Overhead Construction Standards

nationalgrid

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SECTION	PAGE
• 1.0 COPYRIGHT NOTICE	1-1
• 1.1 STANDARDS ARE PROPERTY OF NATIONAL GRID	1-1
• 1.2 TRANSMISSION VOLTAGES	1-1
• 1.3 SUB-TRANSMISSION VOLTAGES	1-2
• 1.4 PRIMARY DISTRIBUTION VOLTAGES	1-2
• 1.5 SECONDARY DISTRIBUTION VOLTAGES, SINGLE PHASE	1-3
• 1.6 SECONDARY DISTRIBUTION VOLTAGES, THREE PHASE	1-3
• 1.7 CONSTRUCTION GUIDELINES FOR COMLPIANCE	1-4 THRU 1-5
• ABBREVIATIONS	1-101 THRU 1-114
• DEFINITIONS	1-201 THRU 1-213

Supersedes 7/18 Issue – Added Sub-transmission section.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/17 Issue – removed 69kv 25hz from the table and added new Sub T section.

1.0 COPYRIGHT NOTICE

Copyright 2018 National Grid.

1.1 STANDARDS ARE PROPERTY OF NATIONAL GRID

1.1.10 Property of National Grid, Warranties

This Distribution Standards book was prepared by National Grid USA Service Company for the general use of National Grid subsidiaries. The information in this book is confidential, proprietary, trade secret information and it remains the property of National Grid. This book is made available to you with the express understanding that neither National Grid nor any of its affiliates, officers, directors, agents or employees assumes any warranty or representation with respect to the contents of this book or its accuracy or completeness.

1.1.20 Confidentiality

The person(s) accepting this book shall maintain the confidentiality of the specification or standards provided except that such person(s) may disclose the information to its partner(s), employee(s), agent(s), contractor(s), or subcontractor(s) if (1) the National Grid companies and (2) the party to whom the information has been disclosed acknowledges receipt of this disclosure.

1.1.20 Transfer, Copy, Reproduction and Return

This book shall not be transferred, copied, or reproduced in any form by any person or organization, without written authorization of National Grid. The consignee of this manual is required to return it, in its entirety, to the National Grid representative responsible for its issuance, immediately subsequent to the completion of the assignment, project, or contract.

1.2 TRANSMISSION VOLTAGES

This is a list of nominal transmission system voltages presently in use within the National Grid Service Territory. All voltages are 60 Hz unless otherwise noted. Non-standard service voltages are followed by an asterisk (*).

Voltage	Operating Location
46,000	MA, NH, VT, Nantucket
69,000	MA, RI, NY
115,000	MA, NH, NY, RI
138,000	NY
230,000	MA, NY
345,000	MA, NH, NY, RI
450 kV +/- Volts DC	MA, NH

1.3 SUB-TRANMISSION VOLTAGES

1. This is a list of nominal sub-transmission system voltages presently in use within the National Grid Service Territory. All voltages are 60 Hz unless otherwise noted. 3-wire supply from a high-impedance-grounded-wye transformer.

3-Phase, 3 Wire

Voltage	Operating Location
23,000	NY, MA
34,500	NY
46,000	NY

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

1.4 PRIMARY DISTRIBUTION VOLTAGES

These are lists of nominal primary distribution system voltages presently in use within the National Grid Service Territory. All voltages are 60 Hz unless otherwise noted. Non-standard service voltages are followed by an asterisk (*).

1.4.10 3-Phase, 3 Wire

Voltage	BIL (kV)	Voltage Code	Operating Location
2,400Δ *	75	H	MA, RI
4,160Y *	75		MA, NY
4,800Δ	75	M	MA, NY
7,200Δ *	75		NY
11,000Δ	95		RI (Note 1)
13,200Y *	95		NY
13,800Δ *	95		MA
13,800Y *	95		MA (Note 2)
23,000Y	125		MA, RI
23,000Y	150		MA
23,000Δ	150		MA, RI
34,500Y *	150		RI (Note 3)

Notes:

2. In Providence, RI, Non-effectively grounded supply.
3. Worcester, MA, 13,800 kV 3-phase, 3-wire supply from a high-impedance-grounded-wye transformer.
4. In southern RI and northeast MA, 34.5 kV 3-phase, 3-wire supply.

1.4.20 3-Phase, 4 Wire

Voltage	BIL (kV)	Voltage Code	Operating Location
3,740GRDY/2160 *	75		MA
4,160GRDY/2,400	75	J	MA, NY, RI
8,320GRDY/4,800 *	75	G	MA
12,470GRDY/7,200	95	F	MA, RI
13,200GRDY/7,600	95	L	MA, NY
13,800GRDY/7,960	95	W	MA, RI
24,940GRDY/14,400	125	K	MA
34,500GRDY/19,900	150	T	MA, RI

Supersedes 7/18 Issue – Renumbered notes, removal of 25 HZ, removal of NH and renumbered sections.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

1.5 SECONDARY DISTRIBUTION VOLTAGES, SINGLE PHASE

1.5.10 2 Wire

Voltage
120 (Note 1)
240 (Note 1)

1.5.20 3 Wire

Voltage
120/240
120/208 (Note 2)

Notes:
1. For lighting only.
2. Underground Network

1.6 SECONDARY DISTRIBUTION VOLTAGES, THREE PHASE

1.6.10 3 Wire

Voltage
240 *
480 *
600 *

1.6.20 4 Wire

Voltage
125/216Y (Note 1)
208Y/120
240/120 (Note 2)
480Y/277

Notes:
1. Underground Network
2. 240 V open or closed Delta with 120 V for lighting.

Supersedes 7/17 update – Renumbered sections.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

1.7 CONSTRUCTION GUIDELINES FOR COMPLIANCE FOR DISTRIBUTION AND SUB TRANSMISION STANDARDS

As part of the construction audit review, questions have been raised as to when existing construction shall be brought in compliance with current Distribution Standards. The following is a general outline as to what the Company expectations are with regard to this matter.

New Construction – All new construction shall be built to current National Grid Distribution Standards.

Existing Construction – Existing construction or maintenance work (i.e., outside of complete structure replacement, reconductoring or conversions) does not require that the existing structure be brought in compliance with the current Distribution Standards provided that the work being done maintains the integrity of the original structure's construction. Safety concerns (such as clearances) or potential reliability issues at the structure shall be addressed as part of the work that is being performed.

Emergency Construction – Emergency or temporary construction does not require that the existing structure be brought in compliance with the current Distribution Standards provided that the work being done maintains the integrity of the original structure's construction. Critical safety concerns that may result in undue hazard or potential harm to Company personnel or to the general public shall be addressed as part of the emergency work that is being performed. Potential reliability issues or general safety concerns at the structure shall be reported to local supervision. Emergency or temporary construction shall be brought into compliance with Distribution Standards as soon as practical.

Note 1: During structure replacement, reconductoring, or conversion work, all minimum clearances and separations per current Distribution Standards shall be followed.

Note 2: In all cases, work being completed on any given structure shall be in compliance with National Grid Electric Operating Procedures as well as all applicable federal, state or local law / ordinance. (e.g., For the case where a driven ground rod is found to be missing on a required structure, appropriate permissions (e.g., Dig Safe, Dig Safely) must be acquired prior to correcting the situation.)

Some examples of safety or potential reliability concerns include, but are not limited to:

- ***Safety***
  - Clearances
  - Potted porcelain cutout on pole
  - *Missing guy marker(s)*
  - *Missing structure or switch number*
  - Missing equipment locks

- **Reliability**
  - Improper bonding and grounding
    - Missing or exposed ground rod(s)
    - Street lighting
    - Metallic Riser conduits
    - Guy wire (wye system)
    - Switch handles
    - Control cabinets
    - Equipment tank/mounts
    - Spacer cable supports (tangent, C and E-brackets)
    - Arresters (flexible braid utilized for arrester disconnector)
    - Secondary neutral

Supersedes 7/18 Issue – renumbered sections.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

- Down ground molding
- Potted porcelain cutout on pole
- Missing surge arrester(s)
- Missing animal guard(s)

New Standard

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

These abbreviations are taken from ANSI Standard Y1.1 and other standards organizations. The asterisk (*) denotes terms deemed necessary but not acceptable or defined by the above mentioned standards. The left column lists words/phrases while the right column lists the abbreviation.

A			
ADJUST, ADJUSTING, ADJUSTABLE	ADJ	A	AMPERE
AIR BREAK SWITCH	ABS	*A/C	AIR CONDITIONER
AIR CIRCUIT BREAKER	ACB	AAAC	ALL ALUMINUM ALLOY CONDUCTOR
* AIR CONDITIONER	A/C	AAC	ALL ALUMINUM CONDUCTOR
AL CONDUCTOR STEEL REINFORCED	ACSR	AB	ANCHOR BASE
ALL ALUMINUM ALLOY CONDUCTOR	AAAC	ABS	AIR BREAK SWITCH
ALL ALLUMINUM CONDUCTOR	AAC	AC	ALTERNATING CURRENT
ALTERNATING CURRENT	AC	ACB	AIR CIRCUIT BREAKER
ALUMINUM	AL	ACSR	AL CONDUCTOR STEEL REINFORCED
ALUMOWELD	AW	ADJ	ADJUST, ADJUSTING, ADJUSTABLE
ALUMOWELD ALUMINUM CONDUCTOR	AWAC	AL	ALUMINUM
AMERICAN WIRE GAUGE	AWG	AMP	AMPERE
AMPERE	AMP, A	APPROX	APPROXIMATE
ANCOR BASE	AB	ARR	ARRESTER
AND SO FORTH	ETC	ASYM	ASYMMETRICAL
APPROXIMATE	APPROX	AUTO	AUTOMATIC
ARRESTER	ARR	AUX	AUXILIARY
ASYMMETRICAL	ASYM	AVE	AVENUE
AUTOMATIC	AUTO	AVG	AVERAGE
AUXILIARY	AUX	AW	ALUMOWELD
AVENUE	AVE	AWAC	ALUMOWELD ALUMINUM CONDUCTOR
AVERAGE	AVG	AWG	AMERICAN WIRE GAUGE
B			
BASIC INSULATION IMPULSE LEVEL	BIL	B	BLACK
BLACK	BLK, B	BIL	BASIC INSULATION IMPULSE LEVEL
BLUE	BLU, BL	BL	BLUE
BOLT	BLT	BLDG	BUILDING
BRACKET	BRKT	BLK	BLACK
BRASS	BRS	BLT	BOLT
BRITISH THEMAL UNIT	BTU	BLU	BLUE
BRONZE	BNZ	BNZ	BRONZE
BROWN	BRN,BR	BR	BROWN
BUILDING	BLDG	BRKT	BRACKET
BY PASS	BYP	BRN	BROWN
		BRS	BRASS
		BTU	BRITISH THERMAL UNIT
		BYP	BY PASS

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

C			
CAPACITOR	CAP	C TO C	CENTER TO CENTER
CATALOGUE	CAT	CAP	CAPACITOR
CENTER	CTR	CC	CUBIC CENTIMETER
CENTER LINE	CL	CFM	CUBIC FEET PER MINUTE
CENTER TO CENTER	C TO C	CIR	CIRCLE, CIRCULAR
CENTIGRADE	° C	CKT	CIRCUIT
CIRCLE, CIRCULAR	CIR	CL	CENTER LINE
CIRCUIT	CKT	CL	CLASS, CLASSIFICATION
CLAMP	CLP	CLF	CURRENT-LIMITING FUSE
CLASS, CLASSIFICATION	CL	CLP	CLAMP
COMPANY	CO	CNDCT	CONDUCTOR
COMPATIBLE UNIT	CU	CO	COMPANY
* COMPRESS, COMPRESSION	COMP	CO	CUTOUT
COMPLETELY SELF-PROTECTED	CSP	*COMP	COMPRESS, COMPRESSION
* CONCENTRIC	CONC	*CONC	CONCENTRIC
CONDUCTOR	CNDCT	CONN	CONNECTOR, CONNECTION, CONNECT
CONDUCTOR, MULTIPLE “EXAMPLE”	3/C	CORP	CORPORATION
* CONDUCTORS PARALLELED	CP	COV	COVER, COVERED
* CONDUCTORS TWISTED	CT	*CP	CONDUCTORS PARALLELED
CONNECTOR, CONNECTION, CONNECT	CONN	CSP	COMPLETELY SELF-PROTECTED
COPPER	CU	*CT	CONDUCTORS TWISTED
COPPERWELD	CW	CT	CURRENT TRANSFORMER
* COPPERWELD-COPPER	CCW	CTR	CENTER
CORPORATION	CORP	CU	COMPATIBLE UNIT
COVER, COVERED	COV	CU	COPPER
CROSS LINK POLYETHYLENE	XLP	CU FT	CUBIC FEET
CROSS SECTION	XSECT	CU IN	CUBIC INCH
CROSSARM	XARM	CU M	CUBIC METERS
CUBIC CENTIMETER	CC	CU YD	CUBIC YARDS
CUBIC FEET PER MINUTE	CFM	*CUST	CUSTOMER
CUBIC FEET	CU FT	CW	COPPERWELD
CUBIC INCH	CU IN	*CWCU	COPPERWELD-COPPER
CUBIC METER	CU M	CY	CYCLE
CUBIC YARD	CU YD		
CURRENT-LIMITING FUSE	CLF		
CURRENT TRANSFORMER	CT		
* CUSTOMER	CUST		
CUTOUT	CO		
CYCLE	CY		

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

D			
* DEADEND	DE	D	DEPTH
DELTA	Δ	*DB	DIRECT BURIED
DEPARTMENT	DEPT	DBL	DOUBLE
DEPTH	D	DC	DIRECT CURRENT
DIAMETER	DIA	*DE	DEAD END
* DIRECT BURIED	DB	DEPT	DEPARTMENT
DIRECT CURRENT	DC	DF	DOUGLAS FIR
DISCONNECT	DISC	DIA	DIAMETER
DISTRIBUTE, DISTRIBUTION	DISTR	DISC	DISCONNECT
DOUBLE	DBL	DISTR	DISTRIBUTE, DISTRIBUTION
DOUBLE POLE SWITCH	DP SW	DN	DOWN
DOUGLAS FIR	DF	DP SW	DOUBLE POLE SWITCH
DOWN	DN	*DPX	DUPLEX
* DUPLEX	DPX		
E			
EACH	EA	E	EAST
EAST	E	EA	EACH
* EIGHT HOLE	8H	EC	ELECTRICAL CONDUCTOR
ELBOW	ELB	EG	FOR EXAMPLE
ELECTRIC, ELECTRICAL, ELECTRONIC	ELEC	EHV	EXTRA HIGH VOLTAGE
ELECTRICAL CONDUCTOR	EC	ELB	ELBOW
EMBEDDED	EMB	ELEC	ELECTRIC, ELECTRICAL, ELECTRONIC
ENGINEER, ENGINEERING	ENGR	EMB	EMBEDDED
ENTRANCE	ENTR	ENCL	ENCLOSED, ENCLOSURE
EQUIPMENT	EQPT	ENGR	ENGINEER, ENGINEERING
EQUIVALENT	EQUIV	ENTR	ENTRANCE
ETHYLENE PROPYLENE	EP	*EP	ETHYLENE PROPYLENE
* ETHYLENE PROPYLENE RUBBER	EPR	*EPR	ETHYLENE PROPYLENE RUBBER
* EXTRA HIGH VOLTAGE	EHV	EQPT	EQUIPMENT
		EQUIV	EQUIVALENT
		ETC	AND SO FORTH

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

F			
FAHRENHEIT	° F	FC	FOOT CANDLE
FEEDER	FDR	FDR	FEEDER
FEET	FT, '	*FG	FIBERGLASS
* FIBERGLASS	FG	FIG	FIGURE
FIGURE	FIG	FLDT	FLOODLIGHT
FLOODLIGHT	FLDT	FOA	FORCED OIL W/ FORCED AIR COOLER
FOOT	FT, '	FREQ	FREQUENCY
FOOT CANDLE	FC	FT	FOOT, FEET
FOOT POUNDS	FT-LB	FT-LB	FOOT POUND
FOR EXAMPLE	EG	*FTN	FULL TENSION
FORCED OIL W/FORCED AIR COOLER	FOA		
FOUR CONDUCTORS	4/C		
* FOUR CONDUCTORS PARALLELED	4CP		
* FOUR CONDUCTORS TWISTED	4CT		
FREQUENCY	FREQ		
* FULL TENSION	FTN		
G			
GALLON	GAL	GAL	GALLON
GALLONS PER HOUR	GPH	GALV	GALVANIZED
GALLONS PER MINUTE	GPM	GALVI	GALVANIZED IRON
GALLONS PER SECOND	GPS	GALVS	GALVANIZED STEEL
GALVANIZED	GALV	GND	GROUND
GALVANIZED IRON	GALVI	GP	GENERAL PURPOSE
GALVANIZED STEEL	GALVS	GPH	GALLONS PER HOUR
GENERAL PURPOSE	GP	GPM	GALLONS PER MINUTE
GRAY	GRA, GY	GPS	GALLONS PER SECOND
GREEN	GRN	GRA	GRAY
GROUND	GND	GRN	GREEN
		GY	GRAY
H			
HANDHOLE	HH	H	HEIGHT
HARD DRAWN	HD DRN	HD	HEAVY DUTY
HARDWARE	HDW	*HD	HIGH DENSITY
HEAVY DUTY	HD	HD DRN	HARD DRAWN
HEIGHT	H	*HDPE	HIGH DENSITY POLYETHYLENE
HERTZ	HZ	*HDTR	HIGH DENSITY TRACK RESISTANT
* HIGH DENSITY	HD	HDW	HARDWARE
* HIGH DENSITY POLYETHYLENE	HDPE	HH	HANDHOLE
* HIGH DENSITY TRACK RESISTANT	HDTR	*HMP	HIGH MOLECULAR POLYETHYLENE
* HIGH MOLECULAR POLYETHYLENE	HMP	HORIZ	HORIZONTAL
HIGH PRESSURE	HP	HP	HIGH PRESSURE
HIGH PRESSURE SODIUM VAPOR	HPS	HP	HORSEPOWER
HIGH TENSION	HT	HPS	HIGH PRESSURE SODIUM VAPOR
HIGH VOLTAGE	HV	HT	HIGH TENSION
HIGHWAY	HWY	HV	HIGH VOLTAGE
HORIZONTAL	HORIZ	HWY	HIGHWAY
HORSEPOWER	HP	HZ	HERTZ

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

I			
IMPEDANCE	IMPD	ID	INSIDE DIAMETER
INCANDESCENT	INCAND	I.E.	THAT IS
INCH	IN, "	IMPD	IMPEDANCE
INCHES PER SECOND	IPS	IN	INCH
INDUCTION, INDUCTANCE	IND	INCAND	INCANDESCENT
INFORMATION	INFO	*IND	INDUCTION, INDUCTANCE
INSIDE DIAMETER	ID	INFO	INFORMATION
INSTANTANEOUS	INST	INST	INSTANTANEOUS
INSULATE, INSULATING, INSULATOR	INSUL	INSUL	INSULATE, INSULATING, INSULATOR
INTERRUPT	INTRPT	INTRPT	INTERRUPT
		IPS	INCHES PER SECOND
J			
* JOINTLY OWNED	JO	JCT	JUNCTION
* JUMPER	JMP	*JMP	JUMPER
JUNCTION	JCT	*JO	JOINTLY OWNED
K			
KILOVAR	KVAR	K	THOUSAND
KILOVOLT	KV	KCMIL	THOUSAND CIRCULAR MILS
KILOVOLT-AMPERE	KVA	KV	KILOVOLT
KILOWATT	KW	KVA	KILOVOLT-AMPERE
KILOWATT HOUR	KWH	KVAR	KILOVAR
		KW	KILOWATT
		KWH	KILOWATT HOUR

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

L			
LARGE	LGE	L	LENGTH
LEAD COVERED	LC	*L	LUMEN
LEAD OVER HEIGHT	L/H	L/H	LEAD OVER HEIGHT
LENGTH	L	LB	POUND
LIGHT	LT	*LBK	LOAD BREAK
LIGHT EMITTING DIODE	LED	*LBS	LOAD BREAK SWITCH
LIGHTING	LTG	LBS	POUNDS
LIMITER	LMTR	LC	LEAD COVERED
* LOAD BREAK	LBK	LED	LIGHT EMITTING DIODE
* LOAD BREAK SWITCH	LBS	LGE	LARGE
* LOAD TAP CHANGER	LTC	LIM	LIMIT
LOW VOLTAGE	LV	LMTR	LIMITER
LUBRICATED, LUBRICATION	LUB	LPW	LUMENS PER WATT
* LUMEN	L	LT	LIGHT
LUMENS PER WATT	LPW	*LTC	LOAD TAP CHANGER
* LUMINAIRE	LUM	LTG	LIGHTING
		LUB	LUBRICATED, LUBRICATION
		*LUM	LUMINAIRE
		LV	LOW VOLTAGE
M			
MACRO UNIT	MU	M	THOUSAND POUNDS (GUY STRANDS)
MAINTENANCE	MAINT	MA	MILLIAMPERE
MANHOLE	MH	MAINT	MAINTENANCE
MANUFACTURE, MANUFACTURER	MFR	MATL	MATERIAL
MATERIAL	MATL	MAX	MAXIMUM
MATERIAL LIST	ML	*MBS	MINIMUM BREAKING STRENGTH
MAXIMUM	MAX	MCY	MEGACYCLE
* MEDIUM HARD DRAWN	MHD	*MEG	MEGAOHM
* MEGACYCLE	MCY	MESS	MESSEMGER
* MEGAWATT	MWT	MFR	MANUFACTURE, MANUFACTURER
* MEGAWATT HOUR	MWH	MGY	MULTIGROUNDED-Y CONNECTED
* MEGAOHM	MEG	MH	MANHOLE
* MERCURY VAPOR	MV	MH	PROBE START METAL HALIDE
MESSENGER	MESS	*MHD	MEDIUM HARD DRAWN
METAL-OXIDE VERISTER	MOV	MIN	MINIMUM
METER, METERING	MTR	MISC	MISCELLANEOUS
MILLIAMPERE	MA	ML	MATERIAL LIST
MILLION VOLT AMPERES	MVA	MOV	METAL-OXIDE VERISTER
MINIMUM	MIN	MT	MOUNT
* MINIMUM BREAKING STRENGTH	MBS	MTG	MOUNTING
MISCELLANEOUS	MISC	MTR	METER, METERING
MOUNT	MT	MU	MACRO UNIT
MOUNTING	MTG	*MV	MERCURY VAPOR
MULTIGROUNDED-Y CONNECTED	MGY	MVA	MILLION VOLT AMPERES
		*MHW	MEGAWATT-HOUR
		*MWT	MEGAWATT

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

N			
NEGATIVE	NEG	N	NORTH
* NEOPRENE	NEO	NC	NORMALLY CLOSED
NETWORK	NTWK	NEG	NEGATIVE
NEUTRAL	NEUT	*NEO	NEOPRENE
* NICOPRESS	NICPRS	NEUT	NEUTRAL
NOMINAL	NOM	*NICPRS	NICOPRESS
NORMALLY CLOSED	NC	NO	NORMALLY OPEN, NUMBER
NORMALLY OPEN	NO	NOM	NOMINAL
NORTH	N	NTWK	NETWORK
NUMBER	NO, #		
O			
OBSOLETE	OBS	OBS	OBSOLETE
OHM	Ω	OCB	OIL CIRCUIT BREAKER
OIL CIRCUIT BREAKER	OCB	OD	OUTSIDE DIAMETER
ONE CONDUCTOR	1/C	*OH	OVERHEAD
OUNCE	OZ	OVLD	OVERLOAD
OUTSIDE DIAMETER	OD	OZ	OUNCE
* OVERHEAD	OH		
OVERLOAD	OVLD		

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

P			
* PAPER & LEAD	PL	P	PHASE
PARALLEL	PRL	P	POLE
* PARALLEL GROOVE	PG	*PB	PUSH BRACE
* PARTIAL TENSION	PTN	PCT	PERCENT
PEDESTRIAN	PED	PE	PHOTOELECTRIC CON
PERCENT	PCT	PE	POLYETHYLENE
PHASE	P, Ø	PEC	PHOTO ELECTRIC CONTROL
PHOTO ELECTRIC CONTROL	PEC	PECR	PHOTO ELECTRIC CONTROL RECEPTACLE
PHOTO ELECTRIC CONTROL RECEPTACLE	PECR	PED	PEDESTRIAN
PHOTOELECTRIC CONTROL	PE	PF	POWER FACTOR
PINT	PT	*PG	PARALLEL GROOVE
POINT	PT	*PISA	POWER INSTALLED SCREW ANCHOR
POLE	P	*PL	PAPER & LEAD
* POLE MOUNT	PMNT	PLD	PLATED
* POLE TOP EXTENSION	PTX	*PMNT	POLE MOUNT
POLYCARBONATE	POLYCAR	*POLY	POLYETHELENE
* POLYETHELENE	POLY,PE	POLYCAR	POLYCARBONATE
POLYVINYL CHLORIDE	PVC	PORC	PORCELAIN
PORCELAIN	PORC	POS	POSITIVE
POSITIVE	POS	POT	POTENTIAL
POST TOP	PT	PRCST	PRECAST
POTENTIAL	POT	PREFMD	PREFORMED
POTENTIAL TRANSFORMER	PT	PRESS	PRESSURE
POUND	LB	PRI	PRIMARY
POUNDS	LBS	PRL	PARALLEL
POWER	PWR	PSMH	PULSE START METAL HALIDE
POWER FACTOR	PF	PT	PINT
*POWER INSTALLED SCREW ANCHOR	PISA	PT	POINT
PRECAST	PRCST	PT	POST TOP
PREFORMED	PREFMD	PT	POTENTIAL TRANSFORMER
PRESSURE	PRESS	*PTN	PARTIAL TENSION
PRIMARY	PRI	*PTX	POLE TOP EXTENSION
PROBE START METAL HALIDE	MH	PVC	POLYVINYL CHLORIDE
PULSE START METAL HALIDE	PSMH	PWR	POWER
* PUSH BRACE	PB		
Q			
QUADRANT	QDRNT	QDRNT	QUADRANT
* QUARDUPLEX	QPX	*QPX	QUADRUPLEX
QUANTITY	QTY	QT	QUART
QUART	QT	QTY	QUANTITY

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

R			
* RADIAL, RADIUS	RAD	R	RIGHT
RAILROAD	RR	R/W	RIGHT OF WAY
* REACTANCE/RESISTANCE	X/R	*RAD	RADIAL, RADIUS
* REACTANCE	X	RC	REMOTE CONTROL
REACTOR BALLAST	REA	RCPT	RECEPTACLE
REACTOR, REACTIVE	REAC	RD	ROAD
RECEPTACLE	RCPT	RDC	REDUCE, REDUCER, REDUCING
RECLOSER, RECLOSING	REC	RDWY	ROADWAY
REDUCE, REDUCER, REDUCING	RDC	REA	REACTOR BALLAST
REFLECTOR	REFL	REAC	REACTOR, REACTIVE
* REFRACTOR	REFC	REC	RECLOSER, RECLOSING
REGULAR	RGLR	*REFC	REFRACTOR
REGULATED BALLAST	REG	REFL	REFLECTOR
* REGULATOR	REG	REG	REGULATED BALLAST
REMOTE CONTROL	RC	*REG	REGULATOR
REPORT	RPRT	RES	RESISTANCE, RESISTOR
RESISTANCE, RESISTOR	RES	REV	REVISE, REVISION
REVISE, REVISION	REV	*RGBL	RIGID BAIL
RIGHT	RT, R	RGD	RIGID
RIGHT HAND	RH	RGLR	REGULAR
RIGHT OF WAY	R/W	RH	RIGHT HAND
RIGID	RGD	RMS	ROOT MEAN SQUARE
* RIGID BAIL	RGBL	RND	ROUND
ROAD	RD	RPRT	REPORT
ROADWAY	RDWY	RR	RAILROAD
ROOT MEAN SQUARE	RMS	RT	RIGHT
ROUND	RND	RUB	RUBBER
RUBBER	RUB		

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

S			
SECOND, SECONDARY	SEC	S	SOUTH
SECTION, SECTIONAL	SECT	SB	SILICON BRONZE
SECTIONALIZER	SECT	*SBLT	SPLIT BOLT
SELF-SUPPORTING	SS	SD	SOFT DRAWN
SEMI-FLEXIBLE BAIL	SFB	SEC	SECOND, SECONDARY
SERIES	SER	SECT	SECTION, SECTIONAL
SERVICE	SVCE	SECT	SECTIONALIZER
SILICON BRONZE	SB	SER	SERIES
SINGLE	SGL	SFB	SEMI-FLEXIBLE BAIL
SINGLE CONDUCTOR	1/C	SGL	SINGLE
SINGLE HOLE	1H	SO	SOLELY OWNED
SINGLE PHASE	1PH, 1Ø	SOD	SODIUM
* SINGLE POLE	1P	SOL	SOLID
SINGLE POLE DOUBLE THROW	SPDT	*SP	SOUTHERN PINE
SINGLE POLE SINGLE THROW	SPST	*SPA	SOUTHERN PINE ASPHALT
SINGLE POLE SWITCH	SP SW	*SPC	SOUTHERN PINE CREOSOTE
* SINGLE STRAND EYE	SSE	*SPCA	SPACER CABLE
SIX CONDUCTORS TWISTED	6CT	*SPCT	SOUTHERN PINE-CELLON TREATMENT
SIX HOLE	6H	SPCR	SPACER
SODIUM	SOD	SPDT	SINGLE POLE DOUBLE THROW
SOFT DRAWN	SD	SPEC	SPECIFICATION
SOLELY OWNED	SO	SPPC	SOUTHERN PINE-CELLON TREATMENT
SOLID	SOL	SPST	SINGLE POLE SINGLE THROW
SOUTH	S	SP SW	SINGLE POLE SWITCH
SOUTHERN PINE	SP	*SQU	STRAIN QUADRANT
* SOUTHERN PINE ASPHALT	SPA	SS	SELF SUPPORTING
* SOUTHERN PINE CREOSOTE	SPC	*SSE	SINGLE STRAND EYE
* SOUTHERN PINE PENTA IN CREOSOTE	SPPC	SPPC	SOUTHERN PINE-CELLON TREATMENT
* SOUTHERN PINE-CELLON TREATMENT	SPCT	SST	STAINLESS STEEL
SPACER	SPCR	*SST	STRAIN STRAIGHT
* SPACER CABLE	SPCA	STA	STATION, STATIONARY
SPECIFICATION	SPEC	STD	STANDARD
* SPLIT BOLT	SBLT	STL	STEEL
STAINLESS STEEL	SST	*ST LT	STREET LIGHT
STANDARD	STD	STR	STRAND, STRANDED
STATION, STATIONARY	STA	STRN	STRAIN
STEEL	STL	*SUB	SUBSTATION
STRAIN	STRN	SUPV	SUPERVISE, SUPERVISORY
* STRAIN QUADRANT	SQU	SUSP	SUSPENSION
* STRAIN STRAIGHT	SST	SVCE	SERVICE
STRAND, STRANDED	STR	SW	SWITCH, SWITCHED
* STREET LIGHT	ST LT	SWGR	SWITCHGEAR
* SUBSTATION	SUB	SYM	SYMBOL
SUPERVISE, SUPERVISORY	SUPV	SYMM	SYMMETRIC, SYMMETRICAL
* SUSPENSION	SUSP	SYS	SYSTEM
SWITCH, SWITCHED	SW		
SWITCHGEAR	SWGR		
SYMBOL	SYM		
SYMMETRIC, SYMMETRICAL	SYMM		
SYSTEM	SYS		

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

T			
TANGENT	TAN	TAN	TANGENT
TEARDROP	TDROP	TBASE	TRANSFORMER BASE
TEMPERATURE	TEMP	TCC	TIME-CURRENT CURVE
TERMINAL, TERMINATOR	TERM	TD	TIME DELAY
THAT IS	I.E.	TDROP	TEARDROP
* THERMOPLASTIC	THPL	*TEA	TRIPLE EYE ANCHOR ROD
THOUSAND	K	TEMP	TEMPERATURE
THOUSAND CIRCULAR MILS	KCMIL	TERM	TERMINAL, TERMINATOR
THOUSAND POUNDS (GUY STRAND)	M	*TES	TRIPLE EYE SCREW ANCHOR
THREAD, THREADED	THD	THD	THREAD, THREADED
THREE CONDUCTOR	3/C	*THDLES	THREADLESS
* THREE CONDUCTORS PARALLELED	3CP	*THPL	THERMOPLASTIC
* THREE CONDUCTORS TWISTED	3CT	THRU	THROUGH
THROUGH	THRU	TND	TINNED
TIME-CURRENT CURVE	TCC	TPL	TRIPLE
TIME DELAY	TD	TR	TRACK RESISTANT
TINNED	TND	TRX	TRIPLEX
TRACK RESISTANT	TR	*TSE	TRIPLE STRAND-EYE
TRANSFORMER	XFMR		
TRANSFORMER BASE	TBASE		
TRANSMISSION	XSMN		
TRIPLE	TPL		
* TRIPLE EYE ANCHOR ROD	TEA		
* TRIPLE EYE SCREW ANCHOR	TES		
TRIPLE POLE DOUBLE THROW	3PDT		
TRIPLE POLE SINGLE THROW	3PST		
TRIPLE POLE SWITCH	3P SW		
* TRIPLE STRAND-EYE	TSE		
TRIPLEX	TRX		
TWO CONDUCTORS	2/C		
* TWO CONDUCTORS PARALLELED	2CP		
* TWO CONDUCTORS TWISTED	2CT		
* TWO HOLE	2H		
TWO POLE	2P		
U			
ULTRAVIOLET LIGHT	UV	*UG	UNDERGROUND
* UNDERGROUND	UG	UGY	UNGROUNDED-Y CONNECTION
UNGROUNDED-Y CONNECTION	UGY	UNIV	UNIVERSAL
UNIVERSAL	UNIV	UV	ULTRAVIOLET LIGHT
V			
VACUUM	VAC	V	VOLT
VARNISHED CAMBRIC	VC	VA	VOLT AMPERE
* VAULT	VLT	VAC	VACUUM
VERTICAL	VERT	VC	VARNISHED CAMBRIC
* VINYL	VYL	VERT	VERTICAL
VOLT	V	*VLT	VAULT
VOLT AMPERE	VA	VOL	VOLUME
VOLUME	VOL	*VYL	VINYL

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

W			
WATT	W	W	WATT
WATT HOUR	WHR	W	WEST
WATT HOUR METER	WHM	W	WHITE
WATTMETER	WM	W	WIDTH
WEATHERPROOF	WP	W/	WITH
WEEK	WK	W/B	WITH BRACKET
WEIGHT	WT	WD	WIDTH
WEST	W	WD	WOOD
WHITE	WHT, W	WHM	WATT HOUR METER
WIDTH	WD, W	WHR	WATT HOUR
WITH	W/	WHT	WHITE
WITH BRACKET	W/B	WK	WEEK
* WITHOUT	WO/	WM	WATT METER
WOOD	WD	*WO/	WITHOUT
WYE	Y	WP	WEATHERPROOF
		WT	WEIGHT
X			
		*X	REACTANCE
		X	STRAND
		*X/R	REACTANCE/RESISTANCE
		XARM	CROSSARM
		XFMR	TRANSFORMER
		XLP	CROSS LINK POLYETHYLENE
		XSECT	CROSS SECTION
		XSMN	TRANSMISSION
Y			
YARD	YD	Y	WYE
YARDS	YDS	Y	YELLOW
YEAR	YR	YD	YARD
YELLOW	YEL, Y	YDS	YARDS
		YEL	YELLOW
		YR	YEAR
Z			
ZINC	ZN	ZN	ZINC
* ZINC PLATED	ZP	*ZP	ZINC PLATED

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SPECIAL CHARACTERS			
1/C	ONE CONDUCTOR		
1/C	SINGLE CONDUCTOR		
1/H	ONE HOLE		
*1/H	SINGLE HOLE		
1P	ONE POLE		
1P	SINGLE POLE		
1PH	SINGLE PHASE		
1Ø	SINGLE PHASE		
2/C	TWO CONDUCTOR		
*2CP	TWO CONDUCTORS PARALLELED		
*2CT	TWO CONDUCTORS TWISTED		
*2H	TWO HOLE		
2P	TWO POLE		
3/C	THREE CONDUCTOR		
*3CP	THREE CONDUCTORS PARALLELED		
*3CT	THREE CONDUCTORS TWISTED		
3P	THREE POLE		
3P SW	TRIPLE POLE SWITCH		
3PDT	TRIPLE POLE DOUBLE THROW SW		
3PST	TRIPLE POLE SINGLE THROW SW		
4/C	FOUR CONDUCTOR		
*4CP	FOUR CONDUCTORS PARALLELED		
*4CT	FOUR CONDUCTORS TWISTED		
*4H	FOUR HOLE		
4P	FOUR POLE		
4P SW	FOUR POLE SWITCH		
4PDT	FOUR POLE DOUBLE THROW SW		
4PST	FOUR POLE SINGLE THROW SW		
6CT	SIX CONDUCTORS TWISTED		
6H	SIX HOLE		
*8H	EIGHT HOLE		
Δ	DELTA		
Ω	OHM		
Ø	PHASE		
‘	FOOT OR FEET		
“	INCH OR INCHES		
°C	CENTIGRADE		
°F	FAHRENHEIT		
#	NUMBER		

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Organizations and Documents

ORGANIZATION	ABBREVIATION
AMERICAN NATIONAL STANDARDS INSTITUTE	ANSI
AMERICAN SOCIETY OF TESTING AND MATERIALS	ASTM
AMERICAN WOOD PERSERVERS ASSOCIATION	AWPA
ASSOCIATION OF EDISON ILLUMINATING COMPANIES	AEIC
DEPARTMENT OF TRANSPORTATION	DOT
EDISON ELECTRIC INSTITUTE	EEI
ILLUMINATING ENGINEERING SOCIETY	IES
INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS	IEEE
INSULATED CABLE ENGINEERS ASSOCIATION	ICEA
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION	NEMA
NATIONAL FIRE PROTECTION ASSOCIATION	NFPA
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	OSHA
UNDERWRITERS LABORATORY	UL
DOCUMENT	**ABBREVIATION**
ELECTRIC OPERATING PROCEDURE (National Grid)	EOP
NATIONAL ELECTRICAL CODE	NEC
NATIONAL ELECTRICAL SAFETY CODE	NESC

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

DEFINITIONS

The following sources were used as a reference to define the following terms:

1. IEEE Standard Dictionary of Electrical & Electronic Terms – IEEE STD 100
2. The Lineman's and Cableman's Handbook
3. National Electrical Code
4. National Electrical Safety Code

A

AAC - (All Aluminum Conductor) A conductor made wholly of 1350 alloy aluminum.

AAAC - (All Aluminum Alloy Conductor) A conductor made wholly of 5005-H19 or 6201-T81 higher strength alloy aluminum.

ACSR - (Aluminum Conductor Steel Reinforced) A composite conductor made up of a combination of aluminum and steel wires. In the usual construction the aluminum wires surround the steel wires.

ACTUAL SPAN - The horizontal distance between two adjacent structures. The distance can be either to the structure ahead, Actual Span ahead, or to the back structure, Actual Span back. The Actual Span affects sags and clearances from the conductors to the ground.

ALIVE - Electrically connected to a source of potential difference, or electrically charged so as to have a potential difference from that of the ground. **Note:** The term "alive" is sometimes used in place of the term "current-carrying", where the intent is clear, to avoid repetitions of the longer term. (IEEE-100)

AMPACITY - The current-carrying capacity, expressed in amperes, of an electrical conductor under stated thermal conditions. (Per NESC)

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

ANCHOR GUY MARKER - A protective cover over the guy, often a length of plastic or metal shaped to a semicircular or tubular section and equipped with a means of attachment to the guy. (IEEE-100)

ANODE - An electrode through which current enters any conductor of the nonmetallic class. (IEEE-100)

ARRESTER - See Surge Arrester

AWG - (American Wire Gauge) The standard system used for designating wire diameter, also referred to as the Brown and Sharpe wire gauge. This system is based on a direct correlation between gauge number, cross section, weight, and the DC resistance of conductors.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

B

BAY-O-NET FUSE - A pad mount transformer fuse, used to protect the line-side system from damage caused by transformer faults. Provides transformer protection from overloading and secondary fault current.

BIL - (Basic Lightning Impulse Insulation Level) A specific insulation level expressed in kilovolts of the crest value of a standard lightning impulse. (IEEE-100)

BOLLARD - A series of short posts set at intervals to delimit an area (as a traffic island) or to exclude vehicles

BONDING - The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed. (IEEE-100)

The electrical interconnecting of conductive parts, designed to maintain a common electrical potential. (NESC)

BOOST - Raise or attempt to raise voltage.

BUCK - Lower or attempt to lower voltage.

BUCKARM - A crossarm placed approximately at right angles to the line crossarm and used for supporting branch or lateral conductors or turning large angles in line conductors. (IEEE-100)

BUSHING PLUG - An interface for a transformer/switch that allows cable to be attached with an elbow connector.

C

CABLE - A conductor with insulation, or a stranded conductor with or without insulation and other coverings (single-conductor cable), or a combination of conductors insulated from one another (multiple-conductor cable). (OSHA, NESC, IEEE-100)

CABLE JACKET - A protective covering over the insulation, core, or sheath of a cable. (IEEE-100)

CABLE RACK - A device usually secured to the wall of a manhole, cable raceway, or building to provide support for cables. (IEEE-100)

CABLE SHEATH - A conductive protective covering applied to cables. **Note**: A cable sheath may consist of multiple layers, of which one or more is conductive. (IEEE-100)

CATHODE - An electrode through which current leaves any conductor of the nonmetallic class. (IEEE-100)

CATHODIC PROTECTION - Reduction or prevention of corrosion by making a metal, the cathode in a conducting medium by means of a direct electric current. (IEEE-100)

CIRCULAR MIL - A unit of area equal to π/4 of a square mil (= 0.7854 square mil). The cross-sectional area of a circle in circular mils is therefore equal to the square of its diameter in mils. A circular inch is equal to one million circular mils. **Note**: One mil equals 0.0001 inches. There are 1974 circular mils in a square millimeter. (IEEE-100)

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CLEARANCE - The clear distance between two objects measured surface to surface.(OSHA, NESC)

CONDUCTOR - A material, usually in the form of a wire, cable, or bus bar, suitable for carrying an electric current. (OSHA)

CONDUCTOR INSULATIONS -

BR	Butyl rubber
EPR	Ethylene propylene rubber
XLPE	Cross-linked polyethylene
TRXLPE	Tree-retardant polyethylene
PILC	Paper Insulated, lead covered
VC	Varnish Cambric

CONDUCTOR, BARE - One having no covering or insulation whatsoever. (IEEE-100)

CONDUCTOR COMPACT - A round stranded conductor having all layers stranded in the same direction and successively passed through forming dies that forms the round conductor strands into a diamond-like shape. This results in a smoother, more nearly circular outer surface and effectively eliminates the void between individual wire strands.

CONDUCTOR COMPRESSED - A concentric stranded conductor which, after completion of the stranding operation, is passed through forming dies that compress the strands of the outer layer into a diamond-like shape. This results in a smoother, more nearly circular outer surface, and reduces the void between individual strands in the outer layer.

CONDUCTOR CONCENTRIC - A single straight core wire strand surrounded by one or more layers of helically wound wires in a fixed round geometric arrangement. Each layer after the first has six more strands than the preceding layer and is applied in a direction opposite to that of the layer under it.

CONDUCTOR COVERED - A conductor covered with a dielectric having no rated insulating strength or having a rated insulating strength less than the voltage of the circuit in which the conductor is used.

CONDUCTOR INSULATED - A conductor covered with a dielectric (other than air) having a rated insulated strength greater than or equal to the voltage of the circuit in which it is used. (NESC)

CONDUIT SYSTEM - Any combination of duct, conduit, conduits, manholes, handholes and/or vaults joined to form an integrated whole. (IEEE-100)

CONNECTOR - A coupling device employed to connect conductors of one circuit or transmission element with those of another circuit or transmission element. (IEEE-100)

CONTINUOUS LOAD - A load where the maximum current is expected to continue for three (3) hours or more.

CORE LOSS, TRANSFORMER - The measured power loss, expressed in watts, attributable to the material in the core and associated clamping structure of a transformer that is excited, with no connected load, at a core flux density and frequency equal to that in the core when rated voltage and frequency is applied and rated load current is supplied. (IEEE-100)

CURRENT CARRYING PART - A conducting part intended to be connected in an electric circuit to a source of voltage. **Note:** Non-current carrying parts are those not intended to be so connected. (OSHA)

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CURRENT LIMITING FUSE - A fuse that, when it is melted by a current within its specified current-limiting range, abruptly introduces a high arc voltage to reduce the current magnitude and duration. **Note:** The values specified in standards for the threshold ration, peak let-through current, and I^2t characteristic are used as the measures of current-limiting ability. (IEEE-100)

CURRENT LIMITING FUSE CARRYING - A pad mount transformer fuse that limits the potential for catastrophic failure of the transformer, due to internal faults.

CUTOUT - An assembly of a fuse support with either a fuse holder, fuse carrier, or disconnect blade. When a fuse holder or fuse carrier is used, this device is used to automatically interrupt the flow of current through any particular apparatus or instrument. (IEEE-100)

D

DEAD - Isolated, tagged, tested de-energized and grounded. (Safety Manual)

DEAD-FRONT (TRANSFORMERS & SWITCHGEAR) – Without live parts exposed to a person on the operating side of the equipment. (IEEE-100)

DEADEND GUY - An installation of line or anchor guys to hold the pole at the end of a line. (IEEE-100)

DE-ENERGIZED - The absence of normal operating voltages associated with the operation of the system or control circuits. (Safety Manual)

Disconnected from all sources of electrical supply by open switches, disconnectors, jumpers, taps, or other means. **Note:** De-energized conductors or equipment could be electrically charged or energized through various means, such as induction from energized circuits, portable generators, lightning, etc. (NESC)

DEMAND - The load integrated over a specific interval of time. (IEEE-100)

DISCONNECT - A device having a disconnecting blade for use as a disconnecting or isolating switch. (IEEE-100)

DUCT - A single enclosed raceway for conductors or cables. (NESC)

DUCT BANK - An arrangement of conduit providing one or more continuous ducts between two points. (IEEE-100)

DUCT SEALING - The closing of the duct entrance for the purpose of excluding water, gas, or other undesirable substances. (IEEE-100)

DUPLEX CABLE - A cable composed of two (2) insulated single conductors or one (1) insulated conductor and one (1) bare neutral conductor twisted together. (IEEE-100)

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 01.00.004

DUTY - Continuous Duty – Operation at a substantially constant load for an indefinitely long time.

Intermittent Duty – Operation for alternate intervals of:
1) load and no load; or
2) load and rest; or
3) load, no load, and rest.

Periodic Duty - Intermittent operation in which the load conditions are regularly recurrent.

E

EFFECTIVELY GROUNDED - Intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to limit the buildup of voltages to levels below that which may result in undue hazard to persons or to connected equipment. (NESC)

An alternating-current system or portion thereof may be said to be effectively grounded when, for all points on the system or specified portion thereof, the ratio of zero-sequence reactance to the positive-sequence reactance is less than three and the ratio of zero-sequence resistance to positive-sequence reactance is less than one for any condition of operation and for any amount of connected generator capacity. (IEEE-100)

ELBOW - A cable to apparatus connector.

ENCLOSED - Surrounded by case, cage, or fence designed to protect the contained equipment and limit the likelihood, under normal conditions, of dangerous approach or accidental contact by persons or objects. (NESC)

EXTRA-HIGH VOLTAGE SYSTEM - See Voltage Systems

F

FAULT CURRENT - A current that flows from one conductor to ground or to another conductor owing to an abnormal connection (including an arc) between the two. **Note:** A fault current flowing to ground may be called a ground fault current. (IEEE-100)

FEEDER - A set of conductors originating at a main distribution center and supplying one or more secondary distribution centers, one or more branch-circuit distribution centers, or any combination of these two (2) types of equipment. (IEEE-100)

FEED-THRU - A device to electrically connect elbows or other accessories.

FUSE - An overcurrent protective device with a circuit-opening fusible part that is heated and severed by the passage of overcurrent through it. (IEEE-100)

G

GROUND - A conducting connection, whether intentional or accidental, by which an electric circuit or equipment is connected to the earth or to some conducting body of relatively large extent that serves in place of the earth. (IEEE-100)

GROUND CURRENT - Current flowing in the earth or in a grounding connection. (IEEE-100)

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

GROUND GRID - A system of grounding electrodes consisting of interconnected bare cables buried in the earth to provide a common ground for electrical devices and metallic structures. (IEEE-100)

GROUND MAT - A system of bare conductors, on or below the surface of the Earth, connected to a ground or a ground grid to provide protection from dangerous voltages. (IEEE-100)

GROUND ROD - A rod that is driven into the ground to serve as a ground terminal, such as a copper-clad rod, solid copper rod, or galvanized iron pipe or rod. (IEEE-100)

GROUNDING TRANSFORMER - A transformer intended primarily to provide a neutral point for grounding purposes. **Note:** It may be provided with a Delta winding in which resistors or reactors are connected. (IEEE-100)

GUARDED - Covered, fenced, enclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, mats or platforms, designed to limit the likelihood, under normal conditions, of dangerous approach or accidental contact by persons or objects. **Note:** Wires that are insulated but not otherwise protected are not normally considered to be guarded. See exceptions under applicable rules. (NESC)

GUY - A tension member having one end secured to a fixed object and the other end attached to a pole, crossarm, or other structural part that it supports. (IEEE-100)

H

HANDHOLE - An access opening, provided in equipment or in a below-the-surface enclosure in connection with underground lines, into which personnel reach but do not enter, for the purpose of installing, operating, or maintaining equipment or cable or both. (NESC)

HIGH VOLTAGE SYSTEM - See Voltage Systems.

I

IMPEDANCE VOLTAGE (TRANSFORMER) - The voltage required to circulate rated current through one of two specified windings of a transformer when the other winding is short-circuited, with the windings connected as for rated voltage operation. **Note:** It is usually expressed in per unit or percent, of the rated voltage of the winding in which the voltage is measured. (IEEE-100)

INRUSH CURRENT (TRANSFORMER) - The maximum root-mean-square or average current value, determined for a specific interval, resulting from the excitation of the transformer with no connected load, and with essentially zero-source impedance, and using the minimum primary turns tap available and its rated voltage. (IEEE-100)

INSULATING CAP- A cap that is used for insulating, shielding and sealing a bushing plug.

INSULATION- That which is relied upon to insulate the conductor from other conductors or conducting parts or from ground (as applied to cable). (NESC)

INSULATOR - Insulating material in a form designed to support a conductor physically and electrically separate from another conductor or object. (IEEE-100)

ISOLATED NEUTRAL SYSTEM - A system that has no intentional connection to ground except through indicating, measuring, or protective devices of very high impedance. (IEEE-100)

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

J

JACKET - A protective covering over the insulation, core, or sheath of a cable. (NESC)

L

LATERAL CONDUCTOR - A wire or cable extending in a general horizontal direction at an angle to the general direction of the line conductor. (IEEE-100)

LAY (CABLE) - The helical arrangement formed by twisting together the individual elements of a cable. (IEEE-100)

LIGHTNING ARRESTER - See Surge Arrester.

LIVE - See Alive.

LIVE FRONT (TRANSFORMERS & SWITCHGEAR) - With live parts exposed to a person on the operating side of the equipment.

LOAD FACTOR - The ratio of the average load over a designated period of time to the peak load occurring in that period. (IEEE-100)

LOAD LOSSES (TRANSFORMER) - Those losses which are incident to the carrying of a specified load. Load losses include I^2R loss in the winding due to load and eddy currents, stray loss due to leakage fluxes in the windings, core clamps, and other parts; and the loss due to circulating current (if any) in parallel windings, or in parallel winding strands. (IEEE-100)

LOCATION -

Damp Location – Partially protected locations under canopies, marquees, roofed open porches, and like locations; and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold-storage warehouses.

Dry Location – A location not normally subject to dampness or wetness. Any location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.

Wet Location – Installations underground or in concrete slabs or masonry in direct contact with the earth, and locations subject to saturation with water or other liquids such as vehicle washing area, and locations exposed to weather and unprotected.

LOSS FACTOR - The ratio of the average power loss to the peak-load loss during a specified period of time. (IEEE-100)

LOW VOLTAGE - See Voltage Systems.

LUG - A wire connector device to which the electrical conductor is attached by mechanical pressure or solder. (IEEE-100)

LUMINAIRE - A complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply. (IEEE-100)

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

M

MANDREL - A tapered or cylindrical axle used to pull through conduit for inspections.

MANHOLE - A subsurface enclosure that personnel may enter and is used for the purpose of installing, operating, and maintaining submersible equipment and cable. (NESC)

MANUAL - Operated by mechanical force, applied directly by personal intervention. (IEEE-100)

MANUAL OPERATION - Operated by hand without using any other source of power. (IEEE-100)

MEDIUM VOLTAGE SYSTEM - See Voltage System.

MULTI- GROUNDED NEUTRAL SYSTEM - A distribution system of the 4 wire type where all transformer neutrals are grounded, and neutral conductors are directly grounded at frequent points along the circuit. (IEEE-100, NESC)

A system of conductors in which a neutral conductor is intentionally grounded solidly at specified intervals. A multigrounded or multiple grounded systems may or may not be effectively grounded. (NESC)

N

NAMEPLATE - A plaque giving the manufacturer's name and the rating of the equipment to which it is attached. (IEEE-100)

NETWORK - An aggregation of interconnected conductors consisting of feeders, mains, and services. (IEEE-100)

NEUTRAL CONDUCTOR - The conductor that is intended to be so energized, that, in the normal steady state, the voltages from every other conductor to the neutral conductor, at the terminals of entry of the circuit into a delimited region, are definitely related and usually equal in amplitude. (IEEE-100, NESC)

A system conductor other than a phase conductor that provides a return path for current to the source. Not all systems have a neutral conductor. An example is an ungrounded delta system containing only three energized phase conductors. (NESC)

NO-LOAD LOSSES - Those losses which are incident to the excitation of the transformer. No-load (excitation) losses include core loss, dielectric loss, conductor loss in the winding due to exciting current, and conductor loss due to circulating current in parallel windings. These losses change with the excitation voltage. (IEEE-100)

NOMINAL SYSTM VOLTAGE - See Voltage, Nominal.

NON-EFFECTIVELY GROUNDED - An alternating-current system or portion thereof may be said to be non effectively grounded when, for all points on the system or specified portion thereof, the ratio of zero-sequence reactance to the positive-sequence reactance is greater than three and the ratio of zero-sequence resistance to positive-sequence reactance is greater than one for any condition of operation and for any amount of connected generator capacity.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

NOT EFFECTIVELY GROUNDED - Not permanently connected to earth through a ground connection or connections of sufficiently high impedance and not having sufficient current-carrying capacity to prevent the building up of voltages that may result in undue hazard to connected equipment or to persons.

NOVOID X - Filling compound for G & W porcelain potheads and armored cable joint boxes.

O

OFC - Oil Fused Cutout.

OPEN WIRE - Single conductor, bare, covered or insulated, and separated by air from other conductors, e.g, not a cable.

P

PAD-MOUNTED - A general term describing equipment positioned on a surface-mounted pad located outdoors. **Note**: The equipment is usually enclosed with all exposed surfaces at ground potential. (IEEE-100)

PAD-MOUNTED TRANSFORMER - A transformer utilized as part of an underground distribution system, with enclosed compartment(s) for high voltage and low voltage cables entering from below and mounted on a foundation pad. (IEEE-100)

PARKING STAND - A bracket designed for installation on an apparatus, suitable for holding accessory devices, such as insulated parking bushing and grounding bushing. (IEEE-100)

PILC- Paper Insulated Lead Covered Cable

POLE-TYPE TRANSFORMER - A transformer that is suitable for mounting on a pole or similar structure. (IEEE-100)

POTHEAD - A device that seals the end of a cable and provides an insulated exit for the conductor or conductors. (IEEE-100)

POWER FUSE - A fuse consisting of an assembly of a fuse support and a fuse unit or fuseholder that may or may not include the refill unit or fuse link. **Note:** The power fuse is identified by the following characteristics: (1) Dielectric withstand (basic impulse insulation level) strengths at power levels; (2) Application primarily in stations and substations; (3) mechanical construction basically adapted to station and substation mounting. (IEEE-100)

PRESSURE RELIEF DEVICE - A means for relieving internal pressure in a transformer, possibly preventing explosive shattering of the tank or tank cover, following prolonged passage of fault current due to external faults or internal transformer faults. (IEEE-100)

PULLING EYE - A device that may be fastened to the conductor or conductors of a cable or formed by or fastened to the wire armor and to which a rope may be directly attached in order to pull the cable into or from a duct. (IEEE-100)

PUSH BRACE - A supporting member, usually of timber placed between a pole or other structural part of a line and the ground or a fixed object. (IEEE-100)

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Q

QUADRUPLEX CABLE - A cable composed of four (4) insulated single conductors or three (3) insulated conductors and one (1) bare neutral conductor twisted together.

R

RADIAL SYSTEM - A system in which independent feeders branch out radially from a common source of supply. (IEEE-100)

RISER POLE - Pole on which overhead wires connect to underground cable.

RULING SPAN - A calculated deadend span length, which will have the same changes in conductor tension due to changes of temperature and conductor loading, as will be found in a series of spans of varying lengths between deadends. (IEEE-100)

S

SAG - The distance measured vertically from a conductor to a straight line joining its two (2) points of support. Unless otherwise stated, the sag referred to is the sag at the midpoint of the span. (IEEE-100)

SECONDARIES - Circuits 600 volts and below.

SEPARATION - The distance between two objects, measured surface to surface, and usually filled with a solid or liquid material. (NESC)

SERVICE DROP - The overhead conductors between the electric supply or communication line and the building or structure being served. (NESC)

SERVICE ENTRANCE CONDUCTORS, OVERHEAD SYSTEM – The service conductors between the terminals of the service equipment and point usually outside the building, clear of building walls, where jointed by tap or splice to the service drop. (NEC)

SERVICE ENTRANCE CONDUCTORS UNDERGROUND SYSTEM - The service conductors between the terminals of the service equipment and the point of connection to the service lateral. **Note:** Where service equipment is located outside the building walls there may be no service-entrance conductors, or they may be entirely outside the building. (NEC)

SERVICE LATERAL - The underground service conductors between the street main, including any risers at a pole or other structure or from transformers, and the first point of connection to the service-entrance conductors in a terminal box, meter, or other enclosure with adequate space, inside or outside the building wall. Where there is no terminal box, meter, or other enclosure with adequate space, the point of connection shall be considered to be the point of entrance of the service conductors into the building. (NEC)

SIDE BREAK SWITCH - A switch in which the travel of the blade is in a plane parallel to the base of the switch. (IEEE-100)

SIDEWALL PRESSURE - The crushing force exerted on a cable during installation. (IEEE-100, NESC)

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SOLIDLY - GROUNDED — Grounded through all adequate ground connection in which no impedance has been inserted intentionally. **Note:** Adequate as used herein means suitable for the purpose intended. (IEEE-100)

SPACER CABLE - A type of electric supply-line construction consisting of an assembly of one or more covered conductors, separated from each other and supported from a messenger by insulating spacers. (IEEE-100, NESC)

SPAN LENGTH - The horizontal distance of two (2) adjacent supporting points of a conductor. (IEEE-100)

SPLICE - A physical connection of two (2) or more conductors to provide electrical continuity. (IEEE-100)

SPLICE TYPES- Double Wye: also known as a double double or an H splice, splices four cables together.

Modula/Separable: A joint that is built that can be easily taken apart by mechanical means.

Normal: A splice of two similar cables.

Reducing: A type of splice that will join two different sizes of cable together.

Reducing/Transition: To splice a PILC cable to a smaller solid dielectric cable.

Transition: Splicing together PILC cable to solid dielectric cable.

Trifurcating: Splicing a 1-3/C cable to a 3-1/C cable.

Trifurcating/Transition: Splicing a 1- 3/C PILC cable to 3-1/C solid dielectric cable.

Wye: Splicing 3 cables together.

STEP-DOWN TRANSFORMER - A transformer in which the energy transfer is from a higher voltage circuit to a lower voltage circuit. (IEEE-100)

STEP-UP TRANSFORMER - A transformer in which the energy transfer is from a lower voltage circuit to a higher voltage circuit. (IEEE-100)

SUBMARINE CABLE - A cable designed for service under water. **Note:** Submarine cable is usually a lead-covered cable with a steel armor applied between layers of jute. (IEEE-100)

SUBMERSIBLE TRANSFORMER - A transformer so constructed as to be successfully operable when submerged in water under predetermined conditions of pressure and time. (IEEE-100)

SUBWAY TRANSFORMER - A submersible-type distribution transformer suitable for installation in an underground vault. (IEEE-100)

SURGE ARRESTER - A protective device for limiting surge voltage on equipment by discharging or bypassing surge current; it prevents continued flow of follow current to ground, and is capable of repeating these functions as specified. (IEEE-100)

SWEEP - A manufactured bend installed at pad mounted equipment locations.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SWITCH -	Disconnecting or Isolation Switch -	A mechanical switching device used for changing the connections in a circuit or equipment from the source of power. **Note:** It is required to carry normal load current continuously, and also abnormal or short-circuit currents for short intervals as specified. It is required to open or close circuits either when negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the switch poles occurs.
	Load-Interrupter Switch -	A disconnecting or isolating switch equipped with an interrupter and designed to interrupt currents not in excess of the continuous-current rating of the switch.
	Regulator Bypass Switch -	A specific device or combination of devices designed to bypass a regulator.

T

TERMINAL -	A conducting element of equipment or a circuit intended for connection to an external conductor. (IEEE-100)
TERMINAL CONNECTOR -	A connector used for attaching a conductor to a lead, terminal block, or stud of electric apparatus. (IEEE-100)
TERMINAL PAD -	A usually flat conducting part of a device to which a terminal connector is fastened. (IEEE-100)
TERMINATOR -	An insulator used to protect each cable conductor passing through the device and provide complete external leakage insulation between the cable conductor(s) and ground.
TERMINATOR /POTHEAD -	A device that seals the end of a cable and provides insulated egress for the conductor or conductors. (IEEE-100)
TIE LINE -	A transmission/distribution line connecting two (2) or more power systems. (IEEE-100)
TOTAL LOSSES -	The sum of the no-load and load losses, excluding losses due to accessories. (IEEE-100)
TRIPLEX CABLE -	A cable composed of three (3) insulated single conductors or two (2) insulated single conductors and a bare neutral conductor twisted together. (IEEE-100)

U

ULTRA HIGH VOLTAGE SYSTEM -	See Voltage System
UNGROUNDED -	A system, circuit, or apparatus without an intentional connection to ground except through potential indicating or measuring devices or other very high impedance devices. (IEEE-100)
UNIGROUNDED NEUTRAL SYSTEM -	A system of conductors in which one conductor is intentionally grounded solidly at a specific location, typically at the source.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 01.00.004

V

VAULT - A structurally sound enclosure, including all side, top, and bottom, above or below ground where entry is limited to personnel qualified to install, maintain, operate, or inspect the equipment or cable enclosed. The enclosure may have openings for ventilation, personnel access, cable entrance, and other openings required for operation of equipment in the vault. (NESC)

VOLTAGE, - NOMINAL A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (as 120/240, 480Y/277, 600, etc.). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment. See "Electric Power Systems and Equipment – Voltage Ratings (60 Hz)" (ANSI C84.1-82, IEEE-100)

VOLTAGE - SYSTEMS

Low-Voltage System - An electric system having a maximum root-mean-square alternating-current voltage of 1000 volts or less. (IEEE-100)

Medium Voltage System - An electric system having a maximum root-mean-square alternating-current voltage above 1000 volts to 72,500 volts. (IEEE-100)

High Voltage System - An electric system having a maximum root-mean-square alternating current voltage above 72,500 volts to 240,000 volts. (IEEE-100)

Extra-High Voltage System - An electric system having a maximum root-mean-square alternating current voltage above 240,000 volts to 800,000 volts. (IEEE-100)

Ultra-High Voltage System - An electric system having a maximum root-mean-square alternating current voltage above 800,000 volts to 2,000,000 volts. (IEEE-100)

VOLTAGE TO - GROUND For grounded circuits, the voltage between the given conductor and that point or conductor of the circuit that is grounded. For ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit. (IEEE-100)

W

WEIGHT SPAN - Distance to the low point in the Actual Span ahead + distance to the low point in the Actual Span back. The weight span is a calculated term used to determine the vertical loading in crossarms and poles from the weight of ice coated conductors.

WIND SPAN - ½ Actual Span ahead + ½ Actual Span back. The wind span is a calculated term used to determine the transverse loading on the pole from the wind on ice coated conductors.

WOUND - Single Wound – One cable wound on a reel.
Triple Wound – Three cables in parallel wound on a reel.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
2.4	7/20	• Added sub-transmission voltage section • Reformed section numbering • Removed NH references in distribution voltages. • Removed 25 Hertz feeder references.	John Vartanian	JP Knauss Director of Electric Engineering.
2.3	7/18	• Corrected note 2 in 1.3.10 • New Section 1.6 Compliance • Updated Copyright	John Vartanian	Jonathan Gonynor, Director O&M T&D Services
2.2	7/17	• Corrected title in 1.3.20	John Vartanian	Jonathan Gonynor, Director O&M T&D Services
2	7/15	• Added new section 1.0 and 1.1. • Renumbered later sections and pages. • Added document control notices at tops of pages.	G. Paul Anundson	Jonathan Gonynor, Director O&M T&D Services
1/1	7/12	• Added additional abbreviations	John Vartanian	Susan Fleck, VP of Standards, Policies, & Code

Superceded 7/17 Issue- Update 2.3

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/20 Issue – Updated index to reflect changes in document

SECTION	PAGE
• 2.0 GENERAL	2-1
• 2.1 POLE SPECIFICATION AND IDENTIFICATION	2-1
• 2.2 POLE LENGTH	2-2
• 2.3 POLE STRENGTH	2-2 THRU 2-4
• 2.4 POLE SETTING	2-4 THRU 2-5
• 2.5 POLE LOCATION	2-5
• 2.6 POLE ATTACHMENTS	2-5
• 2.7 WOOD POLE SALVAGE	2-5 THRU 2-6
• 2.8 ALTERNATIVE POLES	2-6
• 2.9 POLE LINE HARDWARE	2-6 THRU 2-9
• 2.10 POLE CLASSIFICATION	2-10 THRU 2-17
• CONSTRUCTION DRAWINGS	
o Wood pole specifications and setting depths	2-101
o Average pole weights and center of gravity	2-102
o Installation of pole on solid rock (rock anchors)	2-105
o Pole Top Extensions	2-106
o Method of pole numbering wood poles	2-111
o Phase and feeder identification	2-112 – 2-112A
o Self-supporting fiberglass poles	2-113
o Clean Corridor Pole Set	2-301
o 3 Phase UG Primary Clean Corridor Pole Set	2-301A
o Nesting Platform – Wood Frame	2-501
o Nesting Platform - Fiberglass	2-501B
o Cutout Cover	2-502
o Conductor Cover	2-503
o Conductor Arm	2-504

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

2.0 GENERAL

This Section covers the selection and installation of distribution poles and hardware for use on the overhead distribution systems. To ensure that the structural integrity is economically maintained for the expected life of the equipment, all wood products are treated with an acceptable preservative. Currently, pentachlorophenol (penta) preservative is purchased. The use of such equipment is most critical for maintaining a safe, reliable, and efficient overhead distribution system.

2.1 POLE SPECIFICATION AND IDENTIFICATION

Distribution poles shall be solid wood, fiberglass (fiber-reinforced polymer), or metal and in accordance with applicable standards such as ANSI Standard O5.1, Company MS2005, and MS2010. In general, poles listed on Page 2-101 are used for distribution circuits. However, where taller poles are required or pole loading is such that larger poles are required, poles traditionally stocked for transmission or sub-transmission structures may be used. Distribution pole strengths are designated by “class” 1 through 6. These classes establish pole circumference minimums Transmission Class H1 poles are utilized for critical structures as part of our storm hardening efforts (refer to Section 4 – Storm Hardening).

2.1.10 Pole Numbering

Each pole carrying Company attachments shall be Company identified and individually numbered on the road-side face of the pole, approximately 7 feet above grade, as shown on Drawing 2-111. On privately owned poles, which have Company equipment attached, a single letter “P” shall be installed below the pole number. Main junction and equipment support poles may also be identified by having the line number placed above the pole number.

Each individual pole line (8 or more poles) shall have poles consecutively numbered beginning at its origination from the main line. Short branch lines expected to never contain more than eight poles shall be sub-numbered from the tap pole.

2.1.20 Reflectors

In Massachusetts, pole reflectors (Std Item Z12), mounted vertically facing traffic approximately 4 feet above grade, are required on all poles located on state highways within 6 feet of the traveled way, not protected by a guardrail. Existing poles, where construction is taking place and the above requirements are met, shall have reflectors installed. All other states within the National Grid service territory do not have a reflector requirement, but reflectors may be used where deemed appropriate.

Reflective Color – On ramps, freeways, divided highways, and one-way streets, reflective material shall face oncoming traffic and shall be colored white on the right side of the roadway and yellow on the left side of the roadway. On two-way undivided roadways, reflective material shall be colored white and shall be placed on poles to the right of, and facing, oncoming traffic on each side of the road.

2.1.30 Phase and Feeder Numbering

Phase and feeder identification shall be installed on the first pole outside of the substation and when requested.

Phase identification shall be installed and located per construction drawings (2-112, 2-112A) on all smart technology devices as follows:

a. 3Φ reclosers 3Φ advanced capacitors, 3Φ voltage regulators, and 3Φ feeder monitors.

Prior to any work on multi-phase lines, phase identification shall always be confirmed with proper testing equipment (e.g. phase tester). Absolute phase relationship can be best identified using Company approved long distance phasing tools.

Supersedes 7/19 Issue – Revised 2.1.30 Phase and Feeder Numbering.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

2.1.40 Warning Signs

All non-wood poles supporting lines operating in excess of 2,000 volts shall be marked with warning signs “Dangerous, Keep Away.” See Standard ID’s P23B1, P23B2 and P23B3. This applies to Massachusetts only.

2.2 POLE LENGTH

The pole length and the available Company space on the pole shall be selected so that there is adequate clearance for all Company conductors and equipment that may reasonably be needed in the future. Space should be provided for communication circuits only if the communication company has arranged for joint ownership of the pole. Refer to Section 17 - Joint Use - for more information on pole ownership.

The conductor profile should also be considered in selecting pole length. If poles are set less than 150 feet apart, a difference of more than 5 feet in elevation should be avoided. For longer spans, this difference may be increased proportionately. If it is not possible to stay within these limits, it may be necessary to check the stringing and final tensions and to deadend conductors to avoid uplift or excessively heavy downward loads.

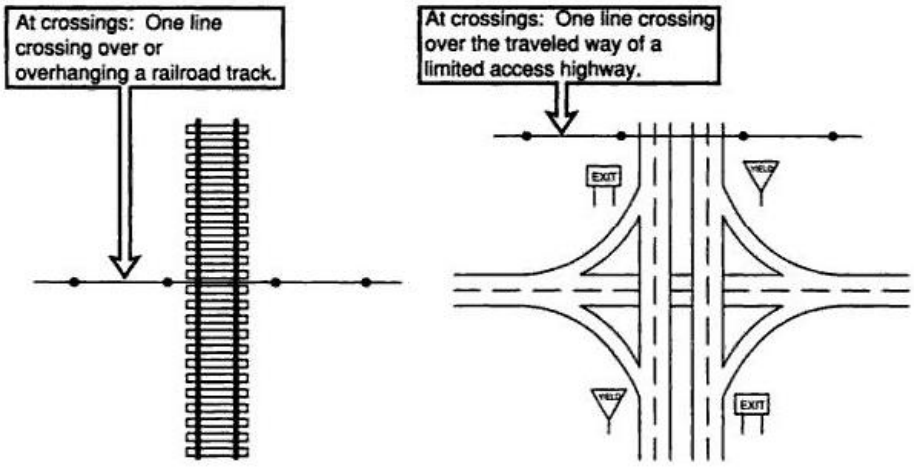
2.3 POLE STRENGTH

2.3.10 National Electric Safety Code Construction Grades and Overload Factors

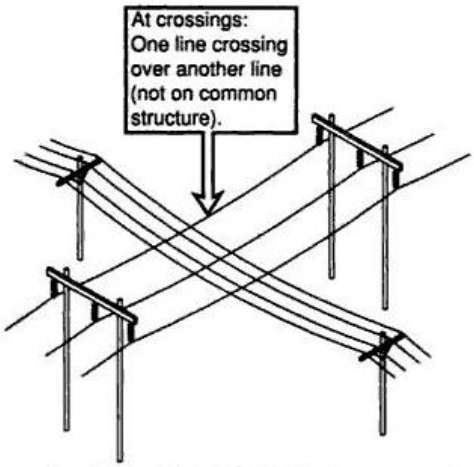
The National Electrical Safety Code (NESC) specifies grades of construction which satisfy required strength for safety. The relative order of grades for supply and communication conductors and supporting structures is B, C, and N, with Grade B being the highest strength. National Grid structures are typically built to Grade C except where Grade B is required per the NESC or other National Grid requirements. Grade N is not used. Increases in strength are accomplished by the use of overload factors and strength factors. For example, when designing a line to support transverse wind loads the calculated value must be multiplied by 2.5 to satisfy Grade B. The same design would be multiplied by 1.75 to satisfy Grade C. See Tables 1 and 2 for applicable overload and strength factors. Additionally, see Section 2.10.10 Examples 1, 2 and 3.

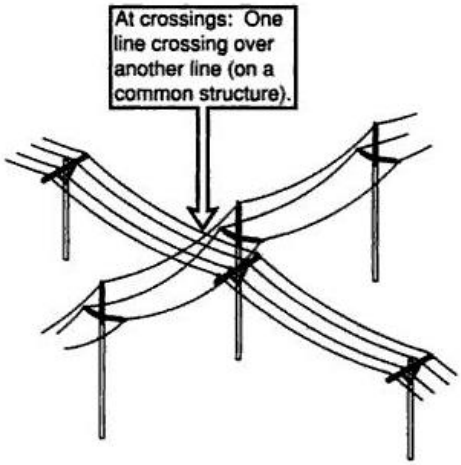
Repaging

Grade B construction is primarily required at crossings. Refer to the following figures for where Grade B is required. For crossings where one line crosses over another, Grade B is required for the top line only. The bottom line need only have the grade of construction that would be required if the line at the higher level were not there.

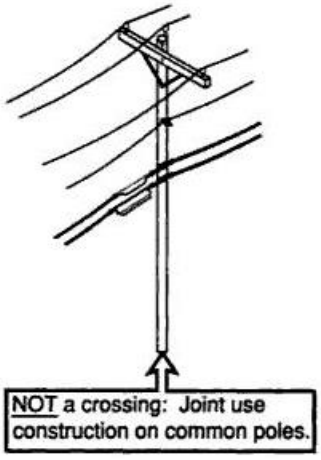


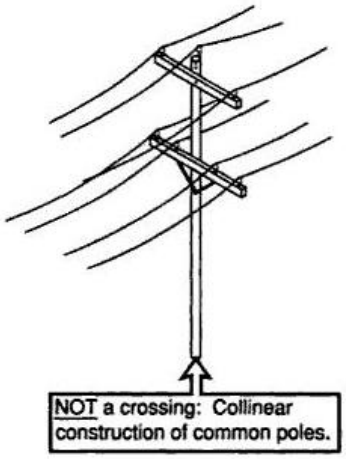
Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.





The following two figures are examples where Grade B construction is **not** required:





Breaking strengths of poles are shown on Page 2-101. The appropriate NESC overload factors and strength factors for structures and supported facilities not exceeding 60 feet above ground or water level are shown in Table 1 and Table 2. In the application of overload factors and strength factors, the objective is to design a structure with resistance greater than the maximum load expected during the lifetime of the structure and to design the structure with an acceptable level of safety and reliability. Final design loading is calculated by multiplying the transverse, vertical, and longitudinal forces by these overload factors and by installing appropriate guying per the requirements in Section 3. Spacing of holes shall be drilled on centers at least 4 inches apart when drilled on the same plane and holes located on opposing planes shall be drilled on centers at least four hole diameters apart. NOTE: On joint owned poles, the joint pole owner should be consulted for minimum spacing requirements relating to attachments located in the "communication space".

Supersedes 7/11 Issue – Text and figures shift on page.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Table 1

Overload Factors			
	Grade B	Grade C	
		At crossings	Elsewhere
Vertical Loads	1.50	1.90**	1.90**
Transverse Loads			
Wind	2.50	2.20	1.75
Wire Tension	1.65	1.30*	1.30*
Longitudinal Loads			
In General	1.10	No requirement	No requirement
At Deadends	1.65	1.30*	1.30*

* For metal or prestressed concrete, portions of structures, crossarms, guys, foundations, and anchors, use a value of 1.10

** For metal, prestressed concrete, or fiber-reinforced polymer portions of structures and crossarms, guys, foundations, and anchors, use a value of 1.50

Table 2

Strength Factors		
	Grade B	Grade C
Wood Structures	0.65	0.85
Metal, Fiber-Reinforced Polymer Structures	1.0	1.0

2.3.20 Transverse Strength

Poles with heavy wire loading on lines should be checked for unbalanced load due to wind. See Section 6.1.10 for transverse wind calculations and Section 3 for guying calculations.

2.3.30 Deadend and Angle Strength

Poles at deadends and angles shall be guyed as specified in Section 3. If guys are not practical, the bearing of the soil rather than the pole strength is usually the critical value. In general, unbalanced loads at 60˚F shall not exceed 300 pounds. Slack spans should be used to limit unbalanced loading. Other options such as alternate poles (laminated wood, steel, etc) or concrete embedment can be considered. Contact Distribution Standards Engineering for assistance with pole selection or other options.

2.3.40 Vertical Strength

When transformers or other such equipment approaches their maximum size and there are other loads from down guys, change of grade, etc., heavier poles may be required. Heavy anchor guys should be avoided on these particular poles. Head guys or slack spans are recommended to keep the size of the anchor guy at a minimum.

Poles with heavy vertical loads may require additional support to prevent the pole from tipping or sinking into the ground. A footing and appropriate backfill such as #2 crushed stone is recommended where there is good reason to doubt the bearing of the soil. Particular weights can be determined through various standard or material specification sections or by checking nameplate information.

2.4 POLE SETTING

Any permits or rights-of-way required from authorities or property owners regarding pole location, digging, tree trimming, and/or conductor installation shall be obtained before proceeding with the work. The communication companies shall be notified and provision made for joint occupancy, if desired, before pole installation plans are issued.

Supersedes 7/11 Issue – Added reference to Section 6.1.10 transverse wind load.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

For depth of setting into earth, rock, or wet soil, see Page 2-101. The general setting depth of a pole into earth is 10% of its total length plus two feet. The depth of holes on slopes shall be measured from the low or downhill side of the pole. For solid rock, granite, or basalt, blasting or rock drilling may not be practical, and poles may be installed in rock anchored mounts as shown on Drawing 2-105. Consult with Standards Engineering for poles that will be located in very wet or standing water areas, as they may require the use of multiple pole guys or foundation supports.

Every effort should be made to set poles so that the resulting line will be as straight, orderly, and inconspicuous as possible. The poles shall be vertical and in line with each other when the conductors have been installed. This requires care and judgment when raking poles against the pull and towards the uphill side on slopes, tamping backfill, and in using appropriate backfill such as #2 crushed stone when necessary. Increased setting depth should be considered where soil conditions may be unreliable. Poles that tip after installation should be straightened and thoroughly retamped, and/or appropriate backfill such as #2 crushed stone shall be used if necessary. The diameter of the hole shall be large enough to permit free entrance of the butt, and to permit tamping throughout the entire depth. Sides of the hole shall be straight.

Pole gains shall normally be faced away from deadends, long spans, or other construction. They shall be faced away from crossings (where one line crosses over or under another line). This arrangement is recommended even when construction does not require crossarms. Pole gains should alternate direction faced along the line. This improves the crossarm resistance to unbalanced longitudinal loads such as in the event of partial line failures.

Supersedes 7/14 Issue – Added Contaminated Site Section.

2.4.10 Contaminated Sites

For sites with environmental conditions associated with the presence of subsurface oil or hazardous material contamination, establishment of a “Clean Corridor” for Company electric facilities would limit potential, present and future hazardous exposures to our field workers. Drawing 2-301 and Drawing 2-301A provide details concerning “Clean Corridor” installations. “Clean Corridors” may be established by National Grid or by third parties (e.g., site developers). Coordinate with Environmental during project planning, as specified in procedures EG-301 – Project Planning and Permitting and EG-1709 – Projects on Sites with Environmental Encumbrances.

2.5 POLE LOCATION

Poles should be located where they can best serve both present and future customer requirements, where appearance is not objectionable to the community, where they are not likely to have to be moved in the near future, and where they are least likely to be struck by motor vehicles. Adequate conductor clearances, per Section 7, must be maintained. Poles shall not be set closer than 6 inches from the street side of a curb.

When staking out new lines or when rebuilding on streets with existing poles, the overall appearance of the line after completion should be considered. Existing poles should be used when practical, but installing more poles than necessary must be avoided. Frequent road crossings should also be avoided.

Poles and accompanying guys set in alleys, parking lots, and similar areas should be located to minimize vehicle damage. If necessary, arrange for guard rail installation, concrete bumpers, or other protection to minimize vehicle damage to poles and guys in these areas. Special attention shall be given to guard poles holding overhead primary equipment.

Pole line layout must include planning for future buildings or structures along the property lines or, if local ordinances specify, along the established building line. If it is likely that a new structure will be erected in the foreseeable future, the right-of-way should be adequate enough to provide required clearances for such structure.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

2.6 POLE ATTACHMENTS

No Company attachments to poles owned by others (foreign poles) shall be made until proper approval has been obtained from the pole's owner(s). Likewise, no attachments, temporary or permanent, to Company owned poles by any entity, including persons, companies, or government entities, other than those specifically approved in a written agreement with the entity, shall be made to Company poles without prior approval.

In addition, permanent pole steps shall not be utilized on wood distribution poles.

2.7 WOOD POLE SALVAGE

When a wood distribution pole that has been in service for less than ten years needs to be removed, one should consider reusing the pole if the following conditions are met.

1. The pole shall be at least a 35 foot, class 5 pole.
2. The pole shall be in sound condition. It shall be free from surface defects that would interfere with climbing. It shall also be free of surface rot, butt decay, ragged or decayed roof, and with no sign of longitudinal cracks or crossbreaks.
3. The pole shall also be of standard framing.

2.8 ALTERNATIVE POLES

Alternative poles including fiberglass and metal per appropriate material specifications can be purchased and installed resulting in a cost effective installation.

2.8.10. Fiberglass Poles

Lightweight easy to handle fiberglass poles can be selected for difficult locations including rights-of-ways, wetlands, and backyards. Unique environmental conditions including woodpecker attack may also warrant a fiberglass pole installation.

2.8.20. Metal Poles

Metal poles can be selected for installation locations when increase pole strength requirements are necessary due to heavy equipment loading, environmental loading, or where guying cannot be accomplished. Since these poles are designed specific, all specifications and moments shall be calculated and provided to supplier for appropriate fabrication. Metal pole installations will require additional insulation equipment such as fiberglass crossarms and brackets, insulators, and additional surge arresters to maintain appropriate lightning insulation values. In addition, metal poles shall not be installed in heavily corrosive environments which results in oxidation.

2.8.30. Attachments

Most standard, non-cleated line hardware can be used on alternative poles with conventional fasteners and installation practices. Structural attachments must be made with through bolts and square washers which enhances the load-bearing capacity interface. Fiberglass crossarms and fiberglass armless brackets shall be used. Fiberglass crossarms include centermounts for attaching and down grounds shall be installed using nylon clips with self tapping screws. Equipment and line attachment bolts may, when practical utilize the standard evenly spaced step bolt holes. Except for un-guyed installations, the same wood pole burial depth and backfill requirements exist.

