible to pedestrians only; service drop clearance	232, Table 232-1
(Mar 27, 79)	250 *78/80*	Application of an overload capacity factor of 4.0 to the vertical load on an eccentric loaded column	261A2b
(June 1, 79)	251 *78/80*	Clearance requirements for building in transit	234
(June 25, 79)	252 *78/80*	Clearance of service drop	238D
(July 11, 79)	253 *78/80*	Grounding of rolling metal gate of a substation	92E
(Aug 29, 79)	254 *78/80*	(a) Distinction between rule, recommendation, Note exception (b) Requirements for guy insulator	283B1
(Oct 15, 79)	255 *78/80*	Clearance for CATV amplifier power feed	220B2; 235E; 235G
(Nov 2, 79)	256 *78/80*	Effect of trees on minimum clearances	232, Table 232-1
(Nov 2, 79)	257 *78/80*	Disconnecting provision acceptability	173B
(Nov 6, 79)	258 *78/80*	Location of padmounted equipment	231B Section 38
(Nov 7, 79)	259 *78/80*	(a) Steel tower and footings—bonding requirements	94A3
		(b) Acceptability as ground electrode of 20 ft steel wire wrapped around rebar cage	94B6

Request Date	IR Number	Subject	Rule
		(c) Does 95A3 apply only to buildings or are steel supporting structures included also?	95A3
(Nov 8, 79)	260 *78/80*	Determination of diagonal clearance	234 Fig 234-1;
(Oct 23, 79)	261 *78/80*	Conductor clearance for line near recreational water area	232, Table 232-1
(Nov 12, 79)	262 *78/80*	Conductor clearance to swimming pool slide	234E1 Table 234-3
(Jan 4, 80)	263 *78/80*	Acceptability of steel wire wrapped around reinforcing bar cage as grounding electrode	94A3
(Jan 21, 80)	264 *78/80*	Horizontal clearance between wires in a triangular configuration	235 Table 235-5
(Mar 3, 80)	265 *78/80*	Guarding requirement applicability Clearance to building	234C4b
(Mar 7, 80)	266 *78/80*	Ice loading computation on noncircular cross-section conductor	251A
(Mar 20, 80)	267 *78/80*	(a) Voltage between conductors	235C
		(b) Ground required at distribution transformer	94B4a
(May 16, 80)	268 *78/80*	(a) Is base of epoxy extension arm noncurrent carrying?	238A, B Table 238-1
		(b) Spacing required between noncurrent carrying parts of adjacent supply and communication circuits	

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(May 21, 80)	269 *78/80*	Communication cable clearance to ground	232A, Table 232-1
(June 25, 80)	270 *78/80*	Clearance over snow covered ground	232A
(June 13, 80) (July 16, 80)	271 *78/80*	Warning signs on tubular steel poles	280A1b
(July 14, 80)	272 *78/80*	Grade of construction for conductors/structure	242
(July 24, 80)	273 *78/80*	Use of steel-clad copper wire as neutral conductor on direct buried, bare concentric neutral cable	332
(July 25, 80)	274 *78/80*	Clearance to conveyor structure	234C
(Aug 6, 80)	275 *78/80*	Clearance to ground for equipment on structures—not above a roadway	286E
(Aug 18, 80)	276 *78/80*	Meaning to be attached to "prevent" in connection with equipment enclosures	110A
(Aug 25, 80)	277 *78/80*	Ground clearance for service	232 Table 232-1
(Aug 25, 80)	278 *78/80*	Installation of submarine cable on islands in connection with aids to navigation	330
(Sept 4, 80)	279 *78/80*	Clearance for aerial secondary and service conductors with an insulated neutral	230C
(Sept 9, 80)	280 *78/80*	Neutral separation on distribution transformer poles to minimize dc flow	96A

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Oct 14, 80)	281 *78/80*	Clearances to noncurrent-caryying metal parts clearance for CATV	235
(Oct 17, 80)	282 *78/80*	Clearance for oversize haulage trucks	232A
(Dec 8, 80)	283 *78/80*	Clearance at crossing between transmission line and rigid bus structure	124A Table 2
(Jan 13, 81)	284 *81/84*	Clearance for sailboating	232A, Table 232-1
(Dec 19, 80)	285 *81/84*	Location of high longitudinal strength structures with respect to higher-grade section in line of lower-grade construction	261A4a
(Jan 19, 81)	286 *81/84*	Spacing between communication cables of power and communication utilities when located below supply lines	235C1, Table 235-5
(Jan 19, 81)	287 *81/84*	Objectionable voltages, neutral/ground	92D
(Jan 23, 81)	288 *81/84*	Clearance from communication cable to tap & drip loop of supply cable	235C; 235D
(Jan 30, 81)	289 *81/84*	Clarification of clearance at crossing	233A, Fig 233-1
(Jan 30, 81)	290 *81/84*	Conductor clearance; applicability of catenary curve considerations	232A; 233A1; 234A
(Feb 2, 81)	291 *81/84*	(a) Connection of fence grounding conductor to fence posts	93C

Request Date	*IR Number*	*Subject*	*Rule*
		(b) Extension of existing 6 ft fence	013; 110A; IR 177; 201b
(Mar 4, 81) (Mar 10, 81)	292 *81/84*	Clearance required when second cable is added; Communication cable additional clearance; Reduced clearance to guys	013B2 232B, Table 232-1
(Apr 7, 81)	293 *81/84*	Is tagging of remote *close/trip* control required if device is otherwise rendered inoperable	423C
(Mar 25, 81)	294 *81/84*	4.8 kV ungrounded delta, change from grade C to B, believed inadvertent when footnote 7 changed	242, Table 242-1 Footnote 7 Table 15 (73 Ed.)
(May 6, 81)	295 *81/84*	Wye distribution system with neutral omitted in one feed	92B2; 215B
(May 27, 81)	296 *81/84*	Replacement of structures strength and clearance required in completed work	013B
(Jan 12, 81)	297 *81/84*	AIEE Std 41, March 1930 (ASA C29a-1930) appears to have been superseded byANSI C29.1-1976 Electric Power Insulator, Test	273
(June 1, 81)	298 *81/84*	Grounding of lamp posts	92D; 93; 215C1; 314B
(June 15, 81)	299 *81/84*	(a) Connection of two items to same grounding electrode	97A

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
		(b) Connection of arrester ground to grounded neutral	97C1b
		(c) Reasons for prohibiting solid interconnection of arrester grounding conductor and secondary grounding conductors	97
(June 25, 81)	300 *81/84*	(a) Guarding by fence enclosure	110A
		(b) Applicability of clearances: i) within fence enclosure; ii) within vault	124A, Table 2
(June 29, 81)	301 *81/84*	Depth of burial in rock and acceptable supplemental protection	353D2
(July 21, 81)	302 *81/84*	At crossing, Grade C Construction Definition of crossing	261A2, Table 261-3
(Aug 20, 81)	303 *81/84*	Protective covering requirements for power conductors passing through communication space	239A
(Aug 24, 81)	304 *81/84*	Minimum allowable clearance	232B2b; 232B2c(1)
(Oct 6, 81)	305 *81/84*	Clearance to tanks containing flammables	234C, Table 234-1
(Dec 8, 81)	306 *81/84*	Clearance for underbuild	233C1, Table 233-1
(Dec 10, 81)	307 *81/84*	Guard over ground lead	93D1
(Dec 16, 81)	308 *81/84*	Clearance over waterways	232A, Table 232-1
(Dec 21, 81)	309 *81/84*	Clearance to building	234C4 (73 Ed.)

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Nov 11, 81)	310 *81/84*	Vertical clearance between line and, at supports	235C, Table 235-5
(Nov 12, 81)	311 *81/84*	Clearance to street lighting brackets	238B, Table 238-1
(Jan 8, 82)	312 *81/84*	Clearance from supply equipment to CATV cable	239F1
(Feb 23, 82)	313 *81/84*	Clearance to flag pole with flag	234C2, Table 234-1
(Feb 23, 82)	314 *81/84*	(a) Thickness of pole butt plates	94B4b
		(b) Acceptability of #6 copper wire as a grounding electrode	97C
(Mar 11, 82)	315 *81/84*	Guarding of Supporting Structure—Potentially exposed to "abrasion by traffic"	280A2(A)
(Mar 18, 82)	316 *81/84*	Classification of below grade structure	323
(Mar 17, 82)	317 *81/84*	Overload capacity factor for guyed pole used as a column	261A2e, Table 261-3
(Mar 18, 82)	318 *81/84*	Door latch operation from inside requirement applicability to hinged-door cover on below grade structure	323F2
(Mar 26, 82)	319 *81/84*	Clearance to front of control board	125A3, Table 125-1
(Apr 1, 82)	320 *81/84*	Adequacy of protection against mechanical damage	161
(Apr 5, 82)	321 *81/84*	Grade of construction for joint use with 7.2 kV open wire above communication circuits	242, Table 242-1

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Apr 29, 82)	322 *81/84*	Clearance from bottom of wave trap supporting insulator to ground	124A1, Table 124-1 Footnote 1
(May 18, 82)	323 81/84	Clearance to building	233A3; 234C3, Table 234-1 Figure 234-1
(June 4, 82)	324 81/84	Clearance of structure from roadway	231B1
(June 8, 82)	325 81/84	2nd Barrier requirements —pad mounted equipment	381G
(June 9, 82)	326 *81/84*	Clearance of neutrals and guys from other supporting structures	234B
(June 30, 82)	327 *81/84*	(a) Classification if adequate ventilation is provided (b) Is interlocking required	127A1
(Aug 6, 82)	328 *81/84*	Clearance from 34.5 kV supply conductor to street light bracket	238, Table 238-1
(Aug 20, 82)	329 *81/84*	Clearance between metal sheathed supply cable and communications	238, Table 238-1 Note 1
(Aug 19, 82)	330 *81/84*	Clearance between anchor guy and 8.7 kV (1977 Ed.)	235E1, Table 235-6
(Aug 25, 82)	331 *81/84*	(a) Effect of customer service entrance grounds on pole butt plate restrictions at transformer locations (b) Reasons for 2 pole butt plates to count as one made electrode such as a driven rod	94B4a&b

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Aug 26, 82)	332 *81/84*	Tension (initial or final) during extreme wind loading calculations	250; 251
(Oct 1, 82)	333 *81/84*	Does former tank grounding quality for reduced (30 inch) clearance	238B, Table 238-1
(Oct 21, 82)	334 *81/84*	Definition of "supplemental protection"	353D2c
(Oct 25, 82)	335 *81/84*	Overload factors: wire tension load vs. wind or weight load	261A, Table 261-1,2,3; 261B, Table 261-4; 261C, Table 261-5; 262A, Table 262-1; 262C, Table 262-3
(Jan 25, 83)	336 *81/84*	Application of "when installed" and "at replacement" values	261A, Table 261-3
(Feb 17, 83)	337 *81/84*	(a) Clearance to ground measured diagonally (b) Clearance, neutral to ground (c) Reason for 14 fL minimum for neutrals	232; 230E1&2, Table 232-1 Item 10
(Mar 5, 83)	338 *81/84*	(a) Grounds at transformer locations (b) Adequacy of grounding	94B4 96A
	339 *81/84*	Number not used (Request withdrawn)	
(Apr 28, 83)	340 *81/84*	Effective grounding of guys; suitability of proposed configurations	215C; 92C2; 93D1 & D3
(May 2, 83)	341 *81/84*	Grounding of fully insulated, jacketed, concentric cable	96A3 97C
(June 16, 83)	342 *81/84*	Pole clearance for vertical jumper to recloser terminal	239D2, Table 239-2

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(July 26, 83)	343 *81/84*	Cable supported by pipeline structure	230C; 232A; 234D1; 235E1
(July 29, 83)	344 *81/84*	Original construction over farmland; clearance to ground for reconstructed spans	013B; 232
(July 23, 83)	345 *81/84*	Energized wire passing through trees, serving as a head guy	215C2; 281A
(July 29, 83)	346 *81/84*	Meaning of "crossings"	261H3a
(Aug 29, 83)	347 *81/84*	Guy Strand Insulation for corrosion reduction	283C
(Sept 27, 83)	348 *81/84*	Structure load stress vs. allowable stress basis (yield, proportionately, AISC allowable)	261A, Tables 261-1 & 2
(Oct 13, 83)	349 *81/84*	(a) Purpose of tree trimming (b) Spacing of oil-filled transformer from building	281; 152A2
(Nov 15, 83)	350 *81/84*	Guy marker requirements in case of 2 guys on one anchor	282E
(Nov 30, 83)	351 *81/84*	Service drop line conductor in aerial clamp saddle; clearance to pole	235E1, Table 235-6
(Dec 21, 83)	352 *81/84*	Clearance over cultivated land for 200° operating temperature	232B1a; 232B1d
(Dec 27, 83)	353 *81/84*	Clarification of line conductor clearance to guy	235E1 & 3, 233A3, 233C3
(Nov 3, 83)	354 *81/84*	Unlabeled, empty duct leading to live parts	370B, 373

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Jan 27, 84)	355 *81/84*	Pole mounted regulator bank with platform; clearance required for workmen on platform	124A1, 286C & 422B
(Feb 14, 84)	356 *81/84*	Bonding requirements for adjacent pad-mounted supply equipment and communication circuit pedestals in an underground system	93C7
(Feb 10, 84)	357 *81/84*	Clarification of readily climbable with respect to a particular configuration	280A1b, 280A2
(Mar 13, 84)	358 *81/84*	Applicability of requirement for GF Indication System	354E2
(Mar 22, 84)	359 *81/84*	Minimum mid-span separation between a supply conductor < 750 V and a communication conductor - for spans over 150 ft	235C2b(3), 235C2b(1)a
(June 8, 84)	360 *81/84*	Additional clearance requirements	232B, 232B2c & d
(Aug 28, 84)	361 *81/84*	Clearance of conductors over a residential driveway	232A, Table 232-1
(Sept 10, 84)	362 *81/84*	Pole clearances for CATV system cable	235C1, Table 5
(Sept 14, 84)	363 *81/84*	(a) Which equipment is to be grounded? (b) What is well defined area? (c) What is adequate grounding?	238B, Table 1, Footnote 1

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Oct 11, 84)	364 *81/84*	Concentric neutral UG cable; Placement of separate grounding conductor (for cable corrosion protection)	92B3
(Oct 29, 84)	365 *81/84*	Clearance between line conductor and anchor guys	235E1, Table 6 235E3a, 235B3a, b
(Nov 1, 84)	366 *81/84*	Grounding of insulating jacketed cable neutral	92B2b(3)
(Nov 14, 84)	367 *84/87*	Clearance required for sailboats in an inlet that has an upstream restriction on height	232A, Table 232-1
(Dec 5, 84)	368 84/87	Classification, for clearance purposes, of outdoor advertising signs (billboards) that have catwalks and that are with or without ladders	234C, Table 234-1
(Jan 15, 85)	369 *84/87*	Relocation of line	013B1
(Mar 1, 85)	370 *84/87*	Underbuilding on existing structures	013B
(Feb 27, 85)	371 *84/87*	Reduced vertical clearance requirements	232A, Table 232-1
(Mar 14, 85)	372 *84/85*	Calculating clearances	235C
(Mar 14, 85)	373 *84/87*	Provision of adequate bonding	354E4
(Mar 25, 85)	374 *84/87*	Application of 238 to service equipment and supply equipment	238
(Apr 3, 85)	375 84/87	Reduction of horizontal clearance	234B
(Apr 4, 85)	376 84/87	Crossarm length and longitudinal strength	261D, Table 261-6

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Apr 8, 85)	377 84/87	Accessibility to pedestrians	234C3, Table 234-1
(Apr 18, 85)	378 84/87	Vertical clearance between communication and supply lines	235C
(May 8, 85)	379 *84/87*	Required strength of wood poles at replacement	261A2b, Table 261-3
(Aug 27, 85)	380 *84/87*	Insulation of workers using buckets and aerial equipment	422B
(Dec 13, 85)	381 *84/87*	Clearance above fences and walls	234C, Table 234-1
(Feb 10, 86)	383 *84/87*	Clearance requirements in tunnels or on bridges	234C, D
(Feb 26, 86)	384 *84/87*	Submarine cable burial depth and grounding requirements	353D
(Mar 7, 86)	385 *84/87*	Definition of "limited access highway"	Table 242-1
(Mar 26, 86)	386 *84/87*	Minimum cross-section dimensions of wood crossarms	261D, Table 261-1
(Apr 22, 86)	387 *84/87*	Vertical clearance between supply conductor and communication cable attachment hardware	238B
(Apr 28, 86)	388 *84/87*	Spacing required between noncurrent-carrying parts of adjacent supply and communication circuits	238A,B, Table 238-1
(May 1, 86)	389 *84/87*	Crossarm bending stress, overload capacity factors, and vertical clearance	261, Table 261-2
(May 7, 86)	390 *84/87*	Bonding of grounds and dimensions of grounding rods	99C

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(July 18, 86)	391 *84/87*	Grade of construction for colinear and at crossing conductors	Table 242-1
(July 11, 86)	392 *84/87*	Drip loops and slack cables from an aerially mounted transformer are parts of the span	235C2b(1)(a)
(Aug 18, 86)	393 *84/86*	Vertical clearance between supply and communication lines	235C2b(1)(a)
(Sept 26, 86)	394 *84/87*	Spacing of ground connections in circuits without a neutral	96A3
(Oct 26, 86)	395 *84/87*	Working load of insulator must not exceed 50% of ultimate strength	277
(Oct 30, 86)	396 *84/87*	Barriers for pad-mounted equipment	381G
(Nov 26, 86)	397 *84/87*	Climbability of guyed dead end poles	280A1b
(Nov 26, 86)	398 *84/87*	Guying of joint-use poles	261C2
(Jan 30, 87)	399 *84/87*	Horizontal clearance to building or its attachments	234C4(a)
(Mar 13, 87)	400 *84/87*	Surfaces used to determine horizontal clearance between line conductors	235B1
(Apr 7, 87)	401 *84/87*	Meanings of "should" and "shall"	350E
(Apr 8, 87)	402 *84/87*	Tagging energized circuits by SCADA systems	421G
(May 7, 87)	403 *84/87*	Communication line requirement applied to fiber optic cable systems	Definitions

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Apr 28, 87)	404 *84/87*	Application of Rules 011 and 012 and Parts 1 and 2 to a generation and transmission utilityserving a distribution utility	011, 012
(Apr 28, 87)	405 *84/87*	Application of Rules 011 and 012 and Part 4 to a generation and transmission utility notified of an accident on a served distribution utility system	011, 012
(Apr 28, 87)	406 *84/87*	Application of Rules 011 and 012 and Part 4 to off-duty utility personnel	011, 012
(Apr 22, 87)	407 *84/87, 88/90*	Size of grounding conductor required for 786 kcmil aluminum neutral	93C2
(June 26, 87)	408 *84/87*	Manual stopping devices	130B
(June 11, 87)	409 *84/87*	Clearances on roofs	234C4
(July 22, 87)	410 *84/87*	Length of ground required to be in contact with earth	94B2c
(Aug 7, 87)	411 *84/87*	Height of gap permitted between ground and bottom of fence	110A
(Aug 6, 87)	412 *84/87*	Maximum permissible resistance to ground for two electrodes connected in parallel	96A2
(Aug 31, 87)	413 *84/87, 88/90*	Crossing structure as related to messenger and grounding conductors	92C3

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Oct 12, 87)	414 *84/87* *88/90*	Alternative to 8-ft driven ground rod	94B
(Oct 12, 87)	415 *84/87* *88/90*	Climbability of pipe risers	280A1b
(Oct 23, 87)	IR 416 *88/90*	Protection of risers	239C
(Oct 20, 87)	IR 417 *88/90*	Definition of "supplemental mechanical protection"	351C1
(Nov 24, 87)	IR 418 *88/90*	Multi-grounded common neutral used as lightning protection	97A
(Jan 26, 88)	IR 419 *88/90*	Artificial illumination in distribution substations	111A
(Apr 12, 88)	IR 420 *88/90*	Application of Rules 97A and 97D1 to grounding conductors on ungrounded systems	97A
(June 17, 88)	IR 421 *88/90*	Climbing space on structures and poles	236
(July 12, 88)	IR 422 *88/90*	Bonding and interconnection of grounding conductors	97A
(Aug 15, 88)	IR 423 *88/90*	The intent and requirements for temporary aerial powerline construction	014
(Oct 14, 88)	IR 424 *88/90*	Wet and dry flashover voltages between conductors of the guyed circuit	283A2
(Jan 11, 89)	IR 425 *88/90*	Application of rule to catenary systems	262H3
(Jan 25, 89)	IR 426 *88/90*	Clearance for span guys grounded at both ends	235E

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(June 12, 89)	IR 427 *88/90*	Grounding of a transformer installation	97A
(June 12, 89)	IR 428 *88/90*	Clearance over driveway to grain bins	Table 232-1
(Aug 14, 89)	IR 429 *88/90*	Grounding requirements for existing systems	96A2
(Sept 7, 89)	IR 430 *88/90*	Inclusion of weight of pole in vertical load	Table 261-3
(Oct 16, 89)	IR 431 *88/90*	Requirements for fiber optic cable	224A
(Nov 3, 89)	IR 432 *88/90*	Meaning of "road" as used in Rule 231	231
(Dec 12, 89)	IR 433 *88/90*	Tagging procedures by SCADA	442E
(Dec 13, 89)	IR 434 *88/90*	Tagging procedures by SCADA	442E
(Jan 26, 90)	IR 435 *88/90*	Metallic handhold covers of pull boxes containing street lights	314B
(Feb 14, 90)	IR 436 *88/90*	Clearances of communication lines	224A
(Jul 16, 90)	IR 437 *88/90*	Definition of supply lines and communication lines	224A4
(Feb 2, 90)	IR 438 *88/90*	Mixing Methods A and B for wood structures	261A2
(Mar 22, 90)	IR 439 *88/90*	Attachment of insulated, multiple-conductor cable of secondary voltage to pole surface	239F7
(Apr 4, 90)	IR 440 *88/90*	Does helix anchor meet requirements as a driven rod made electrode?	94B2
(May 1, 90)	IR 441 *88/90*	Climbing joint-use poles	432

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Jul 11, 90)	IR 442 *88/90*	Insulation requirements for secondary grounding conductor	97D2
(July 30, 90)	IR 443 *88/90*	Construction of fiber optic cable in the clear space on joint-use poles by a local power company	224A

Section 1. Introduction to the National Electrical Safety Code

012	See 014	IR 423
012	See 93C2	IR 407
012	See Table 232-1	IR 428
012	See 239C	IR 416
012	See 262H3	IR 425
012	See 351C1	IR 417

014

The intent and requirements for temporary aerial powerline construction

REQUEST (Aug 15, 88) IR 423

Please provide an official interpretation of the National Electrical Safety Code (NESC) on the intent and requirements for temporary aerial powerline construction.