2.8.40. Unguyed Poles

For installations where guying is not an option due to structures near the pole or other objects restricting guy wire placement, an unguyed fiberglass pole can be installed. Three pole sizes are available; 45/H4 (STD ID P77DH4), 50'/H5 (STD ID P77DH5) and a 55'/H6 (STD ID P77DH6).

Supersedes 7/20 – Updated 2.6.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

2.9 POLE LINE HARDWARE

Pole line hardware will be of a type specifically developed for utility pole line installation in accordance with industry specifications.

2.9.10 Crossarms

Overhead distribution crossarms shall be solid wood or fiberglass and in accordance with applicable standards such as Company MS2121 and MS2142. Both wood and fiberglass crossarms can be installed on any type of pole (wood, fiberglass, steel, etc.), however, fiberglass arms are not designed to be used for alley-arm construction.

For installations above 2000 lbs. tension, Engineering shall make sure that the conductor tension under NESC heavy loading conditions obtained from Section 6 is less than the permissible deadend loading per conductor of the crossarm assembly. However, if the conductor tension is limited to 2000 lbs, the NESC allows the use of double wood crossarm or equivalent strength fiberglass assemblies for Grade B and C. In addition, the deadend span should be less than the maximum span length allowed due to vertical crossarm strength limitations. However, this is seldom a limiting factor in distribution design.

For Grade B construction, the NESC requires the use of double wood or equivalent strength fiberglass crossarms at each crossing structure, at deadends, and at corners where line angles exceed 20 degrees. Under similar conditions, where brackets are used to support conductors and there is no crossarm below, double brackets or a support assembly equivalent in strength to double wood crossarms shall be used (NESC 261D5c). Wires, conductors, or other cables of one line are considered to be at crossings when they cross over another line, whether or not on a common supporting structure, or when they cross over or overhang on a railroad track or the traveled way of a limited access highway or navigable waterways requiring waterway crossing permits. Joint-use or collinear construction in itself is not considered to be at crossings (refer to Section 2.3.10 above for more information).

2.9.20 Vertical Strength of Wood Crossarms

The NESC requires that the sum of each vertical load attached to a crossarm assembly, multiplied by the load's appropriate NESC vertical overload factor (Table 1), and the load's distance to the center of the crossarm assembly not exceed the permitted vertical moment capacity of the crossarm.

Vertical loads on the crossarm assembly per NESC include;
1. The weight of the conductors.
2. The weight of a 250 lb line worker.
3. The self-weight of the crossarm.
4. The weight of other hardware including cutouts.

Depending on this information, the maximum span length allowed for various conductors can be obtained by using the following formula:

$\sum$Applied vertical load moments ≤ Permitted vertical moment capacity

$$((D_1 + D_2) \times S \times W \times F_V) + M_E \leq N \times M_V \times F_S$$

S = Weight span length (ft.)
D_1, D_2 = distance of conductor from center of the crossarm (ft., see Figure 1)
N = number of crossarms
W = unit weight of conductor (lbs/ft.)
M_E = moment due to weight of equip. attached to crossarm (ft.-lbs.)

Supersedes 1/06 Issue - Text shift.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

M_v = vertical moment capacity of the crossarm with predrilled holes
$M_v = F_b \times X_v$ (ft.-lbs.)
X_v = vertical section modulus of the crossarm (in.^{3})
$X_v = (bd^3 - ba^3 - ad^3)/6d$
b = width(in., top of arm), d = depth(in., face of arm)
a = diameter (in.) of crossarm mounting holes
F_b = the designated modulus of rupture for crossarms
(ANSI 05.1 → F_b = 8,000 lbs/in^2)
F_S = NESC strength factor
F_V = NESC vertical overload factor

2.9.30 Longitudinal Strength of Wood Crossarms

It may be assumed that longitudinal loads do not contribute to the vertical loading on crossarm assemblies. However applied vertical loads do have to be considered when determining the permitted longitudinal load of a crossarm assembly. Depending on this information, the following relationship needs to be satisfied to avoid overloading the wood fibers of crossarms:

$$\frac{\sum \text{Applied Vertical Load Moments}}{\text{Permitted Vertical Moment Capacity}} + \frac{\sum \text{Applied Longitudinal Load Moments}}{\text{Permitted Longitudinal Moment Capacity}} \leq 1$$

Applied vertical load moments and permitted vertical moment capacity were defined in 2.9.20 above. Applied longitudinal load moments and permitted longitudinal moment capacity for deadend crossarm assemblies are as follows:

$\sum$Applied longitudinal load moments = $(D_1 + D_2) \times L \times F_{OL}$
Permitted longitudinal moment capacity = $N \times M_h \times F_S$
L = permissible deadend loading per conductor (lbs.)
D_1, D_2 = distance of conductor from center of the crossarm (ft., see Figure 1)
N = number of crossarms
M_h = longitudinal moment capacity of the crossarm with predrilled holes
$M_h = F_b \times X_h$ (ft.-lbs.)
X_h = longitudinal section modulus of the crossarm (in.^{3})
$X_h = (db^3 - ab^3 - da^3)/6b$
b = width(in., top of arm), d = depth(in., face of arm)
a = diameter (in.) of crossarm mounting holes
F_b = the designated modulus of rupture for crossarms
(ANSI 05.1 → F_b = 8,000 lbs/in^2)
F_S = NESC strength factor
F_{OL} = NESC longitudinal overload factor

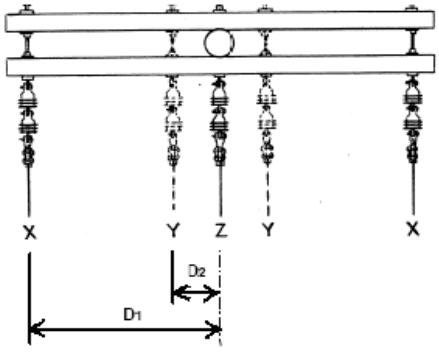


Figure 1

Supersedes 7/14 Issue - Text shift.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/08 Issue - Text shift; ,minor editorial changes.

2.9.40 Crossarm Braces

The NESC requires all crossarms to be securely supported by bracing, if necessary, to support all loads including the weight of line workers. Wood crossarm braces shall be used for all standard construction installations increasing the pole top distribution insulation level.

2.9.50 Insulators

The operating performance of overhead distribution lines is dependent upon the quality of the line insulators. Line insulators can be porcelain or polymer. Polymer (HDPE) pin type insulators for distribution are available and shall be used with all new and existing covered conductors including tree wire, spacer cable, and older polyethylene covered conductor. HDPE insulators and conductor coverings are dielectrically compatible with neither one being electrically over-stressed. During insulator replacement, always examine existing conductor covering for erosion, cracks, or puncture holes. If significant damage exists, install a porcelain radio free insulator and skin the covering back at least 30 inches on each side.

A #4 solid, soft drawn, thermoplastic rubber (TPR) covered aluminum tie wire is available and is the only tie wire that shall be used with all HDPE insulators with unskinned, covered aluminum or unskinned, covered copper conductors. The TPR covering provides similar dielectric characteristics and a slip-proof grip on covered conductors.

HDPE insulators can be used on bare conductors in areas where vandalism occurs provided environmental contamination doesn't exist and conductor operating temperatures are below 100°C.

2.9.60 Pole Top Extension

Pole top extensions shall be installed only on sound wood poles. The wood pole top should be squared off to accept the adapter base bracket and to facilitate installation; the base component may be installed onto the pole first, before the wood or fiberglass extending member is attached.

Do not use pole top extensions (wood or fiberglass) at deadends or Grade B locations (e.g. crossings). Transverse loading shall be limited to 1600 lbs (applied 12 inches below top of extension) in compliance with NESC overload factors in Table 1.

2.9.70 Raptor Protection

One or more state and federal laws legally protect many species of birds in the Company's service territory. So that the Company complies with laws and regulations protecting these birds, it is necessary to follow appropriate procedures regarding raptor protection. A 60" separation between energized and/or grounded facilities is generally recognized. Since this is rarely encountered on distribution lines, covers can be installed to prevent simultaneous contact between energized and/or grounded facilities.

Any distribution pole with an active nest or confirmed nesting attempts should be reported to Environmental. The distribution pole may need to be modified per appropriate raptor construction drawings as determined appropriate in consultation with Environmental.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

2.10 POLE CLASSIFICATION

Selecting the proper class pole is an important decision in distribution design. The pole class is mainly dependent upon the loading that the pole must withstand under NESC heavy loading conditions. Conductor loading, equipment loading, and downward forces caused by guying, must all be considered in order to select the proper class of pole.

This section will include methods of determining the class of an unguyed pole considering conductor loading and equipment loading only. See Section 3 for determining the class of a guyed pole.

2.10.10 Example 1

Given:

Determine the class of pole required to support the following wires and equipment on a 40 foot, unguyed wood pole with a 150 foot wind span for Grade C construction (non-crossing) under heavy loading conditions (4 lbs/sf wind, ½" radial ice). Assume a 3 degree line angle.

3-477kcmil Al AAC bare conductors - 33.5' attachment height
(Outside phases are the same horizontal distances from the pole, therefore no bending moment is created)
3/C-1/0 triplex secondary - 27.3' attachment height
0.750-1/4" messenger (CATV) - 24.0' attachment height
134-216 fiber optic and 1/4" messenger telephone cable - 23.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 22.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 21.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 20.0' attachment height
1-50 kVA single-phase transformer - 29.5' attachment height
- 16" from the center of transformer to the center of pole

Step	Action	Use
1	Check the pole strength due to the transformer vertical load: The weight of the transformer is 750 lbs. Check the allowable weight that can be mounted from 4.5 feet (54 inches) from the top of the pole by using Table 3. Try Class 5 first.	Transformer weight = 750 lbs Allowable weight = **2085 lbs** Class 5 is adequate for vertical load. (This case will most likely not govern since vertical load typically do not govern for unguyed poles.)
2	Calculate the groundline moment due to the conductor wind load.	Moment = $F_w \times S_w \times W_w \times H$ F_w = NESC overload factor for wind load (See Section 2, Table 1.) S_w = wind span length (ft) W_w = transverse conductor loading (lbs/ft) Ww = (Cond Dia, in + 1 in ice) x 1ft/12 in x 4 psf (Section 6.1.10 "Transverse") H = conductor attachment height (ft) 3-primaries:3 x 1.75 x 150 x 0.5977 x 33.5 = 15,767 1-secondary: 1.75 x 150 x 0.6767 x 27.3 = 4,849 1-CATV: 1.75 x 150 x 0.6897 x 24.0 = 4,345 1-Fiber optic cable: 1.75 x 150 x 0.7297 x 23.0 = 4,405 1-400 pair tel. cable: 1.75 x 150 x 1.1150 x 22.0 = 6439 1-400 pair tel. cable: 1.75 x 150 x 1.1150 x 21.0 =6146 1-400 pair tel. cable: 1.75 x 150 x 1.1150 x 21.0 = 5,854 ft-lbs Total groundline moment = **47,806 ft-lbs**

Supersedes 7/11 Issue -Revised Example 1.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/15 Issue – Corrected calculation error in Step 6.

3	Calculate ground line moment due to transverse line tension from 3° line angle.	Moment = $F_w \times W_t \times$ H x sine 3° ÷ 2 F_w = NESC overload factor for wind load W_t = NESC Heavy wire tension (lbs) H = equipment attachment height (ft) 3-primaries: 3 x 1.3 x 2,000 x 0.0262 x 33.5 = 6,838 ft-lbs 1-secondary: 1.3 x 2,000 x 0.0262 x 27.3 = 1,857 ft-lbs 1-CATV: 1.3 x 2,000 x 0.6897 x 24.0 = 1,633 ft-lbs 1-Fiber optic cable: 1.3 x 2,000 x 0.0262 x 23.0 = 1,565 ft-lbs 1-400 pair tel. cable: 1.3 x 2,000 x 0.0262 x 22.0 = 1,497ft-lbs 1-400 pair tel. cable: 1.3x 2,000 x 0.0262 x 21.0 = 1,429ft-lbs 1-400 pair tel. cable: 1.3x 2,000 x 0.0262 x 20.0 = 1,361ft-lbs Total groundline moment **= 16,179 ft-lbs**
4	Calculate the groundline moment due to the equipment wind load.	Moment = $F_w \times W_e \times$ H F_w = NESC overload factor for wind load (Table 1.) W_e = transverse equipment loading (lbs) (Table 6) H = equipment attachment height (ft) 1-50 kVA single-phase xfmr - 1.75 x 44 x 29.5 = 2272 Total groundline moment = **2,272 ft-lbs**
5	Calculate the bending moment due to the equipment offset.	Moment = $F_v \times$ weight of equipment $\times$ (d/12) F_v = NESC overload factor for vertical loads d = distance from the center of equipment to the center of pole (inches) 1-50 kVA single-phase xfmr - 1.90 x 750 x 16/12 = 1,900 Total bending moment = **1,900 ft-lbs**
6	Calculate the pole's groundline moment due to the wind load.	Use Table 4. (See foot note in table) Try Class 3 first. Total groundline moment = **2,934 ft-lbs**
7	Calculate total applied moment at groundline. (Sum of steps 2 through 6)	47,806 + 16,179 + 2,272 + 1,900 + 3,697 = **71,091 ft-lbs**
8	Find the permitted moment of pole at groundline by using Table 5.	40 foot Class 3 pole = 81,600 ft-lbs (Table 5) Permitted moment > Calculated moment **81,600ft-lbs>71,091 ft-lbs** Since the permitted moment capacity of the wood pole at groundline is larger than the applied moments, 40 foot Class 3 is adequate

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Example 2 (This is the same example as above expect that Grade B construction applies.

Given:

Determine the class of pole required to support the following wires and equipment on a 40 foot, unguyed wood pole with a 150 foot wind span for Grade B construction (non-crossing) under heavy loading conditions (4 lbs/sf wind, ½" radial ice). Assume a 3 degree line angle.

3-477 kcmil Al AAC bare conductors - 33.5' attachment height
(Outside phases are the same horizontal distances from the pole, therefore no bending moment is created)
3/C-1/0 triplex secondary - 27.3' attachment height
0.750-1/4" messenger (CATV) - 24.0' attachment height
134-216 fiber optic and 1/4" messenger telephone cable - 23.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 22.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 21.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 20.0' attachment height
1-50 kVA single-phase transformer - 29.5' attachment height
- 16" from the center of transformer to the center of pole

Step	Action	Use
1	Check the pole strength due to the transformer vertical load: The weight of the transformer is 750 lbs. Check the allowable weight that can be mounted from 4.5 feet (54 inches) from the top of the pole by using Table 3. Try Class 5 first.	Transformer weight = 750 lbs Allowable weight = **2085 lbs** Class 5 is adequate for vertical load. (This case will most likely not govern since vertical load typically do not govern for unguyed poles.)
2	Calculate the groundline moment due to the conductor wind load.	Moment = $F_w \times S_w \times W_w \times H$ F_w = NESC overload factor for wind load (See Section 2, Table 1.) S_w = wind span length (ft) W_w = transverse conductor loading (lbs/ft) Ww = (Cond Dia, in + 1 in ice) x 1ft/12 in x 4 psf (Section 6.1.10 "Transverse") H = conductor attachment height (ft) 3-primaries:3 x 2.50 x 150 x 0.5977 x 33.5 = 22,525 ft-lbs 1-secondary: 2.50 x 150 x 0.6767 x 27.3 = 6,927 ft-lbs 1-CATV: 2.5 x 150 x 0.6897 x 24.0 = 6,207 ft-lbs 1-Fiber optic cable: 2.50 x 150 x 0.7297 x 23.0 = 6,293 ft-lbs 1-400 pair tel. cable: 2.50 x 150 x 1.1150 x 22.0 = 9,199 ft-lbs 1-400 pair tel. cable: 2.50 x 150 x 1.1150 x 21.0 = 8,781 ft-lbs 1-400 pair tel. cable: 2.50 x 150 x 1.1150 x 20.0 = 8,363 ft-lbs Total groundline moment = **68,294 ft-lbs**
3	Calculate ground line moment due to transverse line tension from 3° line angle.	Moment = $F_w \times W_t \times$ H x sine 3° ÷ 2 F_w = NESC overload factor for wind load W_t = NESC Heavy wire tension (lbs) H = equipment attachment height (ft) 3-primaries: 3 x 1.65 x 2,000 x 0.0262 x 33.5 = 8,679 ft-lbs 1-secondary: 1.65 x 2,000 x 0.0262 x 27.3 = 2,357 ft-lbs 1-CATV: 1.65 x 2,000 x 0.6897 x 24.0 = 2,073 ft-lbs 1-Fiber optic cable: 1.65 x 2,000 x 0.0262 x 23.0 = 1,986 ft-lbs
4	Calculate the groundline moment due to the equipment wind load.	Moment = $F_w \times W_e \times$ H F_w = NESC overload factor for wind load (Table 1.) W_e = transverse equipment loading (lbs) (Table 6)

Supersedes 7/11 Issue - New Example 2

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

		H = equipment attachment height (ft) 1-50 kVA single-phase xfmr – 2.5 x 44 x 29.5 = 3,245 ft-lbs Total groundline moment = **3,245 ft-lbs**
5	Calculate the bending moment due to the equipment offset.	Moment = $F_w \times W_e \times H$ F_w = NESC overload factor for wind load (Table 1.) W_e = transverse equipment loading (lbs) (Table 6) H = equipment attachment height (ft) 1-50 kVA single-phase xfmr – 2.5 x 44 x 29.5 = 3,245 ft-lbs Total groundline moment = **3,245 ft-lbs**
6	Calculate the pole's groundline moment due to the wind load.	Moment = $F_v \times$ weight of equipment $\times$ (d/12) F_v = NESC overload factor for vertical loads d = distance from the center of equipment to the center of pole (inches) 1-50 kVA single-phase xfmr - 1.5 x 750 x 16/12 = 1,500 Total bending moment = **1,500 ft-lbs**
7	Calculate total applied moment at groundline. (Sum of steps 2 through 6)	68,294 + 20,535 + 3,245 + 1,500 + 5,245 = 98,819 ft-lbs
8	Find the permitted moment of pole at groundline by using Table 5.	40 foot Class H1 pole = 172,800 x 0.765 ft-lbs (Table 5 – *see foot note*) = **98,819 ft-lbs** Permitted moment > Calculated moment **132,192 ft-lbs> 98,819 ft-lbs** **Since the permitted moment capacity of the wood pole at groundline is larger than the applied moments, 40 foot Class H1 is adequate**

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Example 3.

Given:

Determine the class of pole required to support the following wires and equipment on a 45 foot, unguyed wood pole with a 150 foot wind span for Grade B construction (non-crossing) under heavy loading conditions (4 lbs/sf wind, ½" radial ice). Assume a 3 degree line angle.

Double circuit Spacer Cable 6-477 kcmil Al AAC bare conductors - 38.5' attachment height
(Outside phases are the same horizontal distances from the pole, therefore no bending moment is created)
3/C-1/0 triplex secondary - 32.3' attachment height
0.750-1/4" messenger (CATV) - 28.0' attachment height
134-216 fiber optic and 1/4" messenger telephone cable - 27.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 26.0' attachment height

Step	Action	Use
1	Calculate the groundline moment due to the conductor wind load.	Moment = $F_w \times S_w \times W_w \times H$ F_w = NESC overload factor for wind load (See Section 2, Table 1.) S_w = wind span length (ft) W_w = transverse conductor loading (lbs/ft) Ww = (Cond Dia, in + 1 in ice) x 1ft/12 in x 4 psf (Section 6.1.10 "Transverse") H = conductor attachment height (ft) 2-Messenger wires: 2 x 2.5 x 150 x 0.04957 x 38.5 = 14,312 6-primaries: 6 x 2.50 x 150 x 0.6807 x 38.5 = 58,963 1-secondary: 2.50 x 150 x 0.6767 x 32.3 = 8,196 1-CATV: 2.5 x 150 x 0.6897 x 28.0 = 7,242 1-Fiber optic cable: 2.50 x 150 x 0.7297 x 27.0 = 7,388 1-400 pair tel. cable: 2.50x 150 x 1.1150 x 26.0 = 10,871 ft-lbs Total groundline moment = 106,972 ft-lbs
2	Calculate ground line moment due to transverse line tension from 3° line angle.	Moment = $F_w \times W_t \times$ H x sine 3° ÷ 2 F_w = NESC overload factor for wind load W_t = NESC Heavy wire tension (lbs) H = conductor attachment height (ft) 2-Messenger wires 3 x 1.65 x 2,000 x 0.0262 x 38.5 = 6,649 6-primaries6 x 1.65 x 2,000 x 0.0262 x 38.5 = 8,679 1-secondary: 1.65 x 2,000 x 0.0262 x 32.3 = 2,789 1-CATV: 1.65 x 2,000 x 0.6897 x 28.0 = 2,418 1-Fiber optic cable: 1.65 x 2,000 x 0.0262 x 27.0 = 2,332 1-400 pair tel. cable: 1.75 x 150 x 1.1150 x 26.0 = 2,245 ft-lbs Total groundline moment = 36,381 ft-lbs
3	Calculate the pole's groundline moment due to wind load.	Use Table 4. (See foot note in table) Try Class H1 Total groundline moment = 4,820x 1.43 = 6,893 ft-lbs
4	Total applied moment at groundline (sum of steps 1-3)	106,972 + 36,381 + 6,893 = 150,246 ft-lbs
5	Find the permitted moment of pole at groundline by using Table 5.	45 foot Class H1 pole = 197,100 x 0.765 ft-lbs (Table 5 – *see foot note*) = 150,782 ft-lbs 150,782 > 150,246 Use 45 Foot Class H1 Pole

Supersedes 7/11 Issue - New Example 3.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/14 Issue – Corrected equipment weight typo for 45/H1 Cluster Mount 60" .

Table 3

MAXIMUM ALLOWABLE WEIGHT OF EQUIPMENT

POLE SIZE/CLASS	DISTANCE FROM TOP OF POLE TO THE TOP MOUNTING BOLT OF THE EQUIPMENT									
	SINGLE MOUNT WOOD POLES					CLUSTER MOUNT WOOD POLES				
	24"	36"	54"	60"	84"	24"	36"	54"	60"	84"
35/H1	5822	6351	7271	7705	9246	7889	8600	9837	10413	12488
35/1	5220	5580	6165	6365	7300	6960	7440	8220	8490	9730
35/2	4250	4530	5020	5190	5975	5665	6040	6695	6920	7970
35/3	3405	3640	4025	4170	4800	4540	4850	5370	5560	6395
35/4	2675	2870	3190	3305	3805	3570	3830	4255	4410	5070
40/H1	4860	5246	5898	6141	7252	6541	7056	7926	8250	9731
40/1	4445	4705	5150	5320	6020	5925	6270	6870	7100	8030
40/2	3620	3840	4215	4345	4930	4825	5120	5620	5795	6575
40/3	2900	3085	3400	3510	3980	3870	4115	4535	4680	5310
40/4	2300	2435	2680	2770	3160	3065	3245	3575	3695	4215
45/H1	4250	4440	4933	5108	5915	5550	5934	6587	6819	7887
45/1	3920	4135	4500	4620	5180	5225	5510	6000	6165	6905
45/2	3190	3390	3685	3790	4260	4255	4520	4915	5055	5685
45/3	2560	2710	2960	3030	3410	3416	3615	3945	4040	4545
45/4	2015	2140	2335	2405	2720	2690	2855	3110	3210	3630
50/H1	3605	3834	4217	4352	4965	4791	5092	5597	5775	6581
50/1	3505	3685	3995	4100	4560	4675	4915	5325	5465	6080
50/2	2840	3010	3255	3345	3720	3790	4015	4345	4460	4960
50/3	2280	2410	2615	2690	2990	3040	3210	3485	3585	3985
50/4	1805	1900	2075	2125	2385	2410	2535	2765	2830	3180
55/H1	3175	3359	3667	3774	4252	4195	4436	4838	4978	5603
55/1	2978	3154	3442	3544	4000	3945	4176	4553	4687	5285
55/2	2785	2949	3220	3317	3774	3698	3915	4271	4398	4960
55/3	2885	2738	2991	3083	3484	3441	3644	3978	4099	4628
	SINGLE MOUNT FIBERGLASS POLES					CLUSTER MOUNT FIBERGLASS POLES				
35/4	2740	2760	2800	2810	2895	3653	3680	3733	3747	3860
40/3	2380	2390	2415	2420	2475	3173	3187	3220	3227	3300
45/2	2580	2585	2605	2615	2660	3440	3447	3473	3487	3547

1. This table can be used for both Grade B and Grade C construction.
2. Based on 2' lug spacing (for 3' lug spacing see note 4).
3. Assumed that the bottom attachment point is the critical location for eccentric loading (2% deflection).
4. For 167kVA (219A) regulator cluster mounts add 5% to the values shown above (or multiply by 1.05) due to 3' lug spacing.
5. Fiberglass pole information is from Roark, deflection for cantilever with applied moment

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Table 4

Distribution Pole Groundline Moments Due To Wind Load (ft-lbs)
(Set in Earth)

	Class H1	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
35 foot	2693	2505	2330	2155	1979	1804	1643
40 foot	3668	3399	3166	2934	2701	2468	2236
45 foot	4820	4449	4151	3830	3532	3234	2936
50 foot	6156	5665	5264	4864	4492	4120	-----
55 foot	7691	7017	6529	6040	5586	-----	-----
60 foot	9372	8535	7950	7364	6778	-----	-----
65 foot	11186	10225	9533	8842	-----	-----	-----
70 foot	13195	12091	11285	10479	-----	-----	-----

Multiply these values by 1.26 for Grade C at-crossings and 1.43 for Grade B.

Table 5

Distribution Pole Permitted Groundline Moments (ft-lbs)
(Set in Earth)

	Class H1	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
35 foot	145800	105188	86488	70125	56100	44413	35063
40 foot	172800	122400	100640	81600	65280	51680	40800
45 foot	197100	139613	114793	93075	74460	58948	46538
50 foot	221400	156825	128945	104550	83640	66215	-----
55 foot	245700	174038	143098	116025	92820	-----	-----
60 foot	270000	191250	157250	127500	102000	-----	-----
65 foot	294300	208463	171403	138975	-----	-----	-----
70 foot	318600	225675	185555	150450	-----	-----	-----

Multiply these values by 0.765 for Grade B for wood structures
Multiply these values by 1.0 for fiberglass poles

Supersedes 7/11 Issue - Added H1 Class poles to Tables 4, 5.

Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Table 6

Transverse Equipment Loading For 4 lbs/sq. ft Wind Load

EQUIPMENT	Effective Area (sq. ft)	Load Reduction Factor	Reduced Eff. Area (sq. ft)	Transverse Equipment Load (lbs)
Capacitor Bank 450kVAR Sw.	3	90%	3	12
Capacitor Bank 1200kVAR Sw.	7	85%	6	24
Floodlight (All)	3	90%	3	12
Gang Operated Switch	18	90%	16	65
Primary Metering	7	85%	6	24
Recloser three-phase	4	90%	4	16
Regulator - 76kVA(100A) single-phase	12	85%	10	40
Regulator - 167kVA(219A) single-phase	15	85%	13	52
Regulator - 3-76kVA(100A) three-phase	24	85%	20	80
Regulator - 3-167kVA(219A) three-phase	30	85%	26	104
Streetlight (All)	4	85%	3	13
Trans. single phase up to 75kVA	12	90%	11	44
Trans. single phase 100kVA and up	17	90%	15	60
Transformer 3-100kVA and up	34	90%	31	124

Table 7

Common Telephone & CATV Cables Transverse Load Factor (Wind)

Description		Conductor Diameter (in.)	Transverse Load (lbs./ft.)
#22 AWG and 3/8" Messenger	200 Pair	1.815	0.938
	300 Pair	2.115	1.038
	400 Pair	2.345	1.115
#24 AWG and 3/8" Messenger	600 Pair	2.295	1.098
	900 Pair	2.685	1.228
Fiber Optic and ¼" Messenger (non-armored)	3-36	0.640	0.547
	38-72	0.739	0.580
	74-84	0.781	0.594
	86-96	0.820	0.607
	98-108	0.850	0.617
	110-120	0.889	0.630
	122-132	0.931	0.644
	134-216	0.979	0.660
	218-264	1.045	0.682
Fiber Optic and 3/8" Messenger (non-armored)	144	1.159	0.720
Fiber Optic Self Supporting Figure "8" Cable (non-armored)	2-72 & 2-36	0.949	0.650
	74-84	0.991	0.664
	86-96	1.030	0.677
	98-108	1.060	0.687
	110-120	1.099	0.700
	122-132	1.141	0.714
	134-144	1.189	0.730
¼" Messenger (CATV)	0.750	1.069	0.690
	0.635	0.883	0.628
	0.500	0.751	0.584
	0.412	0.652	0.551

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = PW(A)(B)	Distribution Wood Pole, (A)=Pole Length, (B)=Pole Class

ANSI 05.1 POLE CLASS (see Note 2)	**CLASS H1**	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**
Minimum Top Circumference	29 in.	27 in.	25 in.	23 in.	21 in.	19 in.	17 in.
Minimum Top Diameter	9.2 in.	8.6 in.	8 in.	7.3 in.	6.7 in.	6 in.	5.4 in.
Breaking load in lbs. @ 2 feet from top for unguyed poles set in earth at standard setting depth.	5400 #	4500 #	3700 #	3000 #	2400 #	1900 #	1500 #

Southern Yellow Pine and Douglas Fir Poles (Ultimate Fiber/Bending Stress = 8000 psi)

Pole Length	Setting Depth (Feet)		Minimum Circumference in inches as measured 6 feet from the pole butt							
(Feet)	In Earth	In Rock	Wet Soil	H1	CL1	CL2	CL3	CL4	CL5	CL6
35	6	4	8	41.5	39	36.5	34	31.5	29	27
40	6	4	8	43.5	41	38.5	36	33.5	31	28.5
45	6.5	4.5	8.5	45.5	43	40.5	37.5	35	32.5	30
50	7	4.5	9	47.5	45	42	39	36.5	34	-----
55	7.5	5	9.5	49.5	46.5	43.5	40.5	38	-----	-----
60	8	5.5	10	51	48	45	42	39	-----	-----
65	8.5	6	10.5	52.5	49.5	46.5	43.5	-----	-----	-----
70	9	6.5	11	54	51	48	45	-----	-----	-----

Western Red Cedar Poles (Ultimate Fiber/Bending Stress = 6000 psi)

Pole Length	Setting Depth (Feet)			Minimum Circumference in inches as measured 6 feet from the pole butt						
(Feet)	In Earth	In Rock	Wet Soil	H1	CL1	CL2	CL3	CL4	CL5	CL6
35	6	4	8	45.5	42.5	40	37.5	34.5	32	30
40	6	4	8	48	45	42.5	39.5	36.5	34	31.5
45	6.5	4.5	8.5	50	47.5	44.5	41.5	38.5	36	33
50	7	4.5	9	5	49.5	46.5	43.5	40	37.5	-----
55	7.5	5	9.5	52.5	51.5	48.5	45	42	-----	-----

1. See Page 2-102 for weights for common pole sizes and wood species and Section 22.
2. Class and technical data taken from current ANSI specification 05.1. Poles are classed according to minimum size and minimum breaking load capacity. All poles of the same class shall have the same strength. Pole species of lower ultimate fiber (bending) strength will be larger in diameter than stronger/harder specie poles.
3. Basic formulas for area and diameter calculations are: $A=\pi r^2$, $C=\pi D$, and $D=C/\pi$.
4. Poles that are to be located in areas that are very wet or in areas that have standing water should be referred to Standards Engineering as they may require the use of multiple pole guys or foundation supports.

Supersedes 7/08 Issue - Added H1 Class poles to Table.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

POLE LENGTH	POLE LIFTING SUPPORT LOCATION (Measured in feet from butt)	AVERAGE WEIGHT IN POUNDS						
		FULL LENGTH TREATED SOUTHERN YELLOW PINE POLES						
		CLASS H1	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5	CLASS 6
25		-----	777	671	582	512	442	371
30		-----	1024	901	777	671	582	512
35	16	1572	1324	1148	985	865	742	636
40	18.5	1942	1642	1430	1236	1077	936	794
45	20.5	2278	1977	1713	1483	1289	1112	-----
50	22	2666	2348	2030	1766	1536	1494	-----
55	23	3054	2737	2384	2066	1784	-----	-----
60	14 & 45	3461	3160	2720	2366	2048	-----	-----
65	14 & 47.5	3902	3584	3108	2702	-----	-----	-----
70	15 & 50	4362	4044	3514	3037	-----	-----	-----
		FULL LENGTH TREATED DOUGLAS FIR POLES						
30		-----	920	820	664	552	452	352
35	16	1342	1060	1004	804	708	608	524
40	18.5	1681	1340	1256	1016	888	776	664
45	20.5	1907	1680	1524	1228	1060	932	-----
50	22	2147	1936	1780	1412	1228	-----	-----
55	23	2500	2160	2036	1612	1400	-----	-----
60	14 & 45	3008	2372	2304	1836	1568	-----	-----
65	14 & 47.5	3392	2668	2584	1836	-----	-----	-----
70	15 & 50	3812	3024	2880	2344	-----	-----	-----
		FULL LENGTH TREATED WESTERN RED CEDAR POLES						
30		-----	-----	-----	501	428	375	328
35	16	-----	829	728	636	549	482	426
40	17.5	-----	1022	899	776	675	602	535
45	19.5	-----	1224	1070	935	815	728	-----
50	21.5	1624	1448	1271	1098	958	871	-----
55	23	1884	1674	1464	1277	1128	-----	-----
60	14 & 45	2156	1912	1669	1453	1278	-----	-----
65	14 & 47.5	2430	2156	1882	1638	-----	-----	-----
70	15 & 50	2736	2422	2108	1842	-----	-----	-----
		FIBERGLASS POLES						
35	17.5	-----	-----	-----	-----	350	-----	-----
40	20	-----	-----	-----	450	-----	-----	-----
45	22.5	-----	-----	700	-----	-----	-----	-----

Supersedes 7/11 Issue – Added H1 Class poles.

1. Detailed wood pole specifications are published in ANSI 05.1 and by The American Wood Preserver's Association (AWPA).
2. When lifting poles, care must be taken to avoid excessive bending and the possibility of cracking. Poles shorter than 60 feet may be picked up at the center of gravity of the pole. Poles 60 feet and longer shall be picked up at two points, listed in the above Table under Center Of Gravity.
3. Extremely wet wood poles may exceed maximum weights by 100-300 pounds.

Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Doc. # ST. 02.00.001

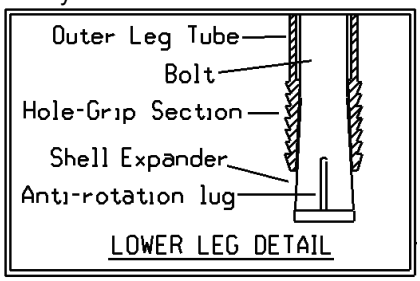
CU = PMNT3P14A	3 Anchor Leg
CU = PMNT4P14A	4 Anchor Leg
CU = PMNT5P14A	5 Anchor Leg

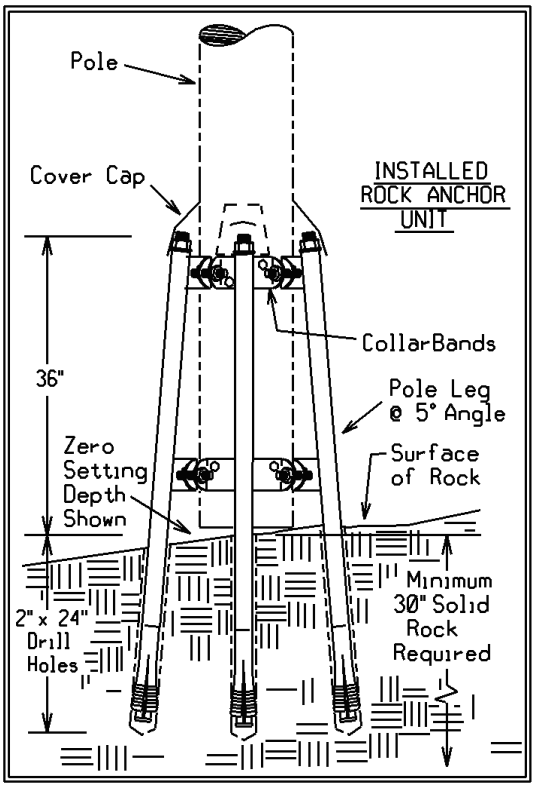
When Distribution poles are to be set in areas where sound bedrock is at or near the surface, the pole rock anchor (Item P14A) is recommended. Rock anchors may be installed above or below grade and, when properly installed, provide anchorage equaling or exceeding standard soil installations.

Failure to use all of the packaged hardware or to adhere to the following procedure will result in an improper installation.

The anchor assembly may be bonded to grounding conductors but shall not be considered as a grounding component.

The Drilling Template (Items P14AT - P14CT) must be ordered separately and shall be retained for future re-use.



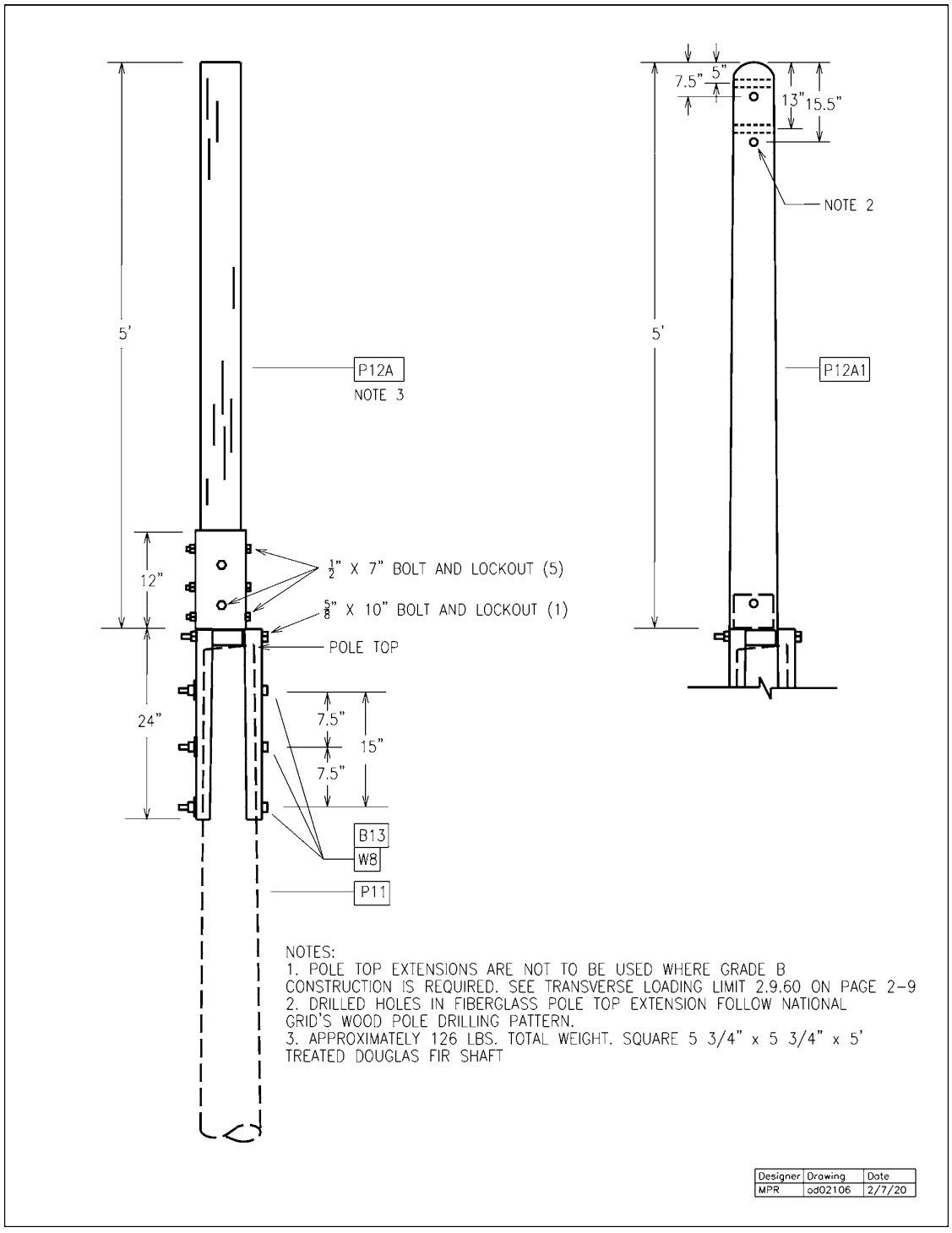


Selection and Installation

1. Location must allow 24” deep anchor leg holes drilled into (a 30” minimum thickness of) strong, solid rock. Pole butt must rest on rock surface at some point and rock shall slope not more than 3” across pole diameter. Non-solid rock or soil overburden must be removed to expose the solid rock. Pole anchor may be installed above or below grade but the legs shall be installed into 24” of solid rock. Reduced or zero setting depth may reduce pole length required, allowing selection of a shorter pole.
2. Measure pole butt diameter approximately 6” from butt end to determine the number of anchor legs required. For 8” to 12” diameter poles, use 3 anchor legs. 11” to 16” diameter poles, use 4 legs. 15” to 20” diameter poles, use 5 legs.
3. Adjust the Drilling Template to the pole butt diameter (as measured 6” from butt end). Place the template on the rock and adjust to level. Drill the first hole (sloping outward) at the highest hole location (if location is not level) to a 24” depth. Dill holes must be in solid, hard rock.
4. Place two anchor legs into drilled holes and loosely connect their collarbands.
5. Install pole in place, plumb, and hold in position. Install remaining anchor leg(s) and tighten interconnecting band bolts - sufficiently to slightly deflect band collars.
6. Rigorously tighten the large nuts at the top of anchor legs to force open the expansion shields at leg bottom ends. If sufficient force (torque) is not developed, unsound rock is indicated.
7. Install **all** remaining lag bolts.
8. Install anchor leg top covers. Install rock anchor identification tag (Std Item P25) just below the pole number tags. The identification tag is especially important if rock anchor assembly is buried in the future and may not be visible. Anchor bolt holes may be grouted where ice may be a concern.
9. Guy all angles and deadends as required per Section 3.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

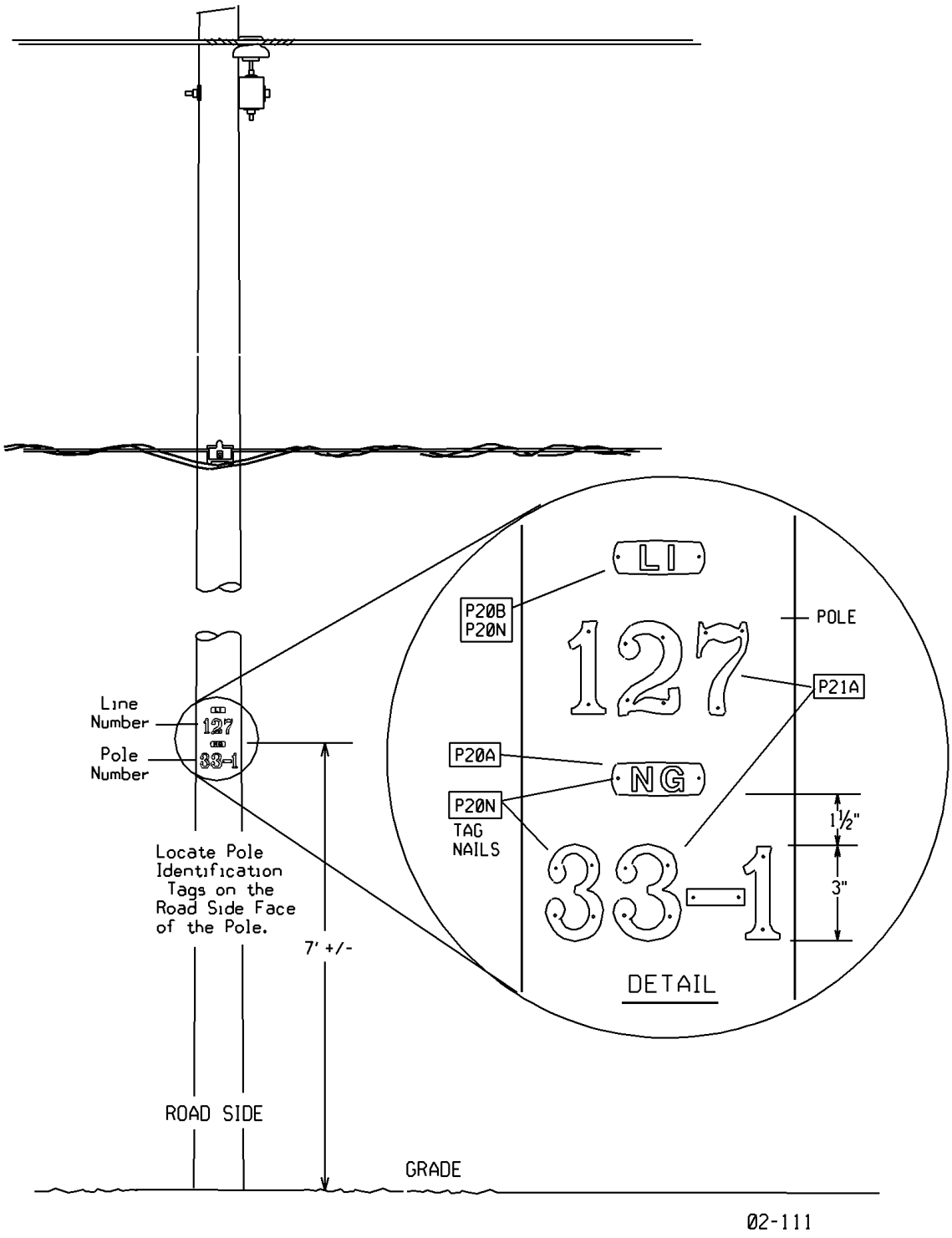
Supersedes 7/19 Issue – Added note on transverse loading



NOTE: Pole top extensions are not to be used where Grade B Construction is required.

POLE TOP EXTENSIONS			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		2-106	7/20

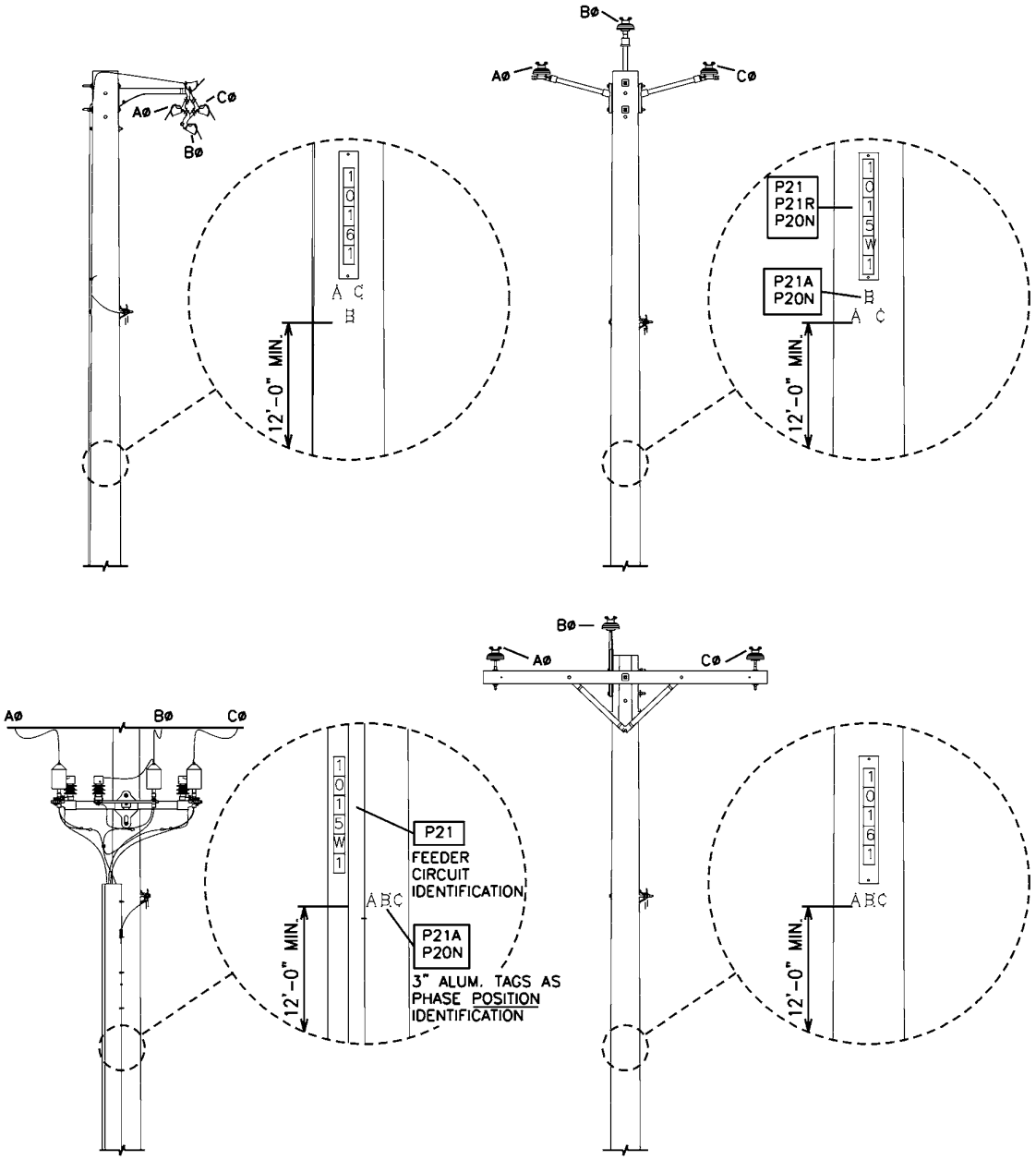
Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



METHOD OF NUMBERING WOOD POLES			
ISSUE	**PAGE NUMBER**		
7/08	**2-111**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/11 Issue – Revised drawing.



NOTE:
1. SHOWN HERE ARE STANDARD PHASE AND FEEDER IDENTIFICATION DETAILS WHEN SUCH APPLICATIONS ARE APPROPRIATE. SEE PARA. 2.1.30 FOR FURTHER INFORMATION.

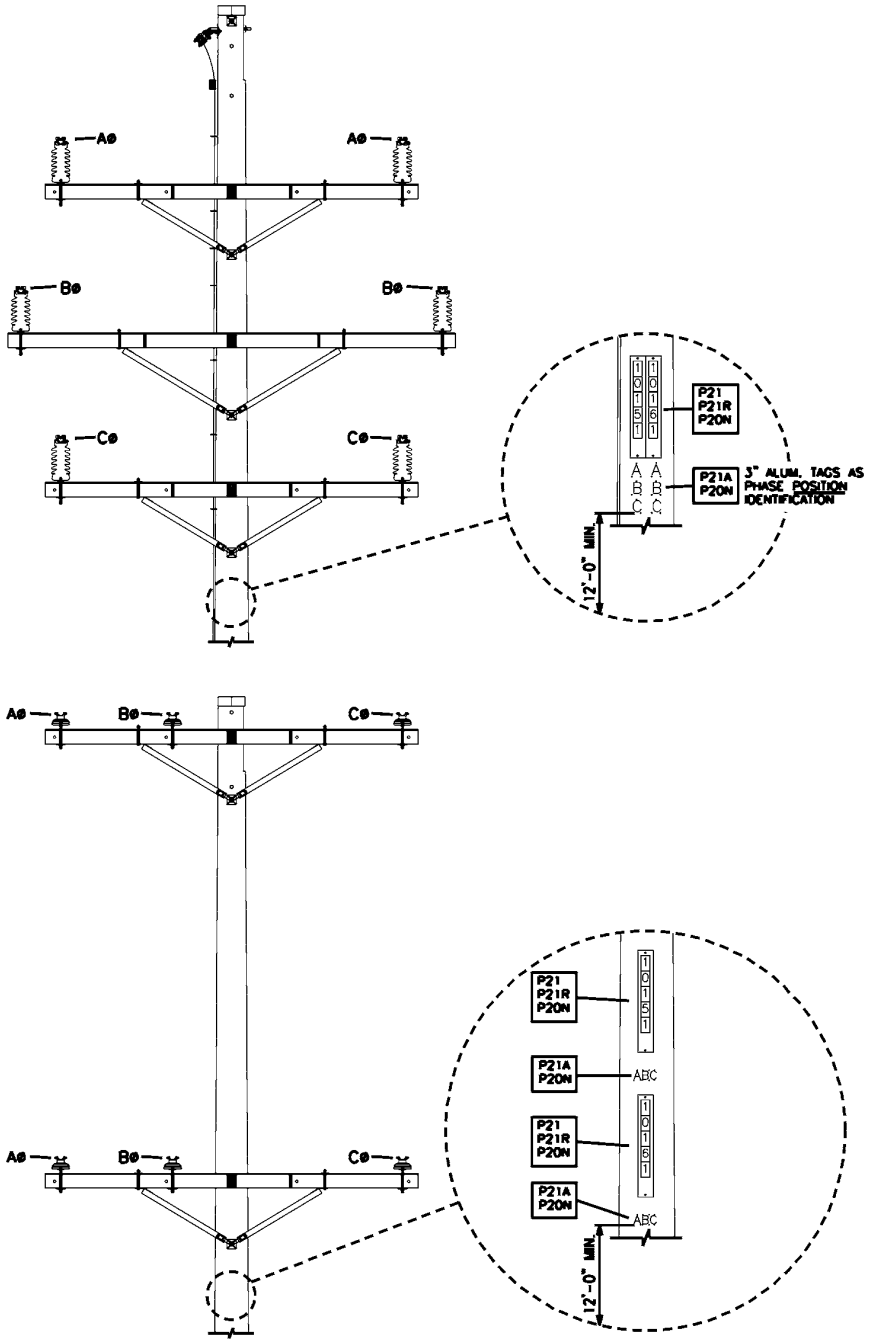
Designer	Drawing	Date
MPR	od02112	7/15/19

PHASE AND FEEDER IDENTIFICATION

nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		2-112	7/19

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

New drawing added.



NOTE:
1. SHOWN HERE ARE STANDARD PHASE AND FEEDER IDENTIFICATION DETAILS WHEN SUCH APPLICATIONS ARE APPROPRIATE. SEE PARA. 2.1.3 FOR FURTHER INFORMATION.

Designer	Drawing	Date
MPR	od02112A	7/15/19

PHASE AND FEEDER IDENTIFICATION

ISSUE	PAGE NUMBER		
7/19	2-112A	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

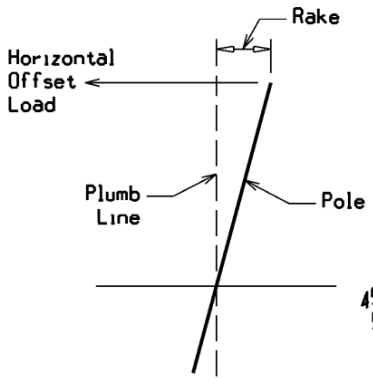
This page has intentionally been left blank.

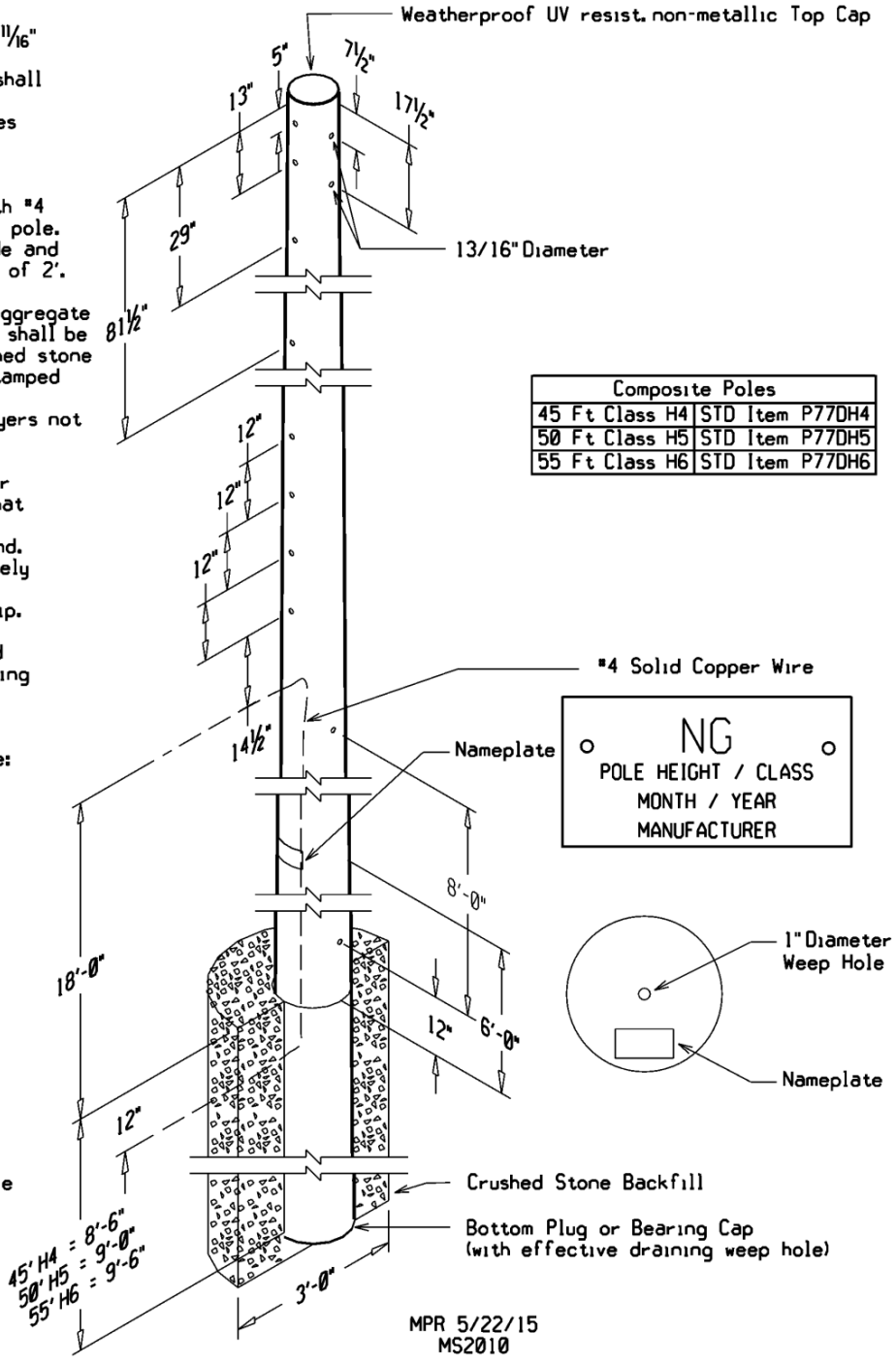
Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Notes:

1. All holes shall be predrilled 11/16" diameter for 5/8" bolts, unless otherwise stated. Fiberglass shall be reinforced at holes if necessary and predrilled holes shall be capped with permanent-removable caps.
2. Poles shall come equipped with #4 solid copper wire internal to pole. Wire shall exit 12" below grade and 18' above grade for a length of 2'.
3. Crushed stone backfill with aggregate not exceeding 3/4" in diameter shall be used to back fill poles. Crushed stone backfill shall be thoroughly tamped using mechanical tampers or appropriate hand tools in layers not exceeding 12" in depth.
4. Poles with line angles greater than 10° shall be raked so that they are plumb when weather conditions are at 60°F, no wind. The poles deflect approximately 6" per 1,000 lbs. horizontal offset load applied at the tip. Designers may determine the resultant offset load applied and prescribe a rake according to this deflection rate. Alternatively, the following table may be used to approximate installation rake:

Line Angle Range, degrees	Rake
0-10	Plumb
10-30	6"
30-60	1'-0"
60-90	1'-6"
90-120	2'-0"
120-180	2'-6"





Composite Poles	
45 Ft Class H4	STD Item P77DH4
50 Ft Class H5	STD Item P77DH5
55 Ft Class H6	STD Item P77DH6

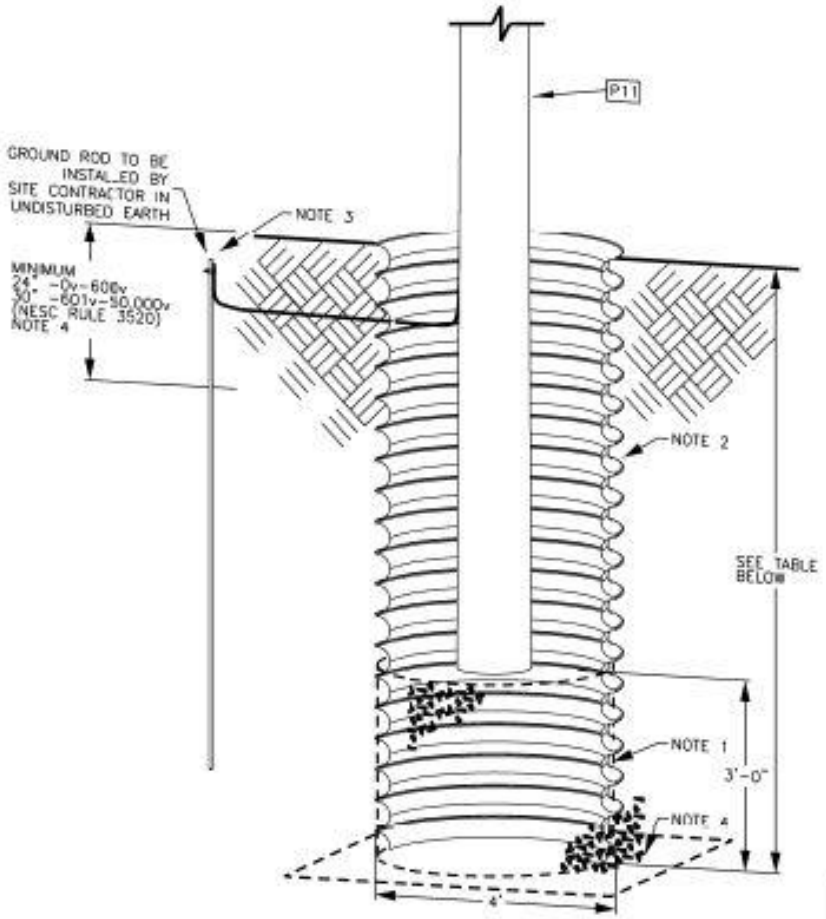
MPR 5/22/15
MS2010

Note: **MASS Only**. Warning signs "Dangerous, Keep Away." See Standard ID's P23B1, P23B2 and P23B3. Apply at 15 ft above grade.

Supersedes 7/16 Issue. Corrected title error.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

New drawing added.



CORRUGATED METAL PIPE DEPTH TABLE

POLE HEIGHT	SET DEPTH
40'	9'-0"
45'	9'-6"
50'	10'-0"
55'	10'-6"

NOTES:

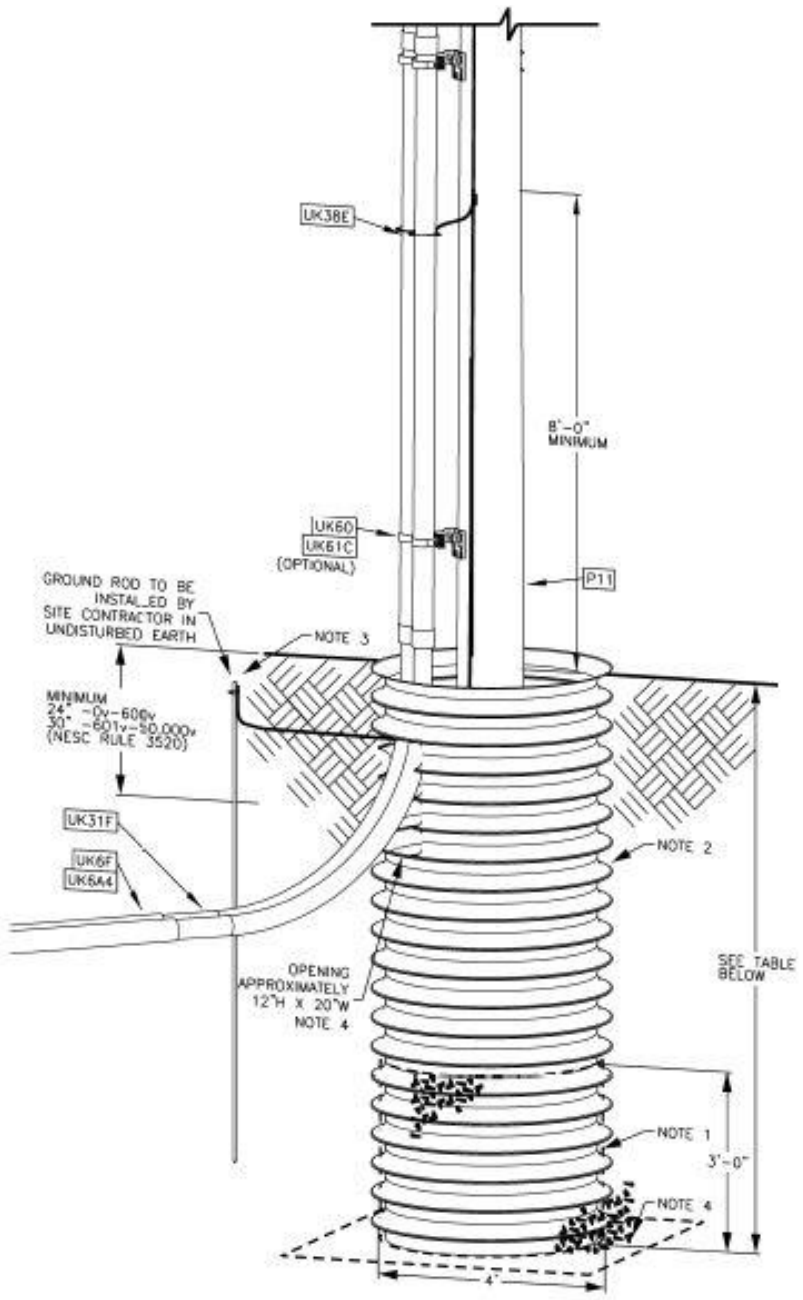
1. CRUSHED STONE BACKFILL WITH AGGREGATE NOT EXCEEDING ¾" IN DIAMETER SHALL BE USED TO BACK FILL POLES. CRUSHED STONE BACKFLL SHALL BE THOROUGHLY TAMPED USING MECHANICAL TAMPERS OR APPROPRIATE HAND TOOLS IN LAYERS NOT EXCEEDING 12" IN DEPTH.
2. CORRUGATED METAL PIPE WITH CORRUGATIONS 2- ⅔" X ½", MINIMUM 16 GUAGE.
3. SEE 13-114 FOR GROUND DETAILS.
4. INSTALL GEOTEXTILE FABRIC AS A BARRIER ON ALL CORRUGATED METAL PIPE OPENINGS.
5. UTILITY CREWS TO INSTALL POLE AND CONNECT TO GROUNDING ALREADY INSTALLED WITH CORREGATED PIPE, GEOTEXTILE BARRIER AND CRUSHED STONE BACKFILL.
6. CORRUGATED STEEL PIPE SHALL BE FREE OF ALL BURS AND JAGGED EDGES IN ORDER TO REDUCE THE RISK OF CUTTING INJURIES DURING HANDLING. CORRUGATED PIPE SHALL BE FITTED WITH EDGE TRIM SUCH AS NEOPRENE RUBBER TO COVER BURS AND JAGGED EDGES.

Designer	Drawing	Date
MPR	cd02301	6/30/20

CLEAN CORRIDOR POLE SET

nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		2-301	7/20

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



CORRUGATED METAL PIPE DEPTH TABLE

POLE HEIGHT	SET DEPTH
40'	9'-0"
45'	9'-6"
50'	10'-0"
55'	10'-6"

NOTES:

1. CRUSHED STONE BACKFILL WITH AGGREGATE NOT EXCEEDING ¾" IN DIAMETER SHALL BE USED TO BACK FILL POLES. CRUSHED STONE BACKFILL SHALL BE THOROUGHLY TAMPED USING MECHANICAL TAMPERS OR APPROPRIATE HAND TOOLS IN LAYERS NOT EXCEEDING 12" IN DEPTH.
2. CORRUGATED METAL PIPE WITH CORRUGATIONS 2- ⅔" X ½", MINIMUM 16 GUAGE.
3. SEE 13-114 FOR GROUND DETAILS.
4. INSTALL GEOTEXTILE FABRIC AS A BARRIER.
5. CORRUGATED STEEL PIPE SHALL BE FREE OF ALL BURS AND JAGGED EDGES IN ORDER TO REDUCE THE RISK OF CUTTING INJURIES DURING HANDUNG. CORRUGATED PIPE SHALL BE FITTED WITH EDGE TRIM SUCH AS NEOPRENE RUBBER TO COVER BURS AND JAGGED EDGES.

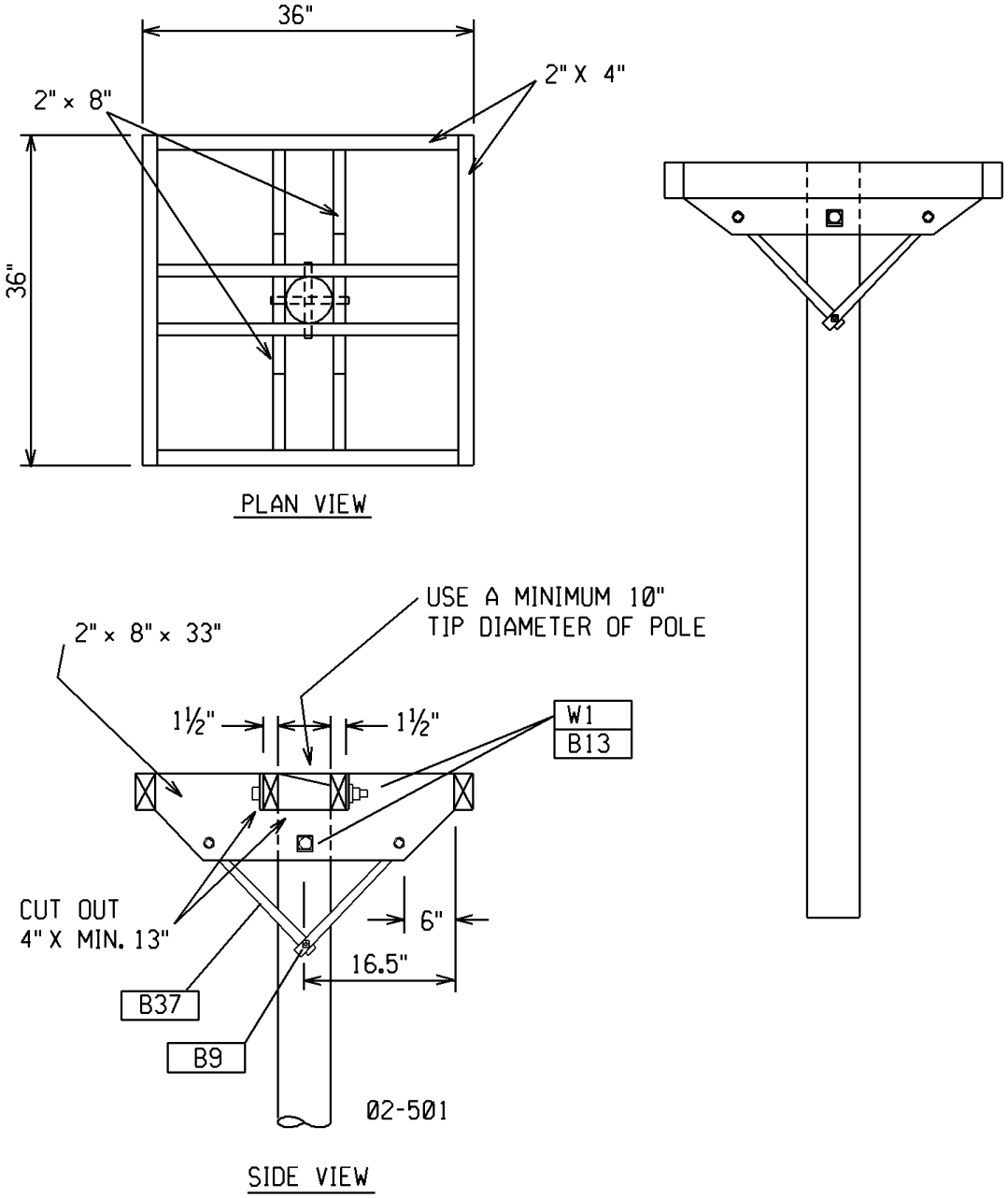
Designer	Drawing	Date
MPR	cd0230tA	6/30/20

New Drawing added.

3 PHASE UG PRIMARY CLEAN CORRIDOR POLE SET

ISSUE	PAGE NUMBER		
7/20	2-301A	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



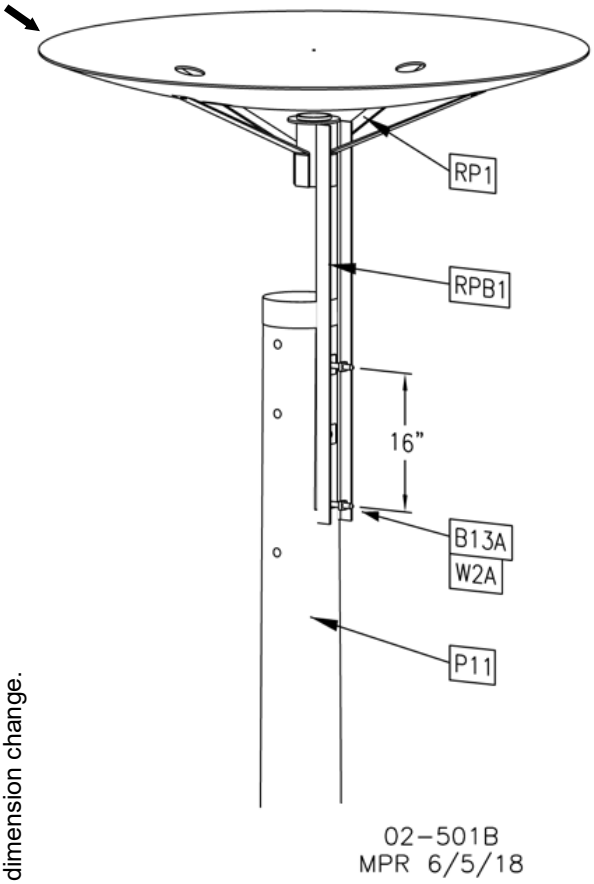
NOTES:

1. Platform shall be installed onto a separate pole set adjacent to line.
2. Platform shall utilize pressure treated lumber and all joints shall be properly fastened using #8 x 3" galvanized wood screws and glue. All screw holes shall be predrilled to prevent splitting.
3. Staple a 36" x 36" piece of 2" x 4" galvanized wire mesh over the top of the platform using 1" galvanized wire staples (fencing staples).

NESTING PLATFORM – WOOD FRAME			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		2-501	7/21

Supersedes 7/11 issue – Drawing title correction.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



02–501B
MPR 6/5/18



Supersedes 7/16 Issue – Drawing dimension change.

Notes:

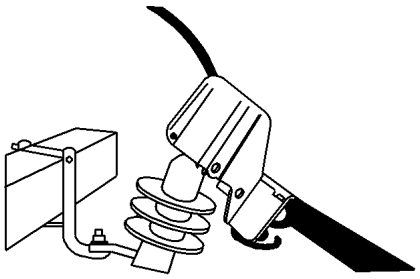
1. The primary option shall be to install platform on a separate pole nearby line.
2. If an independent pole is not possible, the platform may be installed directly on pole carrying energized lines. It is recommended that work be performed with the line de-energized.
3. For distribution voltages up to 15kV, maintain a minimum of 12-inches clearance in any direction between a phase conductor and any part of the platform, the supporting bracket or the through bolts.
4. For clearances greater than 15kV, consult NESC Table 235-6.
5. Always consult with National Grid Environmental before planning for and handling raptor nests.

NESTING PLATFORM – FIBERGLASS WITH STEEL SUPPORT BRACKET			
ISSUE	**PAGE NUMBER**		
7/21	**2-501B**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

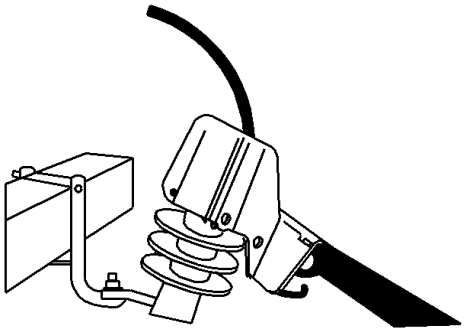
Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

1. Install stinger cover onto cutout tap.

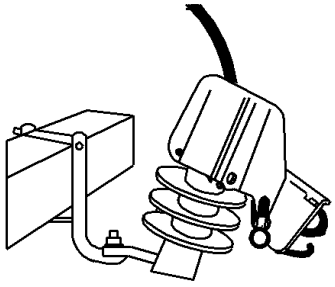
2. Use a shotgun hotstick - the holes in the top lip are designed to fit a shotgun. From the front of the cutout, guide the cover so the tap passes through the slit in the back as shown in this picture.



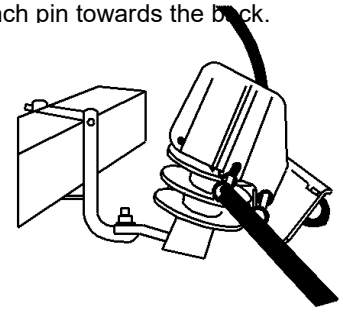
3. Now set the cover down on the cutout.



4. Install snap fit pins with a shotgun stick.



5. Finished installation. The 5.5-inch pin is installed towards the front of the cutout and the 3.5-inch pin towards the back.

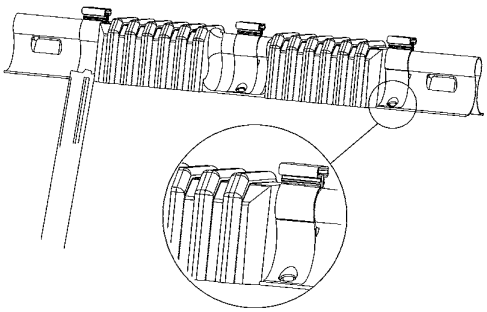


Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

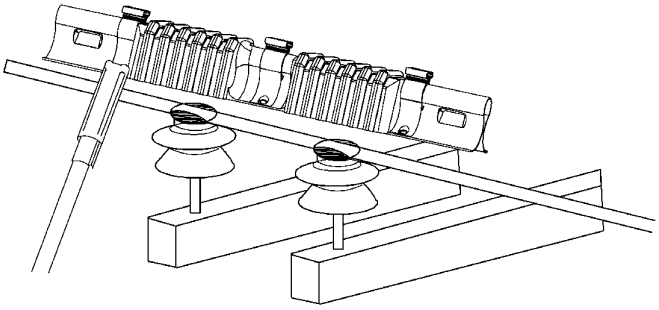
CU = CPWR32P	Cover

Cover Installation – STD Item T40

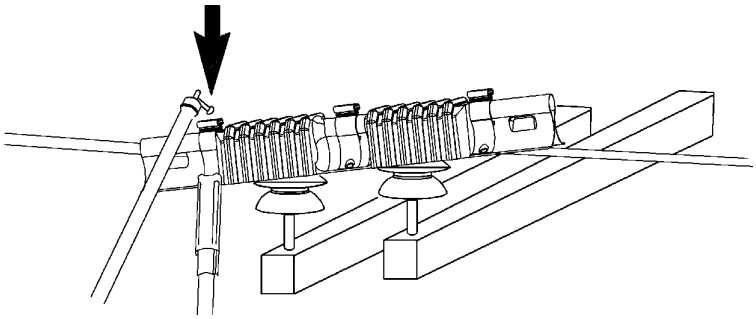
1. Secure cover to shotgun type hotstick through one of the four outside holes provided in the omega clip.



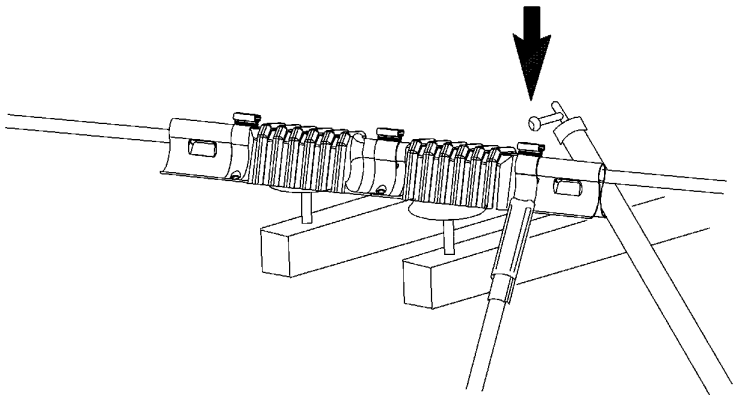
2. Drape the cover over the insulators and straddle the conductor.



3. Secure cover to conductor by taking a second hotstick and pushing down at the top of the clip. Disconnect hotsticks.



4. Secure hotstick to omega clip at opposite end of cover. Repeat step 3.



New Construction Drawing

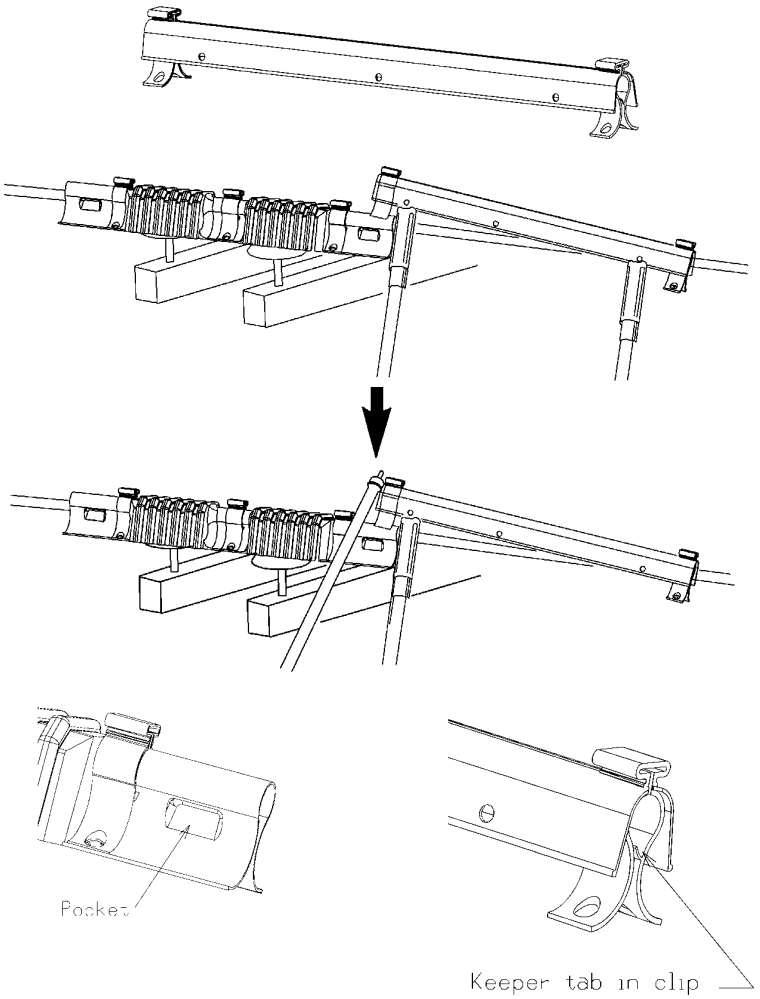
CONDUCTOR COVER			
ISSUE	**PAGE NUMBER**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid
7/21	**2-503**		

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

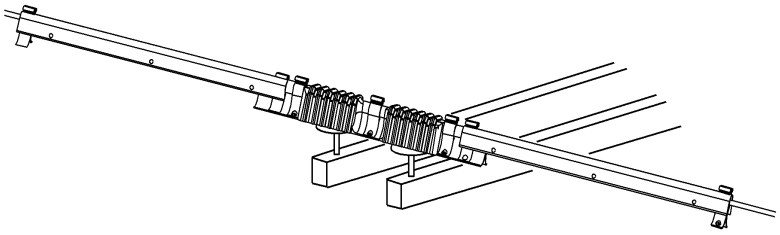
New Construction Drawing

Arm Installation – STD Item T43

5. Secure the hotsticks in the holes along the arm. Clip over and into the pockets on the cover by taking a second hotstick and pushing down at the top of the clip. Make sure "keeper" tab in clip sits into the pocket of the cover.