We are currently constructing a new navigation lock at a dam project. As part of this work, a significant portion of the project's underground distribution facilities are being relocated. During the lock construction period (1987–1993), the project's 13.8 kV distribution system has been temporarily rerouted as an aerial system on wood structures. This relocation is anticipated to be in service for 3 to 5 yr, at which time it will be replaced by a new permanent underground system. A plan of the distribution line is enclosed.

Two of our interpretations on this project have been called into question. The first concerns temporary vs. permanent construction requirements. The aerial system was constructed under a performance contract. This contract required the contractor to design and construct a powerline to the NESC requirements for Heavy Loading District, Grade B construction. Because the project was an interim installation, it was titled "the temporary south shore power distribution system" in the contract documents. The contractor was required to place the line in service and maintain it for 18 mo, at which time it was to be turned over to us for maintenance for the remainder of its service life. The contractor decided to design it using the "at replacement" overload capacity factors found in Table 261-3 of the 1987 Edition of the NESC.

We determined that the relocation of the distribution system did not qualify as a "temporary installation" under the provisions of NESC Sections 014 and 26. While it may be a temporary rerouting when compared to the permanent system, it will still be in service for several years in a severe weather environment.

The second Code interpretation concerns the use of Extreme Wind Loading Criteria. Much of the aerial system is installed on a bluff along a river. While the line does not cross the river, and the structures are not taller than 60 ft, the line is parallel and adjacent to the river. The line is in excess of 60 ft above the water surface in these areas. Since the gorge of this river is subject to very high winds, we interpreted the NESC Rule 012 to require the use of the Extreme Wind Loading Rule 250 for design of the distribution system.

We are the administrative body with jurisdiction over this project. Our contractor is contesting our interpretations of the NESC. We request your official interpretation of the requirements, applicability, and intent for "temporary installations" as defined by the NESC as well as the requirements and intent for Extreme Wind Loading conditions. In particular, please address what time constraints are intended for length of service of these facilities.

INTERPRETATION (Mar 13, 89)

The NESC does not specify a time limit under which a particular installation is, or is not, temporary. It is the responsibility of the designer to consider the loading conditions expected to occur at the site *during the expected life* of the installation, whatever that life-span.

Rule 250C was added to recognize that, for large conductors, high winds on conductors without ice may be the controlling design consideration, instead of the ice/wind combination of Rule 250B.

Rule 250C is not required to be considered unless the structure or supported facilities exceed 60 ft above the ground or water level below. In the situation described here, the installation is near a bluff along a river and the conductor level is more than 60 ft above the nearby water level. However, neither the structures nor supported facilities are located more than 60 ft above the surface directly beneath, so only Rule 250B would be *required* to be considered.

NESC Rule 250A3 recognizes that "loadings actually experienced may be greater than those specified" in Rule 250B. Rule 012 requires that, "For all particulars not specified in these rules, construction and maintenance should be done in accordance with accepted good practice for the given local conditions."

It is not appropriate for this Committee to determine whether any portion of this riverside location constitutes an unspecified condition of such impact that good practice for the given local conditions would require consideration of higher wind loadings; that is the responsibility of the designer.

Section 9. Grounding Methods for Electric Supply and Communication Facilities

92B1	**See 97A**	**IR 427**
92C1	**See 92C3**	**IR 413**
92C2	**See 92C3**	**IR 413**
92C2	**See 215C2**	**IR 440**

92C3

Crossing structure as related to messenger and grounding conductor

REQUEST (August 31, 87) IR 413

I'm writing for an interpretation of the 1987 National Electrical Safety Code as it relates to Rule 92C3.

Please provide an interpretation of the meaning of "crossing structure" as related to the messenger and grounding conductor. Is a crossing structure where messengers cross each other, or is it where messengers cross the grounding conductors?

INTERPRETATION (Mar 13, 1989)

This rule has been reworded for clarity in the 1990 Edition. The purpose of the rule is to limit the voltage potential between grounded guys and messengers attached to the same supporting structure. Both colinear lines and crossing lines are recognized.

On colinear lines, guys and messengers to be grounded are required to be either (a) connected to the same grounding conductor on the supporting structure upon which they are supported, or (b) connected to conductors that are grounded and bonded together at the intervals along the line specified in Rules 92C1 and 92C2.

Where the route of one line crosses that of another, and circuits of both lines are supported by a common structure at the point of crossing, guys and messengers to be grounded are required to be bonded together at the crossing structure. They are not, however, required to be grounded at the crossing structure if they are connected to conductors (neutrals, messengers, etc.) that are themselves grounded and bonded together at other locations at intervals specified in Rules 92C1 and 92C2.

92D **See 93C2** **IR 407**

93C1 **See 93C2** **IR 407**

93C **See 93C2** **IR 407**

93C2

Size of grounding conductor required for 795 kcmil aluminum neutral

REQUEST (Apr 22, 1987) IR 407

Your assistance is requested in interpreting the following rules for the circumstances given:

1. **Rule 93C2.** The largest primary conductor on our 12.47GrdY/7.2 and 34.5GrdY/19.9 kV distribution system is 795 kcmil all aluminum. The neutral commonly used along with this phase conductor size is 336.4 kcmil all aluminum, except where the neutral is carried on the same crossarm with the phase conductors. In this case, the neutral is also sized at 795 kcmil all aluminum for mechanical reasons. The neutral is grounded at each pole to a made electrode, usually a wire wrap at the butt of the pole. Ground rods or metal plates are to be used at transformer locations. The grounding conductor used for all multigrounded neutrals, including 795 kcmil aluminum, is #6 soft drawn copper.

Our concern is whether the NESC requires a grounding conductor larger than #6 soft drawn copper for connection to the 795 kcmil all aluminum neutral.

(a) Rule 93C2 refers to "continuous total ampacities." Is the grounding conductor required to have 1/5 the ampacity of the neutral conductor at the same conductor temperature? Or, can a higher conductor temperature be used for the grounding conductor since it is annealed already and not under tension?

(b) From the background information I have provided, do we need to increase our grounding conductor size for use with the 795 kcmil all aluminum conductor to comply with Rule 93C2? Please note that the 1987 NEC does not require anything larger than #6 copper as the grounding conductor for the electrode types we use or plan to use (Rule 250-94, Exception 1a. Also see the NEC 1987 Handbook, page 230, Figure 250-35).

(2) **Rule 93C8.** Does the "ampacity" referred to in this rule mean "continuous ampacity," or does it refer to "short time ampacity" as defined at the beginning of Rule 93C?

(3) **Rule 94B4a.** Rule 94B3c describes a metal plate that has not less than 2 ft^2 exposed surface area and that is buried not less than 5 ft deep as being more useful in areas of high soil resistivity than a driven rod. We are considering the use of a plate with a one-side surface area of 288 in^2 attached to the pole butt. We would like to use this large butt plate as the sole grounding electrode at transformer locations. Note that this plate is much larger than the minimum 0.5 ft^2 required in Rule 94B4b.

(a) May the large butt plate just described be used as the sole grounding electrode at transformer locations? Or does the location of the plate (attached to the pole butt) disqualify it?

(b) If attachment to the pole butt disqualifies the plate, would burial at a depth of, say, six in below the pole butt allow its use as the sole grounding electrode at transformer locations?

4. **Rule 97D1.** On our system we have a limited number of older 2400 V delta primary distribution circuits. At transformer installations, separate grounding conductors were used to connect to separate electrodes, but the separate grounding conductors were bonded together near the ground line, as shown in Fig IR 407-1. Rule 97B in the 1973 NESC edition states that "This does not prohibit the bonding together of these separate made electrodes or groups of electrodes near the ground level."

(a) Does this practice (bonding of the separate grounding conductors near ground level) meet the requirements of 1973 and prior editions of the NESC?

(b) Does the practice meet the current requirements of Rule 97D1?

(c) If bonding of the separate grounding conductors near ground level is not allowed, does interconnection through a spark gap or equivalent device constitute "connection of two electrodes in parallel" for application of Rule 96A2?

5. Rule 235A3. Does "phasor difference" in this rule imply the phase-to-phase voltage with the normal 120 degrees phase difference, or does it mean the phase-to-phase voltage with 180 degrees phase difference? The possibility of asynchronous operation for any situation on our system is only remotely possible.

6. Rule 235C, Table 235-5. An earlier interpretation (IR 267a, March 20, 1980) states that "In applying Rule 235C, the calculation of voltage should assume 180 degrees phase difference." Table 235-5 has been completely revised for the 1987 Edition. Whereas, the heading formerly stated "All voltages are between conductors involved...," the heading now states "Voltages are phase to ground...." Basic clearances in the table are now given as a number of inches plus "0.4 per kV over 8.7 kV."

We are not sure whether the earlier interpretation (IR 267a) applies for certain situations under the current edition. Asynchronous operation under any condition is only remotely possible on our system, but may be more probable in some situations, such as when two supply circuits on the same structure belong to different utilities. Also, we are confused as to the proper interpretation of the "per kV over 8.7 kV" in the table.

Please indicate which of the following interpretations is correct in calculating the vertical clearance "C" between line conductors on the same supporting structure for the stated conditions.

Case 1. A phase conductor of a 34.5GrdY/19.9 kV circuit over a different phase conductor of a different 34.5GrdY/19.9 kV circuit, same utility, same conductor sag, with 120 degrees phase difference normally between circuits.

Method 1. Asynchronous operation assumed and "per kV" interpreted to mean voltage between conductors involved.

$$C = 16 + 0.4 \times (19.9 + 19.9 - 8.7) = 28.4 \text{ in}$$

Method 2. 120 degrees phase difference assumed and "per kV" interpreted to mean voltage between conductors involved.

$$C = 16 + 0.4 \times (34.5 - 8.7) = 26.3 \text{ in}$$

Method 3. Voltage between conductors ignored and "per kV" interpreted to mean voltage to ground of the upper level circuit if over 8.7 kV.

$$C = 16 + 0.4 \times (19.9 - 8.7) = 20.5 \text{ in}$$

Method 4. Voltage between conductors ignored and "per kV" interpreted to mean voltage to ground of each conductor if over 8.7 kV.

$$C = 16 + 0.4 \times [(19.9 - 8.7) + (19.9 - 8.7)] = 25.0 \text{ in}$$

Case 2. Phase conductors of the same 34.5GrdY/19.9 kV circuit placed in a vertical configuration.

Method 1. $C = 16 + 0.4 \times (19.9 + 19.9 - 8.7) = 28.4$ in

Method 2. $C = 16 + 0.4 \times (34.5 - 8.7) = 26.3$ in

Method 3. $C = 16 + 0.4 \times (19.9 - 8.7) = 20.5$ in

Method 4. $C = 16 + 0.4 \times [(19.9 - 8.7) + (19.9 - 8.7)] = 25.0$ in

7. Rule 235E, Table 235-6. Footnote 12 states that "Phase to phase voltages shall be determined according to Rule 235A3." Should 180 degrees phase difference be assumed between phase conductors of different circuits, both for determining which column to enter, and in applying the 0.4 multiplier "per kV over 8.7 or 50 kV?"

8. Rule 242, Table 242-1. In Table 242-1, the term "limited access highways" is used. Does this refer to one or both of the following highway types?

(a) Where full control of access is exercised (freeways, interstate highways with no at-grade crossings or driveway connections).

(b) Where partial control of access is exercised (state highways and some county roads where selected at-grade crossings and driveway connections are allowed).

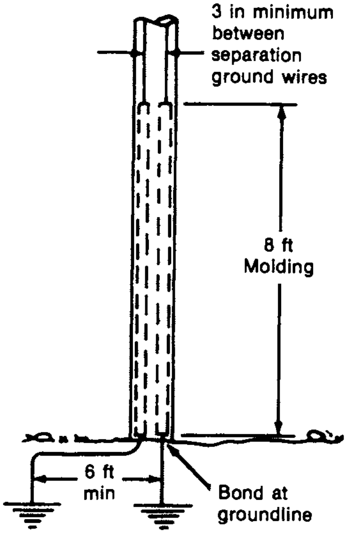

Fig IR 407-1

INTERPRETATION (Feb 6, 89)

Question 1a. The temperature of the grounding conductor is not specified in Rule 93C2. As a result, Rule 012 is operable. Note that Rule 92D requires "the capability of conducting anticipated fault current without thermal overloading or excessive voltage buildup."

Question 1b. The Interpretations Committee cannot act as a consultant in design matters.

Question 2. Rule 93C1 requires (where determinable) the use of short-time ampacity for single-grounded systems, and 93C2 requires the use of continuous ampacity for multigrounded systems. Note that the resistance of the ground electrode may change as current flow heats the soil.

Question 3. Plates that meet only the requirements of Rule 94B4b are *not* permitted to be the sole grounding electrode at a transformer location.

Plates or sheets meeting the size and depth requirements of Rule 94B3c are permitted to be the sole grounding electrode at a transformer location.

Rule 94B3c does not prohibit such a plate from being underneath a pole. This rule requires plate electrodes to have a minimum of 288 in^2 of surface area exposed to the soil.

Question 4. These questions were addressed to a large degree in 1981 in IR 299. However, detailed research into the history of the NESC indicates that a correction and amplification is appropriate.

The practice illustrated with Question 4 has never been allowed by the NESC rules. Bonding of the *electrodes* near the ground line (NOT the grounding conductors themselves) was allowed by the 5th and 6th Editions only.

The fourth and previous editions and the 1977 and subsequent editions have not allowed direct interconnection of either the required separate grounding conductors or the required separate grounding electrodes on a delta or single-grounded system.

In the 4th and prior editions, 20 ft of separation between the required separate primary and secondary electrodes was required. Due to the manner in which the rules changed, and then changed back in subsequent editions, the 20-ft separation is no longer explicitly stated, although it is accepted as good practice when interconnection of the electrodes or grounding conductors is prohibited; the intervening earth resistance limits transfer of a primary surge voltage to the secondary.

Rule 96A2 is not applicable; it refers to the use of a parallel-connected, two-electrode system to achieve required resistance levels where a one-electrode system is not enough. In high-resistance ground locations, a separate system of bonded electrodes may be required to obtain the ground resistance needed for each of the separate grounding electrodes required by Rule 97A (1987).

Questions 5 and 7. Phasor difference means exactly what it implies. If the worst-case phase shift is known, either under normal or emergency conditions, then it may be used. If the phase shift is unknown, then "accepted good practice" of Rule 012 requires the use of the ultimate worst case: 180 degrees.

Question 6. The phase-to-ground voltages specified in the heading to Table 235-5 are intended to be used with the column headings and the row headings to determine the applicable requirements *within* the table. If that applicable clearance requirement includes the 0.4 in adder, Rule 235A3 is intended to be used to determine the voltage to be used for the clearance adder calculation. Rule 235A3 specifies that, unless otherwise stated, the voltage between line conductors of different phases of different circuits is considered to be the greater of:

(a) the phasor difference of the voltages of both circuits, or
(b) the line-to-ground voltage of the higher voltage circuit.

If the two phases are synchronous or closely matched, this rule provides for the case where the lower voltage circuit is off. Thus, the clearance is a continuous straight-line function from 8700 V through 50 kV and beyond.

Question 8. See IR 385.

93C8 See 93C2 IR 407

94B

Alternative to 8-ft driven rod

REQUEST (Oct 12, 87) IR 414

Question 1. Rule 94B2c, Exception 1, states: or "...other types of electrode employed." Does this phrase mean:

(1) only those items listed in Rules 94B3, 94B4, 94B5, or 94B6 (i.e., buried wire, strips, plates, pole butt plates, wire wraps, concentric neutral cable, and concrete-encased electrodes), or,
(2) other types, designs, or configurations of electrodes or grounding systems that, through a qualified engineering study, can be demonstrated to perform as well as or better than a driven rod?

Question 2. Rule 94B3a, Exception 2, states: "Other lengths or configurations may be used..." Does this exception apply strictly to wire, or can it be applied to the entire system of electrodes (i.e., driven rods, plates, strips, etc.)?

Background: Our line crews have asked if a multiple driven rod system, where the rods are shorter than 8 ft, can be used where rock bottom prohibits the use of an 8-ft rod. We conducted an engineering study (see "Installation of Ground Rods in Rock Areas—Final Report," by John L Vrabel, P.E.) and concluded that two 1/2 in x 5-1/2 ft rods separated by a distance of 1-1/2 to 2 ft would be equivalent or better than one 8-ft driven rod. We believe that this grounding system meets the intent of Rule 94B, but we are not sure if the language in Rule 94B2 or 94B3 allows this type of system.

Question 3. Does the multiple driven short rod system (in J. L. Vrabel's report) meet the intent of Rule 94B?

INTERPRETATION (Feb 14, 89)

Question 1. Types of electrodes *other than driven rods* may be used in rocky areas where a driven depth of 8 ft cannot be obtained.

Question 2. Exception 2 to Rule 94B3a is located in the text so as to apply only to wire covered by Rule 94B3a.

Question 3. Driven rods are:

a. required to be at least 8 ft in length [94B2a],
b. required to be at least 5/8 in diameter if iron or steel (or 1/2 in if Cu-clad, SS, or SS Clad) [94B2a], and
c. required to be driven to a depth of at least 8 ft, unless rock limits the driven depth (in which case the rod may be driven at an angle or other types of electrodes may be used) [94B2c].

Where one electrode will not give the conductivity (low resistance) required by Rule 96, additional rods may be interconnected until the resistance to earth of the electrode system is satisfactory.

Both the depth of an electrode and the amount of its surface area exposed to the soil will affect its performance. As shown by the requirements for the various types of *electrodes* specified in the NESC, greater earth contact area is required as the depth of placement decreases.

- 5/8 in x 8 ft iron rod (188 in^2) averaging 4 ft deep, but reaching to the 8 ft level [94B2]
- 100 ft of .162-in wire (600+ in^2) at 18 in deep [94B3a]
- 5-ft long (720 in^2) strip at 18 in deep [95B3a]
- 2 sq ft (288 in^2) of metal plate at 5 ft deep [94B3a]

The double 5.5-ft rod electrode concerned in this case is essentially an 11-ft long rod that is folded in half; it is functionally equivalent to an 11-ft rod driven at an angle to a depth of 5.5 ft. As the angle and driven depth of the rod (94B2c) decrease, the rod decreases in grounding capability and approaches becoming a horizontal strip (94B3b), thus requiring an increase in the surface area in order to retain its functional capability. If the rod is of appropriate diameter for the material (you didn't mention the material), it may meet Rule 94B2c, Exception 1, unless Rule 96 could be met with one or more of these installations. In that case, some other type of electrode with more surface area or placed at a greater depth would be needed. Under our procedures, we do not evaluate specific design studies; that is the responsibility of the utility or its designer.

Requirements for construction and location of "an electrode" should not be confused with requirements when more than one electrode is required to meet Rule 96. If multiple electrodes are required, each of the installations should be far enough apart (not less than 6 ft) to use "new" earth to achieve the required conductivity [94B2b].

94B2	**See 215C2**	**IR 440**
94B4	**See 97A**	**IR 427**
94B4a	**See 97A**	**IR 427**
94B4c	**See 97A**	**IR 427**
94B3c	**See 93C2**	**IR 407**
94B4a	**See 93C2**	**IR 407**
94B4b	**See 93C2**	**IR 407**
96	**See 94B**	**IR 414**
96A	**See 97A**	**IR 420**
96A2	**See 93C2**	**IR 407**

96A2

Grounding requirements for existing systems

REQUEST (Aug 14, 89) IR 429

This request concerns interpretation of 1987 National Electrical Safety Code Rules 96A2, Single Grounded (Unigrounded or Delta) Systems, and 96A3, Multiple Grounded Systems.

Rule 96A2

Does this code provision apply to delta or floating wye primary transformer installations on three phase, three wire primary laterals emanating from three phase, four wire multigrounded wye primary systems?

Does this code provision apply to the resistance of grounds for lighting and power circuits, when run separately from other classes of equipment per Rule 97A2? If so, can the requirement be alternatively satisfied by installing an additional ground one span away from the transformer?

Rule 96A3

Does this code provision require that a neutral conductor be extended to new or rebuilt delta or floating wye primary three phase transformer banks being constructed on existing three phase, three wire primary laterals which emanate from four wire multigrounded sources?

[The Secretary of the NESC Committee and the Requestor corresponded, and the Requestor resubmitted his question concerning Rule 96A3. The text of that resubmission follows.]

Thank you for your response. This request for clarification is submitted as you suggested in our telephone conversation of this date. It is understandable that interpretations and clarifications can be rendered only in writing, and only by committee action.

Our original request was for an interpretation of 1987 NESC Rule 96A3 as it applies to new or rebuilt transformer installations on *existing* three phase, neutral-less laterals that branch from four-wire multigrounded primary distribution systems. You refered me to a previous Interpretation (IR 394) addressing a question about construction of a *new* line. That interpretation is silent, however, in regard to the Rule's application to existing lines.

In various rural regions of our service area, we have several miles of three-phase, three-wire primary distribution lines that were built many years ago to serve only three-phase loads. Although these lines are fed by multigrounded wye sources, neutral conductors were not originally provided, as they were not needed for the three-phase transformer connection, and were not required to comply with the grounding codes in effect at the time of construction.

Rule 96A3 of the 1987 NESC requires that the neutral be grounded at each transformer location. On "grandfathered" lines constructed long ago without a neutral, does this rule apply? If so, does it require that a neutral conductor be extended:

a) When a new transformer bank is installed?
b) When an existing transformer bank is rebuilt?
c) When one or more transformers in a bank are replaced?
d) When a single pole is replaced?
e) When multiple poles are replaced?
f) When primary conductors are replaced?

INTERPRETATION (Jan 22, 90)

In the 1977 Edition, the National Electrical Safety Code first specified that good practice for grounding the neutrals of multi-grounded systems required at least four ground connections in *each mile of the line.* The intention is that, on multigrounded systems where overcurrent protection is used to detect a ground fault and remove it from the system, the neutral is to be carried in each span of such systems. Where the equipment cases are required to be grounded under Rule 215, connection of the case to the system neutral allows the protection system to operate during a high voltage fault to the case in order to limit the transfer of such voltages to secondary circuits or other areas. The 1987 Edition of the NESC clarified the intent of the 1977 language by adding the word "entire" to make the language refer to each mile of the *entire* line.

The 1977 Edition, for the first time, allowed existing facilities to remain unchanged without being modified to meet the 1977 Edition—if the existing facilities met the requirements of the previous code.

The 6th and previous editions did not specify whether the neutral of a multigrounded system was required to be carried throughout the line, so Rule 200C applied. Rule 200C of the 6th Edition (which moved to Rule 012 in 1981) required that, for all particulars not specified in the code, construction be made according to *accepted good practice.*

The NESC specifically allows utilities to experiment with different types of construction under qualified supervision. The fact that one or more utilities try a particular type of construction does not mean that such construction will always be found to be acceptable as meeting the requirements of good practice. Determination of what constitutes good practice under the given local conditions is the responsibility of the entity responsible for the facilities involved.

In summary, multigrounded systems constructed under the 1977 and later editions are intended to have the system neutral carried throughout the entire system of conductors connected thereto, including taps serving only transformer banks with the high side connected in a delta configuration such as you have described, regardless of whether the neutral is utilized in the circuit connections.

96A3 **See 96A2** **IR 429**

96A3 **See 97A** **IR 427**

97 **See 97A** **IR 418, IR 422**

97A **See 93C2** **IR 407**

97A

Multi-grounded common neutral used as lightning protection

REQUEST (Nov 24, 87) IR 418

This request concerns clarification of National Electrical Safety Code Rule 97A.

May the multigrounded comon neutral conductor of a primary (12470GRDY/7200 V or 4160GRDY/2400 V) and secondary circuit (120/240 V) be located above the primary for lightning protection?

Above an unrelated circuit of even higher voltage (34.5 kV or 69 kV) on the same structure?

Must the multigrounded common neutral conductor so located be considered a lightning rod for the purpose of Rule 97A?

INTERPRETATION (Aug 29, 88)

In the context of the NESC, a multigrounded neutral conductor is a ground*ed* conductor, not a ground*ing* conductor. A ground*ing* conductor under Rule 97 is not considered a ground*ed* conductor; Rule 97 applies to the conductors that connect a grounded conductor or part to the electrode.

The neutral, even when used as a lightning protection wire, is *not* considered to be a lightning rod.

97A

Application of Rules 97A and 97D1 to grounding conductors on ungrounded systems

REQUEST (Apr 12, 88) IR 420

Rule 97A requires separate grounding conductors to be run to the grounding electrode for the following classes:

1. Surge arresters of circuits over 750 V, and frames of any equipment operating at over 750 V.
2. Lighting and power circuits under 750 V.
3. Lightning rods, unless attached to a grounded metal supporting structure.

This rule also permits the separate grounding conductors to be run, alternately, to "a sufficiently heavy ground bus or system ground cable which is well-connected to ground at more than one place."

It is our design practice, on ungrounded systems, to run separate grounding conductors to separate grounding electrodes. The separate electrodes are then interconnected with a ground cable. This ground cable is thus connected to ground at two places. Does the intent of Rule 97A permit the interconnection of the separate grounding conductors in this manner?

Rule 97D1 delineates additional requirements for separate grounding conductors on ungrounded or single-grounded systems.

Interconnection of the secondary neutral and the primary surge arrester grounding conductor is permitted through a spark gap or a device that performs an equivalent function. This rule also requires that at least one other grounding connection be made on the secondary neutral and that its grounding electrode be located a distance of not less than 20 ft from the surge arrester grounding electrode. Is it the intent of Rule 97D1 that the secondary neutral ground electrode always be located at least 20 ft from the surge arrester grounding electrode, including when no spark gap is used? Rule 97A requires that the grounding electrodes be separated, but does not specify a separation distance.

INTERPRETATION (Feb 6, 89)

The two electrodes plus the interconnecting conductor may constitute a system ground cable if well-connected to ground (see the definition in ANSI/IEEE Std 100-1988, IEEE Standard Dictionary of Electrical and Electronic Terms) but rarely will they be well enough connected (see Rule 97A) to constitute a ground bus that is "sufficiently heavy" to provide the effective grounding (see definition) needed to limit the voltage rise impressed on the secondary by a primary voltage surge to an acceptable level. See Rule 96A.

In the 4th and prior editions, a 20-ft separation between the required separate primary and secondary electrodes was required. Due to the manner in which the rules changed, and then changed back in subsequent editions, the 20 ft separation is no longer explicitly stated, although it is accepted as good practice when interconnection of the electrodes or grounding conductors is prohibited; the intervening earth resistance limits transfer of a primary surge voltage to the secondary. See also the answer to Question 4 of IR 407.

97A

Bonding and interconnection of grounding conductors

REQUEST (July 12, 88) IR 422

We have a unigrounded three phase, three wire 26.4 kV distribution system. This system is grounded at the source in a Y-configuration and supplies three-phase load. Rule 97A requires that for such a circuit the grounding conductors of surge arresters and equipment frames over 750 V must be run to the grounding electrode separately from the grounding conductors of lighting and power circuits under 750 V. Rule 97B permits interconnecting the grounding conductors of these two equipment classes by using a single grounding conductor if there is a direct earth grounding connection at each surge arrester location and if the secondary neutral is common with, or connected to, a primary neutral meeting the grounding requirements of Rule 97C.

On this system, a three-phase padmounted transformer is supplied by a jacketed, direct-burial concentric neutral primary cable fed from the overhead 26.4 kV line. See Fig IR 422-1. At the cable riser pole the grounding conductor for the surge arresters is directly connected to a made grounding electrode at the base of the pole. The concentric neutral of the primary cable is bonded to the surge arrester grounding conductor at the pothead, surge arresters, and also at their support on the pole. At the padmounted transformer the concentric neutral of the primary cable is connected to the padmounted equipment frame. A grounding conductor is run from this connection point directly to a made grounding electrode. The secondary neutral for the lighting and power circuit under 750 V is grounded by a separate grounding conductor run directly to a separate made grounding electrode.

The concentric neutral of the primary cable essentially bonds together the grounding conductor for the surge arresters at the cable riser pole and the padmounted equipment frame grounding conductor. Since Rule 97A is silent on bonding, is such a bond permissible? We believe it is.

Second, can the grounding conductor at the padmounted equipment frame be bonded to the separate secondary neutral grounding conductor when a primary cable neutral meeting the requirements of Rule 97C is not present? We believe it can, as shown in Fig IR 422-1.

Third, in this example, does Rule 97B permit interconnection of the padmounted equipment frame grounding conductor and the secondary neutral grounding conductor if, on the riser pole, a multiple-grounded common neutral (from another circuit of a different primary voltage from a different source substation) meeting Rule 97C is connected to the arrester grounding conductor and the concentric neutral of the cable? This is illustrated in Fig IR 422-2. We feel such an interconnection is permissible and complies with the intent of the Rule.

Does your interpretation change if the second circuit is of the same primary voltage (26.4 kV) but, again, from a different source substation? We feel this should not make a difference.

We have come to our interpretation based on our review of the history of this Rule, which is included as Attachment A. Please review these questions and provide an interpretation.

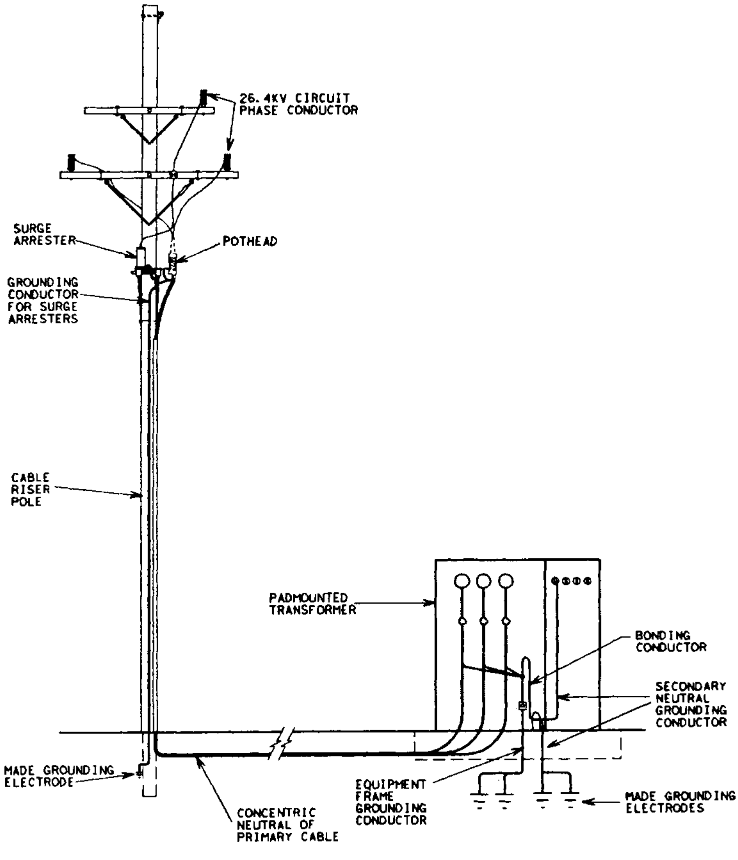
26.4KV CIRCUIT
PHASE CONDUCTOR
SURGE
ARRESTER
POTHEAD
GROUNDING
CONDUCTOR
FOR SURGE
ARRESTERS
CABLE
RISER
POLE
PADMOUNTED
TRANSFORMER
BONDING
CONDUCTOR
SECONDARY
NEUTRAL
GROUNDING
CONDUCTOR
MADE GROUNDING
ELECTRODE
EQUIPMENT
FRAME
GROUNDING
CONDUCTOR
CONCENTRIC
NEUTRAL OF
PRIMARY CABLE
MADE GROUNDING
ELECTRODES

Fig IR 422-1

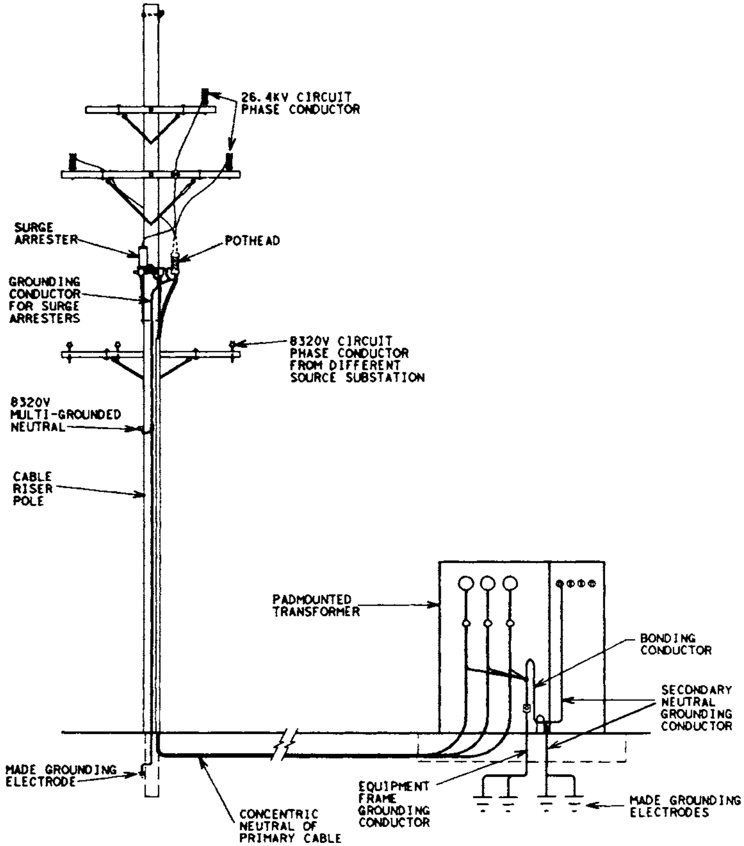
26.4KV CIRCUIT
PHASE CONDUCTOR
SURGE
ARRESTER
POTHEAD
GROUNDING
CONDUCTOR
FOR SURGE
ARRESTERS
8320V CIRCUIT
PHASE CONDUCTOR
FROM DIFFERENT
SOURCE SUBSTATION
8320V
MULTI-GROUNDED
NEUTRAL
CABLE
RISER
POLE
PADMOUNTED
TRANSFORMER
BONDING
CONDUCTOR
SECONDARY
NEUTRAL
GROUNDING
CONDUCTOR
MADE GROUNDING
ELECTRODE
CONCENTRIC
NEUTRAL OF
PRIMARY CABLE
EQUIPMENT
FRAME
GROUNDING
CONDUCTOR
MADE GROUNDING
ELECTRODES

Fig IR 422-2

IR 422, Attachment A
Discussion of the History of NESC Rule 97

The First Edition of the NESC (Code) was issued August 1, 1914. A discussion of this edition suggested that arrester grounds not be used for other purposes.

The Second Edition of the Code (11/15/16) prohibited arrester ground connections to the same artificial ground as other classes and, where practicable, required that they be at least 20 ft from other artificial grounds. The accompanying discussion cited concern over disconnection of the actual common ground connection resulting in circulating currents between different equipment classes. It suggested that "different grounds, offers usually a greater degree of reliability and safety."

The Third Edition of the Code (10/31/20) repeats the language of the Second Edition on arrester grounds. The Discussion (10-31-20) for this edition again points out the concern over loss of a "single wire" resulting in loss of grounding leaving "a large amount of equipment unprotected." In discussing a common ground wire from an equipment frame and the grounded conductor of a circuit, with regard to the case becoming energized if the common wire is severed, it acknowledged that "Connection to the same ground does not create this hazard, since the two can not be in electrical connection with each other without being also connected to ground." The requirement that "...separate artificial grounds shall be used for arresters" is repeated.

The Fourth Edition of the Code (11/15/27) again repeats the language of the Second and Third Edition, regarding arrester grounds. Equipment frames, wire runways, and service conduits were permitted at this time to utilize the same grounding conductors, provided the secondary distribution system had multiple grounds to water piping. Water piping at that time was metallic. The Discussion (9/21/28) of this edition pointed out that, "In the case of multiple grounds to water pipe systems, the contingency of losing the grounding connection is rather remote, and an exception is consequently made in this case for a common grounding wire for equipment and secondary circuits." Arrester grounds must be separate to prohibit other circuits or equipment from having a dangerous potential impressed upon them upon discharge of the arrester if a common ground were used.

The Fifth Edition of the Code (8/27/41) for the first time allowed interconnection of the arrester grounding conductor and grounded secondary conductor, provided there was a direct grounding connection at the arrester and the secondary was elsewhere grounded at one point to a continuous metallic underground water piping system, or the secondary neutral had at least four grounds per mile in addition to service grounds. Furthermore, the direct ground connection at the arrester could be omitted if there were at least four water pipe grounds per mile on the secondary. However, with respect to individual artificial grounds for arresters, this edition continued to require that separate grounding conductors and electrodes be used. A new provision was made though, that "This does not prohibit the bonding together of these separate electrodes near the ground level."

The Discussion (7/15/44) of this edition states "Where the failure of a single grounding conductor might produce undesirable potentials on the equipment or other apparatus, it is advisable to use separate grounding conductors. Connection of the separate conductors to the same ground electrode does not involve such potentials, since the separate grounding conductors cannot be in electrical connection with each other without being also connected to ground. Where multiple grounds are used, danger from the failure of individual grounding conductors is eliminated."

The basic concern throughout the first five editions of the Code is essentially to avoid unwanted potential rise in one class of apparatus due to the loss of an effective ground on another. The two main examples of this are impressing a dangerous potential on a secondary circuit due to the discharge of a surge arrester, and energizing an equipment frame through contact with an ungrounded secondary grounding conductor. Initially, separation of the grounding conductors and electrodes for each class of apparatus was presented as the way to solve this problem, since severing any one grounding conductor would not jeopardize others. The Third Edition recognized that the same was true if an equipment frame grounding conductor went to the same grounding electrode as a secondary circuit grounding conductor. There were still reservations at that time, though, against allowing this for arrester grounds. The Fourth Edition carried the interconnection of frame and secondary circuit grounding concept further by recognizing that if you had multiple grounds of low resistance on the secondary, such as to water piping, one grounding conductor could be allowed to ground both the frame and the secondary at the frame, since severing such a grounding conductor still left the secondary well grounded. The Fifth Edition finally allowed interconnection of arrester and secondary circuit grounding conductors, recognizing that with a direct ground at the arrester and with the secondary grounded to the low resistance ground of either a metallic water system or a neutral with at least four grounds per mile, discharge of the arrester upon loss of its direct ground would not be unsafe. Furthermore, if there were four or more water pipe grounds per mile of secondary, even the direct arrester ground could be omitted. This indicates that if an effective low resistance ground can be assured, interconnection is safe; and if multiple such grounds are obtained, no direct arrester ground is even needed. Likewise, it is seen that bonding of two classes of grounding electrodes at the ground line poses little risk to the basic concern, since severing either grounding conductor above this location separates the apparatus.

The Sixth Edition of the Code (6/8/60) is essentially the same as the Fifth Edition.

The 1973 NESC is the same as the Sixth Edition.

The 1977 NESC significantly rearranged the wording of Rule 97 from the 1973 Edition. The 1973 NESC permitted, as one of four options, the interconnection of a lightning arrester and grounded secondary conductor: "In urban water-pipe areas, there are four metallic water-pipe grounds in each mile of secondary and not less than four such ground connections on any individual secondary, in which case the direct earth grounding connection at the arrester may be omitted." This provision was not included in the 1977 NESC. As discussed in Interpretation Request 299, the reason for this omission is unclear. Likewise, permission to bond separate made electrodes near the ground level, while not addressed, is not prohibited.

The 1981 NESC Rule 97 is essentially the same as 1977, with minor editorial changes to parts of paragraph A.

The 1984 NESC substantially modified paragraph D to address means of interconnection through spark gaps or equivalent devices, but made no changes to paragraph A and B.

The 1987 NESC Rule 97 is essentially identical to the 1984 edition.

INTERPRETATION (Mar 13, 89)

Question 1. The surge arrester ground and frame ground of Question 1 are both included within Class I of Rule 97A and may, therefore, be interconnected.

Question 2. No. See IR 420 and Question 4 of IR 407. The requirements of Rules 97B and 97C are *not* met.

Question 3. Yes. The wording of Rule 97B does not specify that the primary neutral must be of the same circuit as that feeding the secondary circuit to be grounded.

Question 4. The interpretation does not change.

97A

Grounding of a transformer installation

REQUEST (June 12, 89) IR 427

I am requesting your assistance in interpreting the NESC compliance of both the described distribution transformer installation, and the installation of the multigrounded distribution neutral. Figs IR 427-1 to IR 427-6 show the transformer installation in question, a schematic of this transformer installation, a sketch of the location of the three-phase and single-phase services in relation to the buildings, and a sketch of distribution pole installations.

Question 1: Can a corner-grounded Delta secondary conductor be considered a neutral under 97A? If so, can interconnection of this grounded corner with the primary neutral comply with Rule 97B?

Question 2: Does the "jumper" at the three-phase service main comply with 92B1, which states, "grounding connections shall be made at the source, and at the line side of all service equipment...?"

Question 3: The established multigrounded distribution system consists of pole wire wraps in a geographic area with topsoil predominantly mixed with sand, and a subsoil ranging from sand to gravel. A recently (June, 1988) relocated section of 12470Y/7200 distribution system, of approximately six miles in length, was installed in one of the few "pockets" of low resistivity soil (clay). The method of construction was to place the pole, with wire wrap, into a drilled hole, backfill the hole with medium gravel, and then crown the top of the hole with clay. Can this be considered effectively grounded, using the NESC definition?