6. Installation complete.



Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
10	7/21	• Updated 2.1.30 Phase and Feeder Numbering • Revised 2.6 Pole Attachments • Removed Raptor from drawings 2-501 thru 2-504	Michael Abbott	Director T&D Line Engineering & Standards
9	7/20	• Updated Index • Added 2.4.10 Contaminated Sites • Reformatted pages • Added reference to 2.9.60 on Drawing 2-106 • Added Drawings 2-301 & 2-301A	Michael Abbott	J.P. Knauss, Director Electrical Engineering
8	7/19	• Added reference to H1 poles in 2.1. • Revised 2.1.30 Phase numbering. • Revised Drawing 2-106. • Revised Drawing 2-112. • Added Drawing 2-112A	Michael Abbott	J.P. Knauss, Director Electrical Engineering
7	7/18	• Drawing 2-501. Corrected drawing title. • Drawing 2-501B. Dimensions modified.	Brian Reynolds	Jonathan Gonynor, Director T&D O&M Services
6	7/17	• Revised 2.10.10, Example 1, part 6. Overload factor of 1.26 from Table 4 incorrect. No overload factor required. • Corrected title error on pp 2-113.	Brian Reynolds	Jonathan Gonynor, Director T&D O&M Services
5	7/16	• Added 2.1.40 Warning Signs • Correct typo error in Example 1, step 3. • Added drawing 2-501B	Brian Reynolds	Jonathan Gonynor, Director T&D O&M Services
4	7/15	• Added self-supporting fiberglass composite poles 2-113. Revised section 2.8.40 and table of contents. • Corrected equipment weight typo for 45/H1 Cluster Mount 60”.	Brian Reynolds	Jonathan Gonynor, Director T&D O&M Services
3	7/14	• Expanded NESC Construction Grade definition 2.3.10 • Revised Example 1 in section 2.10.10 and added Example 2 and 3. • Added H1 pole class design strengths to Tables 3, 4 and 5. • Added H1 pole class to the ANSI 05.1 Table. • Added H1 pole class to the SYP and Douglas fir bending stress table. • Added H1 pole class to the pole weight table.	Brian Reynolds	Rob Sheridan Director of Utility of the Future
2	7/11	• Added examples of when NESC Grade B Construction is needed. • Added figure showing fiberglass pole top extension to Drawing 2-106. • Minor editorial changes throughout the text portion of the section.	Katie Croteau	Susan Fleck, VP of Standards, Policies, & Code
1	07/08	• Under 2.1, changed page number & added MS2010. • Under 2.3 and 2.4, changed reference page number.	Katie Croteau	Allen Chieco, Director of Distribution Standards and Work Methods

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

		• Under 2.8.10, changed application requirement excluding spacer cable. • Under 2.8.30, added centermount information for fiberglass & changed 2.9.20 title. • Changed 2.9.30 title. • Added information on insulator examination & use in 2.9.50. • Added raptor protection paragraph (2.9.70). • Added fiberglass information to Table 3. • Changed Table 5 fiberglass note. • Added fiberglass information to page 2-102. • Updated CU numbers on page 2-105. • Changed company tag name on page 2-111. • Added animal guards and tag holders to drawing on page 2-112. • New construction drawings - pages 2-500 through 2-504.		

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 202 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SUBJECT	PAGE
• 3.0 GENERAL	3 - 1
• 3.1 WHEN TO GUY	3 - 1
• 3.2 TYPES OF GUY WIRES/POLE SUPPORTS	3-2 THRU 3-5
• 3.3 GUYING MATERIALS	3-5 THRU 3-8
• 3.4 BONDING AND ISOLATION/INSULATION	3-8 THRU 3-9
• 3.5 CLEARANCES	3-9 THRU 3-12B
• 3.6 DETERMINING THE STRENGTH REQUIRED TO SUPPORT THE POLE	3-13 THRU 3-28
• 3.7 WORKSHEETS AND EXAMPLES	3-29 THRU 3-40
• CONSTRUCTION DRAWINGS	
o Screw Anchors	3-102
o Rock Anchor	3-103
o Hand Dug Anchor	3-104
o Plank Anchor	3-104B
o Manta-Ray Anchor	3-104C
o 12.5M Down Guy Assembly	3-105
o 25M Down Guy Assembly	3-106
o Stub Pole Guy - Delta Circuits	3-107D
o Stub Pole Guy - Wye Circuits	3-107Y
o Stub Pole Guy with Secondary - Delta Circuits	3-108D
o Stub Pole Guy with Secondary - Wye Circuits	3-108Y
o Sidewalk/Strut Guy - Delta Circuits	3-109D
o Sidewalk/Strut Guy - Wye Circuits	3-109Y
o Push Brace	3-111
o Steel Guy Stub Pole	3-112
o Bonding Guys	3-114
o Pole to Pole Guy (Span Guy) - Delta Circuits	3-115D
o Pole to Pole Guy (Span Guy) - Wye Circuits	3-115Y
o Secondary Guy Wires - Wye System	3-118
o Secondary Guy Wires - Delta System	3-119
o Guying Open Wire Secondary Racks (Wye and Delta)	3-120
o Sub-Transmission Down Guy 12.5M and 16M	3-121
o Sub-Transmission Down Guy Single and Flared – 25M	3-122
o Sub-Transmission Stub Pole Guy – 12.5M and 16M	3-123
o Sub-Transmission Double Guy – 12.5M and 16M	3-124
o Sub-Transmission Double Guy, Single Anchor 12.5 and 16M	3-125
o Sub-Transmission Double Guy, Double Anchor 25M	3-126
o Fiberglass Pole Guying Attachment	3-127

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

GENERAL

This section of the Standards is used to determine the appropriate guy/pole support necessary to support distribution poles and their equipment. The Standards in this section meet or exceed the requirements of the most recent publication of the National Electric Safety Code (NESC).

3.1 WHEN TO GUY

3.1.10 Deadend Poles

Poles at deadends, where an uneven number of wires terminate on each side of the pole, shall always be guyed. Where it is not practical to guy such a pole directly, the conductors may be deadended on the first or second pole from the end of that line. That pole shall be guyed and slack spans shall be strung to the terminal pole. The unbalanced force at the top of the unguyed pole shall in no case exceed 50% of the breaking strength of the pole.

3.1.20 Junction Poles

The junction pole with a lateral line deadend tap shall be guyed in the same manner as a 0deadend pole.

Supersedes 7/19 Issue – Updated Section 3.1.30

3.1.30 Transition Poles

Poles unbalanced more than 10% by a change in the number or size of conductors shall be longitudinally guyed (includes deadend in-line secondaries on tangent poles). Pole to pole guys to distribute the imbalance shall be considered. Review Section 6.5.30 if deadending with different size conductors.

3.1.40 Line Poles with Transverse (Lateral) Loading

Poles subject to excessive lateral loading shall be side guyed as required. These loadings include heavy unbalanced service pulls (e.g. when all services are taken off from one side of a line of poles); heavy transverse wind loading (e.g. long span north-south lines); and normally loaded pole lines set in soft soils. Transverse loading values for standard conductors are given in Section 6 (Primary Conductors). Transverse guying may also be required where poles are located in extremely hazardous locations.

3.1.50 Line Angle Poles

Poles at line angles where the steady unbalanced force due to conductor tension caused by the angle exceeds 300 lbs. (this includes 3 phase line poles at angles over 2 degrees and 1 phase line poles at angles over 4½ degrees) shall be guyed. Angles over 60 degrees require deadending the lines in both directions and guying both ways.

3.1.60 Guying on New York State rights-of-way and highways

For lines crossing the New York State Thruway Authority rights-of-way or other state highway rights-of-way in New York, structures supporting for crossing span shall be sideguyed in both directions, if it is practicable, and headguyed away from the crossing span. Adjoining poles shall also be guyed as well. Push brace can be used as an option. On curves road and lines cross shall take special precautions. No guying from trees without owner permissions and guying is subject to clear zone restriction.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

3.2 TYPES OF GUY WIRES/POLE SUPPORTS

3.2.10 Anchor/Down Guys

This is the most common type of guy wire used on distribution circuits. The lower end of the guy is anchored in the earth. This type of guy wire shall be installed in accordance with Drawing 3-105 or 3-106.

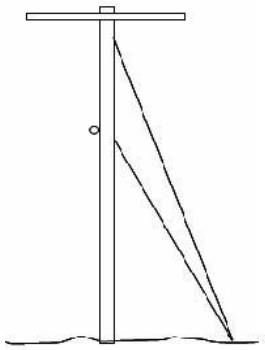


Figure 1 - Anchor/Down Guy

3.2.20 Stub Guys

When it is not feasible to guy directly to an anchor, a guy stub pole may be installed. When the guy stub pole is set where there is a possibility of a line being extended at a later date, the pole shall be of a length and class expected for such line extension. See Drawings 3-107D/3-107Y and 3-108D/3-108Y for installation details.

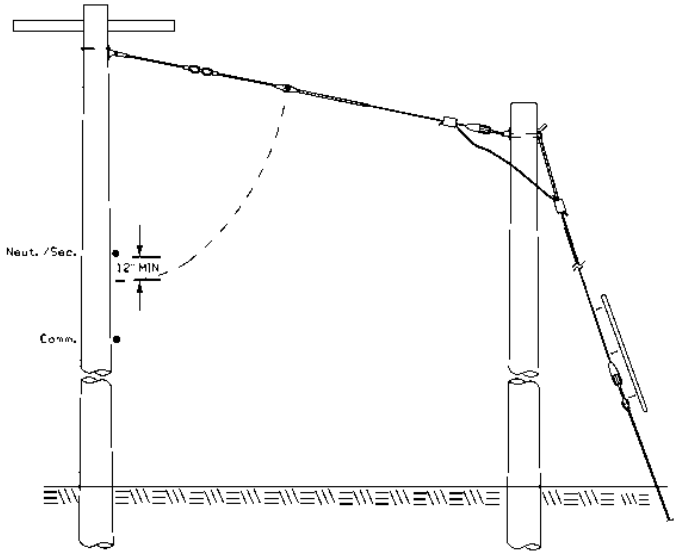


Figure 2 - Stub Guy

Supersedes 1/06 Issue - Revised Section 3.2, added figures for each type of guy.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

A. Steel Guy Stub Poles

If additional strength is required for the stub pole, steel guy stub poles are available for use. The pole is manufactured in accordance with National Grid MS2355 and is installed in accordance with Drawing 3-112.

3.2.30 Span Guys/Pole to Pole Guys

When it is not feasible to install an anchor guy directly on the pole, pole to pole guys may be installed to an adjacent pole. A minimum clearance of 15’ 6” is required at the lower attachment point if the guy wire is above driveways, parking lots, alleys, and other land possibly traversed by vehicles that are more than 8’ in height or by riders on horses or other large animals. If spaces and ways are subject to pedestrian or restricted traffic only (areas where riders on horses or other large animals, vehicles, or other mobile units exceeding a total height of 8’ are prohibited by regulation or permanent terrain configurations), a minimum height of 9’ 6” may be used (NESC Rule 232B, Table 232-1).. Refer to Drawing 3-115D/3-115Y for installation details.

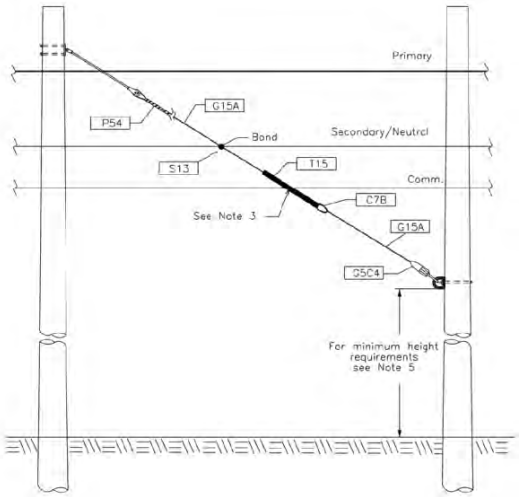


Figure 3 - Span Guy/Pole to Pole Guy

3.2.40 Sidewalk/Strut Guy

Where suitable land or access rights cannot be obtained for a sufficient guy lead length on an anchor guy, a sidewalk/strut guy shall be installed. Refer to Drawing 3-109D/3-109Y for installation details.

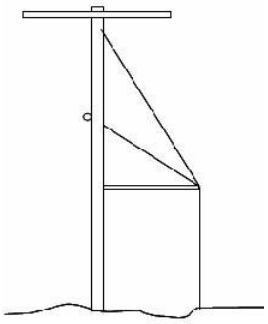


Figure 4 - Sidewalk/Strut Guy

Supersedes 7/10 Issue – Revised Section 3.2.30 on Figure 3.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

3.2.50 Push Brace

Where the aforementioned means of guying a pole are not feasible, a push brace may be installed as shown on Drawing 3-111. For pole loading calculators, a push brace is treated as a regular down (anchor) guy installed on the opposite side of the pole. Refer to the table below for the minimum class pole that can be used for this installation.

Equiv. Amount of Guying	35 Foot Pole	40 Foot Pole	45 Foot Pole	Line Pole Setting to Balance Up-Lift
6M	5	5	4	Normal
12M 18M	5 4	4 3	3 2	Normal depth but backfill with crushed stone and earth well-tamped.
24M 30M	3 2	2 1	1 X	Set an extra foot deep; bolt with two 24” x 12” planks with two 5/8” bolts; backfill with crushed stone and earth well-tamped.
36M	1	X	X	Requires special considerations.

Table 1 - Minimum Class of Push Brace Pole Allowed

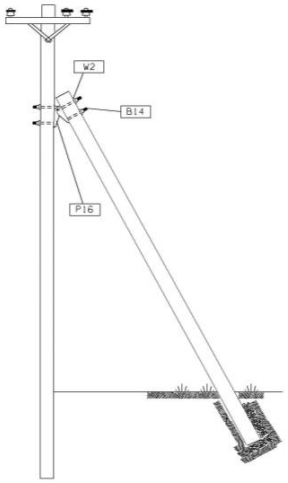


Figure 5 - Push Brace

3.2.60 Storm Guys

Pole lines located where topographical features may cause extreme winds (on ridgelines, for example) may require the installation of storm guys to offset the unbalanced condition created by these winds.

3.2.70 Unguyed Poles

Contact Distribution Standards Engineering or see Section 2 (Poles/Hardware) for requirements/alternatives for unguyed line angle poles. Slack span construction may be used where suitable land or guying rights cannot be obtained at line angle or deadend pole locations. Spans adjacent to the line angle should have approximately twice the normal sag. This added sag may limit span length in order to meet NESC midspan clearance requirements. Total pole loads shall be determined jointly with all telecommunication parties attached to the pole. Telecommunication conductors and equipment loading must also be considered when determining if guying may be omitted on angle poles.

Supersedes 1/06 Issue - Revised Section 3.2, added figures for each type of guy.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

3.2.80 Steel Stub Pole

A steel guy stub pole is used when rights cannot be obtained or space is not available for conventional guying installations. The steel guy stub pole specification is in accordance with Material Specification MS 2355 and installed in accordance with Page 3-112. The maximum horizontal load per attachment point is 13,400 lbs. The maximum combined horizontal load on the pole stub on both attachment points is 24,000 lbs. (21,600 lbs with .9 overload factor per NESC). For a guy at an angle ( ) other that horizontal (See Page 3-112), the equivalent horizontal tension per attachment point is determined by the formula T x Cosine . This value shall not be greater that 13,400 lbs. T equals the tension on the guy and equals the angle of the guy from horizontal. Example: For a guy with a design tension of 15,000 lbs. at an angle of 30 degrees, 15,000 x Cosine 30 degrees = 15,000 x .866 = 12,990 lbs. Since this load does not exceed the maximum horizontal load of 13,400 lbs for an attachment point, this load is acceptable. Note: Two guys with this load would exceed the maximum allowable horizontal load on this stub (13,400 lbs x 2 = 26,800 lbs., which is greater than the allowed maximum combined horizontal load of 21,600 lbs).

3.3 GUYING MATERIALS

3.3.10 Guy Wire

There are currently two sizes of guy wire available for new construction, but the table below also includes some of the common sizes that were previously used on the system in case there is equipment being added to an existing guyed pole.

Std Item #	Size	RBS (Rated Breaking Strength)	Use Strength (90% of the RBS)
G11 (old)	1/4" galvanized steel (3M)	3150 lbs	2800 lbs
G13A (old)	5/16" galvanized steel (6M)	6000 lbs	5400 lbs
G15A (old)	3/8" galvanized steel (10M)	11500 lbs	10350 lbs
G15A	**3/8" alumoweld (12.5M)**	**12630 lbs**	**11367 lbs**
(old)	11/32" (13M)	12630 lbs	11367 lbs
G17A	**7/16" galvanized steel (16M)**	**18000 lbs**	**16200 lbs**
G17B	7/16" copperweld (16M)	16890 lbs	15200 lbs

Table 2 - Guy Wire Sizes and Strengths

Items G15A and G17A are the two sizes of guy wire currently used for new construction on distribution circuits. Item G17B is commonly used for guy wire on sub-transmission/distribution supply circuits or it is used as a messenger wire in some situations. The other sizes listed are not available but are listed for reference purposes.

3.3.20 Anchor Rod and Helix

Anchor selection is based primarily upon actual field soil conditions. A standard 10 inch screw anchor (Std Item A16A) shall be used unless soil conditions are known to be unsuitable for the required holding capacity or the anchor location is inaccessible to a digger truck. Installation of or failure to install the standard 10 inch screw anchor will provide the best basis for determining whether a different anchor is needed. A 14 inch screw anchor (Std Item A16B) shall be used in lower class soil conditions (see the following table and Drawing 3-102). Maximum soil/anchor holding strength should be sought since this will likely be the weakest link of the guy-anchor assembly. If a screw anchor cannot be installed because it is inaccessible to a digger truck, a hand dug anchor can be used. See Drawing 3-104.

Usually knowledge of the soil types encountered on site will help promote proper anchor selection. Observation of the soil removed from the pole bore hole is the best practical methods for judging the site soil type. The following table should be used as a general guide for determining soil type and anchor selection.

Added 3.2.80 Steel Stub Pole design guide.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Soil Class	Soil Description	Recommended Anchor
0	Sound unweathered rock	A13A - Rock Anchor 
1	Very dense and/or cemented sands, coarse gravel and cobbles	A16C - Twin 4” Helix 
2	Dense sand, very hard silts & clay, coarse gravel	A16A - 10” Helix 
3	Dense sands & clay, hard silts & clay, gravel, shale, hardpan, broken rock	
4	Compacted sands, gravel, claypan, hard silts & clays	
5	Compacted coarse sand, sandy gravels, still silts & clay	
6	Loose coarse sand, firm clay loam, damp clay	A16B - 14” Helix 
7*	Loose fine sand, varied clays, silt loam, fill	
8*	Swamp, saturated loam, marshland, peat	

Table 3 - Soil Classes and Recommended Anchors

Notes:

*** -** Anchor should penetrate through saturated strata to class 5, 6, or 7 substrata for best results.

- Anchor selection as shown is for general use. Best judgement may be used to decide between Class 1 and 2 (twin 4” or single 10”), and Class 5 and 6 (single 10” or single 14”).

- Actual anchor holding capacity will depend on the real holding capacity of the soil. General soil holding capacities, provided by the anchor manufacturers, are reduced to NESC required 90% and are shown in the following table.

STANDARD SCREW ANCHOR	APPROXIMATE EXPECTED SOIL HOLDING CAPACITY – IN LBS X 90% FOR STANDARD SCREW ANCHORS INSTALLED IN THESE SOIL CLASS TYPES						
	DENSE/ROCKY SOILS……LOOSE/SOFT SOILS						
	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5	CLASS 6	CLASS 7
Twin 4” HELIX (for Hard Soils) (A16C)	32,000	27,000	16,000				
Single 10” HELIX (all Normal Soils) (A16A)	32,000	25,200	21,600	18,000	14,000	10,000	8,000
Single 14” HELIX (for Soft Soils) (A16B)				28,000	22,000	19,000	15,000

Table 4 - Approximate Holding Capacity for Anchors

Note: Soil holding strength is an important component of the guy-anchor system. These holding capacity values were derived from field testing results obtained by the manufacturers. The installing torque required during installation is proportional to the resulting holding strength of the system. The skill and experience of the operator is generally the best or only indicator of a sound anchor installation.

Supersedes 1/06 Issue - Information on this page was previously found in Section 3.5.20.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/10 Issue – Eliminated Guy Hook TG10 and added additional guy hook details.

3.3.30 Bolts

Two bolts sizes are used for guying – a 5/8" and a 3/4". The lengths will vary depending on the diameter of the pole, what all it is holding, etc. Refer to the table below for rated strength and use strength for each type of bolt used for guying.

Std Item	Description	Minimum Tensile Strength	Use Strength (90% of Min Tensile Strength) per NESC
B13_	5/8" square head machine bolt	12,400 lbs	11,000 lbs
B14_	3/4" square head machine bolt	18,350 lbs	16,500 lbs

Table 5 - Thru-Bolt Strengths

3.3.40 Guy Hooks

Guy hooks are selected based on strength needed and angle at which the guy will be installed. The B20A or B20B items are used for span, pole or the seldom used arm guys where the pull is very close to horizontal. TG17 is used on fiberglass poles. A detailed installation drawing can be found in Section 9 for TG17.

Guy Hooks			
Item	**Bolt Size**	**Use Strength**	**Remarks**
B20A	1-5/8"	11,000 lbs	Meets/ exceeds use rating of bolts
B20B	1-3/4"	16,500 lbs	
G33A	1-5/8"	11,000 lbs	
G33B[Y]	2-3/4"	16,500 lbs	
G33C[E]	1-3/4"	25,000 lbs	
G33D[E]	1-3/4"	25,000 lbs	
TG13*	2-3/4"	20,000 lbs	
TG14**	2-3/4"	28,000 lbs	
TG15[E]	2-3/4"	30,000 lbs	
TG17	3-5/8"		Use with 12.5M guy wire only

Table 6 - Guy Hooks and Rated Strengths

***TG13:** For a single 16M down guy wire, use with one ¾" thru-bolt, a 3" square curved washer, and two lag screws.
For 12.5M pole to pole/span guys and stub pole guys, use with two ¾" thru-bolts and two 3" square curved washers.

****TG14**: For a dual 12.5M down guy wire, use with one ¾" thru-bolt, one 3" square curved washer, and two lag screws.
For dual 12.5M pole to pole/span guys and stub pole guys, use with two ¾" thru-bolts and two 3" square curved washers.

3.3.50 Guy Grips

Guy grips/connectors, both preformed (Std Item P54) and automatic (Std Item G5C), are full-tension devices, based on the heaviest strand for which they were designed and rated for over 95% of the conductor rated breaking strength. The preforms can be located at any attachment point – at the top by the guy hook, at the bottom by the anchor, or in the middle at insulators. The automatic guy grip is used at the anchor only (shall not be used at the top of the guy). For areas where automatics rust and break due to salt or other contaminants, refer to Section 8 - Coastline Construction.

3.3.60 Fiberglass Guy Strain Insulators

Guy strain insulators are to be installed in distribution guys to maintain the basic insulation impulse level (BIL) of the pole top, to provide and maintain the required clearances from equipment as specified by the NESC, and to provide additional worker safety. Refer to the following table for installation guidelines.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std Item #	Size	Rated Breaking Strength	Use Strength (90% of the RBS) per NESC
I24	12” fiberglass rod	15,000 lbs	13,500 lbs
TI95B	54” fiberglass rod	15,000 lbs	13,500 lbs
TI95C	54” fiberglass rod	30,000 lbs	27,000 lbs
TI95D	72” fiberglass rod	30,000 lbs	27,000 lbs
TI95E	120” fiberglass rod	30,000 lbs	27,000 lbs

Table 7 - Fiberglass Guy Strain Insulators

For more information on placement of fiberglass insulators in the guy wires, refer to Section 3.4 below.

Note: Ceramic guy insulators (“Johnny Balls”) are no longer approved for use on new guy wire construction.

3.4 BONDING AND ISOLATION/INSULATION

The NESC requires that all guy wire shall be effectively grounded or insulated.

3.4.10 Effectively Grounded or Multi-Grounded Wye Circuits

A. Primary Guy Wires

All primary guy wires shall have a fiberglass insulating rod (54” minimum length) at the top (pole end) of the guy. The guy wire shall also be bonded to the system neutral using a compression connector **except** where the bond wire will create a work method problem. If the exception is taken, the guy wire shall be insulated/isolated as described below for guy wires on delta circuits. See Drawings 3-105 and 3-106 for more details.

B. Secondary Guy Wires

All secondary guy wires shall be attached at the lowest secondary attachment point (usually the secondary cable). All secondary guy wires on an effectively grounded or multi-grounded wye circuit shall be bonded to the system neutral using a compression connector. See Drawing 3-118 for more details.

3.4.20 Delta or Uni-Grounded Circuits

A. Primary Guy Wires

All primary guy wires shall have a minimum of two 54” fiberglass insulating rods at the top (pole end) of the guy. There shall be a minimum of 12” of fiberglass from the bottom insulator that extends past the secondary connection to prevent the transfer of energy from electric conductors to any third party attachments if the guy were slack against the pole. It is acceptable to use a combination of fiberglass rods to obtain the 12” of fiberglass below the secondary connection. See Drawing 3-105 and 3-106 for more details.

B. Secondary Guy Wires

All secondary guy wires shall be attached at the lowest secondary attachment point (usually the secondary cable). All secondary guy wires on delta or uni-grounded circuits shall be insulated with a minimum of one fiberglass insulating rod (12” minimum length). See Drawing 3-119 for more details.

Supersedes 7-10 Issue –Added TI95E 120” fiberglass rod.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/10 Issue - Added multi-circuit guying guidelines.

3.4.30 Stub Guy Poles

Refer to Drawings 3-107W and 3-107D for construction details when there is no secondary on the stub pole. Refer to Drawings 3-108W and 3-108D when there is secondary on the stub pole.

3.4.40 Ceramic/Porcelain Insulators (Johnny Balls)

This type of guy insulator is no longer accepted for use on new construction. Ceramic/porcelain insulators can either be removed from the guy wire or a jumper wire can be placed across the insulator when the guy wire is being brought up to current Standards (i.e. during a conversion, structure replacement, or when reconductoring a line).

3.4.50 Voltage Conversions

When performing circuit voltage conversions, if the guy wires are properly built to current Standards for the existing type of circuit (delta or wye), there is no requirement to change the guy wires after the conversion is complete.

A. **EXAMPLES**

1. Converting a 5kV class delta circuit to a 15kV class wye circuit:
   - Build guy wires to current Standards for guy wires on a 15kV class delta circuit.
   - This includes removing existing ceramic/porcelain guy insulators (commonly referred to as “Johnny balls”) or installing a jumper wire across it as these are no longer used for guy wire insulation and installing required fiberglass guy insulators.
   - It is not necessary to go back and bond the guy wires or jumper out the guy insulators as part of the conversion project.

2. Converting a 5kV class wye circuit to a 15kV class wye circuit:
   - Build guy wires to current Standards for guy wires on a 15kV class wye circuit.
   - This includes installing the 54” fiberglass at the top of primary guy wires where not already installed and/or removing existing ceramic/porcelain guy insulators (commonly referred to as “Johnny balls”) or installing a jumper wire across it as these are no longer used for guy wire insulation and installing required fiberglass guy insulators.
   - This includes bonding all guy wires to the system neutral where not already bonded.

3.4.60 Guying on Multi-Circuit Structures

On structures where at least one ungrounded/delta circuit is present, the guying standards in Section 3.4.20 (Delta or Uni-Grounded Circuits) shall be followed.

On structures where all circuits are multi-grounded wye, the guying standards in Section 3.4.10 (Effectively Grounded or Multi-Grounded Wye Circuits) shall be followed since all neutrals on these structures will be bonded together.

3.5 CLEARANCES

When installing guy wires, adequate clearance shall be maintained between all conductors and guy wires and guy strain insulators per NESC Table 235-6 and Note 11. Minimum clearance depends upon the type of guy

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

wire installed and the normal operating voltage. Additional clearance may be required due to conductor movement as a result of wind. Refer to the following tables for required clearances.

Clearance between the primary conductor and fiberglass guy strain insulator may be reduced by no more than 25% of the clearance between the primary conductor and guy wire. This reduced clearance is shown in the following tables.

3.5.10 Down/Sidewalk Guys

Primary Voltage (Phase to Phase)	Clearance - Primary to Guy Wire	Clearance - Primary to Guy Insulator
Up to 8.7kV	6”	5”
>8.7kV to 15kV	8”	6”
>15kV to 25kV	11”	9”
>25kV to 35kV	13”	10”
>35kV to 50kV	17”	13”

Table 8 - Down/Sidewalk Guy Clearances

3.5.20 Span Guys

Primary Voltage (Phase to Phase)	Clearance - Primary to Guy Wire	Clearance - Primary to Guy Insulator
Up to 8.7kV	12”	9”
>8.7kV to 15kV	15”	11”
>15kV to 25kV	19”	15”
>25kV to 35kV	23”	17”
>35kV to 50kV	29”	22”

Table 9 - Span Guy Clearances

3.5.30 Other Guys

These guy wires are defined as a guy wire that is neither a down guy nor a span guy, but a guy wire that is attached to two distribution poles that do not have conductors parallel to the guy wire (a stub pole guy, for example).

Primary Voltage (Phase to Phase)	Clearance - Primary to Guy Wire	Clearance - Primary to Guy Insulator
Up to 8.7kV	6”	5”
>8.7kV to 15kV	7”	6”
>15kV to 25kV	13”	10”
>25kV to 35kV	17”	13”
>35kV to 50kV	23”	18”

Table 10 - Other Guy Wire Clearances

3.5.40 Other Clearance Considerations

The same clearances apply for double circuit construction; however additional fiberglass rods may be needed to prevent contact with the lower primary if the guy wire were to break (see Figure 6 below).

Supersedes 7/10 Issue - Text shifted.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 03.00.001

Supersedes 7/10 Issue - Edited Figure 6 and Figure 7.

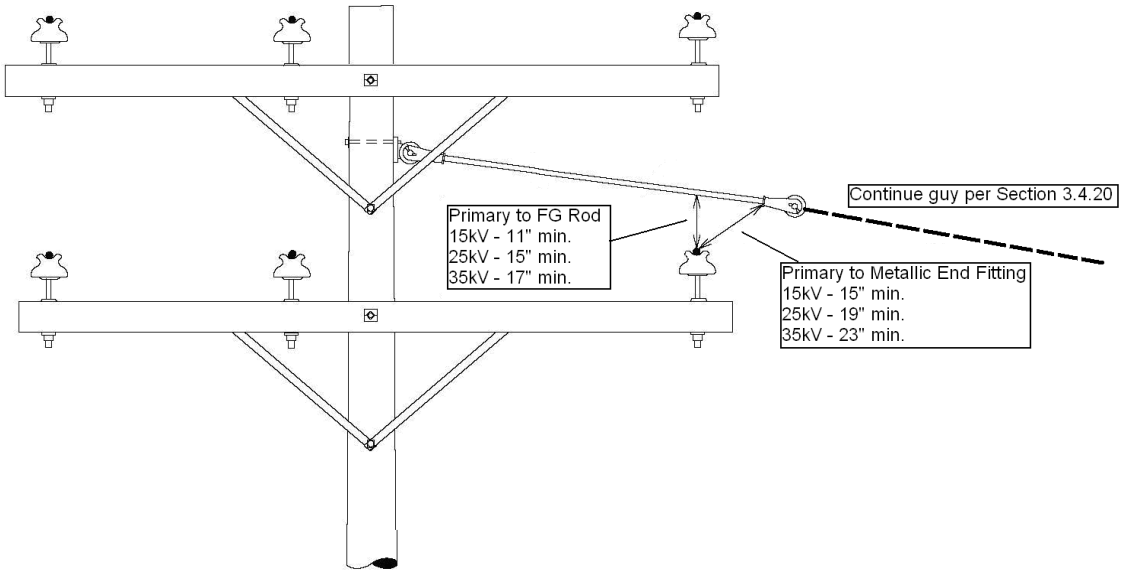


Figure 6 - Double Circuit Guy Wire (Using Table 9 Clearances)

For poles that also have a transformer on it, clearance needs to be maintained between the guy wire and bushings (see Figure 7 below).

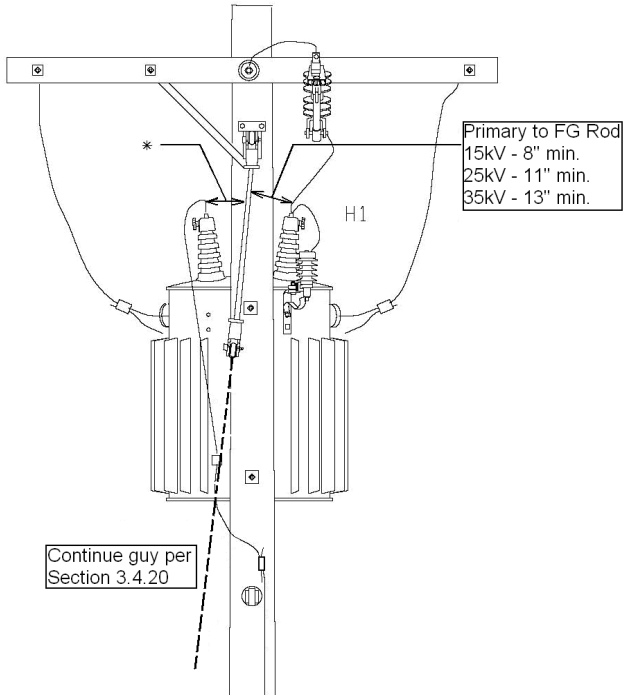


Figure 7 - Guy Wire Clearances (Using Table 8 Clearances)

If a pole-to-pole guy (span guy) is attached above the primary conductors, additional clearance may be needed towards the middle of the span where there can be conductor movement due to wind. In the example below in Figure 8, spacer cable messenger is deadended on one side of the pole at the top of the figure, and there is a guy wire attached on the other side of the pole above the primary conductors.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Where the guy wire passes by a conductor, adequate clearance must be maintained between the conductor and guy wire and/or guy insulator. If the conductor to guy wire/insulator clearance point is near the pole attachment, the clearances from Table 9 are required. If the clearance to the guy/insulator clearance point is further than a few feet from the guy attachment point to the pole, additional clearance is required to take into account conductor movement due to wind. Refer to Section 6 to calculate the maximum conductor horizontal movement using the conductor swing angle.

For this type of installation, do not install the middle phase of the primary conductors directly above the guy wire (do not use a pole top pin). Install the middle phase on the crossarms, as shown.

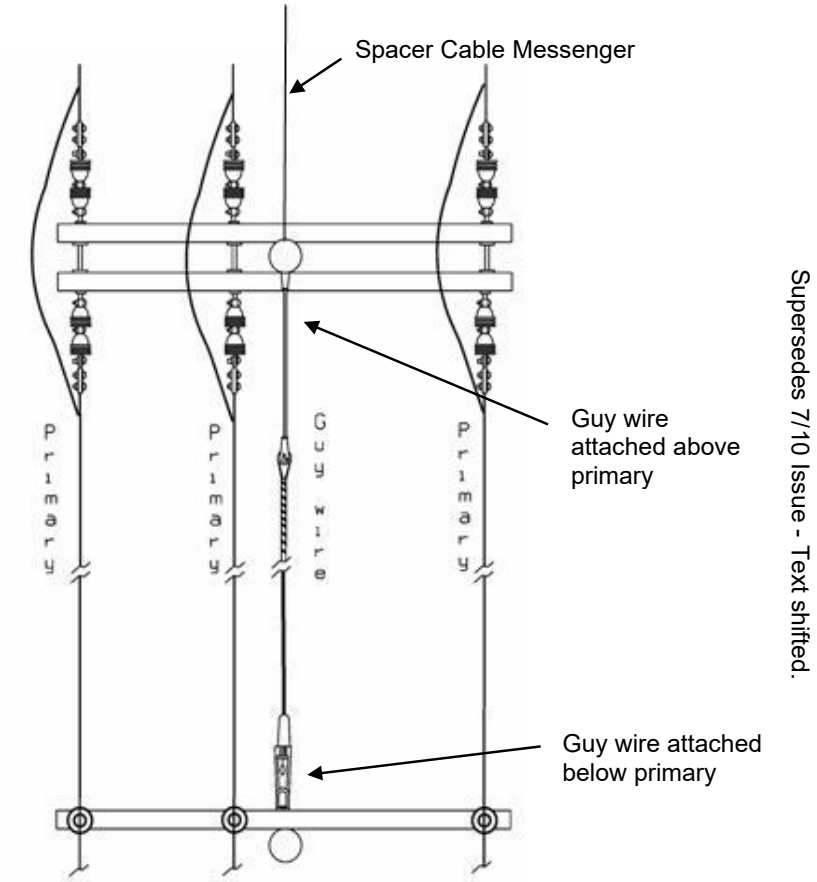


Figure 8 - Span Guy Clearance Considerations - Top View

Supersedes 7/10 Issue - Text shifted.

3.5.50 Guy Wire Clearance to Neutrals

The NESC requires 6” of clearance between the guy wire and the neutral. By using a fiberglass rod the distance between the conductor (neutral) and the fiberglass rod can be reduced by 25%. Therefore, the clearance between the fiberglass rod and the neutral shall be no less than 5”.

3.5.60 Guy Wire Clearance to Third Party Conductors

Per NESC, 6” of clearance is required between the guy wire and communication cables. This clearance may be reduced to no less than 3” if abrasion protection (Std Item T15) is added to the guy wire. See Drawing 3-115D/3-115Y for installation details.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

3.5.70 Existing Insulated Guy Wire Configuration Guide

The following Figure 8A provides a quick reference design guidance when additional communication or electric facilities (such as conductors, wires, cables, cabinets, or active devices) are being added on an existing pole. The latest edition (2017) of the National Electric Safety Code (NESC) requires that anchor guy wires be grounded (effectively grounded wye systems) or properly insulated to limit the likelihood of any portion of an anchor guy becoming energized within 8 feet of the ground level in the event that the anchor guy becomes slack or broken. Though no longer required by the NESC, National Grid continues to require that new installations of insulated anchor guys limit the likelihood of an anchor guy becoming a conductive path between an energized conductor or part and a conductor of another circuit in the event that the anchor guy becomes slack or broken.

New poles and any associated guy wires shall be built to current National Grid construction standards.

Definitions

Anchor guy meets NESC – *The guy wire is grounded (effectively grounded wye systems) or insulated to limit the likelihood of any portion of an anchor guy becoming energized within 8 feet of the ground level in the event that the anchor guy becomes slack or broken.1*

Anchor guy meets National Grid standards – *The guy wire is grounded (effectively grounded wye systems) or insulated to limit the likelihood of an anchor guy becoming a conductive path between an energized conductor or part and a conductor of another circuit in the event that the anchor guy becomes slack or broken.1*

7/18 New Issue.

Requirements for Adding Facilities to Existing Poles with Anchor Guy Wires
When additional communication or electric facilities (such as conductors, wires, cables, cabinets, or active devices) are being added on an existing pole, the actions required specific to anchor guy wires based on existing conditions are identified below:

Field Condition prior to adding facilities:

Existing anchor guy meets National Grid standards –
 If the existing anchor guy is properly grounded or insulated per National Grid standards after the addition of new facilities on the pole, no modifications to the anchor guy is required to allow the new facilities on the pole.
 If the existing anchor guy will not meet National Grid standards after the addition of new facilities on the pole, the anchor guy must be modified or replaced per National Grid standards before the new facilities are added on the pole.

Existing anchor guy does not meet National Grid standards –
 If the existing anchor guy is properly grounded or insulated per NESC requirements after the addition of new facilities on the pole, no modifications to the anchor guy is required to allow the new facilities on the pole.
 If the existing anchor guy will not meet the NESC requirements after the addition of new facilities on the pole, the anchor guy must be modified to meet the NESC or may need to be replaced per National Grid standards before the new facilities are added on the pole.

Note - Fiberglass guy strain insulators or porcelain (“johnny ball”) guy insulators are acceptable insulating materials for existing guy wires. In effectively grounded wye systems exceeding 12kV phase-to-ground or in non-effectively grounded or delta systems exceeding 12kV phase-to-phase voltage, a single johnny ball insulator in guys may not be adequate. Contact Standards Engineering for additional information about the use of johnny ball insulators in guys for these systems.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

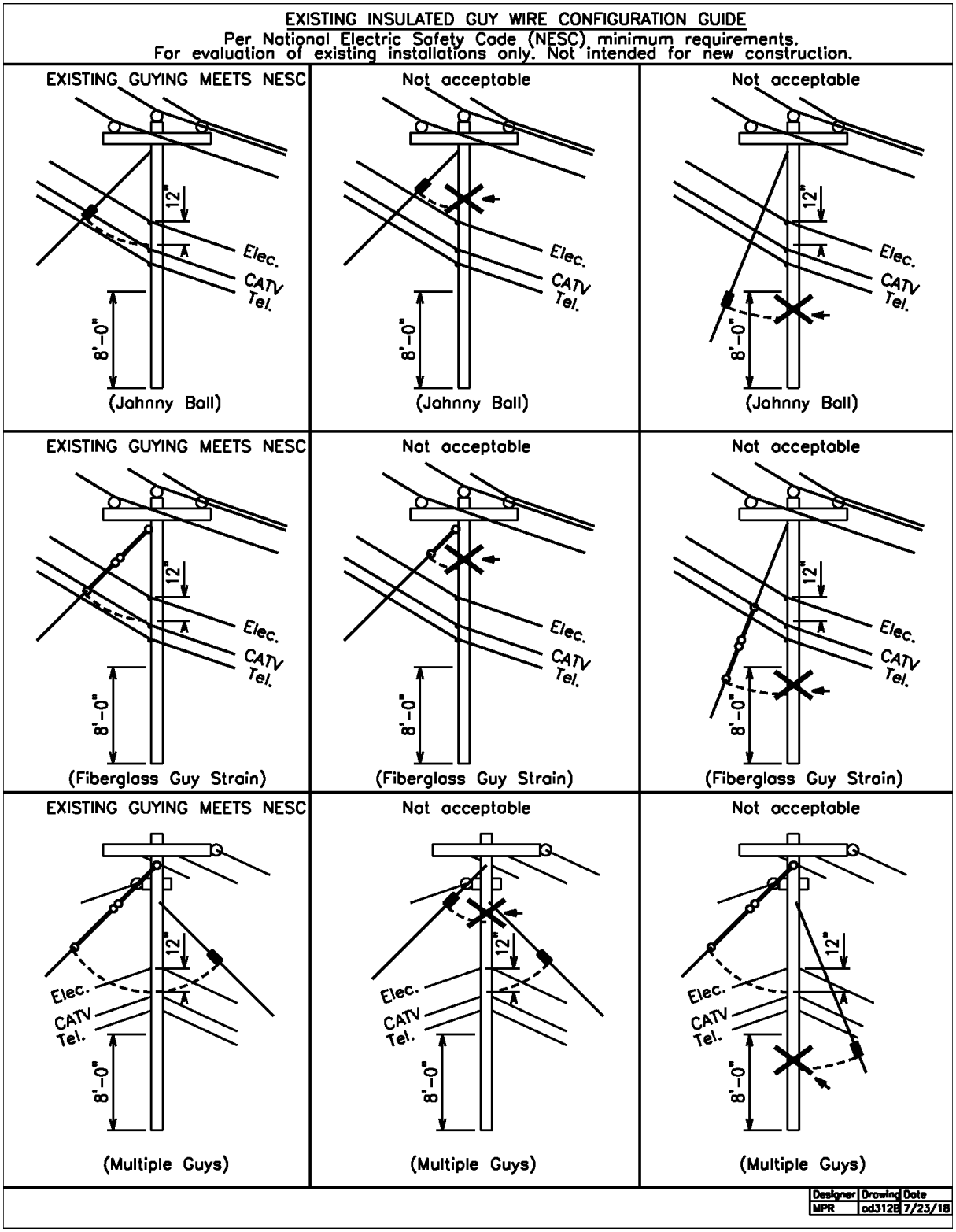


Figure 8A – Existing Insulated Guy Wire Configuration Guide

Copyright 2010 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/10 Issue - Changed material used for abrasion protection in 3.5.60.

3.6 DETERMINING THE STRENGTH REQUIRED TO SUPPORT THE POLE

3.6.10 General

The amount of guy strength required to prevent a pole from leaning or falling over depends on the storm loaded tension of the conductors, the line angle (pull or corner) on the pole, and the length of the lead away from the pole (lead/height ratio).

Wherever possible, guying layout should be preformed in the field before construction begins so that obstacles to the desired guying can be taken into consideration. All pole and guy locations should be staked or otherwise marked to assure adequate lead lengths and proper locations.

Guys should be installed as close to the unbalanced load as possible. Guy anchor assemblies shall be designed for the sum of all loads placed upon them. The unbalanced force above the top guy shall be less than 50% of the resisting moment of the pole at the point of guy attachment.

If there are other loads of similar magnitude below the top guy, they should be balanced with a second guy. Deadended secondaries limited to a 2,000 lb design may be installed without an additional guy unless the magnitude of the total loading (primary and secondary) dictates the use of more than one guy. All communication conductors and messengers shall be guyed by the Owner of the telecommunication facilities against their unbalanced loads where required.

Design of the guy assembly shall include the following NESC overload factors for Grade C and B construction.

TYPE OF LOAD	NESC TABLE 253-1 OVERLOAD CAPACITY FACTOR	
	Grade C	Grade B
Vertical Loads	1.90	1.50
Transverse Loads: Wind	1.75	2.50
Transverse Loads: Wire Tension	1.10	1.65
Longitudinal Loads: In General	None	1.10
Longitudinal Loads: At Deadends	1.10	1.65

Table 11 - NESC Overload Factors for Guy Wires

Construction Component	Grade C	Grade B
Poles	0.85	0.65
Guy Wire	0.9	0.9
Anchors and Foundations	1.0	1.0

Table 12 - Strength Factors for Poles, Guys and Anchors (per NESC)

3.6.20 Procedure

Determine the pull or corner on the pole if applicable. The following diagrams illustrate methods of determining pull on the pole (in feet) by direct measurement. When measuring pull, if D is 100 feet, then P is the pull (also in feet). If D is other than 100 feet, the pull would be (100/D)*P

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

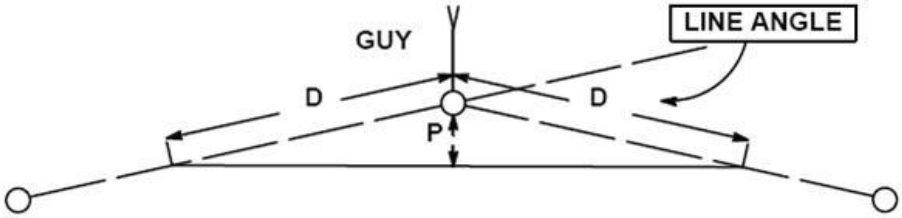


Figure 9 - Preferred Method of Finding Pull

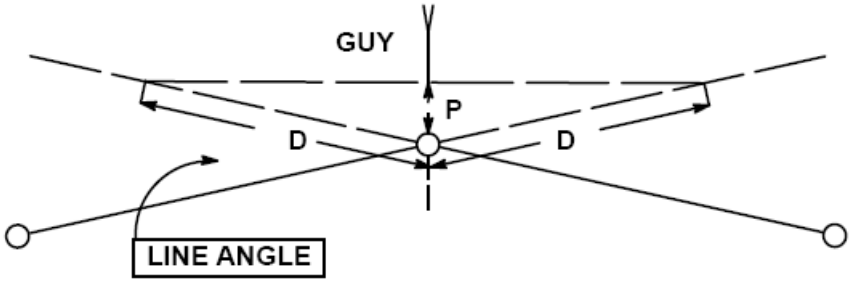


Figure 10 - Alternate Method #1 of Finding Pull

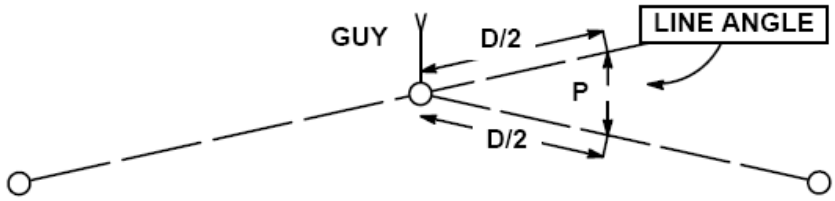


Figure 11 - Alternate Method #2 of Finding Pull

Copyright 2010 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

New page. Info was previously found on Page 3-75.

Line Angle (degrees)	Pull (feet)	Line Angle Factor	Line Angle (degrees)	Pull (feet)	Line Angle Factor
1	0.9	0.0175	31	26.7	0.5150
2	1.7	0.0349	32	27.6	0.5299
3	2.6	0.0524	33	28.4	0.5446
4	3.5	0.0698	34	29.2	0.5592
5	4.4	0.0872	35	30.1	0.5736
6	5.2	0.1045	36	30.9	0.5878
7	6.1	0.1219	37	31.7	0.6018
8	7.0	0.1392	38	32.6	0.6157
9	7.8	0.1564	39	33.4	0.6293
10	8.7	0.1736	40	34.2	0.6428
11	9.6	0.1908	41	35.0	0.6561
12	10.5	0.2079	42	35.8	0.6691
13	11.3	0.2250	43	36.7	0.6820
14	12.2	0.2419	44	37.5	0.6947
15	13.1	0.2588	45	38.3	0.7071
16	13.9	0.2756	46	39.1	0.7193
17	14.8	0.2924	47	39.9	0.7314
18	15.6	0.3090	48	40.7	0.7431
19	16.5	0.3256	49	41.5	0.7547
20	17.4	0.3420	50	42.3	0.7660
21	18.2	0.3584	51	43.1	0.7771
22	19.1	0.3746	52	43.8	0.7880
23	19.9	0.3907	53	44.6	0.7986
24	20.8	0.4067	54	45.4	0.8090
25	21.6	0.4226	55	46.2	0.8192
26	22.5	0.4384	56	46.9	0.8290
27	23.3	0.4540	57	47.7	0.8387
28	24.2	0.4695	58	48.5	0.8480
29	25.0	0.4848	59	49.2	0.8572
30	25.9	0.5000	60	50.0	0.8660

Line Angle Factor = Sine (Line Angle in Degrees)

Table 13 - Line Angle Factors

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Refer to the following figure when measuring the lead to height ratio of a guy.

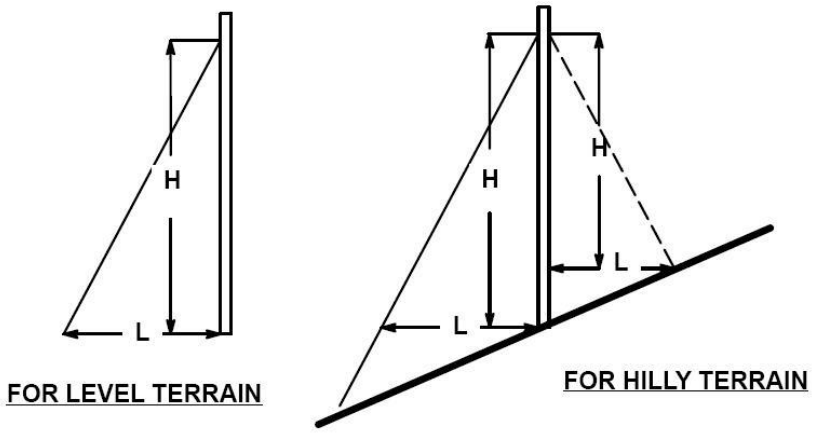


Figure 12 - Measuring Lead and Height

When the terrain slopes and the guy will be installed higher or lower than the base of the pole, adjustments must be made to the lead and height measurements. **Note: The Lead/Height ratio shall never be less than 0.3 because guy loading on the pole becomes excessive.**

The following “Quick Calculations” can be used for most guying calculations. For more detailed calculations and examples, refer to Section 3.7 (Worksheets and Examples).

A. Quick Calculation - Line Angles

1. Find the total conductor and equipment (if applicable) tension by multiplying the number of wires by the storm loaded tension of each wire and adding equipment loading information found in Table 15. Storm loaded tensions can be found in Section 6.
2. Multiply the total loaded tension by the NESC safety factor required (see Table 11).
3. Using Figure 13 on the following page, locate this total loaded tension on the “A” scale.
4. Follow the line diagonally up to where it intersects Line Angle.
5. Follow this point horizontally to the right of the “B” scale, which gives you the resultant horizontal loading.
6. Continue that point horizontally to the right where it intersects the L/H ratio line.
7. Follow the arc down from this point to the “C” scale - which is the guy tension.
8. Use the result to determine the proper materials needed.

B. Quick Calculation - Deadends

1. Find the total conductor and equipment (if applicable) tension by multiplying the number of wires by the storm loaded tension of each wire and adding equipment loading information found in Table 15. Storm loaded tensions can be found in Section 6.
2. Multiply the total loaded tension by the NESC safety factor required (see Table 11).
3. Using Figure 13 on the following page, locate this tension on the “B” scale.
4. Follow this point to the right where it intersects with the L/H ratio line.
5. Follow the arc down from this point to the “C” scale - which is the guy tension.
6. Use the result to determine the proper materials needed.

New page. Figure on this page was previously found on Page 3-101. Quick calculations added.

Copyright 2010 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

New page with new figure for quick calculations.

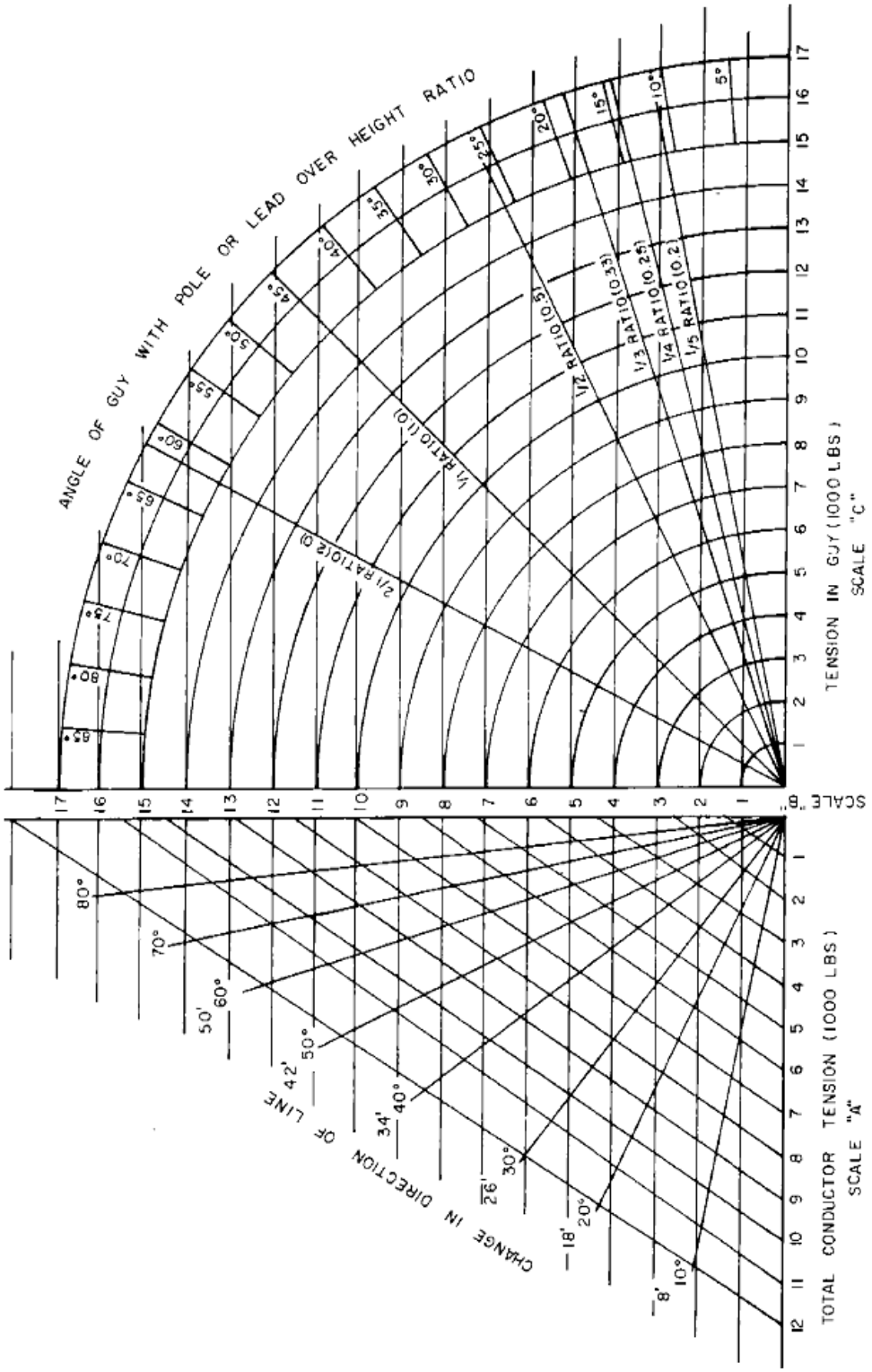


Figure 13 - Guy Wire Chart

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

3.6.30 Tables Needed for Calculations

Refer to the following tables for calculating guy wire loading.

Description		Conductor Size Diameter (in.)	Conductor Tension (lbs.)	Transverse Load Factor (lbs./ft.)
#22 AWG and 3/8" Messenger	25 Pair	1.000	6,600	0.667
	50 Pair	1.175	6,600	0.725
	100 Pair	1.445	6,600	0.815
	200 Pair	1.815	6,600	0.938
	300 Pair	2.115	6,600	1.038
	400 Pair	2.345	6,600	1.115
#24 AWG and 3/8" Messenger	600 Pair	2.295	6,600	1.098
	900 Pair	2.685	6,600	1.228
Fiber Optic and ¼" Messenger (non-armored)	3-36	.0640	2,850	0.547
	38-72	0.739	2,850	0.580
	74-84	0.781	2,850	0.594
	86-96	0.820	2,850	0.607
	98-108	0.850	2,850	0.617
	110-120	0.889	2,850	0.630
	122-132	0.931	2,850	0.644
	134-216	0.979	2,850	0.660
	218-264	1.045	2,850	0.682
Fiber Optic and 3/8" Messenger (non-armored)	144	1.159	6,000	0.720
Fiber Optic Self Supporting Figure "8" Cable (non-armored)	2-72 & 2-36	0.949	2,850	0.650
	74-84	0.991	2,850	0.664
	86-96	1.030	2,850	0.677
	98-108	1.060	2,850	0.687
	110-120	1.099	2,850	0.700
	122-132	1.141	2,850	0.714
	134-144	1.189	2,850	0.730
¼" Messenger (CATV)	0.750	1.069	2,850	0.690
	0.635	0.883	2,850	0.628
	0.500	0.751	2,850	0.584
	0.412	0.652	2,850	0.551

Table 14 - Common Telephone & CATV Cables - Maximum Allowed Conductor Tensions and Transverse Load Factor (Wind)

New page. Info on this page was previously found on Page 3-72.

Copyright 2010 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

EQUIPMENT	SQ. FT EPA	DISTANCE BELOW POLE TOP	LOAD REDUCTION FACTOR	SQ. FT. REDUCED EPA	4 LBS./ SQ. FT WIND LOAD
Capacitor Bank 9 x 50 kVAR	3	5’	90%	3	12 lbs
Capacitor Bank 6 x 200kVAR	7	5’	85%	6	24 lbs
Conductor – Primary	See Sect. 6	2’	100%		Lbs/ft x Span ft
Conductor - Secondary	See Sect. 6	8’	100%		Lbs/ft x Span ft
Conductor Comm. Allowance		11’	70%		75 lbs
Floodlight (All)	3	9’	90%	2	8 lbs
Gang Operated Switch	18	4’	90%	16	65 lbs
Primary Metering	7	6’	85%	6	24 lbs
Recloser 1- 3Ø	4	5’	90%	4	16 lbs
Regulators 3 X 100a	22	7’	85%	19	76 lbs
Regulators 3 x 219A	30	7’	85%	26	104 lbs
Streetlight (All)	4	10’	85%	3	13 lbs
Trans. 1Ø up to 75kVA	12	5’	90%	10	42 lbs
Trans. 1Ø 100kVA and up	17	5’	90%	15	61 lbs
Trans. 3 x 100 kVA	14	5’	90%	19	52 lbs
Trans. 2 x 250 kVA	21	5’	90%	19	76 lbs

Table 15 - Transverse Load Factors (Wind) for Overhead Equipment

New page. Info found on this page was previously on Page 3-73.

Poles	Class 1 Factor (lbs.)	Class 2 Factor (lbs.)	Class 3 Factor (lbs.)	Class 4 Factor (lbs.)	Class 5 Factor (lbs.)
25 foot	66	62	58	53	49
30 foot	85	79	73	67	62
35 foot	104	97	90	82	75
40 foot	123	115	106	98	90
45 foot	143	133	123	114	100
50 foot	163	152	141	130	120
55 foot	184	171	159	147	--------
60 foot	205	191	177	164	--------

Table 16 - Transverse Load Factors (Wind) for Wood Poles

All loads that are applied to poles that are guyed are transferred into vertical or axial loads. Therefore the limiting factor of the pole is at what point a pole will fail due to buckling.

The following tables list these maximum loading points (lbs) based on pole class and where the guy wire is attached to the pole.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 03.00.001

Guy Attachment from top of pole (ft)	30 FOOT POLE				
	Class 1	Class 2	Class 3	Class 4	Class 5
1	102,090	75,852	56,512	38,820	27,870
2	117,289	84,971	63,433	43,549	31,374
3	131,792	95,546	71,470	49,037	35,451
4	148,707	107,885	80,859	55,447	40,222
5	172,864	122,379	91,900	62,982	45,842
6	196,923	139,529	104,979	71,905	52,511
7	225,611	159,990	120,601	82,559	60,489
8	266,602	184,625	139,431	95,397	70,120

Table 17 - Buckling Limits for 30ft Poles (lbs)

Guy Attachment from top of pole (ft)	35 FOOT POLE						
	Class H2	Class H1	Class 1	Class 2	Class 3	Class 4	Class 5
1	131,492	104,138	79,516	59,541	43,590	31,081	21,480
2	148,445	117,905	90,152	67,613	49,590	35,436	24,552
3	163,980	130,429	99,795	74,903	54,987	39,334	27,288
4	181,651	144,688	110,779	83,211	61,140	43,781	30,411
5	206,669	165,068	126,548	95,199	70,070	50,279	35,009
6	230,377	184,254	141,348	106,411	78,389	56,304	39,252
7	257,744	206,417	158,450	119,373	88,012	63,279	44,166
8	296,277	237,901	182,845	137,948	101,876	73,388	51,339

Table 18 - Buckling Limits for 35ft Poles (lbs)

Guy Attachment from top of pole (ft)	40 FOOT POLE								
	Class H4	Class H3	Class H2	Class H1	Class 1	Class 2	Class 3	Class 4	Class 5
1	166,225	133,382	105,664	82,508	63,385	47,796	35,276	25,393	17,749
2	180,906	145,240	115,128	89,960	69,163	52,199	38,566	27,795	19,456
3	197,242	158,440	125,667	98,261	75,603	57,110	42,237	30,477	21,363
4	220,419	177,245	140,747	110,199	84,916	64,256	47,617	34,440	24,207
5	241,266	194,109	154,228	120,833	93,179	70,568	52,346	37,903	26,678
6	264,680	213,056	169,379	132,789	102,474	77,672	57,671	41,806	29,464
7	297,604	239,799	190,855	149,815	115,779	87,901	65,389	47,506	33,569
8	328,098	264,502	210,631	165,442	127,946	97,217	72,386	52,647	37,249
9	362,746	292,576	233,116	183,215	141,790	107,821	80,356	58,505	41,447
10	411,120	331,912	264,742	208,323	161,441	122,956	91,801	66,978	47,566
11	457,418	369,465	294,851	232,153	180,029	137,219	102,539	74,890	53,250
12	510,799	412,776	329,587	259,655	201,491	153,693	114,950	84,039	59,826
13	585,009	473,180	378,207	298,303	231,783	177,063	132,656	97,177	69,341

Table 19 - Buckling Limits for 40ft Poles (lbs)

New page. Info on this page was previously found on Pages 3-60 and 3-61.

Copyright 2010 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Guy Attachment from top of pole (ft)	45 FOOT POLE								
	Class H4	Class H3	Class H2	Class H1	Class 1	Class 2	Class 3	Class 4	Class 5
1	129,446	104,125	82,714	63,617	48,984	37,033	26,802	19,325	13,753
2	139,856	112,569	89,485	68,834	53,047	40,145	29,064	20,982	14,964
3	151,309	121,863	96,940	74,580	57,524	43,575	31,558	22,812	16,301
4	167,734	135,257	107,741	82,914	64,058	48,617	35,234	25,532	18,317
5	181,992	146,843	117,049	90,090	69,659	52,917	38,364	27,832	20,007
6	197,789	159,683	127,368	98,046	75,872	57,690	41,838	30,389	21,886
7	220,210	177,992	142,157	109,461	84,840	64,626	46,898	34,144	24,683
8	240,172	194,239	155,232	119,545	92,727	70,697	51,320	37,406	27,090
9	262,475	212,396	169,850	130,820	101,551	77,492	56,271	41,061	29,791
10	293,836	238,039	190,593	146,835	114,156	87,261	63,403	46,367	33,761
11	322,539	261,435	209,454	161,386	125,562	96,061	69,818	51,114	37,281
12	354,942	287,855	230,760	177,826	138,454	106,012	77,074	56,487	41,270
13	400,149	324,864	260,738	200,978	156,705	120,184	87,429	64,210	47,071
14	471,721	383,762	308,719	238,078	186,151	143,220	104,305	76,915	56,750
15	523,529	426,124	342,988	264,538	206,979	159,368	116,096	85,694	63,326
16	595,235	484,969	390,783	301,470	236,191	182,135	132,753	98,178	72,774
17	665,420	542,416	437,310	337,403	264,516	204,129	148,824	110,167	81,784
18	747,031	609,236	491,444	379,213	297,486	229,741	167,541	124,138	92,293
19	859,784	701,857	566,756	437,423	343,589	265,729	193,885	143,922	107,314

Table 20 - Buckling Limits for 45ft Poles (lbs)

New page. Info on this page was previously found on Page 3-61.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Guy Attachment from top of pole (ft)	50 FOOT POLE							
	Class H4	Class H3	Class H2	Class H1	Class 1	Class 2	Class 3	Class 4
1	111,481	90,157	72,049	55,732	43,241	32,257	23,511	17,118
2	122,126	98,890	79,140	61,251	47,604	35,540	25,928	18,924
3	130,992	106,136	84,997	65,801	51,184	38,228	27,902	20,389
4	140,652	114,033	91,384	70,764	55,091	41,161	30,056	21,989
5	154,487	125,401	100,630	77,964	60,796	45,458	33,223	24,363
6	166,248	135,028	108,427	84,026	65,576	49,050	35,864	26,330
7	179,132	145,578	116,975	90,673	70,821	52,992	38,763	28,490
8	197,393	160,604	129,215	100,210	78,393	58,701	42,974	31,656
9	213,259	173,612	139,769	108,422	84,882	63,582	46,567	34,340
10	230,752	187,959	151,414	117,483	92,047	68,973	50,536	37,307
11	255,303	208,188	167,916	130,349	102,280	76,694	56,238	41,604
12	277,143	226,121	182,490	141,696	111,266	83,460	61,223	45,339
13	301,408	246,052	198,695	154,313	121,262	90,988	66,772	49,499
14	335,159	273,895	221,441	172,056	135,399	101,663	74,662	55,459
15	365,964	299,226	242,061	188,119	148,145	111,268	81,747	60,783
16	400,511	327,643	265,202	206,149	162,457	122,057	89,706	66,766
17	448,196	367,027	297,417	231,290	182,521	137,217	100,921	75,258
18	492,966	403,893	327,473	254,718	201,145	151,265	111,293	83,071
19	543,763	445,734	361,597	281,320	222,300	167,226	123,080	91,955
20	613,473	503,370	408,798	318,175	251,754	189,496	139,568	104,466

Table 21 - Buckling Limits for 50ft Poles (lbs)

New page. Info on this page was previously found on Page 3-62.

Copyright 2010 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Guy Attachment from top of pole (ft)	55 FOOT POLE							
	Class H4	Class H3	Class H2	Class H1	Class 1	Class 2	Class 3	Class 4
1	98,214	78,456	61,841	48,949	37,412	28,045	20,559	15,066
2	104,694	83,654	65,956	52,247	39,949	29,961	21,974	16,123
3	111,689	89,266	70,401	55,811	42,690	32,032	23,506	17,268
4	121,834	97,422	76,877	61,037	46,724	35,089	25,776	18,980
5	130,181	104,122	82,186	65,301	50,007	37,571	27,613	20,357
6	139,227	111,385	87,943	69,926	53,569	40,265	29,608	21,853
7	152,208	121,827	96,239	76,634	58,752	44,198	32,532	24,065
8	163,092	130,570	103,172	82,213	63,052	47,453	34,945	25,878
9	174,944	140,091	110,724	88,293	67,739	51,002	37,576	27,857
10	191,773	153,637	121,493	97,015	74,483	56,125	41,390	30,750
11	206,172	165,210	130,678	104,420	80,197	60,454	44,603	33,173
12	221,936	177,881	140,736	112,533	86,458	65,200	48,126	35,830
13	244,096	195,729	154,933	124,050	95,370	71,977	53,177	39,671
14	263,471	211,310	167,307	134,045	103,089	77,832	57,528	42,961
15	284,819	228,481	180,945	145,066	111,602	84,291	62,329	46,593
16	314,549	252,436	200,011	160,556	123,599	93,422	69,141	51,786
17	341,151	273,842	217,022	174,320	134,238	101,501	75,152	56,342
18	370,692	297,616	235,917	189,615	146,062	110,482	81,835	61,411
19	411,480	330,498	262,101	210,918	162,574	123,059	91,227	68,587
20	448,913	360,635	286,066	230,341	177,600	134,480	99,734	75,052

Table 22 - Buckling Limits for 55ft Poles (lbs)

New page. Info on this page was previously found on Page 3-63.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Strut Length (feet)	Strut Height Below Guy Attachment Height (feet)	Strut Factor	Strut Length (feet)	Strut Height Below Guy Attachment Height (feet)	Strut Factor
8	6	1.250	10	6	1.166
8	7	1.329	10	7	1.221
8	8	1.414	10	8	1.281
8	9	1.505	10	9	1.345
8	10	1.601	10	10	1.414
8	11	1.700	10	11	1.487
8	12	1.803	10	12	1.562
8	13	1.908	10	13	1.640
8	14	2.016	10	14	1.720
8	15	2.125	10	15	1.803
8	16	2.236	10	16	1.887
8	17	2.349	10	17	1.972
8	18	2.462	10	18	2.059
8	19	2.577	10	19	2.147
8	20	2.693	10	20	2.236
8	21	2.809	10	21	2.326
8	22	2.926	10	22	2.417
8	23	3.044	10	23	2.508
8	24	3.162	10	24	2.600

Table 23 - Strut Factors

New page. Info on this page was previously found on Page 3-76.

Copyright 2010 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

New page. Info on this page was previously found on Page 3-77.

Sidewalk/Strut Guy Pole Loading Factors
Allowable Pole Design Compression at Guy Attachment Point (Ca)

Guy attachment from top of pole	35 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
2'	71,089	53,351	39,161	28,009
3'	77,851	58,500	43,002	30,809
4'	85,495	64,323	47,350	33,981
5'	94,172	70,938	52,294	37,591
6'	104,068	78,488	57,941	41,720

Guy attachment from top of pole	40 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
2'	56,623	42,749	31,595	22,782
3'	61,337	46,364	34,315	24,782
4'	66,578	50,385	37,342	27,012
5'	72,423	54,873	40,723	29,505
6'	78,964	59,898	44,513	32,301

Guy attachment from top of pole	45 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
2'	46,876	35,590	25,864	18,755
3'	50,363	38,281	27,860	20,233
4'	54,191	41,238	30,054	21,861
5'	58,404	44,495	32,473	23,657
6'	63,053	48,090	53,147	50,965

Guy attachment from top of pole	50 Foot Pole		
	Class 1	Class 2	Class 3
2'	39,963	29,868	21,818
3'	42,658	31,920	23,350
4'	45,589	34,154	25,433
5'	48,783	36,590	26,839
6'	52,270	39,251	28,830

Table 24 - Sidewalk/Strut Guy Pole Loading Factors (Ca)

These tables are for Grade C Construction. For Grade B Construction, multiply each value by .76.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Sidewalk/Strut Guy Pole Loading Factors
Allowable Pole Design Moment at the Strut location on the pole (Ma)

Strut attachment from top of pole	35 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
20’	92,710	75,424	60,433	47,572
18’	86,337	70,105	56,046	44,006
16’	80,263	65,042	51,878	40,622
14’	74,480	60,228	47,921	37,417
12’	68,983	55,659	44,171	34,384
10’	63,762	51,326	40,622	31,521
6'	58,812	47,224	37,268	28,820

Strut attachment from top of pole	40 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
24’	105,962	86,948	70,357	56,024
22’	99,021	81,086	65,459	51,981
20’	92,391	75,494	60,794	48,138
18’	86,063	70,165	56,356	44,489
16’	80,030	65,092	52,139	41,029
14’	74,287	60,270	48,138	37,754
12'	68,825	55,693	44,347	34,658

Strut attachment from top of pole	45 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
30’	128,270	106,313	84,142	67,720
28’	120,404	99,594	78,765	63,231
26’	112,867	93,164	73,622	58,946
24’	105,650	87,017	68,708	54,859
22’	98,748	81,146	64,018	50,965
20’	92,153	75,546	59,546	47,260
18'	85,859	70,209	55,287	43,739

Strut attachment from top of pole	50 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
34'	144,595	117,142	93,404	75,742
32'	136,092	110,164	87,759	70,991
30'	127,928	103,470	82,346	66,442
28'	120,098	97,052	77,160	62,092
26'	112,594	90,905	72,197	57,936
24'	105,410	85,024	67,452	53,970
22'	98,537	79,401	62,919	50,189

Table 25 - Sidewalk/Strut Guy Pole Loading Factors (Ma)

New page. Info on this page was previously found on Page 3-78.

Copyright 2010 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Strut Length	Standard Weight Galvanized Pipe	
(Ft.)	2 Inches	2 ½ Inches
6	21,175	38,386
7	17,922	34,289
8	14,959	30,890
9	12,166	26,248
10	9,876	22,253
11	8,089	18,760
12	6,816	15,691

Table 26 - Pipe Strut Compression Capacity (lbs)

New page. Info on this page was previously found on Page 3-79.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Guy Attachment Height on Pole Above Ground (feet)	Guy Lead Length from Center of Pole to Anchor (feet)																			
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
20	3.027	2.693	2.437	2.236	2.075	1.944	1.835	1.744	1.667	1.601	1.544	1.495	1.452	1.414	1.381	1.351	1.325	1.302	1.281
21	3.162	2.809	2.539	2.326	2.155	2.016	1.900	1.803	1.720	1.650	1.589	1.537	1.491	1.450	1.414	1.382	1.354	1.329	1.306
22		2.926	2.641	2.417	2.236	2.088	1.966	1.863	1.775	1.700	1.635	1.579	1.530	1.487	1.448	1.414	1.384	1.357	1.332
23		3.044	2.744	2.508	2.318	2.162	2.032	1.923	1.831	1.751	1.682	1.623	1.570	1.524	1.483	1.447	1.414	1.385	1.359
24		3.162	2.848	2.600	2.400	2.236	2.100	1.985	1.887	1.803	1.730	1.667	1.611	1.562	1.519	1.480	1.445	1.414	1.386
25			2.952	2.693	2.483	2.311	2.168	2.047	1.944	1.855	1.778	1.711	1.653	1.601	1.555	1.514	1.477	1.444	1.414
26			3.057	2.786	2.566	2.386	2.236	2.109	2.001	1.908	1.827	1.757	1.695	1.640	1.592	1.548	1.509	1.474	1.443
27			3.162	2.879	2.650	2.462	2.305	2.172	2.059	1.962	1.877	1.803	1.738	1.680	1.629	1.583	1.542	1.505	1.472
28				2.973	2.735	2.539	2.375	2.236	2.118	2.016	1.927	1.849	1.781	1.720	1.667	1.619	1.575	1.537	1.501
29				3.068	2.820	2.615	2.445	2.300	2.177	2.070	1.977	1.896	1.825	1.761	1.705	1.655	1.609	1.568	1.532
30				3.162	2.905	2.693	2.515	2.365	2.236	2.125	2.028	1.944	1.869	1.803	1.744	1.691	1.644	1.601	1.562
31					2.990	2.770	2.586	2.430	2.296	2.180	2.080	1.991	1.914	1.845	1.783	1.728	1.678	1.634	1.593
32					3.076	2.848	2.657	2.495	2.356	2.236	2.131	2.040	1.959	1.887	1.823	1.765	1.713	1.667	1.624
33					3.162	2.926	2.728	2.560	2.417	2.292	2.184	2.088	2.004	1.929	1.863	1.803	1.749	1.700	1.656
34						3.005	2.800	2.626	2.477	2.349	2.236	2.137	2.050	1.972	1.903	1.841	1.785	1.734	1.688
35						3.083	2.872	2.693	2.539	2.405	2.289	2.187	2.096	2.016	1.944	1.879	1.821	1.768	1.720
36						3.162	2.944	2.759	2.600	2.462	2.342	2.236	2.142	2.059	1.985	1.918	1.857	1.803	1.753
37							3.017	2.826	2.662	2.519	2.395	2.286	2.189	2.103	2.026	1.957	1.894	1.838	1.786
38							3.089	2.893	2.724	2.577	2.449	2.336	2.236	2.147	2.067	1.996	1.931	1.873	1.819
39							3.162	2.960	2.786	2.635	2.503	2.386	2.283	2.191	2.109	2.035	1.969	1.908	1.853
40								3.027	2.848	2.693	2.557	2.437	2.331	2.236	2.151	2.075	2.006	1.944	1.887
41								3.095	2.911	2.751	2.611	2.488	2.378	2.281	2.194	2.115	2.044	1.979	1.921
42								3.162	2.973	2.809	2.665	2.539	2.426	2.326	2.236	2.155	2.082	2.016	1.955
43									3.036	2.868	2.720	2.590	2.474	2.371	2.279	2.196	2.120	2.052	1.990
44									3.099	2.926	2.775	2.641	2.522	2.417	2.322	2.236	2.159	2.088	2.024
45									3.162	2.985	2.830	2.693	2.571	2.462	2.365	2.277	2.197	2.125	2.059
46										3.044	2.885	2.744	2.619	2.508	2.408	2.318	2.236	2.162	2.094
47										3.103	2.940	2.796	2.668	2.554	2.451	2.359	2.275	2.199	2.129
48										3.162	2.995	2.848	2.717	2.600	2.495	2.400	2.314	2.236	2.165
49											3.051	2.900	2.766	2.646	2.539	2.441	2.353	2.273	2.200
50											3.107	2.952	2.815	2.693	2.582	2.483	2.393	2.311	2.236

Table 27 - Guy Factors

New page. Info on this page was previously found on Page 3-74.

Copyright 2010 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 03.00.001

3.7 Worksheets and Examples

The following worksheets are provided to assist in determining the appropriate pole class for tangent distribution pole structures. The method followed by the worksheet is valid for span lengths with a ratio less than 3:1. For span lengths that have a ration of 3:1 or greater, apply the wind load perpendicular on the longest span. The wind applied to the shorter span shall be multiplied by the cosine of the line angle.

The worksheets are divided into three sections:
1. Axial load due to wind on conductors and equipment.
2. Weight of conductors and equipment on the pole.
3. Axial load due to conductor tension.

Step	Action
1	Fill in the appropriate information on the worksheet.
2	Subtotal the separate sections of the worksheet.
3	Calculate the total axial load that will be applied to the pole.
4	Select the appropriate pole. **3.4** Select the Axial Loading table for the pole height used. **3.5** Determine the lowest guy attachment point on the pole **3.6** Choose the lowest pole class that will support the axial load imposed upon the pole. **Note:** There are circumstances where if the communications utilities were to be removed that a greater pole class would be required to support the electric utilities facilities. Therefore, always select the highest pole class determined from the worksheet.

Table 28 - Worksheet Instructions

New page. Info on this page was previously found on Page 3-59.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

3.7.10 Angle Pole Worksheet - 0° to 60°

Transverse Load Due to Wind

Conductor Name/Size	Number of Cond.		Ave. Span Length of Conductor (ft)		Transverse Load of Conductor or Equipment (lbs)		Cosine of 1/2 the line angle		H/L of the guy supporting the conductors		Total Axial Load on the pole (lbs)
Primary Distribution Conductor(s)											
		X		X		X		X		=	
		X		X		X		X		=	
		X		X		X		X		=	
Neutral Conductors											
		X		X		X		X		=	
Secondary Conductors											
		X		X		X		X		=	
		X		X		X		X		=	
Communications Conductor(s)											
		X		X		X		X		=	
		X		X		X		X		=	
		X		X		X		X		=	
		X		X		X		X		=	
Service Conductor(s)											
		X		X		X		X		=	
		X		X		X		X		=	
Equipment											
								X		=	
								X		=	
								X		=	
Transverse Axial Loading Due to Wind										=	

Weight of Conductors and Equipment

Conductor Name/Size	Number of Conductors or Equipment		Average Span of Conductor		Wt. per ft w/ice of Cond. Or Wt of Equip. (lbs)		Total
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
Weight of Conductors and Equipment						=	

New page. Info on this page was previously found on Page 3-65.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

7/18 – Revised footnote to refer to correct tables.