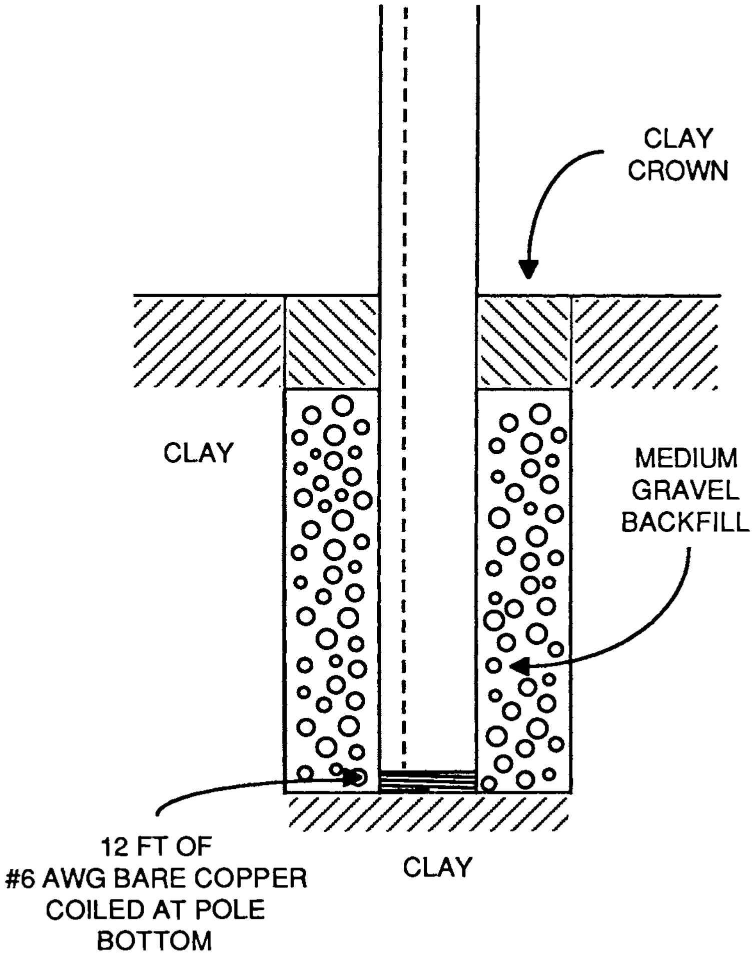

Fig IR 427-1

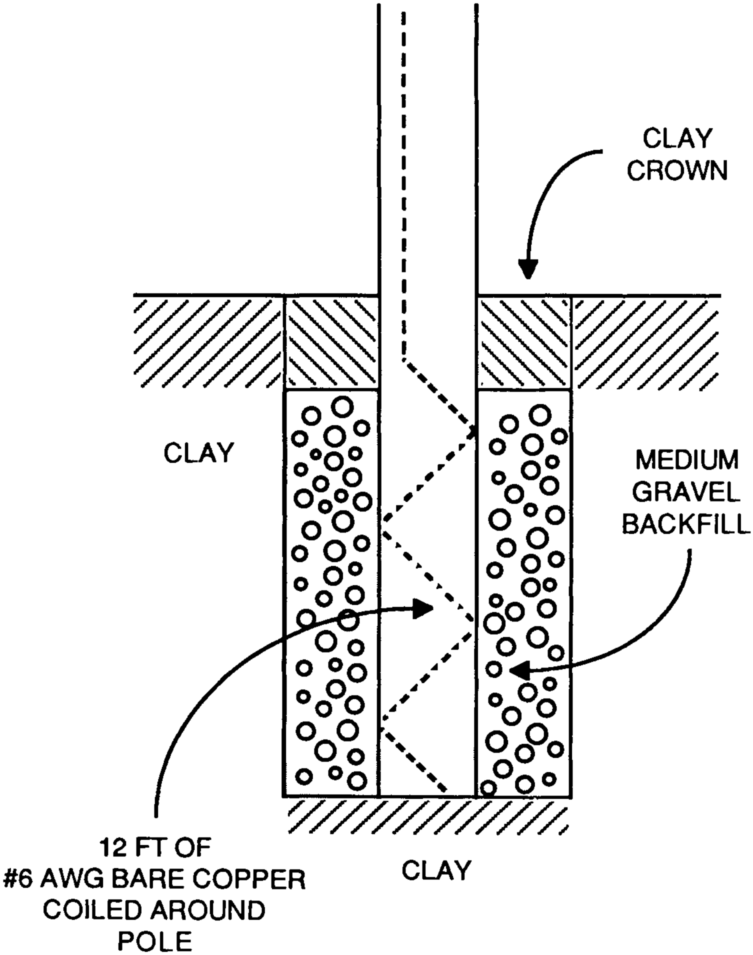
CLAY
CROWN
CLAY
MEDIUM
GRAVEL
BACKFILL
12 FT OF
#6 AWG BARE COPPER
COILED AROUND
POLE
CLAY

Fig IR 427-2

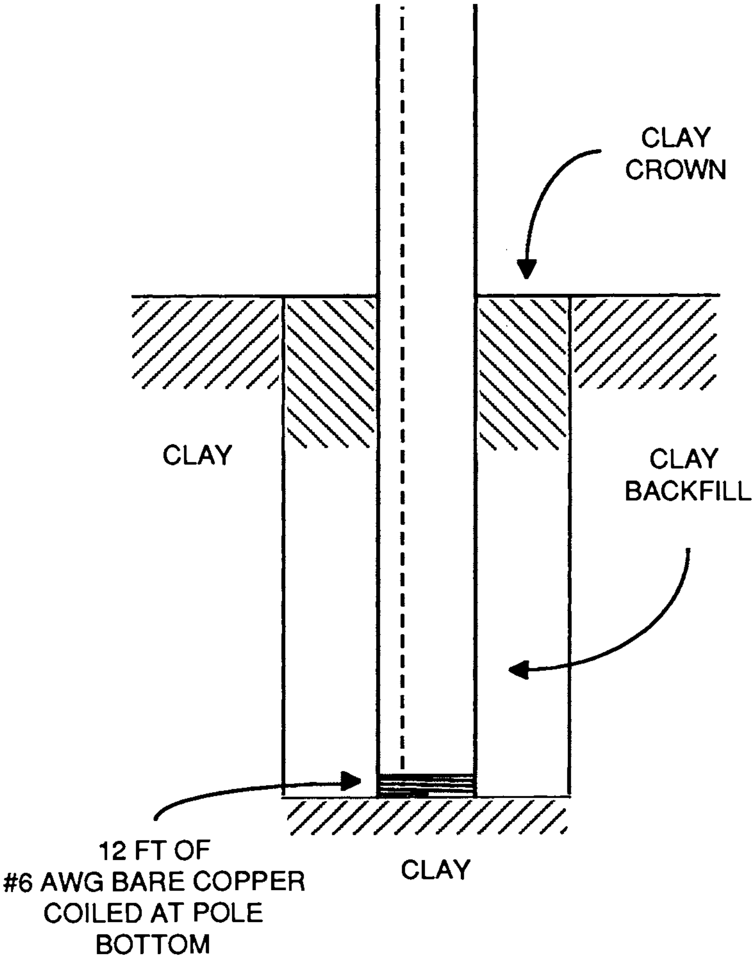
CLAY
CROWN
CLAY
CLAY
BACKFILL
12 FT OF
#6 AWG BARE COPPER
COILED AT POLE
BOTTOM
CLAY

Fig IR 427-3

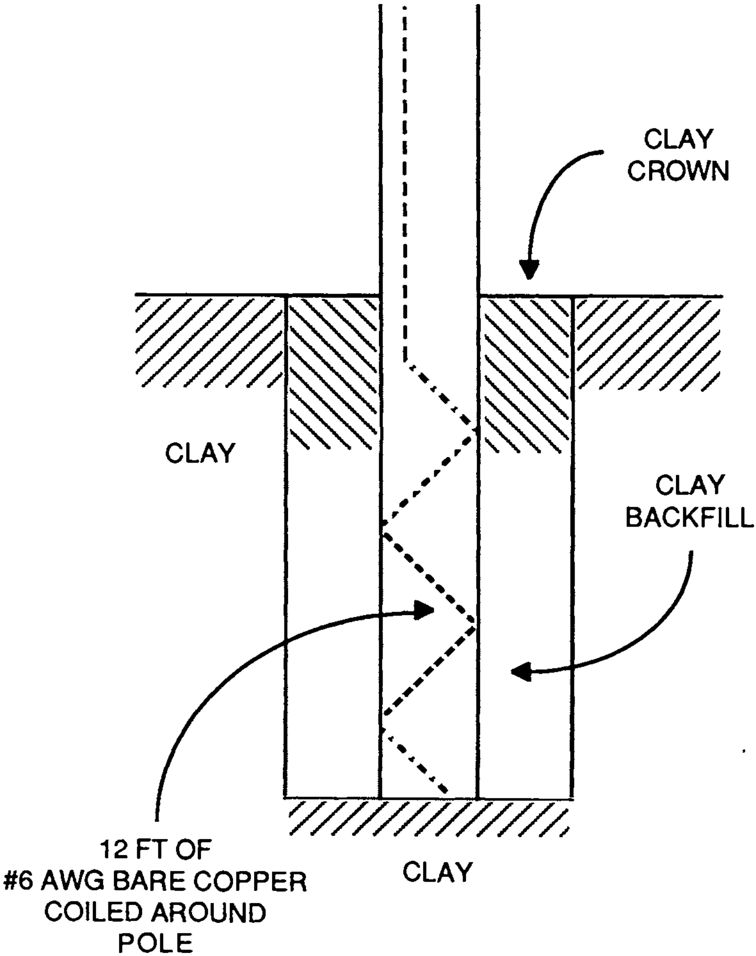
CLAY
CROWN
CLAY
CLAY
BACKFILL
12 FT OF
#6 AWG BARE COPPER
COILED AROUND
POLE
CLAY

Fig IR 427-4

97A

Fig IR 427-5

97A

Fig IR 427-6

97A

Fig IR 427-7

97A

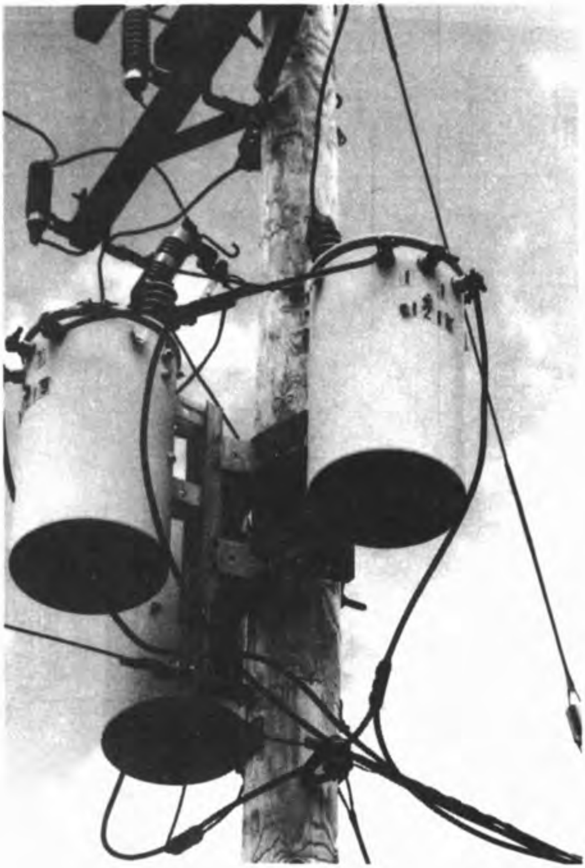

Fig IR 427-8

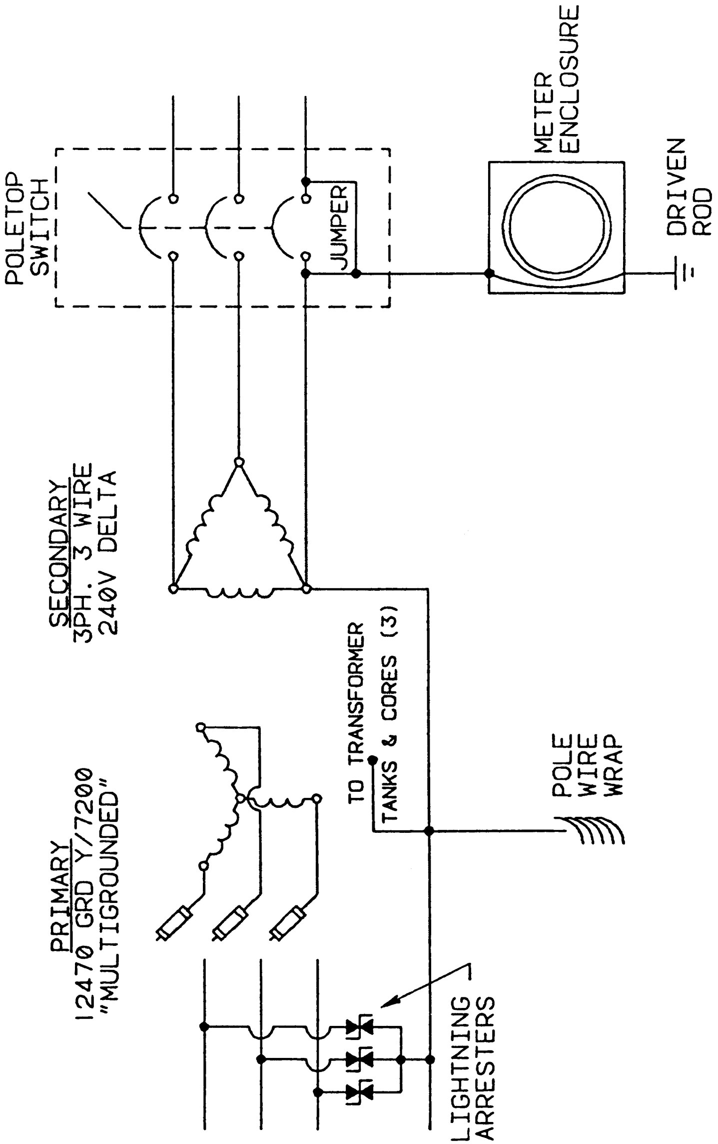
POLETOP
SWITCH
JUMPER
METER
ENCLOSURE
DRIVEN
ROD
SECONDARY
3PH. 3 WIRE
240V DELTA
TO TRANSFORMER
TANKS & CORES (3)
POLE
WIRE
WRAP
PRIMARY
12470 GRD Y/7200
"MULTIGROUNDED"
LIGHTNING
ARRESTERS

Fig IR 427-9

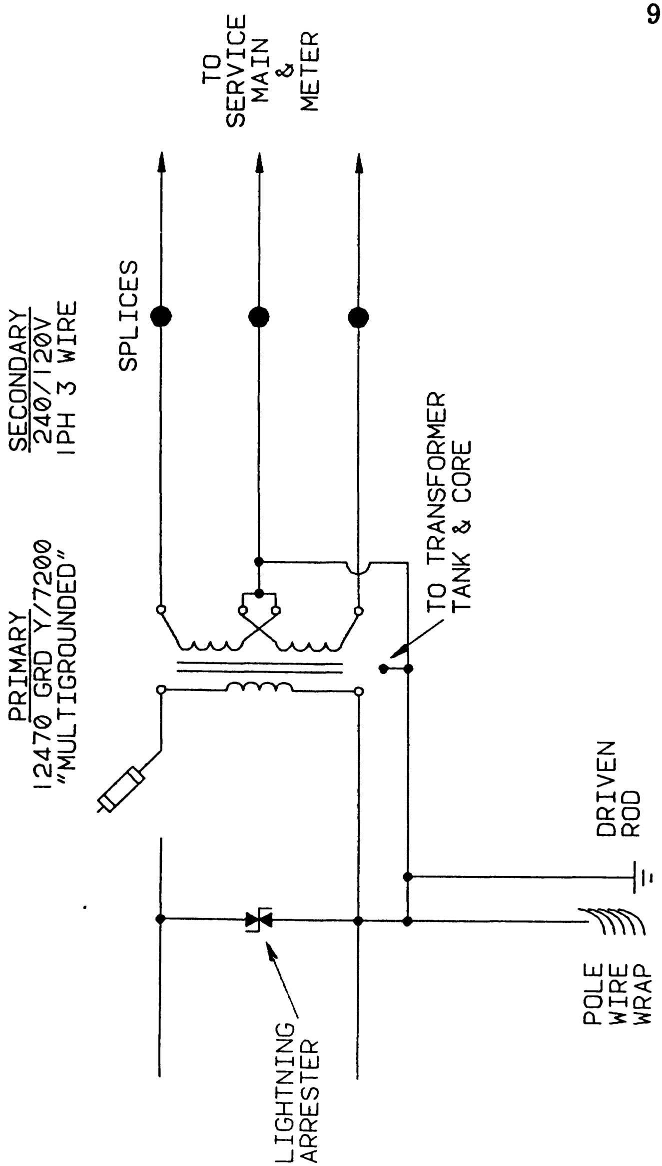
TO
SERVICE
MAIN
&
METER
SECONDARY
240/120V
1PH 3 WIRE
SPLICES
PRIMARY
12470 GRD Y/7200
"MULTIGROUNDED"
TO TRANSFORMER
TANK & CORE
DRIVEN
ROD
POLE
WIRE
WRAP
LIGHTNING
ARRESTER

Fig IR 427-10

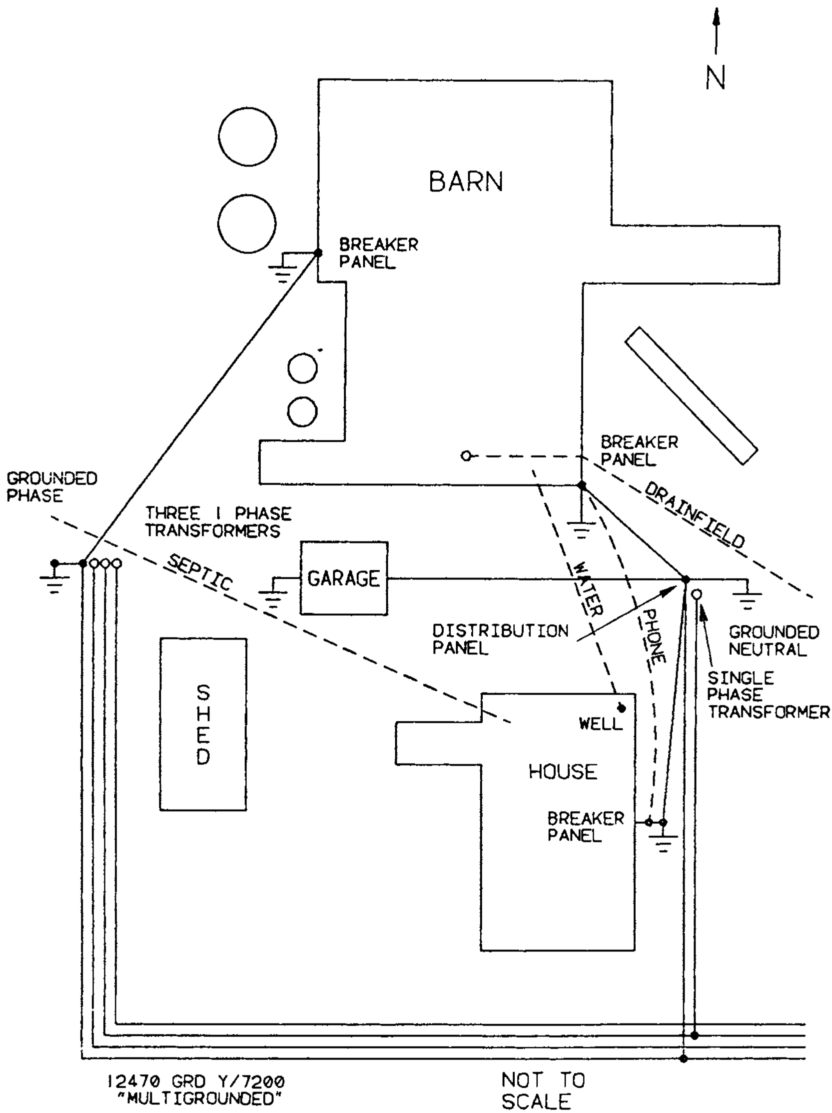
N
BARN
BREAKER PANEL
BREAKER PANEL
GROUNDED PHASE
THREE 1 PHASE TRANSFORMERS
SEPTIC
GARAGE
DRAINFIELD
WATER
PHONE
DISTRIBUTION PANEL
GROUNDED NEUTRAL
SINGLE PHASE TRANSFORMER
SHED
WELL
HOUSE
BREAKER PANEL
12470 GRD Y/7200
"MULTIGROUNDED"
NOT TO SCALE

Fig IR 427-11

INTERPRETATION (Nov 3, 89)

Question 1. A grounded phase conductor cannot be considered a neutral conductor; it is a grounded secondary phase conductor. See the definitions of "neutral conductor" and "grounding conductor" in IEEE Std 100-1988, IEEE Standard Dictionary of Electrical and Electronics Terms. See also IR 234.

The corner-grounded delta secondary is classified under Rule 97A2. The primary neutral is typically interconnected to the surge arresters, which are classified under Rule 97A1. As such, Rule 97A prohibits interconnection of these classes unless Rule 97B is met.

The installation you have illustrated violates Rule 97B in several respects. First, 97B1 requires a direct earth grounding connection at each surge arrester location; i.e., a driven rod electrode or equivalent electrode is required. A pole butt plate or pole butt wrap is not allowed to be the sole grounding electrode at transformer (surge arrester) locations—see Rule 94B4a. The schematic implies that there is a butt wrap or pole wrap, instead of a driven ground, at the first transformer location; this can exist but cannot count as the ground connection at the arrester location.

In addition, the grounded secondary phase conductor is not a secondary neutral and does not qualify under the wording of Rule 97B2. Lastly, the primary neutral may not meet Rule 97C; see the comments under Question 3.

Question 2. The jumper at the 3-phase service entrance appears to meet the requirements of Rule 92B1. We point out that, if the service entrance panel is on the pole with the poletop switch, one ground rod is appropriate; if the two are at different locations, an additional ground rod would be needed at the service entrance.

Question 3. You have shown two types of wire wrap (pole wrap and butt coil) and two types of backfill (clay and medium gravel). The butt-coil wire wraps of Figs IR 427-1 and IR 427-3 are functionally equivalent to a pole butt plate and meet the requirements of Rules 94B4a and 94B4c if the clay is of low resistance.

Since the wire wrap in Fig IR 427-4 is surrounded by clay, it meets Rules 94B4a and 94B4c if the clay is of low enough resistance. However, Fig IR 427-2 does not meet the requirements of Rule 94B4; the wire wrap is not in contact with a low resistance earth material.

It should be noted again that electrodes such as those of Figs IR 427-1, IR 427-3 and IR 427-4 cannot be the sole grounding electrode at a transformer location (Rule 94B4a); they can, however, be used elsewhere on a line to achieve the multigrounding requirements of Rules 96A3 and 97C if at least two butt wraps are used per additional ground connection required by those rules and they are placed in earth of low resistance.

Although not intended as part of this interpretation of the NESC, we note that you may also wish to consider the requirements of National Electrical Code (NEC) article 250-54, Common Grounding Electrode.

97A1	**See 97A**	**IR 427**
97A2	**See 96A2**	**IR 429**
97B	**See 93C2**	**IR 407**
97B	**See 97A**	**IR 422, IR 427**
97B1	**See 97A**	**IR 427**
97B2	**See 97A**	**IR 427**
97C	**See 97A**	**IR 422, IR 427**
97D1	**See 93C2**	**IR 407**
97D1	**See 97A**	**IR 420**

97D2

Insulation requirements for secondary grounding conductor

REQUEST (Jul 11, 90) IR 442

I would like to request an interpretation of the insulation requirements set forth in the last line of Rule 97D2. From discussions with other utilities, I have found that there is no universal interpretation of this provision in Rule 97D2.

The application in question is as follows. We have numerous farm service installations where primary and secondary neutral systems have been isolated to eliminate or reduce stray voltage. In accordance with the rule, the primary grounding conductor is bare copper, and 600 V insulated copper wire is used for the secondary ground conductor. However, most of the installations also have metallic conduit containing service cable as well as a meter base attached to transformer pole. Both of the items are bare uninsulated metallic objects and bonded directly or indirectly to the secondary neutral system.

It seems to me that the intent of requiring 600 V insulation for the secondary ground conductor, as specified in the last sentence in Rule 97D2, is to ensure that the general public or line workers cannot come into contact with the potential difference that could exist between the two neutral systems. If that is a correct interpretation of this provision, it seems to me that other equipment mounted below the 18 ft level and electrically tied to the secondary neutral must either be constructed of material that is insulated for 600 V (such as PVC conduit), or alternately, as in the case of the meter socket, removed from the pole and relocated to a new site at least 6 ft away. Failure to insulate or remove these items of equipment would essentially defeat the purpose of utilizing 600 V insulation on the secondary ground conductor.