Transverse Load Due to Conductor Tension

Conductor Name/Size	Number of Cond.		Max. Cond. Tension (See Section 6)		Sine of 1/2 the line angle		H/L of the guy supporting the conductors		Axial Load on the pole (lbs)
Primary Distribution Conductor(s)									
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
Neutral Conductor									
		X		X		X		=	
Secondary Conductor(s)									
		X		X		X		=	
		X		X		X		=	
Communications Conductor(s)									
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
Transverse Axial Loading Due to Conductor Tension								=	

Transverse Axial Loading Due to Service Conductor Tension

Conductor Name/Size	Number of Cond.		Max. Cond. Tension (See Section 6)		Sine of 1/2 the line angle		H/L of the guy supporting the conductors		Axial Load on the pole (lbs)
Service Conductors									
		X		X		X		=	
		X		X		X		=	
Transverse Axial Loading Due to Service Conductor Tension								=	

	Transverse Axial Loading Due to Wind (lbs)		Wt of Cond. And Equipment (lbs)		Transverse Axial Loading Due to Cond. Tension (lbs)		Transverse Axial Loading Due to Service Cond. Tension (lbs)		Grade C & B Overload Capacity Factor	
Total Axial Load Applied to Pole =	(	+		+		+	)	X	**2.20**	

Refer to the appropriate pole buckling limit table (Tables 17-22) based on pole height to determine the correct class of pole to install.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

3.7.20 Deadend Pole Worksheet

Transverse Load Due to Wind

Conductor Name/Size	Number of Cond.		1/2 of the span length (ft)		Transverse Load of Cond. (lbs)		H/L of the guy supporting the conductors		Axial Load on the pole (lbs)
Primary Distribution Conductor(s)									
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
Neutral Conductor									
		X		X		X		=	
Secondary Conductor									
		X		X		X		=	
Communications Conductor(s)									
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
Equipment									
						X		=	
						X		=	
Transverse Axial Loading Due to Wind								=	

Transverse Load Due to Wind on Service Conductors

Conductor Name/Size	Number of Cond.		Avg. span length of Cond. (ft)		Transverse load of Cond. (lbs)		Cosine of the line Angle		H/L of the guy supporting the conductors		Total Axial Load on Pole (lbs)
Service											
		X		X		X		X		=	
		X		X		X		X		=	
Transverse Axial Loading Due to Wind on Service Conductors										=	

New page. Info on this page was previously found on Page 3-67.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Weight of Conductors and Equipment

Conductor or Equipment Name/Size	Number of Conductors or Equipment		Average Span of Conductors		Wt per ft w/ice of Cond. Or Wt of Equipment (lbs)		Total
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
Transverse Load Due to Conductor Tension						=	

Transverse Load Due to Conductor Tension

Conductor or Equipment Name/Size	Number of Conductors or Equipment		Average Span of Conductors		Wt per ft w/ice of Cond. Or Wt of Equipment (lbs)		Total
Primary Distribution Conductor(s)							
		X		X		=	
		X		X		=	
		X		X		=	
Neutral Conductor							
		X		X		=	
Secondary Conductors							
		X		X		=	
		X		X		=	
Communications Conductor(s)							
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
Transverse Axial Loading Due to Conductor Tension						=	

New page. Info on this page was previously found on Page 3-68.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 03.00.001

Transverse Loading Due to Service Conductor Tension

Conductor Name/Size	Number of Cond.		Max. cond. Tension (See Section 6)		Sine of 1/2 of the line angle		H/L of the guy supporting the conductors		Axial Load on Pole (lbs)
Service Conductor(s)									
		X		X		X		=	
		X		X		X		=	
Transverse Axial Loading Due to Service Conductor Tension								=	

	Trans. Axial Loading Due to Wind (lbs)		Trans. Axial Loading Due to Wind on Serv. Cond.		Wt of Equipment		Trans. Axial Loading Due to Cond. Tension (lbs)		Trans. Axial Loading Due to Serv. Cond. Tension (lbs)		Grade C & B Overload Capacity Factor		
Total Axial Load Applied to Pole =	(	+		+		+		+	)	X	2.20	=	

Refer to the appropriate pole buckling limit table (Tables 17-22) based on pole height to determine the correct class of pole to install.

RESULTS

Enter information below. Select the highest pole class from the results.

Participants of Pole	Guy Lead (ft)	Lowest Guy Attachment from top of pole (ft)	Pole Class
Electric and Communications Conductors			
Electric (one guy)			
Electric (two guys)			

EXAMPLE: Line design requires a 45 ft. pole with a calculated Total Axial Load of 19,000 lbs. determined by using the worksheet above. Look up 19,000 lbs in Table 19 for a 45 ft pole and start with the lowest guy attachment. For this example, assume a 15 ft. guy attachment (Communications guy), 1 ft. guy attachment (Electric primary guy) and 8 ft. guy attachment (Electric secondary guy if used) and record results in the table below. Select the highest class pole so if communications are removed from a pole, the pole is still strong enough for the remaining electric facilities.

Participants of Pole	Guy Lead	Lowest Guy Attachment from top of pole	Pole Class
Electric and Communications Conductors	**15 ft**	**15 ft**	**5**
Electric (one guy)	**15 ft**	**1 ft**	**4**
Electric (two guys)	**15 ft**	**8 ft**	**5**

In this example, the highest class pole is a Class 4 pole which would be the correct selection.

7/18 – Revsied footnote below second table to refer to correct tables.

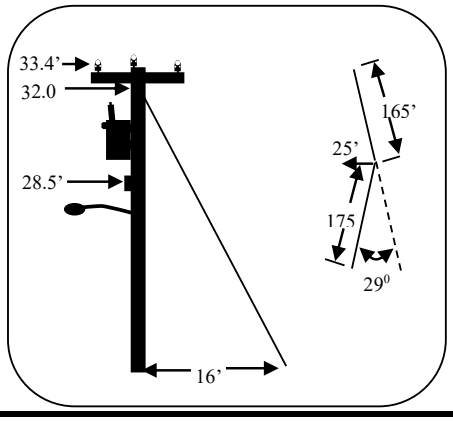
Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 03.00.001

Supersedes issue 7/17 – Revised Wind Load Tensions (WLT) for 3 – 477 Kcmil AL bare.

3.7.30 EXAMPLE #1: ANGLE GUYING

Given:

15 kV class construction
150 ft. ruling span
175 ft. actual front span
165 ft. actual back span
1 – 40 ft., class 3 wood pole
3 – 477 kcmil Al AAC bare conductors (W21BA)
1 – 3/c – 1/0 Al triplex secondary cable (W15C)
1 street light (attachment height = 27 ft.)
1 – 50 kVA transformer
(attachment height = 30 ft.)
Corner Pull – 25 ft. or 29 degrees
Grade B construction
Soil Classification = 4



Transverse Wind Loading: Steps 1-6

Step	Action	Use
1	Determine Conductor Wind Load Tensions (WLT) from Sections 6 and 11.	3 - 477 kcmil Al bare (W21BA) = 0.598 lbs./ft. 1 - 3/c 1/0 Al triplex secondary cable (W15C) = 0.666 lbs./ft.
2	Calculate Total Conductor Wind Load Tension.	Total Conductor Wind Load Tension (WLT) = (No. of Conductors) x (Conductor WLT) x $\frac{\text{(Back Span + Front Span)}}{2}$ x (Conductor/Equipment Height /Guy Height) Total Conductor Wind Load Tension = *(3 x 0.598 lbs. / ft.) x ((175 ft. + 165 ft.) / 2) x (33.4/32) +* *(1 x 0.666 lbs. / ft.) x ((175 ft. + 165 ft.) / 2) x (28.5/32) = 419.16 lbs.*
3	Determine and calculate Total Equipment Wind Load Tension from Table 15 and Table 16.	Equipment Wind Load = Wind load x (Attachment height/Guy height) 1 – 40 ft. Class 3 wood pole (Table 16) = 106 lbs x (17 ft./32 ft.) = **57 lbs.** 1 – 50 kVA transformer (Table 15) = 42 lbs x (30 ft./32 ft.) = **40 lbs.** 1 – streetlight (Table 15) = 13 lbs x (27 ft./32 ft.) = **11 lbs.** Total Equipment Transverse Wind Load = **108 lbs.**
4	Calculate Transverse Wind Loading.	Transverse Wind Loading = (Total Conductor Transverse Wind Loading) + (Total Equipment Transverse Wind Loading) Transverse Wind Loading – 419.16 lbs. + 108 lbs. = 527.16 lbs.
5	Determine Construction Grade Overload Factor from Table 11.	Grade B, Transverse Loads: Wind, Overload Factor = 2.50
6	Calculate Total Transverse Wind Loading.	Total Transverse Wind Loading = (Transverse Wind Loading) x (Overload Factor) Total Transverse Wind Loading = 527.16 lbs. x 2.50 = **1,317.9 lbs**.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

EXAMPLE #1: ANGLE GUYING (continued)

Transverse Wire Tension Steps 7-11

Step	Action	Use
7	Determine Conductor Tensions from Section 6 and Section 10	3 - 477 kcmil Al AAC bare (W21BA) = 2,000 lbs. 1 - 3/c 1/0 Al triplex secondary cable (W15C) = 1,925 lbs.
8	Calculate Total Tension at the guy attachment height.	Total Conductor Tension = $(No.ofConductors)x\left(\frac{ConductorHeight}{GuyHeight}\right)x(ConductorTension)$ Total Conductor Tension = $\left(3x\frac{33.4\,ft.}{32.0\,ft}x2{,}000lbs.\right)+\left(1x\frac{28.5\,ft.}{32.0\,ft.}x1{,}925lbs.\right)=7{,}977lbs.$
9	Determine Line Angle Factor from Table 13.	Pull = 25 ft.; Line Angle = 29 degrees; Line Angle Factor = 0.5008
10	Determine Construction Grade Overload Factor from Table 11.	Grade B, Transverse loads: Wire Tension, Overload Factor = 1.65
11	Calculate Transverse Wire Tension.	Transverse Wire Tension = (Total Conductor Tension) x (Line Angle Factor) x (Overload Factor) Transverse Wire Tension = 7,977 lbs. x 0.5008 x 1.65 = 6,592 lbs.

Anchor Guy Requirements Steps 12-17

Step	Action	Use
12	Calculate Total Transverse Tension.	Total Transverse Tension = (Transverse Wind Loading) + (Transverse Wire Tension) Total Transverse Tension = 1,317.9 lbs. + 6,592 lbs. = 7,09.9 lbs.
13	Determine Guy Factor from Table 27	Guy Height = 32.0 ft.; Guy Lead = 16 ft.; Guy factor = 2.236
14	Calculate Total Tension in guy wire and anchor.	Tension (guy wire) = (Total Transverse Tension) x (Guy Factor) Tension (guy wire) = 7,909.9 lbs. x 2.236 = 17,686.5 lbs. Tension in guy wire = tension in anchor (except sidewalk guys)
15	Determine guy wire Strength Factor from Table 12.	Grade B, guy wire, Strength Factor = 0.9 Grade B, anchor, Strength Factor = 1.0
16	Determine Guy Wire and Anchor Requirements.	Guy Wire Req. = $\frac{Tension(GuyWire)}{StrengthFactor}=\frac{17{,}686.5}{.9}=19{,}651.7lbs.$ Anchor Req. = $\frac{Tension(Anchor)}{StrengthFactor}=\frac{17{,}686.5}{1.0}=17686.5lbs.$
17	Determine Guy Components from Table 2, Table 4, Table 7, etc.	**Guy Wire Required = 19,651.7 lbs**. Use a 25M guy (looped 12.5M guy wire) (G15A) with one 54 in. strain insulator (30,000 lbs.) (TI95C) **Anchor Required = 17,686.5 lbs** Soil Class = 4 Use one 14 in. Helix (A16B) with one 1in. x 7 ft. rod (A18K)

Supersedes 7/17 issue – Calculation revised due to change in 3 -477 kcmil WLT.

Note: Refer to Section 3.7.10 Angle Pole Worksheet - 0° to 60° to ensure pole meets buckling requirements.

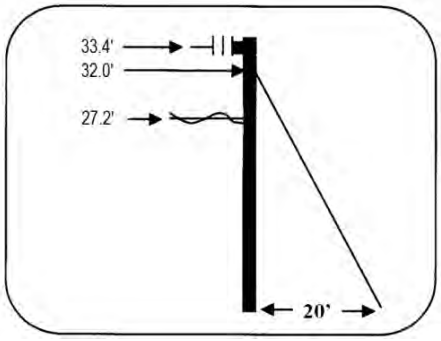
Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/10 Issue – Revised secondary attachment point per 9-417

3.7.40 EXAMPLE #2: DEADEND GUYING

Given:

15 kV class construction
150 ft. ruling span
1 – 40 ft., class 3 wood pole
3 – 1/0, Al AAAC, bare conductors (W14B)
1 – 3/c – 1/0 Al. triplex secondary cable ((W15C)
Grade C construction
Soil Classification = 4



Transverse Wire Tension: Steps 1-8

Step	Action	Use
1	Determine Conductor Tensions from Section 6 and Section 10	1 - 1/0 Al AAAC, bare (W14B) = 2,000 lbs. 1 - 3/c 1/0 Al secondary cable (W15C) = 1,925 lbs.
2	Calculate Total Conductor Tension at the guy attachment height	Total Conductor Tension = $(No.ofConductors)x\left(\frac{ConductorHeight}{GuyHeight}\right)x(ConductorTension)$ Total Conductor Wind Load Tension = $\left(3x\frac{33.4\ ft.}{32.0\ ft.}x2{,}000lbs.\right)+\left(1x\frac{27.2\ ft.}{32.0\ ft.}x1{,}925lbs.\right)=7{,}899lbs.$
3	Determine Guy Factor from Table 27	Guy Height = 32.0 ft.; Guy Lead = 20 ft.; Guy Factor = 1.887
4	Determine Construction grade Overload Factor from Table 11.	Grade C, Longitudinal loads: Deadends, Overload Factor = 1.10
5	Calculate Tension in guy wire and anchor	Tension (guy wire) = (Total Conductor Tension) x (Guy Factor) x (Overload Factor) Tension (guy wire) = 7,899 lbs. x 1.887 x 1.10 = 14,906 lbs. Tension in guy wire – tension in anchor (except sidewalk guys).
6	Determine guy wire and anchor Strength Factor from Table 12.	Grade C, guy wire, Strength Factor = 0.9 Grade C, anchor, Strength Factor = 1.0
7	Determine guy wire and anchor requirements	$GuyWire\ \mathrm{Re}q.=\frac{Tension(GuyWire)}{(StrengthFactor)}=\frac{14{,}906lbs.}{0.9}=16{,}562lbs.$ $Anchor\ \mathrm{Re}q.=\frac{Tension(anchor)}{(StrengthFactor)}=\frac{14{,}906lbs.}{1.0}=14{,}906lbs.$
8	Determine Guy Components from Table 2, Table 4, Table 7, etc.	**Guy wire required = 16,562 lbs**. Use a 25M guy (looped 12.5M guy wire) (G15A) with one 54 in. strain insulator (30,000 lbs.) (TI-95B) **Anchor required = 14,906 lbs** Soil class = 4 Use one 10 in. Helix (A16A) with one 1 in. x 7 ft. rod (A18K)

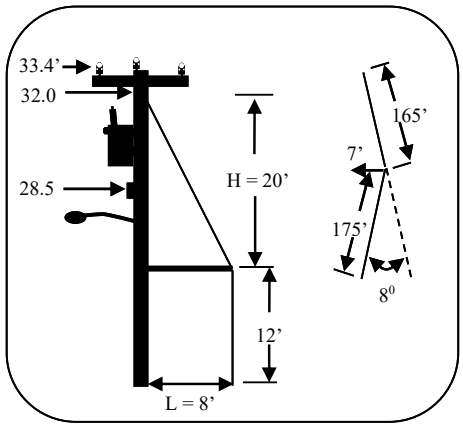
Note: Anchors and anchor rods installed for joint company use must be sized to hold both electric and telephone company conductors and equipment.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 03.00.001

3.7.50 **EXAMPLE #3: SIDEWALK/STRUT GUYING**

Given:

15 kV class construction
150 ft. ruling span
175 ft. actual front span
165 ft. actual back span
1 – 40 ft., class 3 wood pole
3 – 1/0 AAAC, bare conductors (W14B)
1 – 3/c 1/0 Al triplex secondary cable (W15C)
1 – streetlight (attachment height = 27 ft.)
1 – 50 kVA transformer
(attachment height = 30 ft.)
Corner Pull – 7 ft. or 8 degrees
Grade B construction
Pole height above ground – 34 ft.
Soil Classification = 4
Strut attachment from top of pole = 22 ft.



Transverse Wind Loading: Steps 1-6

Step	Action	Use
1	Determine Conductor Wind Load Tensions from Sections 6 and 10.	3- -1/0 Al AAAC, bare (W14B) bare = 0.4656 lbs./ft. 1- 3/c 1/0 Al. triplex secondary cable (W15C) = 0.652 lbs./ft.
2	Calculate Total Conductor Wind Load Tension	Total Conductor Wind Load Tension = (No. of Conductors) x (Conductor WLT) x $\frac{\text{(Back Span + Front Span)}}{2}$ x (Conductor/Equipment Height /Guy Height) Total Conductor Wind Load Tension = $(3x0.4656lbs./\ ft.)x\left(\frac{175\ ft.+165\ ft.}{2}\right)x\frac{33.4}{32}+$ $(1x0.652lbs./\ ft.)x\left(\frac{175\ ft.+165\ ft.}{2}\right)x\frac{28.5}{32}=347lbs.$
3	Determine and calculate Total Equipment Wind Load Tension from Table 15 and Table 16.	Equipment Wind Load = Wind load x (Attachment height/Guy height) 1 – 40 ft. Class 3 wood pole (Table 16) = 125 lbs. x (17 ft./32 ft.) = **66 lbs**. 1 – 50 kVA transformer (Table 15) = 42 lbs. x (30 ft./32 ft.) = **38 lbs.** 1 – streetlight (Table 15) = 13 lbs. x (27 ft./32 ft. = **11 lbs.** Total Equipment Transverse Wind Load = **115 lbs.**
4	Calculate Transverse Wind Loading	Transverse Wind Loading = (Total Conductor Transverse Wind Loading) + (Total Equipment Transverse Wind Loading) Transverse Wind Loading – 347 lbs. + 115 lbs. = 462 lbs
5	Determine Construction Grade Overload Factor from Table 11.	Grade B, Transverse Loads: Wind, Overload Factor = 2.50
6	Calculate Total Transverse Wind Loading	Total Transverse Wind Loading = (Transverse Wind Loading) x (Overload Factor) Total Transverse Wind Loading = 462 lbs. x 2.50 = **1,155 lbs**.

New page. Info on this page was previously found on Page 3-54.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

EXAMPLE #3: SIDEWALK GUYING (continued)

Transverse Wire Tension Steps 7-18

Step	Action	Use
7	Determine Conductor Tensions from Section 6.	3 - 1/0 Al AAAC, bare (W14B) bare = 2,000 lbs. 1 - 3/c 1/0 Al triplex secondary cable (W15C) = 1,925 lbs.
8	Calculate Total Tension at the guy attachment height.	Total Conductor Tension = $(No.ofConductors)x\left(\frac{ConductorHeight}{GuyHeight}\right)x(ConductorTension)$ Total Conductor Tension = $\left(3x\frac{33.4\,ft.}{32.0\,ft}x2{,}000lbs.\right)+\left(1x\frac{28.5\,ft.}{32.0\,ft.}x1{,}925lbs.\right)=7{,}977lbs.$
9	Determine Line Angle Factor from Table 13.	Pull = 7 ft.; Line Angle = 8 degrees; Line Angle Factor = 0.1395
10	Determine Construction Grade Overload Factor from Table 11.	Grade B, Transverse loads: Wire Tension, Overload Factor = 1.65
11	Calculate Transverse Wire Tension	Transverse Wire Tension = (Total Conductor Tension) x (Line Angle Factor) x (Overload Factor) Transverse Wire Tension = 7,977 lbs. x 0.1395 x 1.65 = 1,836 lbs.
12	Calculate Total Transverse Tension	Total Transverse Tension = (Transverse Wind Loading) + (Transverse Wire Tension) Total Transverse Tension = 1,155 lbs. + 1,836 lbs = 2,991 lbs.
13	Calculate Tension on the anchor	Tension (anchor) = (Total Transverse Tension) x (Pole height above ground) / (Strut Length) $Tension(anchor)=2{,}991lbs.x\frac{34\,ft.}{8\,ft.}=12{,}712lbs.$
14	Calculate Compression on the strut	Compression (Strut) = Total Transverse Tension) x (Pole height above ground) / (Guy attach height – strut attach height) $Compression(Strut)=2{,}991lbs.x\frac{(34\,ft.)}{(32\,ft.-12\,ft.)}=5{,}085lbs.$
15	Determine the Strut Factor from Table 23.	Strut length = 8 ft., Guy attachment height less Strut attachment height = 20 ft. Strut Factor = 2.693
16	Calculate tension in guy wire	Tension (guy wire) = (Compression (strut) x Strut Factor) Tension (guy wire) = 5,085 lbs. x 2.693 = 13,694 lbs.
17	Determine guy wire and anchor Strength Factor from Table 12.	Grade C, guy wire, Strength Factor = 0.9 Grade C, anchor, Strength Factor = 1.0
18	Determine guy wire and anchor requirements	$GuyWire\ \mathrm{Re}q.=\frac{Tension(GuyWire)}{StrengthFactor}=\frac{13{,}694lbs.}{0.9}=15{,}216lbs.$ $Anchor\ \mathrm{Re}q.=\frac{Tension(Anchor)}{StrengthFactor}=\frac{12{,}712lbs.}{1.0}=12{,}712lbs.$ Tension (guy wire) will always be greater than tension (anchor) on all sidewalk guying installations.

New page. Info on this page was previously found on Page 3-55.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 03.00.001

EXAMPLE #3: SIDEWALK GUYING (continued)

Transverse Wire Tension (continued) Step 19

Step	Action	Use
19	Determine Guy Components from Table 2, Table 4, Table 7, etc.	**Guy required = 15,443 lbs.** Use a 25M guy (looped 12.5M guy wire) (G15A) with one 54 in. strain insulator (30,000 lbs.)(TI-95B) **Anchor required = 12,903 lbs.** Soil class = 4 Use one 10 in. Helix (A16A) with one 1 in. x 7 ft. rod (A18K)

Pole Moment & Compression Strength Steps 20-26

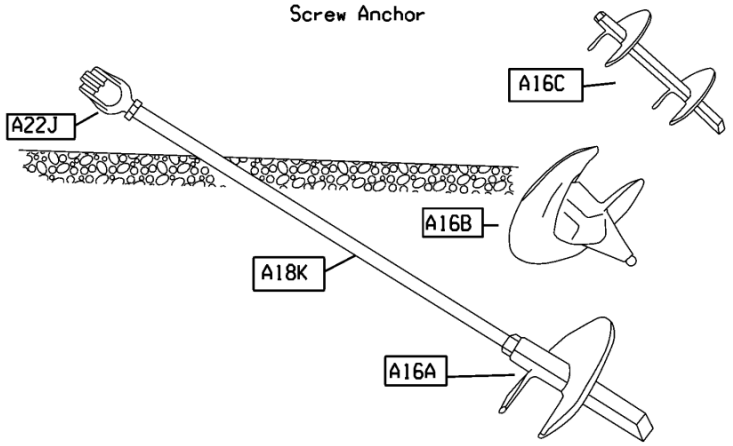
Step	Action	Use
20	Determine Pole Moment (M) and Compression (CC)	M equals (Pole height above ground minus distance between guy attachment and strut attachment (H) times horizontal load). CC equals anchor tension determined from Step 13.
21	Calculate Pole Moment (M)	M = (34 ft. – 20 ft.) x 2,991lbs. = **41,874 ft-lbs**.
22	Calculate Compression (CC)	From Step 13, CC = **12,712 lbs**.
23	Determine lowest guy attachment from top of pole	Lowest guy attachment is 2 ft. from top of pole
24	Determine allowable Pole Moment (Ma) and Compression (Ca) from Table 25 and Table 24.	A safely loaded pole is determined by the equation **CC/Ca + M/Ma<1**
25	Calculate if Pole Size and Class are adequate for attached load.	From Sidewalk/Strut guy Pole Loading Factor Tables for a 40 ft., Class 3 pole Calculate if CC/Ca + M/Ma<1 Lowest guy attachment is 2 ft. from top of pole: **Ca** = **31,595** from Table 24 Strut attachment 22 ft. from top of pole: **Ma** = **65,459** from Table 25 **CC = 12,712** from Step 13 **M = 41,874** from Step 21 Therefore, (12,712/31,595) + (41,874/65,459) = **1.04**
26	Determine if pole is adequate	Since 1.04 is more than 1, a 40 ft. Class 3 pole is not adequate so a 40 ft. Class 2 pole is required.

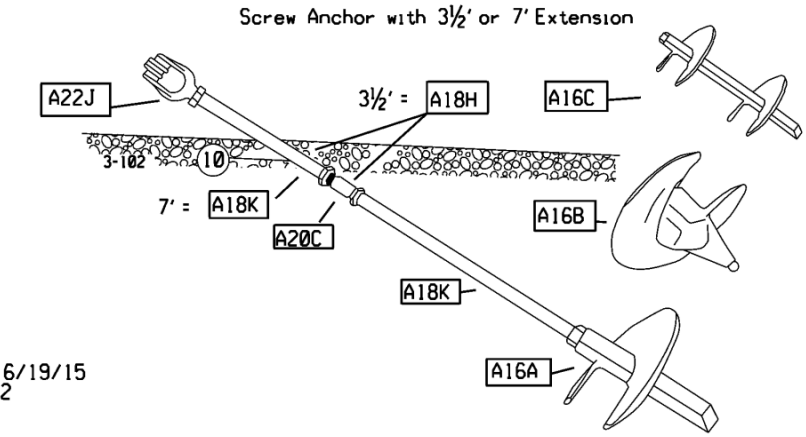
New page. Info on this page was previously found on Page 3-56.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.

Supersedes 7/09 Issue – Eliminated anchor stick-up of 6" -10", added flight embedment requirement, and added CU note





To achieve maximum holding capacity, the torque applied should approach 5,500 foot-pounds and the upper-most anchor flight shall be a minimum of 5 times the largest flight diameter below grade. This can be translated to hydraulic auger gauge pressure (psi) per the following table.

Hydraulic Auger Gauge Pressure (psi)	Applied Torque Low Speed (ft.-lbs.)	Predicted Holding Capacity (lbs.)	
		10" Screw Anchor Helix	14" Screw Anchor Helix
750	1,600	11,200	16,000
1,000	3,250	22,750	25,000
1,250	5,000	34,000	37,000

Notes:

1. To assure an adequate screw anchor installation, use these values if the digger has a hydraulic auger pressure gauge. Contact Standards to confirm that your digger has the gauges necessary to utilize this information. The digger operator should notify the designer / engineer what anchor holding strength was achieved based on applied auger gauge pressure. If the desired holding strength is not achieved, continue installing the anchor rod deeper with a 3.5 ft. or 7 ft. extension rod. If the desired holding strength is still not achieved, consider installing a second anchor rod with additional guys.
2. Disturb the soil as little as possible.
3. Maintain alignment during installation.
4. Do not use more than one (1) extension rod per installation.

SCREW ANCHOR			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-102	7/16

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.

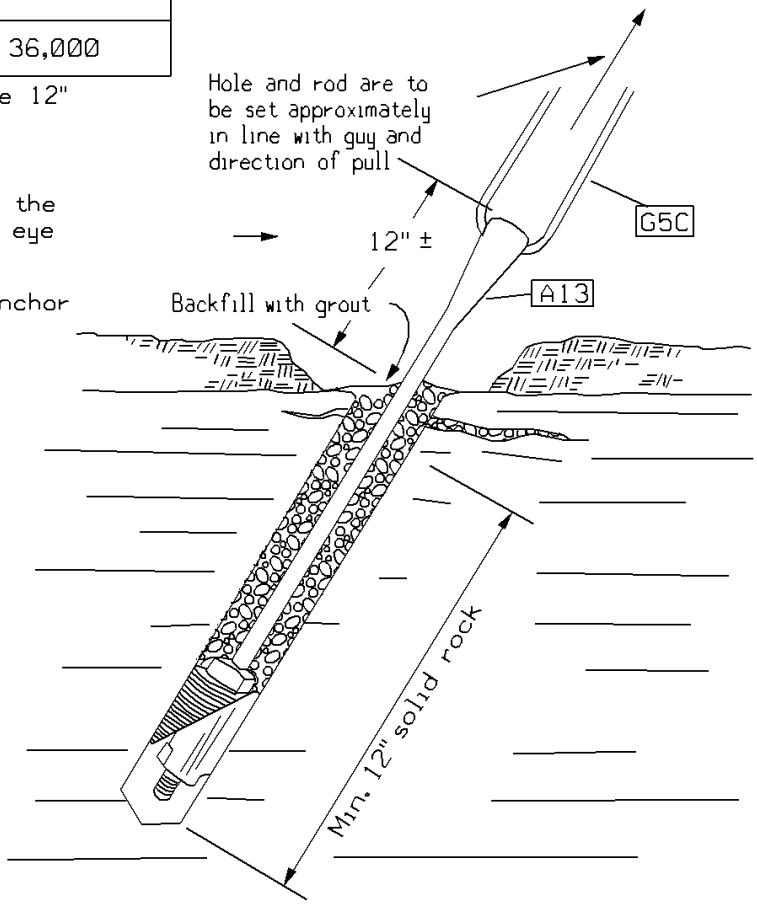
Guidelines for Installation of the expanding rock anchor are as follows:

1. Remove the soil to the top of the rock layer.

2. Drill the properly sized hole, in line with the final installed guy angle, into the solid rock. The drill hole must be clean and smooth and sized per the chart below.

Anchor Rod Diameter	Anchor Size	Required Hole Size	Holding Strength (lbs)
1"	2¼"	2⅜"	36,000

Minimum depth for the hole should be 12" into the solid rock.



3. Insert the unexpanded anchor into the hole and insert a bar through the eye of the anchor rod.

4. Turn the bar clockwise until the anchor is firmly expanded against the sides of the hole.

5. Test pull the anchor before backfilling by applying a load in the direction of the final guy angle. If the anchor is properly set, there should be no movement or creep of the anchor while applying the test load. If creep does occur (under load) corrective action is required, since this movement would indicate that the anchor is set in soft, weathered rock or possibly in a rock joint or fracture zone in the rock.

6. Where corrective action is necessary, additional drilling into sound rock and resetting of the anchor should be attempted. Where the rock is indicated to be soft or weathered, the installation of a twin 4" screw anchor should be attempted.

7. Rock anchors shall be backfilled with a sand-cement grout to keep out surface water that could result in deterioration of the rock through freezing and thawing.

Supersedes 7/07 Issue – Added CU note.

ROCK ANCHOR			
ISSUE	**PAGE NUMBER**		
7/16	**3-103**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.

Use this hand-dug anchor when a screw anchor cannot be installed due to surrounding obsticles such as cable or pipes.

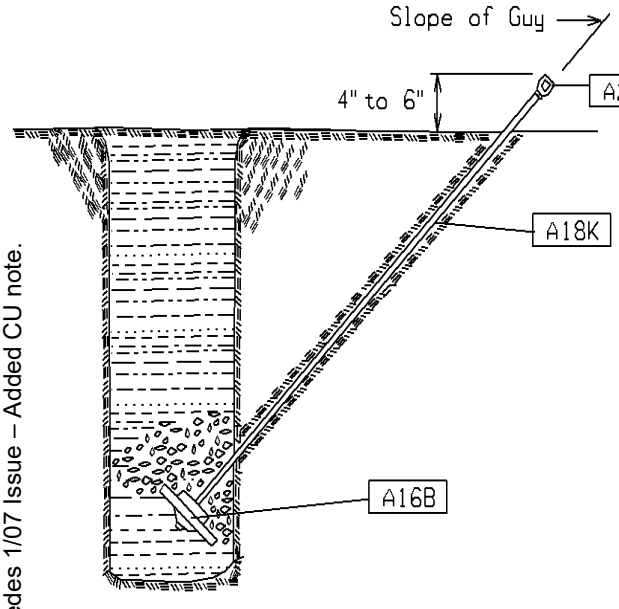


Figure 1

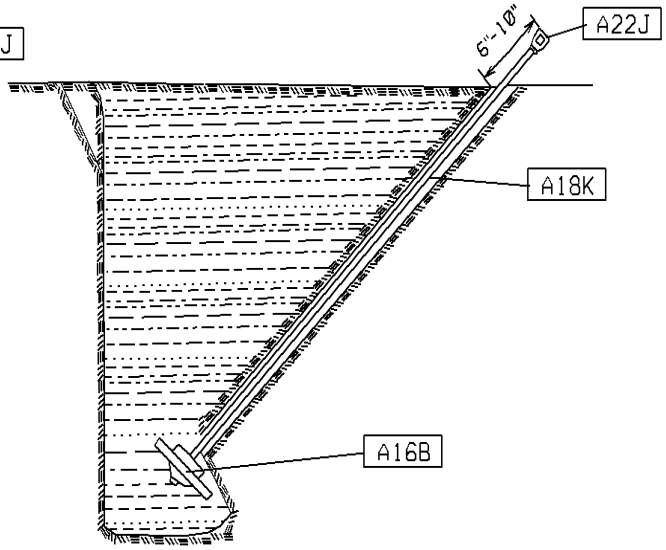


Figure 2

Supersedes 1/07 Issue – Added CU note.

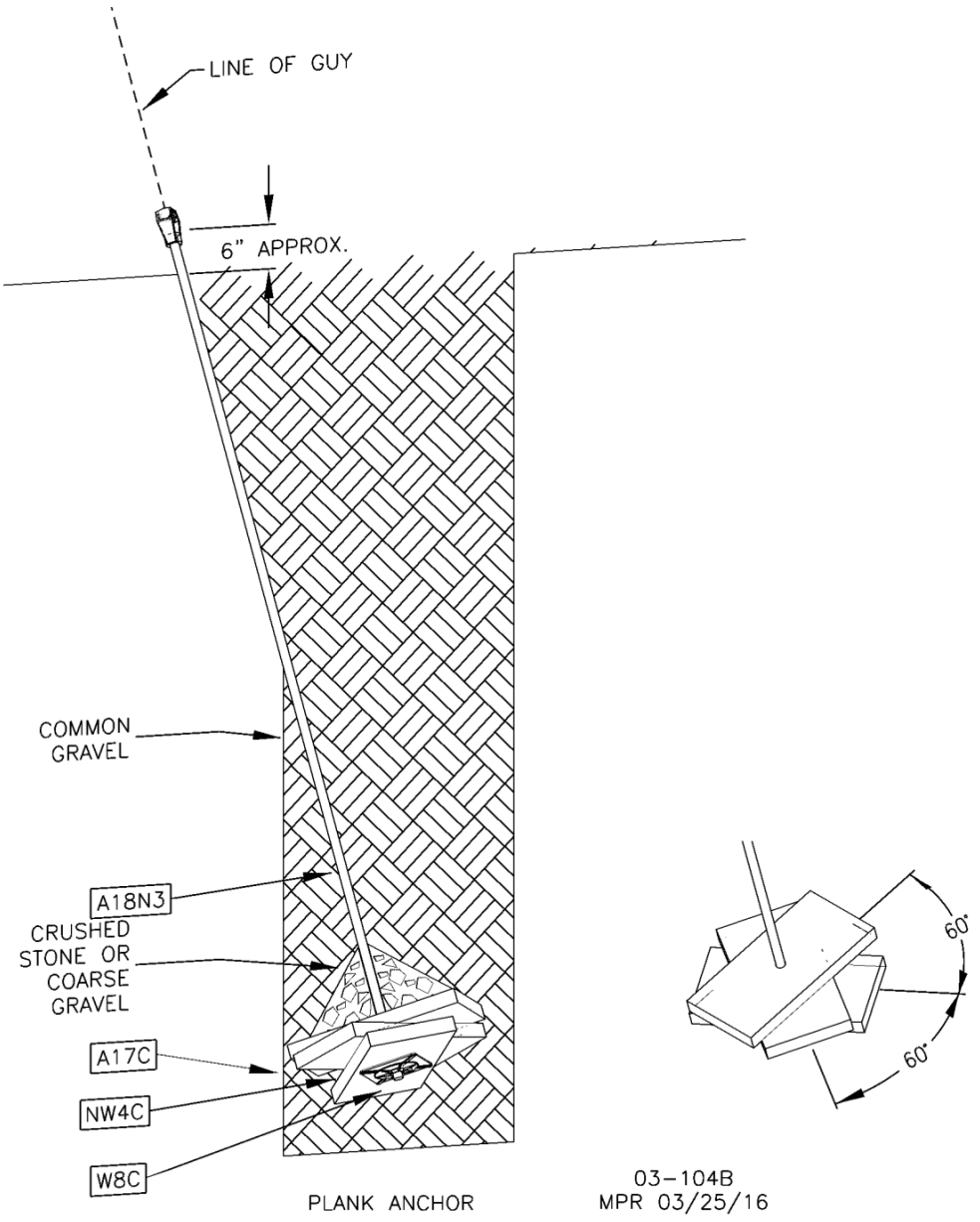
Installation Procedure

A. Dig hole a minimum 5½ feet deep.
B. Cut channel for rod to line up with guy.
C. Scrape loose earth to far corner of bottom of hole to square with bottom of anchor.
D. Attach 14" Helix (A16B) to 1" x 7' Rod (A18K).
E. Fit anchor assembly in hole.
F. Line up anchor rod with slope of guy (upper guy when two guys are attached).
G. Tamp crushed stone or coarse gravel between face of anchor and undisturbed earth. Fill void completely.
H. Backfill all earth removed - thoroughly tamping by layers.

HAND DUG ANCHOR			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-104	7/16

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.



PLANK ANCHOR

03–104B
MPR 03/25/16

7/16 – New issue.

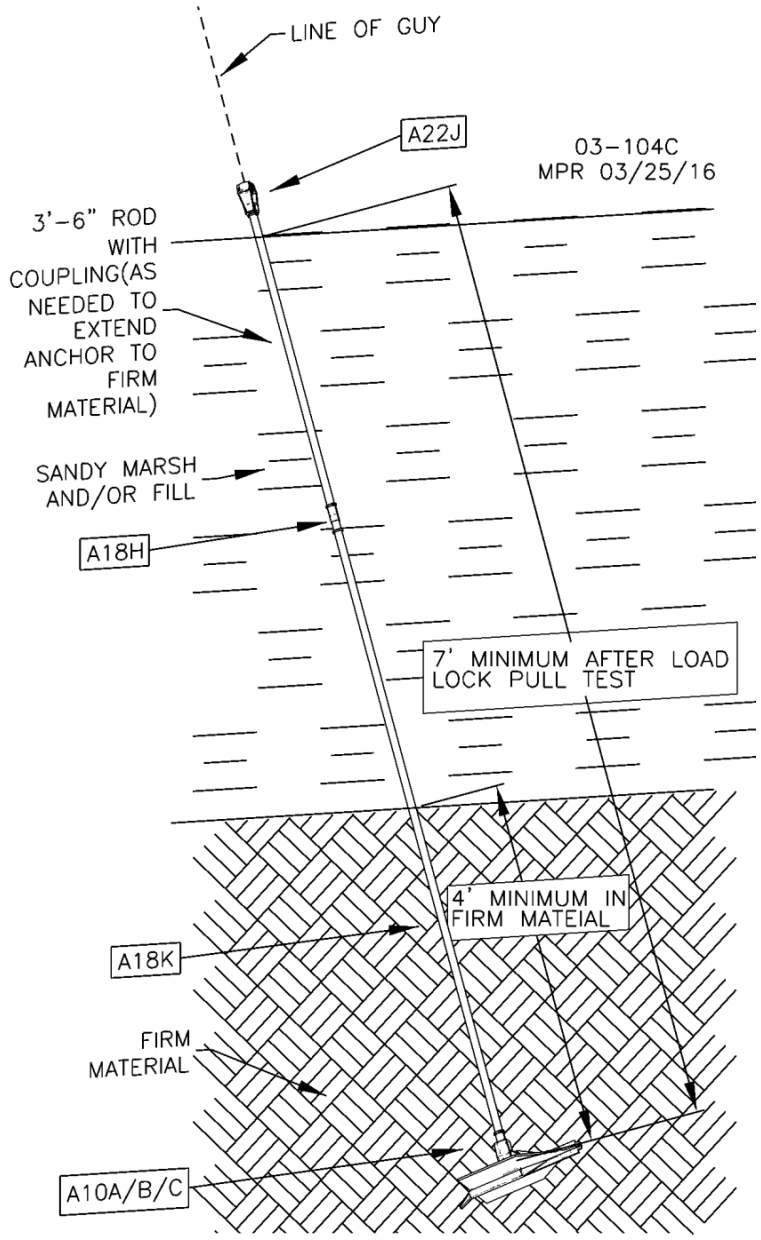
Notes:

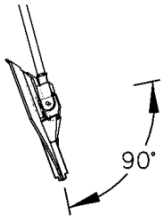
1. Anchors shall be installed so that the anchor rod aligns with the guy wire with a tolerance of +/- 5-degrees. Where multiple guy wires use the same anchor, the rod shall align with the highest guy wire.
2. Individual anchors shall be separated by a minimum of 4-feet.
3. Anchors shall be installed by first excavating a hole to the required depth. A rod trench shall then be dug which allows the anchor rod to rest in alignment with the guy wire. The trench shall be as narrow as possible.
4. The rod and anchor assembly shall be placed in the trench and adjusted to align with the guy wire. The hole shall then be back filled and machine tamped in 6-inch layers to final grade.

PLANK ANCHOR			
ISSUE	**PAGE NUMBER**		
7/16	**3-104B**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.





MANTA RAY ANCHOR

Notes:

1. Use anchor A10A for soft soil conditions, A10B for medium density soil and A10C for high density soil. See table 3, pp 3-6.
2. Anchors shall be installed so that the anchor rod aligns with the guy wire with a tolerance of +/- 5-degrees. Where multiple guy wires use the same anchor, the rod shall align with the highest guy wire.
3. Individual anchors shall be separated from each other by a minimum of 4-feet.
4. The assembled anchor head and rod shall be driven suing the drive steel in alignment with the guy wire.
5. The anchor shall be driven to a minimum initial embedment of 10-feet. If soft material is encountered, driving shall continue until the anchor has achieved a minimum of 4-feet into firm material. Additional rods shall be coupled to the driven rod as needed to achieve the required embedment depth.
6. The anchor shall be load locked and proof tested using the load locker LL-1. Anchors shall be proof tested to 90% of the specified load.
7. The anchor shall be rejected if it fails the proof test or if the final embedment after proof testing is less than 7-feet measure along the length of the rod.

7/16 – New Issue.

MANTA-RAY ANCHOR			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-104C	7/16

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = GUY-3-105,12.5MDWNG/TI95B	GROUNDED 12.5M GUY - WYE PRIMARY (FIG #1)
CU = GUY-3-105,12.5MDWN2-TI95B	INSULATED 12.5M GUY - DELTA PRIMARY (FIG #2)

Figure 1 - Primary Guy for WYE Circuits

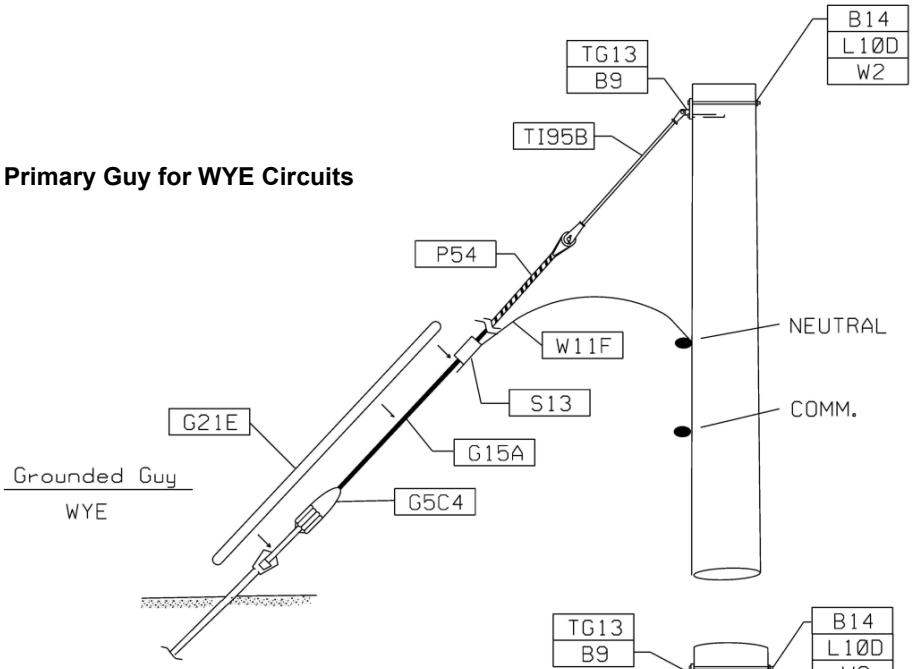
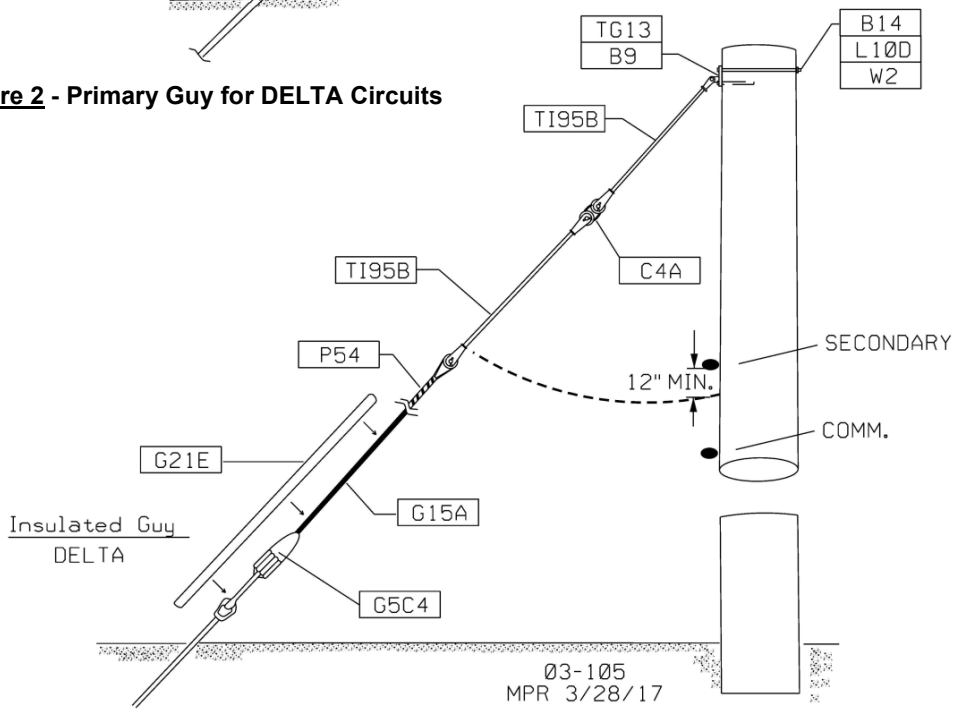


Figure 2 - Primary Guy for DELTA Circuits



Supersedes 7/6 Issue – Change W1 to W2, add L10D-Fig 1, Fig2.

NOTE: If the lower fiberglass rod does not extend a minimum of 12” below the secondary attachment if the guy were slack against the pole, additional fiberglass rods shall be used (applies to delta circuits).

Guy hook TG13 requires 1, ¾” diameter through bolt (upper hole position) and 2, 4” x ½” diameter lag screws (lower hole positions).

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = GUY-3-106,25MDOWN	GROUNDED 25M GUY - WYE PRIMARY (FIG #1)
CU = GUY-3-106,25MDWN2-TI95C	INSULATED 25M GUY - DELTA PRIMARY (FIG #2)

Supersedes 7/10 Issue – Added 8' -0" minimum spacing to ground requirement. Added L10D Fig 1 and 2.

Figure 1 - 25M Down Guy on WYE Circuits

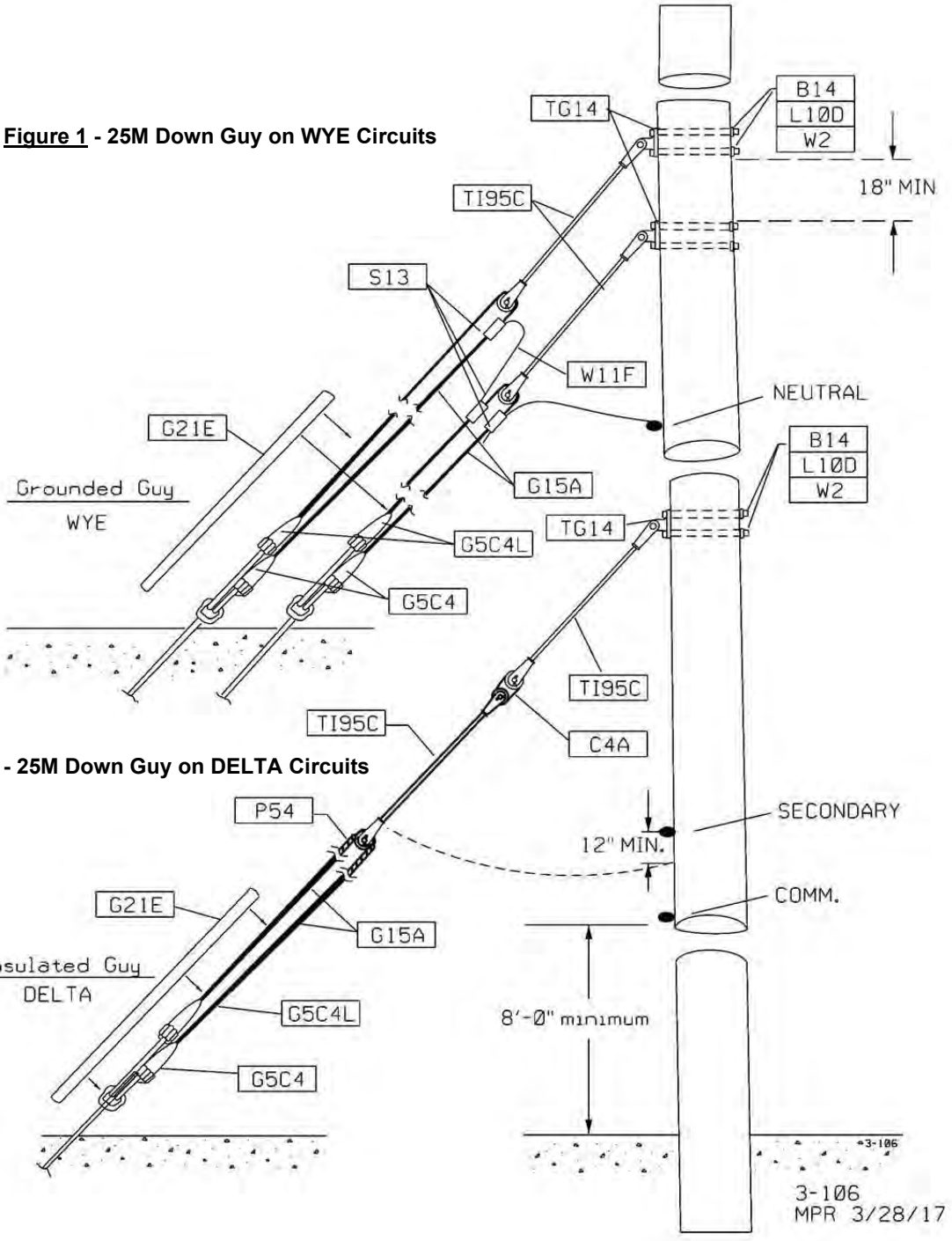


Figure 2 - 25M Down Guy on DELTA Circuits

NOTE 1: If the lower fiberglass rod does not extend a minimum of 12" below the secondary attachment if the guy were slack against the pole, additional fiberglass rods shall be used (applies to delta circuits).

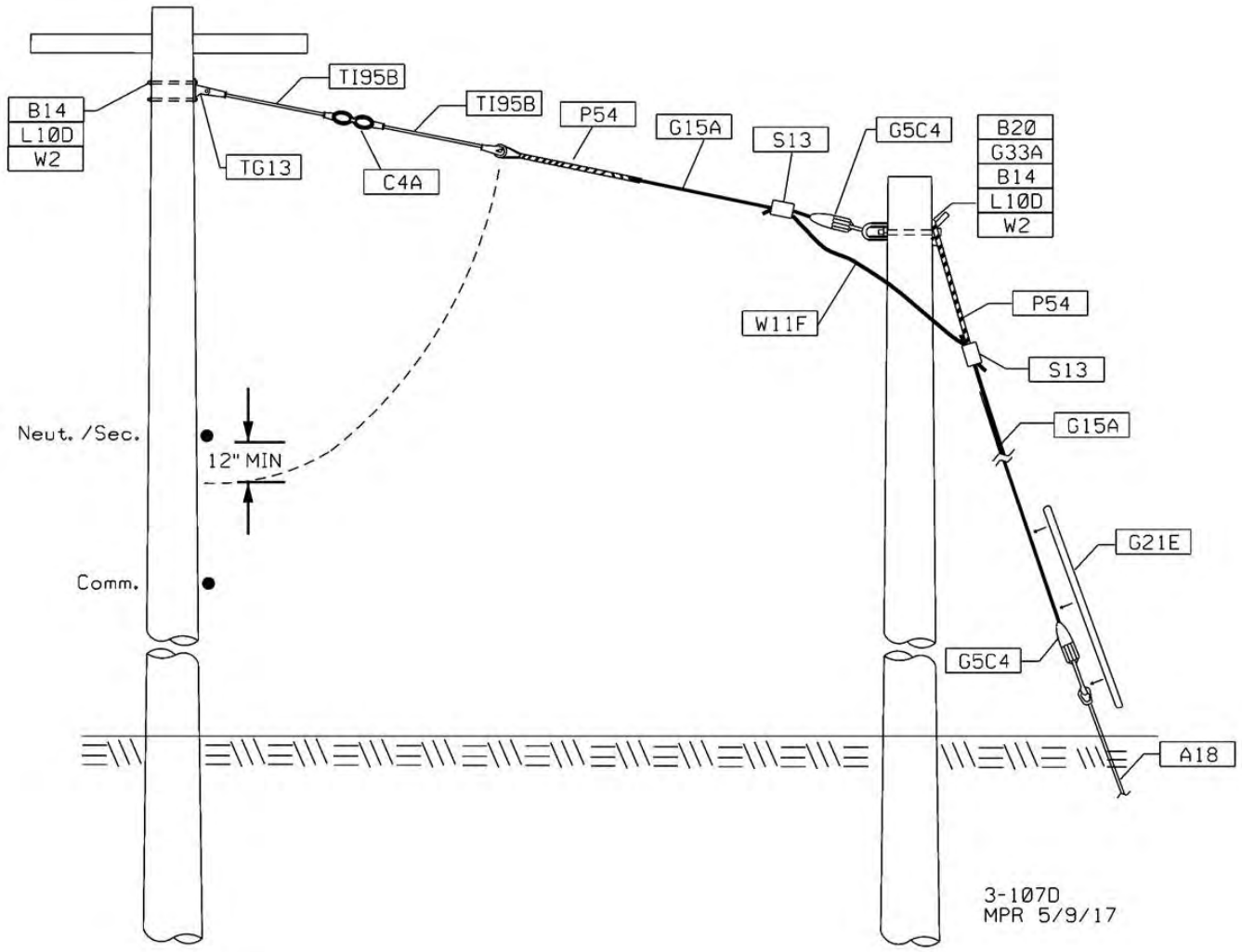
NOTE 2: Adjacent anchors to have a 4 foot minimum separation (for both wye and delta circuits).

25M DOWN GUY ASSEMBLY			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-106	7/17

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = GUY-3-107D,12.5MSPANPRIDP	GUY,12.5M SPAN GUY- DELTA PRIMARY	(SPAN GUY COMPONENTS ONLY)
CU = GUY-3-107D,12.5MDWNNOINS	GUY,12.5M DOWN NO INSUL- STUB POLE	(ANCHORED DOWN GUY WIRE)

CU = GUY-G15A,WIRE12.5M	GUY, G15A, WIRE 12.5M ALUMO-WELD	(GUY WIRE ONLY)



Supersedes 7/10 Issue – Added L10D two places.

NOTE 1: If the lower fiberglass rod does not extend a minimum of 12” below the secondary attachment if the guy were slack against the pole, additional fiberglass rods shall be used.

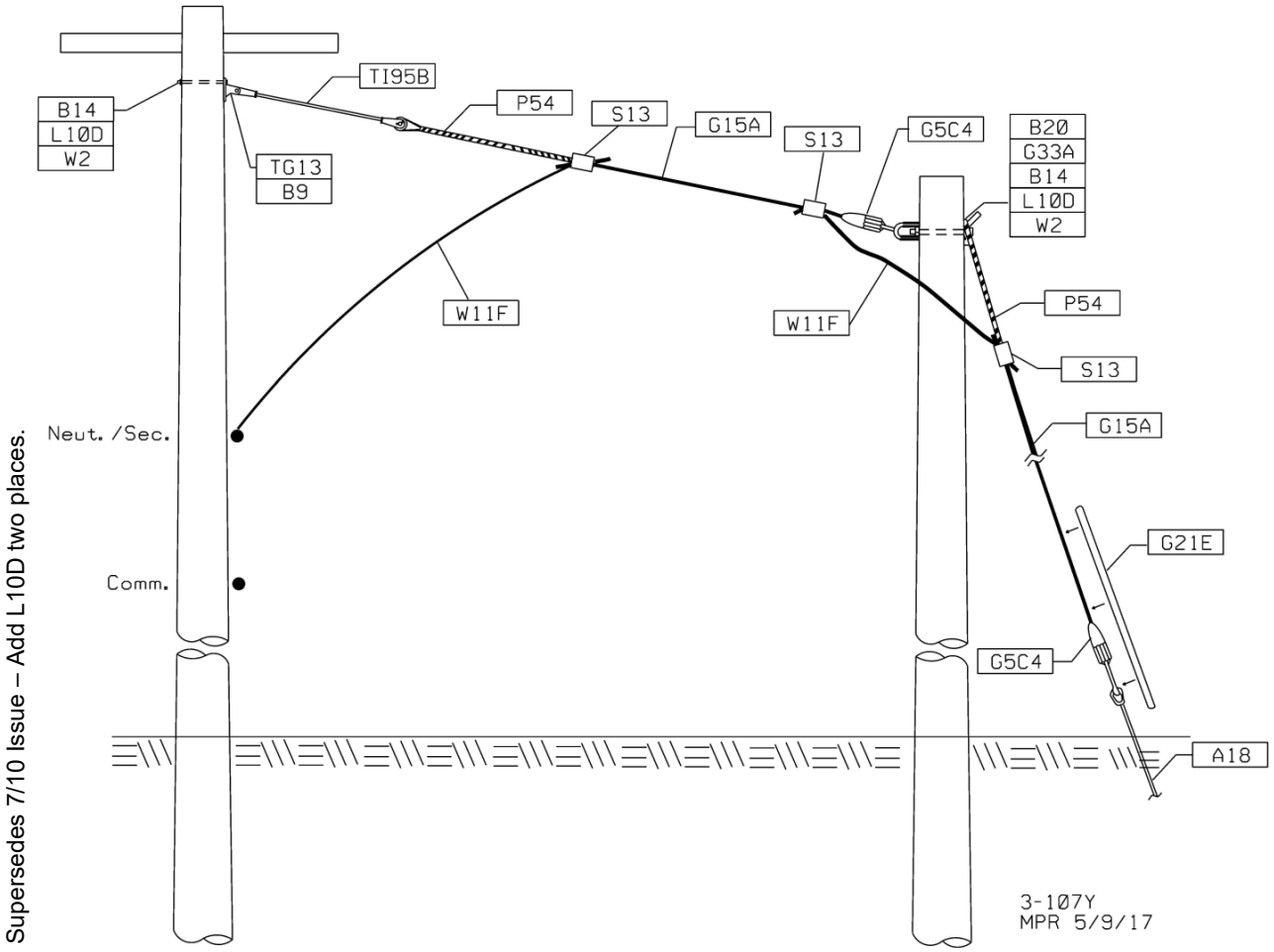
NOTE 2: It is acceptable to use the tail of the stub pole guy wire as a bond to the pole-to-pole guy wire, or vice versa. Otherwise, a piece of #4 solid copper wire should be used as a bond wire as shown in the drawing above. DO NOT bond to the preform or the bail of the automatic. These connections must be wire to wire and a compression connector must be used.

STUB POLE GUY - DELTA CIRCUIT			
ISSUE	**PAGE NUMBER**		
7/17	**3-107D**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = GUY-3-107Y,12.5MSPANPRIYP	GUY,12.5M SPAN GUY- WYE PRIMARY	(SPAN GUY COMPONENTS ONLY)
CU = GUY-3-107Y,12.5MDWNGNOINS	GUY,12.5M DOWN GROUNDED NO INSUL- STUB POLE	(ANCHORED DOWN GUY WIRE)

CU = GUY-G15A,WIRE12.5M	GUY, G15A, WIRE 12.5M ALUMO-WELD	(GUY WIRE ONLY)



Supersedes 7/10 Issue – Add L10D two places.

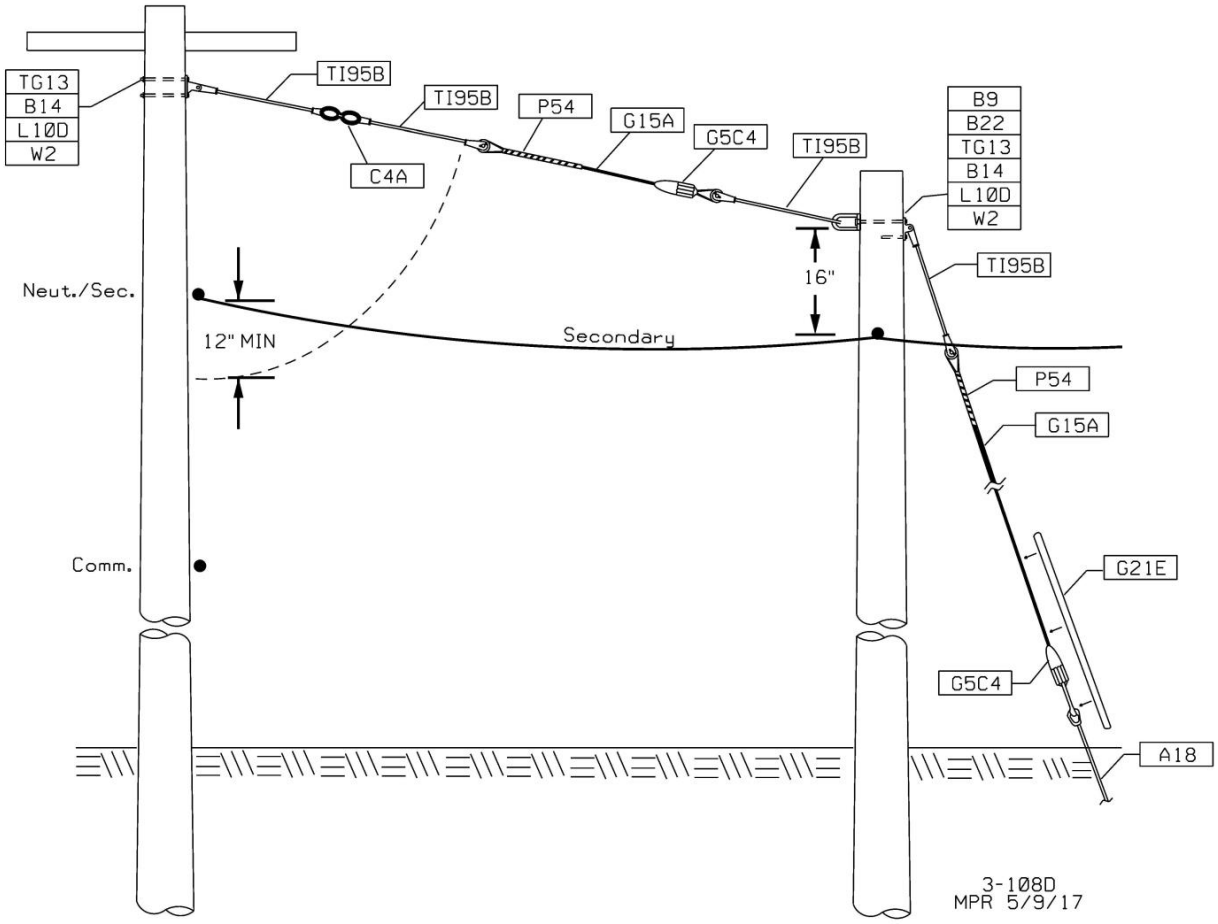
NOTE: It is acceptable to use the tail of the stub pole guy wire as a bond to the pole-to-pole guy wire, or vice versa. Otherwise, a piece of #4 solid copper wire should be used as a bond wire as shown in the drawing above. DO NOT bond to the preform or the bail of the automatic. These connections must be wire to wire and a compression connector must be used.

STUB POLE GUY - WYE CIRCUIT			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-107Y	7/17

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = GUY-3-108D,12.5MSPANSECDP	GUY,12.5M SPAN GUY, W/SEC - DELTA PRIMARY	(SPAN GUY COMPONENTS ONLY)
CU = GUY-3-108D,12.5MDWNW/INS	GUY,12.5M DOWN W /INSUL - STUB POLE	(ANCHORED DOWN GUY WIRE)

CU = GUY-G15A,WIRE12.5M	GUY, G15A, WIRE 12.5M ALUMO-WELD	(GUY WIRE ONLY)



NOTE: If the lower fiberglass rod does not extend a minimum of 12” below the secondary attachment if the guy were slack against the pole, additional fiberglass rods shall be used.

Guy hook TG13 on the pole side requires 2, ¾” diameter through bolts. Guy hook TG13 on the stub pole requires 1, ¾” diameter through bolt (upper hole position) and 2, 4” x ½” diameter lag screws (lower hole positions).

Supersedes 7/16 Issue – Add L10D two places.

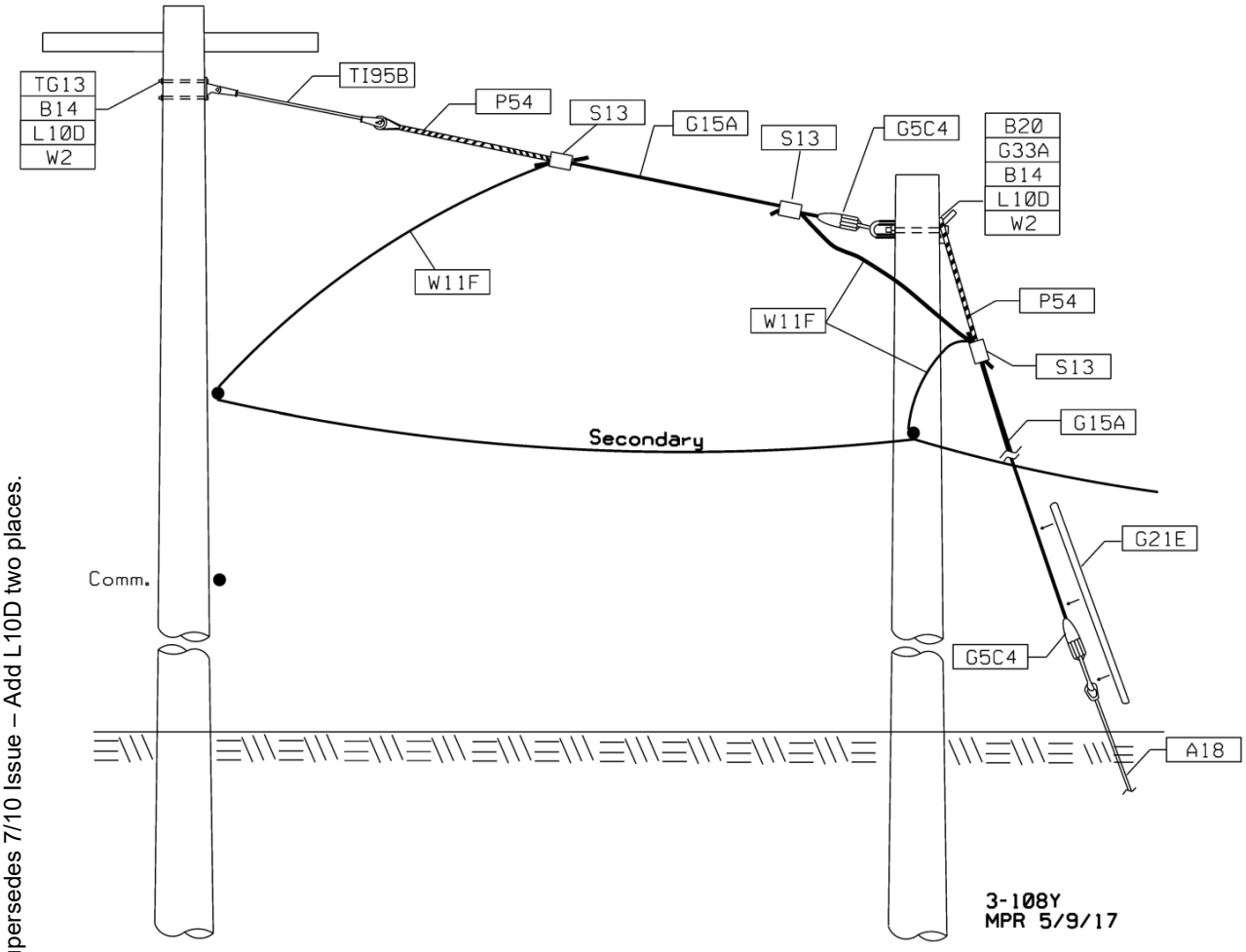
STUB GUY WITH SECONDARY - DELTA CIRCUIT			
ISSUE	**PAGE NUMBER**		
7/17	**3-108D**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Doc. # ST. 03.00.002

CU = GUY-3-108Y,12.5MSPANSECYP	GUY, 12.5M SPAN GUY, W/SEC - WYE PRIMARY	(SPAN GUY COMPONENTS ONLY)
CU = GUY-3-108Y,12.5MDWNGNOINS	GUY, 12.5M DOWN GROUNDED NO INSUL- STUB POLE	(ANCHORED DOWN GUY WIRE)

CU = GUY-G15A,WIRE 12.5M	GUY, G15A, WIRE 12.5M ALUMO-WELD	(GUY WIRE ONLY)



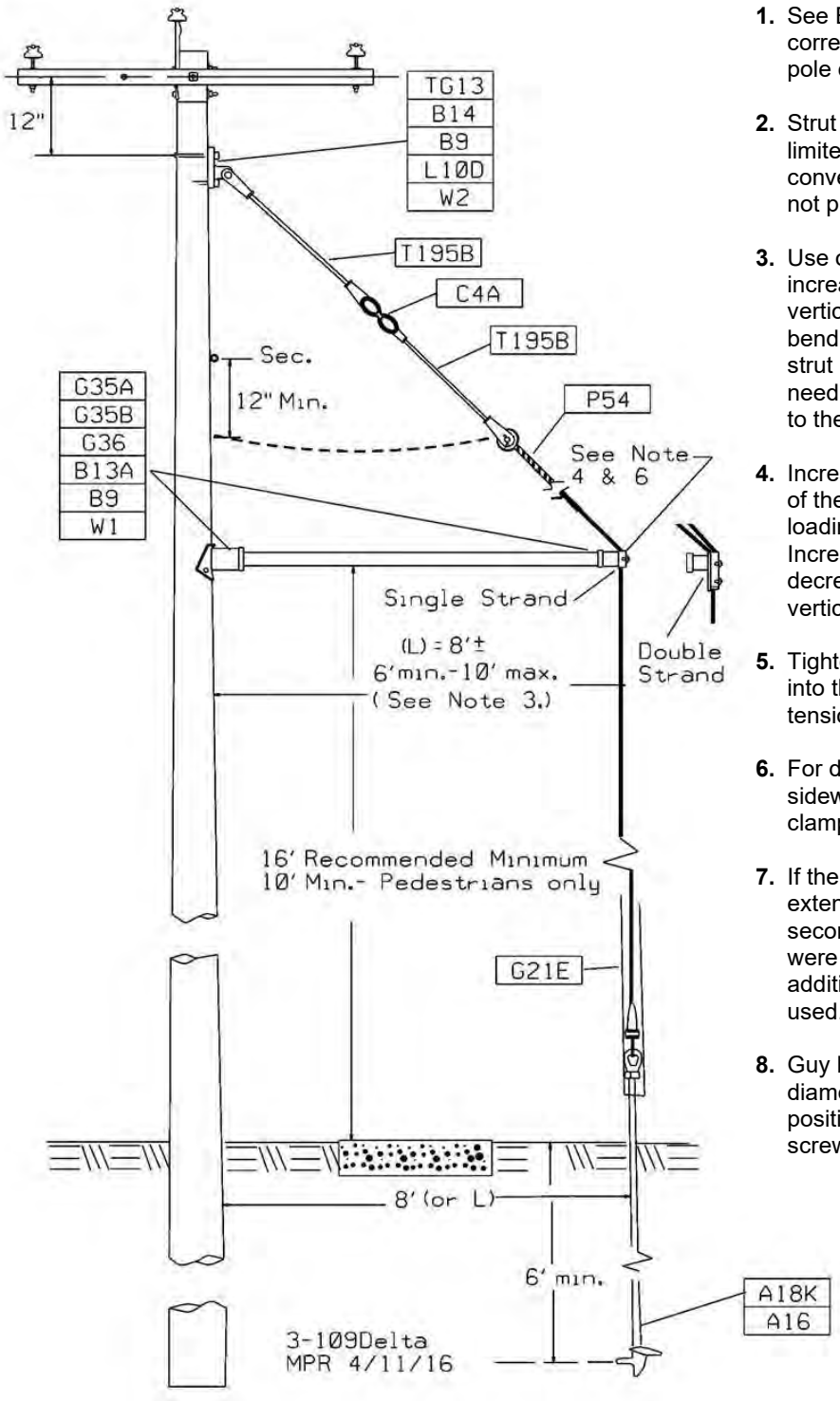
Supersedes 7/10 Issue – Add L10D two places.

NOTE: It is acceptable to use the tail of the stub pole guy wire as a bond to the pole-to-pole guy wire, or vice versa. Otherwise, a piece of #4 solid copper wire should be used as a bond wire as shown in the drawing above. DO NOT bond to the preform or the bail of the automatic. These connections must be wire to wire and a compression connector must be used.

STUB POLE GUY WITH SECONDARY - WYE CIRCUIT			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-108Y	7/17

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = GUY-3-109D,12.5MSTRUT	12.5M STRUT GUY - DELTA PRIMARY
CU = GUY-3-109D,25MSTRUT	25M STRUT GUY - DELTA PRIMARY



NOTES:

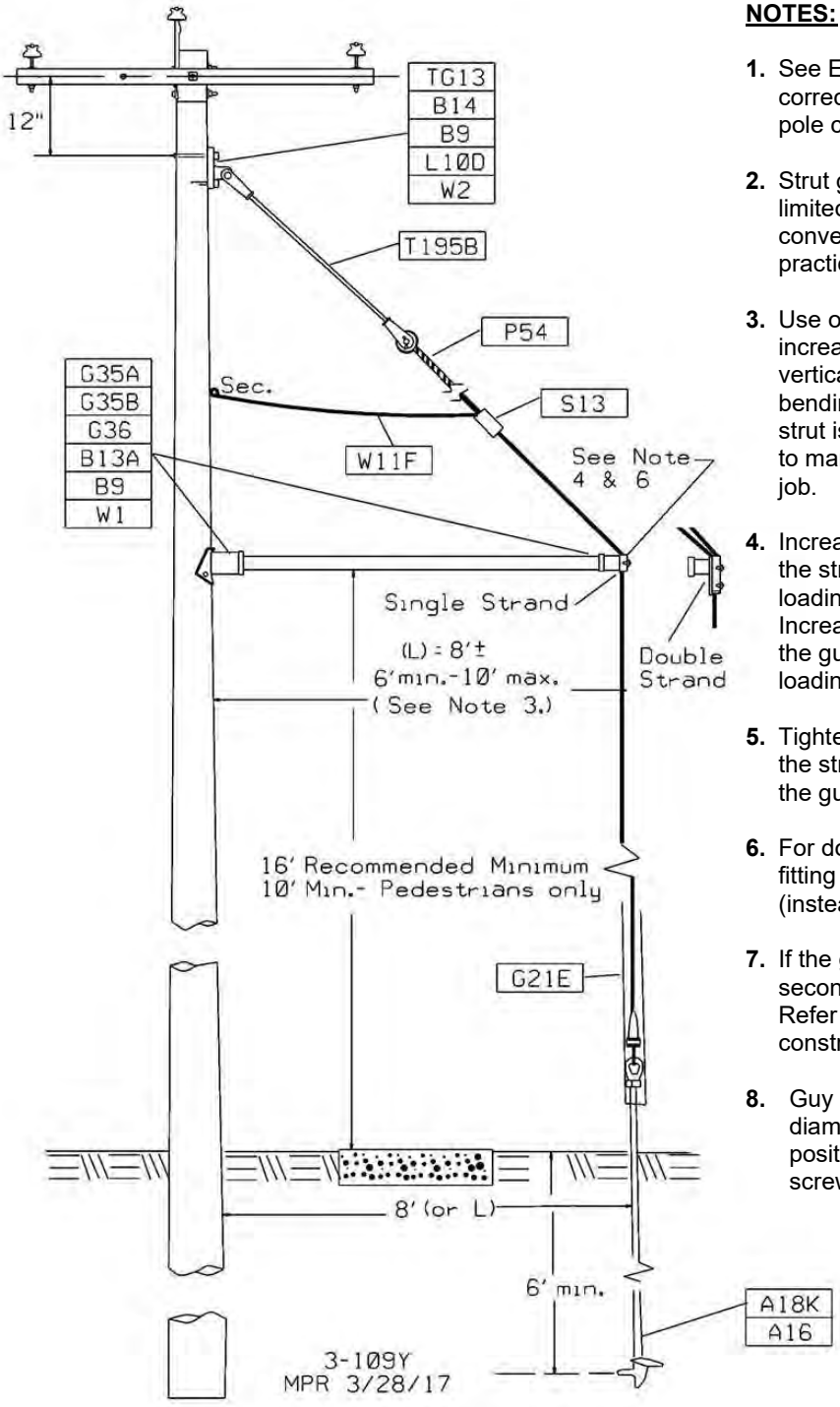
1. See Example #3 to determine the correct guy strand & strut size and pole class.
2. Strut guys shall be used only for limited pole loadings and where conventional guying methods are not practical.
3. Use of strut guys significantly increases guy strand tension and vertical pole load and introduces bending stress to the pole. If a 10' strut is needed, engineering will need to manually add item UK30D to the job.
4. Increasing the height above grade of the strut increases the lateral pole loading and increases guy tension. Increasing the strut length decreases the guy tension and vertical pole loading.
5. Tighten the end of the guy strand into the strut end-clamp before tensioning the guy.
6. For double guy strands, use sidewalk fitting G35C with guy clamp G7B (instead of G35B).
7. If the lower fiberglass rod does not extend a minimum of 12" below the secondary attachment if the guy were slack against the pole, additional fiberglass rods shall be used.
8. Guy hook TG13 requires 1, ¾" diameter through bolt (upper hole position) and 2, 4" x ½" diameter lag screws (lower hole positions).

Supersedes 7/16 Issue – Added L10D.

SIDEWALK/STRUT GUY - DELTA CIRCUIT			
ISSUE	**PAGE NUMBER**		
7/17	**3-109D**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = GUY-3-109Y,12.5MSTRUT	12.5M STRUT GUY- WYE PRIMARY
CU = GUY-3-109Y,25MSTRUT	25M STRUT GUY - WYE PRIMARY



NOTES:

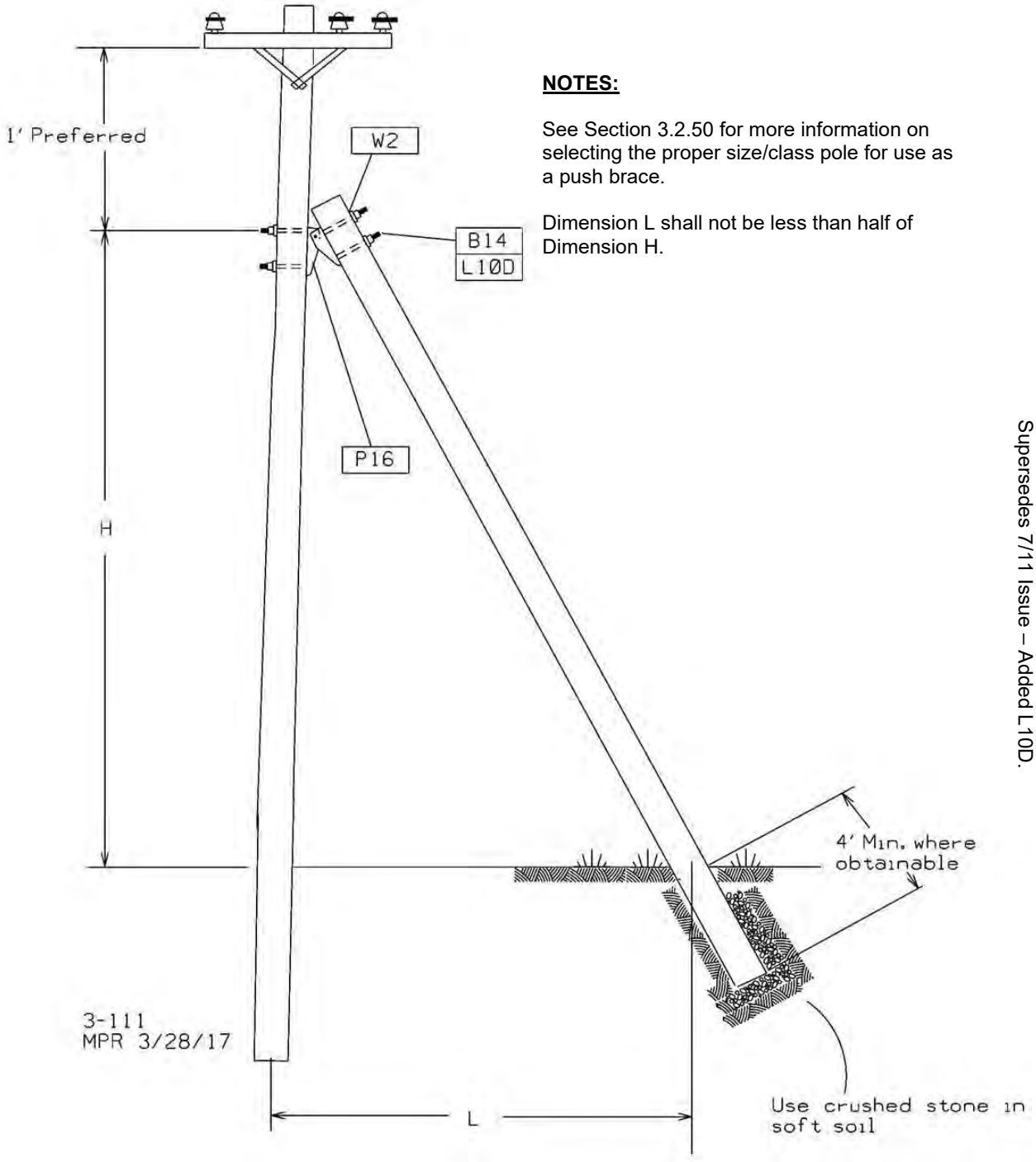
1. See Example #3 to determine the correct guy strand & strut size and pole class.
2. Strut guys shall be used only for limited pole loadings and where conventional guying methods are not practical.
3. Use of strut guys significantly increases guy strand tension and vertical pole load and introduces bending stress to the pole. If a 10' strut is needed, engineering will need to manually add item UK30D to the job.
4. Increasing the height above grade of the strut increases the lateral pole loading and increases guy tension. Increasing the strut length decreases the guy tension and vertical pole loading.
5. Tighten the end of the guy strand into the strut end-clamp before tensioning the guy.
6. For double guy strands, use sidewalk fitting G35C with guy clamp G7B (instead of G35B).
7. If the guy wire is not bonded, a second fiberglass rod is required. Refer to Drawing 3-109D for construction details.
8. Guy hook TG13 requires 1, ¾" diameter through bolt (upper hole position) and 2, 4" x ½" diameter lag screws (lower hole positions).

Supersedes 7/16 Issue – Added L10D.

SIDEWALK/STRUT GUY - WYE CIRCUIT			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-109Y	7/17

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = PBR-3-111,(XX)'CLASS(Y)	PUSH BRACE – (XX) = POLE SIZE, (Y) = POLE CLASS
CU = PBR-3-111,(XX)'CLASS(Y)JO	PUSH BRACE –(XX) = POLE SIZE, (Y) = POLE CLASS – TEL SET



NOTES:

See Section 3.2.50 for more information on selecting the proper size/class pole for use as a push brace.

Dimension L shall not be less than half of Dimension H.

Supersedes 7/11 Issue – Added L10D.