Some other utilities have told me that this interpretation is not correct, and that this is really not the intent of this provision. Rather, they interpret the requirement for 600 V insulation as applying only to the grounding conductor, in order to ensure the effective elimination of stray voltage, and not as a safety precaution to prevent inadvertent human contact.[1]

Since the cost to remove metering and service equipment from the pole is rather high, considering the number of installations involved, we would appreciate receiving confirmation that our interpretation of Rule 97D2 is correct before proceeding with this work.

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[1]Even with this interpretation, however, it is difficult to understand how these utilities can rationalize leaving the meter socket on the pole, since an accidental interconnection between the meter socket and the primary down ground could occur as easily as it could between the primary and secondary down grounds.

INTERPRETATION

(In process)

Part 1. Rules for the Installation and Maintenance of Electric Supply Stations and Equipment

111A

Artificial illumination in distribution substations

REQUEST (Jan 26, 88) IR 419

Your assistance is requested in interpreting Rule 111A for the circumstances given:

Background. Our standard policy is to provide portable artificial illumination for use in unmanned distribution substations. Our distribution substations do not have permanent means of artificial illumination.

Concern #1. Our concern is whether the NESC requires permanent means of artificial illumination.

Concern #2. Our concern is whether the NESC requires any means of artificial illumination in unmanned outdoor distribution substations.

INTERPRETATION (Feb 14, 89)

At unmanned stations, either permanent or portable lighting may be used during such times that personnel perform work in the station at night.

Part 2. Safety Rules for the Installation and Maintenance of Overhead Electric Supply and Communication Lines

200C **See 96A2** **IR 429**

215 **See 96A2** **IR 429**

215C2

Guys installed on supporting structures of overhead power lines

REQUEST (May 29, 90) IR 440

We would like to request clarification of the NESC's intention regarding guys installed on supporting structures of overhead power lines. It is our understanding that the guy must either be isolated by use of a strain insulator or must be effectively grounded (Rule 215C2).

Our standard approach for grounding guys is shown in Fig IR 440-1. We consider the anchor to be an effective ground electrode based on actual resistance readings taken on a number of helical anchors installed on recent projects. We bond the guy to the anchor, thereby effectively grounding the guy.

We believe our method meets the intent of the NESC. However, some state inspectors have taken the position that an anchor does not satisfy the NESC requirements for a made electrode. We are, therefore, requesting an official interpretation of whether an anchor installed in accordance with the following specifications meets the requirements of NESC 94B2.

1. As a minimum, the anchor installation consists of a 5-ft long twin helix lead section, a minimum of two 7-ft long extensions, and an 18-in guy adaptor. The minimum driven depth is 19 ft. The shafts used on the anchor and anchor extensions are 1-1/2 in square shafts made from galvanized steel.
2. The portion of the guy extending above ground is protected with a full-round plastic guy guard.
3. The guy is bonded to the anchor using a bonding clamp specifically designed for this application.

We would appreciate your review of our installation in general and specifically your interpretation of whether the helix anchor meets the requirements of NESC 94B2 as a driven rod made electrode.

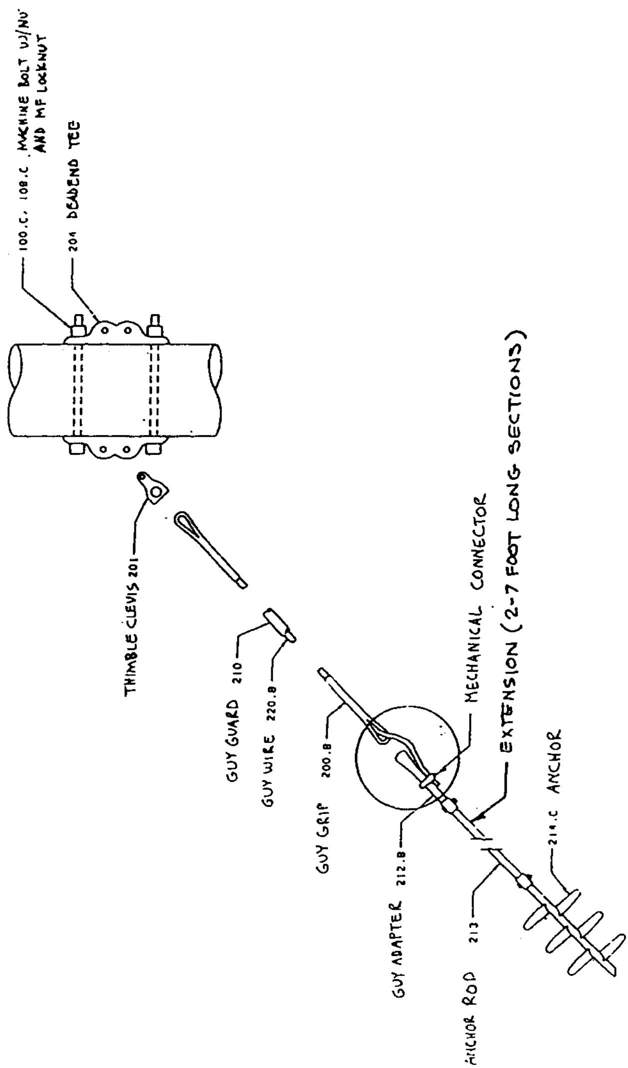

Fig IR 440-1
Standard Installation

INTERPRETATION (May 29, 90)

Connection of the guy to a grounding conductor on the structure is specifically required by Rule 92C2 so that, if a guy becomes loose or separated from its anchor, the guy will remain grounded. It is recognized that guys attached to anchors that are not effectively insulated by corrosion protection coatings may contribute significantly to the effective grounding of a supply neutral or communication messenger, but such a connection cannot be the sole means of grounding a guy.

224A

Requirements for fiber optic cable

REQUEST (Oct 16, 89) IR 431

There appears to be a conflict between Rule 224A and the definition "fiber optic cable—supply."

Rule 224A appears to allow only communication (fiber optic) cables that are used exclusively in the operation of a supply circuit to be installed in the supply line space on a pole. By the definition of "fiber optic cable—supply," fiber optic cable owned by the electric supply company can be installed in the supply space on a pole without regard to its use. Is fiber optic cable exempt from the use requirements of article 224A and subject to only the clearance requirements of article 230F?

INTERPRETATION

Rule 230F allows a fiber optic supply cable to be located like a neutral meeting Rule 230E1 (i.e., 30 in vertical clearance at the pole and 12 in in midspan); alternatively, the exception allows it to be considered as ordinary communication only if it meets Rule 224A3.

Regardless of whether any portion of the fiber optic cable or its suspension system is conductive, a fiber optic cable suspension attachment must be located in *either* the supply space or the communication space on a pole and it must meet the clearances required from facilities in the other space. If it is located in the communication space, it must be 40 in below supply secondary or 30 in below a 230E1 neutral; it cannot be located between the supply space and the communication space. If it is to go from the supply space to the communication space, the transfer must be made as a vertical conductor on a structure. Neither a fiber optic cable nor a 230E1 neutral can be located between the supply space and the communication space in the span, nor can either one be supported at the pole between the two spaces.

Rule 224A applies to all communication circuits used exclusively in the operation of supply circuits. It was originally written to address communication circuits utilizing metallic signal conductors and is intended to limit the opportunity for transfer of an inappropriate voltage to the communication space. Adherence to *either* Rule 224A3 or 224A4 is required.

Fiber optic supply cables cannot transfer a voltage over the dielectric fibers themselves, but they can transfer voltages over metallic messengers (if they are so supported) or over backup copper conductors or metallic shields (if they are included). Therefore, adherence to Rule 224A is required if a fiber optic supply cable is to be located in the communication space.

224A

Clearances of communication lines

REQUEST (Feb 14, 90) IR 436

A municipally owned power company acting through a commission, supplying power and water service to a city, is planning the installation of coaxial cable to supply cable television (described in the NESC by definition as a communication circuit) via a drop wire, to the residents of the city. At a later date, the same cable facility will be used as a Supervisory Control and Data Acquisition System (SCADA), otherwise known as Paragould Information and Communications Utility Systems (PICUS) to be used in the control of supply lines. Their engineering department has decided that, since part of the cable will be used at a later date as a SCADA-PICUS system, it falls into the category of communication conductors used in the operation of supply lines and therefore requires only a sixteen inch vertical clearance at the supports.

As applied to the 1990 Edition, we have the following questions:

QUESTION ONE—Rule 224A deals with overhead communications used exclusively in the operation of supply circuits. Since the PICUS system, when completed, will not be used exclusively for

SCADA operations, we feel that Rule 224A does not apply. Is this correct?

QUESTION TWO—During the period that the coaxial cable will serve *solely* as a means of delivering video signals to private residences, we feel that it is a violation of the NESC's definition of a "communications line" (page 55) to categorize the cable as anything other than a communications cable and it would have to be required to observe all clearances for ordinary communications systems. Do you concur?

QUESTION THREE—Assuming the combined SCADA-PICUS system does not fall under Rule 224A because of its dual role, then according to Table 235-5 it must fall under category 1b, Communications Conductor Used in the Operation of Supply Lines. This would require a sixteen-inch clearance from secondaries. We interpret this to mean that a forty-inch clearance is to be maintained to the nearest communication line. Is this also your interpretation?

Cable television clearances have always been identified as those applied to the telephone industry in order to protect the public from accidental power contacts. Providing cable service through drops that are within the same sheath as SCADA lines on existing poles with drops that are too close to the secondary plant is a double hazard to the public.

We hope you will be of help in resolving this undesirable and potentially dangerous situation.

INTERPRETATION (JUL 30, 90)

1. Rule 224A does not apply.

2. CATV cables are considered as communication cables.

3. Category 1a of Table 235-5 applies to CATV cables. If a joint CATV/SCADA cable is to be used, the SCADA portion of the cable would be required to meet Rule 224A3 so that the whole cable would be considered as a communication cable. The 40-in clearances from supply secondary would be required for this cable.

224A

Construction of fiber optic cable in the clear space on joint-use poles by a local power company

REQUEST (July 30, 90) IR 443

A local power company has recently begun placing considerable amounts of all-dielectric fiber optic cable for use as both (1) load control and (2) data circuits. It is our opinion that pole clearances are being violated because of misinterpretation of Rules 224A and 230F. In order to help us resolve this problem please provide your interpretation of the following:

1. We interpret Rule 224A to apply to those circuits dedicated to operation of supply circuits and not for circuits transmitting data for other purposes. Is this correct?

2. We further interpret Rule 224A3 to mean that supply operating circuits that do qualify as "ordinary communications" must observe the rules established in the Code for "ordinary communications." We consider the special case of fiber-optic communications in Rule 230F2 as further reinforcement for our interpretation. Are these assumptions correct?

3. Fiber-optic cable that does not qualify as ordinary communications cable is defined as fiber-optic supply under Rule 230F1, and must be placed to meet the 30-in pole clearance from communications, and 12 in in the span, as are neutrals meeting Rule 230E1. Are we interpreting this Rule correctly?

To help visualize the clearances we are referring to, we attach the following three photographs:

1. Photo (1) shows a typical separation between the neutral highest cable and the fiber optic cable of about 10 in. Photo (1) also shows a clearance between CATV communications and the supply fiber optic cable of 24 in instead of the 30 in we feel is required.

2. Photo (2) depicts a 6-in clearance between secondary triplex and the fiber cable. In our opinion, this categorizes the cable as fiber optic supply.

3. Photo (3) shows a midspan clearance between CATV communications and the fiber optic supply cable between 1 and 2 when in our opinion, 12 in is required.

INTERPRETATION
(In process)

224A4

Definition of supply lines and communication lines

REQUEST (Jul 16, 90) IR 437

This is to request your interpretation of the definition of "communication lines" in the 1990 Edition of the NESC with regard to traffic control devices.

Our practices have for years recognized traffic control cables as COMMUNICATIONS, and required a minimum of one foot working clearance from telephone plant. On the other hand, we have recognized the 120 V ac power to the lamps as SUPPLY—and observed appropriate clearances.

Recently a municipality has established a traffic signal system supplied and controlled by a group of conductors wrapped into a single sheath. Some of these conductors control relays that coordinate the traffic signals; others, however, are 120 V conductors that supply lamps in the signals. Is the "hybrid" cable as constructed to be placed at the "supply" or "communication" level on the poles? Note that the poles are jointly used for both supply and communications facilities.

We are concerned about the safety of our workers in close proximity to this type of cable layup, if it appears in the communications space.

Would you reaffirm our interpretation of "supply" and "communication" as it pertains to traffic control signals?

INTERPRETATION (Jul 16, 90)

Power circuits operating traffic signaling lamps above 90 V are considered as electric supply circuits of the applicable voltage, not communication circuits. A cable containing such voltages would be thus considered regardless of whether it also included a communication circuit to switch the lamps on and off. See the definition of Communication Lines and Rule 224A4.

230E1 **See 224A** **IR 431**

230F **See 224A** **IR 431**

230F1 **See 224A** **IR 443**

231

Meaning of "road" as used in Rule 231

REQUEST (Nov 3, 89) IR 432

I represent a defendant in a lawsuit. The minor-plaintiff's claim is that he was riding a motorcycle down a private road when he came in contact with a van, ricocheted off, and allegedly struck his head against a utility pole. He complains that the utility pole was in the middle of a 30-ft easement.

The area in question is entirely private property that extends several hundred yards from the east side of a highway.

When the developer laid the property out in 1953, he requested that my client's poles be placed in the middle of a 30-ft easement. That affords 15 ft of clearance on each side of the poles. The poles run parallel to the highway. A private dirt road runs alongside the poles, which allows the residents of the property and their guests a method of ingress to and egress from their lots. Frequently, the path is only one lane wide. Approaching cars must find a spot to pull over to let the other car pass.

Plaintiff's expert has testified that Rule 231 from your 1981 Code would apply to our facts because we placed a new pole in the same area in calendar 1982. He also suggested that the 1984 National Electrical Safety Code (NESC) would apply because plaintiff's injury occurred in 1985.

My primary question is whether Rule 231 would apply to a utility pole that is placed on a plot of ground that is entirely private in nature. It has never been maintained by any unit of government nor has it ever been paved. There is some question as to whether owners at one time or another brought in some gravel to be put into the dirt.

My second question is whether either the 1981 or 1984 Editions of the NESC would apply when the original poles and lines were installed in 1953, and a replacement pole was simply installed nearby so as to be in the same line.

[The Secretary of the NESC Committee and the Requestor corresponded, and the Requestor resubmitted his question concerning Rule 231. The text of that resubmission follows.]

I am not seeking a consultation.

Rather, I am seeking an interpretation of the word, "road," as it is used in Rule 231 of your 1981 and 1985 Editions of the NESC.

I apologize for any confusion. Admittedly, my letter went beyond that request. However, my real reason in writing was to determine whether a parcel of land that is entirely under private ownership would qualify as a "road" within the meaning of your Rule 231. What we have are owners of property that periodically drive over the same area, so that a two-track trail develops.

Plaintiffs have retained an "expert" who has rendered an opinion that the code does apply and that it is violated. He rendered that opinion without consultation with your committee.

INTERPRETATION (Jul 16, 90)

The NESC does not especially define "road"; rather, it depends upon ordinary dictionary usage. *Webster's Ninth New Collegiate Dictionary* defines "road" as "an open way for vehicles, persons, and animals; especially one lying outside of an urban district." The implication is that the road is intended for such traffic. This contrasts with the definitions of trail: "a track made by passage especially through a wilderness" and "a marked or established path or route especially through a forest or mountain." The NESC refers to roads, not trails. We do not know whether your area is a road or trail, and are not allowed to make the determination even if the required information were available.

The 1977 and later Editions clearly allow (in Rule 013B or Rule 202, as applicable) existing installations to remain in compliance with the code edition applicable to its construction.

You mention a pole being added in 1982. That would not affect the edition applicable to the existing facilities. If that is merely an in-line service pole, it is not required to meet the 1981 Edition because the edition applicable to the line design was the 6th Edition, which required existing facilities to be upgraded to it. It is recognized that poles may be added or moved within a line to accommodate several requirements. However, the 1981 Edition could be used if desired. If the new pole was to serve a new requirement, such as a tap from the line or an extension of the line, the 1981 Edition would be required for the tap or extension only, not the existing line.

However, all of these questions beg the central issue. If this passageway is a "road," as long as the poles are far enough away from the traveled way of the road to allow ordinary vehicles to use the road without restriction, such poles meet the requirements of good practice, regardless of applicable code edition.

The fact that a vehicle leaves the traveled way out of control speaks to the driving habits of one or more drivers, not the appropriateness of the pole location; the pole might as well be a tree for all practical purposes in that instance.

Table 235-5 **See 224A** **IR 436**

Table 232-1

Clearance over driveway to grain bins

REQUEST (June 12, 89) IR 428

I am writing as a representative of a cooperative association. This cooperative provides electrical utility service in primarily rural areas. It is our policy to construct and maintain electrical distribution lines in accordance with the standards set forth in the National Electrical Safety Code (NESC). To my knowledge, all of the electrical utilities in our State follow the National Electrical Safety Code and it has been adopted by the State Commerce Commission, which regulates public investor-owned utilities.

Recently, an electrical engineer working for a private citizen has questioned our interpretation of the NESC with respect to the vertical clearance of our electrical transmission lines. The specific situation is as follows:

The co-op has a three-phase 7200 V electrical transmission line built on a county road right-of-way, running parallel to the county road. The area on either side of the road is mainly farmland with some residences.

The three-phase line, at one particular point, crosses over a gravel driveway that runs from the county road to some grain bins. Figs IR 428-1 to IR 428-3 show pictures of the area. The gravel driveway is subject to truck traffic and, of course, various farm equipment.

In determining the vertical clearance of the three-phase lines over this gravel driveway, the co-op has followed Table 232-1 of the 1984 Edition of the NESC. We have interpreted row two of Table 232-1, "Roads, Streets, Alleys..." as being applicable to this situation. Thus, we have used the standard of 20 ft plus the additions for the length of a span and voltage of the line as the minimum clearance.

The above-mentioned electrical engineer is of the opinion that Table 232-1 does not apply to this situation. He reasons that because Table 232-1 does not mention farm equipment and, in particular, portable grain augers, Table 232-1 does not apply. He recognizes that truck traffic includes all vehicles over eight feet, but nevertheless maintains that the requirements for "Roads, Streets, Alleys..." does not apply. He states that if the co-op is going to be guided by Table 232-1 in this situation, they should follow the requirements for Part 1, "Track Rails of Railroads." He finds no other part of the NESC applicable.

The co-op requests that the committee provide us with an interpretation of Table 232-1 as it relates to this situation. If there is any further information you need, please notify me and I will immediately supply you with that information. Thank you for your assistance.

 Table 232-1

Fig IR 428-1

Table 232-1

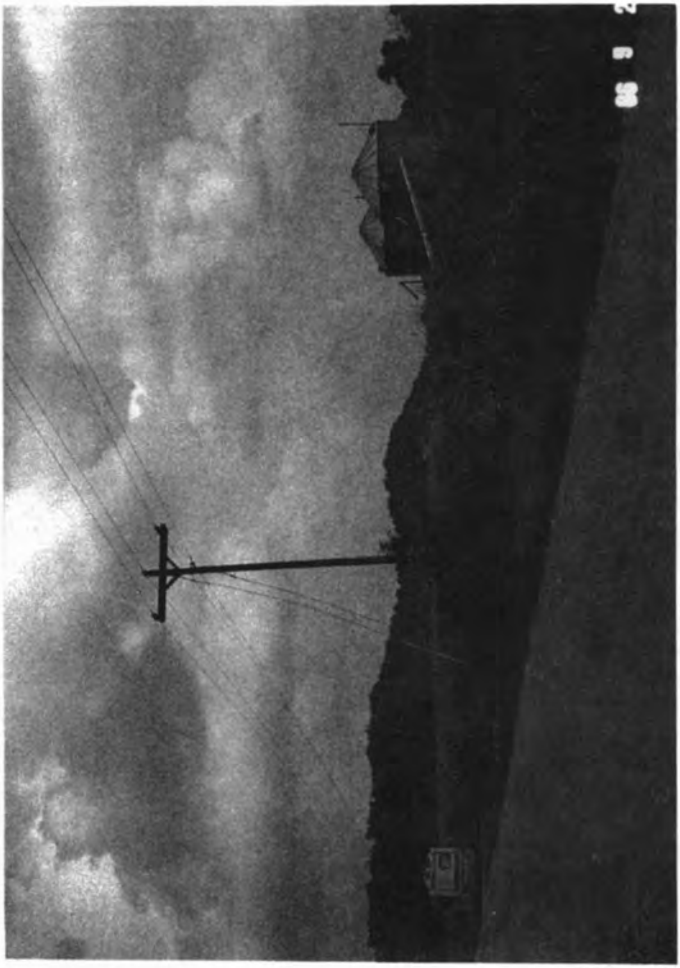

Fig IR 428-2

Table 232-1

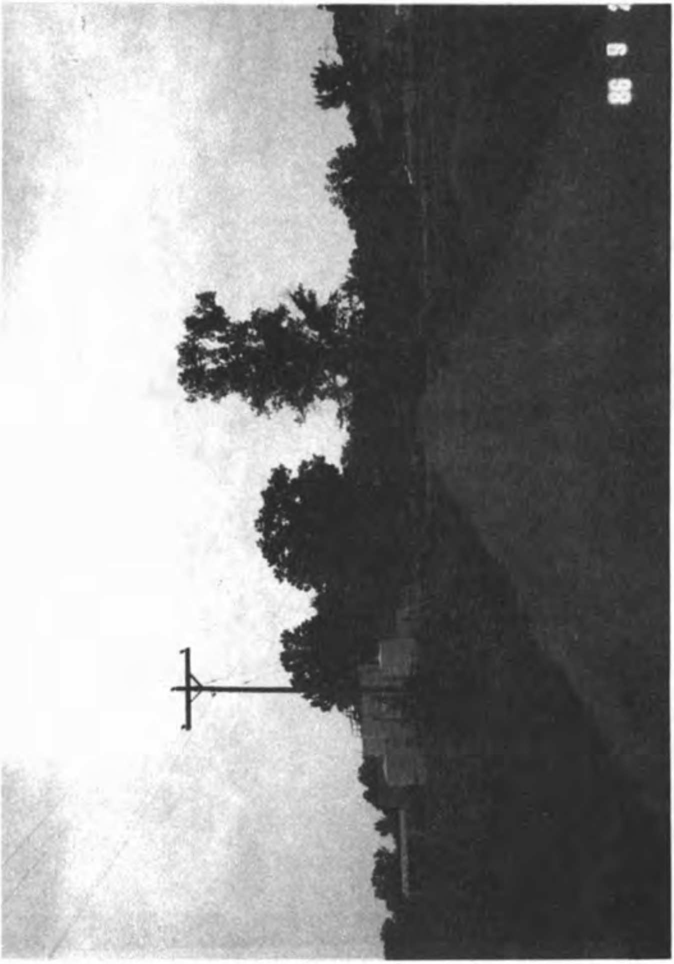

Fig IR 428-3

INTERPRETATION (Aug 18, 89)

Grain augers are required and expected to be down in the transported position when on highway rights-of-way; in such areas, Item 2 or Item 9 of Table 232-1 would apply, as applicable.