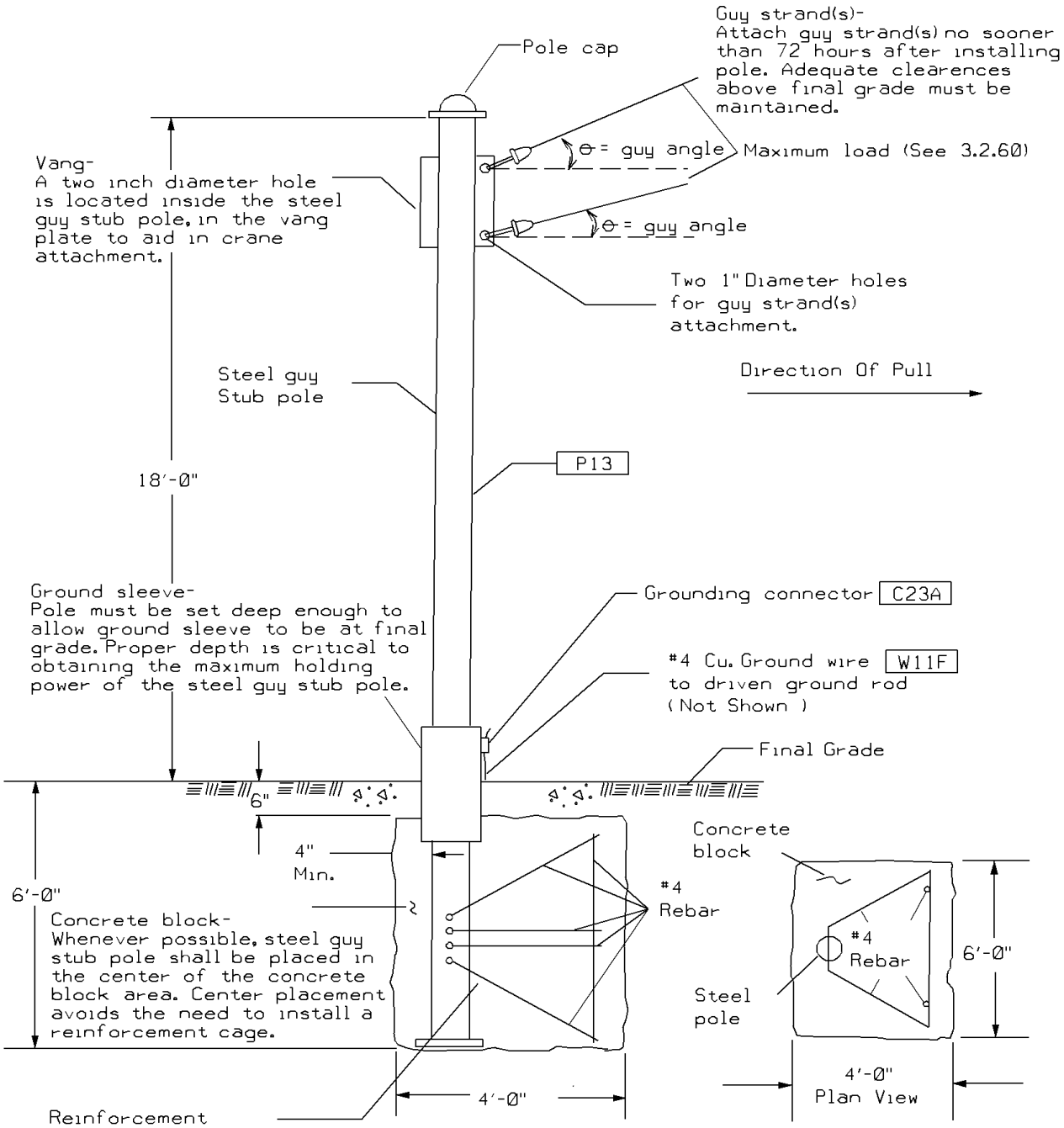
PUSH BRACE			
ISSUE	**PAGE NUMBER**		
7/17	**3-111**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Doc. # ST. 03.00.002

CU = ANC-3-112,STLGUYSTUBPOLE	STEEL GUY STUB

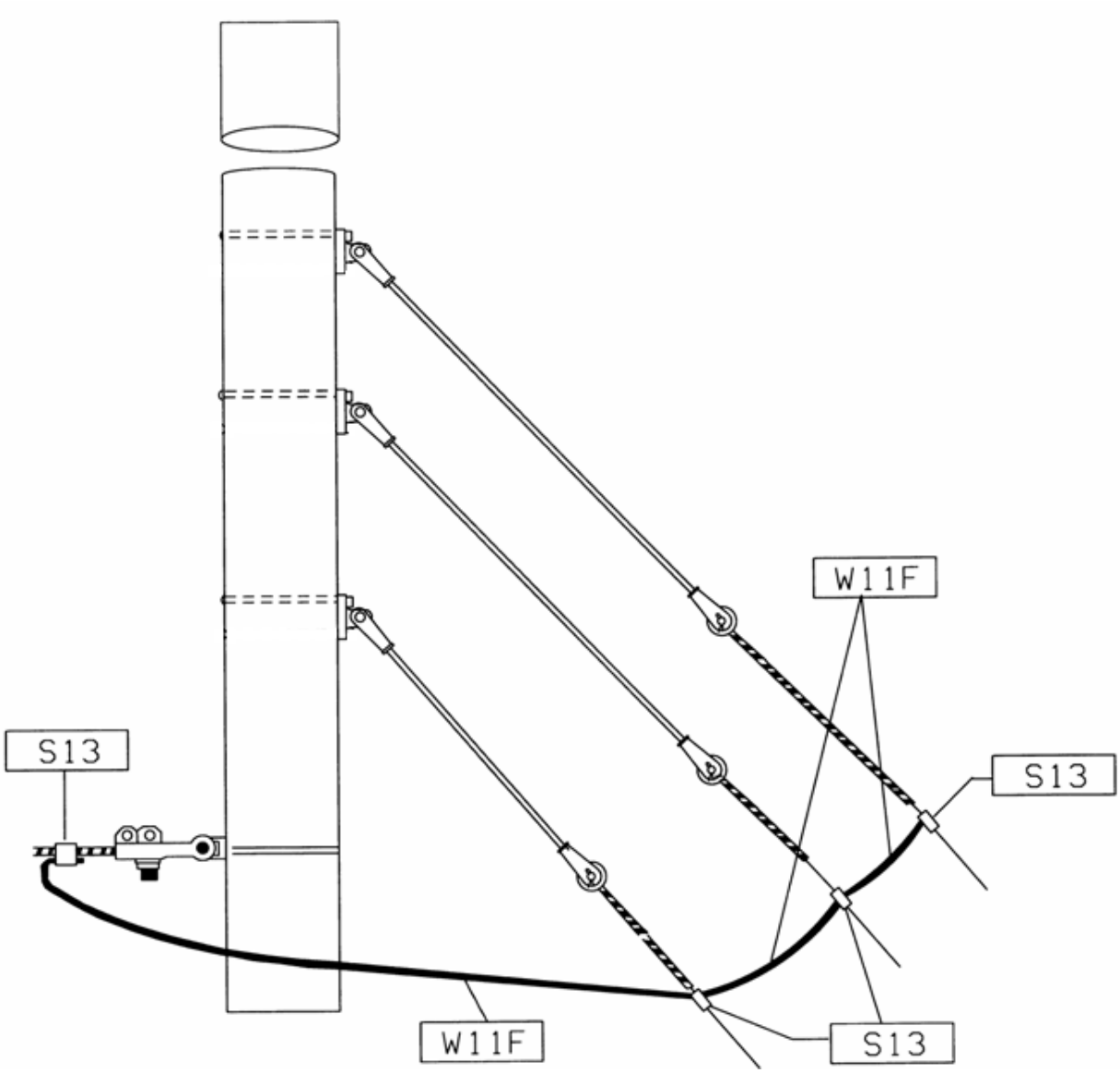
Supersedes 7/09 Issue – Page shift due to other updates.



STEEL GUY STUB POLE			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-112	7/10

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = GUY-3-114,BONDGUY	BONDING GUY



Supersedes 1/06 Issue – Updated CU.

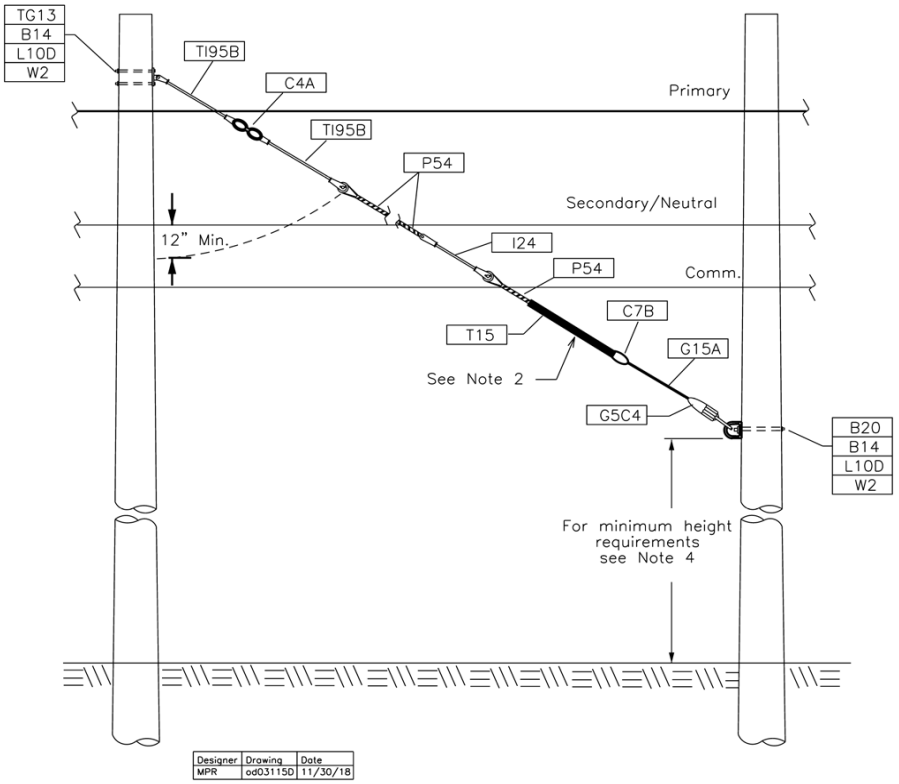
BONDING GUYS			
ISSUE	**PAGE NUMBER**		
7/09	**3-114**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = GUY-3-115D,12.5MPOLE-POLE	GUY,12.5M POLE TO POLE - DELTA PRIMARY	(SPAN GUY COMPONENTS ONLY)

CU = GUY-G15A,WIRE12.5M	GUY, G15A, WIRE 12.5M ALUMO-WELD	(GUY WIRE ONLY)

Supersedes 7/19 Issue – Update note 6.



NOTES:

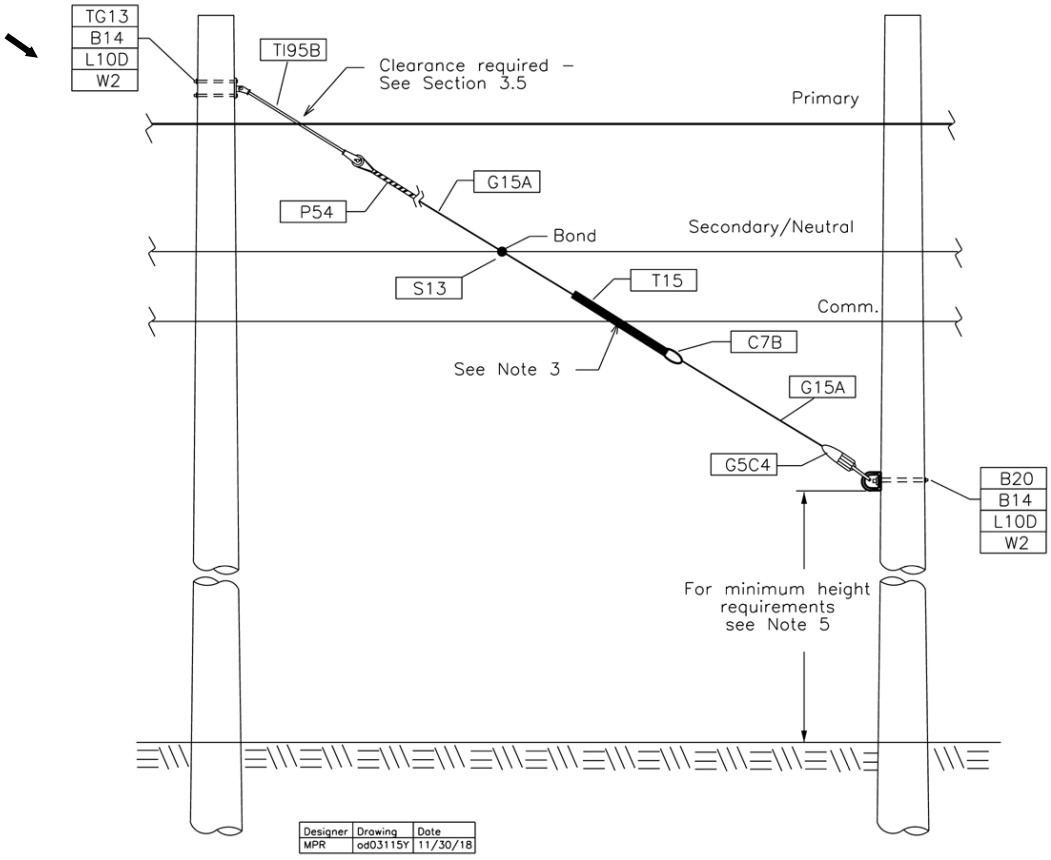
1. Always use a minimum of two fiberglass rods (54" minimum length) at the top of the guy where it is attached near the primary wires. If the lower fiberglass rod does not extend a minimum of 12" past the secondary if the guy were slack against the pole, additional fiberglass rods shall be installed. Install one fiberglass rod (12" minimum length) placed in the guy wire so that it sits between the secondary and communication cables.
2. Per the NESC, 6" of clearance is required between the guy wire and any communication cables. This clearance may be reduced to no less than 3" if abrasion protection (Std Item T15) is added to the guy wire.
3. The pole to pole guy wire must be installed with the minimum clearances to primary conductors shown in the table in Section 3.5. For most installations, this will require off-setting the center phase from a pole top pin to a crossarm, even if the guy wire is attached to the pole below the primary conductor. Refer to Figure 8 in Section 3.5 for more information.
4. A minimum clearance of 15' 6" is required if the guy wire is above driveways, parking lots, alleys, and other land possibly traversed by vehicles that are more than 8' in height or by riders on horses or other large animals. If spaces and ways are subject to pedestrian or restricted traffic only (areas where riders on horses or other large animals, vehicles, or other mobile units exceeding a total height of 8' are prohibited by regulation or permanent terrain configurations), a minimum height of 9' 6" may be used (NESC Rule 232B, Table 232-1).
5. If the lower end of the guy wire is attached above all communication attachments, the 12" fiberglass rod (I24) is not needed.
6. If installing a span guy on pole with no primary wires, all secondary and communication clearances, assembly hardware, and bonding shown in the figure above are required.

POLE TO POLE GUY (SPAN GUY) - DELTA CIRCUIT			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-115D	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = GUY-3-115Y,12.5MPOLE-POLE	GUY,12.5M POLE TO POLE – WYE PRIMARY (SPAN GUY COMPONENTS ONLY)

CU = GUY-G15A,WIRE,12.5M	GUY, G15A, WIRE 12.5M ALUMO-WELD (GUY WIRE ONLY)



Supersedes 7/19 Issue – Update note 6.

NOTES:

1. Always use a minimum of one fiberglass rod (54” length minimum) at the top of the guy where it is attached near the primary wires.
2. Bond the guy wire to the neutral as the guy wire passes the secondary cable using a compression connector.
3. Per the NESC, 6” of clearance is required between the guy wire and any communication cables. This clearance may be reduced to no less than 3” if abrasion protection (Std Item T15) is added to the guy wire.
4. The pole to pole guy wire must be installed with the minimum clearances to primary conductors shown in the table in Section 3.5. For most installations, this will require off-setting the center phase from a pole top pin to a crossarm, even if the guy wire is attached to the pole below the primary conductor. Refer to Figure 8 in Section 3.5 for more information.
5. A minimum clearance of 15’ 6” is required if the guy wire is above driveways, parking lots, alleys, and other land possibly traversed by vehicles that are more than 8’ in height or by riders on horses or other large animals. If spaces and ways are subject to pedestrian or restricted traffic only (areas where riders on horses or other large animals, vehicles, or other mobile units exceeding a total height of 8’ are prohibited by regulation or permanent terrain configurations), a minimum height of 9’ 6” may be used (NESC Rule 232B, Table 232-1).
6. If installing a span guy on pole with no primary wires, all secondary and communication clearances, assembly hardware, and bonding shown in the figure above are required.

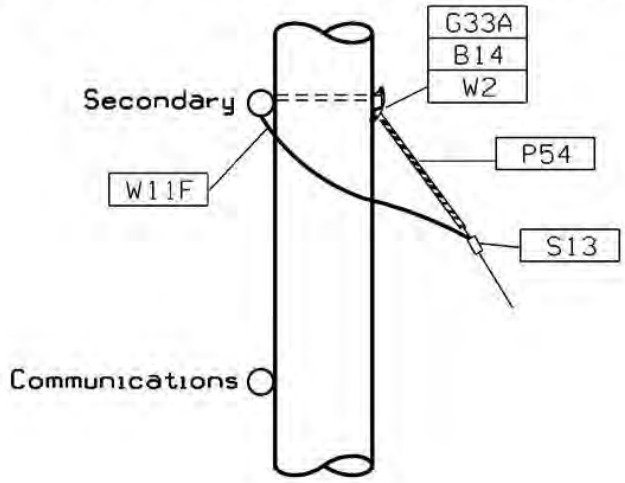
POLE TO POLE GUY (SPAN GUY) - WYE CIRCUIT			
ISSUE	**PAGE NUMBER**		
7/21	**3-115Y**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

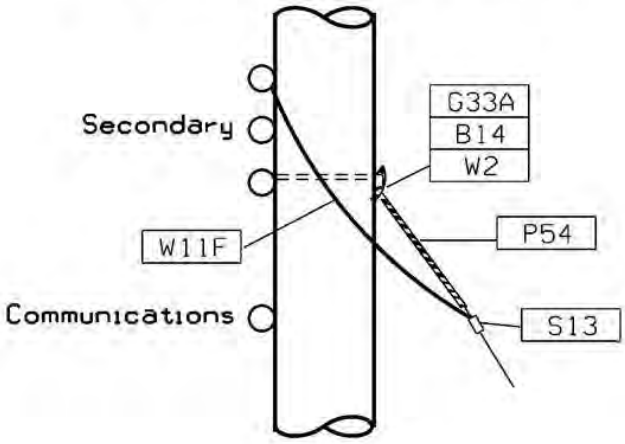
CU = GUY-3-118,12.5MDWNGSECYP	GUY, 12.5M DOWN GUY,SECONDARY - WYE PRIMARY

Supersedes 7/11 Issue – Added detail for open wire secondary and W2..

Wye - Secondary Triplex/Quadplex/Etc



Wye - Open Wire Secondary



3-118
MPR 5/24/17

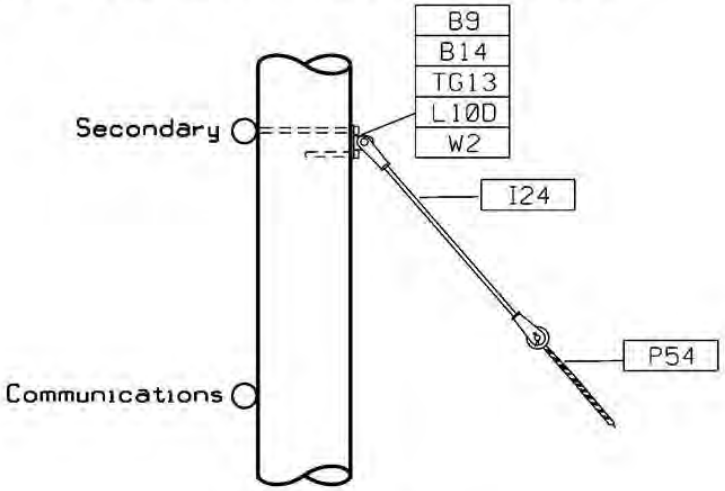
NOTE: For guy wire placement related to other secondary configurations on the pole, see Pages 10-100 and 10-101.

SECONDARY GUY WIRES - WYE CIRCUIT			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-118	7/17

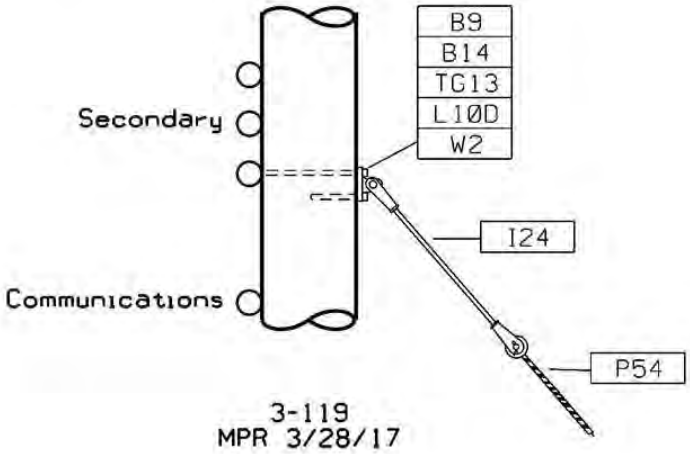
Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU= GUY-3-119,12.5MDWNGSECD	GUY,12.5M DOWN GUY,SECONDARY- DELTA PRIMARY

Delta - Secondary Triplex/Quadplex/Etc



Delta - Open Wire Secondary



3-119
MPR 3/28/17

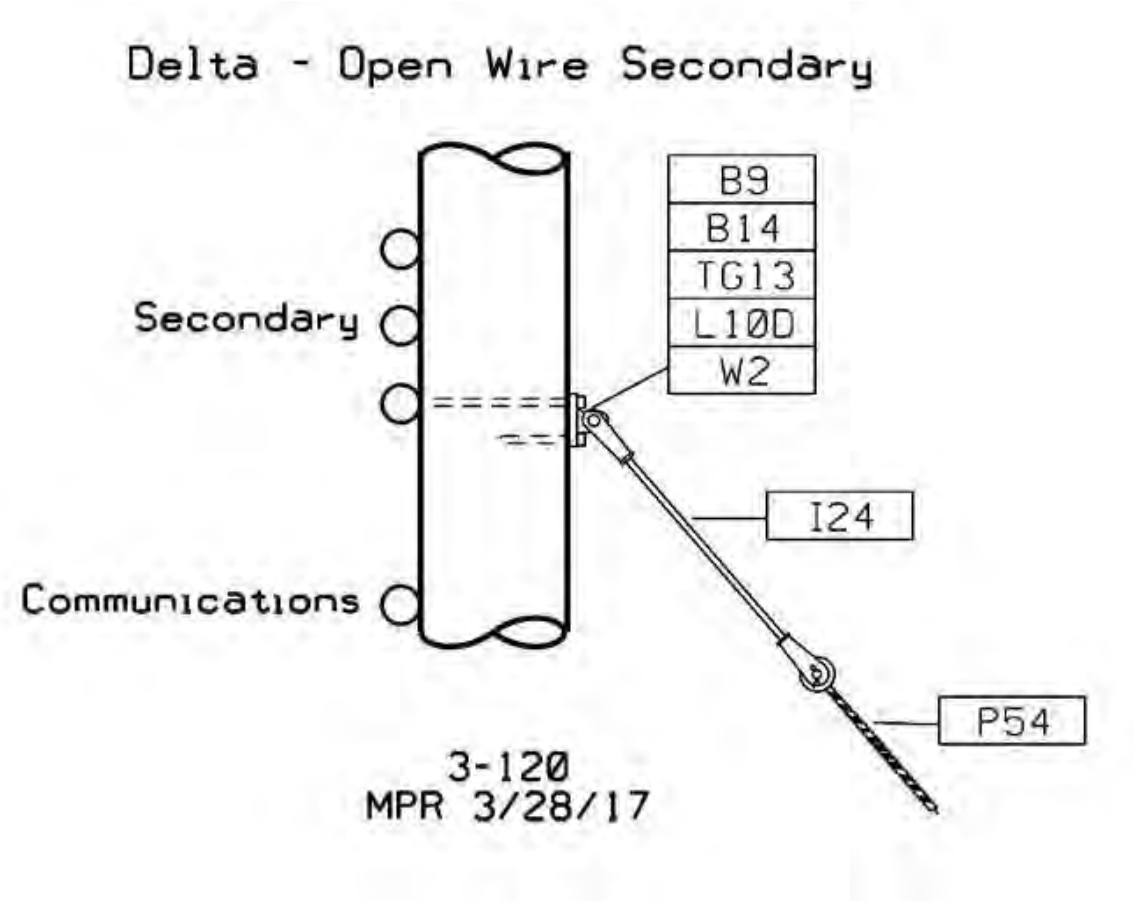
Supersedes 7/16 Issue – Add W2, add L10D 2 places.

NOTE: For guy wire placement related to other secondary configurations on the pole, see Pages 10-100 and 10-101.

Guy hook TG13 requires 1, ¾" diameter through bolt (upper hole position) and 2, 4" x ½" diameter lag screws (lower hole positions).

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = GUY-3-120,12.5MDWNGSECOW	GUY, 12.5M DOWN GUY SECONDARY OPEN WIRE



Supersedes 7/16 Issue – Add W2, add L10D.

Note: Guy hook TG13 requires 1, ¾" diameter through bolt (upper hole position) and 2, 4" x ½" diameter lag screws (lower hole positions).

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.

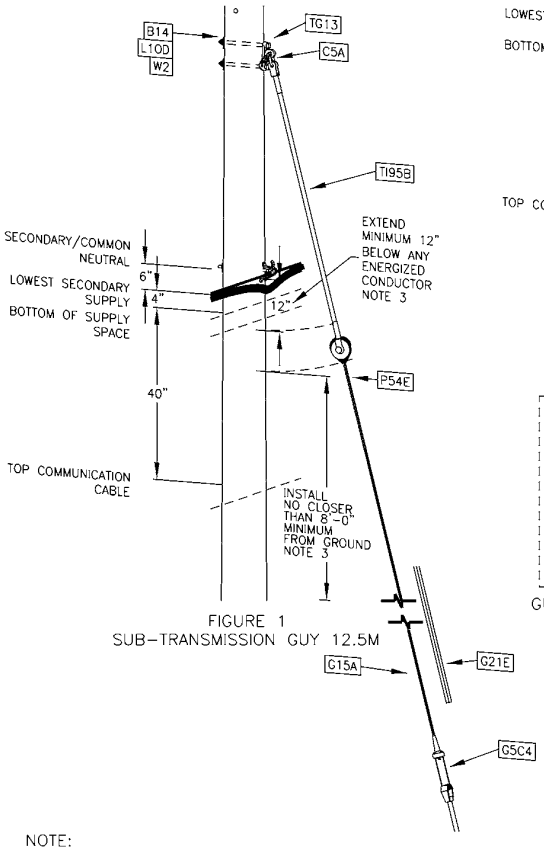


FIGURE 1
SUB-TRANSMISSION GUY 12.5M

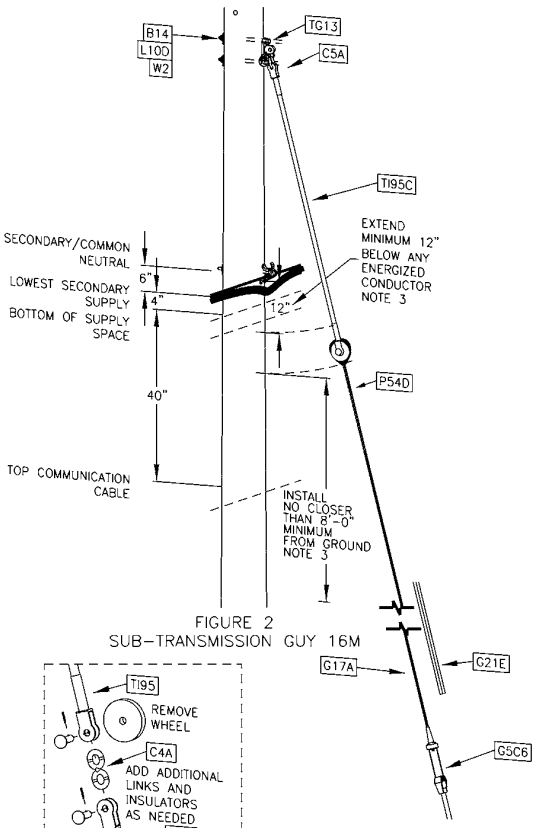
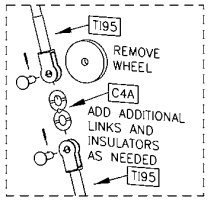


FIGURE 2
SUB-TRANSMISSION GUY 16M



GUYING EXTENSION DETAIL
SEE NOTE 3

Designer	Drawing	Date
MPR	od3121	4/30/20

NOTE:

1. THESE GUY ASSEMBLIES ARE INTENDED FOR USE ON SUB-TRANSMISSION LINES.
2. GUY PLATE TG13 REQUIRES ONE, ¾" DIAMETER BOLT (B14) IN THE UPPER HOLE POSITION AND 2, ½" LAG BOLTS (B9) IN THE TWO LOWER HOLE POSITIONS FOR GUY LEADS AT 1:1 OR LESS (SHORTER). FOR GUY LEADS GREATER THAN 1:1 (LONGER), USE TWO, ¾" (B14) BOLTS IN THE TOP AND BOTTOM.
3. FIELD SHALL INSTALL ADDITIONAL GUY STRAIN INSULATORS (TI-95C) OR POSITION THE GUY STRAIN INSULATORS SUCH THAT IF THE GUY WIRE/SPAN GUY BECOMES BROKEN OR SLACK OR IF AN ENERGIZED CONDUCTOR BECOMES SLACK THE FOLLOWING SAFETY CONDITIONS MUST BE MET:
   A) ANY PART OF THE GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED DUE TO CONTACT WITH AN ENERGIZED CONDUCTOR SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   B) THE ENTIRE GUY STRAIN INSULATOR ATTACHED TO A GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   C) THE GUY STRAIN INSULATORS SHALL BE INSTALLED TO LIMIT THE LIKELIHOOD OF AN ANCHOR GUY BECOMING A CONDUCTIVE PATH BETWEEN AN ENERGIZED CONDUCTOR OR PART AND A CONDUCTOR OF ANOTHER CIRCUIT

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.

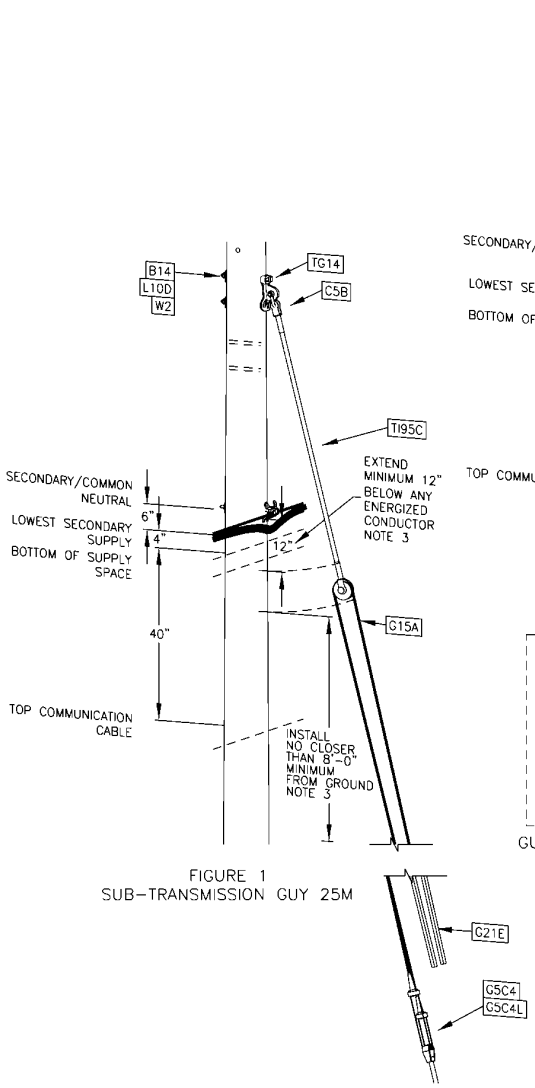
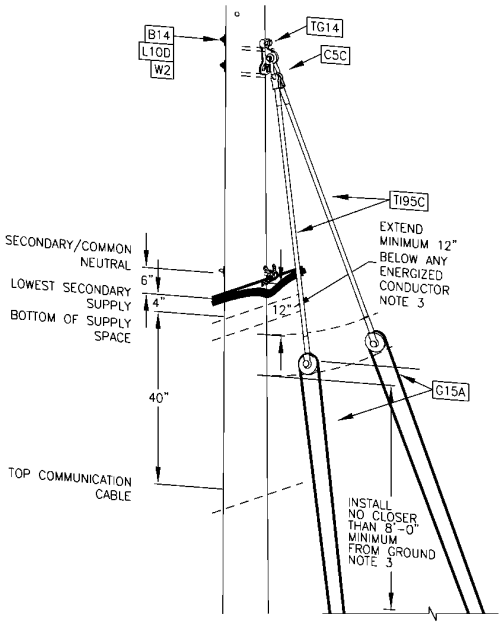
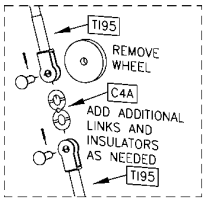


FIGURE 1
SUB-TRANSMISSION GUY 25M





GUYING EXTENSION DETAIL
SEE NOTE 3

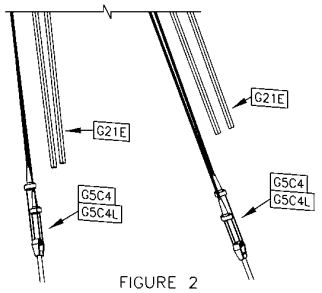


FIGURE 2
SUB-TRANSMISSION GUY 25M FLARED

Designer	Drawing	Date
MPR	od3122	4/30/20

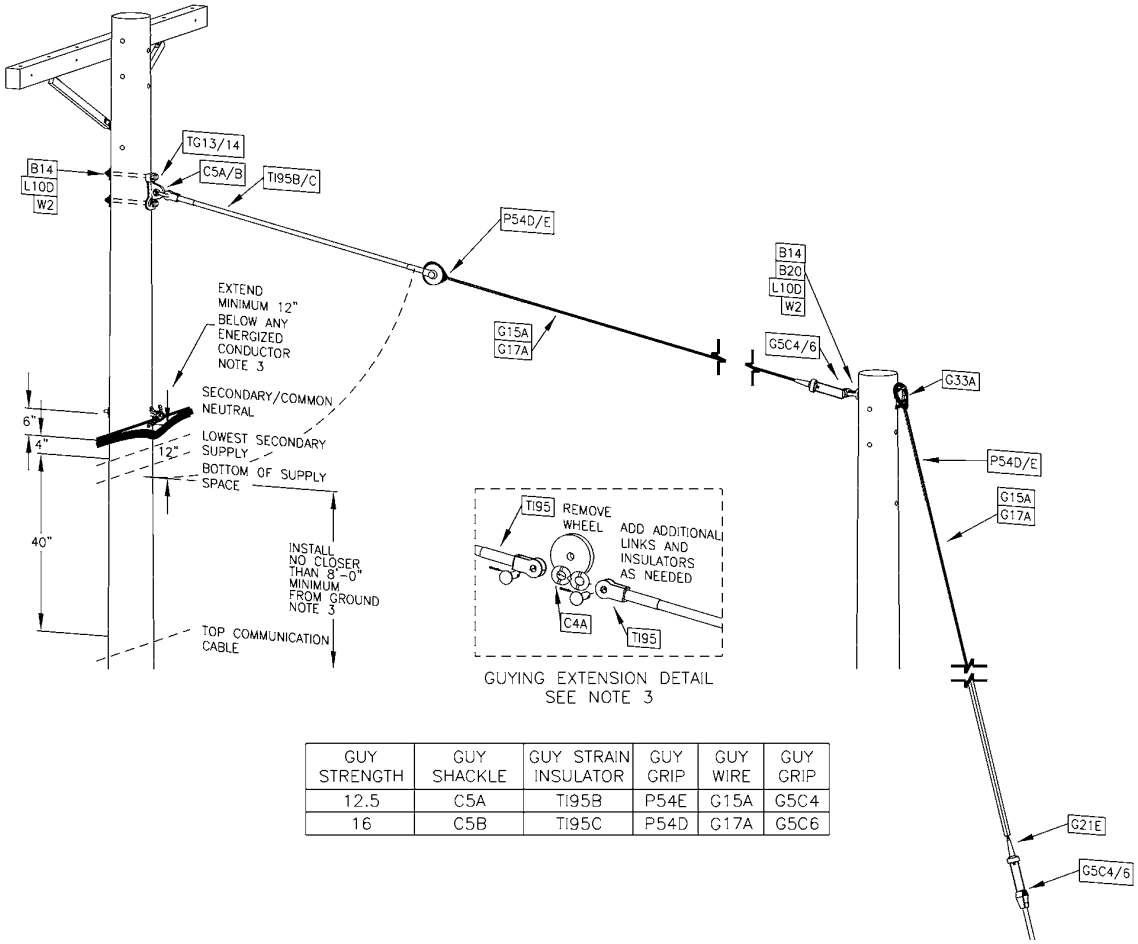
NOTE:

1. THESE GUY ASSEMBLIES ARE INTENDED FOR USE ON SUB-TRANSMISSION LINES.
2. GUY PLATE TG14 REQUIRES TWO, ¾" DIAMETER BOLT (B14) IN BOTH THE UPPER AND LOWER HOLE POSITIONS FOR ALL INSTALLATIONS.
3. FIELD SHALL INSTALL ADDITIONAL GUY STRAIN INSULATORS (TI-95C) OR POSITION THE GUY STRAIN INSULATORS SUCH THAT IF THE GUY WIRE/SPAN GUY BECOMES BROKEN OR SLACK OR IF AN ENERGIZED CONDUCTOR BECOMES SLACK THE FOLLOWING SAFETY CONDITIONS MUST BE MET:
   A) ANY PART OF THE GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED DUE TO CONTACT WITH AN ENERGIZED CONDUCTOR SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   B) THE ENTIRE GUY STRAIN INSULATOR ATTACHED TO A GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   C) THE GUY STRAIN INSULATORS SHALL BE INSTALLED TO LIMIT THE LIKELIHOOD OF AN ANCHOR GUY BECOMING A CONDUCTIVE PATH BETWEEN AN ENERGIZED CONDUCTOR OR PART AND A CONDUCTOR OF ANOTHER CIRCUIT

SUB-TRANSMISSION DOWN GUY SINGLE AND FLARED – 25M			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-122	7/20

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.



GUY STRENGTH	GUY SHACKLE	GUY STRAIN INSULATOR	GUY GRIP	GUY WIRE	GUY GRIP
12.5	C5A	TI95B	P54E	G15A	G5C4
16	C5B	TI95C	P54D	G17A	G5C6

Designer	Drawing	Date
MPR	od3123	4/30/20

NOTE:

1. THESE GUY ASSEMBLIES ARE INTENDED FOR USE ON SUB-TRANSMISSION LINES.
2. GUY PLATE TG13 AND TG14 REQUIRE TWO, ¾" DIAMETER BOLT (B14) IN BOTH THE UPPER LOWER HOLE POSITIONS FOR ALL INSTALLATIONS.
3. FIELD SHALL INSTALL ADDITIONAL GUY STRAIN INSULATORS (TI-95C) OR POSITION THE GUY STRAIN INSULATORS SUCH THAT IF THE GUY WIRE/SPAN GUY BECOMES BROKEN OR SLACK OR IF AN ENERGIZED CONDUCTOR BECOMES SLACK THE FOLLOWING SAFETY CONDITIONS MUST BE MET:
   A) ANY PART OF THE GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED DUE TO CONTACT WITH AN ENERGIZED CONDUCTOR SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   B) THE ENTIRE GUY STRAIN INSULATOR ATTACHED TO A GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   C) THE GUY STRAIN INSULATORS SHALL BE INSTALLED TO LIMIT THE LIKELIHOOD OF AN ANCHOR GUY BECOMING A CONDUCTIVE PATH BETWEEN AN ENERGIZED CONDUCTOR OR PART AND A CONDUCTOR OF ANOTHER CIRCUIT

SUB-TRANSMISSION STUB POLE GUY – 12.5M AND 16M

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.

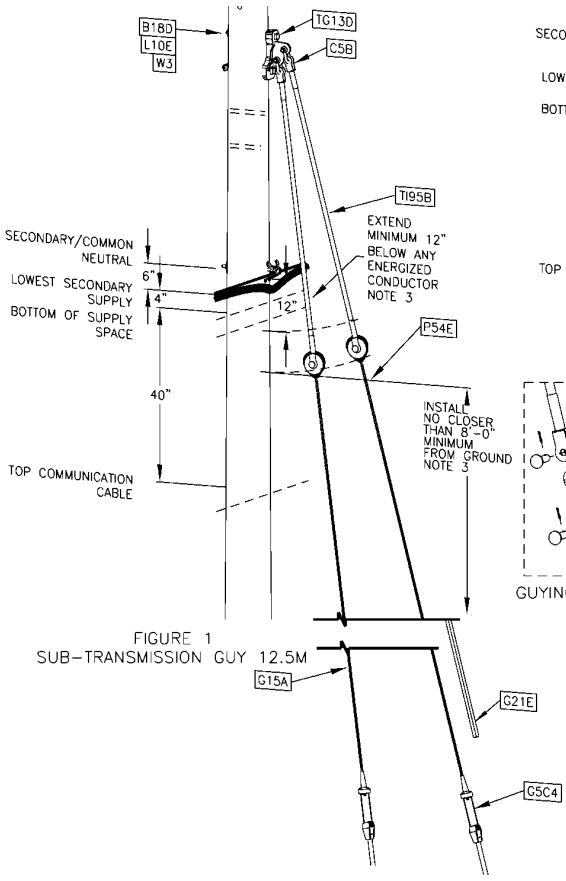


FIGURE 1
SUB-TRANSMISSION GUY 12.5M

GUYING EXTENSION DETAIL
SEE NOTE 3

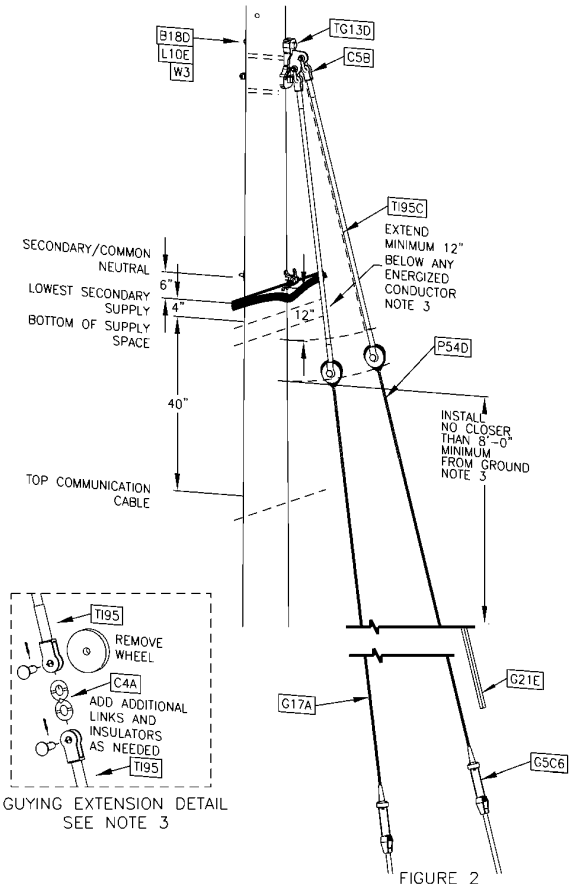


FIGURE 2
SUB-TRANSMISSION GUY 16M

Designer	Drawing	Date
MPR	od3124	4/30/20

NOTE:
1. THESE GUY ASSEMBLIES ARE INTENDED FOR USE ON SUB-TRANSMISSION LINES.
2. GUY PLATE TG13D REQUIRES TWO, 7/8" DIAMETER BOLT (B18) IN BOTH THE UPPER LOWER HOLE POSITIONS FOR ALL INSTALLATIONS.
3. FIELD SHALL INSTALL ADDITIONAL GUY STRAIN INSULATORS (TI-95C) OR POSITION THE GUY STRAIN INSULATORS SUCH THAT IF THE GUY WIRE/SPAN GUY BECOMES BROKEN OR SLACK OR IF AN ENERGIZED CONDUCTOR BECOMES SLACK THE FOLLOWING SAFETY CONDITIONS MUST BE MET:
   A) ANY PART OF THE GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED DUE TO CONTACT WITH AN ENERGIZED CONDUCTOR SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   B) THE ENTIRE GUY STRAIN INSULATOR ATTACHED TO A GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   C) THE GUY STRAIN INSULATORS SHALL BE INSTALLED TO LIMIT THE LIKELIHOOD OF AN ANCHOR GUY BECOMING A CONDUCTIVE PATH BETWEEN AN ENERGIZED CONDUCTOR OR PART AND A CONDUCTOR OF ANOTHER CIRCUIT

SUB-TRANSMISSION DOUBLE GUY – 12.5M AND 16M			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-124	7/20

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

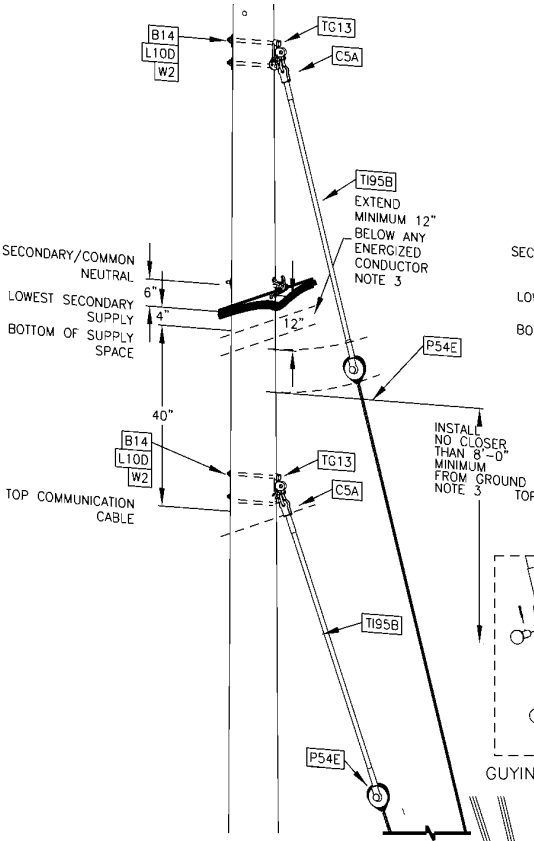


FIGURE 1
SUB–TRANSMISSION GUY 12.5M

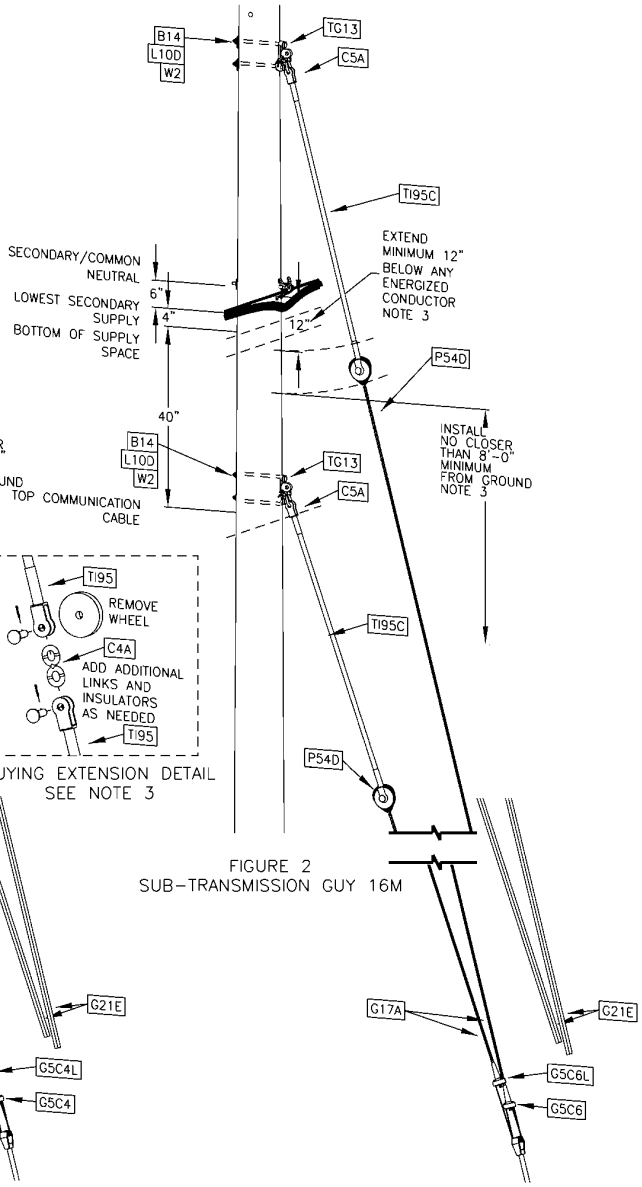


FIGURE 2
SUB–TRANSMISSION GUY 16M

NOTE:

1. THESE GUY ASSEMBLIES ARE INTENDED FOR USE ON SUB–TRANSMISSION LINES.
2. GUY PLATE TG13D REQUIRES TWO, ¾" DIAMETER BOLT (B14) IN BOTH THE UPPER AND LOWER HOLE POSITIONS FOR ALL INSTALLATIONS.

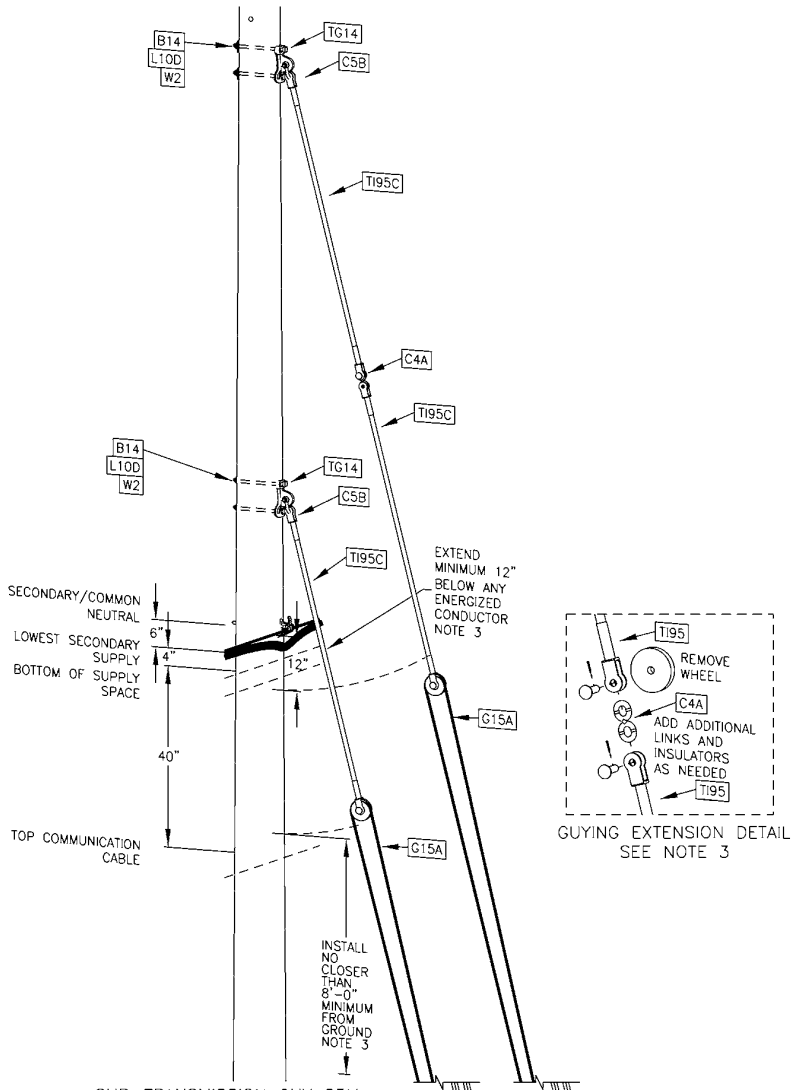
Designer	Drawing	Date
MPR	od3125	4/30/20

3. FIELD SHALL INSTALL ADDITIONAL GUY STRAIN INSULATORS (TI–95C) OR POSITION THE GUY STRAIN INSULATORS SUCH THAT IF THE GUY WIRE/SPAN GUY BECOMES BROKEN OR SLACK OR IF AN ENERGIZED CONDUCTOR BECOMES SLACK THE FOLLOWING SAFETY CONDITIONS MUST BE MET:
   A) ANY PART OF THE GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED DUE TO CONTACT WITH AN ENERGIZED CONDUCTOR SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   B) THE ENTIRE GUY STRAIN INSULATOR ATTACHED TO A GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   C) THE GUY STRAIN INSULATORS SHALL BE INSTALLED TO LIMIT THE LIKELIHOOD OF AN ANCHOR GUY BECOMING A CONDUCTIVE PATH BETWEEN AN ENERGIZED CONDUCTOR OR PART AND A CONDUCTOR OF ANOTHER CIRCUIT

SUB-TRANSMISSION DOUBLE GUY SINGLE ANCHOR – 12.5M AND 16M

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Doc. # ST. 03.00.002



SUB-TRANSMISSION GUY 25M

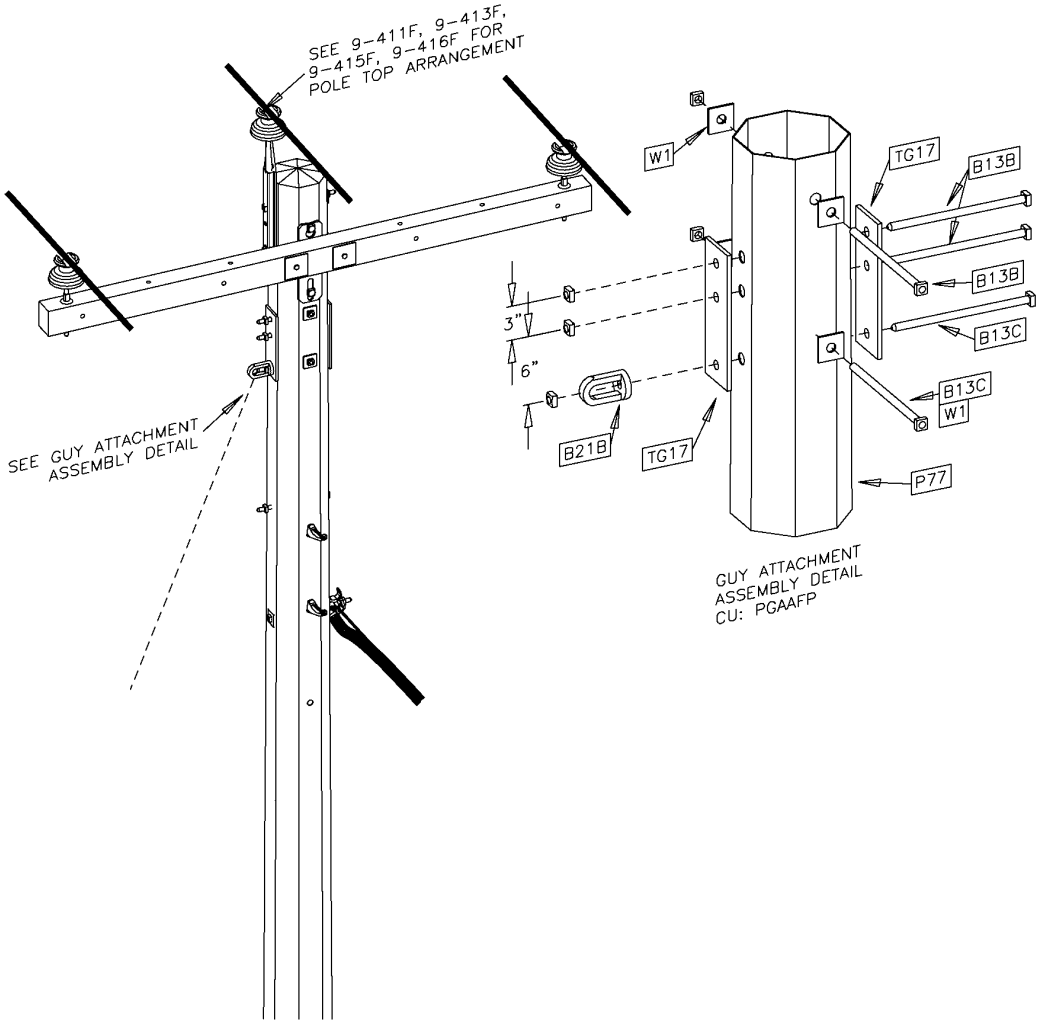
NOTE:

1. THESE GUY ASSEMBLIES ARE INTENDED FOR USE ON SUB-TRANSMISSION LINES.
2. GUY PLATE TG14 REQUIRES TWO, ¾" DIAMETER BOLT (B14) IN BOTH THE UPPER AND LOWER HOLE POSITIONS FOR ALL INSTALLATIONS.
3. FIELD SHALL INSTALL ADDITIONAL GUY STRAIN INSULATORS (TI-95C) OR POSITION THE GUY STRAIN INSULATORS SUCH THAT IF THE GUY WIRE/SPAN GUY BECOMES BROKEN OR SLACK OR IF AN ENERGIZED CONDUCTOR BECOMES SLACK THE FOLLOWING SAFETY CONDITIONS MUST BE MET:
   A) ANY PART OF THE GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED DUE TO CONTACT WITH AN ENERGIZED CONDUCTOR SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   B) THE ENTIRE GUY STRAIN INSULATOR ATTACHED TO A GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   C) THE GUY STRAIN INSULATORS SHALL BE INSTALLED TO LIMIT THE LIKELIHOOD OF AN ANCHOR GUY BECOMING A CONDUCTIVE PATH BETWEEN AN ENERGIZED CONDUCTOR OR PART AND A CONDUCTOR OF ANOTHER CIRCUIT

Designer	Drawing	Date
MPR	od3126	4/30/20

SUB-TRANSMISSION DOWN GUY DOUBLE ANCHOR – 25M			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		3-126	7/20

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



Designer	Drawing	Date
MPR	od03127	5/15/20

FIBERGLASS POLE GUYING ATTACHMENT

ISSUE	PAGE NUMBER		
7/20	3-127	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
13	7/21	• Update note 6 on pp 3-115D and 3-115Y • Added dialogue in Section 3.1.30	Cheng Lin	Director, T&D Line Engineering & Standards
12	7/20	• Correct drawings on pp3-121, 3-123, 3-124, 3-125, and 3-126 • Added drawing 3-127	Cheng Lin	J.P. Knauss, Director Electrical Engineering
11	7/19	• Corrected drawing on pp 3-115D, 3-115Y, and 3-125 • Corrected calculation on example 3-35 • Added Section 3.1.60 Guying on New York State Highway • Corrected title to 3-126.	Cheng Lin	J.P. Knauss, Director Electrical Engineering
10	7/18	• Corrected footnotes no pp 3-31 and 3-34. • Added Existing Insulated Guy Wire Configuration Guide pp 3-12A and 3-12B.	Brian Reynolds	Jonathan Gonynor, Director T&D O&M.
9	7/17	• Corrected example #1 Sec 3.7.30 and example #2, Sec 37.40. • Revised drawings 3-105, 106, 107D, 107Y, 108D, 108Y, 109D, 109Y, 111, 115D, 115Y, 118 thru 124. • Added new drawings 3-125 and 3-126..	Brian Reynolds	Jonathan Gonynor, Director T&D O&M.
8	7/16	• Added Sub-Transmission guy drawing 3-121, 3-122, 3-123 and 3-124.	Brian Reynolds	Jonathan Gonynor, Director T&D O&M.
7	7/15	• Revised drawing 3-102 to eliminate anchor rod stick-up requirement of 6”-10” and added screw anchor embedment requirement. • Eliminated guy hook TG10. • Added additional bolt information about guy hook TG13 and TG14. • Revised drawings 3-105, 3-108D, 3-109D, 3-109Y, 3-119 and 3-120	Brian Reynolds	Jonathan Gonynor, Director T&D O&M.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

6	7/13	• Added steel stub pole design guide	Brian Reynolds	Cheryl Warren, VP of Asset Management
5	7/12	• Added provisions for span guys with no primary wires (drawings 3-115D and 3-115Y).	Brian Reynolds	Susan Fleck, VP of Standards, Policies, & Codes
4	7/11	• Removed open wire secondary information from 3-118 and 3-119 and created new drawing 3-120 with the information. • Revised material used for abrasion protection on span guys (drawings 3-115D and 3-115Y). • Added Section 3.4.60 - Guying on multi-circuit structures.	Katie Croteau	Susan Fleck, VP of Standards, Policies, & Codes
3	7/10	• Revisions made to entire section - rearranged information in order to make information easier to locate and understand. • Removed Drawings 3-99, 3-101, 3-113, 3-116, and 3-117. All information from these pages is now in the text portion of the section. • Revised Drawings 3-105 and 3-106 - Updated Primary Guy Wires on Delta Systems. • Revised 3-107 - now split into two drawings to show differences between stub pole guys on delta and wye systems. • Revised 3-108 - now split into two drawings to show differences between sidewalk guys on delta and wye systems. • Revised 3-115 - now split into two drawings to show differences between pole to pole guys on delta and wye systems. • Added Drawing 3-118 to show secondary guy wires on a wye system. • Revised Drawing 3-119 to show only secondary wires on a delta system.	Katie Croteau	Allen Chieco, Director of Distribution Standards and Work Methods

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

2	7/09	• Revised wording on pages 3-10 & 3-79 • Updated CUs on drawings 3-102, 3-103, 3-104, 3-105, 3-106, 3-107, 3-108, 3-109, 3-111, 3-112, 3-114, 3-115. • Added Page 3-117, 3-118 & 3-119	Katie Croteau Joe Tumidajski	Allen Chieco, Director of Distribution Standards and Work Methods
1	7/08	• Section 3.0 modified to clarify bonding and insulation requirements. • Section 3.2.10 – Corrected solid rock soil classification to Class 0. • Corrected section numbering (3.5.10 and 3.5.20). • Step 1, Action – Added reference to Section 10 on page 3-51. • Step 1, Action – Added reference to Section 10 on page 3-54 • Modified note 4 and drawing on page 3-115. • Added column on right hand side of table on page 3-116. • Added pages 3-117, 3-118 & 3-119	Joe Tumidajski Paul Anundson	Allen Chieco, Director of Distribution Standards and Work Methods

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SECTION	PAGE
• 4.0 GENERAL	4-1
o 4.0.10 Storm Hardening	4-1
o 4.0.20 Objectives	4-1 THRU 4-2
o 4.0.30 Implementation Through Standards	4-2 THRU 4-3
• 4.1 APPLICATION TO NEW CONSTRUCTION	4-4
o 4.1.10 Critical Structures	4-4 THRU 4-6
o 4.1.20 Preventing Cascading	4-6 THRU 4-7
o 4.1.30 Coastal Areas	4-7
• 4.2 STORM HARDENING EXISTING LINES	4-8
o 4.2.10 Critical Structures	4-8 THRU 4-9
o 4.2.20 Preventing Cascading	4-9
o 4.2.30 Coastal Areas	4-9 THRU 4-10
o 4.2.40 Other Items	4-10
• 4.3 FUTURE UPDATES	4-11

Supersedes 7/16 Issue – Updated page numbers.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

This page left intentionally blank.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/16 Issue – Updated Section 4.0 information about EPRI research programs and background information about resiliency.

4.0 GENERAL

Electric utilities have been experiencing more frequent and severe storms over the past several years. At the same time, customer expectations for electric power have changed and interruptions lasting days are no longer acceptable.

Distribution grid resilience may be defined as: "the ability to withstand and reduce the magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event." IEEE Technical Report PES-TR65, The Definition and Quantification of Resilience, Page 2, April 2018. In looking at resilience, we look at two time horizons – near-term and long-term. Near-term considerations for resilience focus on operation and restoration after a major event. Long-term considerations focus on infrastructure improvements that must be done before a major event – including aspects of grid operation, vegetation management, and electrical and structural strength and robustness of distribution system components. Resilience considers all hazards and events, including high-impact low-probability events that are commonly excluded from reliability reporting. Often for distribution systems, it is more effective to make the network smarter and more responsive to extreme weather events rather than making the network more redundant. The storm hardening standards discussed in this section focus on one aspect of resilience – making distribution system components more resilient electrically and structurally.

Design, construction and operational changes can approach improved distribution performance during extreme weather events in a number of distinct ways by: (i) reducing the number of customers experiencing outages, (ii) reducing the duration of outages when they are experienced by customers and (iii) mitigating the impact to customers during outages in the distribution system. Distribution resiliency improvements can be achieved through changes in design standards, construction practices, material specifications, and maintenance, inspection and restoration practices. Standards revisions discussed in this section are centered on design standards, construction practices, material specifications. Maintenance, inspection and restoration practices are not addressed in these standards and are being addressed in appropriate operating practices.

National Grid is supporting a Grid Resiliency Research Program at the Electric Power Research Institute (EPRI) through funding and participation in the research program's steering committee. This continuing work includes reviewing a number of alternatives: reinforcing overhead distribution structures, adding breakaway devices in overhead conductor supports to reduce overhead structure damage, undergrounding all or portions of the distribution system, and smart grid and distribution automation options to reduce the number of customers affected by distribution system problems. As additional information becomes available from EPRI, its recommendations will be evaluated for inclusion in these standards as appropriate.

4.0.10 Storm Hardening

Our experience is that during extreme weather events, most of the damage to our overhead distribution system is caused by falling limbs and trees. The approaches discussed here attempt to reduce electrical outages caused by trees and limbs or reduce structural damage caused by trees and limbs that cause electrical outages. In particular, the standards discussed here are aimed at limiting the numbers of customers affected by tree and limb related outages and limiting the duration of those outages by allowing partial restoration of feeders and allowing quicker restoration of damaged lines.

4.0.20 Objectives

The standards discussed here are aimed at hardening critical structures and preventing damage to large numbers of structures through cascading failures from a single tree or limb.

Where an individual structure failure would cause outages on multiple feeders or would prevent or slow the restoration of service to customers, such structures are considered critical structures. Tie point structures are considered critical structures because two separate feeders are attached to these structures and failure of a single tie point structure would affect customers on both feeders and the ability to restore service to our customers by transferring loads. Double circuit

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

structures are considered critical structures because two separate feeders are attached to these structures and failure of a double circuit structure would affect customers on both feeders. Recloser structures are considered critical structures because we use reclosers to automatically isolate damaged potions of feeders from undamaged portions and a failure of a recloser structure would mean that customers on both sides of the recloser would remain out of service until the recloser structure could be repaired or replaced. Loadbreak switch structures are considered critical structures because crews use loadbreak switches to isolate damaged potions of feeders from undamaged portions and a failure of a loadbreak switch structure would mean that customers on both sides of the loadbreak switch would remain out of service until the loadbreak switch structure could be repaired or replaced. New and revised standards for hardening critical structures are discussed below.

A single tree or limb can cause the failure of a large number of structures through cascading. Stronger deadend crossarms and the insertion of periodic deadend structures in lines have been adopted as new standards to prevent the failure of large numbers of structures through cascading. The objective of these new standards is to provide faster restoration of service to our customers by preventing the failure of large numbers of structures caused by a single tree or limb.

4.0.30 Implementation Through Standards

While this section of the standards book describes and explains the changes that have been made to our standards for storm hardening, most of the actual changes to our standards are located in other sections of our standards. This is because many of these changes to our standards are intended to be part of our routine construction going forward, not just for use in strom hardening particular feeders.

A. Drawings in Other Sections

This is a list of standard drawings that have been modified to reflect the policies outlined in this section:

1. 9-415 1Φ (Delta) and 3Φ Crossarm Pole Top – 0-15 kV – 46º– 60º Angles / Back-To-Back Deadends (Tangent)
2. 9-416 1Φ (Delta) and 3Φ Double Crossarm Pole Top – 0-15 kV – Angles -61º – 90º and Deadends
3. 9-417 1Φ (Delta) and 3Φ Double Crossarm Pole Top – 0-15 kV Deadends
4. 9-422 1Φ (Delta) and 3Φ (Wye) Crossarm Pole Top – 0-15 kV – To 1Φ (Delta) and 2Φ (Wye) 11º – 20º Tap
5. 9-424 1Φ (Delta) and 3Φ Double Crossarm Pole Top – 0-15 kV Crossings 11º–45º / Angles 21º–45º – Tao To 1Φ (Delta) and 2Φ (Wye)
6. 9-435 1Φ (Delta) and 3Φ Crossarm Pole Top – 0-15 kV – 0º – 10º Tap To 1Φ (Delta) or 3Φ Crossarm
7. 9-835 1Φ (Delta) and 3Φ Armless Pole Top – 0-15 kV – 0º – 20º – Tap To 3Φ Crossarm
8. 12-141 3Φ Primary Sectionalizing - Loadbreak Switch Below Crossarm Installation 15-35 kV
9. 12-142 3Φ Primary Sectionalizing – Conductor Deadend On Loadbreak Switch Installation 15-35 kV
10. 12-143 3Φ Primary Sectionalizing – Loadbreak Switch With Shunt Cutouts Installation 15-35 kV

Supersedes 7/16 Issue –Repaging because of added text.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

11. 12-144 3Φ Primary Sectionalizing – Hook Stick Loadbreak Switch Below Crossarm Installation 15kV
12. 12-145 3Φ Primary Sectionalizing – Hook Stick Loadbreak Conductor Deadend On Switch Installation 15kV
13. 12-335 3Φ Electronic Recloser Effectively Grounded Installation 15-35kV
14. 12-338 3Φ Electronic Recloser Effectively Grounded Installation 12.47 kV, 13.2 kV, 13.8 kV Applications with Frame Mounted PTs

B. Design Criteria Adopted in This Section

The following items are design criteria are adopted in this section and are not otherwise found in the standards:

1. Section 4.1.10 D – Multiple Circuit Structures
2. Section 4.1.20 B – Periodic Deadends
3. Section 4.2 – Storm Hardening Existing Lines

C. Design Criteria in Other Sections

A description of NESC Grade B design requirements has been added to the standards in Section 2 – Poles & Hardware.

Supersedes 7/16 Issue – Repaging because of added text.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

4.1 APPLICATION TO NEW CONSTRUCTION

Storm hardening standards are now part of our standards for all new construction. In the locations discussed in this section, storm hardened structures will be used for all new or replaced structures. The intent is that the storm hardening provisions discussed in this section become a routine part of all future construction at National Grid.

There is no standards requirement to modify existing lines to meet these new standards. However, when a particular feeder or line segment is targeted for storm hardening based on its performance, follow the provisions of Section 4.2 – Storm Hardening Existing Lines, below.

4.1.10 Critical Structures

A. Tie Points

At the ends of feeders, tie points allow the transfer of customer load from one distribution circuit (feeder) to another. The structure at this tie point becomes critical to system performance during extreme weather events because a structure failure will take both circuits out of service (affecting customers on both circuits) and prevent the transfer of load from one circuit to the other where one of the circuits is still in service. These structures can be strengthened by deadending conductors at the structure and strengthening the structure in the directions of the conductors on both sides of the tie point structure.

New Requirements: Our standards now require that all new or replaced structures at tie points be strong enough to remain standing if all of the wires in one direction are broken by falling trees and tree limbs. To meet this requirement, standards now require the following:

1. When a new loadbreak switch or recloser is installed at a tie point structure, including replacements, meet the tie point strength requirements by following current standards for the new loadbreak switch or recloser. These standards can be found at 12-141, 12-142, 12-143, 12-144, 12-145, 12-335 and 12-338.

   Note: Standards 12-141, 12-144, 12-335 and 12-338 require class H1 minimum poles for the pole supporting the loadbreak switch or recloser. Standards 12-142, 12-143 and 12-145 require both poles adjacent to the loadbreak switch pole to be class H1 minimum poles.

2. When a new tie point is established without a loadbreak switch or recloser or a tie point structure without a loadbreak switch or recloser is replaced, (i) conductors at the tie point structure shall be deadended in both directions and (ii) the structure shall use a class H1 minimum pole. See standard 9-415 for an appropriate deadend structure.

B. Reclosers / Automatic Switches

Throughout our distribution system, we have a large number of switching points that are used to isolate customers on one part of a feeder from problems on another part of the feeder. Some of these switching points, reclosers, sectionalizers, Scadamate switches and remote controlled loadbreak switches, are parts of automated switching schemes. Failures of these structures affect our ability to quickly restore service to customers on unaffected parts of feeders. As with switching devices at tie points between feeders, these structures can be strengthened by deadending conductors at the structure and strengthening the structure in the directions of the conductors on both sides of the tie point structure.

Supersedes 7/16 Issue –Repaging because of added text.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Our standards now require that all new or replaced structures with reclosers or other automatic switches be strong enough to remain standing if all of the wires in one direction are broken by falling trees and tree limbs. To meet this requirement, standards now require the following:

1. When a new three phase recloser is installed, including replacements, meet the strength requirements for the recloser by following the current standards for the new recloser. These standards can be found at 12-335 and 12-338. EXCEPTION: When replacing a G&W Viper recloser installed before July 1, 2015, if the existing pole is a class 2 minimum, the pole does not need to be replaced with a class H1 minimum pole.

   Note: Standards 12-335 and 12-338 require class H1 minimum poles for the pole supporting the loadbreak switch or recloser.

C. Manually Operated Loadbreak Switches

Throughout our distribution system, we have a large number of switching points that are used to isolate customers on one part of a feeder from problems on another part of the feeder. Manually operated loadbreak switches are parts of switching schemes used to restore customers during storm events. Failures of these structures affect our ability to quickly restore service to customers on unaffected parts of feeders. As with switching devices at tie points between feeders, these structures can be strengthened by deadending conductors at the structure and strengthening the structure in the directions of the conductors on both sides of the tie point structure.

New Requirements: Our standards now require that structures supporting or surrounding all new or replaced manually operated loadbreak switches be strong enough to remain standing if all of the wires in one direction are broken by falling trees and tree limbs. This requirement does not apply to structures supporting disconnect switches. To meet this requirement, standards now require the following:

1. When a new loadbreak switch is installed with conductors on a separate crossarm above the loadbreak switch (preferred standards 12-141 and 12-144), including replacements, (i) conductors at the loadbreak structure shall be deadended in both directions and (ii) the structure shall use a class H1 minimum pole. EXCEPTION: When replacing a set of underslung disconnect switches with a hookstick operated loadbreak switch (standard 12-144), if the existing pole is a class 3 minimum, the pole does not need to be replaced with a class H1 minimum pole.

2. When a new loadbreak switch is installed with conductors deadended on the loadbreak switch frame (non-preferred standards 12-142 and 12-145), including replacements, strengthen the adjacent structures on both sides of the loadbreak switch structure by: (i) deadending conductors in both directions and (ii) use a class H1 minimum pole. See standard 9-415 for an appropriate deadend structure.

D. Multiple Circuit Structures

Where a single line of poles supports multiple circuits, each of the structures in this line becomes critical to system performance during extreme weather events because a structure failure will take both circuits out service (affecting customers on both circuits). Multiple circuit lines are typically the first part of the feeders near the source substations and extend until the feeders can be separated to go off in different directions to supply customers in different areas. This practice allows all of the circuits coming out of a substation to leave the substation on the public way in front of the substation or on private

Supersedes 7/16 Issue – Added an exception in Section 4.1.10(B)(1).

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

rights-of way. An outage in this portion of line will interrupt service to all or most of the customers on each feeder.

As discussed above, ongoing EPRI research is investigating the level of strengthening required to prevent lines from falling down when struck by trees and tree limbs.

New Requirements: Until the EPRI results are available, new multiple three-phase circuit lines shall be designed to NESC Grade B requirements. This new design requirement will require stronger conductors, attachments and structures. While implementation of new standard requirement will help reduce mechanical damage caused by trees and limbs, it will not reduce electrical contacts caused by trees and tree limbs and will not eliminate the outages associated with those electrical contacts. Guidance for applying NESC Grade B requirements has been added to Section 2 – Poles and Hardware of our standards. This requirement applies only where there is more than one three-phase circuit line on the structure.

Another option for addressing some of the issues with multiple circuit lines is to eliminate multiple circuit structures by installing the circuits, or all but one of the circuits, underground rather than on a common line of poles. This option would help reduce electrical contacts, as well as mechanical damage, caused by trees and tree limbs and the associated outages. While often not practical, consideration should be given to this option, particularly where additional future circuits along the same route are expected.

Supersedes 7/18 Issue –Modified Grade B requirement for multiple circuit lines.

4.1.20 Preventing Cascading

A. Periodic Deadends

Portions of overhead distribution lines with a large number of tangent (straight line) pole structures between deadend or other stronger structures may experience cascading failures of poles. When all or most of the wires on one side of a pole are broken, the tension of the wires on the other side of the pole will break poles designed for tangent loads. These failures will cascade down a line of poles until the failures reach a pole with enough strength to withstand the unbalanced loads. Poles with deadends, such as junction poles, and poles with higher strength for other reasons, such as equipment poles and poles with line angles, will often provide adequate strength to stop cascading failures. This strategy will reduce the duration of outages experienced by our customers by limiting cascading failures will limit the number of poles that will have to be replaced at any one location and help reduce the duration of outages experienced by our customers during major storm events.

New Requirements: For new lines in new locations and when major work is performed on a line segment, the design should allow a maximum of 20 spans (19 structures) between structures adequate to stop cascading failures. Deadend structures, junction structures, structures with a line angle over 15 degrees, or storm hardened tie point, recloser or loadbreak structures described above are considered adequate to stop cascading failures. See standard 9-415, 9-715 and 16-115 for examples of appropriate deadend structures. In spacer cable construction, only the messenger must be deadended.

When the EPRI research described above is complete, this alternative will be reevaluated and compared to new alternatives developed in the EPRI research for costs and effectiveness in reducing cascading failures.

B. Deadend Crossarms

Because we are counting on structures with deadends to stop cascading failures, we have reviewed the strength of deadend crossarm alternatives. The fiberglass deadend crossarms that we already use in some special applications are stronger and may give us

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

a longer service life than our standard double wood crossarms for deadend installations. and may give us a longer service.

New Requirements: For most structures with deadend crossarms, we have replaced double wood deadend crossarms with fiberglass deadend crossarms in most of our standard deadend and junction pole structures. These new updated standards can be found at 9-415, 9-416, 9-417, 9-422, 9-424, 9-435 and 9-835 and are intended for use for all new and replacement structures of these types.

While we have incorporated fiberglass crossarms in most of our common structures with deadend crossarms, a number of double wood crossarm applications remain in our standards. These are structures where the double wood crossarms are used in non-deadend applications, such as large running angles, or where the double crossarms are used for mounting special equipment.

4.1.30 Coastline Areas

A. Coastline Areas

For purposes of this section, a “Coastline Area” is any area within 1/2 mile of a saltwater coastline. This definition is different than the “Coastline Area” definition used in Section 8 – Coastline Construction of these standards. As used here, the term “Coastline Area” does not include areas known to experience with heavy road salt contamination that are not within 1/2 mile of a saltwater coastline.

B. Pole Strength Requirements

When new poles are installed in Coastline Areas, install poles that are one pole strength class higher than would otherwise be required by other parts of these standards. Exception: This one pole strength class higher requirement does not apply to poles installed to meet requirements for critical structures in Section 4.1.10 above.

In Coastline Areas, poles will generally be exposed to higher direct wind loads than poles further inland. Distribution poles within 1/2 mile of a saltwater coastline may be directly exposed to severe winds during major storm events. Our historic experience indicates that inland pole failures during these events are the result of damage from trees and flying debris rather than from direct wind loading on poles and wires.

Supersedes 7/18 Issue – Repaging because of added text.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

4.2 STORM HARDENING EXISTING LINES

Storm hardening standards are now part of our standards for all new or replaced structures. There is no standards requirement to modify existing lines to meet these new standards. However, when a particular feeder or line segment is targeted for storm hardening based on its performance, follow the provisions should be followed:

4.2.10 Critical Structures

A. Tie Points

Our standards now require that all new or replaced structures at tie points be strong enough to remain standing if all of the wires in one direction are broken by falling trees and tree limbs. When storm hardening an existing line, we recommend the following for tie point structures:

1. Where an existing tie point structure has a loadbreak switch or recloser, the tie point strength requirements may be met by (i) meeting the strength requirements for a new loadbreak switch or recloser at a tie point (see Section 4.1.10(A)(1) above) or (ii) strengthening adjacent structures on both sides of the tie point structure. When strengthening adjacent structures, (i) deadend conductors in both directions and (ii) use a class H1 minimum pole. See standard 9-415 for an appropriate deadend structure.

2. Where an existing tie point structure does not have a loadbreak switch or recloser, (i) conductors at the tie point structure shall be deadended in both directions and (ii) the structure shall use a class H1 minimum pole. See standard 9-415 for an appropriate structure.

B. Reclosers / Automatic Switches

Our standards now require that all new or replaced structures with reclosers or other automatic switches be strong enough to remain standing if all of the wires in one direction are broken by falling trees and tree limbs. When storm hardening an existing line, we recommend the following for structures supporting reclosers or other automatic switches:

1. Where an existing structure has a three phase recloser, the recloser structure strength requirements may be met by (i) following the current standards for reclosers or (ii) strengthening adjacent structures on both sides of the recloser structure. Standards for recloser structures can be found at 12-335 and 12-338. Adjacent structures may be strengthened by (i) deadending conductors in both directions and (ii) using a class H1 minimum pole. See standard 9-415 for an appropriate deadend structure.

C. Manually Operated Loadbreak Switches

Our standards now require that structures supporting or surrounding all new or replaced manually operated loadbreak switches be strong enough to remain standing if all of the wires in one direction are broken by falling trees and tree limbs. This requirement does not apply to structures supporting disconnect switches. When storm hardening an existing line, we recommend the following for manually operated loadbreak switch structures:

1. Where an existing loadbreak switch has conductors on a separate crossarm above the loadbreak switch, the loadbreak switch strength requirements may be met by (i) following the current standards for new loadbreak switches or (ii) strengthening adjacent structures on both sides

Supersedes 7/16 Issue –Repaging because of added text.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

of the loadbreak switch structure. The standards for these loadbreak switch structures can be found at 12-141 and 12-145. When strengthening adjacent structures, (i) deadend conductors in both directions and (ii) use a class H1 minimum pole. See standard 9-415 for an appropriate deadend structure.

2. Where an existing loadbreak switch structure has conductors deadended on the fiberglass switch arm, strengthen adjacent structures on both sides of the loadbreak switch structure by: (i) deadending conductors in both directions and (ii) using a class H1 minimum pole. See standard 9-415 for an appropriate deadend structure.

D. Multiple Circuit Structures

Our standards now require new multiple circuit lines to be designed to NESC Grade B requirements. Application of this new design requirement to multiple circuit portions of feeders to be storm hardened is recommended. This new design requirement will require stronger conductors, attachments and structures. While implementation of new standard requirement will help reduce mechanical damage caused by trees and limbs, it will not reduce electrical contacts caused by trees and tree limbs and will not eliminate the outages associated with those electrical contacts. Guidance for applying NESC Grade B requirements has been added to Section 2 – Poles and Hardware of our standards.

Supersedes 7/16 Issue – Repaging because of added text.

4.2.20 Preventing Cascading

A. Periodic Deadends

For new lines in new locations and when major work is performed on a line segment, our standards now recommend that the design should allow a maximum of 20 spans (19 structures) between structures adequate to stop cascading failures. Deadend structures, junction structures, structures with a line angle over 15 degrees, or storm hardened tie point, recloser or loadbreak structures described above are considered adequate to stop cascading failures. Application of this new design requirement to multiple circuit portions of feeders to be storm hardened is recommended

B. Deadend Crossarms

New Requirements: For most structures with deadend crossarms, we have replaced double wood deadend crossarms with fiberglass deadend crossarms in most of our standard deadend and junction pole structures. These new updated standards can be found at 9-415, 9-416, 9-417, 9-422, 9-424, 9-435 and 9-835 and are intended for use for all new and replacement structures of these types. When storm hardening an existing line, we recommend that double wood deadend crossarms be visually inspected and that crossarms showing signs of decay, splitting or other defects be replaced. The new replacement crossarms should be installed to current standards for new or replaced crossarms.

4.2.30 Coastline Areas

A. Coastline Areas

For purposes of this section, a “Coastline Area” is any area within 1/2 mile of a saltwater coastline. This definition is different than the “Coastline Area” definition used in Section 8 – Coastline Construction of these standards. As used here, the term “Coastline Area” does not include areas known to experience with heavy road salt contamination that are not within 1/2 mile of a saltwater coastline.

B. Pole Strength Requirements

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Our standards now require that all new or replaced poles in Coastline Areas, be installed with poles that are one pole strength class higher than would otherwise be required by other parts of these standards. Exception: This one pole strength class higher requirement does not apply to poles installed to meet requirements for critical structures in Section 4.2.10 above.

4.2.40 Other Items

A. Lightning Arresters

When storm hardening an existing line, we recommend reviewing the application of lightning arresters on the line for compliance with current standard practices. In particular, where a feeder has a history of poor performance during lightning events, compliance with the reliability based practices in Section 13.6.40 of these standards is recommended.

B. Crossarms

When storm hardening an existing line, we recommend that double wood crossarms be visually inspected and that crossarms showing signs of decay, splitting or other defects be replaced. The new replacement crossarms should be installed to current standards for new or replaced crossarms.

C. Coastal Construction

When storm hardening an existing line in areas covered by our coastal construction standards, we recommend reviewing the existing line against our coastal construction standards (see Section 8 – Coastal Construction) and visually inspecting the line for signs of tracking or corrosion. Such areas are areas within 1/2 mile of a saltwater coastline, areas beyond 1/2 mile from a saltwater coastline where experience shows that the area experiences heavy salt spray and areas where experience shows that the area experiences heavy road salt contamination. Insulators showing visible signs of tracking and electrical connectors showing visible signs of corrosion should be replaced.

Supersedes 7/16 Issue –Repaging because of added text.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

4.3 FUTURE UPDATES

This standard and the practices described in it continue to be works in progress. National Grid is supporting an ongoing Grid Resiliency Research Program at EPRI through funding and participation in the research program's steering committee. This work will continue through 2018. As results become available from the ongoing EPRI work, the practices outlined in this standard will be reviewed to implement best practices based on the available information.

Supersedes 7/16 Issue – Repaging because of added text.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
5	7/19	• Updated 4.1.10(D) to indicate that Grade B construction is only required for lines with multiple three-phase circuit lines	G. Paul Anundson	J. P. Knauss, Director, Electrical Engineering
4	7/18	• Updated Section 4.0 information about EPRI research programs. • Added an exception in Section 4.1.10(B)(1) to the requirement to use a class H1 pole for new reclosers.	G. Paul Anundson	Jonathan Gonynor, Director T&D O&M Services
3	7/17	• Added an exception in 4.1.10(C)(1) to the requirement to use a class H1 pole for all hookstick loadbreak switches. • Added additional examples of drawings for deadending conductors to prevent cascading failures and clarified that only the messenger must be deadended in spacer cable construction – Section 4.1.20(A).	G. Paul Anundson	Jonathan Gonynor, Director T&D O&M Services
2	7/16	• Corrected References to Section 3 – Poles & Hardware. • Clarified application of requirements for applying new standards in Sections 4.1.10 and 4.2.10. • Added new requirements for Coastal Areas – Sections 4.1.30 and 4.2.30. • Copyright notice headers and repaging revisions throughout the section.	G. Paul Anundson	Jonathan Gonynor, Director T&D O&M Services
1	7/15	• Limited H1 pole requirement for reclosers to three phase reclosers at 4.1.10(B) and 4.2.10(B).	G. Paul Anundson	Jonathan Gonynor, Director T&D O&M Services

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SECTION	PAGE
• 5.0 GENERAL	5-1
• 5.1 SELECTION OF CONNECTORS	5-1
• 5.2 LOCATION OF CONNECTORS	5-1
• 5.3 CONDUCTOR PREPARATION	5-1
• 5.4 INSULATION OF CONNECTORS	5-1
• 5.5 TYPES OF CONNECTORS	5-2 THRU 5-4
• 5.6 COMPRESSION TOOLS AND DIES	5-4
• 5.7 SELECTION OF CONNECTORS	5-111 THRU 5-112
• 5.8 SELECTION AND INSTALLATION OF H-TAP CONNECTORS	5-121 THRU 5-122
• 5.9 INSULATING CONNECTIONS (600 VOLTS)	5-123
• 5.10 SELECTION AND INSTALLATION OF PARALLEL GROOVE TAP CONNECTORS	5-131 THRU 5-132
• 5.11 SELECTION AND INSTALLATION OF FIRED ON WEDGE TAP CONNECTORS	5-133
• 5.12 SELECTION AND INSTALLATION OF AUTOMATIC SPLICES	5-141 THRU 143
• 5.13 SELECTION AND INSTALLATION OF COMPRESSION SPLICES	5-144
• 5.14 SELECTION AND INSTALLATION OF HOT LINE CONNECTORS	5-147
• 5.15 SELECTION AND INSTALLATION OF TERMINATION CONNECTORS	5-148
• 5.16 SELECTION OF REPAIR SLEEVES	5-149

Supersedes 1/08 Issue – Corrected page numbering.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

5.0 GENERAL

Automatic, bolted, and compression type connectors are used for all work on the overhead distribution system. All connectors shall be installed using the correct tools, dies, and connectors. Each connector has a specific location to be used (See Page 5-111). Some exceptions may be made for temporary work or for connections that may have to be removed. **Note: All conductors shall be thoroughly cleaned (wire brushed) prior to connector installation.**

5.1 SELECTION OF CONNECTORS

Connector items shall be selected from Pages 5-111 and 5-112. Details of the size range and die index numbers are shown on the material list. Corresponding conductor range and die information, the number of crimps required, and the crimp-limit lines are printed or embossed on the connectors as well. Unless a compression connector, or its packaging, is properly marked for the wire size and die information, a bolted connector shall be employed.

5.2 LOCATION OF CONNECTORS

Splices shall be located where they are needed, but they will not be used on conductors crossing over railroads or limited access highways, or in spans on either side of those crossings.

Automatic tension splices shall not be used on services or slack spans conductors.

When aluminum cables are joined to copper, efforts should be made to keep the aluminum above the copper, and oxide-inhibiting compound/grease (G9B) should be applied between the surfaces.

When installing taps, allow sufficient slack and properly train the tap conductor to avoid putting stress on the connection or conductors.

5.3 CONDUCTOR PREPARATION

Conductor surface preparation is essential to ensure proper contact between conductors and the connector. Surface oxidation and contaminants will greatly interfere with the establishment of a sound electrical connection. An insulating oxide naturally forms on all conductor surfaces exposed to air. The oxide formation is relatively quick and transparent to the eye. **Always** thoroughly wire brush the conductors (both new conductors and conductors in service) before making connections. **Never** use the same wire brush to clean both an aluminum and copper conductor. Copper contaminants transferred to the aluminum conductor will cause the aluminum conductor to corrode. The Standard Item for a wire brush is NTE1 in Section 22-Material Catalog.

5.4 INSULATION OF CONNECTORS

Splices and tap connectors on service/secondary conductors up to 600 V shall be covered with snap-on covers (C60). Bare messenger/neutral connectors shall not be covered.

Splices and tap connectors on bare primary conductors shall not be covered or taped.

Splices on tree wire/spacer cable conductors shall be covered or taped. Tree wire/spacer cable is considered a “covered” rather than “insulated” conductor. **Note**: **Always cover any unused, exposed bare conductor.** Splices on these conductors shall be taped or covered using one of the following methods:

- Gelwrap Cover (C62 & C63) – Use on all 15 kV splices for 1/0 thru 795kcmil. Installation instructions are included in the cover package.
- Cold Shrink Cover (S16) – This Cover is no longer available from the Manufacturer.
- Taped Cover – Use on all 15 kV and 35 kV splices. See Section 16 for installation instructions.

Supersedes 7/16 Issue – Section 5.4; Cold shrink cover is no longer available.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

5.5 TYPES OF CONNECTORS

5.5.10 Splices

There are two types of Line splices: Automatic and Compression. Applications should be as specified in A and B below.

All splices must be located a minimum distance of 30 inches from pin insulators for all installations.

For tree wire and covered conductor splicing, remove covering with approved stripper for given conductor size and covering thickness. Always cover any unused, exposed bare conductor per section 5.4.

For Spacer Cable splicing, follow procedures outlined in Section 16. Stagger splices 30" inches from other phases. **Do not** use automatic line splices on spacer conductors.

A. Automatic Line Splices

An automatic line splice is a full tension splice for aluminum and copper conductors (Std. Items S19A thru S19V). They are to be used on full tension conductors only. They are not designed to be used on spacer cable phase conductors, slack spans, or secondary/service cable phase conductor. **Note:** Because service cable is a low tension conductor, an automatic splice shall not be used on a service cable messenger/neutral. See Page 5-141 for installation instructions.

B. Compression Line Splices

A compression splice can be a full tension, partial tension or non-tension splice for aluminum and copper conductors. Full tension splices are used on overhead bare wire and tree wire primary aluminum conductors (Std. Items S20B thru S20G and S20R1 thru S20R4) and copper conductors (Std. Items S23A thru S23N). **Note:** Although spacer cable phase conductors are a partial tension conductor, full tension compression splices shall be used. A partial tension splice is used for secondary/service messengers/neutrals (S22E thru S22H). A non-tension splice is used for non-tension conductors such as secondary/service phase conductors (Std. Items S26C and S26D). See Page 5-144 for installation instructions.

5.5.20 Taps

A. Bolted Connectors

There are several different types of bolted connectors presently used throughout the Company.

1. Parallel Groove Connector

The tap connector is the extruded aluminum parallel groove connector (Std. Items C7A thru C7J). This connector is used for overhead primary aluminum to aluminum or aluminum to copper tap connections. See Page 5-131 for connector sizes and range taking information. **Note:** Cast aluminum parallel groove connectors are not an approved connector and shall not be used for overhead tap connections.

2. Hot Line Clamp/Vice Connectors

Hot line clamp/vice connectors are used in very limited applications. Hot line clamps shall **NOT** be used for temporary jumpers as noted in Standards Bulletin 05-05. The limited applications for hotline clamps/vice connectors are as follows:

- Energized line installations on distribution class primary circuits above 15kV.

Supersedes 7/08 Issue – Added text to Splices – Min dist to insulator and TW /Spacer cable Reqmts.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

- Energized line installations or maintenance on primary circuits below 15KV when rubber gloving is not allowed (such as off a pole), or crew make up does not allow gloving above 600 volts (such as OPC/Trouble man).
- Energized line installations of equipment (such as sectionalizers and reclosers) on primary circuits.
- Energized line installations of a line regulator.
- Energized line installation of a lightning arrester. (**Note:** Non-energized arrester connections **MUST** be done with parallel groove or fired on wedge).
- Installation and removal of Current Limiting Fuses used for Capacitor Banks on energized line installations.

There are both clamp and vice type hot line connectors and they are applied as follows:

- Aluminum clamp type hot line connectors (Std. Items C24A thru C24C) are used to tap aluminum primary conductors with an aluminum or copper tap for transformers, capacitors, and primary taps. Bronze clamp type hot line connector (Std. Item C24D) is used to tap copper primary conductors with a copper tap for transformers, capacitors, and primary taps.
- Aluminum vice type hot line connectors (Std. Items C16C thru C16G) are used for mainline connections such as switches, reclosers, and regulators.

Note: Stirrups shall not be used for future installations. See Page 5-147 for installation instructions

3. Split Bolt Connector: Nantucket Use Only

The split bolt connector is a bronze connector for primary and service/secondary copper conductors only (Std. Items C27A thru C27E). This connector is used in Nantucket on overhead primary and service/secondary that is exclusively copper.

4. Vice Connector

The vice connector is a single bolt bronze connector for copper conductors only (Std. Items C6N1 thru C6N7). This connector is used for overhead primary copper conductors, streetlighting, and some grounding applications.

B. Compression Connectors

1. Secondary/Services Connections up to 600 Volts

The H-Tap compression connector is used for secondary/service connections up to 4/0 AWG aluminum to aluminum or aluminum to copper and 600 V maximum (Std. Items S13B thru S13LI). See Page 5-121 for installation information. For secondary/service connections above 600 V, bolted or fired-on wedge connectors shall be used.

2. Primary Connections

Primary compression tap connectors are not a standard connection and therefore shall not be used.

3. Grounding Connections

A C-type compression connector shall be used for bonding copper grounding conductors (Std. Items S14A thru S14L). This connector can be installed with a hand or battery operated tool.

Supersedes 7/07 Issue – . Revised HLC usage for equipment and to include cap banks with CLF's .

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

C. Fired-on Wedge Connectors

The fired-on wedge connector is used by the Company for overhead primary aluminum to aluminum, or aluminum to copper tap connections (Std. Items S15G thru S15R7). See Page 5-133 for installation information.

5.5.30 Deadends

Deadend connectors are a mechanical connection. They are designed to have a holding strength greater than the maximum tension of the conductor attached to it. They are not designed to be electrical connectors.

A. Bolted Deadends – Strain Clamps (Straight and Quadrant)

Used on distribution primary and larger secondary and service cables for deadening AAC, AAAC, and ASCR conductors. Remove covering on covered conductor before installing the clamps. To select the correct deadend for the conductor desired, See Section 22-Material Catalog Standard Items C13A1 thru C13Q.

B. Formed Deadends

Used for deadending primary and secondary and service cable messengers – AAC, AAAC, AWAC and CW. Also, may be used to deadend primary spacer cable phase conductors. Do not remove covering for latter application. Use with proper thimble clevis or thimble eye. **WARNING:** Do not use with tree wire construction. See Section 22-Material Catalog Standard Items P52A1 thru P52P, and P54A thru P54J.

5.5.40 Terminations

Terminal connectors are used on airbreak/loadbreak switches, transformers, disconnect switches, or any application from aluminum cable to flat aluminum or copper pad or bus bar. **Note:** For applications where taps from copper flat pads to aluminum cables are made, preferred practice is to install copper taps with copper terminal connectors at the copper pads and aluminum tap connectors at the aluminum cables. See Section 22-Material Catalog Std. Item C9.

5.6 COMPRESSION TOOLS AND DIES

Burndy tools and dies, to compress connectors on standard conductors from #6 AWG through 500kcmil, are available. The battery-operated tool can be used for work on services and secondaries up to 4/0 AWG. The hand-operated tool is also available for conductors up to 4/0 AWG.

The HYPRESS Y35 hand-operated hydraulic tool is used primarily for work with larger connectors on conductors through 500kcmil. Although the Y35 will accommodate the same conductor range as the hand-operated tool, it is not generally used on the smaller range conductors (4/0 or less) unless a great number of crimps are required or connectors are used that do not easily yield to compression.

When new tools are to be selected, the Kearny hand-operated tool and the HYPRESS Y35 and dies are suggested. See illustrated tools and a list of standard dies on Page 5-121.

All compression tools shall be tested frequently to see that they are in adjustment. It is desirable that the test be made by the worker who will use the tool. See instructions furnished with the tool.

Supersedes 1/06 Issue – Revised Std. Item reference to C9

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

5.7 SELECTION OF CONNECTORS

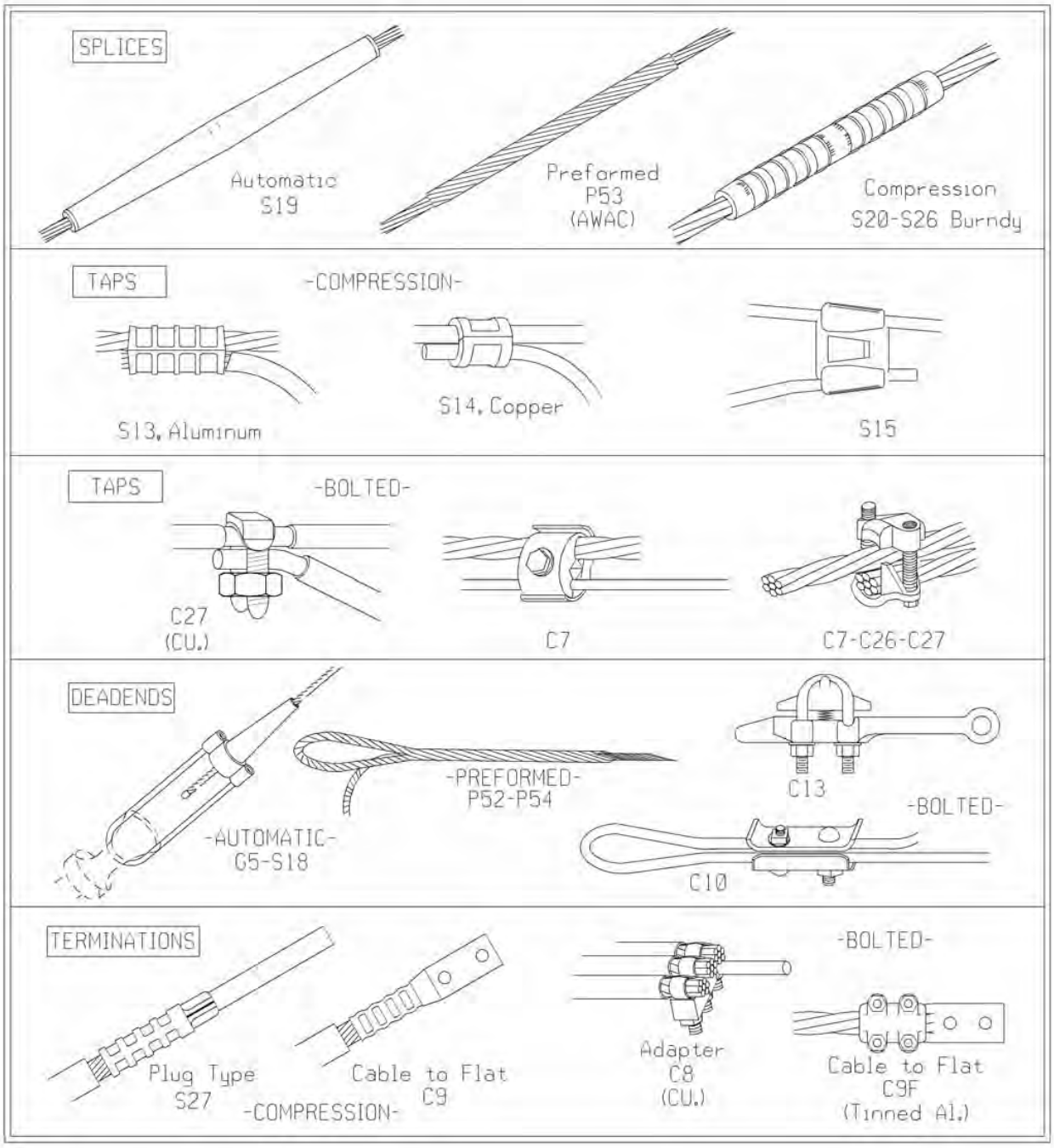
The following table identifies the different types of connectors used for overhead distribution conductors. The connectors listed below are electrical connectors except for the deadend connectors, which are strictly a mechanical connection

APPLICATION	CONDUCTOR	RECOMMENDATED CONNECTOR (IDENTIFIED BY STD ITEM)				
		AUTOMATIC	PREFORMED	COMPRESSION	WEDGE	BOLTED
SPLICES Full Tension	AL. ACSR AWAC STEEL CU & CCW	S19 S19 S19 S19	 P53	S21 S20 S20 S23		
Partial Tension	AL & ACSR	S19		S22		
Non-Tension	AL. ACSR AL. & CU CU. CCW	DO NOT USE		S13, S26 S13 S13 S14,S24		C7,C26 C7,C26 C27 C27
TAPS	AL. & ACSR AL. & CU CU. & CCW CU. & G.S.			S13 S13 S14 S14	S15 S15	C7,C16, C26 C7,C26, S16 C27,S17 C27
DEADENDS Full Tension	AL. & ACSR AWAC STEEL CU. & CCW	S18 G5	P52 P54 P54			C10,C13 C10,C13
TERMINATIONS Non-tension	AL. CU.			C9,S27 C9,S27		C9 C8,C9
HOT LINE TAPS	AL. & ACSR CU.					C16,C24 C24
GROUNDING & BONDING	CU.			S14		C23,G2, G4

Notes:

1. See Section 22-Material Catalog for Item ID's of each connector using the Standard Items shown above.
2. Full Tension (Class 1) - Splice shall hold at least 95% of the strongest conductor's rated breaking strength.
3. Partial Tension (Class 2) - Splice shall hold a minimum 40% of the strongest conductor's rated breaking strength.
4. Non-Tension (Class 3) - Splice shall hold a minimum 5% of the strongest conductor's rated breaking strength and shall be used for applications such as loops, taps, multiplex cable phase conductors, etc.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



Notes:

1. Remove PE or other covering. Avoid nicking conductor.
2. Clean all AL and CU. conductors of oxide scale by wire brushing and oxide inhibitor (G9) on conductor if the connector is not inhibitor loaded.
3. For compression connections, follow package instructions. Check wire size, insert conductor fully and start indents at the center for splices and taps and near the closed end on termination type connectors. On covered service and secondary conductors and primary spacer cable, re-cover connections as shown on Pages 5-151 and 5-152 or use PE covers (C60) where applicable.
4. For installation of automatic splices and deadends, refer to Pages 5141 and 5-142.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

5.8 H-TAP CONNECTORS

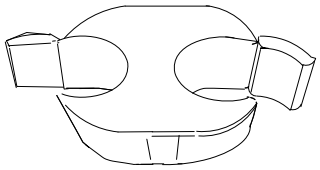


Figure 1

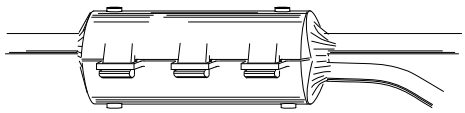


Figure 2

Supercedes Issue 01/06 - Item ID's removed, see Section 22.

Table 1

CONNECTOR SERIES ON BOX	H-TAP CONNECTOR (FIGURE 1)	600 V INSULATED COVER (FIGURE 2)
	STD ITEM	STD ITEM
1	S13B	C60E
2	S13H	
4	S13J	C60G
5	S13LI	
6	S13L	
7	S13KI	

Table 2

CONNECTOR SERIES ON BOX	RUN RANGE AL. to AL Or AL. to CU		RUN RANGE AL. to AL Or AL. to CU		DIE SIZE	# OF MECHANICAL OR BATTERY OPERATED TOOL CRIMPS	# OF HYDRAULIC TOOL CRIMPS
	Solid	Strand	Solid	Strand			
1	#6 to #1	#6 to #1	#6 to #1	#6 to #1	O	4	2
2	#1 to 2/0	#3 to 2/0	#6 to 1/0	#6 to #1	O	5	2
4	2/0 to 4/0	#1 to 3/0	2/0 to 3/0	#1 to 2/0	D	5	2
5	250 to 300	4/0	#6 to 1/0	#6 to #1	D	5	2
6	250 to 300	3/0 to 4/0	2/0 to 3/0	#1 to 2/0	D	7	3
7	250 to 300	3/0 to 4/0	250 to 300	3/0 to 4/0	D	7	3

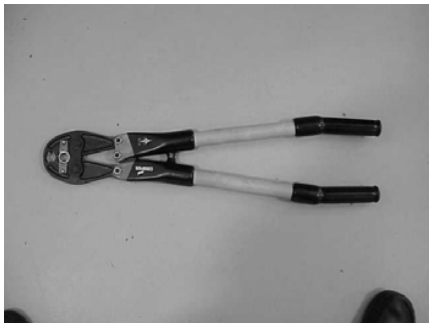
Installation Notes:

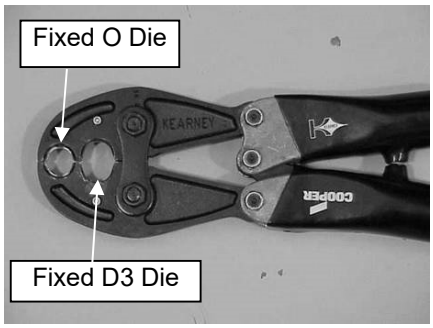
1. For services and secondary connections up to 600 V, H-Tap compression connectors (Figure 1) and insulated covers (Figure 2) shall be used. The H-Tap connectors are for connections of 4/0 aluminum to aluminum or aluminum to copper conductors. Each connector is pre-filled with an oxide inhibitor to maintain a reliable electrical connection. Use insulated covers to insulate the live leg connectors up to 600 V. See Table 1 above for the correct cover to use with a given connector.
2. Each H-Tap connector is shipped in its own box. Each box contains information about the range taking and die size to use. These connectors also have a Connector Series Number that identifies their size. All suppliers use this numbering series. The numbers range from 1 to 7 as indicated on Table 1 and 2. These numbers are also on each connector box to help in selecting the correct connector. Note: The number 3 connector is missing from Table 1 and 2 above because its conductor range is not required in National Grid territory.
3. Cables conductors where connections are required, use the Conductor Spreader Tool.
4. All conductors shall be cleaned (wire brushed) prior to connector installation.

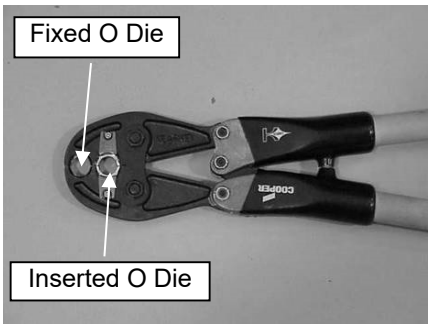
Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

5. For aluminum to copper connections, be sure the copper conductor is installed under the aluminum conductor.
6. For a temporary service, bolted connectors may be used if the company's service drop conductors will be remaining at the location (temporary to permanent). If all the conductors are to be removed, use the H-Tap connectors.
7. H-Tap connectors are non-removable. When replacing an existing conductor, remove the insulating cover from the connector, if one is installed, and cut the conductor as close as possible from the connector and recover the connector with a new plastic cover to re-insulate. Then, install a new connector with the new or existing conductor and cover the connector with the plastic insulating cover. Note: There is no need to insulate a neutral connection. Leaving the old H-Tap connectors on the conductor creates no electrical problem with the installation. If available space on the secondary conductor becomes a problem, cut out a section of old secondary conductor and splice in a new piece of conductor.
8. **Warning:** Do not use these connectors for copper to copper conductor connections.
9. H-Tap compression connectors can be installed with a mechanical, hydraulic or battery operated compression tool using an "O" or "D" die as indicated on Table 1. The tools have a build in "D" die. The "O" die is installed into the "D" die of the tool. To simplify the separation of multiplex

MECHANICAL COMPRESSION TOOL







HYDRAULIC COMPRESSION TOOL



BATTERY OPERATED COMPRESSION TOOL



Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

5.9 INSULATING CONNECTIONS (600 VOLTS)

Connections on insulated Secondary/Service conductors shall be covered with snap on covers. Taping should be avoided unless there are no other options.

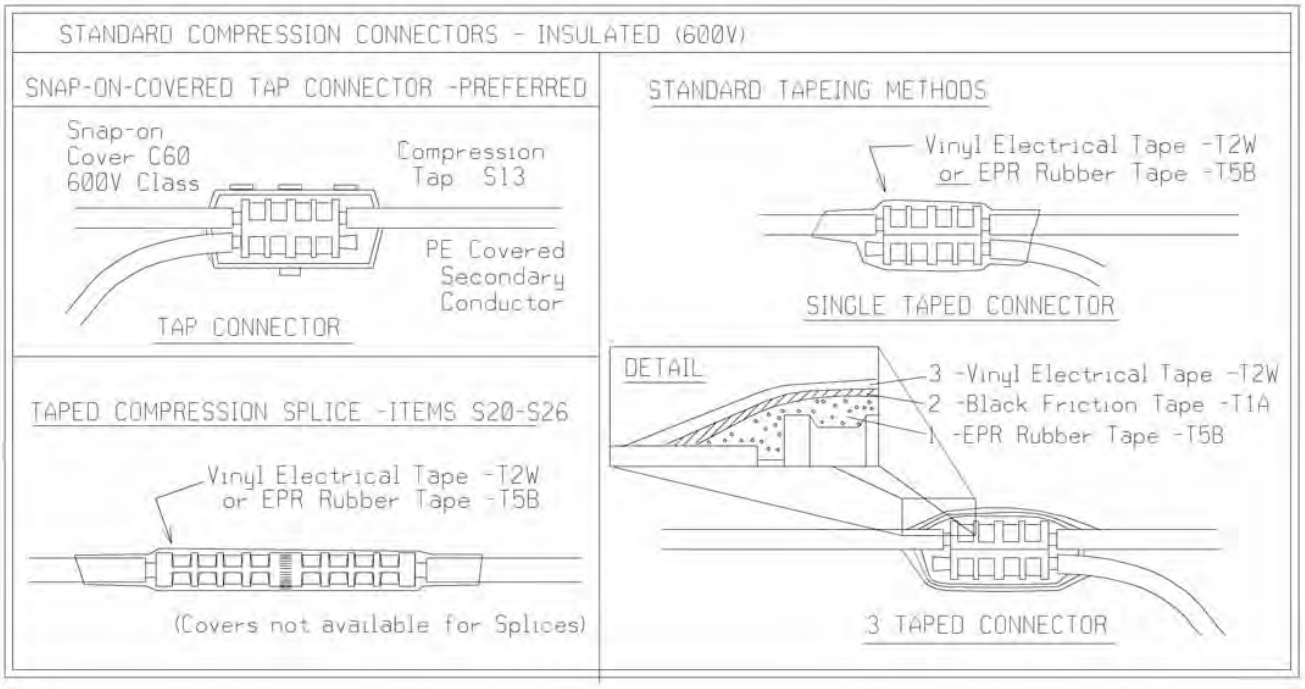
Use snap-on covers (C60) to provide low-voltage protection over compression connectors on covered secondary and service wires. Two or more half-lapped layers of vinyl electrical tape (T2W) or rubber insulating tape (T5B) may be substituted if the proper cover is not available. Do not overstretch the tape and the last two turns should be applied without tension. For nominal 600V insulation class, Polyethylene (or PVC) material provides approximately 200-300V per mil thickness. Unstretched Vinyl tape (T2W) is 8.2 mils thickness and rubber insulating tape (T5B) is 30 mils ("ordinary writing paper is 4 mils thick"). 1 mil = .001 "

Installation Notes:

1. Always clean conductors, wire brushing, (including newly stripped covered conductors) before connector installations. General notes for connector installation can be found on 5-112.

2. Train the conductors so that connections will not be subjected to unnecessary tensions. For large irregular connections or connectors depressions, fill the space with plastic sealer (T5D4).

3. If better insulation or mechanical protection is needed or to buffer sharp edges (i.e. around crimps, etc.) use first a few half-lapped layers of rubber insulating tape (T5B). Apply the rubber insulating tape (as recommended by the manufacturer) so that the sticky side (toward the spool) faces outward as it is applied. This rubber insulating tape is self amalgamating, U.V. and weather resistant but is usually covered using a couple of layers of black friction tape (T1A) and a few outside layers of vinyl tape (T2W). Always use the friction tape between the rubber and vinyl tapes to prevent possible adverse inter-reaction of the materials.



Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

5.10 PARALLEL GROOVE CONNECTORS

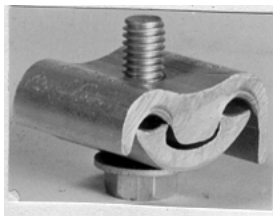


Figure 1

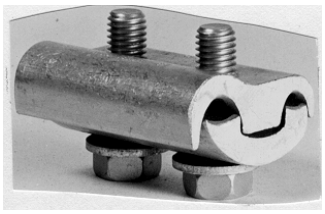


Figure 2

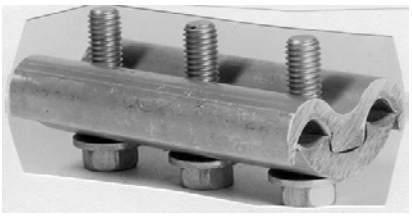


Figure 3

GROOVE A			GROOVE B					
AAC AL or CU	ACSR, AWAC, AAAC	WIRE DIA. RANGE (INCHES)	AAC AL or CU	ACSR, AWAC, AAAC	WIRE DIA. RANGE (INCHES	STD ITEM	FIGURE NUMBER	BOLT SIZE (INCH)
8 – 2	6 – 2	0.128 – 0.325	8 – 2	6 – 2	0.128 – 0.325	C7A	1	5/16
1/0	1/0	0.338 – 0.398	Str. 12	N/A	0.080 – 0.092	9320571 (SAP ID)	1	3/8
6 – 3/0	6 – 2/0	0.162 – 0.464	6 – 3/0	6 – 2/0	0.162 – 0.464	C7B	1	3/8
2 – 3/0	2 – 3/0	0.292 – 0.502	2 – 3/0	2 – 3/0	0.292 – 0.502	C7E	2	3/8
4/0 – 400.0	3/0 – 336.4	0.464 – 0.743	6 – 2/0	6 – 2/0	0.162 – 0.464	C7D	1	1/2
4/0 – 400.0	3/0 – 336.4	0.464 – 0.743	1/0 – 3/0	2 – 3/0	0.292 – 0.502	C7G	2	1/2
4/0 – 400.0	3/0 – 336.4	0.464 – 0.743	4/0 – 400.0	3/0 – 336.4	0.464 – 0.743	C7I	3	1/2
450.0 – 1000.0 AL & 450.0 – 500.0 CU	477.0 – 795.0	0.743 – 1.152	6 – 3/0	6 – 2/0	0.162 – 0.464	C7DA	1	5/8
450.0 – 1000.0 AL & 450.0 – 500.0 CU	477.0 – 795.0	0.743 – 1.152	4/0 – 400.0	3/0 – 336.4	0.464 – 0.743	C7H	2	5/8
450.0 – 1000.0 AL & 450.0 – 500.0 CU	477.0 – 795.0	0.743 – 1.152	450.0 – 1000.0 AL & 450.0 – 500.0 CU	477.0 – 795.0	0.743 – 1.152	C7J	3	5/8

Supersedes 7/13 – Corrected Conductor sizes in table

600 Volt Insulated Covers for these parallel groove connectors only	
Connector – Std Item	Cover – Std Item
C7B	C60R
C7E	C60S
C7D	



Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Installation Notes:

1. Locate larger parallel plate above when possible. This provides an "Umbrella Effect" (see Figure 4 on right)

2. Position so rain will not wash from copper wire onto aluminum wire. Use lower position only when necessary.

3. Locate connector in jumper section when possible and not on span wire.

4. The connection is "non-tension" so there should be no pull or tension on the wires in the connector.

5. Clean conductor surfaces with wire brush. Remove all pieces of insulation/covering in case of insulated/covered wire.

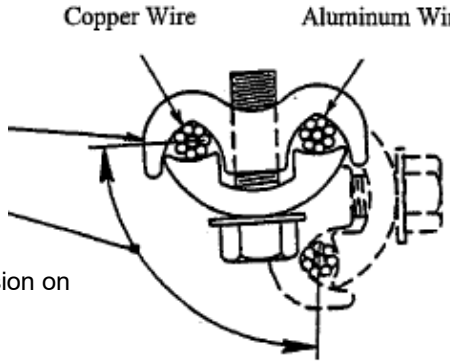


Figure 4

6. Connector groove must be clean. Approved connectors are individually packaged in plastic and protected by a covering of inhibitor compound. Wire brushing a new connector is not necessary.

7. In all cases, apply an inhibitor compound (NG9) on the entire aluminum and copper conductor surfaces that will be located within the connector. All voids shall be filled.

8. Free ends shall extend 1/2 inch beyond end of connector.

9. Tighten bolts properly. It is important to use care to tighten bolts uniformly and to recommended torques (see Table 1 below), particularly since aluminum bolts are covered with a grease. **Note: without a torque wrench, bolts should be tightened approximately 3/4 to 1-1/2 turns beyond the point where the bolt is snug in place. WARNING: Do not over-tighten and deform the connector.**

Table 1

REQURIED BOLT TORQUE			
5/16" – 8 lb. ft.	3/8" – 15 lb. ft.	1/2" - 25 lb. ft	5/8" – 40 lb. ft.

10. Do Not Reuse Connectors – Body and bolts may be distorted; also, it is difficult to clean properly and cover all surfaces with compound.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

5.11 FIRED-ON WEDGE CONNECTORS

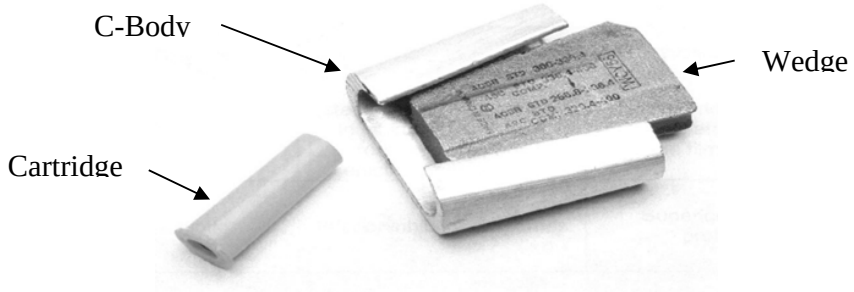
Installation Notes:

1. For complete information about fired-on wedge connector installation/removal and tool use/maintenance, refer to the manufacturer's "Customer Manual".
2. Position so rain will not wash from copper wire onto aluminum wire.
3. Locate connector in jumper section when possible and not on span wire.
4. The connection is "non-tension", and there should be "no-pull" on wires in the connector.
5. Clean conductor surfaces with wire brush. Remove all pieces of insulation/covering in case of insulated/covered wire.
6. Free ends shall extend 1/2 inch beyond end of connector.
7. Select the connector and charge Table 1 below.
8. **WARNING:** Do not reuse connectors as the body and wedge may be distorted; also, it is difficult to clean properly and cover all surfaces with compound.

Supercedes Issue 7/14 – added copper Wedge connectors .

SELECTION CHART			
RUN	**TAP**	**STD ITEM**	**CHARGE COLOR**
1/0 AL. & ACSR	1/0 AL & ACSR	S15G	Blue
1/0 AL. & ACSR	#2 AL	S15H	White
1/0 AL. & ACSR	#4 AL & ACSR	S15J	Red
336.4 AL. & ACSR	336.4 AL. & ACSR	S15L	Blue
336.4 AL. & ACSR	4/0 CU.	S15M	Blue
336.4 AL. & ACSR	2/0 AWAC	S15N	Blue
336.4 AL. & ACSR	1/0 AL. & ACSR	S15N1	Blue
336.4 AL. & ACSR	#2 AL., ACSR, & CU	S15P	Blue
336.4 AL. & ACSR	500 AL. & CU.	S15R5	Yellow
336.4 AL. & ACSR	750 AL. & CU.	S15R7	Yellow
477 AL AAC or 477 (Compact)*	#2 CU	S15S	Yellow
477 (Compact)*	#4/0 CU	S15T	Yellow
477 AL AAC	#4/0 CU	S15U	Yellow
477 (Compact)*	477 (Compact)*	S15V	Yellow
477 AL AAC	477 AL AAC	S15W	Yellow
477 AL AAC	477 (Compact)*	S15X	Yellow
500 CU	#4/0 CU	S17R	Blue
#4/0 CU	#4/0 CU	S17S	Blue
#2/0 CU	#2/0 CU	S17T	Blue

*Spacer Cable



Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 1/06 Issue – Added "3. Important Note" about wire brushing and adding corrosion inhibitor to conductors

5.12 AUTOMATIC SPLICES

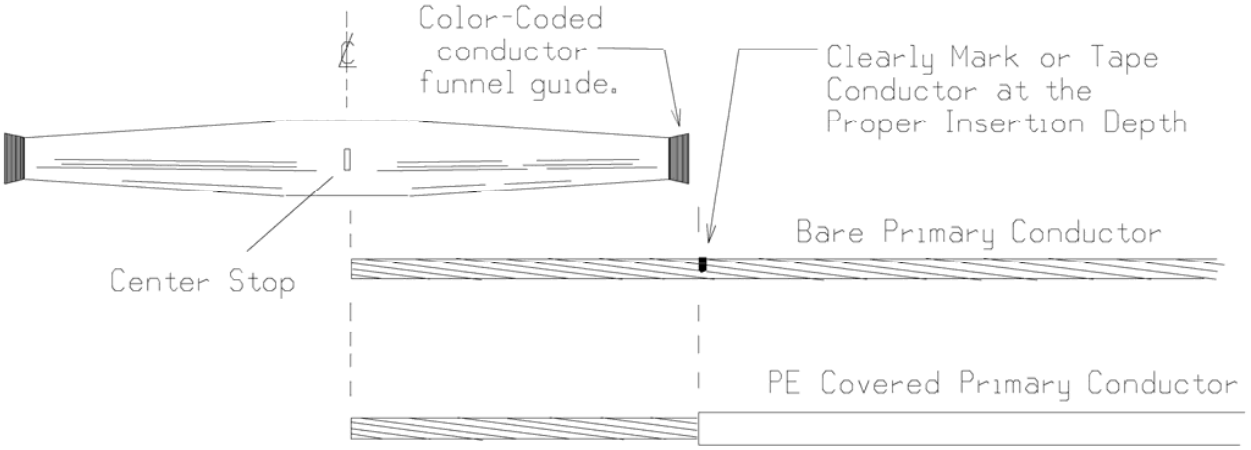
Automatic splices are stamped with the intended conductor range and are color identified at the ends with a band colored pilot-cup.

Approved automatic splices are full-tension, full-current rated devices for application on primary distribution lines.

Installation Notes:

1. Mark the full insertion depth on the conductor by placing the cut-end of the conductor to the connector center-line. See Figure 1 below.
2. Make sure the conductor is cut squarely, cleanly, straight, and free of burrs before insertion. Improper installation is the cause of most premature failures. Separated strands may not enter the internal pilot-cup and become wedged between the gripping jaws, preventing function of these essential components. A temporary tape wrap at the cut location will help reduce strand unwrapping during cutting.
3. **Important Note: All conductors must be cleaned (wire-brushed) immediately prior to making the connection. A non-conductive, thin, and invisible oxide layer begins formation within one minute on aluminum conductors and copper conductors. After wire brushing, immediately add corrosion inhibitor to the cleaned surfaces (Corrosive inhibitor Item ID 8010034)**
4. Insert the conductor fully into the connector in one complete motion. Do not pull back on the conductor or twist the conductor before insertion is complete. Conductor will move out slightly during final pull-set as the internal jaws "set". Internal pilot-cup must reach full insertion to clear jaws.
5. Automatic full-tension splices are not to be used on spans other that full-tension (i.e. slack spans and services). Wind-caused negative-tension episodes may release the holding jaws.
6. In repairing a burndown, the conductor should be cut back sufficiently to remove stretched, burned, or annealed strands.
7. The following Standard "Automatic" splices and Deadend Connectors can be found in Section 22-Materials Catalog:

- Standard Item G5C – Strand-vice Guy Grips (See Section 3 for application)
- Standard Item S18K & M – Aluminum Conductor Deadends
- Standard Item S19A-I – Copper & Copperweld Conductor Splices
- Standard Item S19J-M – Aluminum Conductor Splices
- Standard Item S19P-R – Steel Strand Splices



Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Table 1 Automatic Splices for Bare Aluminum Conductors

SPLICE STD ITEM	CONDUCTOR				
	SIZE AWG-KCMIL	CODE NAME	STRANDS	O.D. IN INCHES	CONDUCTOR STD ITEM
S19K	1/0, AAAC	AZUSA	7	0.398	W20A
S19M	336.4 AAC	TULIP	19	0.666	W20B
S19T	477 AAC	COSMOS	19	0.793	W21BA

Table 2 - Automatic Splices for Tree Wire Aluminum Conductors

(**Note:** All other sizes of tree wire/spacer cable shall be spliced with a compression splice. See Section 16 – Aerial/Spacer Cable for splicing details)

SPLICE STD ITEM	CONDUCTOR				
	KV	SIZE AWG-KCMIL	STRANDS	O.D. IN INCHES	CONDUCTOR STD ITEM
S19K	15	1/0 6201	7	0.728	W20CA
S19K	35	1/0 6201	7	1.028	W21NA

Table 3 - Automatic Splices for Non-Standard Bare Aluminum Conductors

SPLICE STD ITEM	CONDUCTOR				
	SIZE AWG-KCMIL	CODE NAME	STRANDS	O.D. IN INCHES	CONDUCTOR STD ITEM
S19J	#4 ACSR				
S19N	2/0 – 3/0				
S19M	394.5 AAC	CANTON	19	0.721	NONE
	636 AAC	ORCHID	37		NONE

Table 4 - Automatic Splices for Non-Standard Covered Aluminum Conductors

SPLICE STD ITEM	CONDUCTOR					
	SIZE AWG-KCMIL	CODE NAME	STRANDS	BARE COND O.D. INCHES	TOTAL O.D. INCHES	CONDUCTOR STD ITEM
S19K	1/0 ACSR	ALMOND	6/1	0.398	0.313	NONE
S19K	1/0 AAAC	OILNUT	7	0.398	0.523	NONE
S19M	336.4 AAC	ANONA	19	0.666	0.791	NONE

Table 5 - Automatic Splice for AWAC Messenger for Spacer Cable

SPLICE STD ITEM	CONDUCTOR			
	SIZE AWG-KCMIL	STRANDS	O.D. IN INCHES	CONDUCTOR STD ITEM
S19L	1/0 – 3/4 AWAC	7	0.487	W21NE

Table 6 - Automatic Reducing Splice for Aluminum Conductor

SPLICE STD ITEM	CONDUCTOR					
	SIZE AWG-KCMIL	STRANDS	CONDUCTOR ITEM ID	SIZE AWG-KCMIL	STRANDS	CONDUCTOR STD ITEM
S19T	477 AAC	19	W21BA	336.4 AAC	19	W20B

Supersedes Issue 7/08 - Some Item ID's removed,

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes Issue 7/08 - Some Item ID's removed, see Section 22.

Table 7 - Automatic Splice for Non-Standard Bare Copper Conductor

SPLICE STD ITEM	CONDUCTOR			
	SIZE AWG-KCMIL	STRANDS	O.D. IN INCHES	CONDUCTOR STD ITEM
S19A	#6 SOL			
S19G	#6A CW & CCW, #4 STR			
S19BB	#3 HD	7	0.260	W11G
S19BB	#3A CW	3	0.326	NONE
S19C	#2 HD	7	0.292	W13B
S19BB	#1 HD	7	0.328	W13I
S19I	#1 HD	3	0.360	W13J
S19I	1/0 HD	7	0.368	W13K
S19B	2/0 HD	7	0.414	NONE
S19D	2/0 CW & CCW	7		
S19E	4/0 HD	7	0.522	W19B

Table 8 - Automatic Splice for Non-Standard Covered Copper Conductor

SPLICE STD ITEM	CONDUCTOR				
	SIZE AWG-KCMIL	STRANDS	BARE COND O.D. INCHES	TOTAL O.D. INCHES	CONDUCTOR STD ITEM
S19BB	#3 HD	7	0.260	0.354	W11H
S19I	1/0 HD	7	0.369	0.494	W13L
S19E	4/0 SD	19	0.528	0.690	W19C

Table 9 - Automatic Splice for Non-Standard Copper Messenger for Spacer Cable

SPLICE STD ITEM	CONDUCTOR			
	SIZE AWG-KCMIL	STRANDS	O.D. IN INCHES	CONDUCTOR STD ITEM
S19U	3/8 CW	7	0.385	NONE

Table 10 - Automatic Reducing Splice for Copper Conductor

SPLICE ITEM ID	CONDUCTOR	
	LARGE END	SMALL END
S28A	4 SOL, 6 STR	6 SOL, 8 STR
S28C1	1 SOL, 2 STR	2 SOL, 3 STR
S28B	2-3SOL, 3 STR	6 SOL, 8 STR
S28C	2-3 SOL, 3 STR	4 SOL, 6 STR
S28D	1/0 SOL, 1 STR	2-3 SOL, 3 STR
S28E	2/0 SOL, 1/0 STR	1/0 SOL, 1 STR
S28F	3/0 SOL, 2/0 STR	2 SOL, 3 STR
S28G	3/0 SOL, 2/0 STR	1/0 SOL, 1 STR
S28H	3/0 SOL, 2/0 STR	2/0 SOL, 1/0 STR
S28J	4/0 STR	3/0 SOL, 2/0 STR

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

5.13 COMPRESSION SPLICES

Installation Notes:

1. A compression splice installation shall confirm to specific manufacturer's instructions supplied with the splice and as noted below. **Note importance of installation details such as wire brushing and cleaning conductors, measurements and marking, adding oxidizing inhibitor compound when not already included in the connector, conductor straightening, cutting of aluminum strands, installation of steel splice, use of proper die, location of compression, etc.**

2. Compression splices are stamped with the intended conductor range, manufacturer's name, die information, and crimp indicator markings. Crimping inline splice connectors should begin near the center (to allow for connector growth) and successive crimps should be rotated to reduce a "banana" effect.

3. To locate a compression splice, find the type conductor in Table 1 (Aluminum) or Table 2 (Copper) below and look under the associated Standard Item in Section 22-Material Catalog. **Note:** For spacer cable and messenger splice selection and installation information; see Section 16-Aerial/Spacer Cable.

Table 1

CONDUCTOR TYPE - ALUMINUM	STD ITEM
Non-Tension One Piece – Service/Secondary Phase Conductors	
#2 and 1/0 AAC Aluminum	S26C & S26D
Partial Tension One-Piece - Service Phase Conductors & Messenger	
#4 AL – 336.4kcmil AL	S22E THRU S22H
Full Tension One-Piece – Primary Conductors	
ACSR Aluminum Conductor	S20B THRU S20G
AAC AND AAAC Aluminum Conductor	S21C1 THRU S21L
Full Tension Two-Piece – Primary Conductors	
ACSR Aluminum Conductor	S20R1 THRU S20R4

Table 2

CONDUCTOR TYPE - COPPER	STD ITEM
Non-Tension One-Piece -	
2/0 & 4/0 CU STR	S24E & S24G
Full Tension One-Piece – Primary Conductors	
CU, CW & CCW	S23A THRU S23N
ACSR Aluminum Conductor	

Supersedes 1/06 Issue – Highlighted Importance of installation details, Note 1

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

5.14 HOT LINE CONNECTORS

Hot line clamp/vice type connectors shall be used **only** when Hot Stick work is required. **Note:** Clean conductor surfaces by wire brushing until conductor surface is bright and shiny. **Warning:** Do not damage conductor. New connectors are packaged in plastic and pre-filled with oxidizing inhibitor. **Note:** Do not use stirrups or bails. Do not reuse connectors after use.

Bronze hot line clamp connectors shall be used for copper mainline to copper taps (See Table 1 below).

Aluminum hot line clamp connectors shall be used to connect aluminum mainline to aluminum or copper taps (See Table 2 below).

Aluminum hot line vice connectors shall be used to connect aluminum mainline to aluminum or copper mainline. (See Table 3 below).

Supersedes Issue 7/08 - Item ID's removed, see Section 22.

Table 1

BRONZE CLAMP TYPE (Figure 1)				
RUN SIZE RANGE		TAP SIZE RANGE		STD ITEM
#6 Solid	400kcmil	4/0	#6 Solid	C24D

Table 2

ALUMINUM CLAMP TYPE (Figure 1)								
RUN SIZE RANGE				TAP SIZE RANGE				
MAX.		MIN.		MAX.		MIN.		
ACSR	AL	ACSR	AL	ACSR	AL & CU	ACSR	AL & CU	STD ITEM
1/0	1/0	#8	#8	1/0	1/0	#8	#8	C24A
336kcmil	394kcmil	#6	#6	3/0	4/0	#6	#6 Sol	C24B
336kcmil	394kcmil	#4	#4	336kcmil	394kcmil	#4	#4	C24C
336kcmil	477kcmil	#6	#6	336kcmil	477kcmil	#6	#6	C24A1

Table 3

ALUMINUM VICE TYPE (Figure 2)				
RUN SIZE RANGE		TAP SIZE RANGE		
MAX.	MIN.	MAX.	MIN.	
AL & ACSR	AL & ACSR	CU & AL & ACSR	CU & AL & ACSR	STD ITEM
336.4kcmil	4/0	336.4kcmil	4/0	C16C
795kcmil	336.4kcmil	1/0	#4	C16D
477kcmil	336.4kcmil	336.4kcmil	#3	C16E
477kcmil	4/0	477kcmil	4/0	C16F
795kcmil	336.4kcmil	795kcmil	336.4kcmil	C16G



Figure 1

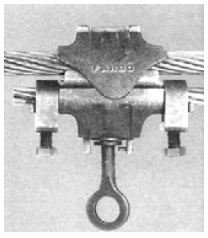


Figure 2

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

5.15 TERMINAL CONNECTORS

Installation Notes:

1. Install terminal connectors so that water drains from the aluminum to the copper surfaces, i.e., aluminum over copper connection.

2. Clean conductor surfaces thoroughly with wire brush and apply connector inhibiting compound (NG9D) liberally on the conductor and the surface of the terminal.

3. Bolted terminal to conductor using alloy bolts and nuts furnished with connector.

4. Clean pad on equipment with wire brush and apply connector compound (NG9D) on entire contact surface. Bolt surfaces together, using stainless steel bolts (B8B15 thru B8C30), nuts (B8C40) flat washers (B8W3) and Belleville washers (B8W10). See Figure 1.below.

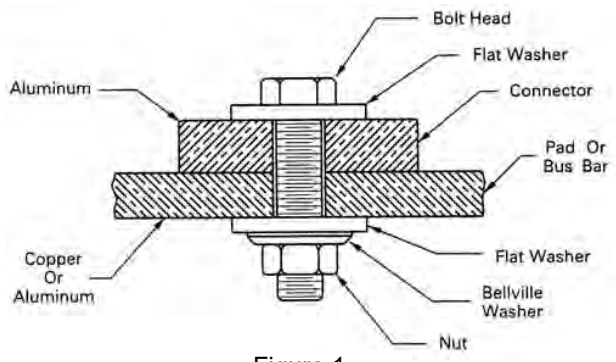


Figure 1

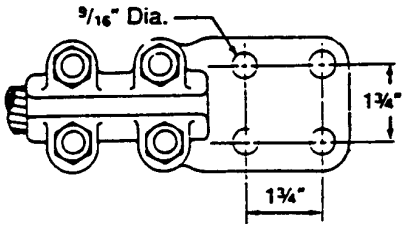


Figure 2

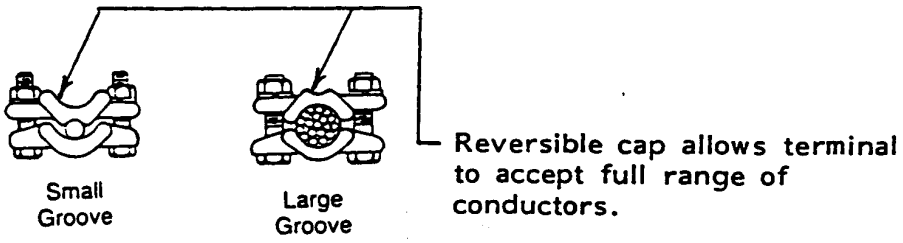


Figure 3

SELECTION AND INSTALLATION OF TERMINAL CONNECTORS			
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	nationalgrid
1/06	5-148		

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

5.16 REPAIR SLEEVES

Table 1 below shows material to repair damaged bare overhead aluminum conductors. The materials include line guard, armor rod and compression sleeves. The repair material to choose depends upon the number of broken conductor strands as shown in Table 1. Table 2 shows tools and dies for installing compression sleeves.

Table 1

Wire Size		Line Guard		Armor Rod		Compression Sleeve	
All Aluminum AAC, All Aluminum Alloy (AAAC) and Spacer Cable (Compact)	**Cond. Dia. in.**	**Max. Broken Strands**	**Std Item / SAP ID**	**Max. Broken Strands**	**Std Item / SAP ID**	**Max. Broken Strands**	**Std Item / SAP ID**
1/0 AAAC 7 str. concentric	0.396	1	P51C	2	9319672		
4/0 AAC 7 str. concentric	0.522	1	9313104			3	9313353
4/0 AAAC 7 str. concentric	0.563	1	9313104			3	
336.4 AAC 19 str. - concentric	0.666	3	9315738	5	9319674	9	9312431
477 AAC 19 str. - concentric	0.793	3	9313126				
636 AAC 37 str. - concentric	0.918	4	9313187				
795 AAC 37 str. - concentric	1.026	4	9313184				
ACSR Conductors							
1/0 ACSR 6/1	0.398	1	P51C			3	9315764
3/0 ACSR 6/1	0.502	1	9314042				
336.4 ACSR 18/1	0.684	4	P51G				
477 ACSR 18/1 Pelican	0.814					9	9313355

Table 2

Wire Size	Cond. Dia. in.	Compression Sleeve Tools and Dies					
		Std Item / SAP ID	**Splice Cat.#**	**Tool 6 Ton MD6 BCT500 PATMD6**	**Tool 12 Ton Y35 Y750 PAT5018V**	**Tool 15 Ton Y46 PAT4618V**	**Tool 60 Ton Y60BHU**
4/0 AAC 7 strand	0.522	9313353	YCU28A	W249 (28)	U249 (14)		
4/0 AAAC 7 strand	0.563						
336.4 AAC 19 strand	0.666	9312431	YCU301A		U321 (20)		
1/0 ACSR 6/1	0.398	9315764	YCU25R	W243 (20)	U243 (10)		
477 ACSR 18/1	0.814	9313355	YOU321R		U327 (21)	U327 (21) with PT-6515 adapter	L327 (7)

Some Item ID's removed, see Section 22.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
7.0	7/20	• Corrected index numbering error.	Anthony Miuccio	J.P. Knauss, Director, Electric Engineering
6.0	7/17	• Added note to 5-1 regarding coldshrink discontinuation • Removed taping reference on 5-1	Dave Allen/Anthony Miuccio	Jon Gonynor Director T&D, O&M Services
5.0	7/16	• Added slacking of taps in Section 5.2 • Added use snap on covers on services and secondary to 5.9. • Added Copper fired on wedges to 5.11	Dave Allen	Jon Gonynor Director T&D, O&M Services
4.0	7/15	• Corrected table in section 5.10 Pg. 5-131	Dave Allen	Jon Gonynor Director T&D, O&M Services
3.0	7/14	• Added fired on wedge connectors for 477 conductor.	Dave Allen	Rob Sheridan Director of Utility of the Future
2.0	7/13	• Removed PS Item ID's through out entire section. Added SAP ID's	Dave Allen	Rob Sheridan Director of Utility of the Future
1.1	7/12	• Added use of hot line clamps for CLF's on capacitors in section 5.5.20 • Added Min dist to insulator and TW/Spacer requirements in Section 5.5.10. Added note to 5.4	John Vartanain Dave Allen	Susan Fleck, VP of Standards, Policies & Codes
1	07/08	• Revised hot line clamp usage rewording, added note of lightning arresters in 5.5.20. • Revised Std. Item reference to C9 in 5.5.40. • Corrected connector cover Item ID in 5-10. • Changed charge color for Item ID 3507246 from red to white in 5.11. • Added Note 3 in 5.12. • Changed Item ID 0806400 to 0806404 and added reducing splice Item ID 9201781 on page 5-143. • Highlighted Importance of installation details in Note 1 in section 5.13. • Deleted reference to 25kV and 35kV and added Item IDs to Tables 1, 2, and 3 in section 5.14.	Joe Tumidajski	Al Chieco, Director of Distribution Standards and Work Methods

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/17 Issue – Corrected description of " Planetree" to AAAC.

SECTION	PAGE
• 6.0 GENERAL	6-1
• 6.1 BASIC DATA	6-1 THRU 6-2
• 6.2 SAGS AND TENSIONS	6-2 THRU 6-5
• 6.3 MAXIMUM SPANS	6-5
• 6.4 AMPACITY	6-5 THRU 6-6
• 6.5 PLANNING CONDUCTOR INSTATLLATIONS	6-6 THRU 6-7
• 6.6 INSTALLING CONDUCTORS	6-7 THRU 6-8
• CONSTRUCTION DRAWINGS	
• STANDARD CONDUCTORS	6-100
o 1113.0 kcmil, 54/19 Stranding, Bare ACSR, "FINCH" – 35kV	6-101 THRU 6-102
o 795.0 kcmil, 54/7 Stranding, Bare ACSR, "CONDOR" – 35kV	6-103 THRU 6-104
o 795.0 kcmil, 37 Strand, Bare AAC, "ARBUTUS" – 15kV	6-105 THRU 6-106
o 795.0 kcmil, 19 Strand, Compact AAC, 320 mil Covered Tree Wire – 35 kV	6-107 THRU 6-108
o 795.0 kcmil, 19 Strand, Compact AAC, 180 Mil Covered Tree Wire – 15 kV	6-109 THRU 6-110
o 477.0 kcmil, 26/7 Stranding, Bare ACSR, "HAWK" – 15kV	6-111 THRU 6-112
o 477.0 kcmil, 19 Strand, Bare AAC, "COSMOS" – 15kV	6-113 THRU 6-114
o 477.0 kcmil, 19 Strand, Compact AAC, 320 mil Covered Tree Wire – 35 kV	6-115 THRU 6-116
o 477.0 kcmil, 19 Strand, Compact AAC, 160 mil Covered Tree Wire – 15 kV	6-117 THRU 6-118
o 336.4 kcmil, 18/1 Stranding, Bare ACSR, "MERLIN" – 15kV	6-119 THRU 6-120
o 336.4 kcmil, 19 Strand, Bare AAC, "TULIP" – 15kV	6-121 THRU 6-122
o 336.4 kcmil, 19 Strand, Compact AAC, 165 mil Covered Tree Wire– 15kV	6-123 THRU 6-124
o 1/0, 7 Strand, Bare 6201-T81 AAAC, "AZUSA" – 15kV	6-125 THRU 6-126
o 1/0, 7 Strand, Concentric Round 6201-T81 AAAC, 315 mil Covered Tree Wire – 35kV	6-127 THRU 6-128
o 1/0, 7 Strand, Concentric Round 6201-T81 AAAC, 165 mil Covered Tree Wire – 15kV	6-129 THRU 6-130
• NON-STANDARD CONDUCTORS	6-200
o 636.0 kcmil, 37 Strand, Bare AAC, "ORCHID"	6-201
o 636.0 kcmil, 37 Strand, AAC, 95 Mil HDPE Covering, "TANGERINE"	6-202
o 336.4 kcmil, 19 Strand, AAC, 170 mil HDPE Covering, "ANONA"	6-203
o 336.4 kcmil, 19 Strand, AAC, 80 mil HDPE Covering, "CRABAPPLE"	6-204
o 336.4 kcmil, 19 Strand, AAC, 60 mil PE Covering, "ANONA"	6-205
o 4/0, 6/1 Stranding, Bare ACSR, "PENGUIN"	6-206
o 4/0, 7 Strand, Bare AAAC, "ALLIANCE"	6-207
o 4/0, 7 Strand, Bare AAC, "OXLIP"	6-208
o 4/0, 7 Strand, AAC, 60 Mil PE Covering, "OLIVE"	6-209
o 4/0, 7 Strand, AAAC, 60 Mil PE Covering, "PLANETREE"	6-210

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SECTION	PAGE
o 4/0, 19 Strand, AAC, 60 Mil PE Covering, “POMENGRANITE”	6-211
o 1/0, 6/1 Stranding, Bare ACSR, “RAVEN”	6-212
o 1/0, 6/1 Stranding, ACSR, 110 Mil PE Covering, “ALMOND”	6-213
o 1/0, 6/1 Stranding, ACSR, 60 Mil PE Covering, “ALMOND”	6-214
o 1/0, 7 Strand, AAAC, 60 Mil XLPE Covering, “OILNUT” – 15kV	6-215
o #2, 6/1 Stranding, Bare ACSR, “SPARROW”	6-216
o #2, 6/1 Stranding, ACSR, 45 Mil PE Covering, “PIGNUT”	6-217
o #4, 7/1 Stranding, Bare ACSR, “SWANATE”	6-218
o #4, 7/1 Stranding, ACSR, 30 Mil PE Covering, “HICKORY”	6-219
o #4, 6/1 Stranding, ACSR, 30 Mil PE Covering, “BUTTERNUT”	6-220
• NON-STANDARD COPPER CONDUCTORS	6-300
o 4/0, 7 Strand, Hard Drawn Copper, Bare	6-301
o 1/0, 7 Strand, Hard Drawn Copper, Bare	6-302
o 1/0, 7 Strand, Hard Drawn Copper, 60 Mil PE Covering	6-303
o #2, 3 Strand, Type A Copper – Copperweld, Bare	6-304
o #2, 7 Strand, Hard Drawn Copper, Bare	6-305
o #2, 7 Strand, Soft Drawn Copper, 45 Mil PE Covering	6-306
o #3, 7 Strand, Hard Drawn Copper, Bare	6-307
o #3, 7 Strand, Hard Drawn Copper, 45 Mil PE Covering	6-308
o #4, 3 Strand, Type A Copper – Copperweld, Bare	6-309
o #4, Solid, Hard Drawn Copper, Bare	6-310
o #4, Solid, Hard Drawn Copper, 30 Mil PE Covering	6-311
o #6, 3 Strand, Type A Copper – Copperweld, Bare	6-312
o #6, Solid, Hard Drawn Copper, Bare	6-313
o #6, Solid, Hard Drawn Copper, 30 mil PE Covering	6-314

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

6.0 GENERAL

This Section covers the physical and electrical data on standard primary conductors and those that have been commonly used on overhead distribution systems.

Detailed design data for primaries, aerial and spacer cable, street lighting, and other specific conductor applications are covered in their respective sections of the text.

6.1 BASIC DATA

Basic conductor data is shown on drawings and tables indicated in the index. This data may differ in minor detail from those shown in other handbooks. The information shown here, however, should be used for all Company records and correspondence unless otherwise approved. If there are any questions concerning accuracy, please consult Standards Engineering.

6.1.10 Definitions & Notes:

PE = Regular Polyethylene Covering
AAC = All Aluminum Conductor (Type ECA or EC)
AAAC = All Aluminum Alloy Conductor, 5005 or 6201 aluminum alloy
1/0 AAAC (123.3 kcmil) is the electrical equivalent of 1/0 ECA
4/0 AAAC (246.9 kcmil) is the electrical equivalent of 4/0 ECA
394.5 kcmil AAAC is the electrical equivalent of 336.4 kcmil ECA
XLPE = Cross-Link Polyethylene Covering
HDPE = High Density Polyethylene Covering
ACSR = Aluminum Cable Steel Reinforced
CCW = Copper – Copperweld
ECA = Electrical Conductivity Aluminum, also known as “All Aluminum” or “AAC”
HD = Hard Drawn Copper
SD = Soft Drawn Copper

Note 1 – The outer layer on aluminum cable shall be right-hand twist (on copper, left-hand twist).
Note 2 – A Mylar separator shall not be included between the conductor and the insulation.
Note 3 – Manufacturer’s identification shall be printed on the outside of the covered conductor covering.
*Note 4 – Although tree wire /spacer cable and other covered line conductors offer some electrical protection, it is **NOT INSULATED CONDUCTOR** and shall not be depended upon in this respect.*

Loading Definitions

Deadend - Maximum tensions that will exist under conditions of “Heavy Loading” in conductors strung to standard sags. Values for NESC Grades B & C are based on 60% rated breaking strength; however, a 50% rated breaking strength value shall be employed for all new work. Values for Grade N are based on 70% rated breaking strength. These are furnished for use when maintaining existing Grade N lines. Use these values for guy and pole strength calculations and for calculation of crossarm strength at deadends.

Transverse - Loads resulting from a 4 lb./sq.foot wind blowing at right angles to the line with conductors covered by ½ inch ice (Heavy Loading). Use these values for transverse guy and pole strength calculations.

Vertical - Weight of conductors plus ½ inch radial ice. Use these values for calculations of vertical crossarm strength.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Total - Total resultant of vertical and transverse loads on conductors under "Heavy Loading" plus an adder of 0.30 lbs./foot (Total Load = $\sqrt{(T^2 + V^2)}$ + 0.3 lbs./foot). Use for slack span calculations and for other sag and tension problems.

Swing Angle - Angle at which the conductor will be displaced from the vertical by a 6 lbs./sq. foot wind blowing at right angles to the line at 60˚F/15˚C. Use these values for horizontal clearance calculations. Calculate horizontal displacement by R sine α where R = max. sag and α = swing angle.

Swing Angle = $\alpha = \tan^{-1}\left(\frac{W_h}{W_v}\right)$

$W_h = \frac{P}{12} \times d$ P = 6 (6 lbs./sq. foot), 12 Inch Conductor Length

d = Conductor Diameter

W_v = Unloaded Weight of Conductor (lbs./foot)

6.2 SAGS AND TENSIONS

All overhead lines must meet minimum clearance requirements of the NESC in force at the time the line is constructed. Prior to the 1977 issue of the NESC, minimum basic clearances allowed for increased sag due to ice loading or operation at a 120˚F/50˚C maximum conductor temperature.

The 1977 revision to the NESC, under Rule 232B2, permits the owner to establish a conductor maximum operating temperature while maintaining minimum clearance requirements. The Company has established a 176˚F/80˚C maximum allowable conductor operating temperature under normal conditions and a 194˚F/90˚C maximum allowable conductor operating temperature under emergency conditions for a specific period of time.

6.2.10 Limiting Tensions

In the design of overhead lines, three limiting values of tension shall be observed:

A. Initial Unloaded or Stringing Tension is that which will exist before the application of any external load or immediately after new conductors have been installed. The initial unloaded tension at 0˚F/-18˚C shall not exceed 35% of rated breaking strength. The temperature of 0˚F/-18˚C is used instead of 60˚F/15˚C required by the NESC because the aluminum manufacturers have indicated that 0˚F/-18˚C is more critical for aluminum than 60˚F/15˚C. Although it is not necessary, the 0˚F/-18˚C tension is used for conductors other than aluminum to be consistent.

B. Maximum Design Tension is that to which the conductor is subjected upon occurrence of the maximum climatic loading specified for design work in the NESC Heavy Loading area. The maximum conductor tension, either initial or final, shall not exceed 50% of rated breaking strength. This limit is less than the 60% required by the NESC to allow for higher tensions due to spans longer than the ruling span and to allow for slight tolerances in sagging. A 2,000 lb. tension limitation is common for most distribution conductors, especially those that deadend on crossarms. All conductors except spacer cable messengers and specially noted conductors shall be limited to an approximate maximum tension of 2000 lbs. A 3,000 lb. tension limitation is acceptable, with appropriate hardware, in situations where the resulting line has a clear advantage over standard 2,000 lb. design because of lower costs due to longer spans or improved appearance of the line.

C. Final Unloaded Tension is that which the conductor assumes under no external loading but after the maximum design tension has been sustained for sufficient time to permit stretching to cease. The final unloaded tension at 0˚F/-18˚C shall not exceed 25% of

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

rated breaking strength. The 0˚F/-18˚C tension is used for the same reason as in the above criteria A.

The sag tables demonstrate sags under various temperatures and loading conditions. New conductors strung to "Stringing" (Initial) values will have initial, maximum and final tensions as specified. The sag will increase under design loading, then change as shown in "Final" sags depending on temperature and loading.

The Initial Sag tables are based on the Ruling Span Method of calculation and the Final Sag tables are based on the Deadend Method, as discussed below. In the event that Initial or Final Sags that are not shown are required, contact Standards Engineering.

6.2.20 Deadend or Uniform Spans

Sag tables based on deadend span methods assume that there is only one span or that all spans are the same length. This method is useful for short spans in urban areas where the spacing is reasonably uniform. If long spans in a section of line are sagged according to a deadend table, short spans in the same section will have a sag value that may or may not correspond with the table. For this reason, it is customary to sag a span of average length near the center of the line and to recognize that there may be slightly more or less sag in the longer and shorter spans than is indicated by the tables.

In order to determine the sag value for a specific span length, multiply the ruling span sag value by the ratio provided in Table 1 for the corresponding actual span length. In the event that the needed actual span length is not provided in this table, a method for determining the resultant ratio value is provided below.

Table 1
Ratio of Deadend Span Sag to Sags at Other Span Lengths with Same Tension

ACTUAL SPAN	DEADEND SPAN										
	50'	75'	100'	125'	150'	175'	200'	225'	250'	275'	300'
100'	4.00	1.78	1.00	0.64	0.44	0.33	0.25	0.20	0.16	0.13	0.11
110'	4.84	2.15	1.21	0.77	0.54	0.40	0.30	0.24	0.19	0.16	0.13
120'	5.76	2.56	1.44	0.92	0.64	0.47	0.36	0.28	0.23	0.19	0.16
130'	6.76	3.00	1.69	1.08	0.75	0.55	0.42	0.33	0.27	0.22	0.19
140'	7.84	3.48	1.96	1.25	0.87	0.64	0.49	0.39	0.31	0.26	0.22
150'	9.00	4.00	2.25	1.44	1.00	0.73	0.56	0.44	0.36	0.30	0.25
160'	10.24	4.55	2.56	1.64	1.14	0.84	0.64	0.51	0.41	0.34	0.28
170'	11.56	5.13	2.89	1.85	1.28	0.94	0.72	0.57	0.46	0.38	0.32
180'	12.96	5.76	3.24	2.07	1.44	1.06	0.81	0.64	0.52	0.43	0.36
190'	14.44	6.42	3.61	2.31	1.60	1.18	0.90	0.71	0.58	0.48	0.40
200'	16.00	7.11	4.00	2.56	1.78	1.31	1.00	0.79	0.64	0.53	0.44
210'	17.64	7.84	4.41	2.82	1.96	1.44	1.10	0.87	0.71	0.58	0.49
220'	19.36	8.60	4.84	3.10	2.15	1.58	1.21	0.96	0.77	0.64	0.54
230'	21.16	9.40	5.29	3.39	2.35	1.73	1.32	1.04	0.85	0.70	0.59
240'	23.04	10.24	5.76	3.69	2.56	1.88	1.44	1.14	0.92	0.76	0.64
250'	25.00	11.11	6.25	4.00	2.78	2.04	1.56	1.23	1.00	0.83	0.69

Method for Determining Ratio:

1. Choose Deadend Span.
2. Find deadend span sag from sag table for temperature and deadend span desired.
3. Multiply deadend span sag by above ratio for actual spans as line is laid out to obtain actual span.
4. For deadend span to actual span ratio other than those listed above:

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

$$RATIO = \frac{(ACTUAL\ SPAN)^2}{(DEADEND\ SPAN)^2}$$

6.2.30 Ruling Spans

This is a calculated span length for which the conductor tension, under changes in temperature and loading, best represents the average tension in the conductor in a particular series of spans between deadends. Ideally, a line should be installed in such a way that all spans of the line have equal horizontal line tension. If this is done, longitudinal forces on pole tops between spans are theoretically zero. Deadend poles and poles located at bends in the line will typically require guying in order to counteract the line tension.

Sag tables based on the ruling span method recognize variations in span length. This method assumes that the line will be strung to uniform tension. If this is done, all spans will have initial sags that are very near the values in the table. After the conductors are tied into place, however, and after ice and wind loads stretch the wires, the tension may not be uniform and the sags may vary from the calculated values. If the actual spans are much longer or shorter than the ruling span, the tension and sags may be different than the calculations.

The ruling span can most accurately be determined through the following equation:

$$\text{Ruling Span} = \sqrt{\frac{\left(L_1{}^3 + L_2{}^3 + L_3{}^3 + \ldots L_N{}^3\right)}{\left(L_1 + L_2 + L_3 + \ldots L_N\right)}}$$

Where L_1, L_2, L_3, etc. are the lengths of the first, second, third, etc., spans between deadends.

Spans that are longer than 150% of the average should be avoided or should be sagged independently and guyed to hold the unbalanced tension. All new standard construction for tension should conform to the Company's design which limits tension to 50% of the conductor rated breaking strength by following the above mentioned ruling span calculation.

6.2.40 Slack Spans

When guys cannot be installed on the end pole of a line, they may be placed on an adjacent pole. A slack span should then be installed to the end pole. Slack spans may also be necessary for other applications. They are not recommended if there is any way of avoiding them, but when used, calculations should be made as follows:

$$\text{String Sag in Feet} = \frac{W \times L^2}{8 \times T}$$

W = Total loaded weight lbs./ft.
L = Total length of span in ft.
T = Tension in pounds. See Section 2-Poles / Hardware for strength required in poles.

Example:

50 foot span, 3-336.4 kcmil bare AAC to be deadended on an un-guyed Class 5 pole.
Use T = 200 lb. per conductor.

W = 1.48 lbs./foot (from Page 6-121)
L = 50 feet (span length)
T = 200 lbs.

Supersedes 1/07 Issue – Corrected page reference for conductor information.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

$$S = \frac{W \times L^2}{8 \times T} = \frac{1.48 \times 50^2}{8 \times 200} = \frac{3700}{1600} = 2.3125 Feet$$

Sag the conductor at 2.31 feet, at normal temperature. This approximation *assumes* that the conductors will have 2.31 feet of sag at 0˚F/-18˚C when subject to ice and wind.

6.3 MAXIMUM SPANS

Maximum spans, as shown in the table or on the pole top drawings, are based on many factors including: sag vs. pole height, transverse load vs. pole strength, vertical weight vs. strength of crossarms, and ratio of sag to separation of conductors. Spans are limited so that standard poles of reasonable height and class may be used for most work. They also are limited to reduce probability of wires coming together due to wind effects.

Span length should be limited to recommended values for all normal work. Longer spans may be used, except at railroad or major crossings, if clearances are adjusted accordingly. If longer spans are still essential, separate deadend spans should be designed by Standards Engineering to meet the field conditions.

6.4 AMPACITY

Current in overhead line conductors should be limited so that voltage drops will be held to reasonable values; so that conductors will not be severely annealed or damaged; so that switches, connectors, etc. will not be overloaded and that clearances are not exceeded. Any feeder that is desired to be operated at the elevated operating temperature permitted for emergency conditions should be assessed to verify that available clearances are present to account for the resulting additional sag as outlined in each respective conductor data table. Minimum clearances, outlined in Section 7 – Clearances, should not be compromised.

Table 2
Ampacity Design Parameters

SPECIFICATION	BARE CONDUCTOR SUMMER / WINTER	TREE WIRE SUMMER / WINTER
Maximum Allowable Steady State Conductor Temperature (˚C) For Normal Operating Conditions	176˚F/80˚C	167˚F/75˚C
Maximum Allowable Steady State Conductor Temperature (˚C) For Emergency Contingencies	194˚F/90˚C	194˚F/90˚C
Ambient Air Temperature (˚C)	100˚F/37.7˚C / 50˚F/10˚C	100˚F/37.7˚C / 50˚F/10˚C
Wind Speed (FT. / SEC.)	3 FEET/SEC.	3 FEET/SEC.
Angle between Wind and Conductor	90˚	90˚
Coefficient of Emissivity	0.75	0.91
Coefficient of Absorption	0.75	0.91
Climatic Data Record (CDR) elevation above sea level (FT.)	914.2125 FEET	914.2125 FEET
Conductor Direction (North – South, East – West)	North – South	North – South
CDR Latitude in Degrees	42˚	42˚
Solar Heating	12:00 PM (noon)/NONE	12:00 PM (noon)/NONE
Atmosphere	CLEAR	CLEAR
Conductor Resistance in Ohm/mi. for the Low Temperature @ 77˚F/25˚C	Conductor Specific – In Accordance with Low Conductor Temperature	Conductor Specific – In Accordance with Low Conductor Temperature
Conductor Resistance in Ohm/mi. for the High Temperature @ 167˚F/75˚C	Conductor Specific – In Accordance with High Conductor Temperature	Conductor Specific – In Accordance with High Conductor Temperature

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

The "Normal" rating is the maximum rating for daily operation without encountering excessive loss of life, etc. and accounting for load cycles as well as ambient temperature cycles. Limits are based on allowable sags, clearance issues, and avoiding damage. The "Emergency" rating is the ultimate or maximum rating for a specific period of time, accounting for peak load cycle and ambient temperature cycles, without enduring excessive loss of life. Emergency ratings are applicable to short-term relief and should not exceed a 24 hour load cycle. For design purposes, emergency ratings exceeding a full load cycle were assumed resulting in a conductor rating that does not promote excessive loss of conductor life during such contingencies. This more conservative view was used for overhead conductors because of the concern for a permanent annealing of the conductor. For overhead conductors, such annealing could result in excess sag, and ultimately create clearance issues. In any case, the "Emergency" ampacity rating should not be exceeded nor allowed for prolonged duration in excess of 24 hours.

Primary overhead conductors have two (2) ampacity ratings for summer conditions and two (2) ampacity ratings for winter conditions as defined below:

Normal: The Normal rating shall be interpreted as the maximum value for normal peak loads on all new and rebuilt feeders. This is done to accommodate emergency conditions where ampacity may be increased for a period of time no greater than 24 hours. Existing feeders may be loaded to these levels if a review indicates that appropriate clearances can be maintained. (100% ampacity for normal operating conductor temperature limit; 176˚F/80˚C for bare conductors, 167˚F/75˚C for spacer cable / tree wire / covered conductors)

Emergency: The Emergency rating shall be interpreted as the absolute maximum ampacity allowed for a given conductor. This ampacity should not be exceeded under any condition unless an appropriate engineering review has been conducted. (100% ampacity for operating conductor at an elevated temperature during emergency conditions limited to a 24 hour period; 194˚F/90˚C for both bare and spacer cable / tree wire / covered conductors)

6.5 PLANNING CONDUCTOR INSTALLATIONS

6.5.10 General

Background knowledge of conductor sag and tensions, and ampacity are essential for all phases of planning, as well as determining the appropriate conductor, pole class and height, guy designs, etc. Designs will also be influenced by features that are discussed in specific Sections of these standards, including: Primaries, Street Lighting, and Secondaries.

The size for conductor should follow planning criteria or reviewed by a distribution system planning engineer. The distribution designer who selects the materials should furnish guidance to the field whenever it is required. For example, the distribution designer should furnish stringing sags at 32˚F/0˚C, 60˚F/15˚C, and 90˚F/32˚C and should indicate the spans that should be checked for sag whenever ruling span or slack span sag is needed.

For normal urban work refer to the standard tables, or curves, with variations discussed in Section 22-Materials Catalog.

6.5.20 Employment of 3,000 lb. Maximum Design Tension

Advantages of using design tensions greater than 2,000 lbs. may be substantial under certain circumstances. The advantages include reduced costs, avoiding need for intermediate poles when converting from single phase to three phase, and improved appearance resulting from fewer poles. If advantages like this are clearly evident, 3,000 lb. span construction may be used

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

for three phase lines in rural areas where the presence of secondaries and telephone is minimal and future urbanization is not anticipated. Isolated situations where conventional construction results in excessive sag may also be justification for 3,000 lb. construction. Crossarm tangents, vertical construction, deadends, and 336.4 kcmil or 477 kcmil 18/1 bare ACSR conductors should be employed for 3000 lb construction. Heavy duty arms with gain plates should be used where vertical construction for line angle poles and double deadends are not practical. The 3,000 lb. section of line shall be isolated from 2,000 lb. line sections by proper longitudinal guys at each end.

6.5.30 Deadending Different Conductors

When different conductors are deadended from the opposite directions on the same pole, the load may be balanced under heavy load conditions but not under normal temperatures. Normal conditions must exist when the foreman installs the cable. Three 336.4 kcmil and one 1/0 ACSR conductors, for example, create an unbalanced load of about 8,000 lbs. under heavy loading conditions. One spacer cable messenger will almost balance this with a tension of 7,700 lbs. Under pre-stressed conditions, the spacer cable will be stressed to 5,000 lbs. The open wires, however, will have tensions not over 400 or 500 lbs. each or less than 2,000 lbs. total. For this reason, the spacer cable must be deadended and guyed against the stress. Similar conditions will be met when two small conductors are balanced against one large one. A head guy to the next pole will often be sufficient to take up small unbalanced loads.

6.6 INSTALLING CONDUCTORS

6.6.10 General

In order to obtain the desired tensions it is essential that the conductor be sagged correctly. This Standard has been prepared to guide the installation of conductors.

6.6.20 Sagging Open Wire Primaries – Long Span

For long span work or for special construction, the planner will usually select a ruling span, pick the span that should be sagged, choose the stringing sags, and show them on the construction drawing. If conditions in the field make it impractical to sag this span, the planner should be consulted and the new stringing sags provided.