IF the line is over private lands, instead of public rights-of-way, Item 4 of Table 232-1 would apply. If the line were to be placed so close to a grain bin (which the photo indicates is *not* the case here) that the line is in the area in which an auger would be expected to be raised for loading, then that is a special case to be treated appropriately under Rule 012 of the 1984 Edition of the NESC.

The 1990 Edition has codified grain bin clearances for the first time. Additionally, if an installation meets the requirements of the 1990 Edition, it is not required to meet the requirements of any other edition. By the time you read this, the 1990 Edition will be available for use.

235A3 **See 93C2** **IR 407**

235C **See 93C2** **IR 407**

235E **See 93C2** **IR 407**

235E

Clearance for span guys grounded at both ends

REQUEST (Jan 25, 89) IR 426

Please furnish an interpretation of Rule 235E of the 1987 Edition of the National Electric Safety Code:

The span guy, as shown in Fig IR 426-1, is considered as "all other guys" and the required clearance from the phase to the span guy, for a system operating at 69 kV, Table 235-6, would be 31.98 in [23 in + (69(1.05) - 50)0.4]. If that same span guy were bonded to the down grounds of both poles to which it was attached, can the required clearance from the phase to the span guy be considered as if it were an "anchor guy" and the clearance reduced to 21.61 in [16 in + (69(1.05) - 50)0.25]?

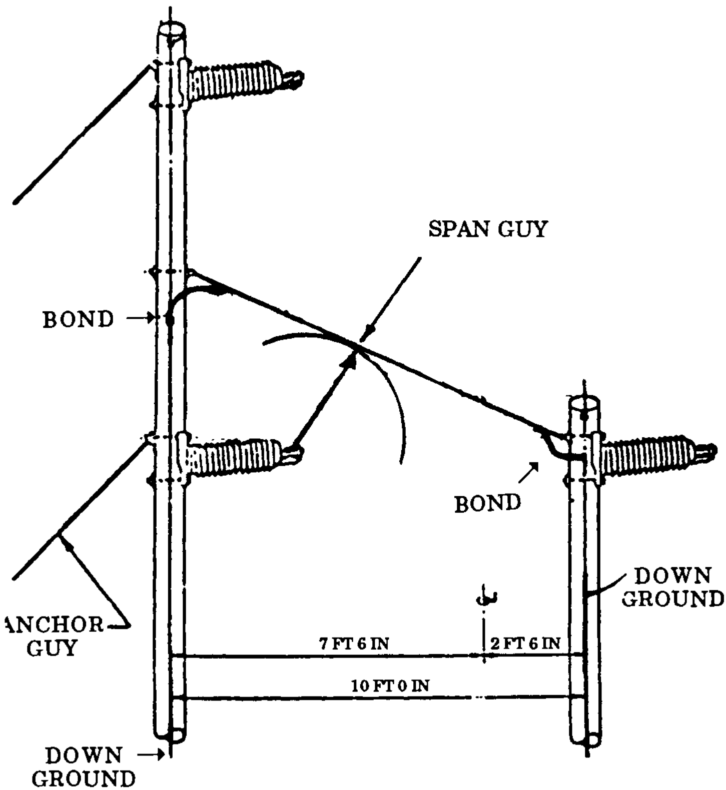

Fig IR 426-1

INTERPRETATION (Mar 13, 89)
No.

Table 235-5 See 93C2 IR 407

Table 235-6 See 93C2 IR 407

Table 235-6 See 235E IR 426

236

Climbing space on structures and poles

REQUEST (June 17, 88) IR 421

Your assistance is requested in interpreting Rule 236 for the circumstances given:

Background. Our standard policy is to provide climbing space on the power poles we install. Due to tap lines and uncontrollable circumstances, some of our poles do not have climbing space for workers to ascend to the top of the pole.

Concern. Our concern is whether the NESC requires the climbing space on *all* structures and poles?

Background. Rule 236—Climbing Space says that "the following requirements apply only to portions of structures which workers ascend."

Aerial lift equipment is provided for workmen to ascend structures without climbing space. Therefore, utilities have historically installed structures without climbing space.

Concern. Do we need to provide climbing space regardless of this fact?

INTERPRETATION (NOV 11, 88)

Prior to the advent of aerial lift bucket trucks, workers were required to climb structures to install and maintain lines and equipment; climbing space was, therefore, required. The 1977 and subsequent editions recognize that portions of structures that are bypassed with the use of aerial lift equipment need not be provided with climbing space in those portions of the structure. See also the Exceptions to Rule 236E. Note that Rule 237—Working Spaces still applies.

Even though they might ordinarily use an aerial lift, if workers will sometimes be expected to climb structures on pole steps or with climbing gaffs (such as during storm repair), then appropriate climbing spaces are required in the portions that the workers would be expected to climb.

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237 **See 236** **IR 421**

239C

Protection of risers

REQUEST (Oct 23, 87) IR 416

We request an interpretation of Rule 239C of the 1987 Edition of the National Electrical Safety Code. The Rule reads, in part:

> **Mechanical Protection Near Ground**
> Where within 8 ft (2.45 m) of the ground, all vertical conductors, cables, and grounding wires shall be protected by a covering which gives suitable mechanical protection.

We request the Committee's opinion on whether and under what conditions Schedule 40 PVC conduit provides "suitable mechanical protection" for risers on utility poles.

The National Electrical Code, ANSI/NFPA 70-1987, clearly does not allow Schedule 40 PVC for risers over 600 volts installed on customer premises. Article 710-3(b)(1) of the NEC reads, in part:

> **Protection from Damage.** Conductors emerging from the ground shall be enclosed in approved raceway. Raceways installed on poles *shall be of rigid metal conduit, intermediate metal conduit, PVC Schedule 80 or equivalent* extending from the ground to a point 8 feet (2.44 m) above finished grade [emphasis added].

We would appreciate your opinion on this question.

INTERPRETATION (Aug 29, 88)

"Suitable mechanical protection" for risers on utility poles cannot be specified for all conditions. What may be required for some local conditions may not be required, or may not be enough, for other local conditions. NESC Rule 012 requires the installation to be such as to be accepted as *good practice* for the *given local conditions.*

You asked if Schedule 40 PVC pipe was appropriate. Our procedures do not allow the subcommittee to act in a consulting capacity in such matters; it is the responsibility of the installer to consider what is necessary to meet the NESC requirements.

For your information, the schedule of a PVC pipe is an incomplete specification. There are six "Schedule 40" PVC pipes listed by ASTM. They vary by polymer, impact strength, tensile strength, modulus of elasticity, and deflection under load. Diameter also affects crush resistance.

239F7

Attachment of insulated, multiple-conductor cable of secondary voltage to pole surface

REQUEST (Mar 22, 90) IR 439

Our interpretation of Rule 239F7 in the 1990 Edition of the National Electrical Safety Code, for insulated, multiple conductor cables of secondary voltage, which includes triplex and quadraplex cables in a vertical run, is that they may be attached directly to the pole surface, provided they are protected by non-metallic covering. Are we interpreting this rule correctly?

INTERPRETATION (Aug 31, 90)

Rule 239F7 (now 239G7) was added in the 1984 Edition of the NESC specifically to allow low-voltage service or secondary cables, such as triplex and quadruplex, to be directly attached to poles, as long as a nonmetallic covering was placed over the cable. This new rule is essentially an Exception to Rule 239F3 (now 239G3). The intention was to allow use of the U-guard for low-voltage service or secondary cables, rather than requiring a conduit. The intention of the subcommittee was to follow the same voltage, covering, and height limitations as used for jacketed multiple-conductor cables in Rule 239F2 (now 239G2), and that rule wording was used as a model for the new Rule 239F7.

Your request has highlighted the unintentional wording error that resulted from using F2 language as a model for F7 without additional changes. The reference to conductor insulation in the new 239F7 (now 239G7) was only intended to apply to the phase conductors, not the neutral.

242		261A2
242	See 93C2	IR 407
242B	See 262H3	IR 425
Table 242-1	See 93C2	IR 407
Table 242-1	See 262H3	IR 425
Section 25	See 262H3	IR 425
250	See 014	IR 423
252	See Table 261-3	IR430
Section 26	See 014	IR 423

261A2

Mixing Methods A and B for wood structures.

REQUEST (Feb 2, 90) IR 438

The requirements for Grades B and C construction have been changed in the 1990 Code to include two methods for determining the capacity of wood structures and wood crossarms. The rules state that "Either method meets the basic requirements...." My question is: Are combinations of the methods allowed under these rules? That is, may the methods be mixed on a wood structure or crossarm so that Method A is used on some loads and Method B is used on others on the same structure?

INTERPRETATION (Jul 16, 90)

The alternate calculation system introduced only for wood in the 1990 Edition was intended to allow freedom of choice within a rule. Thus, *either* method may be used for a crossarm, but the methods cannot be mixed for a crossarm. Likewise, either method may be used for the supporting wood structure; such method may be the same as (or different from) that used for the crossarm, but the same method must be used for all portions of the supporting structure exclusive of crossarms. It is recognized that, while the methods generally give comparable results, the methods *are* different and are not intended to be intermixed within the application of a particular basic rule.

Table 261-3 See 014 **IR 423**

Table 261-3

Inclusion of weight of pole in vertical load

REQUEST (Sept 7, 89) IR 430

We request interpretation of Table 261-3 regarding the use of overload capacity factors (OCF's) for wood poles. Please interpret if the intent of Table 261-3 OCF's for vertical strength is that they be applied to the weight of the pole in addition to the other vertical loads applied to the structure.

INTERPRETATION (Nov 3, 89)

Rule 261 requires the use of the assumed loads of Rule 252, which includes the weight of the structure.

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262 See 262H3 **IR 425**

262H3

Application of rule to catenary systems

REQUEST (Jan 11, 89) IR 425

In the 1987 Edition of the NESC, Rule 262H3 reads thus:

> **Sags**
> Conductor sags shall be such that, under the assumed loading or Rule 251 for the district concerned, and assuming rigid structures for the purpose of calculations, the tension of the conductor shall not be more than 60 % of its rated breaking strength. Also, the final unloaded tensions at 60 °F (15 °C) shall not exceed 25 % of the conductor rated breaking strength.
> *NOTE:* The factors in Rule 262H3 apply for the loading conditions of Rule 250B. For extreme wind loading conditions see Rule 260C.

We are in the process of designing a catenary system for use on a railroad.

We believe that Rule 262H3 is intended for application in the design of overhead transmission lines that normally pass over areas of general access to the public. These transmission lines are solidly terminated at each end of their length and are subject to tension changes throughout their entire range of operating temperatures. This catenary system, however, is specifically designed for the operating conditions of the railroad and is confined to the limits of the railroad right of way. Because the system is auto tensioned by means of weights, the tension in the system remains constant throughout the majority of its operating temperature range. In addition, because of the two wire configurations of the catenary, oscillation due to wind and pantograph pressures are quickly damped.

We would be pleased if the committee would review the intent of the referenced paragraph and clarify the requirement for its application to specifically designed catenary systems.

INTERPRETATION (Mar 13, 89)

Rule 262 applies to Grade D construction of communication lines; Rule 242B requires railway feeders and trolly contact conductors to be considered as supply.

The NESC rules for loading of conductors and cables are based upon the assumption of deadend attachments to terminate stringing-tension forces. Under such conditions, two requirements are specified when Grade B or C construction is required by Table 242-1:

(1) a maximum tension under the loadings specified in Section 25, and

(2) an "unloaded tension" at 60 °F. No tension is specified if Grade N is required.

In your case, you always have a "loaded" condition, due to the automatic tensioning mechanism. If Grade B or C is required, the tension *under the required loading* of Section 25 is limited to 60% of the rated breaking strength but, in accordance with Rule 012, the "unloaded" tension requirements do not apply.

280A1b

Climbability of pipe risers

REQUEST (Oct 12, 87) IR 415

During some of our inspections, we have observed that a number of pipe risers are installed at a distance from the poles that will allow individuals to climb the riser pipes and gain access to the energized electrical conductors above. This type of installation contributed to a severe electrical accident that occurred when a man climbed a pipe riser (see Fig IR 415-1) and contacted an overhead electrical conductor.

We request an interpretation of Section 280A1b, p. 294, of the 1987 NESC that will specify the intent of the NESC Committee in regard to whether riser pipes as described above should be treated as readily climbable structures.

 280A1b

Fig IR 415-1

INTERPRETATION (Feb 17, 88)

The subject installation does not have sufficient handholds and footholds as to be easily climbed. See the definition of "readily climbable" in ANSI/IEEE Std 100-1988, IEEE Standard Dictionary of Electrical and Electronics Terms, and our answer to IR 357.

283A2

Wet and dry flashover voltages between conductors of the guyed circuit

REQUEST (Oct 14, 88) IR 424

Rule 283A2 of the NESC states, "The guy insulator shall have a rated dry flashover voltage at least double the nominal line voltage and a rated wet flashover voltage at least as high as the nominal line voltage between conductors of the guyed circuit."

The construction of that sentence makes it appear that the words "between conductors" apply only to the wet flashover voltage. Logically, however, it seems that "between conductors" should also apply to the dry flashover voltage.

Question: Does the modifier "between conductors" also apply to the dry flashover voltage?

INTERPRETATION (Feb 6, 89)

Yes.

Part 3. Safety Rules for the Installation and Maintenance of Underground Electric-Supply and Communications Lines

314B

Metallic handhold covers of pull boxes containing street lights

REQUEST (Jan 26, 90) IR 435

We are hereby requesting an interpretation of Rule 314B of the National Electrical Safety Code. It is unclear whether said Rule applies to metallic handhold covers of pull boxes containing street light wires.

INTERPRETATION (May 29, 1990)

Rule 314B does not apply to metallic handhold covers of pull boxes containing street lights.

351C1

Definition of "supplemental mechanical protection"

REQUEST (Oct 20, 87) IR 417

I am requesting a definition of the term "supplemental mechanical protection" as intended in Rule 351C1.

INTERPRETATION (Aug 29, 88)

In its change of Rule 351C1, the 1984 Edition recognized that small lots may require the location of direct-buried cables closer than five feet to pools. In such cases, supplemental mechanical protection is required to limit the opportunity for cable failure due to site disturbance from rock damage, above-ground activity, etc. The type of protection required varies with the expected local problem(s) and is intentionally not specified; Rule 012 requires the supplemental protection to be of such type as to be *accepted* as *good practice* for the *given local condition.*

Part 4. Rules for the Operation of Electric-Supply and Communications Lines and Equipment

432

Climbing Joint-Use Poles

REQUEST (May 1, 1990) IR 441

We interpret rule 432 to mean that a communications worker cannot climb or otherwise ascend a joint-use pole that has the communications facilities attached in violation of the clearance requirements specified from electric supply facilities.

Furthermore, we interpret from section 42 that a communications worker cannot climb or otherwise ascend a joint-use pole that has communications facilities attached in violation of clearance requirements specified from supply facilities unless that communications worker is *also* qualified as an electric supply line worker. If the communications worker is *not* qualified as an electric supply line worker, the communications worker must contact the electric supply company to perform any work on that pole.

Finally, in Section 42 we interpret the phrase "on or in the vicinity of electric supply lines" to delineate the space within which communications facilities are restricted from occupying; i.e., the 30–40 in safety zone. The only workers allowed "on or in the vicinity of electric supply lines" would be workers qualified as electric supply line workers.

Please communicate to us whether our interpretations of these rules are correct.

INTERPRETATION

We have reached an impasse and must render a partial answer to the question.

We understand that the intention of the Work Rules Subcommittee was to require communication workers to check the structure for energized supply facilities that had been damaged and were hanging down in such a fashion as to endanger a communication worker working in the communication space.

Members of the Interpretations Subcommittee who were not members of the Working Group Subcommittee, but were members or alternates on the Main NESC Committee that voted on the changes, report that they did not understand that the rule language change was intended to apply to that strict limitation, in light of other changes made at the same time.

The previous codes had required communication workers to adhere to the supply worker rules when working near energized facilities. See Rule 451D of the 6th Edition. This requirement was dropped when Rule 432 language was revised. Our Main Committee members who were not on the Work Rules Subcommittee understood the intention of the total set of changes to require communication workers to check the structure for clearance violations before climbing and to require a worker qualified to work around supply facilities to correct such violations. While it appears that the Work Rules Subcommittee *did not intend* the several language changes to limit the ability of a communication worker to work on the facilities while in violation of required clearances, it is apparent that several of the Main Committee members believed that the language *was intended* to require correction of the code violation before further work was undertaken, and they voted accordingly. We are unable to resolve this issue.

It is clear, however, that there was no intention to limit a communication worker from correcting communication code violations if the work could be done within the requirements of the communication employee work rules.

442E

Tagging procedures by SCADA

REQUEST (Dec 12, 89) IR 433

Rule 442E requires that, "Controls that are to be de-activated during the course of work on energized or de-energized equipment or circuits shall also be tagged." It also says that, "Tagging of Supervisory Control and Data Aquisition Systems (SCADA) in itself shall not be considered sufficient." Some clarification of this rule was provided in IR 402 with regard to tagging of controls for hot-line or de-energized line work. One situation not specifically addressed was the following:

It is our practice for certain work activities on de-energized transmission lines to disable automatic line reclosing controls on closely adjacent lines. (This is not a Code requirement.) Such adjacent lines may not terminate at the same substations. For this circumstance, we would normally disable automatic line reclosing via SCADA and tag this control point in SCADA. No action is taken to go to the substation and tag out the line reclosing cutoff switch. However, automatic line reclosing by relay action cannot be restored by that switch or any other. For this control point, SCADA blocks automatic line reclosing by relay action. This is similar to but not quite the same situation as tagging out automatic line reclosing controls for hot-line work, and we'd like an interpretation on the rule with regard to this practice.

I note additionally that disabling automatic reclosing by relay action does nothing to prevent manual closing of the same breakers via a local substation control switch. One can conceive of a coincidence of a line tripping (auto line reclosing off via SCADA) and a local electrician then taking independent action to manually close the tripped breakers (untagged controls) a few moments later. But written operating procedures prohibit the operation of any transmission substation equipment or control switches without first receiving switching instructions from the dispatching authority where the SCADA master is located.

INTERPRETATION (Mar 6, 90)

The intent of Rule 442E is to assure that *all points of control* from which re-energization of a de-energized line or changing or reclosing characteristics can be performed will be tagged. IT IS NOT SUFFICIENT TO TAG ONLY THE SCADA SYSTEM; all additional control points are required to be physically tagged. The 1990 Edition revision was made to emphasize this requirement; this action supersedes our answer to IR 402.

[The requestor asked for further clarification of the above Interpretation, and the text of the second Interpretation is as follows:]

The intent of Rule 442E is to assure that *all points of control* from which re-energization of a de-energized line or changing of reclosing characteristics can be performed will be tagged. IT IS NOT SUFFSCIENT TO TAG ONLY THE SCADA SYSTEM; all additional control points are required to be physically tagged. The

1990 Edition revision was made to emphasize this requirement; this action supersedes our answer to IR 402.

Paragraph three of your request indicates that the breakers can be closed via the local substation control switches. It is not sufficient that your operating procedures prohibit such operation; if reclosing can be accomplished manually, tagging is required.

442E

Tagging procedures by SCADA

REQUEST (Dec 13, 89) IR 434

Rule 442E, as revised in the 1990 Edition of the National Electrical Safety Code, states "Controls that are to be de-activated during the course of work on energized or de-energized equipment or circuits shall also be tagged....Tagging of Supervisory Control and Data Aquisition Systems (SCADA) in itself shall not be considered sufficient."

Approximately seven years ago, we adopted a work practice (for live-line work) of placing supervisory controlled breakers in non-reclosing remotely and tagging at the System Control center only—thus requiring no human intervention at the substation location. At that time we also removed all non-reclosing levers from the equipment at the substation site, this being done with the intent that a change in status of the non-reclosing function could not then be readily made at the equipment location.

We feel that this practice is safe, practical, and within the intent of the revised rule, removal of the non-reclosing levers constituting sufficient protection where a tag is not physically placed on equipment in non-reclosing. Our question to you is—does this practice meet the intent of the rule in your opinion?

INTERPRETATION

Rule 442E requires tagging at all points where circuits or equipment *can* be energized. Removal of the handle may inhibit changing the reclosing function at the equipment location, but it does not provide the *warning* intended by the rule. A physical tag is required to be located at every breaker or switch from which re-energization of a circuit or piece of equipment is possible. This will provide appropriate warning when breaker, switch, or equipment operation is restricted for personnel safety during construction or maintenance.

See also the answer to IR 433.