6.6.30 Sagging Other Open Conductors

Where special conditions warrant, the planner may select the span to be sagged and choose the stringing sags. In many cases, however, the sags will not be specified. In these cases proceed as follows:

A. Choose a span of average length near the center of the section to be pulled.

B. Check the stringing sag tables for a span of that length at the temperature that can be expected during the sagging operations. If the exact span is not shown on the table, use the corresponding ratio multiplier found in Table 1 on Page 6-3 to determine the required value.

If the actual ruling span is not specified, choose a ruling span that is equal to, or slightly more than, the actual span.

If existing conductors are to be re-sagged or re-strung, see Part E below.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

C. Pull up the entire section, equalizing tension in each span. Check the sag in the key span using a sagging stick or scale. Spans of other lengths will not necessarily have sags that match the stringing tables.

D. When different conductors are strung in parallel (e.g. on the same arm) string them to the value of the conductor with the greatest sag. It may be necessary to provide extra clearance for the wires so sagged.

E. When re-sagging or re-stringing old conductors, they should first be pulled tightly to sags somewhat less than final values, and then backed off to meet the final sag curves.

6.6.40 Line of Sight Method of Sagging Conductors

Select the longest span near the center of the line being sagged. Determine the proper stringing sag from the appropriate sag table. Measure down this distance “X” on both poles of the span from the height of the conductor attachment to the pole (see Figure 1 on Page 6-8). Attach a marker at this point that can be seen from the other pole. The conductor should be sagged to the line of sight between the two markers. The sag should be as close as practical to the stringing sag shown in the sag tables. Decreased sags cause tensions greater than design tensions and may overstress conductors, poles, crossarms and guys. Increased sags cause clearances smaller than design clearance.

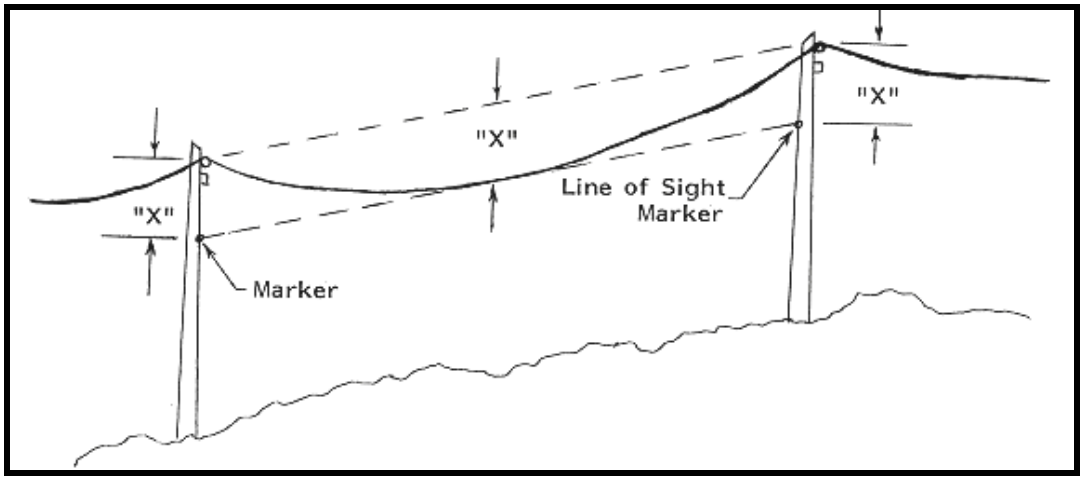


Figure 1 – Line of Sight Method of Sagging Conductors

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Doc. # ST.06.00.003

Standard Overhead Distribution Conductors

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21NG
Item ID:	9302828[E]
CU:	C1113ASSTBRNE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	39,100 lbs.	TRANSVERSE	0.7634 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.9854 sq. in.	VERTICAL	2.546 Lb/Ft	1111	NORMAL	1614
R. (@ 25˚C)	0.0161 Ω / 1000’	TOTAL	2.958 Lb/Ft	1262	EMERGENCY	1709
R. (@ 75˚C)	0.0191 Ω / 1000’					
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	24.33˚			
CONDUCTOR DIAMETER	1.293”					
WEIGHT	1430 lbs / 1000’					

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2672	1772	1394	1162	2461	1810	1499	1287	2318	1837	1578	1389	2208	1857	1639	1471
ACTUAL SPAN (FEET)																
50	2	3	4	5	2	3	4	4	2	3	3	4	2	3	3	4
60	3	4	6	7	3	4	5	6	3	4	5	6	3	4	5	5
70	4	6	8	9	4	6	7	8	5	6	7	8	5	6	6	7
80	5	8	10	12	6	8	9	11	6	7	9	10	6	7	8	9
90	7	10	12	15	7	10	12	14	8	9	11	13	8	9	11	12
100	8	12	15	18	9	12	14	17	9	12	14	15	10	12	13	15
110	10	15	19	22	11	14	17	20	11	14	16	19	12	14	16	18
120	12	17	22	27	13	17	21	24	13	17	20	22	14	17	19	21
130	14	20	26	31	15	20	24	28	16	20	23	26	16	20	22	25
140	16	24	30	36	17	23	28	33	18	23	27	30	19	23	26	29
150	18	27	35	42	20	27	32	38	21	26	31	35	22	26	29	33
160	21	31	39	47	22	30	37	43	24	30	35	40	25	30	34	37
170	23	35	45	53	25	34	41	48	27	34	39	45	28	33	38	42
180	26	39	50	60	28	38	46	54	30	38	44	50	32	37	42	47
190	29	44	56	67	31	43	52	60	33	42	49	56	35	42	47	53
200	32	48	62	74	35	47	57	67	37	47	54	62	39	46	52	58
210	35	53	68	82	38	52	63	74	41	52	60	68	43	51	58	64
220	39	59	75	90	42	57	69	81	45	57	66	75	47	56	63	71
230	43	64	82	98	46	63	76	88	49	62	72	82	51	61	69	77
240	46	70	89	107	50	68	83	96	53	67	78	89	56	67	75	84
250	50	76	96	116	55	74	90	104	58	73	85	97	61	72	82	91
260	54	82	104	125	59	80	97	113	63	79	92	105	66	78	89	99
270	59	88	112	135	64	87	105	122	68	85	99	113	71	84	96	107
280	63	95	121	145	68	93	112	131	73	92	107	121	76	91	103	115
290	68	102	130	156	73	100	121	141	78	98	115	130	82	97	110	123
300	72	109	139	167	79	107	129	150	83	105	123	139	88	104	118	132

****** Simulated with a maximum tension of 4000 lbs. ******

Supersedes 1/07 Issue – Updated item ID.

1113.0 KCMIL, 54/19 STRANDING, BARE ACSR, “FINCH” – 35 kV			
ISSUE	PAGE NUMBER		
7/15	6-101	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21NG
Item ID:	9302828[E]
CU:	C1113ASSTBRNE

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.44	4.20	7.20	8.64	9.84	11.28	11.88	12.48
75	3.84	8.28	12.12	14.40	16.08	18.00	18.84	19.68
100	7.68	13.44	18.00	21.36	23.40	25.68	26.76	27.84
125	13.32	20.04	25.08	29.28	31.68	34.44	35.64	36.84
150	20.64	27.84	33.24	38.40	41.16	44.16	45.60	46.92
175	29.40	36.96	42.72	48.36	51.72	55.08	56.64	58.08
200	39.72	47.40	53.52	59.52	63.48	67.08	68.76	70.32
225	51.48	59.28	65.64	71.76	76.44	80.28	81.96	83.76
250	64.56	72.60	79.08	85.44	90.48	94.68	96.48	98.28
275	79.08	87.24	93.84	100.44	105.60	110.28	112.20	114.12
300	95.04	103.20	109.92	116.64	122.04	127.08	129.12	131.16

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	2.76	5.16	7.32	*4000
75	6.24	9.60	12.24	*4000
100	11.04	15.24	18.12	*4000
125	17.28	22.08	25.20	*4000
150	24.96	30.12	33.48	*4000
175	33.96	39.48	43.08	*4000
200	44.40	50.16	53.88	*4000
225	56.16	62.16	65.88	*4000
250	69.36	75.60	79.32	*4000
275	84.00	90.24	94.08	*4000
300	99.96	106.32	110.28	*4000
** Note: Design Specification Constraint*				

****** Simulated with a maximum tension of 4000 lbs. ******

Supersedes 1/07 Issue – Updated item ID.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21NF
Item ID:	9306375[E]
CU:	C795ASSTBRNE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	28,200 lbs.	**TRANSVERSE**	0.6966 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.7049 sq. in.	**VERTICAL**	2.015 Lb/Ft			
R. (@ 25˚C)	0.0222 Ω / 1000'	**TOTAL**	2.432 Lb/Ft	902	**NORMAL**	1299
R. (@ 75˚C)	0.0265 Ω / 1000'			1021	**EMERGENCY**	1375
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	**SWING**	28.14˚			
CONDUCTOR DIAMETER	1.093"					
WEIGHT	1022 lbs / 1000'					

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2446	1557	1165	938	2192	1537	1228	1028	2004	1523	1274	1100	1874	1513	1310	1157
ACTUAL SPAN (FEET)																
50	2	2	3	4	2	2	3	4	2	3	3	3	2	3	3	3
60	2	4	5	6	3	4	5	5	3	4	4	5	3	4	4	5
70	3	5	6	8	3	5	6	7	4	5	6	7	4	5	6	7
80	4	6	8	10	4	6	8	10	5	6	8	9	5	6	8	8
90	5	8	11	13	6	8	10	12	6	8	10	11	7	8	10	11
100	6	10	13	16	7	10	13	15	8	10	12	14	8	10	12	13
110	8	12	16	20	8	12	15	18	9	12	15	17	10	12	14	16
120	9	14	19	24	10	14	18	22	11	15	17	20	12	15	17	19
130	11	17	22	28	12	17	21	25	13	17	20	24	14	17	20	22
140	12	19	26	32	14	20	25	29	15	20	24	27	16	20	23	26
150	14	22	30	37	16	22	28	34	17	23	27	31	18	23	26	30
160	16	25	34	42	18	26	32	38	20	26	31	36	21	26	30	34
170	18	29	38	47	20	29	36	43	22	29	35	40	24	29	34	38
180	20	32	43	53	23	32	41	48	25	333	39	45	27	33	38	43
190	23	36	48	59	25	36	45	54	28	36	44	50	30	37	42	48
200	25	39	53	66	28	40	50	60	31	40	48	56	33	41	47	53
210	28	44	58	72	31	44	55	66	34	45	53	62	36	45	52	59
220	30	48	64	79	34	48	61	72	37	49	58	68	40	49	57	64
230	33	52	70	87	37	53	66	79	41	53	64	74	43	54	62	70
240	36	57	76	94	40	58	72	86	44	58	69	81	47	59	68	77
250	39	62	82	103	44	62	78	94	48	63	75	87	51	63	73	83
260	42	67	89	111	47	68	85	101	52	68	82	95	55	69	79	90
270	46	71	96	120	51	73	91	109	56	74	88	102	60	74	59	97
280	49	77	103	129	55	78	98	117	60	79	95	110	64	80	92	104
290	53	83	111	138	59	84	105	126	64	85	101	118	69	85	99	112
300	57	89	119	148	63	90	113	135	69	91	109	126	74	91	106	120

****** Simulated with a maximum tension of 3500 lbs. ******

Supersedes 1/07 Issue – Updated item ID.

795.0 KCMIL, 54/7 STRANDING, BARE ACSR, "CONDOR" – 35 kV

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Doc. # ST.06.00.003

Std. Item:	W21NF
Item ID:	9306375[E]
CU:	C795ASSTBRNE

Supersedes 1/07 Issue – Updated item ID.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.20	3.00	6.00	7.68	9.00	10.44	11.16	11.76
75	3.00	6.36	10.44	13.20	14.88	16.92	17.76	18.72
100	5.88	11.16	15.84	19.68	21.72	24.24	25.32	26.40
125	10.56	17.04	22.44	27.12	29.52	32.40	33.72	35.04
150	16.92	24.36	30.12	35.52	38.40	41.64	43.08	44.52
175	24.96	32.88	39.00	44.88	48.36	51.84	53.40	55.08
200	34.44	42.60	49.08	55.20	59.28	63.12	64.92	66.60
225	45.36	53.76	60.36	66.84	71.40	75.48	77.40	79.20
250	57.72	66.12	72.96	79.68	84.72	89.04	90.96	93.00
275	71.28	79.92	86.76	93.72	99.24	103.80	105.84	107.76
300	86.28	94.92	101.88	109.08	114.84	119.64	121.80	123.84

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	2.64	4.32	6.12	*3500
75	5.88	8.40	10.68	*3500
100	10.44	13.80	16.20	*3500
125	16.32	20.16	22.80	*3500
150	23.40	27.84	30.48	*3500
175	31.92	36.72	39.36	*3500
200	41.76	46.80	49.56	*3500
225	52.80	58.08	60.84	*3500
250	65.16	70.68	73.56	*3500
275	78.84	84.48	87.36	*3500
300	93.84	99.60	102.48	*3500
** Note: Design Specification Constraint*				

****** Simulated with a maximum tension of 3500 lbs. ******

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21BF
Item ID:	9302781[E]
CU:	C795ALSTBRNE

PHYSICAL PROPERTIES	
R.B.S.	13,900 lbs.
C.S.A.	0.6245 sq. in.
R. (@ 25˚C)	0.0227 Ω / 1000’
R. (@ 75˚C)	0.0269 Ω / 1000’
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	1.026”
WEIGHT	745 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.675 Lb/Ft
VERTICAL	1.694 Lb/Ft
TOTAL	2.124 Lb/Ft
SWING	34.54˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
880	NORMAL	1265
997	EMERGENCY	1339

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	868	657	554	484	811	669	588	527	779	676	612	560	760	682	629	585
ACTUAL SPAN (FEET)																
50	3	4	5	6	3	4	5	5	4	4	5	5	4	4	4	5
60	5	6	7	8	5	6	7	8	5	6	7	7	5	6	6	7
70	6	8	10	11	7	8	9	10	7	8	9	10	7	8	9	9
80	8	11	13	15	9	11	12	14	9	11	12	13	9	11	11	12
90	10	14	16	19	11	14	15	17	12	13	15	16	12	13	14	16
100	13	17	20	23	14	17	19	21	14	17	18	20	15	16	18	19
110	16	21	24	28	17	20	23	26	17	20	22	24	18	20	22	23
120	19	25	29	33	20	24	27	31	21	24	26	29	21	24	26	28
130	22	29	34	39	23	28	32	36	24	28	31	34	25	28	30	32
140	25	33	40	45	27	33	37	42	28	33	36	39	29	32	35	38
150	29	38	45	52	31	38	43	48	32	37	41	45	33	37	40	43
160	33	44	52	59	35	43	49	54	37	42	47	51	38	42	46	49
170	37	49	58	67	40	48	55	61	42	48	53	58	43	48	51	55
180	42	55	65	75	45	54	62	69	47	54	59	65	48	53	58	62
190	47	62	73	83	50	60	69	77	52	60	66	72	53	59	64	69
200	52	68	81	92	55	67	76	85	58	66	73	80	59	66	71	77
210	57	75	89	102	61	74	84	94	63	73	81	88	65	73	79	85
220	62	82	98	112	67	81	92	103	70	80	89	97	71	80	86	93
230	68	90	107	122	73	89	101	113	76	88	97	106	78	87	94	102
240	74	98	116	133	80	96	110	123	83	96	106	115	85	95	103	111
250	81	107	126	144	86	105	119	133	90	104	115	125	92	103	111	120
260	87	115	137	156	93	113	129	144	97	112	124	135	100	111	120	130
270	94	124	147	169	101	122	139	155	105	121	134	146	108	120	130	140
280	101	134	158	181	108	131	149	167	113	130	144	157	116	129	140	151
290	109	143	170	194	116	141	160	179	121	139	154	168	124	138	150	161
300	116	153	182	208	124	151	171	192	129	149	165	180	133	148	160	173

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

795.0 KCMIL, 37 STRAND, BARE AAC, “ARBUTUS” – 15 kV

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21BF
Item ID:	9302781[E]
CU:	C795ALSTBRNE

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.92	5.64	5.86	8.88	11.28	13.44	15.60	16.56
75	6.00	11.16	11.43	15.24	18.60	21.48	24.60	26.04
100	12.84	18.60	18.91	23.28	27.24	30.72	34.68	36.48
125	21.96	27.84	28.18	33.00	37.44	41.40	46.08	48.12
150	33.00	39.12	39.48	44.52	49.32	53.76	58.92	61.20
175	46.08	52.20	52.58	57.84	63.00	67.80	73.44	75.96
200	61.08	67.32	67.71	73.20	78.48	83.52	89.64	92.28
225	78.24	84.48	84.87	90.36	96.00	101.28	107.52	110.40
250	97.32	103.68	104.08	109.68	115.32	120.72	127.32	130.32
275	118.44	124.80	125.21	130.92	136.68	142.32	149.04	152.16
300	141.60	147.96	148.38	154.20	160.08	165.72	172.80	175.92

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.08	6.84	9.00	*1948
75	9.36	12.84	15.48	*1921
100	16.56	20.64	23.52	*1924
125	25.80	30.12	33.24	*1935
150	36.96	41.64	44.76	*1945
175	50.04	54.84	58.20	*1954
200	65.16	70.20	73.56	*1962
225	82.20	87.36	90.72	*1968
250	101.40	106.56	110.04	*1973
275	122.52	127.80	131.28	*1977
300	145.68	151.08	154.56	*1980
** Note: Design Specification Constraint*				

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21ND
Item ID:	9313225
CU:	C795ALTWHMP35KNE
CU:	C795ALSCHMP35KNE

PHYSICAL PROPERTIES	
R.B.S.	13,480 lbs.
C.S.A.	0.6245 sq. in.
R. (@ 25˚C)	0.0227 Ω / 1000’
R. (@ 75˚C)	0.0271 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.932”
COMPLETE DIAMETER	1.572” (Nominal)
WEIGHT	1,315 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.857 Lb/Ft
VERTICAL	2.603 Lb/Ft
TOTAL	3.041 Lb/Ft
SWING	30.87˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
669	NORMAL	952
828	EMERGENCY	1058

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	942	827	752	691	917	837	781	732	903	844	801	761	894	849	814	782
ACTUAL SPAN (FEET)																
50	5	6	7	7	5	6	6	7	5	6	6	7	6	6	6	6
60	8	9	9	10	8	9	9	10	8	8	9	9	8	8	9	9
70	10	12	13	14	11	12	12	13	11	12	12	13	11	11	12	12
80	13	15	17	18	14	15	16	17	14	15	16	17	14	15	16	16
90	17	19	21	23	17	19	21	22	18	19	20	21	18	19	20	21
100	21	24	26	29	22	24	25	27	22	23	25	26	22	23	24	25
110	25	29	32	35	26	29	31	33	27	28	30	32	27	28	30	31
120	30	34	38	41	31	34	36	39	32	34	36	38	32	34	35	37
130	35	40	44	48	36	40	43	46	37	40	42	44	38	40	41	43
140	41	47	51	56	42	46	50	53	43	46	49	51	44	46	48	50
150	47	54	59	64	48	53	57	61	49	53	56	59	50	53	55	57
160	54	61	67	73	55	61	65	69	56	60	63	67	57	60	62	65
170	61	69	76	83	62	68	73	78	63	68	72	75	64	68	70	73
180	68	77	85	93	70	77	82	88	71	76	80	84	72	76	79	82
190	76	86	95	103	78	85	91	98	79	85	89	94	80	84	88	92
200	84	96	105	115	86	95	101	108	88	94	99	104	89	94	98	102
210	92	105	116	126	95	104	112	119	97	104	109	115	98	103	108	112
220	101	116	127	139	104	114	123	131	106	114	120	126	107	113	118	123
230	111	126	139	152	114	125	134	143	116	124	131	138	117	124	129	134
240	121	138	151	165	124	136	146	156	126	135	143	150	128	135	140	146
250	131	149	164	179	135	148	158	169	137	147	155	163	139	146	152	159
260	142	162	178	194	146	160	171	183	148	159	167	176	150	158	165	172
270	153	174	191	209	157	172	185	198	160	171	181	190	162	170	178	185
280	164	187	206	225	169	185	199	212	172	184	194	204	174	183	191	199
290	176	201	221	241	181	199	213	228	185	198	208	219	187	197	205	214
300	189	215	236	258	194	213	228	244	197	211	223	235	200	210	220	229

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

795.0 KCMIL, 19 STRAND, COMPACT AAC, 320 MIL COVERED TREE WIRE – 35 kV

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21ND
Item ID:	9313225
CU:	C795ALTWHMP35KNE
CU:	C795ALSCHMP35KNE

Supersedes 7/15 Issue – Updated sags and teensions.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	3.84	7.20	7.38	9.96	12.24	14.16	16.32	17.16
75	10.56	14.64	14.86	18.00	20.88	23.40	26.40	27.60
100	20.88	25.08	25.33	28.80	32.04	35.04	38.64	40.20
125	34.08	38.28	38.54	42.24	45.84	49.20	53.16	54.84
150	50.04	54.36	54.62	58.32	62.16	65.76	70.08	72.00
175	68.76	73.20	73.47	77.28	81.24	85.08	89.64	91.68
200	90.48	94.92	95.20	99.12	103.20	107.16	111.84	114.12
225	115.08	119.52	119.81	123.84	128.04	132.00	136.92	139.20
250	142.68	147.12	147.41	151.44	155.76	159.84	164.88	167.28
275	173.28	177.72	178.02	182.16	186.36	190.56	195.72	198.12
300	206.88	211.44	211.73	215.76	220.08	224.28	229.56	232.08

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	5.76	8.28	10.08	*2000
75	12.84	15.96	18.12	*2000
100	23.16	26.64	28.92	*1973
125	36.36	39.96	42.36	*1967
150	52.32	56.16	58.56	*1969
175	71.16	75.00	77.52	*1973
200	92.88	96.84	99.36	*1977
225	117.48	121.44	124.08	*1981
250	145.08	149.16	151.80	*1984
275	175.68	179.76	182.40	*1986
300	209.28	213.36	216.12	*1988
** Note: Design Specification Constraint*				

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21BG
Item ID:	9313226
CU:	C795ALTWHMPNE
CU:	C795ALSCHMPNE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	13,480 lbs.	TRANSVERSE	0.764 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.6245 sq. in.	VERTICAL	2.163 Lb/Ft	714	NORMAL	1005
R. (@ 25˚C)	0.0227 Ω / 1000’	TOTAL	2.594 Lb/Ft	881	EMERGENCY	1118
R. (@ 75˚C)	0.0271 Ω / 1000’					
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	31.63˚			
CONDUCTOR DIAMETER	0.932”					
COMPLETE DIAMETER	1.292” (Nominal)					
WEIGHT	1,049 lbs / 1000’					

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	916	766	677	609	881	777	709	653	861	785	731	685	848	790	747	708
ACTUAL SPAN (FEET)																
50	4	5	6	6	4	5	6	6	5	5	5	6	5	5	5	6
60	6	7	8	9	6	7	8	9	7	7	8	8	7	7	8	8
70	8	10	11	13	9	10	11	12	9	10	11	11	9	10	10	11
80	11	13	15	17	11	13	14	15	12	13	14	15	12	13	14	14
90	14	17	19	21	14	16	18	20	15	16	17	19	15	16	17	18
100	17	21	23	26	18	20	22	24	18	20	22	23	19	20	21	22
110	21	25	28	31	22	25	27	29	22	24	26	28	23	24	26	27
120	25	30	34	37	26	29	32	35	26	29	31	33	27	29	30	32
130	29	35	39	44	30	34	38	41	31	34	36	39	31	34	36	38
140	34	40	46	51	35	40	44	47	36	39	42	45	37	39	41	44
150	39	46	52	58	40	46	50	54	41	45	49	52	42	45	48	50
160	44	53	60	66	46	52	57	62	47	52	55	59	48	51	54	57
170	50	60	67	75	52	59	64	70	53	58	62	67	54	58	61	65
180	56	67	75	84	58	66	72	78	59	65	70	75	60	65	69	72
190	62	74	84	93	64	73	80	87	66	73	78	83	67	72	76	81
200	69	82	93	104	71	81	89	97	73	81	86	92	75	80	85	89
210	76	91	103	114	79	90	98	107	81	89	95	102	82	88	93	98
220	83	100	113	125	86	98	108	117	89	97	104	112	90	97	102	108
230	91	109	123	137	95	107	118	128	97	106	114	122	99	106	112	118
240	99	119	134	149	103	117	128	139	106	116	124	133	107	115	122	129
250	108	129	145	162	112	127	139	151	115	126	135	144	116	125	132	140
260	116	139	157	175	121	137	150	164	124	136	146	156	126	135	143	151
270	125	150	170	189	130	148	162	177	134	147	157	168	136	146	154	163
280	135	162	182	203	140	159	174	190	144	158	169	181	146	157	166	175
290	145	173	196	218	150	171	187	204	154	169	182	194	157	168	178	188
300	155	186	209	233	161	183	200	218	165	181	194	208	168	180	190	201

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Doc. # ST.06.00.003

Std. Item:	W21BG
Item ID:	9313226
CU:	C795ALTWHMPNE
CU:	C795ALSCHMPNE

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	2.88	6.48	6.68	9.48	11.76	13.80	15.96	16.92
75	8.28	12.84	13.09	16.56	19.68	22.32	25.44	26.76
100	16.68	21.48	21.76	25.68	29.28	32.64	36.36	38.04
125	27.72	32.76	33.06	37.20	41.28	44.88	49.20	51.12
150	41.40	46.56	46.86	51.12	55.44	59.40	64.20	66.24
175	57.48	62.64	62.96	67.44	71.88	76.20	81.24	83.52
200	76.08	81.24	81.56	86.04	90.72	95.16	100.44	102.96
225	96.96	102.24	102.57	107.16	111.96	116.52	122.04	124.56
250	120.48	125.64	125.98	130.68	135.48	140.16	145.92	148.56
275	146.40	151.68	152.02	156.72	161.64	166.44	172.32	174.96
300	174.96	180.24	180.58	185.28	190.32	195.12	201.12	203.88

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.92	7.56	9.48	*2000
75	10.92	14.28	16.68	*2000
100	19.44	23.28	25.92	*2000
125	30.60	34.68	37.44	*1987
150	44.28	48.60	51.48	*1980
175	60.36	64.80	67.68	*1979
200	78.96	83.40	86.40	*1981
225	99.96	104.40	107.40	*1983
250	123.36	127.92	131.04	*1985
275	149.40	153.96	157.08	*1987
300	177.84	182.52	185.64	*1988
** Note: Design Specification Constraint*				

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	9302780
CU:	C477BACSR

PHYSICAL PROPERTIES	
R.B.S.	19,500 lbs.
C.S.A.	0.4353 sq. in.
R. (@ 25˚C)	0.0366 Ω / 1000’
R. (@ 75˚C)	0.0438 Ω / 1000’
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.858” (Nominal)
WEIGHT	656 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.6174 Lb/Ft
VERTICAL	1.501 Lb/Ft
TOTAL	1.923 Lb/Ft
SWING	33.18˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
658	**NORMAL**	938
742	**EMERGENCY**	991

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				**150**				**175**				**200**			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2200	1333	913	691	1936	1255	937	750	1707	1200	954	796	1533	1161	967	832
ACTUAL SPAN (FEET)																
50	1	2	3	4	1	2	3	3	1	2	3	3	2	2	3	3
60	2	3	4	5	2	3	4	5	2	3	4	4	2	3	4	4
70	2	4	5	7	2	4	5	6	3	4	5	6	3	4	5	6
80	3	5	7	9	3	5	7	8	4	5	7	8	4	5	7	8
90	4	6	9	12	4	6	9	11	5	7	8	10	5	7	8	10
100	4	7	11	14	5	8	11	13	6	8	10	12	6	8	10	12
110	5	9	13	17	6	9	13	16	7	10	12	15	8	10	12	14
120	6	11	16	21	7	11	15	19	8	12	15	18	9	12	15	17
130	8	12	18	24	9	13	18	22	10	14	17	21	11	14	17	20
140	9	14	21	28	10	15	21	26	11	16	20	24	13	17	20	23
150	10	17	24	32	11	18	24	30	13	18	23	28	14	19	23	27
160	11	19	28	36	13	20	27	34	15	21	26	32	16	22	26	30
170	13	21	31	41	15	23	30	38	17	24	30	36	19	25	29	34
180	14	24	35	46	16	25	34	43	19	27	33	40	21	27	33	38
190	16	27	39	51	18	28	38	47	21	30	37	45	23	31	37	43
200	18	30	43	57	20	31	42	53	23	33	41	50	26	34	41	47
210	20	33	48	63	22	35	46	58	25	36	45	55	28	37	45	52
220	22	36	52	69	25	38	51	64	28	40	50	60	31	41	49	57
230	24	39	57	75	27	41	56	69	31	43	55	65	34	45	54	63
240	26	43	62	82	29	45	61	76	33	47	59	71	37	49	59	68
250	28	46	67	89	32	49	66	82	36	51	64	77	40	53	64	74
260	30	50	73	96	34	53	71	89	39	55	70	84	43	57	69	80
270	33	54	79	104	37	57	77	96	42	60	75	90	47	62	74	86
280	35	58	85	112	40	61	82	103	45	64	81	97	50	66	80	93
290	38	62	91	120	43	66	88	111	48	69	87	104	54	71	86	100
300	40	66	97	128	46	71	95	118	52	74	93	111	58	76	92	107

****** Simulated with a maximum tension of 3000 lbs. ******

Supersedes 7/15 Issue – Corrected normal temperature limit.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	9302780
CU:	C477BACSR

Supersedes 1/07 Issue – Updated item ID.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.84	1.8	4.44	6.12	7.68	9.36	10.08	10.68
75	2.16	4.32	8.28	10.92	12.84	15.12	16.08	17.04
100	4.2	8.16	13.2	16.68	19.08	21.72	23.04	24.12
125	7.44	13.32	19.08	23.4	26.16	29.28	30.72	32.04
150	12.36	19.68	26.04	31.20	34.20	37.68	39.24	40.92
175	19.08	27.48	34.08	39.96	43.20	47.04	48.84	50.52
200	27.48	36.36	43.32	49.80	53.28	57.36	59.28	61.20
225	37.44	46.56	53.64	60.72	64.32	68.76	70.80	72.84
250	48.72	57.96	65.28	72.48	76.56	81.24	83.40	85.44
275	61.20	70.56	78.00	85.44	89.76	94.68	96.96	99.12
300	75.00	84.36	91.92	99.48	104.28	109.32	111.60	113.88

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	2.40	3.48	4.68	3000*
75	5.40	7.20	8.64	3000*
100	9.60	12.00	13.68	3000*
125	15.00	18.00	19.68	3000*
150	21.60	24.96	26.64	3000*
175	29.52	33.12	34.80	3000*
200	38.52	42.48	44.16	3000*
225	48.72	52.92	54.60	3000*
250	60.12	64.44	66.12	3000*
275	72.72	77.28	78.96	3000*
300	86.64	91.20	92.88	3000*
** Note: Design Specification Constraint*				

****** Simulated with a maximum tension of 3000 lbs. ******

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21BA
Item ID:	9314655
CU:	C477ALSTBR

PHYSICAL PROPERTIES	
R.B.S.	8,360 lbs.
C.S.A.	0.3744 sq. in.
R. (@ 25˚C)	0.0373 Ω / 1000'
R. (@ 75˚C)	0.0445 Ω / 1000'
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.792"
WEIGHT	447 lbs / 1000'

LOADING PROPERTIES	
TRANSVERSE	0.598 Lb/Ft
VERTICAL	1.251 Lb/Ft
TOTAL	1.686 Lb/Ft
SWING	41.59˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
640	NORMAL	908
721	EMERGENCY	960

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1087	622	451	363	886	593	469	394	766	576	483	419	696	566	492	438
ACTUAL SPAN (FEET)																
50	2	3	4	5	2	3	4	4	2	3	3	4	2	3	3	4
60	2	4	5	7	3	4	5	6	3	4	5	6	3	4	5	6
70	3	5	7	9	4	6	7	8	4	6	7	8	5	6	7	8
80	4	7	10	12	5	7	9	11	6	7	9	10	6	8	9	10
90	5	9	12	15	6	9	12	14	7	9	11	13	8	10	11	12
100	6	11	15	19	8	11	14	17	9	12	14	16	10	12	14	15
110	7	13	18	22	9	14	17	21	11	14	17	19	12	14	17	19
120	9	16	21	27	11	16	21	24	13	17	20	23	14	17	20	22
130	10	18	25	31	13	19	24	29	15	20	24	27	16	20	23	26
140	12	21	29	36	15	22	28	33	17	23	27	31	19	23	27	30
150	14	24	34	42	17	26	32	38	20	26	31	36	22	27	31	35
160	16	28	38	47	19	29	37	44	22	30	36	41	25	30	35	39
170	18	31	43	53	22	33	41	49	25	34	40	46	28	34	39	44
180	20	35	48	60	25	37	46	55	28	38	45	52	31	39	44	50
190	22	39	54	67	27	41	52	61	32	42	50	58	35	43	49	55
200	25	44	60	74	30	45	57	68	35	47	56	64	39	48	55	61
210	27	48	66	82	33	50	63	75	39	52	61	71	42	52	60	68
220	30	53	72	90	37	55	69	82	42	57	67	78	47	58	66	74
230	33	58	79	98	40	60	76	90	46	62	74	85	51	63	72	81
240	35	63	86	107	44	65	82	98	51	67	80	92	55	68	79	88
250	38	68	93	116	47	71	89	106	55	73	87	100	60	74	85	96
260	42	74	101	125	51	77	97	115	59	79	94	108	65	80	92	104
270	45	79	109	135	55	83	104	124	64	85	101	117	70	87	100	112
280	48	85	117	145	59	89	112	133	69	92	109	126	75	93	107	120
290	52	92	125	156	64	96	120	143	74	98	117	135	81	100	115	129
300	55	98	134	167	68	102	129	153	79	105	125	144	87	107	123	138

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21BA
Item ID:	9314655
CU:	C477ALSTBR

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.96	2.64	2.90	6.60	9.60	11.88	14.40	15.48
75	2.52	6.24	6.59	11.52	15.48	18.84	22.32	23.88
100	5.52	11.64	12.04	17.64	22.56	26.64	31.08	33.00
125	11.16	18.72	19.15	25.20	30.72	35.40	40.68	42.96
150	19.20	27.36	27.82	34.32	40.20	45.48	51.48	54.12
175	29.40	37.68	38.16	44.88	51.24	56.88	63.48	66.36
200	41.52	49.80	50.29	57.12	63.84	69.84	76.92	80.04
225	55.20	63.48	63.98	70.92	77.76	84.12	91.56	94.92
250	70.44	78.72	79.22	86.28	93.36	99.96	107.64	111.24
275	87.24	95.52	96.03	103.20	110.40	117.12	125.28	128.88
300	105.60	113.88	114.40	121.68	129.00	135.96	144.24	148.08

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	3.12	4.80	6.84	*2000
75	7.08	9.60	11.88	*2000
100	12.60	15.84	18.24	*2000
125	19.80	23.40	25.92	*2000
150	28.44	32.52	35.04	*2000
175	38.88	43.08	45.72	*1996
200	50.88	55.44	57.96	*1989
225	64.56	69.24	71.88	*1987
250	79.80	84.60	87.24	*1986
275	96.60	101.52	104.16	*1986
300	114.96	120.00	122.64	*1987

** Note: Design Specification Constraint*

Supersedes 7/15 Issue – Updated sags and tensions.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21NB
Item ID:	9313248[E]
CU:	C477ALTWHMP35KNE
CU:	C477ALSCHMP35KNE

PHYSICAL PROPERTIES	
R.B.S.	8,360 lbs.
C.S.A.	0.3746 sq. in.
R. (@ 25˚C)	0.0373 Ω / 1000’
R. (@ 75˚C)	0.0447 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.722”
COMPLETE DIAMETER	1.362” (Nominal)
WEIGHT	903 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.787 Lb/Ft
VERTICAL	2.061 Lb/Ft
TOTAL	2.506 Lb/Ft
SWING	37.02˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
489	NORMAL	692
603	EMERGENCY	768

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	931	749	646	572	859	740	665	605	818	735	678	630	793	732	687	647
ACTUAL SPAN (FEET)																
50	4	5	5	6	4	5	5	6	4	5	5	5	4	5	5	5
60	5	7	8	9	6	7	7	8	6	7	7	8	6	7	7	8
70	7	9	10	12	8	9	10	11	8	9	10	11	8	9	10	10
80	9	12	13	15	10	12	13	14	11	12	13	14	11	12	13	13
90	12	15	17	19	13	15	17	18	13	15	16	17	14	15	16	17
100	15	18	21	24	16	18	20	22	17	18	20	22	17	19	20	21
110	18	22	25	29	19	22	25	27	20	22	24	26	21	23	24	25
120	21	26	30	34	23	26	29	32	24	27	29	31	25	27	29	30
130	25	31	35	40	27	31	35	38	28	31	34	36	29	31	33	36
140	29	36	41	47	31	36	40	44	32	36	39	42	34	36	39	41
150	33	41	47	53	36	41	46	51	37	42	45	49	39	42	45	47
160	37	47	54	61	40	47	52	57	42	47	51	55	44	48	51	54
170	42	53	61	69	46	53	59	65	48	53	58	62	50	54	57	61
180	47	59	68	77	51	59	66	73	54	60	65	70	56	60	64	68
190	53	66	76	86	57	66	74	81	60	67	72	78	62	67	71	76
200	58	73	84	95	63	73	82	90	66	74	80	86	69	74	79	84
210	64	80	92	105	70	81	90	99	73	82	88	95	76	82	87	93
220	71	88	101	115	76	89	99	109	80	89	97	104	83	90	96	102
230	77	96	111	126	84	97	108	119	88	98	106	114	91	98	105	111
240	84	105	121	137	91	106	118	129	95	106	116	124	99	107	114	121
250	91	114	131	148	99	115	128	140	104	116	125	135	107	116	124	131
260	99	123	142	160	107	124	138	152	112	125	136	146	116	126	134	142
270	106	132	153	173	115	134	149	164	121	135	146	157	125	136	144	153
280	114	142	164	186	124	144	160	176	130	145	157	169	134	146	155	165
290	123	153	176	200	133	154	172	189	139	155	169	182	144	156	167	177
300	131	164	189	214	142	165	184	202	149	166	181	194	154	167	178	189

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21NB
Item ID:	9313248[E]
CU:	C477ALTWHMP35KNE
CU:	C477ALSCHMP35KNE

Supersedes 7/15 Issue – Updated sags and tesnison.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	2.16	4.68	4.90	7.92	10.44	12.60	15.00	15.96
75	6.84	11.16	11.42	15.00	18.24	21.12	24.24	25.68
100	15.00	19.92	20.21	24.24	27.96	31.32	35.16	36.84
125	25.80	30.96	31.26	35.52	39.60	43.44	47.76	49.68
150	39.00	44.16	44.48	48.96	53.40	57.48	62.28	64.44
175	54.48	59.76	60.09	64.68	69.36	73.68	78.84	81.12
200	72.36	77.76	78.09	82.68	87.48	92.04	97.44	99.96
225	92.64	98.04	98.38	103.08	108.00	112.68	118.32	120.96
250	115.32	120.72	121.06	125.88	130.80	135.60	141.48	144.24
275	140.40	145.80	146.14	150.96	156.00	160.92	166.92	169.80
300	167.88	173.28	173.63	178.56	183.72	188.64	194.88	197.64

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.68	6.60	8.16	*2000
75	10.92	13.68	15.36	*1928
100	19.68	22.80	24.60	*1909
125	30.72	34.08	36.00	*1914
150	44.04	47.64	49.56	*1925
175	59.64	63.36	65.28	*1937
200	77.52	81.48	83.40	*1946
225	97.92	101.88	103.80	*1955
250	120.60	124.56	126.48	*1961
275	145.68	149.76	151.68	*1967
300	173.16	177.36	179.28	*1971
** Note: Design Specification Constraint*				

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum

Std. Item:	W21BD
Item ID:	9302808
CU:	C477ALTWHMPNE
CU:	C477ALSCHMPNE

PHYSICAL PROPERTIES	
R.B.S.	8,360 lbs.
C.S.A.	0.3744 sq. in.
R. (@ 25˚C)	0.0373 Ω / 1000’
R. (@ 75˚C)	0.0447 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.722”
COMPLETE DIAMETER	1.042” (Nominal)
WEIGHT	637 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.681 Lb/Ft
VERTICAL	1.596 Lb/Ft
TOTAL	2.035 Lb/Ft
SWING	39.28˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
528	NORMAL	739
647	EMERGENCY	819

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	973	679	546	462	848	664	566	496	778	654	579	521	737	647	589	541
ACTUAL SPAN (FEET)																
50	2	4	4	5	3	4	4	5	3	4	4	5	3	4	4	4
60	4	5	6	7	4	5	6	7	4	5	6	7	5	5	6	6
70	5	7	9	10	6	7	8	9	6	7	8	9	6	7	8	9
80	6	9	11	13	7	9	11	12	8	9	11	12	8	9	10	11
90	8	11	14	17	9	12	14	16	10	12	13	15	11	12	13	14
100	10	14	18	21	11	14	17	19	12	15	17	18	13	15	16	18
110	12	17	21	25	14	18	20	23	15	18	20	22	16	18	20	21
120	14	20	25	30	16	21	24	28	18	21	24	26	19	21	23	26
130	17	24	30	35	19	24	29	33	21	25	28	31	22	25	28	30
140	19	28	34	41	22	28	33	38	24	29	32	36	25	29	32	35
150	22	32	39	47	25	33	38	43	28	33	37	41	29	33	37	40
160	25	36	45	53	29	37	43	49	31	38	42	47	33	38	42	45
170	28	41	51	60	33	42	49	56	36	42	48	53	38	43	47	51
180	32	46	57	67	36	47	55	63	40	48	54	60	42	48	53	57
190	35	51	63	75	41	52	61	70	44	53	60	66	47	53	59	64
200	39	57	70	83	45	58	68	77	49	59	66	74	52	59	65	71
210	43	62	77	91	50	64	75	85	54	65	73	81	57	65	72	78
220	48	68	85	100	54	70	82	93	60	71	80	89	63	72	79	86
230	52	75	93	110	60	77	89	102	65	78	87	97	69	78	86	94
240	57	81	101	119	65	83	97	111	71	85	95	106	75	85	94	102
250	61	88	109	130	70	90	106	121	77	92	103	115	81	93	102	111
260	66	96	118	140	76	98	114	131	83	99	112	124	88	100	110	120
270	72	103	128	151	82	105	123	141	90	107	121	134	95	108	119	129
280	77	111	137	163	88	113	133	151	96	115	130	144	102	116	128	139
290	83	119	147	174	95	122	142	162	103	123	139	155	109	125	137	149
300	88	127	158	187	101	130	152	174	111	132	149	165	117	133	147	160

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21BD
Item ID:	9302808
CU:	C477ALTWHMPNE
CU:	C477ALSCHMPNE

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.44	3.60	3.83	7.08	9.96	12.24	14.64	15.60
75	3.96	8.28	8.58	12.72	16.44	19.56	22.92	24.48
100	9.24	15.12	15.46	20.28	24.60	28.32	32.52	34.44
125	17.76	24.12	24.49	29.64	34.44	38.64	43.56	45.72
150	28.44	35.04	35.42	40.80	45.84	50.52	56.04	58.44
175	41.04	47.64	48.04	53.64	59.04	64.08	69.96	72.60
200	55.56	62.28	62.69	68.40	74.04	79.32	85.56	88.32
225	72.00	78.72	79.14	84.96	90.72	96.24	102.84	105.84
250	90.36	97.08	97.50	103.44	109.32	115.08	121.92	125.04
275	110.76	117.36	117.79	123.84	129.84	135.72	142.80	146.04
300	132.96	139.68	140.10	146.04	152.28	158.28	165.48	168.84

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.84	5.64	7.32	*2000
75	8.64	11.16	13.20	*2000
100	15.48	18.60	20.76	*1976
125	24.48	28.08	30.24	*1954
150	35.28	39.12	41.40	*1950
175	48.00	52.08	54.36	*1952
200	62.52	66.84	69.12	*1956
225	79.08	83.40	85.68	*1961
250	97.44	101.88	104.16	*1966
275	117.84	122.28	124.56	*1970
300	140.04	144.60	147.00	*1973
** Note: Design Specification Constraint*				

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	TC52
Item ID:	9315752
CU:	C33ASSTBR

PHYSICAL PROPERTIES	
R.B.S.	8,700 lbs.
C.S.A.	0.2789 sq. in.
R. (@ 25˚C)	0.0523 Ω / 1000’
R. (@ 75˚C)	0.0625 Ω / 1000’
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.684”
WEIGHT	365 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.5617 Lb/Ft
VERTICAL	1.101 Lb/Ft
TOTAL	1.536 Lb/Ft
SWING	43.14˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
519	NORMAL	733
584	EMERGENCY	775

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2400	1624	972	552	2449	1690	1063	643	2398	1655	1072	693	2217	1503	1001	696
ACTUAL SPAN (FEET)																
50	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2
60	1	1	2	4	1	1	2	3	1	1	2	3	1	1	2	3
70	1	2	3	5	1	2	3	4	1	2	3	4	1	2	3	4
80	1	2	4	6	1	2	3	5	1	2	3	5	2	2	3	5
90	2	3	5	8	2	3	4	7	2	3	4	6	2	3	4	6
100	2	3	6	10	2	3	5	9	2	3	5	8	2	4	5	8
110	3	4	7	12	3	4	6	10	3	4	6	10	3	4	7	10
120	3	5	8	14	3	5	7	12	3	5	7	11	4	5	8	11
130	4	6	10	17	4	5	9	14	4	6	9	13	4	6	9	13
140	4	7	11	19	4	6	10	17	4	6	10	15	5	7	11	15
150	5	8	13	22	5	7	12	19	5	7	11	18	6	8	12	18
160	6	9	14	25	6	8	13	22	6	8	13	20	6	9	14	20
170	7	10	16	29	6	9	15	25	7	10	15	23	7	11	16	23
180	7	11	18	32	7	10	17	28	7	11	17	26	8	12	18	25
190	8	12	20	36	8	12	19	31	8	12	18	29	9	13	20	28
200	9	13	23	40	9	13	21	34	9	13	20	32	10	15	22	31
210	10	15	25	44	10	14	23	38	10	15	23	35	11	16	24	35
220	11	16	27	48	11	16	25	41	11	16	25	38	12	18	26	38
230	12	18	30	53	12	17	27	45	12	17	27	42	13	19	29	42
240	13	19	32	57	13	19	30	49	13	19	29	46	14	21	32	45
250	14	21	35	62	14	20	32	53	14	21	32	49	15	23	34	49
260	15	23	38	67	15	22	35	58	15	22	35	53	17	25	37	53
270	17	25	41	72	16	24	38	62	17	24	37	58	18	27	40	57
280	18	26	44	78	18	25	40	67	18	26	40	62	19	29	43	62
290	19	28	47	84	19	27	43	72	19	28	43	67	21	31	46	66
300	21	30	51	89	20	29	46	77	21	30	46	71	22	33	49	71

****** Simulated with a maximum tension of 3000 lbs. ******

Supersedes 7/09 Issue – Updated item ID.

336.4 KCMIL, 18/1 STRANDING, BARE ACSR, “MERLIN” – 15 kV			
ISSUE	PAGE NUMBER		
7/15	6-119	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	TC52
Item ID:	9315752
CU:	C33ASSTBR

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	1.20	3.24	6.96	8.40	9.84	10.44	11.04
75	1.44	2.64	6.00	10.92	13.92	15.84	16.68	17.52
100	2.52	4.56	9.12	15.12	20.04	22.32	23.40	24.48
125	3.96	6.96	12.60	19.68	25.56	29.40	30.60	31.80
150	5.64	9.72	16.44	24.36	31.32	36.84	38.16	39.60
175	8.04	13.56	21.48	30.24	37.92	45.24	46.80	48.24
200	11.64	19.32	28.44	37.80	45.96	54.96	56.76	58.44
225	16.68	26.40	36.36	46.20	54.84	64.56	67.56	69.36
250	23.16	34.80	45.36	55.56	64.68	74.88	79.08	81.00
275	31.44	44.40	55.32	65.76	75.24	86.04	90.84	93.36
300	41.40	55.08	66.24	77.04	86.76	98.04	102.96	106.68

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	2.52	3.12	3.84	2291
75	5.40	6.36	6.84	2414
100	9.00	10.20	10.32	2553
125	13.32	14.64	14.28	2700
150	18.24	19.44	18.48	2849
175	24.00	25.32	23.88	*2936
200	31.32	32.76	31.08	*2948
225	39.48	41.04	39.12	*2958
250	48.60	50.28	48.24	*2965
275	58.68	60.48	58.20	*2971
300	69.72	71.52	69.24	*2976
** Note: Design Specification Constraint*				

****** Simulated with a maximum tension of 3000 lbs. ******

Supersedes 7/09 Issue – Updated item ID.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W20B
Item ID:	9316037
CU:	C33ALSTBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	6,150 lbs.	TRANSVERSE	0.555 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.2644 sq. in.	VERTICAL	1.040 Lb/Ft	514	NORMAL	725
R. (@ 25˚C)	0.0527 Ω / 1000’	TOTAL	1.479 Lb/Ft	578	EMERGENCY	766
R. (@ 75˚C)	0.0629 Ω / 1000’					
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	46.55˚			
CONDUCTOR DIAMETER	0.666”					
WEIGHT	315 lbs / 1000’					

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1444	827	483	333	1220	707	467	353	998	622	457	367	821	568	450	378
ACTUAL SPAN (FEET)																
50	1	1	2	4	1	2	3	3	1	2	3	3	1	2	3	3
60	1	2	4	5	1	2	4	5	2	3	4	5	2	3	4	5
70	2	3	5	7	2	3	5	7	2	4	5	6	3	4	5	6
80	2	4	6	9	2	4	6	9	3	5	7	8	4	5	7	8
90	3	5	8	12	3	5	8	11	4	6	8	10	5	7	9	10
100	3	6	10	14	4	7	10	13	5	8	10	13	6	8	11	13
110	4	7	12	17	5	8	12	16	6	9	13	16	7	10	13	15
120	5	8	14	20	6	10	15	19	7	11	15	19	8	12	15	18
130	6	10	16	24	7	11	17	23	8	13	17	22	10	14	18	21
140	6	11	19	28	8	13	20	26	9	15	20	25	11	16	21	25
150	7	13	22	32	9	15	23	30	11	17	23	29	13	19	24	28
160	8	15	25	36	10	17	26	34	12	20	26	33	15	21	27	32
170	10	17	28	41	11	20	29	39	14	22	30	37	17	24	30	36
180	11	19	32	46	13	22	33	44	15	25	34	42	19	27	34	41
190	12	21	35	51	14	24	37	49	17	28	37	47	21	30	38	45
200	13	23	39	57	16	27	41	54	19	31	41	52	23	33	42	50
210	15	26	43	63	17	30	45	59	21	34	46	57	25	37	46	55
220	16	28	47	69	19	33	49	65	23	37	50	62	28	41	51	61
230	17	31	52	75	21	36	54	71	25	40	55	68	30	44	56	66
240	19	33	56	82	22	39	58	77	27	44	60	74	33	48	60	72
250	21	36	61	89	24	42	63	84	30	48	65	81	36	52	66	78
260	22	39	66	96	26	46	69	91	32	52	70	87	39	57	71	85
270	24	42	71	104	28	49	74	98	35	56	75	94	42	61	77	91
280	26	46	76	111	31	53	79	105	37	60	81	101	45	66	82	98
290	28	49	82	119	33	57	85	113	40	64	87	108	48	70	88	105
300	30	52	88	128	35	61	91	121	43	69	93	116	52	75	95	113

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

336.4 KCMIL, 19 STRAND, BARE AAC, “TULIP” – 15 kV

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W20B
Item ID:	9316037
CU:	C33ALSTBR

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.72	1.80	2.04	5.40	8.76	11.16	13.80	14.88
75	1.68	3.72	4.06	8.76	13.44	17.04	20.88	22.44
100	3.12	6.36	6.79	12.84	18.60	23.28	28.20	30.24
125	5.88	11.64	12.14	19.20	25.68	31.08	36.96	39.36
150	10.56	18.72	19.27	27.00	33.96	39.96	46.56	49.44
175	18.00	27.60	28.17	36.12	43.56	50.04	57.24	60.48
200	27.84	37.92	38.51	46.80	54.48	61.32	69.12	72.60
225	39.60	49.80	50.39	58.68	66.60	73.80	82.20	85.80
250	52.92	63.00	63.60	72.00	80.16	87.60	96.36	100.20
275	67.68	77.64	78.25	86.76	95.04	102.72	111.84	115.92
300	83.88	93.72	94.33	102.84	111.24	119.16	128.52	132.84

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	3.24	4.32	5.76	1710
75	6.72	8.16	9.48	1862
100	11.04	12.84	13.92	*2000
125	17.40	19.44	20.52	*2000
150	24.96	27.36	28.44	*2000
175	34.08	36.72	37.68	*1997
200	44.52	47.40	48.36	*1994
225	56.40	59.52	60.36	*1993
250	69.72	72.84	73.80	*1992
275	84.48	87.72	88.44	*1992
300	100.56	103.80	104.64	*1993
** Note: Design Specification Constraint*				

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21C
Item ID:	9305136
CU:	

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	6,150 lbs.	TRANSVERSE	0.646 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.2644 sq. in.	VERTICAL	1.390 Lb/Ft			
R. (@ 25˚C)	0.0527 Ω / 1000’	TOTAL	1.833 Lb/Ft	425	NORMAL	593
R. (@ 75˚C)	0.0629 Ω / 1000’			519	EMERGENCY	657
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	43.31˚			
CONDUCTOR DIAMETER	0.607”					
COMPLETE DIAMETER	0.937” (Nominal)					
WEIGHT	497 lbs / 1000’					

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1215	938	713	510	1231	958	739	545	1244	977	764	577	1256	994	787	608
ACTUAL SPAN (FEET)																
50	1	2	3	4	2	3	3	4	2	3	3	4	2	3	3	4
60	2	3	5	6	3	4	5	6	3	4	5	6	4	4	5	5
70	3	5	7	8	4	5	7	8	4	6	7	8	5	6	7	7
80	4	6	9	11	5	7	9	10	6	7	9	10	6	8	9	10
90	5	8	11	14	6	9	11	13	7	9	11	13	8	10	11	12
100	6	10	13	17	7	11	13	16	9	11	13	16	10	12	14	15
110	7	12	16	20	9	13	16	19	10	14	16	19	12	14	16	18
120	9	14	19	24	11	15	19	23	12	16	19	22	14	17	19	22
130	10	16	22	29	12	18	23	27	15	19	23	26	16	20	23	26
140	12	19	26	33	14	21	26	32	17	22	26	30	19	23	27	30
150	13	22	30	38	17	24	30	36	19	25	30	35	22	27	30	34
160	15	25	34	43	19	27	34	41	22	29	35	40	25	30	35	39
170	17	28	38	49	21	31	39	47	25	33	39	45	28	34	39	44
180	19	31	43	55	24	34	43	52	28	37	44	50	32	38	44	49
190	22	35	48	61	27	38	48	58	31	41	49	56	35	43	49	55
200	24	38	53	68	29	42	54	64	35	45	54	62	39	47	54	61
210	26	42	59	75	32	47	59	71	38	50	59	69	43	52	60	67
220	29	46	64	82	36	51	65	78	42	55	65	75	47	57	65	73
230	32	51	70	89	39	56	71	85	46	60	71	82	52	63	72	80
240	35	55	77	97	42	61	77	93	50	65	78	90	56	68	78	87
250	37	60	83	106	46	66	84	101	54	71	84	97	61	74	85	95
260	40	65	90	114	50	71	90	109	59	77	91	105	66	80	91	103
270	44	70	97	123	54	77	98	117	63	83	98	113	71	86	99	111
280	47	75	104	132	58	83	105	126	68	89	106	122	76	93	106	119
290	50	81	112	142	62	89	113	135	73	95	113	131	82	100	114	128
300	54	86	120	152	66	95	120	145	78	102	121	140	88	107	122	137

Supersedes 7/17 Issue – Corrected Sag Table.

336.4 KCMIL, 19 STRAND, COMPACT AAC, 165 MIL COVERED TREE WIRE – 15 kV

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Doc. # ST.06.00.003

Std. Item:	W21C
Item ID:	9305136
CU:	

Supersedes 7/17 Issue – Updated Sag Table

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.20	2.76	5.88	9.00	11.40	13.92	15.00	15.96
75	2.76	5.64	9.96	14.04	17.52	21.24	22.80	24.24
100	6.12	11.40	16.68	21.48	25.56	30.12	32.04	33.96
125	12.24	19.20	24.96	30.24	34.92	40.20	42.48	44.64
150	21.00	28.80	34.80	40.56	45.72	51.60	54.12	56.64
175	32.04	40.08	46.32	52.44	57.84	64.32	67.08	69.84
200	45.00	53.16	59.52	65.76	71.64	78.36	81.48	84.36
225	59.76	67.80	74.40	80.88	86.88	94.08	97.32	100.44
250	76.20	84.24	90.84	97.56	103.80	111.24	114.60	117.96
275	94.32	102.36	109.08	115.80	122.28	129.96	133.56	136.92
300	114.12	122.28	129.00	135.84	142.44	150.36	154.08	157.56

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.84	5.16	6.36	1771
75	7.92	9.6	10.68	1955
100	14.28	16.44	17.52	1932
125	22.32	24.96	26.04	1927
150	32.04	34.92	36	1930
175	43.56	46.68	47.64	1936
200	56.64	59.88	60.84	1943
225	71.4	74.88	75.72	1950
250	87.96	91.44	92.28	1956
275	106.2	109.8	110.52	1961
300	126.12	129.72	130.56	1965
** Note: Design Specification Constraint*				

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W20A
Item ID:	9314544
CU:	C10AAACBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4,280 lbs.	TRANSVERSE	0.466 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0968 sq. in.	VERTICAL	0.673 Lb/Ft			
R. (@ 25˚C)	0.166 Ω / 1000’	TOTAL	1.119 Lb/Ft	256	NORMAL	354
R. (@ 75˚C)	0.195 Ω / 1000’			286	EMERGENCY	374
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	59.98˚			
CONDUCTOR DIAMETER	0.398”					
WEIGHT	115 lbs / 1000’					

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1164	878	638	408	1173	887	650	425	1181	897	662	442	1190	907	675	459
ACTUAL SPAN (FEET)																
50	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
60	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1
70	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2
80	1	1	2	3	1	1	2	3	1	1	2	3	1	1	2	2
90	1	2	2	3	1	2	2	3	1	2	2	3	1	2	2	3
100	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
110	2	2	3	5	2	2	3	5	2	2	3	5	2	2	3	5
120	2	3	4	6	2	3	4	6	2	3	4	6	2	3	4	5
130	2	3	5	7	3	3	5	7	2	3	4	7	2	3	4	6
140	3	4	5	8	3	4	5	8	3	4	5	8	3	4	5	7
150	3	4	6	10	3	4	6	9	3	4	6	9	3	4	6	8
160	4	5	7	11	4	5	7	10	4	5	7	10	4	5	7	10
170	4	6	8	12	4	6	8	12	4	6	8	11	4	6	7	11
180	5	6	9	14	5	6	9	13	5	6	9	13	5	6	8	12
190	5	7	10	15	5	7	10	15	5	7	9	14	5	7	9	14
200	6	8	11	17	6	8	11	16	6	8	11	16	6	8	10	15
210	6	9	12	19	7	9	12	18	6	9	12	17	6	8	11	17
220	7	10	13	20	7	10	13	20	7	9	13	19	7	9	12	18
230	8	10	14	22	8	10	14	21	8	10	14	21	8	10	13	20
240	8	11	15	24	9	11	15	23	8	11	15	23	8	11	15	22
250	9	12	17	26	9	12	17	25	9	12	16	24	9	12	16	23
260	10	13	18	29	10	13	18	27	10	13	18	26	10	13	17	25
270	11	14	20	31	11	14	19	30	11	14	19	29	10	14	19	27
280	11	15	21	33	12	15	21	32	11	15	21	31	11	15	20	29
290	12	17	23	36	13	17	22	34	12	16	22	33	12	16	21	32
300	13	18	24	38	13	18	24	36	13	17	24	35	13	17	23	34

Supersedes 7/15 Issue – Updated RBS, load properties, sags, and tensions.

1/0, 7 STRAND, BARE 6201-T81 AAAC, “AZUSA” – 15 kV

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W20A
Item ID:	9314544
CU:	C10AAACBR

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.36	0.60	0.63	1.08	3.36	7.32	10.80	12.12
75	0.96	1.32	1.39	2.40	6.12	11.40	16.32	18.36
100	1.56	2.40	2.52	4.20	9.24	15.72	22.08	24.72
125	2.52	3.60	3.78	6.36	12.60	20.16	27.96	31.08
150	3.60	5.28	5.52	8.88	16.32	24.96	33.96	37.68
175	4.92	7.08	7.39	11.76	20.28	29.88	40.20	44.40
200	6.48	9.24	9.62	14.88	24.60	35.04	46.44	51.24
225	8.16	11.64	12.08	18.24	28.92	40.32	52.92	58.20
250	10.08	14.28	14.79	21.96	33.60	45.84	59.52	65.28
275	12.24	17.16	17.74	25.92	38.40	51.48	66.12	72.36
300	15.48	21.96	22.67	32.64	46.44	60.12	75.48	81.96

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.60	3.24	2.04	1155
75	7.68	6.72	4.32	1237
100	12.60	11.16	7.32	1328
125	18.48	16.20	10.68	1421
150	24.96	21.84	14.52	1514
175	32.04	27.84	18.72	1605
200	39.60	34.44	23.16	1696
225	47.64	41.28	27.96	1784
250	56.16	48.60	33.12	1870
275	65.04	56.28	38.40	1954
300	75.60	65.76	46.32	*2000
** Note: Design Specification Constraint*				

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21NA
Item ID:	9313250[E]
CU:	C1/0ALPESCNE
CU:	C10ALSCHMPNE

PHYSICAL PROPERTIES	
R.B.S.	4,280 lbs.
C.S.A.	0.0968 sq. in.
R. (@ 25˚C)	0.166 Ω / 1000’
R. (@ 75˚C)	0.195 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.398”
COMPLETE DIAMETER	1.028” (Nominal)
WEIGHT	424 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.676 Lb/Ft
VERTICAL	1.374 Lb/Ft
TOTAL	1.831 Lb/Ft
SWING	50.48˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
200	NORMAL	280
244	EMERGENCY	310

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1259	998	794	617	1273	1022	828	661	1281	1042	858	701	1168	956	801	672
ACTUAL SPAN (FEET)																
50	1	2	2	3	1	2	2	2	1	2	2	2	1	2	2	2
60	2	2	3	4	2	2	3	3	2	2	3	3	2	2	3	3
70	2	3	4	5	2	3	4	5	2	3	4	4	3	3	4	5
80	3	4	5	7	3	4	5	6	3	4	5	6	3	4	5	6
90	4	5	6	8	4	5	6	8	4	5	6	7	4	5	6	8
100	5	6	8	10	5	6	8	10	5	6	7	9	5	7	8	9
110	6	8	10	12	6	8	9	12	6	7	9	11	7	8	10	11
120	7	9	12	15	7	9	11	14	7	9	11	13	8	10	11	14
130	9	11	13	17	8	11	13	16	8	10	13	15	9	11	13	16
140	10	13	16	20	10	12	15	19	10	12	15	18	11	13	16	19
150	11	14	18	23	11	14	17	22	11	14	17	20	12	15	18	21
160	13	16	20	26	13	16	20	25	13	16	19	23	14	17	20	24
170	15	19	23	30	14	18	22	28	14	18	21	26	16	19	23	27
180	16	21	26	33	16	20	25	31	16	20	24	29	18	22	26	31
190	18	23	29	37	18	23	28	35	18	22	27	33	20	24	29	34
200	20	26	32	41	20	25	31	38	20	25	30	36	22	27	32	38
210	22	28	35	45	22	28	34	42	22	27	33	40	24	29	35	42
220	25	31	39	50	24	30	37	46	24	30	36	44	26	32	38	46
230	27	34	42	54	27	33	41	51	26	32	39	48	29	35	42	50
240	29	37	46	59	29	36	44	55	29	35	43	52	31	38	46	55
250	32	40	50	64	31	39	48	60	31	38	46	57	34	42	50	59
260	34	43	54	70	34	42	52	65	34	41	50	61	37	45	54	64
270	37	47	58	75	37	45	56	70	36	45	54	66	40	49	58	69
280	40	50	63	81	39	49	60	75	39	48	58	71	43	52	62	74
290	43	54	67	87	42	52	65	81	42	52	62	76	46	56	67	80
300	46	58	72	93	45	56	69	86	45	55	67	82	49	60	72	85

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

1/0, 7 STRAND, CONCENTRIC ROUND 6201-T81 AAAC,
315 MIL COVERED TREE WIRE – 35 kV

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W21NA
Item ID:	9313250[E]
CU:	C1/0ALPESCNE
CU:	C10ALSCHMPNE

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.44	2.16	2.25	3.48	5.88	8.64	11.52	12.72
75	3.36	4.68	4.84	7.08	10.56	14.04	18.12	19.80
100	6.00	8.16	8.38	11.52	15.84	20.16	25.08	27.24
125	9.24	12.36	12.65	16.68	21.72	26.76	32.64	35.16
150	13.32	17.40	17.74	22.56	28.32	33.96	40.68	43.56
175	18.24	23.16	23.56	29.16	35.52	41.76	49.20	52.44
200	26.04	32.40	32.86	39.24	46.20	52.92	60.84	64.32
225	37.68	45.12	45.62	52.68	60.00	66.96	75.12	78.84
250	52.32	60.36	60.88	68.16	75.72	82.80	91.32	95.16
275	69.48	77.76	78.30	85.80	93.36	100.56	109.32	113.16
300	89.16	97.56	98.09	105.48	113.16	120.48	129.24	133.32

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	5.52	5.64	4.80	1252
75	11.04	11.16	9.24	1395
100	17.88	17.76	14.64	1536
125	25.68	25.20	20.76	1672
150	34.44	33.36	27.60	1800
175	43.92	42.36	35.16	1921
200	55.80	54.00	45.72	1972
225	70.20	68.16	59.40	1986
250	86.40	84.12	74.88	1995
275	104.28	102.00	92.52	*2000
300	124.20	121.80	112.20	*2000
** Note: Design Specification Constraint*				

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W20CA
Item ID:	9302832
CU:	C1/0ALHMPESTNE
CU:	C10ALSCPE1NE

PHYSICAL PROPERTIES	
R.B.S.	4,280 lbs.
C.S.A.	0.0968 sq. in.
R. (@ 25˚C)	0.166 Ω / 1000’
R. (@ 75˚C)	0.195 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.398”
COMPLETE DIAMETER	0.728” (Nominal)
WEIGHT	255 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.576 Lb/Ft
VERTICAL	1.019 Lb/Ft
TOTAL	1.470 Lb/Ft
SWING	54.99˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
214	NORMAL	296
259	EMERGENCY	327

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1215	938	713	510	1231	958	739	545	1244	977	764	577	1256	994	787	608
ACTUAL SPAN (FEET)																
50	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2
60	1	1	2	3	1	1	2	3	1	1	2	2	1	1	2	2
70	2	2	3	4	2	2	3	3	1	2	2	3	1	2	2	3
80	2	3	3	5	2	3	3	5	2	3	3	4	2	2	3	4
90	3	3	4	6	3	3	4	6	2	3	4	5	2	3	4	5
100	3	4	5	8	3	4	5	7	3	4	5	7	3	4	5	6
110	4	5	7	9	4	5	6	9	4	5	6	8	4	5	6	8
120	5	6	8	11	4	6	7	10	4	6	7	10	4	6	7	9
130	5	7	9	13	5	7	9	12	5	7	8	11	5	7	8	11
140	6	8	11	15	6	8	10	14	6	8	10	13	6	8	10	12
150	7	9	12	17	7	9	12	16	7	9	11	15	7	9	11	14
160	8	10	14	19	8	10	13	18	8	10	13	17	8	10	12	16
170	9	12	16	22	9	12	15	20	9	11	14	19	9	11	14	18
180	10	13	17	24	10	13	17	23	10	13	16	21	10	12	16	20
190	11	15	19	27	11	15	19	25	11	14	18	24	11	14	18	23
200	13	16	22	30	12	16	21	28	12	16	20	26	12	15	19	25
210	14	18	24	33	14	18	23	31	13	17	22	29	13	17	21	28
220	15	20	26	36	15	19	25	34	15	19	24	32	15	19	24	30
230	17	22	28	40	16	21	27	37	16	21	27	35	16	20	26	33
240	18	24	31	43	18	23	30	41	18	23	29	38	18	22	28	36
250	20	26	34	47	19	25	32	44	19	24	31	41	19	24	30	39
260	21	28	36	51	21	27	35	48	21	26	34	45	21	26	33	43
270	23	30	39	55	23	29	38	51	22	29	37	48	22	28	35	46
280	25	32	42	59	24	32	41	55	24	31	39	52	24	30	38	49
290	26	34	45	63	26	34	44	59	26	33	42	56	26	32	41	53
300	28	37	48	68	28	36	47	63	28	35	45	60	28	35	44	57

Supersedes 7/15 Issue – Updated RBS, loading properties, sags and tensions.

1/0, 7 STRAND, CONCENTRIC ROUND 6201-T81 AAAC,
165 MIL COVERED TREE WIRE – 15 kV

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Doc. # ST.06.00.003

Std. Item:	W20CA
Item ID:	9302830
CU:	C1/0ALHMPESTNE
CU:	C10ALSCPE1NE

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.84	1.32	1.38	2.28	4.80	7.92	11.16	12.36
75	2.04	2.88	3.01	4.80	8.52	12.72	17.16	18.96
100	3.60	5.04	5.24	8.04	12.84	17.88	23.52	25.80
125	5.64	7.80	8.07	11.88	17.52	23.40	30.12	32.88
150	8.04	11.16	11.49	16.08	22.68	29.40	37.08	40.32
175	10.92	14.88	15.28	20.88	28.32	35.64	44.28	48.00
200	14.28	19.20	19.66	26.16	34.20	42.36	51.84	55.92
225	18.24	24.12	24.64	31.92	40.80	49.56	59.76	64.32
250	25.80	33.72	34.34	42.96	52.56	61.68	72.24	77.04
275	36.96	46.68	47.36	56.88	66.72	75.96	86.88	91.68
300	51.00	61.92	62.62	72.48	82.44	91.80	102.84	107.88

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.56	4.56	3.60	1202
75	9.48	9.12	7.08	1317
100	15.36	14.64	11.40	1436
125	22.20	21.00	16.32	1553
150	29.76	27.96	21.72	1668
175	38.04	35.52	27.72	1778
200	46.92	43.68	34.08	1885
225	56.40	52.32	41.04	1984
250	69.00	64.56	52.44	*2000
275	83.64	78.84	66.36	*2000
300	99.48	94.44	81.72	*2000
** Note: Design Specification Constraint*				

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Doc. # ST. 06.00.004

Non-Standard Overhead Distribution Conductors

Maintenance Only

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	9302815[E]
CU:	

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	11400 lbs.	**TRANSVERSE**	0.6387 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.4995 sq. in.	**VERTICAL**	1.479 Lb/Ft			
R. (@ 25˚C)	0.0282 Ω / 1000’	**TOTAL**	1.911 Lb/Ft	766	**NORMAL**	1095
R. (@ 75˚C)	0.0335 Ω / 1000’			866	**EMERGENCY**	1159
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	**SWING**	37.55˚			
CONDUCTOR DIAMETER	0.918”					
WEIGHT	597 lbs / 1000’					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	1.32	4.44	7.80	10.56	12.72	15.12	16.08	17.04
75	4.08	9.48	13.68	17.28	20.28	23.64	25.08	26.40
100	9.48	16.20	21.00	25.32	29.04	33.12	34.92	36.72
125	17.52	24.60	29.76	34.68	38.88	43.80	45.96	48.00
150	27.36	34.68	40.20	45.48	50.28	55.68	58.20	60.48
175	39.12	46.56	52.32	57.84	63.00	69.00	71.64	74.28
200	52.68	60.12	66.00	71.88	77.40	83.76	86.64	89.52
225	67.92	75.48	81.60	87.60	93.36	100.08	103.20	106.20
250	85.08	92.64	98.76	105.00	111.00	118.08	121.32	124.44
275	103.92	111.48	117.84	124.20	130.32	137.64	141.00	144.36
300	124.68	132.24	138.60	145.08	151.32	158.88	162.36	165.84

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-20**	**0**	**15**	**-20**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	3.60	5.88	8.04	*1994
75	8.28	11.40	13.92	*1947
100	14.76	18.60	21.24	*1936
125	23.16	27.36	30.12	*1939
150	33.12	37.68	40.68	*1945
175	45.00	49.68	52.80	*1953
200	58.56	63.48	66.60	*1959
225	73.92	78.96	82.08	*1965
250	91.08	96.24	99.36	*1970
275	110.04	115.20	118.44	*1974
300	130.68	135.96	139.20	*1977
** Note: Design Specification Constraint*				

Supersedes 1/07 Issue – Added item ID.

636.0 KCMIL, 37 STRAND, BARE AAC, “ORCHID”
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	9302815[E]
CU:	C636ALSTPENE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	11,400 lbs.	TRANSVERSE	0.7022 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.5278 sq. in.	VERTICAL	1.745 Lb/Ft			
R. (@ 25˚C)	0.0282 Ω / 1000'	TOTAL	2.181 Lb/Ft	627	NORMAL	985
R. (@ 75˚C)	0.0335 Ω / 1000'			777	EMERGENCY	1072
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	36.64˚			
CONDUCTOR DIAMETER	0.918"					
COMPLETE DIAMETER	1.108"					
WEIGHT	745 lbs / 1000'					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.92	5.40	8.52	11.04	13.08	15.36	16.32	17.28
75	5.76	11.04	14.88	18.24	21.12	24.36	25.68	27.00
100	12.72	18.72	23.04	27.00	30.48	34.44	36.24	37.92
125	21.96	28.20	32.88	37.32	41.40	45.96	48.00	49.92
150	33.24	39.72	44.64	49.44	53.88	59.04	61.32	63.48
175	46.68	53.16	58.32	63.36	68.16	73.68	76.20	78.72
200	62.16	68.64	73.92	79.20	84.24	90.24	92.88	95.52
225	79.56	86.16	91.56	97.08	102.24	108.48	111.36	114.12
250	99.12	105.72	111.24	116.76	122.16	128.64	131.64	134.52
275	120.60	127.32	132.84	138.60	144.12	150.84	153.84	156.96
300	144.24	150.96	156.60	162.36	168.00	174.84	178.08	181.20

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.20	6.60	8.64	*1955
75	9.60	12.72	15.12	*1924
100	17.04	20.76	23.28	*1924
125	26.40	30.48	33.24	*1934
150	37.92	42.24	45.00	*1944
175	51.36	55.92	58.68	*1953
200	66.84	71.52	74.40	*1961
225	84.36	89.16	92.04	*1967
250	103.92	108.72	111.72	*1972
275	125.52	130.44	133.44	*1976
300	149.16	154.08	157.08	*1979

** Note: Design Specification Constraint*

Supersedes 1/07 Issue – Updated item ID.

636.0 KCMIL, 37 STRAND, AAC, 95 MIL HDPE COVERING, "TANGERINE"
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

PHYSICAL PROPERTIES	
R.B.S.	5535 lbs.
C.S.A.	0.3552 sq. in.
R. (@ 25˚C)	0.0528 Ω / 1000'
R. (@ 75˚C)	0.0630 Ω / 1000'
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.666"
COMPLETE DIAMETER	1.006"
WEIGHT	513 lbs / 1000'

LOADING PROPERTIES	
TRANSVERSE	0.6693 Lb/Ft
VERTICAL	1.450 Lb/Ft
TOTAL	1.897 Lb/Ft
SWING	44.44˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
396	NORMAL	626
490	EMERGENCY	680

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.44	4.20	7.56	10.32	12.48	14.88	15.84	16.80
75	3.12	7.56	12.00	15.96	19.08	22.56	24.12	25.44
100	6.96	13.44	18.60	23.28	27.24	31.56	33.48	35.28
125	13.92	21.48	27.00	32.16	36.72	41.88	44.04	46.20
150	23.76	31.44	37.32	42.84	47.88	53.52	56.04	58.44
175	35.40	43.32	49.32	55.20	60.48	66.72	69.48	72.12
200	48.96	56.76	63.00	69.00	74.64	81.24	84.24	87.12
225	64.20	72.12	78.36	84.60	90.48	97.44	100.56	103.68
250	81.24	89.04	95.52	101.88	108.00	115.20	118.56	121.68
275	100.08	107.88	114.36	120.84	127.08	134.64	138.00	141.36
300	120.60	128.52	135.00	141.60	147.96	155.76	159.24	162.72

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.08	6.00	7.80	1733
75	8.16	10.56	12.48	1969
100	14.28	17.28	19.32	*2000
125	22.32	25.68	27.84	*1995
150	32.28	36.12	38.16	*1981
175	44.16	48.12	50.28	*1976
200	57.60	61.80	63.96	*1976
225	72.96	77.28	79.44	*1977
250	90.00	94.32	96.60	*1978
275	108.84	113.28	115.44	*1980
300	129.36	133.92	136.08	*1982

** Note: Design Specification Constraint*

Supersedes 7/10 Issue – Deleted obsolete item ID.

336.4 KCMIL, 19 STRAND, AAC, 170 MIL HDPE COVERING, "ANONA"
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	5790 lbs.	TRANSVERSE	0.6084 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.2845 sq. in.	VERTICAL	1.242 Lb/Ft			
R. (@ 25˚C)	0.0528 Ω / 1000'	TOTAL	1.683 Lb/Ft	432	NORMAL	665
R. (@ 75˚C)	0.0630 Ω / 1000'			530	EMERGENCY	723
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	44.72˚			
CONDUCTOR DIAMETER	0.666"					
COMPLETE DIAMETER	0.826"					
WEIGHT	417 lbs / 1000'					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	2.88	6.36	9.36	11.76	14.28	15.24	16.32
75	2.40	5.64	10.32	14.52	18.00	21.60	23.16	24.60
100	4.68	9.72	15.36	20.52	24.84	29.52	31.56	33.48
125	9.36	16.80	23.04	28.80	33.72	39.12	41.52	43.80
150	16.92	25.56	32.16	38.28	43.68	49.80	52.56	55.08
175	27.00	35.88	42.72	49.20	55.08	61.80	64.68	67.56
200	38.88	47.88	54.84	61.68	67.80	75.00	78.12	81.24
225	52.32	61.32	68.52	75.48	81.96	89.52	92.88	96.24
250	67.44	76.44	83.64	90.84	97.56	105.48	109.08	112.44
275	84.12	93.12	100.44	107.76	114.60	122.88	126.60	130.20
300	102.36	111.36	118.68	126.12	133.20	141.72	145.56	149.28

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.72	5.16	6.72	1688
75	7.56	9.48	10.92	1876
100	12.60	14.88	16.32	*1995
125	19.92	22.68	24.12	*1975
150	28.92	31.92	33.24	*1967
175	39.36	42.60	44.04	*1965
200	51.36	54.84	56.16	*1966
225	64.92	68.52	69.84	*1969
250	80.16	83.76	85.08	*1971
275	96.84	100.56	101.88	*1974
300	115.08	118.92	120.24	*1977
** Note: Design Specification Constraint*				

336.4 KCMIL, 19 STRAND, AAC, 80 MIL HDPE COVERING, "CRABAPPLE"
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	9315425
CU:	C33ALSTPER/T

PHYSICAL PROPERTIES	
R.B.S.	5535 lbs.
C.S.A.	0.2757 sq. in.
R. (@ 25˚C)	0.0528 Ω / 1000’
R. (@ 75˚C)	0.0630 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.666”
COMPLETE DIAMETER	0.786”
WEIGHT	394 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.5949 Lb/Ft
VERTICAL	1.194 Lb/Ft
TOTAL	1.634 Lb/Ft
SWING	44.93˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
441	NORMAL	675
541	EMERGENCY	735

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	2.88	6.48	9.48	11.76	14.28	15.36	16.32
75	2.40	5.64	10.32	14.64	18.00	21.60	23.16	24.60
100	4.32	9.00	14.76	20.04	24.48	29.16	31.20	33.12
125	8.40	15.60	22.08	27.96	33.00	38.52	40.92	43.20
150	15.36	24.12	30.84	37.20	42.72	48.96	51.72	54.36
175	24.84	34.08	41.16	47.88	53.88	60.60	63.60	66.48
200	36.36	45.72	52.92	59.88	66.24	73.56	76.80	79.92
225	49.44	58.80	66.12	73.32	79.92	87.72	91.20	94.44
250	64.08	73.44	80.88	88.20	95.16	103.20	106.92	110.40
275	80.28	89.64	97.08	104.64	111.72	120.12	123.96	127.56
300	98.04	107.28	114.84	122.52	129.72	138.48	142.32	146.16

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	3.72	5.28	6.72	1622
75	7.68	9.48	11.04	1807
100	12.36	14.40	15.72	1990
125	19.32	21.96	23.16	*1978
150	27.96	30.84	32.16	*1970
175	38.16	41.28	42.48	*1968
200	49.80	53.16	54.36	*1969
225	63.00	66.48	67.56	*1971
250	77.76	81.24	82.44	*1973
275	93.96	97.56	98.64	*1976
300	111.72	115.44	116.40	*1978
** Note: Design Specification Constraint*				

Supersedes 7/10 Issue – Updated item ID.

336.4 KCMIL, 19 STRAND, AAC, 60 MIL HDPE COVERING, “ANONA”
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	8350 lbs.	TRANSVERSE	0.5205 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1939 sq. in.	VERTICAL	0.952 Lb/Ft	360	NORMAL	504
R. (@ 25˚C)	0.0822 Ω / 1000'	TOTAL	1.385 Lb/Ft	399	EMERGENCY	527
R. (@ 75˚C)	0.1160 Ω / 1000'					
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	44.05˚			
CONDUCTOR DIAMETER	0.563"					
WEIGHT	291 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.96	1.92	3.96	5.40	7.20	8.04	8.88
75	1.44	2.28	4.68	8.04	9.96	12.48	13.56	14.64
100	2.76	4.80	8.88	13.32	15.72	18.60	20.04	21.24
125	4.92	8.76	14.52	19.80	22.56	25.92	27.48	28.92
150	8.64	14.76	21.48	27.36	30.48	34.20	35.88	37.56
175	14.40	22.56	29.88	36.24	39.60	43.56	45.48	47.28
200	22.68	32.04	39.48	46.32	49.80	54.12	56.16	58.08
225	33.24	42.96	50.52	57.60	61.32	65.88	67.92	69.96
250	45.48	55.20	62.88	70.20	74.04	78.84	81.00	83.16
275	59.16	68.76	76.44	84.00	87.96	92.88	95.16	97.44
300	74.16	83.64	91.44	99.00	103.20	108.24	110.64	112.92

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	2.64	2.76	2.52	*2000
75	5.88	6.24	5.76	*2000
100	10.44	10.92	10.20	*2000
125	16.20	16.92	16.08	*2000
150	23.40	24.24	23.16	*2000
175	31.80	32.76	31.56	*2000
200	41.52	42.60	41.28	*2000
225	52.68	53.64	52.32	*2000
250	65.04	66.12	64.68	*2000
275	78.60	79.80	78.36	*2000
300	93.60	94.80	93.24	*2000
** Note: Design Specification Constraint*				

Supersedes 1/07 Issue - Corrected unloaded sags for 200' and 225' spans.