Listing of Interpretation Requests in Rule Number Order

Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
RULES				
011, 012	Application of Rules 011 and 012 and Parts 1 and 2 to a generation and transmission utility serving a distribution utility	404	Apr 28, 87	1987
011, 012	Application of Rules 011 and 012 and Part 4 to a generation and transmission utility notified of an accident on a served distribution utility system	405	Apr 28, 87	1987
011, 012	Application of Rules 011 and 012 and Part 4 to off-duty utility personnel	406	Apr 28, 87	1987
013	Interpretation of IR 177 and IR 201(b), Rule 13 vs. Rule 110A; extension of 6 ft fence	291	Feb 2, 81	77/81
013	See 93C	291		
013B	Replacement of structures, strength and clearance in completed work	296	May 27, 81	1981
013B	For 5th Edition original construction over farmland, must newly revised spans: (a) be based on "spaces and ways accessible to pedestrians only" or the new 1981 Edition category of "farmlands" (b) meet only 5th Edition	344	July 29, 83	5th and 1981

Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
	or new 1981 rules for ground clearance			
013B	Underbuilding on existing structures	370	Mar 1, 85	1984
013B1	Relocation of line	369	Jan 15, 85	1984
013B2	(1) Clearance required when second cable is added (2) Communication cable additional clearance (3) Reduced clearance to guys	292	Mar 3, 81	1981
014	The intent and requirementsfor temporary aerial powerline construction	423	Aug 15, 88	1987
DEFINITIONS				
Part II	Antenna conflict. Def. 14	157	Feb 25, 74	6th
Part II	Communications lines (CATV circuits) See 238	64		
Definitions	Communication line requirements applied to fiber optic cable systems	403	May 7, 87	1987
SECTION 9				
No Rule	Insertion of choke coil in ground lead	28	Apr 24, 46	
92B	Grounding point on 3-wire delta systems—corner or mid-point of one phase	104	Dec 31, 63	6th
92B	Number of grounds	118	Sept 8, 65	6th

Listing of Interpretation Requests in Rule Number Order

Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
92B1	Use of line conductor as grounding point in place of common point on wye connected secondary	234	July 21, 78	1977
92B2	Wye distribution system with neutral omitted in one feed	295	May 6, 81	1981
92B2b(3)	Grounding of insulating—jacketed cable neutral	366	Nov 1, 84	1981
92B3	Concentric neutral UG cable; placement of separate grounding conductor (for cable corrosion protection)	364	Oct 11, 84	1981
92C2	Effective grounding of guys; suitability of proposed configuration	340	Apr 28, 83	1981
92C3	Crossing structure as related to messenger and grounding conductor	413	Aug 31, 87	1987
92C3	Crossing structure as related to messenger and grounding conductor	413	Aug 31, 87	1987
92D	Objectionable voltage: neutral/ground	287	Jan 19, 80	1981
92D	Grounding of lamp posts	298	June 1, 81	1981
92E	Grounding of rolling gate	253	July 11, 79	1977
93A, B	Grounding of transformer tank with tank grounded arrester, via a spark gap, etc.	107	Feb 24, 64	6th

Listing of Interpretation Requests in Rule Number Order

Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
93C	Connection of fence grounding conductor to fence posts	291	Feb 2, 81	1977/81
93C1	(1) Method of grounding magnetic mechanical protection (2) Method of grounding nonmagnetic mechanical protection	118	Sept 8, 65	6th
93C2	Size of grounding conductor required for 795 kcmil aluminum neutrals	407	Apr 22, 87	1987
93C7	Bonding requirements for adjacent pad-mounted supply equipment and communication circuit pedestals in an underground system	356	Feb 14, 81	1981
93D1	Guard over ground lead	307	Dec 10, 81	1981
93D1 and 3	See 93C2	340		
94A3	Steel tower and footings; bonding requirements	259a	Nov 15, 79	1977
94A3	Acceptability of steel wire wrapped around reinforcing bar cage, as grounding electrode	263	Jan 4, 80	1977
94B	Alternative to 8-ft driven ground rod	414	Oct 12, 87	1987
94B2	Does helix anchor meet requirements as a driven rod made electrode?	440	Apr 4, 1990	1990

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94B2c	Length of ground rod required to be in contact with earth	410	July 22, 87	1987
94B4	Grounds at transformer locations; adequacy of grounding	338	Mar 3, 83	1981
94B4a	Ground required at distribution transformer	267	Mar 20, 80	1977
94B4b	Grounding—pole butt plates	204	Sept 13, 77	1977
94B4a and b	(a) Effect of service entrance grounds on pole butt plate restrictions at transformer locations (b) Reasons for two butt plates to count as one made electrode, such as a driven ground	331	Aug 25, 82	1981
94B4b	(a) Thickness of butt plates (b) Acceptability of #6 copper wire wrap as grounding electrode	314 Revised Response (1)	Feb 23, 82	1981
94B6	Acceptability as a ground electrode of 20 ft of steel wire wrapped around rebar cage	259	Nov 15, 79	1977
95A3	Does 95A3 apply only to buildings or are steel supporting structures included also?	259	Nov 15, 79	1977

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95D	Are galvanized steel group rods regarded as approved equivalent of rods of nonferrous materials?	70	Mar 2, 54	5th
96A	See 94B4			
96A2	Maximum permissible resistance to ground for two electrodes connected in parallel	412	Aug 6, 87	1987
96A2	Grounding requirements for existing systems	429	Aug 14, 89	1987
96A3	Neutral grounding for buried concentric neutral cable with semi-conducting sheath	196	July 14, 77	1977
96A3	Grounding of fully insulated jacketed concentric neutral cable	341	May 2, 83	1981
96A3	Spacing of ground connections in circuits without a neutral	394	Sept 26, 86	1984
96A and B	Ground resistance; (a) limit, (b) measurement	55	Jan 31, 51	5th
96C	Neutral separation on distribution transformer poles to minimize dc flow	280	Sept 9, 80	1977
97	Can grounding conductor of primary spark gap be solidly interconnected with the secondary neutral on an otherwise ungrounded system?	88	July 57	5th
97	See 91A	299		
97A	See 96A and B	55		

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97A	Multi-grounded common neutral used as lightning protection	418	Nov 24, 87	1987
97A	Application of Rules 97A and 97D1 to grounding conductors on ungrounded systems	420	Apr 12, 88	1987
97A	Bonding and interconnection of grounding conductors	422	July 12, 88	1987
97A	Grounding of a transformer installation	427	June 12, 89	1987
97A1	(1) Method of grounding magnetic mechanical protection (2) Method of grounding nonmagnetic mechanical protection	118	Sept 8, 65	6th
97A1	(a) Connection of two items to the same grounding electrode (b) Connection of arrester ground to grounded neutral (c) Reasons for prohibiting solid interconnection of arrester grounding conductor and secondary grounding conductors	299	June 15, 81	6th 1973 printing
97C	Grounding of transformer tank with tank grounded arrester, via a spark gap, etc.	107	Feb 24, 64	6th
97C	See 96A3	341		

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Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
97C	See 94B4b	314		
97C	(9) Allowable interconnection of grounds primary arrester, primary neutral and secondary neutral	118	Sept 8, 65	6th
97C	See 96A3	196		
97C1b	See 97A	299		
97C1b and c	(1, 2, 3, 4, 7) Mechanical protection for interconnected (arrester and neutal) grounding lead; allowable omission of mechanical protection; required number of grounding connections	118	Sept 8, 65	6th
97C1c	Grounded neutral; definition of 4 grounds per mile	166	Nov 1, 74	6th
97D2	Insulation requirements for secondary grounding conductor	442	Jul 11, 90	1990
99C	Bonding of grounds and dimensions of grounding rods	390	May 7, 86	1984
PART 1				
102	See 114, Table 2C	86		
102B	(a) Implication of retrofitting	201	July 27, 77	1977
110	See 114, Table 26	86		
110A	Height of fence	161	May 15, 74	6th
110A	Fence height	177	Dec 18, 75	6th
110A	(b) Fence height	201	July 27, 77	1977

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110A	Meaning to be attached to "prevent" in connection with equipment enclosures	276	Aug 18, 80	1977
110A	Interpretation of IR 177 and IR 201(b), Rule 13 vs. Rule 110A; extension of existing 6 ft fence	291	Feb 2, 81	1977/81
110A	(a) Guarding by fence enclosure (b) Applicability of clearance (1) within fence enclosure (2) within vault	300	Oct 13, 81	1981
110A	See 93C	291		
110A	Height of gap permitted between ground and bottom of fence	411	Aug 7, 87	1987
111A	Artificial illumination in distribution substations	419	Jan 26, 88	1987
114	Clearance of HV conductors around circuit breakers	114	Aug 2, 65	6th
114 Table 2C	(a) Requirements for a fence to prevent unauthorized entry (b) What is practicable limit for reduction of hazards? Does rule apply to employee or public? (c) Is exterior of porcelain arrester a live part?	86	May 1, 57	5th

Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
	(d) Clearance to ground in substation; Measured from earth or concrete supporting base for arresters? (e) Clearance to live parts adiacent to fence separating station area from public? (f) Does locked fence constitute guarding by isolation?			
114A	Outside substation— (a) vertical clearance to live parts (b) definition of voltage	193	Apr 18, 77	5th
114A1	Substation conductor clearance to building	124	Feb 22, 67	6th
114C1	See 114A	193		
124	Clearance to energized parts in substation	192	Mar 24, 77	6th
124 Table 124-2	See 110A	300		
124A Table 1	Clearance from bottom of wave trap supporting insulator to ground	322	Oct 25, 82	1981
124A Table 2	Clearance at crossing between transmission line and rigid bus structure	283	Dec 8, 80	1981
124A1 Table 1	Pole-mounted regulator bank with platform; Clearance required for workmen on platform	355	Jan 27, 84	1981
125A3 Table 1	Clearance to front of control board	319	Mar 26, 82	1981

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127	(a) Classification if adequate ventilation is provided (b) Is interlocking required?	327	June 30, 82	1981
130B	Manual stopping devices	408	June 26, 87	
141	Definition of unsealed jars and tanks	244	Jan 17, 79	1977
152A2	See 281	349		
153A2	Definition of "large"; meaning of "segregated"	241	Nov 30, 79	1977
153B1	Floor drains for transformer installations. Meaning of "outside of building"	240	May 24, 79	1977
161	Adequacy of protection against mechanical damage	320	Apr 1, 82	1981
162	Clearance at crossing between transmission line and rigid bus structure	283	Dec 8, 80	1981
165	44 kV 3ϕ transformer bank fuse protection	106	Jan 6, 64	6th
170	(a) Requirements for disconnect switch (b) Energized switch blade	190	May 23, 77	1977
171	See 170	190		
173B	Disconnecting provision acceptability	257	Nov 2, 79	1977
173C	See 170	190		

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Rule	Subject	IR Number	Request Date	NESC Edition
PART II				
200C	Clearance to buildings and lines	158	Dec 18, 72	6th
201A	Clearance required for communications conductors over roads	195	May 10, 77	6th
201B	See 93C	291		
202B	Reconstruction definition. Does line voltage change from 7.2/12.5 kV require compliance with 1977 Edition?	219	Dec 17, 77	1977
202B	Reconstruction definition. Does line voltage change from 7.2/12.5 kV to 14.4/24.9 kV require compliance with 1977 Edition clearances?	220	Jan 18, 78	1977
202B	Definition of reconstruction	230	Apr 5, 78	1977
202B	New installations, reconstruction, extensions, status of existing installation if cable TV line is added	243	Feb 7, 79	1977
202B1	Meaning of "Reconstruction"	215	Dec 12, 77	1977
212	Intent of term "proximate facilities"	194	May 9, 77	1977
213A2	Systematic inspection—time interval between inspections	90	Oct 24, 58	5th
214A2	Frequency of inspection for service drops	246	Feb 5, 79	6th/ 1977
214A4	See 013B	344		6th
215B	See 92B2	295		

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Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
215C	See 92C2	340		
215C1	Grounding of supporting structures	212	Nov 11, 77	1977
215C1	(a) Magnitude limit of ground fault voltage (b) Intent of "effectively grounded" as applied to structure	277	Feb 23, 78	1977
215C1	See 92D	298		
215C1	See 93C7	356		
215C2	Insulator in down guy	236	Aug 31, 78	1977
215C2	Energized wire passing through trees, serving as a head guy	345	July 23, 83	1981
216B	load on foundation, application of overload capacity factors	216	Dec 21, 77	1977
220B2	Clearance requirements for CATV amplifier power feed	255	Oct 15, 79	1977
220B3	For special construction supply circuits is 550 the maximum allowable voltage or the nominal?	18	Dec 18, 44	
224A	Requirements for fiber optic cable	431	Oct 16, 89	1990
224A	Clearances of communication lines	436	Feb 14, 90	1990
224A	Construction of fiber optic cable in the clear space on joint-use poles by a local power company	443	July 30, 90	1990
224A4	Definition of supply lines and communication lines	437	Jul 16, 90	1990

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Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
Section 23	(a) Clearance between supply conductors and signs (b) Clearance between pad-mounted transformers and gas metering equipment	117	Sept 17, 65	6th
230C	(a) Classification of specific cable construction (b) Clearance requirements	85	Feb 26, 57	5th
230C	Meaning of "supply cables having an effectively grounded continuous metal sheath, or insulated conductors supported on and cabled together with an effectively grounded messenger." Spacer cable	92	May 19, 61	6th
230C	Supply cable requirements, OR vs AND	202	Aug 23, 77	1977
230C	Clearance for serial secondary and service conductors with an insulated neutral	279	Sept 4, 80	1977
230C	Classification of cables; clearance to ground; clearance to bridges; clearance to support cable supported by pipeline structure	343	July 26, 83	1981
230P	(a) Grounded neutral clearance to ground	126	Feb 1, 68	6th

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Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
	(b) Grounded neutral clearance to building			
230E1 and 2	See 232	337		
231	Clearance of structure from roadway	324	June 4, 82	1981
231	Meaning of "road" as used in Rule 231	432	Nov 3, 89	1981
231B	Location of pad-mounted equipment	258	Nov 6, 79	1977
231B1a	Example requested	231	Apr 6, 78 Apr 11, 78	1977
232	Minimum clearance for spacer cable on messenger under heavy loading conditions	123	Mar 7, 66	6th
232	Clearance to ground at high conductor temperature	178	Jan 22, 76	6th
232	See 013B	344		
232 Table 1	Clearance over farm lands for voltages of 50 kV	31	Mar 28, 47	5th
232 Table 1	Clearances of transmission lines over navigable waters	43	Aug 10, 49	5th
232 Table 1	See 013B2	292		
232 Table 1	See 232	337		
232	(a) Clearance to ground measured diagonally (b) Clearance neutral to ground (c) Reason for 14 ft minimum for neutrals	337	Feb 17, 83	1981

Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
232A	See 230C	343		
232A	Clearance for sailboating	284	Jan 13, 81	1981
232A Table 1	Clearance of conductors over a residential driveway	361	Aug 28, 81	1981
232A	(a) Sag—with or without creep (b) Clearance over cultivated field	121	Dec 13, 65	6th
232A	Distinction between urban and rural	125	Dec 23, 66	6th
232A	Clearances applicable to building construction site	159	Apr 11, 74	6th
232A	Basic clearance-wires above ground; "accessible to pedestrians only"	165	Aug 22, 74	6th
232A	Clearance, CATV cable above vacant lot	169	Dec 12, 74	6th
232A	Clearance to building	186	Oct 21, 76	6th
232A	Clearance required for communication conductors over roads	195	May 10, 77	6th
232A	Clearance over snow covered ground	270	June 25, 80	1977
232A	Clearance for oversize haulage trucks	282	Oct 17, 80	1977
232A	Conductor clearance; applicability of catenary curve considerations	290	Jan 30, 81 Feb 11, 81	1981
232A Table 1	Clearance requirements for telephone lines which pass over driveways into farmer's fields in strictly rural areas	76	Sept 13, 55	5th

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Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
232A Table 1	Clearance for cabled service drop, 150 V max to ground	79	Jan 4, 55	5th
232A Table 1	Clearance over farm-land	13	Aug 4, 44	5th
232A Table 1	Do clearances have to be maintained under all weather conditions?	58	Jan 25, 52	5th
232A Table 1	(a) Grounded neutral clearance to ground (b) Spaces and ways accessible to pedestrians	126	Feb 1, 68	6th
232A Table 1	Clearance of power lines above sprinkler head over farm orchard	168	Dec 11, 64	6th
232A Table 1	Clearance above ground in orchard	187	Mar 27, 77	6th
232A Table 1	CATV cable clearance	206	Sept 15, 77	6th
232A Table 1	Service drops, clearance to ground	223	Feb 7, 78	1977
232A Table 1	Clearance over residential driveways	224	Jan 26, 78	1977
232A Table 1	Service drop conductors (a) Minimum height in span (b) Minimum height of point of attachment	247	Apr 3, 79	1977
232A Table 1	Spaces or ways accessible to pedestrians only, service drop clearance	249	Mar 23, 79	1977
232A Table 1	Effect of trees on minimum clearances	256	Nov 15 79	1977

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Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
232A Table 1	Conductor clearance for line near recreational water area	261	Oct 23, 79	1977
232A Table 1	Communication cable clearance to ground	269	May 21, 80	1977
232A Table 1	Ground clearance for service	277	Aug 25, 80	1977
232A Table 1	Clearance over waterways	308	Jan 22, 81	1981
232A Table 232-1	Clearance required for sailboats in an inlet that has an upstream restriction on height	367	Nov 14, 84	1984
232A Table 232-1	Reduced vertical clearance requirements	371	Feb 27, 85	1984
232A Table 232-1	Clearance over driveway to grain bins	428	June 12, 89	1984
232A3	Definition of fixed supports	99	Mar 14, 63	6th
232B	Increased clearances for excess span length	25	Oct 23, 45	
232B	Grounded neutral clearance to ground	126	Feb 1, 68	6th
232B	Additional clearance requirements	360	June 8, 84	1981
232B Exception 2	See 232B	292		
232B1	See 232B	25		
232B1a (1)(2)(3)	See 232B	25		
232B1(a)(d) Table 1	Clearance over cultivated land for200 °F operating temperature	352	Dec 21, 83	1981
232B2	Clearances—wires on different supports, voltages 50 kV; also above ground or rails	160	May 14, 74	6th

Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
232B2	(a) Increase in clearance, V %50 kV (b) Clearance for basic and longer spans (c) Clearance to building corner	83	Nov 1, 56	5th
232B2 and C1	Minimum allowable clearance	304	Aug 24, 81	1981
232B2C	See 232B	360		
232B2d	Transmission line clearances—Meaning of "maximum conductor temperature for which the line is designed to operate" with respect to designed for but unplanned contingencies	207	Oct 3, 77	1977
232B2d	See 232B	360		
232B3	Clearance with suspension insulators	60	Mar 27, 52	5th
233	See 234B2	69		
233	See 234C4a(2)	89		
233A Table 3	Avoiding fatigue failure in conductors under tension	12	Jan 18, 44	5th
233A	Clearance of primary neutral conductor over communication conductor	16	Nov 14, 44	5th
233A Fig 233-1	Clarification of clearance at crossing	289	Jan 30, 81	1981
233A and B	Are clearance increases cumulative in 1, 2, and 3 as indicated in the text on page 52?	62	Nov 27, 52	5th
233A1	See 232A	290		

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Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
233A3	Clearance at crossing between transmission line and rigid bus structure	283	Dec 8, 80	1981
233A3	See 235E1	353		
233B	Conductor clearance from guy of parallel line structure	218	Jan 5, 78	1977
233B1	Horizontal clearance under wind loading. One or both conductors at minimum swing angle?	221	Jan 25, 78	1977
233B1	(a) Centerline spacing for adequate clearance between parallel lines on separate structures (b) Use of switching surge factor in above case	228	Feb 28, 78	1977
233B1b	See 233B1	221		
233B2	See 233B2	83		
233B2	Clearances—Wires on different supports, voltages >50 kV; also above ground or rails	160	May 14, 74	6th
233B2, C3	See 235E1	365		
233C1 Table 1	Clearance for underbuild	306	Dec 8, 81	1981
233C3	See 235E1	353		
234	Clearance for line	158	Dec 18, 72	6th
234	Horizontal and vertical clearances, effect of high temperature	232	Apr 6, 78	1977
234	Clearance requirements for buildings in transit	251	July 5, 79	1977

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Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
234 Fig 234-1	Determination of diagonal clearance	260	Nov 8, 79	1977
234A	See 234C4a(2)	89		
234A	See 232A	290		
234A1	Final condition of a conductor—to determine vertical clearance—storm loading and long term creep	112	June 30, 64	6th
234A3	See 234, Fig 234-1	260		
234B	Clearance to parallel line	96	Dec 7, 62	6th
234B	Does the exception apply to horizontal or vertical clearances or both?	233	May 10, 78	1977
234B	Clearance of neutral and guys from other supporting structures	326	June 9, 82	1981
234B	Reduction of horizontal clearance	375	Apr 3, 85	1984
234B1	Clearance, line to adjacent steel structure; Voltage definition	173	May 29, 75	6th
234B2	Clearance between conductors and supporting structures of another line	69	Dec 30, 53	5th
234C	Clearance to conveyor structure	274	July 25, 80	1977
234C Table 1	Grain bin clearance (building vs tank); 115 kV line	248	Mar 15, 79	1977
234C Table 1 Note 5	Clearance to flagpole with flag	313	Feb 23, 82	1981

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Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
234C Table 1	Clearance to tanks containing flammables	305	Oct 6, 81	1981
234C Table 1	Clearance to building	323	May 18, 82	1977
234C Table 234-1	Classification, for clearance purposes, of outdoor advertising signs (billboards) that have catwalks and that are with or without ladders	368	Dec 5, 84	1984
234C Table 234-1	Clearance above fences and walls	381	Dec 13, 85	1984
234C Table 4	Clearances from buildings; meaning of voltage	154	Jan 29, 74	6th
234C Table 4	Clearances from buildings; meaning of voltage	156	Oct 17, 73	6th
234C Table 4	See 234B1	173		
234C1(a)	Clearance to building	186	Oct 21, 76	6th
234C3 Table 234-1	Accessibility to pedestrians	377	Apr 8, 85	1984
234C3 and 4	See 238B1	82		
234C4	(a) Clearance to building (b) Is clearance (in a specific case) in accordance with the NESC?	87	Aug 5, 57	5th
234C4	See 232B2	83		
234C4	Clearances from building	47	Dec 2, 49	5th
234C4	Clearances to building or similar structure	66	May 14, 53	5th
234C4	Clearance requirements for conductors passing by or over buildings	78	Nov 16, 55	5th

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234C4	Clearance—horizontal and vertical—from buildings	98/98a	Feb 21, 63	6th
234C4	Grounded neutral clearance to building	126	Feb 1, 68	6th
234C4	Clearance applicable to building construction site	159	Apr 11, 74	6th
234C4	Clearance to building	172	May 21, 75	6th
234C4	Clearance to building and guarding	174	Sept 29, 75	6th
234C4	Clearances on roofs	409	June 11, 87	1987
234C4(a)	Horizontal clearance to building or its attachments	399	Jan 30, 87	1984
234C4 Table 4	Horizontal or vertical clearances from buildings	57	Aug 21, 51	
234C4 Table 4	Clearances from buildings	67	Aug 5, 53	
234C4 Table 4	Horizontal clearance of supply conductors	81	Apr 18 and Aug 24, 56	
234C4 Table 4	Clearance to building	309	Dec 17, 81	1973
234C4a	Clearance requirements for conductors passing by or over buildings	77	Nov 15, 55	
234C4a	Clearance to building	113	Nov 12, 64	6th
234C4a	Substation conductor clearance to building	124	Feb 22, 67	6th
234C4a	Clearance to building	186	Oct 21, 76	6th
234C4a	Clearance to chimney; meaning of attachments	198	July 12, 77	6th
234C4a	Governing clearance to building—horizontal or vertical	238	Sept 25, 79	6th

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234C4a	Clearance to building	265	Mar 3, 80	6th/77
234C4a	Horizontal and vertical clearances from a steel windmill tower	74	Aug 1, 55	
234C4a1 Table 4	Clearance of neutral to building	189	Feb 18, 77	6th
234C4a (1) and (2)	Clearance from buildings	59	Mar 10, 52	5th
234C4a (1) and (2)	(a) Should clearance of conductors passing by buildings include swing? (b) Insulator swing considerations (c) Sag increase; span 150 ft or350 ft?	89	Apr 14 and 17, 58	5th
234C4a (2)	See 234C and B	47		
234C4b	Guarding requirement applicability	265	Mar 3, 80	6th/77
234C, D	Clearance requirements in tunnels or on bridges	383	Feb 10, 86	1984
234D	See 230C	85		
234D1	See 230C	343		
234D1 Table 2	Neutral clearance to bridge	208	Oct 31, 77	1977
234E	Conductor clearance to swimming pool slide	262	Nov 12, 79	1977
234E1 Table 3	Rationale involved in calculating basic clearances shown in Table 3	237	Sept 19, 79	1977
234F1c	Electrostatic effects	205	Sept 3, 77	1977
234F2c and d	Increased clearances for long span or sag—applicability to horizontal clearances	203	Aug 25, 77	1977

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Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
235	Clearances to noncurrent carrying metal parts; clearance for CATV	281	Oct 14, 80	1977/81
235 Table 3	Horizontal clearance between wires in a triangular configuration	264	Jan 21, 80	1977
235A Table 6	Compact transmission lines, status with respect to NESC 1973 Edition, especially when jacking for hot line maintenance is taken into account	167	Oct 15, 74	6th
235A Table 6	Clearance between conductors in substations	175	Sept 30, 75	6th
235A Table 9	High voltage transmission lines; excessive clearance requirements	37	June 8, 48	5th
235A Table 9	Clearance between line conductors and span or guy wires	101	Sept 13, 63	6th
235A2a (1) and (2)	See 235A3, Table 9	15		
235A2a(1) and B	See 234C4a(2)	89		
235A3 Table 9	Climbing space minimum clearance	15	Nov 13, 44	5th
235A3 Table 9	Classification of jumper wires at poles	49	May 10, 50	5th
235A3 Table 9	Clearance between line conductors and guy of EHV guyed tower	102	Oct 11 and 22, 63	6th
235B1	Horizontal clearance between line conductors. 2 circuits, 115 kV and 230 kV on same support	222	Jan 25, 78	1977

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Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
235B1	Surfaces used to determine horizontal clearance between line conductors	400	Mar 13, 87	1984
235B2	(a) Centerline spacing for adequate clearance between parallel lines on separate structures (b) Use of switching surge factor in above case	228	Feb 28, 78	1977
235B3a, b	See 235E1	365		
235C	Voltage between conductors	267	Mar 20, 80	1977
235C	Clearance from communication cable to tap and drip loop of supply cable	288	Jan 23, 81	1981
235C	Calculating clearances	372	Mar 14, 85	1984
235C	Vertical clearance between communication and supply lines	378	Apr 18, 85	1984
235C Table 5	Vertical separation of conductors of same circuit	233	May 10, 78	1977
235C Table 5	Clearance between metal sheathed supply cable and communications	329	Aug 20, 82	1981
235C Table 5	Vertical clearance between line conductors at supports	310	Nov 11, 81	1981
235C1 Table 5	Pole clearances for CATV system cable	362	Sept 10, 84	1981
235C1 Table 5	Vertical clearance at supports	209	Oct 31, 77	1977

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Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
235C1 Table 5	Interpretation of clearance measurement; Communication to power conductors	242 242a	Jan 2, 79 Jan 11, 79	1977 1977
235C1 Table 5	Spacing between communication cables of power and communication utilities, when located below supply lines	286	Jan 19, 81	1981
235C2b	Clearance in pole to building spans, between communication and electric supply service drops	226	Feb 23, 78	1977
235C2b(1)(a)	Drip loops and slack cables from an aerially-mounted transformer are parts of the span	392	July 11, 86	1984
235C2b(1)(a)	Vertical clearance between supply and communication lines	393	Aug 18, 86	1984
235C2b(3), C2b(1)a	Minimum mid-span separation between a supply conductor and a communication conductor—for spans over 150 ft	359	Mar 22, 84	1981
235E	Conductor clearance from guy of parallel line structure	218	Jan 5, 78	1977
235E	Clearance to bridle guy	229	Mar 6, 78	1977
235E	Clearance requirements for CATV amplifier power feed	255	Oct 15, 79	1977
235E	Clearance for span guys grounded at both ends	426	Jan 25, 89	1987

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235E1	See 230C	343		
235E1 Table 1	Clearance between line conductor and anchor guys	365	Oct 29, 84	1981
235E1 Table 6	Clearance from line conductors at supports (a) Meaning of minimum clearance (b) Clarification of "voltages are between conductors" (c)Reason for additional clearance on joint poles	210	Oct 31, 77	1977
235E1 Table 6	Clearance between an anchor guy and an 8.7 kV conductor	330	Aug 19, 82	1977
235E1 Table 6	Service drop line conductor in aerial cable clamp saddle; clearance to pole	351	Nov 30, 81	1981
235E1, E3 Table 6	Clarification of line conductor clearance to guy	353	Dec 27, 83	1981
235E3a	See 235E1	365		
235G	See 235E	255		
236	Climbing space	176	Dec 15, 75	6th
236	Climbing space on structures and poles	421	June 17, 88	1987
237B3	Clearance between 8.7–15 kV line and grounded neutral cr secondary conductors	80	Aug 14, 56	5th
238 Definition 45	(a) Definition: communication lines (b) Clarification of CATV cable as a communication circuit	64	June 15, 53	5th

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238	Clearance between supply conductors, communication and CATV cables	127	Feb 28, 68	6th
238	Clearance to noncurrent carrying metal parts. Clearance for CATV	281	Oct 14, 80	1977/81
238	Application of 238 to service equipment and supply equipment	374	Mar 25, 85	1984
238 Table 1	Clearance from a 34.5 kV supply conductor to a street light bracket	328	Aug 6, 82	1981
238 Table 1	See 235C	329		
238 Table 1	13.8 kV distribution clearance with horizontal post insulators without crossarms	115	Aug 4, 65	6th
238A	(a) Clearance between power and signal H43 conductors on same crossarm (b) Clearance between signal conductors and multiple light systems circuit (c) Clearance of vertical supply conductors from communication crossarm (d) Dead ending or guying of communication messenger without insulators	84	Nov 7, 56	5th

Rule	*Subject*	*IR Number*	*Request Date*	*NESC Edition*
	(e) Spacing between crossarms			
238A Table 11	Vertical separation at supports	63	Apr 10, 53	5th
238A and B Table 1	(a) Is base of epoxy extension arm "noncurrent carrying"? (b) Spacing required between noncurrent carrying parts of adjacent supply and communication circuits	268	May 8, 80	1977
238A, B Table 238-1	Spacing required between noncurrent-carrying parts of adjacent supply and communication circuits	388	Apr 28, 86	1984
238A Table 11	Conductor vertical spacing with post insulators	110	May 14, 64	6th
238B	Vertical clearance between supply conductor and communication cable attachment hardware	387	Apr 22, 86	1984
238B Table 1	Interpretation of clearance measurement; Communication to power conductors	242 242a	Jan 2, 79 Jan 11, 79	1977 1977
238B Table 1	Clearance to street lighting brackets	311	Nov 13, 81	1981
238B Table 1	Does grounding transformer tank to multigrounded neutral qualify for reduced (30 in) clearance?	333	Oct 1, 82	1981

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238B Table 1	Single bushing transformer status (current carrying or noncurrent carrying)	333a	Apr 27, 83	1981
238B Table 1	See 235C1, Table 5	362		
238B Table 1 Footnote 4	(a) Which equipment is to be grounded? (b) What is well defined area? (c) What is adequate grounding?	363	Sept 14, 84	1981
238B and E	Clearance for communications conductors used exclusively in the operation of supply lines	52	Aug 30, 60	5th
	See also 238A, Table 11	63		
238B1	(a) Clearance between conductors on adjacent crossarms (b) Service brackets at end of crossarms (c) Clearance to buildings	82	Sept 15, 56	5th
238B3a	See 234B2	69		
238C	See 235A3, Table 9	15		
238D	Clearance between multigrounded neutral and communication service drop	93	Apr 13, 62	6th
238D	Clearance of service drop	252	June 25, 79	1977
238D	Clearance from communication cable to tap and drip loop of supply cable	288	Jan 23, 81	1981

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238D	See 235C	288		
238D and E	See 238B	52		
238E	See 238A, Table 11	52		
238E4	Placement of communication cable above effectively grounded luminaires with drip loops	105	June 15, 64	6th
239A	Protective covering requirements for power conductors passing through communications space	303	Aug 20, 81	1981
239C	Nonmetallic pipe protection for risers	153	Dec 17, 73	6th
239C	(1, 3, 4, 5, 6) Mechanical protection for interconnected (arrester and neutral) grounding lead; allowable omission of mechanical protection; method of grounding either magnetic or nonmagnetic mechanical protection	118	Sept 8, 65	6th
239C	See 93D1	307		
239C	Protection of risers	416	Oct 23, 87	1987
239D2 Table 2	Pole clearance for vertical jumper to recloser terminal	342	June 16, 83	1981
239F	Clearance of primary riser termination from communication cable	225	Feb 14, 78	1977
239F, G2 and 3	See 220B3	18		
239F1	Clearance for supply equipment to CATV cable	312	Jan 8, 82	1981

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239F7	Attachment of insulated, multiple-conductor cable of secondary voltage to pole surface	439	Mar 22, 90	1990
242	Joint use 7.2 kV/ communications-cable joint use poles; insulated strand, self supporting communications cable	109	Apr 24, 64	6th
242	Grade of construction for conductors	272	July 14, 80	1977
Table 242-1	Definition of "limited access highway"	385	Mar 7, 86	1984
Table 242-1	Grade of construction for colinear and at crossing conductors	391	July 18, 86	1984
242 Table 1	Grade of construction or joint use with 7.2 kV open wire above communication circuits	321	Apr 5, 82	1981
242 Tables 1 and 12	4.8 kV ungrounded delta, change from grade C to B believed inadvertent when Footnote 7 changed	294	Mar 25, 81	1977 and 1973
242 Table 14	Interpretation of Footnote "c" appearing in Table 14, allowing Grade C construction	65	June 14, 53	5th
242 Table 15	Grade B crossing spans in a Grade C supply line	111	May 26, 64	6th
242 Table 15	Definition of "constant potential" in grades of construction	162	May 17, 64	6th

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242 Tables 1 and 15	See 242, Tables 1 and 12	294		
242A Table 15 Note 3	(a) Definition of "promptly deenergized" (b) Deflection, unbalanced pull: should dissimilar ice loadings be considered? (c) Crossing of power and communications lines	122	Feb 17, 66	6th
243	Grade of construction for conductors	272	July 14, 80	1977
243B	Clearances between highway lighting standards and transmission lines	120	Dec 3, 65	6th
250	Change of districting from heavy to medium loading	24	May 26, 45	5th
250	Tension (initial or final) during extreme wind loading calculations	332	Aug 26, 82	1981
250C	Application of extreme wind loading	200	July 8, 77	1977
251	(a) Transverse wind loading (b) Definition of "grades" of construction	14	Nov 16, 44	5th
251	Constant to be added to storm loading for messenger supported cable	103	Nov 12, 63	6th
251	Application of K factors	181	Mar 8, 76	6th

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251	See 250	332		
251A	Ice loading computation on noncircular cross-section conductor	266	Mar 7, 80	1977
252	See 251	181		
252B6	See 251	14		
252C1	Grade B crossings in Grade C supply lines	111	May 26, 64	6th
260	Deflection data on tubular steel poles	42	June 30, 49	
260C	Meaning of "other supported facilities"	211	Nov 4, 77	1977
260C	Load on structure or foundation; application of overload capacity factors	213	Nov 26, 77	1977
261	Overload capacity factors for composite components	245	Feb 13, 79	1977
261 Table 261-2	Crossarm bending stress, overload capacity factors, and vertical clearance	389	May 1, 86	1984
261 Table 261-3	Inclusion of weight of pole in vertical load	430	Sept 7, 89	1987
261 Table 6	Allowable stress in members of steel structure	17	Nov 11, 44	5th
261A Table 3	Application of "when installed" and "at replacement" values	336	Jan 25, 83	1981
261A1	Allowable pole loading	184	June 10, 76	6th
261A1 Tables 1 and 2	Structure load stress vs allowable stress basis (yield, proportionality, AISC allowable)	348	Sept 9, 83	1981

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261A2	Mixing Methods A and B for wood structures	438	Feb 2, 90	1990
261A2 Table 3	At crossing, Grade C construction	302	July 21, 81	1981
261A2b	Calculation of support load at angle in line	239	Oct 13, 79	1977
261A2b	Application of an over-load capacity factor of 4.0 to the vertical load on an eccentric loaded column	250	Mar 27, 79	1977
261A2b Table 261-3	Required strength of wood poles at replacement	379	May 8, 85	1984
261A2b, c	Omission of fiber stress calculation point formerly stated in 6th Edition, 261A4a, b	211	Nov 4, 77	6th
261A2d	Application of overload capacity factor, unguyed and guyed angle structures	214	Nov 28, 77	1977
261A3b	Longitudinal strength of towers—Grade B construction	108	Apr 2, 64	6th
261A3e	See 260	46		
261A4	Construction grade of line; effect of additional loading	180	Feb 3, 76	6th
261A4a	Location of high longitudinal strength structures with respect to higher grade section in line of lower grade construction	285	Dec 19, 80	1981
261A4a	See 261C5a	26b		

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261A4e	(a) Vertical and transverse loadings	26a	Dec 15, 53	5th
261A4g	Does the word "spliced" also refer to pole top extensions?	68	Oct 1, 53	5th
261A4g	Spliced and stub pole definitions; extension at top of pole	95	Nov 14, 62	6th
261A6b	(b) Deflection, unbalanced pull: should dissimilar ice loadings be considered?	122	Feb 17, 66	6th
261A, B, C Tables 1 thru 5	Overload capacity factor: wire tension load vs wind or weight load	335	Oct 25, 82	1981
261B	Foundation strength for steel pole structure	191	Mar 23, 77	1977
261C2	Guying of joint-use poles	398	Nov 26, 86	1984
261C5a	(b) Strength requirements for deadend and transverse guys	26b		
261C5a	See 261A4e	26a		
261D	Crossarm; definition and status of integrated conductor support assemblies	151	Nov 15, 73	6th
261D Table 261-1	Minimum cross-section dimensions of wood crossarms	386	Mar 26, 86	1984
261D Table 261-6	Crossarm length and longitudinal strength	376	Apr 4, 85	1984
261D3b, d	Grade B crossing in Grade C supply lines	111	May 26, 64	6th
261D5	Double crossarm over railroad tracks in suspension insulator type of construction	51	Aug 25, 50	

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261D5	(c) Crossing of power	122	Feb 17, 66	6th
261E3	See 261D3b, d	111		
261F2	Grade B construction, conductor size; does Exception 2 apply to railroad crossings?	61	July 16, 52	5th
261F2	Do words "containing steel" describe composite conductor or merely any wire of such a stranded conductor?	20	Feb 15, 45	5th
261F4	(a) Sag—with or without creep	121	Dec 13, 65	6th
261F4	Final condition of a conductor—storm loading and long term creep	112	June 30, 64	6th
261H3a	Meaning of "crossings"	346	July 29, 83	1981
262A2e	Overload capacity factor for guyed pole used as a column	317	Mar 17, 81	1981
262A, C Tables 1 and 3	See 261A, B, C, Tables 1 thru 5	335		
262H3	Application of rule to catenary systems	425	Jan 11, 89	1987
262I2b Table 24	Minimum size of conductors in a crossing span of 215 ft over a railroad track	72	May 31, 55	5th
263D, E	See 261F	61		
272	Insulator electrical strength	119	Sept 2, 65	6th
273	Insulator rating	297	June 12, 81	1981
277	Working load of insulator must not exceed 50% of ultimate strength	395	Oct 26, 86	1984

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280A1b	Meaning of "readily climbable"	199	July 4, 77	1977
280A1b	Warning signs on tubular steel poles	271	June 13, 80	1977
280A1b	Climbability of guyed dead end poles	397	Nov 26, 86	1984
280A1b	Climbability of pipe risers	415	Oct 12, 87	1987
280A1b, A2	Clarification of readily climbable with respect to a particular configuration	357	Feb 10, 84	1981
280A2a	Guarding of supporting structure potentially exposed to "abrasion" by traffic	315	Mar 1, 82	1981
280A2b	Meaning of "closely latticed poles or towers"	128	Apr 15, 68	6th
281	(a) Purpose of tree trimming (b) Spacing of oil-filled transformer from building	349	Oct 3, 83	1981
281A	See 215C2	345		
282B	Fiberglass rod; acceptability in lieu of steel	183	May 17, 76	6th
282C	Guy connection and placement of insulators	217	Dec 9, 78 Jan 3, 78	1977
282D	See 282B	183		
282E	Plastic guy guards	94	Mar 5, 62 Mar 27, 62 Aug 6, 62 Aug 8, 62	6th
282E	Guy guards—on guys to ground anchors—in areas where stock runs	116		
282E	Guy guards; meaning of "traffic"	179	Feb 5, 76	6th

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282E	Guy guards; placement on guy in field	182	June 1, 76	6th
282E	Guy guards in relation to definition of "guarded"	188	June 24, 77	6th
282E	Guy marker requirements in case of two guys on one anchor	350	Nov 15, 83	1981
282F	See 283B4b	50		
282H	Guy grounding; upper end effectively grounded vs. anchor end ground	97	Feb 14, 63	6th
282H	Grounding of guys	163	May 21, 74	6th
283A	Insulator in down guy	236	Aug 31, 76	1977
283A1a	Guy insulators; acceptability of fiberglass as insulating material	75	Aug 29, 55	5th
283A2	Wet and dry flashover voltages between conductors of the guyed circuit	424	Oct 14, 88	1987
283B	Guy connection and placement of insulators	217	Dec 9, 78 Jan 3, 78	1977
283B1	Insulating vs. effectively grounding guy wires	254	Aug 29, 79	6th/77
283B2	Insulators in guys	100	Apr 22, 63	6th
283B2b	Use of double guy insulators in down guy; also, validity of discussions of 4th and 5th Editions of NESC	235	July 27, 78	1977
283B4	Grounding of guys	73	July 29, 55	5th
283B4b	Guys attached to wood poles	50	May 26, 50	5th
283C	Guy strand insulation for corrosion reduction	347	Sept 12, 83	1981

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286C, D	See 124A1	355		
286E	Clearance to ground for equipment on structures—not above a roadway	275	Aug 6, 80	1977
PART III				
300	Location of pad-mounted equipment	258	Nov 6, 79	1977
310	See 300	258		
311	See 300	258		
314B	Neutral grounding for buried concentric neutral cable with semi-conducting sheath	196	July 14, 77	1977
314B	See 92D	298		
314B	See 93C7	356		
314B	Metallic handhold covers of pull boxes containing street lights	435	Jan 26, 90	1990
323	Classification of below grade structure	316	Mar 18, 81	1981
323F2	Door latch operation from inside requirements; applicability to hinged-door cover on below grade structure	318	Mar 18, 82	1981
330	Installation of submarine cable on islands in connection with aids to navigation	278	Aug 25, 80	1977
330D	"Immediate vicinity of a fault" as applied to damage withstanding capability of underground cable	164	May 29, 74	6th

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332	Use of steel-clad copper wire as neutral conductor air direct buried, bare concentric neutral cable	273	July 24, 80	1977
350B	Neutral grounding for buried concentric neutral cable with semiconducting sheath	196	July 14, 77	1977
350E	Meanings of "should" and "shall"	401	Apr 7, 87	1984
351	See 330	278		
351C1	Direct buried cable near swimming pool	170	Feb 25, 75	6th
351C1	Definition of "supplemental mechanical protection"	417	Oct 20, 87	1987
353	See 330	278		
353D	Cable burial depth	155	Feb 5, 74	6th
353D	Communication cable burial depth	171	Mar 19, 75	6th
353D	Submarine cable burial depth and grounding requirements	384	Feb 26, 86	1984
Section 38	Location of pad-mounted equipment	258	Nov 6, 79	1977
353D2	Depth of burial in rock and acceptable supplemental protection	301	June 29, 81	1981
353D2c	Definition of "supplemental protection"	334	Oct 21, 82	1981
354E2	Applicability of requirement for GF indication system	358	Mar 13, 84	1981
354E4	See 93C7	356		
354E4	Provision of adequate bonding	373	Mar 14, 85	1984

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370B	Unlabeled empty duct leading to live parts	354	Nov 3, 83	1981
373	See 370B	354		
374	See 93C7	365		
381G	Unfenced pad-mounted equipment; meaning of two procedures	185	June 29, 76	6th
381G	Second barrier requirements—pad-mounted equipment	325 325a	June 8, 82 Nov 22, 81	1981 1981
381G	Barriers for pad-mounted equipment	396	Oct 30, 86	1984
384A	See 93C7	356		
PART IV				
421G	Tagging energized circuits by SCADA systems	402	Apr 8, 87	1987
422B	See 124A1	355		
422B	Insulation of workers using buckets and aerial equipment	380	Aug 27, 85	1984
422C1	(a) Should clearance of conductors passing by buildings include swing? (b) Insulator swing considerations (c) Sag increase; span 150 ft or 350 ft	89X	Aug 12, 57	5th
423C	Is tagging of remote *close/trip* control required if device is otherwise rendered inoperable?	293	Apr 7, 81	1981
432	Climbing Joint-Use Poles	441	May 1, 90	1990
442E	Tagging procedures by SCADA	433	Dec 12, 89	1990
442E	Tagging procedures by SCADA	434	Dec 13, 89	1990