4/0, 6/1 STRANDING, BARE ACSR, "PENGUIN"
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 1/07 Issue – Corrected unloaded sags for 200' and 225' spans.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	8560 lbs.	TRANSVERSE	0.5213 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1939 sq. in.	VERTICAL	0.893 Lb/Ft	396	NORMAL	555
R. (@ 25˚C)	0.0831 Ω / 1000'	TOTAL	1.334 Lb/Ft	445	EMERGENCY	587
R. (@ 75˚C)	0.0973 Ω / 1000'					
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	50.53˚			
CONDUCTOR DIAMETER	0.563"					
WEIGHT	232 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.48	0.72	1.44	4.80	8.28	11.52	12.72	13.92
75	1.08	1.80	3.72	8.76	13.44	17.88	19.80	21.48
100	2.04	3.48	7.20	13.80	19.32	24.96	27.36	29.52
125	3.60	6.36	12.24	19.80	26.16	32.88	35.64	38.16
150	6.00	10.92	18.84	27.00	34.08	41.52	44.64	47.64
175	9.72	17.64	26.64	35.40	42.96	51.12	54.60	57.96
200	15.60	26.28	35.88	45.00	52.92	61.68	65.52	69.12
225	24.36	36.60	46.44	55.80	64.08	73.32	77.40	81.24
250	35.52	48.36	58.32	67.80	76.32	86.04	90.36	94.56
275	48.60	61.44	71.40	81.00	89.76	99.96	104.40	108.72
300	63.00	75.72	85.80	95.52	104.52	114.96	119.64	124.08

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	2.52	2.64	2.16	*2000
75	5.64	5.88	5.04	*2000
100	9.96	10.32	9.24	*2000
125	15.60	16.08	14.76	*2000
150	22.56	23.04	21.48	*2000
175	30.60	31.20	29.52	*2000
200	40.08	40.68	38.88	*2000
225	50.64	51.36	49.44	*2000
250	62.52	63.24	61.32	*2000
275	75.72	76.44	74.40	*2000
300	90.12	90.84	88.80	*2000
** Note: Design Specification Constraint*				

4/0, 7 STRAND, BARE AAAC, "ALLIANCE"
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W18B
Item ID:	9315759[Y]
CU:	C40ALSTBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	3830 lbs.	TRANSVERSE	0.5073 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1663 sq. in.	VERTICAL	0.835 Lb/Ft			
R. (@ 25˚C)	0.0835 Ω / 1000'	TOTAL	1.277 Lb/Ft	383	NORMAL	535
R. (@ 75˚C)	0.0999 Ω / 1000'			429	EMERGENCY	565
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	52.73˚			
CONDUCTOR DIAMETER	0.522"					
WEIGHT	199 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.72	2.04	5.64	8.88	11.40	13.92	15.00	16.08
75	1.80	4.20	9.12	13.80	17.40	21.12	22.68	24.12
100	3.12	6.96	13.08	18.84	23.40	28.32	30.48	32.40
125	4.92	10.08	17.28	24.12	29.76	35.76	38.40	40.80
150	6.96	13.56	21.72	29.64	36.24	43.32	46.32	49.20
175	9.60	17.40	26.52	35.40	42.84	51.00	54.60	57.84
200	13.32	23.04	33.00	42.48	50.76	59.76	63.72	67.44
225	21.00	33.12	43.44	53.16	61.68	71.28	75.48	79.44
250	31.68	44.88	55.32	65.16	73.92	83.88	88.32	92.52
275	44.64	57.96	68.28	78.24	87.36	97.68	102.24	106.68
300	59.16	72.36	82.68	92.76	101.88	112.56	117.36	121.92

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.20	5.04	6.12	1149
75	8.28	9.36	10.08	1294
100	13.32	14.28	14.52	1437
125	18.96	19.68	19.20	1575
150	25.32	25.68	24.24	1706
175	32.04	32.04	29.64	1831
200	3.33	3.31	3.05	*1915
225	4.22	4.19	3.92	*1915
250	5.21	5.18	4.90	*1915
275	6.31	6.27	5.99	*1915
300	7.51	7.47	7.18	*1915

** Note: Design Specification Constraint*

4/0, 7 STRAND, BARE AAC, "OXLIP"
MAINTENANCE ONLY

ISSUE	PAGE NUMBER		
7/15	6-208	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Supersedes 7/10 Issue – Updated item ID.

Copyright 2010 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 1/07 Issue – Corrected unloaded sags for 200' and 225' spans.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	3445 lbs.	TRANSVERSE	0.5475 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1776 sq. in.	VERTICAL	0.961 Lb/Ft	331	NORMAL	501
R. (@ 25˚C)	0.0835 Ω / 1000'	TOTAL	1.406 Lb/Ft	404	EMERGENCY	545
R. (@ 75˚C)	0.1000 Ω / 1000'					
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	51.98˚			
CONDUCTOR DIAMETER	0.522"					
COMPLETE DIAMETER	0.642"					
WEIGHT	251 lbs / 1000'					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	3.24	6.72	9.72	12.00	14.52	15.48	16.44
75	2.40	6.00	10.80	15.00	18.36	21.96	23.40	24.84
100	4.32	9.48	15.24	20.52	24.84	29.52	31.56	33.48
125	6.84	13.32	20.16	26.28	31.56	37.32	39.84	42.12
150	10.56	18.84	26.28	33.36	39.36	46.08	48.96	51.60
175	18.48	28.32	36.24	43.56	49.92	57.24	60.36	63.36
200	29.40	39.72	47.64	55.20	61.92	69.60	73.08	76.32
225	42.36	52.56	60.60	68.28	75.36	83.52	87.12	90.60
250	57.00	67.08	75.12	82.92	90.24	98.64	102.48	106.08
275	73.20	83.16	91.20	99.12	106.56	115.32	119.28	123.12
300	90.96	100.80	108.72	116.76	124.32	133.32	137.40	141.36

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.68	6.00	7.20	1118
75	9.24	10.56	11.64	1289
100	14.52	15.96	16.56	1450
125	20.64	21.84	21.84	1600
150	27.84	29.04	28.44	*1703
175	37.80	39.12	38.40	*1707
200	49.32	50.64	49.92	*1711
225	62.40	63.84	63.00	*1713
250	76.92	78.36	77.52	*1715
275	93.00	94.56	93.60	*1716
300	110.64	112.20	111.24	*1717

** Note: Design Specification Constraint*

4/0, 7 STRAND, AAC, 60 MIL PE COVERING, "OLIVE"
MAINTENANCE ONLY

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	8560 lbs.	TRANSVERSE	0.5604 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1939 sq. in.	VERTICAL	1.043 Lb/Ft			
R. (@ 25˚C)	0.0831 Ω / 1000'	TOTAL	1.484 Lb/Ft	337	NORMAL	512
R. (@ 75˚C)	0.0973 Ω / 1000'			412	EMERGENCY	557
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	48.05˚			
CONDUCTOR DIAMETER	0.563"					
COMPLETE DIAMETER	0.683"					
WEIGHT	307 lbs / 1000'					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.96	1.92	5.28	8.52	11.64	12.96	14.04
75	1.44	2.40	4.80	9.60	13.92	18.24	20.04	21.72
100	2.88	4.92	9.12	15.12	20.28	25.68	27.96	30.00
125	5.04	8.88	15.00	21.84	27.72	34.08	36.72	39.12
150	8.64	15.00	22.44	29.88	36.24	43.32	46.32	49.20
175	14.40	23.16	31.32	39.12	46.08	53.76	57.00	60.24
200	22.92	33.24	41.76	49.80	57.00	65.28	68.88	72.24
225	33.84	44.76	53.52	61.80	69.36	78.00	81.84	85.44
250	46.80	57.96	66.60	75.12	82.92	92.04	96.00	99.84
275	61.44	72.48	81.24	89.88	97.92	107.28	111.48	115.44
300	77.52	88.44	97.20	105.96	114.12	123.84	128.16	132.36

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	2.76	3.00	2.76	*1999
75	6.24	6.72	6.12	*2000
100	11.16	11.76	10.92	*2000
125	17.40	18.24	17.16	*2000
150	25.08	26.04	24.84	*2000
175	34.08	35.28	33.84	*2000
200	44.52	45.84	44.28	*2000
225	56.40	57.72	56.04	*2000
250	69.60	71.04	69.36	*2000
275	84.24	85.68	83.88	*2000
300	100.32	101.76	99.96	*2000

** Note: Design Specification Constraint*

Supersedes 7/10 Issue - Corrected description in title block to " AAAC. 225' spans.

4/0, 7 STRAND, AAAC, 60 MIL PE COVERING, "PLANETREE"
MAINTENANCE ONLY

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	nationalgrid
7/18	6-210		

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 06.00.004

Supersedes 1/07 Issue – Corrected unloaded sags for 200' and 225' spans.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	3620 lbs.	TRANSVERSE	0.5451 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1678 sq. in.	VERTICAL	0.952 Lb/Ft	330	NORMAL	499
R. (@ 25˚C)	0.0838 Ω / 1000'	TOTAL	1.397 Lb/Ft	402	EMERGENCY	543
R. (@ 75˚C)	0.1000 Ω / 1000'					
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	51.87˚			
CONDUCTOR DIAMETER	0.512"					
COMPLETE DIAMETER	0.632"					
WEIGHT	248 lbs / 1000'					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	2.52	6.00	9.12	11.52	14.04	15.12	16.08
75	2.28	5.16	9.84	14.16	17.64	21.36	22.92	24.36
100	4.08	8.40	14.04	19.44	23.88	28.80	30.84	32.76
125	6.48	12.12	18.72	25.08	30.48	36.36	38.88	41.28
150	9.24	16.20	23.76	31.08	37.32	44.28	47.16	50.04
175	13.44	22.08	30.36	38.28	45.36	53.04	56.40	59.64
200	21.96	32.40	41.04	49.32	56.64	64.80	68.52	71.88
225	33.48	44.52	53.28	61.68	69.24	77.88	81.72	85.44
250	47.16	58.20	66.96	75.48	83.28	92.28	96.24	100.08
275	62.40	73.44	82.08	90.72	98.64	108.00	112.08	116.16
300	79.32	90.12	98.76	107.40	115.44	125.04	129.36	133.56

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.68	5.64	6.60	1129
75	9.12	10.20	10.80	1287
100	14.52	15.60	15.60	1439
125	20.64	21.48	20.76	1582
150	27.48	27.96	26.40	1717
175	35.40	35.76	33.48	*1810
200	46.32	46.68	44.16	*1810
225	58.68	58.92	56.40	*1810
250	72.36	72.72	70.08	*1810
275	87.60	87.96	85.32	*1810
300	104.28	104.64	101.88	*1810
** Note: Design Specification Constraint*				

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	9315758
CU:	C10ASSTBRRLR/T

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4380 lbs.	TRANSVERSE	0.4655 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0968 sq. in.	VERTICAL	0.704 Lb/Ft	242	NORMAL	335
R. (@ 25˚C)	0.1630 Ω / 1000'	TOTAL	1.144 Lb/Ft	268	EMERGENCY	351
R. (@ 75˚C)	0.2160 Ω / 1000'					
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	53.88˚			
CONDUCTOR DIAMETER	0.398"					
WEIGHT	145 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.48	0.72	1.32	2.88	3.96	5.76	6.60	7.56
75	1.08	1.68	2.88	5.52	7.20	9.60	10.80	11.88
100	2.04	3.00	4.92	8.76	10.80	13.68	15.12	16.56
125	3.12	4.56	7.44	12.36	14.76	18.12	19.80	21.48
150	4.44	6.60	10.20	16.20	18.84	22.68	24.60	26.52
175	6.12	8.88	13.44	20.16	23.28	27.48	29.64	31.68
200	7.92	11.40	16.92	24.48	27.84	32.52	34.80	37.08
225	10.08	14.40	20.64	28.92	32.64	37.56	40.08	42.48
250	12.36	17.52	24.72	33.60	37.56	42.84	45.48	48.12
275	17.28	24.72	33.96	42.48	46.92	52.80	55.68	58.44
300	24.72	34.92	45.60	53.40	58.20	64.56	67.56	70.56

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.60	3.24	2.16	1197
75	7.44	6.72	4.44	1292
100	12.36	10.92	7.32	1394
125	17.88	15.84	10.68	1498
150	24.12	21.24	14.52	1601
175	30.84	27.12	18.60	1702
200	38.16	33.48	23.04	1800
225	45.84	40.20	27.84	1896
250	54.00	47.16	32.88	1989
275	64.92	57.48	42.36	*2000
300	77.28	69.36	53.88	*2000

** Note: Design Specification Constraint*

Supersedes 7/10 Issue – Updated item ID.

1/0, 6/1 STRANDING, BARE ACSR, "RAVEN"
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	
CU:	C10ASSTLTRT

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4160 lbs.	TRANSVERSE	0.5407 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1348 sq. in.	VERTICAL	0.921 Lb/Ft	210	NORMAL	320
R. (@ 25˚C)	0.1633 Ω / 1000'	TOTAL	1.368 Lb/Ft	256	EMERGENCY	348
R. (@ 75˚C)	0.2160 Ω / 1000'					
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	53.82˚			
CONDUCTOR DIAMETER	0.398"					
COMPLETE DIAMETER	0.6518"					
WEIGHT	226 lbs / 1000'					

Supersedes 7/09 Issue – Corrected unloaded sags for 200' and 225' spans.

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.84	1.56	3.72	5.76	7.20	8.88	9.60	10.32
75	1.80	3.36	6.72	9.72	11.64	13.92	15.00	15.96
100	3.24	576.00	10.08	14.16	16.44	19.32	20.64	21.84
125	5.04	8.64	13.92	18.96	21.60	24.96	26.52	27.96
150	7.32	12.00	18.12	24.12	27.12	30.84	32.64	34.32
175	9.96	15.72	22.68	29.52	32.88	37.08	39.00	40.92
200	14.28	21.60	29.52	36.84	40.56	45.12	47.16	49.32
225	22.32	31.68	40.08	47.52	51.36	56.28	58.44	60.72
250	33.24	43.56	52.20	59.40	63.60	68.64	70.92	73.20
275	46.32	57.00	65.52	72.72	77.04	82.20	84.72	87.00
300	61.20	71.76	80.28	87.36	91.68	97.08	99.60	102.12

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.20	4.56	4.68	1229
75	8.40	8.76	8.16	1377
100	13.44	13.56	12.24	1523
125	19.32	19.08	16.80	1664
150	25.68	24.96	21.72	1800
175	32.64	31.44	27.00	1928
200	41.04	39.48	34.20	*2000
225	51.96	50.28	44.76	*2000
250	64.20	62.40	56.76	*2000
275	77.64	75.84	70.08	*2000
300	92.40	90.48	84.72	*2000
** Note: Design Specification Constraint*				

1/0, 6/1 STRANDING, ACSR, 110 MIL PE COVERING, "ALMOND"
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	
CU:	C10ASSTPER/T

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4160 lbs.	TRANSVERSE	0.5069 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1081 sq. in.	VERTICAL	0.827 Lb/Ft	220	NORMAL	330
R. (@ 25˚C)	0.1633 Ω / 1000'	TOTAL	1.270 Lb/Ft	267	EMERGENCY	359
R. (@ 75˚C)	0.2160 Ω / 1000'					
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	53.17˚			
CONDUCTOR DIAMETER	0.398"					
COMPLETE DIAMETER	0.518"					
WEIGHT	194 lbs / 1000'					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.72	1.20	2.40	4.32	5.76	7.44	8.28	9.00
75	1.56	2.52	4.68	7.92	9.72	12.00	13.08	14.16
100	2.76	4.44	7.68	11.88	14.04	16.92	18.24	19.56
125	4.32	6.84	11.04	16.32	18.84	22.08	23.64	25.20
150	6.24	9.60	14.76	21.00	23.88	27.60	29.28	31.08
175	8.52	12.84	18.84	25.92	29.16	33.24	35.16	37.20
200	11.16	16.44	23.28	31.20	34.68	39.12	41.28	43.44
225	14.16	20.40	27.96	36.60	40.32	45.24	47.64	49.92
250	20.88	29.52	38.40	46.80	50.88	56.16	58.68	61.08
275	30.48	41.04	50.52	58.56	63.00	68.52	71.16	73.68
300	42.84	54.36	64.08	71.64	76.32	82.08	84.72	87.48

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.08	4.08	3.36	1183
75	8.28	8.04	6.48	1303
100	13.32	12.72	10.08	1427
125	19.20	18.12	14.28	1548
150	25.68	24.00	18.84	1666
175	32.76	30.36	23.76	1780
200	40.32	37.08	28.92	1890
225	48.36	44.40	34.56	1996
250	59.52	55.20	45.00	*2000
275	72.12	67.44	57.00	*2000
300	85.80	80.88	70.32	*2000

** Note: Design Specification Constraint*

Supersedes 7/10 Issue – Deleted obsolete item ID.

1/0 ACSR, 6/1 STANDING, 60 MIL PE COVERING, "ALMOND"
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	9314543
CU:	C10AAACPER/T

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4194 lbs.	TRANSVERSE	0.5286 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1081 sq. in.	VERTICAL	0.843 Lb/Ft	228	NORMAL	344
R. (@ 25˚C)	0.1660 Ω / 1000'	TOTAL	1.295 Lb/Ft	278	EMERGENCY	374
R. (@ 75˚C)	0.1950 Ω / 1000'					
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	60.55˚			
CONDUCTOR DIAMETER	0.468"					
COMPLETE DIAMETER	0.588"					
WEIGHT	166 lbs / 1000'					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.96	1.56	4.20	7.68	11.04	12.36	13.56
75	1.32	2.04	3.48	7.44	12.12	16.92	18.72	20.52
100	2.40	3.60	6.00	11.16	16.92	22.92	25.32	27.60
125	3.72	5.52	8.88	15.12	21.84	29.16	32.16	34.92
150	5.40	7.92	12.24	19.56	27.12	35.52	39.00	42.24
175	7.32	10.56	15.96	24.24	32.64	42.12	46.08	49.92
200	9.48	13.68	20.04	29.16	38.52	48.96	53.40	57.60
225	12.00	17.16	24.48	34.44	44.52	55.92	60.84	65.52
250	14.88	20.88	29.16	39.96	50.76	63.12	68.52	73.56
275	20.40	28.80	38.88	50.64	61.80	74.64	80.16	85.44
300	29.16	40.56	52.20	64.32	75.72	88.68	94.32	99.72

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.20	3.96	3.00	1161
75	8.64	8.16	6.00	1261
100	14.16	13.20	9.84	1368
125	20.52	18.84	14.04	1476
150	27.60	25.20	18.84	1582
175	35.28	32.04	24.00	1685
200	43.56	39.36	29.52	1785
225	52.32	47.16	35.28	1882
250	61.44	55.32	41.52	1976
275	73.56	66.72	51.84	*2000
300	87.48	80.28	64.92	*2000
** Note: Design Specification Constraint*				

Supersedes 7/10 Issue – Updated item ID.

1/0, 7 STRAND, AAAC, 60 MIL XLPE COVERING, "OILNUT" – 15 kV			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		6-215	7/15

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W12B
Item ID:	9306923[Y]
CU:	C02ASSTBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	2850 lbs.	**TRANSVERSE**	0.4379 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.0608 sq. in.	**VERTICAL**	0.599 Lb/Ft	183	**NORMAL**	251
R. (@ 25˚C)	0.2591 Ω / 1000'	**TOTAL**	1.042 Lb/Ft			
R. (@ 75˚C)	0.3360 Ω / 1000'			203	**EMERGENCY**	264
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	**SWING**	60.01˚			
CONDUCTOR DIAMETER	0.316"					
WEIGHT	91 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.48	0.72	1.20	3.12	4.32	6.24	7.08	7.92
75	1.08	1.56	2.76	5.88	7.56	10.08	11.16	12.36
100	1.92	2.88	4.68	8.88	11.04	14.04	15.48	16.80
125	3.00	4.44	7.08	12.24	14.64	18.00	19.68	21.36
150	4.32	6.36	9.84	15.60	18.36	22.20	24.12	25.92
175	5.88	8.52	12.96	19.20	22.20	26.40	28.44	30.48
200	7.68	11.04	16.32	22.80	26.04	30.48	32.76	35.04
225	10.44	15.24	22.08	28.32	31.92	36.96	39.36	41.88
250	16.80	25.08	34.32	39.12	43.32	48.96	51.60	54.24
275	27.60	38.88	47.40	52.08	56.76	62.76	65.52	68.28
300	43.08	55.32	62.04	66.96	72.00	78.12	80.88	83.76

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-20**	**0**	**15**	**-20**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	4.68	4.08	2.28	827
75	9.60	8.04	4.80	921
100	15.36	12.96	7.92	1016
125	22.08	18.60	11.52	1109
150	29.40	24.72	15.48	1199
175	37.20	31.32	19.92	1286
200	45.60	38.40	24.60	1370
225	55.56	47.04	31.44	*1425
250	68.64	59.40	43.44	*1425
275	83.04	73.32	57.24	*1425
300	98.88	88.56	72.84	*1425
** Note: Design Specification Constraint*				

Supersedes 7/10 Issue – Updated item ID.

#2, 6/1 STRANDING, BARE ACSR, "SPARROW"
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	
CU:	C02ASSTPER/T

PHYSICAL PROPERTIES	
R.B.S.	2710 lbs.
C.S.A.	0.0672 sq. in.
R. (@ 25˚C)	0.2591 Ω / 1000'
R. (@ 75˚C)	0.3360 Ω / 1000'
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.406"
COMPLETE DIAMETER	0.496"
WEIGHT	119 lbs / 1000'

LOADING PROPERTIES	
TRANSVERSE	0.4978 Lb/Ft
VERTICAL	0.739 Lb/Ft
TOTAL	1.191 Lb/Ft
SWING	64.37˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
178	NORMAL	266
216	EMERGENCY	289

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.96	1.80	4.08	5.40	7.08	7.92	8.64
75	1.44	2.28	3.84	7.32	9.00	11.28	12.36	13.44
100	2.64	3.96	6.48	10.92	12.96	15.72	17.04	18.36
125	4.08	6.12	9.48	14.76	17.16	20.28	21.84	23.40
150	5.88	8.64	12.96	18.84	21.48	24.96	26.76	28.44
175	8.04	11.64	16.80	22.92	25.80	29.76	31.68	33.60
200	13.92	20.40	27.84	33.00	36.48	40.92	42.96	45.00
225	24.60	33.84	41.88	45.84	49.68	54.36	56.64	58.80
250	40.20	49.92	56.76	60.84	64.80	69.72	72.00	74.16
275	58.32	67.80	73.56	77.76	81.84	86.76	89.04	91.32
300	78.24	87.36	92.28	96.48	100.56	105.60	107.88	110.16

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	5.40	4.92	3.48	827
75	10.68	9.60	6.84	938
100	17.04	15.12	10.92	1047
125	24.24	21.48	15.48	1152
150	32.16	28.32	20.40	1253
175	40.56	35.64	25.80	1349
200	52.80	47.28	36.84	*1355
225	66.84	60.84	50.28	*1355
250	82.44	76.20	65.64	*1355
275	99.84	93.24	82.80	*1355
300	118.80	111.96	101.64	*1355

** Note: Design Specification Constraint*

Supersedes 7/10 Issue – Deleted obsolete item ID.

#2, 6/1 STRANDING, ACSR, 45 MIL PE COVERING, "PIGNUT"
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	
CU:	C04ASBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	2360 lbs.	**TRANSVERSE**	0.4191 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.0411 sq. in.	**VERTICAL**	0.538 Lb/Ft	140	**NORMAL**	191
R. (@ 25˚C)	0.4070 Ω / 1000’	**TOTAL**	0.982 Lb/Ft	155	**EMERGENCY**	201
R. (@ 75˚C)	0.5160 Ω / 1000’					
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	**SWING**	62.46˚			
CONDUCTOR DIAMETER	0.257”					
WEIGHT	67 lbs.					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.48	0.60	0.84	1.80	3.00	4.92	5.88	6.84
75	0.96	1.32	1.92	3.72	5.52	8.04	9.36	10.68
100	1.68	2.28	3.48	6.12	8.40	11.40	12.96	14.52
125	2.64	3.60	5.28	8.88	11.28	14.76	16.68	18.48
150	3.84	5.28	7.44	11.88	14.28	18.24	20.28	22.32
175	5.16	7.08	9.96	14.64	17.40	21.60	23.88	26.16
200	7.08	9.72	13.68	18.36	21.60	26.28	28.68	31.20
225	11.40	16.32	23.16	27.00	31.08	36.72	39.48	42.24
250	20.28	29.16	35.28	40.08	44.88	51.00	53.88	56.64
275	35.76	45.96	50.76	55.92	61.08	67.32	70.20	72.96
300	55.44	63.72	68.64	73.92	79.08	85.20	88.08	90.84

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-20**	**0**	**15**	**-20**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	5.28	4.08	1.80	697
75	10.56	8.28	3.96	781
100	17.04	13.44	6.72	865
125	24.24	19.32	9.96	948
150	32.28	25.80	13.68	1027
175	40.92	32.76	17.76	1104
200	50.52	40.80	23.16	1166
225	63.24	52.32	33.36	*1180
250	78.12	66.36	47.40	*1180
275	94.44	82.20	63.60	*1180
300	112.44	99.60	81.60	*1180
** Note: Design Specification Constraint*				

Supersedes 7/09 Issue – Updated item ID.

#4, 7/1 STRANDING, BARE ACSR, “SWANATE”
MAINTENANCE ONLY

ISSUE	PAGE NUMBER		
7/15	**6-218**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
CU:	C04ASPE

PHYSICAL PROPERTIES	
R.B.S.	2240 lbs.
C.S.A.	0.0439 sq. in.
R. (@ 25˚C)	0.4072 Ω / 1000’
R. (@ 75˚C)	0.5160 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.317”
COMPLETE DIAMETER	0.377”
WEIGHT	82 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.4589 Lb/Ft
VERTICAL	0.627 Lb/Ft
TOTAL	1.077 Lb/Ft
SWING	66.49˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
136	NORMAL	200
164	EMERGENCY	217

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.84	1.32	2.88	4.44	6.36	7.32	8.16
75	1.20	1.80	2.76	5.52	7.56	10.20	11.40	12.60
100	2.16	3.12	4.80	8.64	10.92	14.04	15.60	17.04
125	3.48	4.92	7.32	11.88	14.40	18.00	19.80	21.48
150	4.92	6.96	10.20	15.12	18.00	22.08	24.00	26.04
175	7.68	11.28	16.32	21.24	24.72	29.40	31.56	33.72
200	15.12	22.32	29.52	33.48	37.44	42.48	44.76	47.04
225	29.16	38.28	44.16	48.36	52.56	57.60	59.88	62.16
250	47.76	56.52	61.20	65.52	69.60	74.64	76.92	79.20
275	68.16	76.20	80.28	84.48	88.56	93.60	95.88	98.16
300	90.00	97.20	101.16	105.36	109.44	114.36	116.64	118.80

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	5.76	4.92	2.88	697
75	11.40	9.60	5.88	795
100	18.12	15.24	9.60	892
125	25.68	21.60	13.80	984
150	33.96	28.44	18.36	1072
175	44.16	37.68	25.92	*1120
200	57.72	50.52	38.52	*1120
225	73.08	65.40	53.40	*1120
250	90.24	82.08	70.44	*1120
275	109.32	100.80	89.28	*1120
300	130.08	121.32	110.04	*1120
** Note: Design Specification Constraint*				

Supersedes 17/09Issue – Deleted obsolete item ID.

#4, 7/1 STRANDING, ACSR, 30 MIL PE COVERING, “HICKORY”
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	
CU:	C04ASPE6NE

PHYSICAL PROPERTIES	
R.B.S.	1770 lbs.
C.S.A.	0.0411 sq. in.
R. (@ 25˚C)	0.4120 Ω / 1000'
R. (@ 75˚C)	0.5220 Ω / 1000'
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.310"
COMPLETE DIAMETER	0.370"
WEIGHT	72 lbs / 1000'

LOADING PROPERTIES	
TRANSVERSE	0.4577 Lb/Ft
VERTICAL	0.613 Lb/Ft
TOTAL	1.065 Lb/Ft
SWING	68.73˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
135	NORMAL	199
163	EMERGENCY	216

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.96	1.56	3.48	4.56	6.36	7.20	7.92
75	1.32	2.04	3.48	6.12	7.68	9.84	11.04	12.12
100	2.40	3.60	5.76	9.00	10.80	13.44	14.76	16.08
125	3.84	5.64	8.76	12.00	14.04	17.04	18.60	20.16
150	7.92	12.48	17.76	20.40	23.16	26.88	28.56	30.36
175	19.32	27.36	30.60	33.84	37.08	41.04	42.84	44.64
200	37.92	43.80	47.04	50.40	53.76	57.72	59.64	61.44
225	58.68	63.00	66.24	69.60	72.84	76.92	78.72	80.52
250	81.00	84.72	87.84	91.08	94.32	98.28	100.08	102.00
275	105.00	108.60	111.72	114.96	118.08	122.04	123.84	125.64
300	131.28	134.76	137.76	141.00	144.12	147.96	149.88	151.56

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	6.72	5.76	3.60	591
75	13.08	11.04	7.20	688
100	20.52	17.28	11.28	780
125	28.80	24.24	16.08	866
150	40.68	35.28	26.16	*885
175	55.32	49.32	40.32	*885
200	72.24	65.88	57.12	*885
225	91.44	84.84	76.32	*885
250	112.92	106.08	97.80	*885
275	136.80	129.72	121.44	*885
300	162.84	155.64	147.48	*885
** Note: Design Specification Constraint*				

Supersedes 1/07 Issue - Updated CU.

#4, 6/1 STRANDING, ACSR, 30 MIL PE COVERING, "BUTTERNUT"
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Doc. # ST. 06.00.005

Non-Standard Copper Overhead Distribution Conductors

Maintenance Only

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	9160 lbs.	TRANSVERSE	0.5068 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1663 sq. in.	VERTICAL	1.290 Lb/Ft			
R. (@ 25˚C)	0.0527 Ω / 1000'	TOTAL	1.686 Lb/Ft	486	NORMAL	679
R. (@ 50˚C)	0.0574 Ω / 1000'			545	EMERGENCY	718
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	21.76˚			
CONDUCTOR DIAMETER	0.522"					
WEIGHT	654 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.32	2.28	4.20	6.72	8.88	11.16	12.12	12.96
75	3.36	5.64	8.64	11.88	14.76	17.88	19.20	20.40
100	6.96	10.68	14.40	18.24	21.72	25.44	27.12	28.68
125	12.48	17.52	21.84	26.04	29.88	34.32	36.24	38.04
150	20.28	25.92	30.60	35.28	39.48	44.28	46.44	48.60
175	30.12	36.12	41.04	45.84	50.40	55.68	57.96	60.24
200	41.76	47.88	52.92	57.96	62.76	68.40	70.92	73.32
225	54.96	61.32	66.48	71.64	76.56	82.44	85.08	87.72
250	69.96	76.32	81.60	86.88	91.92	98.04	100.80	103.56
275	86.52	92.88	98.16	103.68	108.84	115.20	118.08	120.84
300	104.64	111.12	116.40	121.92	127.32	133.80	136.68	139.56

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.12	3.84	4.32	*2000
75	7.08	8.28	8.76	*2000
100	12.60	14.16	14.76	*2000
125	19.80	21.60	22.08	*2000
150	28.44	30.48	30.96	*2000
175	38.76	40.92	41.40	*2000
200	50.64	52.92	53.28	*2000
225	64.08	66.48	66.84	*2000
250	79.08	81.48	81.96	*2000
275	95.76	98.28	98.64	*2000
300	114.00	116.52	116.88	*2000

** Note: Design Specification Constraint*

4/0, 7 STRAND, HARD DRAWN COPPER, BARE
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W13K
Item ID:	9315933
CU:	C10BSTC

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4752 lbs.	TRANSVERSE	0.4566 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0829 sq. in.	VERTICAL	0.866 Lb/Ft	313	NORMAL	432
R. (@ 25˚C)	0.1051 Ω / 1000'	TOTAL	1.279 Lb/Ft	350	EMERGENCY	457
R. (@ 50˚C)	0.1150 Ω / 1000'					
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	29.44˚			
CONDUCTOR DIAMETER	0.368"					
WEIGHT	326 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	1.56	2.64	4.92	7.32	9.96	10.92	11.88
75	2.28	3.48	5.40	8.52	11.88	15.36	16.92	18.24
100	4.08	6.00	8.76	12.72	16.68	21.12	23.04	24.84
125	6.48	9.12	12.72	17.40	21.96	27.24	29.52	31.68
150	9.24	12.84	17.16	22.44	27.72	33.72	36.36	38.88
175	12.60	17.04	22.08	27.96	33.84	40.56	43.56	46.32
200	16.44	21.72	27.48	33.96	40.20	47.64	51.00	54.12
225	23.04	29.76	36.24	43.20	49.92	57.72	61.20	64.56
250	32.28	40.08	47.04	54.36	61.32	69.48	73.08	76.68
275	43.44	51.96	59.40	66.84	73.92	82.32	86.16	89.76
300	56.40	65.40	72.84	80.52	87.72	96.36	100.20	104.04

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.60	3.60	2.88	1314
75	7.56	7.32	5.88	1426
100	12.48	11.88	9.48	1542
125	18.12	17.16	13.68	1658
150	24.36	22.92	18.36	1770
175	31.32	29.28	23.52	1877
200	38.76	36.12	29.04	1980
225	48.60	45.60	37.92	*2000
250	60.00	56.76	48.84	*2000
275	72.60	69.24	61.08	*2000
300	86.40	82.80	74.64	*2000
** Note: Design Specification Constraint*				

Supersedes 7/09 Issue - Updated item ID.

1/0, 7 STRAND, HARD DRAWN COPPER, BARE
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4752 lbs.	TRANSVERSE	0.4947 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0942 sq. in.	VERTICAL	0.978 Lb/Ft			
R. (@ 25˚C)	0.1051 Ω / 1000'	TOTAL	1.396 Lb/Ft	278	NORMAL	415
R. (@ 50˚C)	0.1150 Ω / 1000'			337	EMERGENCY	452
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	33.91˚			
CONDUCTOR DIAMETER	0.368"					
COMPLETE DIAMETER	0.488"					
WEIGHT	363 lbs / 1000'					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.20	1.80	3.36	5.88	8.16	10.56	11.52	12.48
75	2.52	4.08	6.48	9.84	12.96	16.32	17.76	19.08
100	4.56	6.84	10.20	14.28	18.12	22.44	24.24	25.92
125	7.20	10.44	14.40	19.20	23.64	28.80	30.96	33.12
150	10.32	14.52	19.20	24.60	29.76	35.52	38.16	40.56
175	14.04	19.08	24.48	30.48	36.12	42.72	45.60	48.36
200	21.00	27.48	33.60	39.96	45.96	52.92	55.92	58.92
225	30.36	37.80	44.40	51.00	57.24	64.44	67.68	70.80
250	41.88	49.80	56.64	63.36	69.72	77.28	80.64	83.88
275	55.08	63.36	70.20	77.04	83.64	91.32	94.80	98.28
300	69.96	78.24	85.20	92.16	98.76	106.68	110.28	113.76

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.84	4.08	3.72	1349
75	7.92	8.04	7.08	1482
100	12.96	12.84	11.04	1617
125	18.72	18.36	15.60	1748
150	25.20	24.48	20.64	1873
175	32.28	31.08	26.28	1991
200	41.88	40.56	35.40	*2000
225	53.04	51.60	46.20	*2000
250	65.52	63.96	58.44	*2000
275	79.20	77.64	72.00	*2000
300	94.32	92.64	87.00	*2000

** Note: Design Specification Constraint*

1/0, 7 STRAND, HARD DRAWN COPPER, 60 MIL PE COVERING
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W13D
Item ID:	9315669[Y]
CU:	C02CUSTBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	5876 lbs.	TRANSVERSE	0.4553 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0680 sq. in.	VERTICAL	0.796 Lb/Ft	249	NORMAL	344
R. (@ 25˚C)	0.1653 Ω / 1000'	TOTAL	1.217 Lb/Ft	279	EMERGENCY	363
R. (@ 50˚C)	0.1809 Ω / 1000'					
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	35.45˚			
CONDUCTOR DIAMETER	0.366"					
WEIGHT	257 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.84	1.20	1.92	3.60	6.60	7.80	9.00
75	1.44	1.92	2.64	3.96	6.60	10.68	12.36	13.92
100	2.64	3.36	4.56	6.72	10.08	15.00	17.16	19.20
125	4.08	5.28	6.96	9.96	14.04	19.80	22.32	24.72
150	5.88	7.56	9.84	13.56	18.36	24.84	27.72	30.48
175	8.16	10.44	13.56	18.00	23.52	30.60	33.84	36.84
200	12.00	15.48	19.80	25.44	31.68	39.24	42.72	45.96
225	17.16	22.32	27.84	34.44	41.16	49.08	52.68	56.04
250	24.48	31.08	37.68	44.88	51.84	60.12	63.72	67.32
275	33.96	41.76	48.96	56.52	63.60	72.12	75.96	79.56
300	45.60	54.24	61.68	69.36	76.68	85.32	89.16	93.00

Supersedes 7/09 Issue - Updated item ID.

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.00	2.52	1.44	1548
75	6.36	5.40	3.12	1628
100	10.56	9.12	5.52	1721
125	15.72	13.56	8.28	1819
150	21.36	18.60	11.64	1918
175	27.96	24.36	15.72	*2000
200	36.48	32.28	22.44	*2000
225	46.20	41.52	30.72	*2000
250	57.12	51.96	40.56	*2000
275	69.00	63.60	51.96	*2000
300	82.20	76.44	64.56	*2000

** Note: Design Specification Constraint*

#2, 3 STRAND, TYPE A COPPER – COPPERWELD, BARE
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W13B
Item ID:	9315684
CU:	C02CHSTBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	3050 lbs.	TRANSVERSE	0.4303 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0522 sq. in.	VERTICAL	0.698 Lb/Ft			
R. (@ 25˚C)	0.1670 Ω / 1000'	TOTAL	1.1207 Lb/Ft	234	NORMAL	321
R. (@ 50˚C)	0.1826 Ω / 1000'			261	EMERGENCY	339
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	35.46˚			
CONDUCTOR DIAMETER	0.292"					
WEIGHT	205 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.96	1.56	2.52	4.80	7.20	9.84	10.92	11.88
75	2.28	3.36	5.16	8.40	11.64	15.24	16.68	18.12
100	4.08	5.88	8.52	12.48	16.44	21.00	22.92	24.72
125	6.36	8.88	12.48	17.04	57.72	27.00	29.28	31.56
150	9.12	12.48	16.80	22.08	27.36	33.48	36.12	38.64
175	12.36	16.68	21.60	27.60	33.36	40.20	43.20	46.08
200	16.08	21.36	26.88	33.48	39.72	47.28	50.52	53.76
225	22.44	29.04	35.52	42.48	49.20	57.12	60.60	63.96
250	33.12	41.04	48.00	55.32	62.16	70.20	73.80	77.40
275	46.44	54.96	62.28	69.60	76.56	84.72	88.44	92.04
300	61.92	70.68	78.00	85.32	92.28	100.56	104.40	108.00

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.68	4.32	3.00	898
75	9.36	8.52	6.00	1003
100	15.12	13.56	9.60	1108
125	21.72	19.32	13.80	1210
150	28.92	25.68	18.60	1306
175	36.84	32.64	23.76	1398
200	45.24	40.08	29.40	1486
225	55.80	49.92	38.16	*1525
250	68.88	62.52	50.64	*1525
275	83.40	76.68	64.68	*1525
300	99.24	92.28	80.28	*1525

** Note: Design Specification Constraint*

Supersedes 7/09 Issue - Updated item ID.

#2, 7 STRAND, HARD DRAWN COPPER, BARE
MAINTENANCE ONLY

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W13E
Item ID:	9312556
CU:	C02CHSTPE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	3050 lbs.	TRANSVERSE	0.4601 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0585 sq. in.	VERTICAL	0.777 Lb/Ft	213	NORMAL	314
R. (@ 25˚C)	0.1670 Ω / 1000’	TOTAL	1.203 Lb/Ft	257	EMERGENCY	342
R. (@ 50˚C)	0.1826 Ω / 1000’					
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	39.95˚			
CONDUCTOR DIAMETER	0.292”					
COMPLETE DIAMETER	0.382”					
WEIGHT	228 lbs / 1000’					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	1.80	3.12	5.64	7.92	10.44	11.40	12.36
75	2.52	3.84	6.24	9.48	12.72	16.08	17.52	18.84
100	4.44	6.72	9.84	13.92	17.76	22.08	24.00	25.68
125	6.96	10.08	14.04	18.84	23.28	28.44	30.72	32.76
150	10.08	14.16	18.72	24.12	29.28	35.16	37.68	40.20
175	13.68	18.60	24.00	29.88	35.64	42.24	45.12	47.88
200	19.92	26.16	32.16	38.64	44.64	51.72	54.84	57.84
225	30.36	37.92	44.40	51.00	57.24	64.44	67.68	70.80
250	43.68	51.60	58.20	64.92	71.16	78.60	81.96	85.20
275	59.04	67.08	73.68	80.40	86.64	94.20	97.68	100.92
300	76.08	84.00	90.60	97.32	103.68	111.36	114.84	118.20

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	4.92	4.68	3.72	926
75	9.72	9.12	7.08	1046
100	15.48	14.40	11.16	1163
125	22.08	20.40	15.84	1274
150	29.40	27.00	20.88	1380
175	37.44	34.08	26.52	1479
200	47.40	43.56	35.04	*1525
225	60.00	55.80	47.16	*1525
250	74.04	69.60	60.84	*1525
275	89.52	84.96	76.20	*1525
300	106.56	101.88	93.12	*1525

** Note: Design Specification Constraint*

Supersedes 7/09 Issue - Updated drawing title.

#2, 7 STRAND, SOFT DRAWN COPPER, 45 MIL PE COVERING
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W11G
Item ID:	9302814[E]
CU:	C03CHSTBRNE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	2433 lbs.	TRANSVERSE	0.4197 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0416 sq. in.	VERTICAL	0.636 Lb/Ft			
R. (@ 25˚C)	0.2106 Ω / 1000'	TOTAL	1.062 Lb/Ft	202	NORMAL	277
R. (@ 50˚C)	0.2303 Ω / 1000'			226	EMERGENCY	292
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	38.57˚			
CONDUCTOR DIAMETER	0.260"					
WEIGHT	163 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.96	1.56	2.52	4.80	7.20	9.84	10.80	11.88
75	2.28	3.36	5.16	8.28	11.64	15.24	16.68	18.12
100	3.96	5.76	8.52	12.48	16.44	21.00	22.92	24.72
125	6.24	8.88	12.36	17.04	21.72	27.00	29.28	31.44
150	9.00	12.48	16.80	22.08	27.36	33.36	36.12	38.64
175	12.36	16.80	21.72	27.72	33.48	40.32	43.32	46.08
200	20.76	27.24	33.24	39.60	45.60	52.56	55.68	58.68
225	33.00	40.56	46.92	53.40	59.40	66.48	69.72	72.72
250	48.36	56.04	62.40	68.88	74.88	82.08	85.32	88.44
275	65.76	73.44	79.68	86.04	92.04	99.24	102.48	105.72
300	84.96	92.40	98.52	104.88	110.88	118.08	121.44	124.68

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	5.28	4.68	3.00	749
75	10.56	9.24	6.12	851
100	16.80	14.64	9.84	950
125	23.88	20.76	14.16	1045
150	31.56	27.48	18.96	1134
175	40.08	34.80	24.36	*1216
200	52.44	46.56	35.76	*1217
225	66.36	60.00	49.32	*1217
250	81.96	75.24	64.68	*1216
275	99.12	92.28	81.72	*1217
300	117.96	110.88	100.56	*1217

** Note: Design Specification Constraint*

Supersedes 7/09 Issue - Updated item ID.

#3, 7 STRAND, HARD DRAWN COPPER, BARE
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W11H
Item ID:	9302709[E]
CU:	C03CHSTPENE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	2433 lbs.	TRANSVERSE	0.4490 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0480 sq. in.	VERTICAL	0.704 Lb/Ft	185	NORMAL	272
R. (@ 25˚C)	0.2106 Ω / 1000'	TOTAL	1.135 Lb/Ft	223	EMERGENCY	296
R. (@ 50˚C)	0.2303 Ω / 1000'					
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	45.00˚			
CONDUCTOR DIAMETER	0.260"					
COMPLETE DIAMETER	0.350"					
WEIGHT	175 lbs / 1000'					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)						
TEMP. ˚F	0	32	60	90	120	158	176
TEMP. ˚C	-20	0	15	32	50	70	80
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)							
50	1.20	1.80	3.00	5.40	7.68	10.20	11.16
75	2.76	3.96	6.12	9.24	12.36	15.84	17.28
100	4.80	6.96	9.84	13.68	17.52	21.84	23.64
125	7.56	10.44	14.16	18.72	23.16	28.20	30.36
150	10.80	14.64	19.08	24.24	29.16	34.92	37.56
175	19.20	24.96	30.24	35.76	40.92	46.92	49.56
200	31.80	38.40	43.92	49.56	54.72	60.84	63.60
225	47.52	54.12	59.64	65.28	70.44	76.68	79.44
250	65.40	71.88	77.28	82.80	88.08	94.32	97.20
275	85.20	91.56	96.84	102.36	107.52	113.88	116.76
300	106.80	113.04	118.32	123.72	128.88	135.24	138.24

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	5.52	5.16	3.96	779
75	10.68	9.84	7.44	896
100	16.92	15.36	11.52	1007
125	24.00	21.60	16.20	1112
150	31.68	28.44	21.36	1210
175	42.84	39.12	31.80	*1217
200	56.04	51.96	44.52	*1216
225	70.92	66.60	59.28	*1217
250	87.60	83.16	75.84	*1217
275	105.96	101.40	94.20	*1217
300	126.24	121.44	114.24	*1217
** Note: Design Specification Constraint*				

Supersedes 7/09 Issue - Updated item ID.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W11D
Item ID:	9315668[Y]
CU:	C04CUSTBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	3938 lbs.	**TRANSVERSE**	0.4302 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.0428 sq. in.	**VERTICAL**	0.653 Lb/Ft			
R. (@ 25˚C)	0.2629 Ω / 1000'	**TOTAL**	1.082 Lb/Ft	186	**NORMAL**	255
R. (@ 50˚C)	0.2875 Ω / 1000'			208	**EMERGENCY**	270
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	**SWING**	41.83˚			
CONDUCTOR DIAMETER	0.290"					
WEIGHT	162 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.60	0.84	1.08	1.56	3.00	5.88	7.32	8.40
75	1.44	1.80	2.40	3.48	5.76	9.72	11.52	13.20
100	2.52	3.12	4.20	6.00	9.00	13.92	16.08	18.24
125	3.84	4.92	6.36	8.88	12.72	18.48	21.00	23.52
150	5.52	7.08	9.00	12.36	16.80	23.28	26.28	29.04
175	7.56	9.60	12.12	16.08	21.24	28.44	31.68	34.92
200	9.84	12.36	15.60	20.28	26.04	33.84	37.44	40.92
225	12.48	15.60	19.32	24.72	31.08	39.60	43.44	47.28
250	15.48	19.08	23.52	29.52	36.48	45.48	49.68	53.76
275	18.72	23.04	27.96	34.56	42.00	51.72	56.16	60.60
300	22.20	27.24	32.76	39.96	47.88	58.20	63.00	67.56

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-20**	**0**	**15**	**-20**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	3.84	3.00	1.44	1069
75	7.92	6.36	3.12	1148
100	13.20	10.56	5.40	1235
125	19.20	15.60	8.16	1323
150	25.92	21.12	11.52	1411
175	33.24	27.24	15.24	1497
200	41.04	33.84	19.32	1581
225	49.44	40.92	23.88	1663
250	58.32	48.36	28.68	1742
275	67.56	56.16	33.84	1819
300	77.16	64.32	39.36	1894

** Note: Design Specification Constraint*

Supersedes 7/09 Issue - Updated item ID.

#4, 3 STRAND, TYPE A COPPER – COPPERWELD, BARE
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W11B
Item ID:	9315667[Y]
CU:	C04CHSOBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	1970 lbs.	TRANSVERSE	0.4010 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0328 sq. in.	VERTICAL	0.564 Lb/Ft	171	NORMAL	232
R. (@ 25˚C)	0.2602 Ω / 1000'	TOTAL	0.992 Lb/Ft	190	EMERGENCY	245
R. (@ 50˚C)	0.2847 Ω / 1000'					
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	38.97˚			
CONDUCTOR DIAMETER	0.204"					
WEIGHT	126 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.96	1.44	2.40	4.56	7.08	9.72	10.80	11.76
75	2.16	3.12	4.92	8.04	11.40	15.00	16.56	18.00
100	3.84	5.52	8.16	12.12	16.08	20.76	22.68	24.48
125	6.00	8.52	11.88	16.56	21.24	26.64	29.04	31.20
150	8.64	12.00	16.20	21.60	26.88	33.00	35.76	38.28
175	16.32	22.08	27.72	33.60	39.00	45.36	48.12	50.76
200	29.04	36.00	41.88	47.64	53.16	59.40	62.28	65.04
225	45.24	52.32	57.96	63.72	69.12	75.48	78.36	81.12
250	63.72	70.56	76.08	81.72	87.12	93.48	96.36	99.24
275	84.12	90.60	96.12	101.64	106.92	113.28	116.28	119.16
300	106.32	112.68	117.96	123.36	128.64	135.12	138.00	140.88

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	5.88	5.04	2.88	635
75	11.52	9.72	5.88	733
100	18.24	15.36	9.48	826
125	25.68	21.60	13.68	913
150	33.96	28.68	18.48	*985
175	46.32	40.32	29.76	*985
200	60.48	54.00	43.68	*985
225	76.56	69.72	59.76	*985
250	94.56	87.36	77.76	*985
275	114.48	107.04	97.56	*985
300	136.20	128.76	119.40	*985

** Note: Design Specification Constraint*

Supersedes 7/09 Issue - Updated item ID.

#4, SOLID, HARD DRAWN COPPER, BARE
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W11E
Item ID:	9312557[Y]
CU:	C04CHSOPE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	1970 lbs.	TRANSVERSE	0.4210 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0356 sq. in.	VERTICAL	0.611 Lb/Ft	159	NORMAL	230
R. (@ 25˚C)	0.2602 Ω / 1000'	TOTAL	1.042 Lb/Ft	191	EMERGENCY	250
R. (@ 50˚C)	0.2847 Ω / 1000'					
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	44.33˚			
CONDUCTOR DIAMETER	0.204"					
COMPLETE DIAMETER	0.264"					
WEIGHT	135 lbs / 1000'					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	1.56	2.52	4.68	7.20	9.72	10.80	11.76
75	2.28	3.36	5.28	8.28	11.52	15.12	16.68	18.00
100	4.08	5.88	8.64	12.48	16.44	20.88	22.80	24.60
125	6.48	9.00	12.48	17.04	21.72	27.00	29.28	31.44
150	10.20	14.04	18.60	23.88	28.92	34.92	37.44	39.96
175	19.44	25.56	30.96	36.60	41.76	47.76	50.40	52.92
200	33.72	40.44	45.96	51.48	56.52	62.64	65.28	67.92
225	51.00	57.60	62.88	68.28	73.44	79.44	82.20	84.84
250	70.32	76.68	81.84	87.24	92.28	98.28	101.16	103.80
275	91.68	97.80	102.84	108.12	113.16	119.16	122.04	124.68
300	114.84	120.84	125.76	130.92	135.96	142.08	144.84	147.60

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	6.12	5.28	3.24	641
75	11.88	10.20	6.48	741
100	18.72	16.08	10.44	835
125	26.40	22.56	14.88	925
150	35.76	30.84	21.48	*985
175	48.60	43.20	33.72	*985
200	63.48	57.72	48.36	*985
225	80.40	74.28	65.16	*985
250	99.24	92.88	84.00	*985
275	120.24	113.64	104.88	*985
300	143.04	136.32	127.68	*985

** Note: Design Specification Constraint*

Supersedes 7/09 Issue - Updated item ID.

#4, SOLID, HARD DRAWN COPPER, 30 MIL PE COVERING
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W9F
Item ID:	9315670[Y]
CU:	C6ABCCW

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	2585 lbs.	**TRANSVERSE**	0.4103 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.0269 sq. in.	**VERTICAL**	0.556 Lb/Ft			
R. (@ 25˚C)	0.4186 Ω / 1000'	**TOTAL**	0.991 Lb/Ft	140	**NORMAL**	190
R. (@ 50˚C)	0.4564 Ω / 1000'			155	**EMERGENCY**	201
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	**SWING**	48.43˚			
CONDUCTOR DIAMETER	0.230"					
WEIGHT	102 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.60	0.72	0.96	1.44	2.52	5.40	6.84	8.04
75	1.32	1.68	2.16	3.24	5.16	9.12	10.92	12.60
100	2.40	3.00	3.84	5.52	8.28	13.08	15.36	17.52
125	3.72	4.68	6.00	8.28	11.88	17.52	20.16	22.68
150	5.28	6.72	8.52	11.52	15.84	22.20	25.20	28.08
175	7.20	9.12	11.40	15.12	20.04	27.24	30.60	33.72
200	9.48	11.76	14.76	19.08	24.72	32.52	36.12	39.72
225	12.00	14.88	18.36	23.40	29.64	38.04	42.00	45.84
250	17.16	21.48	26.64	33.12	40.32	49.32	53.40	57.36
275	26.52	33.24	40.08	47.76	55.32	64.32	68.40	72.36
300	40.44	48.84	56.52	64.44	71.88	80.88	84.96	88.80

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-20**	**0**	**15**	**-20**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	5.04	3.72	1.44	740
75	10.20	7.80	3.24	818
100	16.56	12.72	5.64	899
125	23.76	18.48	8.52	978
150	31.68	24.84	12.00	1055
175	40.32	31.80	15.84	1130
200	49.44	39.24	20.04	1202
225	59.16	47.16	24.72	1272
250	71.88	58.56	33.84	*1292
275	87.00	72.72	47.28	*1293
300	103.56	88.44	63.24	*1293

** Note: Design Specification Constraint*

Supersedes 1/07 Issue - Updated item ID.

#6, 3 STRAND, TYPE A COPPER – COPPERWELD, BARE
MAINTENANCE ONLY

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	
Item ID:	
CU:	C06CHSOBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	1280 lbs.	TRANSVERSE	0.3867 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0234 sq. in.	VERTICAL	0.491 Lb/Ft	128	NORMAL	173
R. (@ 25˚C)	0.4129 Ω / 1000'	TOTAL	0.925 Lb/Ft	142	EMERGENCY	182
R. (@ 50˚C)	0.4527 Ω / 1000'					
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	45.72˚			
CONDUCTOR DIAMETER	0.162"					
WEIGHT	79 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.96	1.32	2.28	4.32	6.84	9.48	10.56	11.52
75	2.04	3.00	4.68	7.68	11.04	14.76	16.32	17.76
100	3.72	5.28	7.80	11.64	15.72	20.28	22.32	24.12
125	9.24	13.56	18.12	22.68	26.88	31.56	33.72	35.64
150	23.40	29.04	33.48	37.80	41.88	46.44	48.60	50.52
175	42.24	47.40	51.48	55.56	59.52	64.08	66.24	68.28
200	63.48	68.16	72.12	76.08	79.92	84.48	86.52	88.68
225	87.12	91.56	95.40	99.24	102.96	107.52	109.68	111.72
250	113.40	117.72	121.32	125.16	128.88	133.44	135.48	137.64
275	142.20	146.40	150.00	153.72	157.44	162.00	164.16	166.20
300	173.76	177.84	181.44	185.16	188.76	193.32	195.48	197.52

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	7.44	6.00	3.00	463
75	14.28	11.52	6.00	548
100	22.08	17.88	9.72	628
125	33.96	28.68	20.04	*640
150	48.84	43.08	34.92	*640
175	66.48	60.48	52.80	*640
200	86.88	80.64	73.20	*640
225	110.04	103.56	96.48	*640
250	135.84	129.24	122.40	*640
275	164.52	157.80	150.96	*640
300	195.96	189.12	182.40	*640

** Note: Design Specification Constraint*

Supersedes 7/09 Issue – Deleted obsolete item ID.

#6, SOLID, HARD DRAWN COPPER, BARE
MAINTENANCE ONLY

Copyright 2015 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Std. Item:	W9E
Item ID:	9312558
CU:	C06CHSOPE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	1280 lbs.	TRANSVERSE	0.4070 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0234 sq. in.	VERTICAL	0.536 Lb/Ft			
R. (@ 25˚C)	0.4129 Ω / 1000'	TOTAL	0.973 Lb/Ft	120	NORMAL	173
R. (@ 50˚C)	0.4527 Ω / 1000'			144	EMERGENCY	189
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	51.91˚			
CONDUCTOR DIAMETER	0.162"					
COMPLETE DIAMETER	0.222"					
WEIGHT	87 lbs / 1000'					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.96	1.56	2.76	5.28	7.68	10.20	11.16	12.12
75	2.28	3.48	5.64	9.00	12.24	15.72	17.16	18.60
100	4.80	7.32	10.92	15.00	18.84	23.04	24.84	26.52
125	14.52	19.68	23.88	27.96	31.68	35.88	37.68	39.48
150	31.08	35.88	39.84	43.68	47.28	51.60	53.52	55.32
175	50.40	54.96	58.56	62.28	65.88	70.08	72.00	73.92
200	72.36	76.68	80.16	83.76	87.36	91.56	93.48	95.40
225	97.08	101.16	104.52	108.12	111.60	115.92	117.84	119.76
250	124.44	128.40	131.88	135.36	138.84	143.04	145.08	147.00
275	154.68	158.64	162.00	165.48	168.96	173.16	175.20	177.12
300	187.80	191.76	195.00	198.48	201.96	206.16	208.20	210.12

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	7.56	6.36	3.84	484
75	14.28	11.88	7.44	577
100	22.80	19.44	13.20	*640
125	35.64	31.68	25.68	*640
150	51.36	47.16	41.40	*640
175	69.96	65.52	60.00	*640
200	91.44	86.76	81.48	*640
225	115.80	111.00	105.84	*640
250	143.04	138.24	133.08	*640
275	173.16	168.24	163.20	*640
300	206.16	201.24	196.20	*640

** Note: Design Specification Constraint*

Supersedes 1/07 Issue - Updated item ID.

#6, SOLID, HARD DRAWN COPPER, 30 MIL PE COVERING
MAINTENANCE ONLY

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
5	7/18	• Corrected Description of “Planetree to AAAC in index. • Corrected Description in title block to “AAAC. 225’ spans” on 6-210. •	G. Paul Anundson	Jonathan Gonynor, Director T&D O&M Services
4	7/17	• Corrected spelling of “Azusa” in Index and in titles on pages 6-125 and 6-126. • Corrected reference for conductor data used in calculation – Section 6.2.40. • Corrected normal rating temperature on page 6-111. • Corrected sag-tension data for standard tree wires on pages 6-105 through 6-110, 6-113 through 6-118 and 6-121 through 6-130.	G. Paul Anundson	Jonathan Gonynor, Director T&D O&M Services
3	7/15	• Updated item IDs throughout standard.	G. Paul Anundson	Jonathan Gonynor, Director T&D O&M Services
2	7/10	• Corrected final unloaded sags for 200’ and 225’ spans on pages 6-203, and 6-205 through 6-217.	G. Paul Anundson	Allen Chieco, Director of Distribution Standards and Work Methods
1	7/09	• Updated CUs on pages 6-127, 6-128, 6-203, 6-205, 6-208, 6-212, 6-213, 6-214, 6-215, 6-216, 6-217, 6-218, 6-219, 6-220, 6-302, 6-304, 6-305, 6-306, 6-307, 6-308, 6-309, 6-311, 6-313. • Updated conductor ampacities on pages 6-107, 6-109, 6-115, 6-117, 6-123, 6-127, 6-129.	G. Paul Anundson	Allen Chieco, Director of Distribution Standards and Work Methods

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/08 - –Revised clearance to swimming pools.

SECTION			PAGE
•	7.0	INTRODUCTION	7-1
•	7.1	GENERAL	7-1 THRU 7-5
•	7.2	RELATIVE LEVELS	7-5
•	7.3	CLEARANCES OF SUPPORTING STRUCTURES FROM RAIL, CURB, HYDRANT & OTHER OBJECTS	7-5 THRU 7-6
•	7.4	VERTICAL CLEARANCE TO GROUND, ROAD, RAILS, ETC.	7-6 THRU 7-9
•	7.5	VERTICAL CLEARANCE OF WIRES, CONDUCTORS AND CABLES ABOVE WATER SURFACES	7-9 THRU 7-10
•	7.6	CLEARANCE TO SWIMMING POOLS	7-10 THRU 7-12
•	7.7	VERTICAL & HORIZONTAL CLEARANCE OF WIRES, CONDUCTORS AND CABLES TO RAIL CARS	7-12 THRU 7-13
•	7.8	VERTICAL CLEARANCE OF EQUIPMENT CASES AND RIGID LIVE PARTS OF EQUIPMENT MOUNTED ON STRUCTURES	7-13 THRU 7-14
•	7.9	CLEARANCE OF WIRES, CONDUCTORS, CABLES AND UNGUARDED LIVE PARTS TO BUILDINGS & OTHER INSTALLATIONS EXCEPT BRIDGES	7-14 THRU 7-18
•	7.10	CLEARANCE TO BRIDGES	7-18 THRU 7-19
•	7.11	SEPARATION OF CONDUCTORS AND SUPPORTS ON THE SAME POLE	7-20 THRU 7-24
•	7.12	CLEARANCE TO PROPERTY LINE	7-25
•	7.13	VERTICAL CLEARANCE BETWEEN WIRES, CONDUCTORS & CABLES AT POINT OF CROSSING DIFFERENT SUPPORTING STRUCTURES	7-25 THRU 7-26
•	7.14	CLEARANCES OF VERTICAL & LATERAL SUPPLY CONDUCTORS FROM OTHER WIRES & SURFACES OF THE SAME STRUCTURE	7-26
•	CONSTRUCTION DRAWINGS		
	o	Increased Horizontal Clearance For All Span Lengths	7-124
	o	Climbing Space	7-127
	o	BIL & Air – Wood Spacing	7-128

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

This page left intentionally blank.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/08 Issue – Deleted reference to nonexistent EOP in 7.0.30.

7.0 INTRODUCTION

7.0.10 Role of the National Electrical Safety Code

The National Electrical Safety Code (NESC) provides basic guidance for minimum clearances to protect the public and employees during the installation, maintenance and operation of electric supply and communication lines, and associated equipment. The NESC is not intended as a design specification or an instruction manual.

7.0.20 Role of this Standard

This standard is intended as a design specification to provide for compliance with the NESC, safe installation, operation and maintenance of lines, an adequate level of service reliability, and space for future equipment or conductors. New poles shall be selected to meet or exceed the clearances shown, which shall be considered as minimum requirements.

7.0.30 Clearance Requirements for Distribution Lines

Installations in New York must comply with the New York State High Voltage Proximity Act. This is basically a 10 foot exclusion zone to protect untrained personnel in proximity to high voltage (over 600 V) conductors.

Each vertical and horizontal clearance shall be observed, but within the limits of each other only.

The uniform clearance system contained in the NESC is based on the dimensions of the expected activities in each area, as well as the relative potential problem caused by each type of facility.

Conductor clearance is stated in terms of the "closest approach." This is the clear distance between surfaces that **must** be maintained under specified conditions.

In general, vertical clearance requirements must be met during maximum sag conditions to provide for the expected activity beneath the line.

In general, horizontal clearance requirements must be met with the conductor at rest to provide for the expected activity alongside the line. Conductor "blowout" (wind displacement) is considered under certain conditions (refer to Sections 7.9, 7.10 and 7.13).

7.1 GENERAL

7.11.10 National Grid Clearance Criteria for Distribution Lines

A. Overhead distribution lines shall be designed to maintain adequate clearances under ice loaded conditions and the line's maximum conductor operating temperature (MCOT). In no case should a distribution line be designed for a MCOT below 120°F/48.9°C.

B. The required MCOT of the distribution line shall be determined by the appropriate planning department.

C. To protect conductors from damage caused by excessive heating, the required MCOT for the distribution shall not exceed the following limits:

i. 176°F/80°C for primary bare conductors 35 kV and below,
ii. 167°F/75°C primary covered conductors 35 kV and below,
iii. 120°F/48.9°C for spacer cable messengers and 167°F/75°C for spacer cable phase

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

conductors (Phase conductor temperatures higher than 120°F/50°C are taken to have no influence in elevating messenger temperatures),

iv. Primary shielded and non-shielded aerial cables 35 kV and below shall be designed to operate with the messenger at 120°F/48.9°C ambient (Phase conductor temperatures higher than 120°F/48.9°C are taken to have no influence in elevating messenger temperatures), and

v. Secondary non shielded cables 0 to 750 V shall be designed to operate with the messenger at 120°F/48.9°C ambient (Temperatures of the insulated conductors, lashed or twisted about the messenger, above 120°F/48.9°C, are taken to have no influence in elevating messenger temperatures).

D. New Installations and Extensions - Clearances for the installation of all new electric supply lines and extensions to existing lines shall be in accordance with the latest edition of the NESC and the requirements of any applicable state or local laws, rules or regulations.

E. Existing Installations - Where an existing installation meets, or is altered to meet, the current NESC Rules, such installation is considered to be in compliance with the current edition of the NESC and is not required to comply with any previous edition of the NESC.

F. Existing installations, including maintenance replacements, that currently comply with prior editions of the NESC, need not be modified to comply with these rules except as may be required for safety reasons by the administrative authority.

G. Where conductors or equipment are added, altered, or replaced on an existing structure, the structure or the facilities on the structure need not be modified or replaced if the resulting installation will be in compliance with either (a) the NESC rules that were in effect at the time of the original installation, (b) the rules in effect in a subsequent edition of the NESC to which the installation has been previously brought into compliance, or (c) rules in the latest edition of the NESC.

H. Clearances listed in the following STANDARDS and tables are considered minimum requirements for new construction. In some instances clearances exceeding those given may be required (e.g. when mandated by local ordinances). Other design considerations applying to Company work and operating practices may result in clearances greater than NESC minimum clearances. For example, vertical clearances for 34.5 kV grounded wye construction are based on pre-1987 codes, which called for 40 inch phase to neutral clearance at the pole and 30 inch phase to neutral clearance mid-span for spans up to 175 feet. These added clearances are deemed more prudent for hot-stick operation and maintenance of 25 kV and 35 kV constructions.

I. Effectively grounded circuits are defined as those circuits originating from a grounded-wye connected transformer or system, or from a system provided with a grounding transformer of sufficient size to stabilize the phase to ground voltage at approximately its normal value, regardless of whether the neutral conductor is present with the circuit. Circuits having a maximum X_0/X_1 ratio of 3.0 at the substation bus are considered effectively grounded circuits.

J. Voltage is the root-mean-square (rms) potential difference between any two conductors or between a conductor and ground. Voltages are expressed in nominal values unless otherwise indicated. Nominal voltage is the value assigned to a system or circuit of a given voltage class for the purpose of convenient designation. Operating voltage of the system may vary above or below the nominal voltage.

Supersedes 1/06 Issue – Editorial and paging revisions.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

K. Voltages in the following tables are phase to ground, unless otherwise noted, for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. "Effectively grounded" means intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to limit the buildup of voltages to levels below that which may result in undue hazard to persons or to connected equipment. The voltage of a circuit not effectively grounded is the highest nominal voltage available between any two conductors on the circuit.

L. Clearance is defined as the clear distance between two objects measured surface to surface.

M. Spacing is defined as the distance between two objects measured center to center.

N. Clearances for tree wire, covered conductor, and spacer cable conductor are taken as if they were bare conductors.

O. Open conductors are defined as electric supply or communication construction in which the conductors are bare, covered or insulated and without grounded shielding, or individually supported at a structure either directly or with insulators.

P. Electric supply lines are those conductors used to transmit electric energy and their necessary supporting or containing equipment.

Q. Communication conductors include fire alarm, telephone, cable television, police alarm, data, telegraph, clock, and other systems used for communication service.

R. Fiber-Optic Cables in the supply space:

There are two general categories:

1. Fiber optic cables supported by an effectively ground metallic messenger.
2. All dielectric fiber optic (ADFO) cable.

Clearance requirements:

1. ADFO cables (i.e. meeting NESC Rule 230F1b) installed in the supply space have no specified clearances from supply conductors and other cables in the supply space.
2. Fiber optic cables supported by an effectively ground metallic messenger (i.e. meeting NESC Rule 230F1a) and ADFO cables (i.e. meeting NESC Rule 230F1b) are prohibited from being installed in the Communication Worker Safety Zone between the supply space and the communication space, but may be treated the same as effectively grounded neutrals for clearance purposes.

Supersedes 1/06 Issue – Fiber-optic cable information updated.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

7.1.20 NESC Vertical Clearance Requirements Illustration – Rules 232 & 235

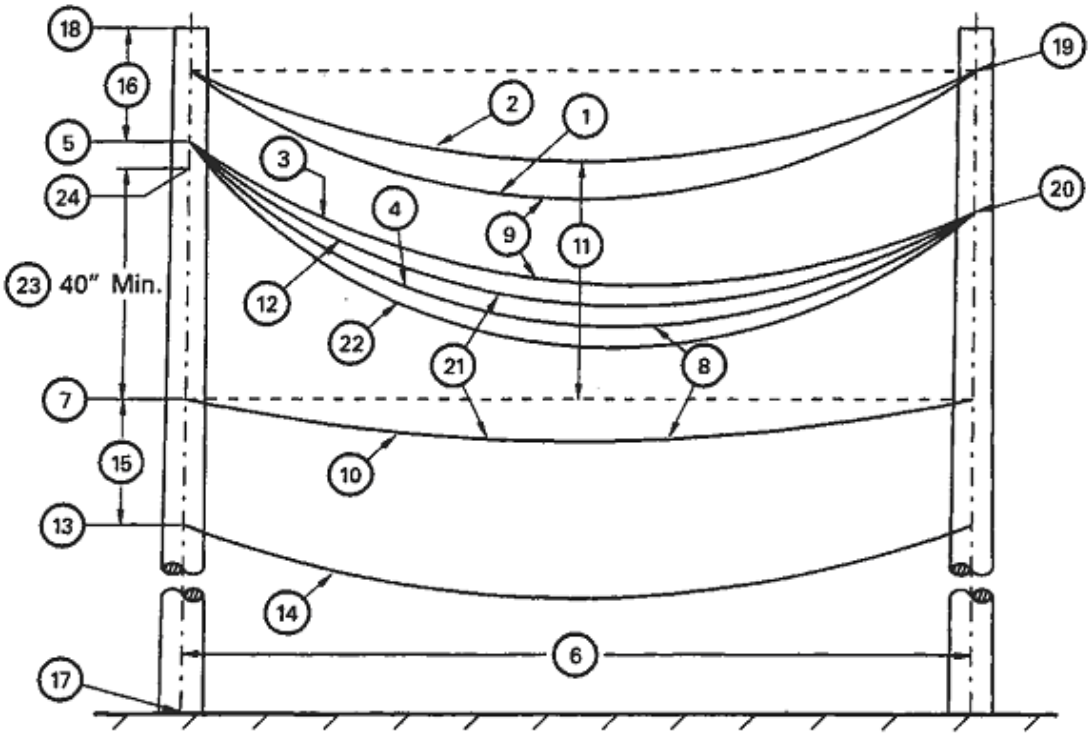


Figure 1

1 - Lowest upper supply conductor at position which produces maximum final sag; effectively grounded circuits 0-22 kV phase to ground.

2 - Lowest upper supply conductor at 60°F/15°C, final, unloaded sag; effectively grounded circuits 0-22 kV phase to ground

3 - Secondary cable, 0-750 V, supported by effectively grounded messenger; messenger at same operating ambient as 1 above.

4 - Effectively grounded neutral associated with 1 above.

5 - Lowest electrical point of attachment.

6 - Actual span length.

7 - Highest communication conductor attachment.

8 - May be reduced to 12 inches for effectively grounded neutral conductors, associated with circuits 0-22 kV phase to ground.

9 - Clearance in-span primary to secondary; must be 75% of that required at support, all span lengths.

10 - Highest communication conductor, Company design based on fire alarm pair or single telephone loop with midspan sag; 4 inches for 0 to 150 feet; 6 inches for 150 to 200 feet; 8 inches for 200 to 250 feet; and 12 inches for 250 to 300 feet; all ambients.

Supersedes 1/06 Issue – Editorial and paging revisions.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

11 - For spans exceeding 150 feet, vertical clearances at the pole between the open supply conductors of over 750 V, but less than 50 kV, and the highest communication conductor, shall be adjusted, so that under conditions of both conductors at 60°F/15°C, no wind, and final unloaded sag, no point in the top supply conductor span shall be below a straight line joining the support points of the highest communication conductor.

12 - Secondary cable, 0-750 V, supported by effectively grounded messenger; at position which produces maximum final sag.

13 - Lowest communication conductor attachment.

14 - Lowest communication conductor.

15 - Communication conductor allocated space.

16 - Electric conductor allocated space.

17 - Final grade.

18 - Top of pole structure.

19 - Primary conductor attachment.

20 - Secondary cable or neutral attachment.

21 - Clearance in-span, secondary to top communication conductor; must be 75% of that required at support; all span lengths.

22 - Effectively grounded neutral conductor associated with top primary conductor; neutral at maximum sag condition.

23 - At pole clearance may be reduced to 30 inches from bottom of grounded non-current carrying equipment, such as transformers, capacitors and voltage regulators.

24 - Lowest electrical ownership.

Supersedes 1/06 Issue – Editorial and paging revisions.

7.2 RELATIVE LEVELS

Where supply lines of different voltages are attached to the same pole or cross one another, the higher voltage conductors should, where practical, be placed above those of lower voltage.

7.3 CLEARANCES OF SUPPORTING STRUCTURES FROM RAIL, CURB, HYDRANT & OTHER OBJECTS

Poles for overhead distribution lines shall be located with adequate clearance to railroad and automobile traffic. The following table demonstrates NESC minimum requirements. These requirements should be exceeded if practicable. State authorities prefer that poles be set back as far as possible from the pavement edge, behind guard rails, back of the ditch, behind sidewalks, curbs, etc. In any case, the approval of the authorities shall be obtained. Avoid poles at exposed corners and similar locations where they are likely to be struck by motor vehicles or snow removal equipment.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Table 1
Clearance of Supporting Structures from Rail, Curb or Hydrant
(Reference: NESC Rule 231)

Supporting structures[1], support arms, attached equipment, and braces shall have the following clearances (in feet) measured between the nearest parts of the objects concerned:

Objects	Minimum (Ft.)	Recommended (Ft.)
A. Fire Hydrants	3[2]	4[2]
B. Streets, Roads, Highways[3]	***Horizontal Clearance for First 15 Feet Above Ground***	
1. With street curbs (clearance measured from street side of the curb)		
a. Arterial Streets which are primarily for through traffic	0.5	2[4]
b. Local Streets which are primarily for access to residences, business or other abutting property	0.5	1[2]
2. With no curbs		See Note 5
C. All Railroad Tracks	***Horizontal Clearance for First 22 Feet Above the Nearest Track Rail***	
	12[6]	

FOOTNOTES:

1. Supporting structures are defined as the main supporting unit, usually a pole or tower.

2. This clearance also applies to anchor guys and push braces.

3. Where a governmental authority exercising jurisdiction over structure location has issued a permit for, or otherwise approved, specific locations for supporting structures, that permit or approval shall govern.

4. Place the supporting structures as far as practical behind the curb within the road right-of-way.

5. Place the supporting structures a sufficient distance from the roadway to avoid contact by ordinary vehicles using the traveled way.

6. This may be reduced to 7 feet where the supporting structure is not the controlling obstruction, provided sufficient space for a driveway is left where the cars are loaded and unloaded.

7.4 VERTICAL CLEARANCES OF WIRES, CONDUCTORS, CABLES, AND EQUIPMENT ABOVE GROUND, ROADWAY, RAILS, ETC.

Clearances for distribution conductors, found in Table 2, above ground, rails, etc., are based on a conductor temperature of 60°F/15°C, no wind.

For lines within the New York State Thruway Authority right-of-way, a basic clearance of 30 feet is required for wires carrying over 7,500 volts. For lines within other state highway rights-of-way in New York, minimum required vertical clearances over roadways are:

i. 18 feet for: wires carrying less than 750 volts; guys, message wires, and communication cables; supply cables encases in a continuous metal sheath; and insulated supply cables fastened to an effectively grounded messenger cable,
ii. 20 feet for wires carrying more than 750 volts to 15,000 volts,
iii. 22 feet for wires carrying more than 15,000 volts to 50,000 volts, and
iv. 22 feet plus 4/10 inch for each 1,000 volt increase for wires carrying more than 50,000 volts.

For clearances near airports in New York refer to ESB # 803 – 808 'Permits'.

Supersedes 7/08 Issue – Added information about clearance requirements over state highways in New York.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 1/06 Issue – Editorial and paging revisions.

Table 2
Minimum Vertical Clearance of Wires, Conductors, and Cables Above Ground, Roadways, or Rails
(Reference: NESC Table 232-1)

Column	Section Heading
1	Grounded guys; messengers, surge protection wires; grounded neutrals; shielded supply cables supported by grounded messenger; ungrounded guys exposed to 0- to 300 V[11,15]; and insulated communication cables and conductors
2A	Non-shielded supply cables, 0 to 750 V, supported by grounded messenger
2B	Non-insulated communication conductors
3	Open supply conductors 0 to 750 V; non-shielded supply cables supported by grounded messenger under 5 $kV_{Ø–Ø}$ or 2.9 $kV_{Ø–G}$; ungrounded guys exposed to over 300 V to 750 V[14]
4	Open supply conductors over 750 V-22 kV; ungrounded guys exposed to 750 V to 22 kV[14]

Nature of Surface Underneath Wires, Conductors, or Cables	1 (ft.)	2A 2B (ft.)	3 (ft.)	4 (ft.)
Where wires, conductors, or cables cross over or overhang				
1. Track rails of railroads (not using overhead electric supply conductors)[2,16]	23.5	24.0	24.5	26.5
2. Roads, streets, and other areas subject to truck traffic [3]	15.5	16.0	16.5	18.5
3. Driveways, parking lots, and alleys[23]	15.5[7,13]	16.0[7,13]	16.5 [7]	18.5
4. Land traversed by vehicles, such as cultivated, grazing, forest, orchards, etc.[26]	15.5	16.0	16.5	18.5
5. Spaces and ways subject to pedestrians or restricted traffic only[9]	9.5	12.0[8]	12.5[8]	14.5
Where Wires, Conductors Or Cables Run Along Highway Or Rights-Of-Way But Do Not Overhang The Roadway				
Nature of Surface Underneath Wires, Conductors, or Cables	**1 (ft.)**	**2A 2B (ft.)**	**3 (ft.)**	**4 (ft.)**
6. Roads, streets, or alleys	15.5[24]	16.0	16.5	18.5
7. Roads in rural districts where it is unlikely that vehicles will be crossing under the line	13.5[10,12]	14.0[10]	14.5[10]	16.5

Note:

For voltages exceeding 22 kV, increase clearances specified above at a rate of 0.4 inches per kV in excess of 22 kV (reference NESC Rule 232C2a).

FOOTNOTES:

Note: Footnotes 1, 4-6, 17-22, and 25, are not used.

2. For wires, conductors, or cables crossing over mine, logging, or similar railways that handle only cars lower than standard freight cars, the clearance may be reduced by an amount equal to the difference in height between the highest loaded car handled and 20 feet, but the clearance shall not be reduced below that required for street crossings

3. Does not include neutral conductors effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1).

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

7. Where vehicles exceeding 8' in height are not normally encountered nor reasonably anticipated, service drop(s) clearances over residential driveways only may be reduced to the following:

	Feet
Insulated supply service drops limited to 300 V to ground	12.5
Insulated drip loops of supply service drops limited to 300 V to ground	10.5
Supply service drops limited to 150 V to ground that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C3)	12.0
Drip loops only of service drops limited to 150 V to ground that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C2 or 230C3)	10.0
Insulated communication service drops	11.5

8. These clearance values for service drops to residential buildings only may be reduced to the following:

	Feet
Insulated supply service drops limited to 300 V to ground	10.5
Insulated drip loops of supply service drops limited to 300 V to ground	10.5
Supply service drops limited to 150 V to ground that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C3)	10.0
Drip loops only of service drops limited to 150 V to ground that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C1 or 230C3)	10.0

9. Spaces and ways subject to pedestrians or restricted traffic only are those where riders on horseback or other large animals, vehicles, or other mobile units exceeding 8 feet in height, are prohibited by regulation or permanent terrain configurations or are otherwise not normally encountered nor reasonably anticipated.

10. Where a supply or communication line along a road is located relative to fences, ditches, embankments, etc., so that ground under the line would not be expected to be traveled except by pedestrians, the clearances may be reduced to the following values:

	Feet
Insulated communication conductor and communication cables	9.5
Conductors of other communication circuits	9.5
Lashed aerial cables (insulated and fully metallic shielded) installed according to these standards and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C1), supply cables limited to 150 V to ground that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C2 or 230C3), and neutral conductors that are effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1)	9.5
Insulated supply conductors limited to 300 V to ground	12.5
Guys	9.5

11. No clearance from ground is required for anchor guys not crossing tracks, rails, streets, driveways, roads, or pathways.

12. This clearance may be reduced to 13 feet for communication conductors and guys.

13. Where this construction crosses over or runs along alleys, driveways, or parking lots not subject to truck traffic, this clearance may be reduced to 15 feet.

Supersedes 7/08 Issue – Revised Footnotes 7 and 8 to reflect 2017 NESC revisions.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

14. Ungrounded guys and ungrounded portions of span guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to slack conductor or guy.

15. Anchor guys insulated in accordance with these standards may have the same clearance as grounded guys.

16. Adjacent to tunnels and overhead bridges that restrict the height of loaded rail cats to less than 20 feet, if mutually agreed to by the parties at interest.

23. For the purpose of this Rule, trucks are defined as any vehicle exceeding 8 feet in height. Areas not subject to truck traffic are areas where truck traffic is not normally encountered nor reasonably anticipated.

24. Communication cables and conductors may have a clearance of 15 feet where poles are in back of curbs or other deterrents to vehicular traffic.

26. When designing a line to accommodate oversized vehicles, these clearance values shall be increased by the difference between the known height of the oversized vehicle and 14 feet.

Supersedes 1/06 Issue – Editorial and paging revisions.

7.5 VERTICAL CLEARANCE OF WIRES, CONDUCTORS AND CABLES ABOVE WATER SURFACES

Vertical clearances of distribution supply wires and conductors over waterways shall not be less than those shown on Table 3: Vertical Clearance Above Water Surfaces. Where the U.S. Army Corps of Engineers has issued a crossing permit, clearances of that permit shall govern, if greater. For canals and waterways controlled by the New York State Department of Transportation, see Electric and Gas System Manual Bulletin #806.

Table 3
Vertical Clearance Above Water Surface (Reference: NESC Table 232-1)

Column	Section Heading
1	Insulated communication conductors and cable; messengers; surge-protection wires; grounded guys; ungrounded guys exposed to 0 to 300 V[11,15]
2	Non-insulated communication conductors; and non-shielded supply cables 0 to 750 V supported by grounded messenger
3	Open supply conductors 0 to 750 V; non-shielded supply cables supported by grounded messenger under 5 $kV_{\Phi-\Phi}$ or 2.9 $kV_{\Phi-G}$; ungrounded guys exposed to over 300 V to 750 V[14]
4	Open supply conductors over 750 V to 22 kV; ungrounded guys exposed to 750 V to 22 kV[14]

Nature of Surface Underneath Wires, Conductors, or Cables	1 (ft.)	2 (ft.)	3 (ft.)	4 (ft.)
Where wires, conductors, or cables cross over or overhang				
1. Water areas not suitable for sailboating or where sailboating is prohibited[21]	14.0	14.5	15.0	17.0
2. Water areas suitable for sailboating including lakes, ponds, reservoirs, tidal waters, rivers, streams, and canals with an unobstructed surface area of: [17,18,19,20,21]				
a. Less than 20 acres	17.5	18.0	18.5	20.5
b. Over 20 to 200 acres	25.5	26.0	26.5	28.5
c. Over 200 to 2000 acres	31.5	32.0	32.5	34.5
d. Over 2000 acres	37.5	38.0	38.5	40.5

Notes:

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 07.00.001

(a) Clearances may be reduced under certain conditions. See NESC Rule 232.

FOOTNOTES:

Note: Footnotes 1-10, 12, 13, and 16 will not be used.

11. No clearance from ground is required for anchor guys not crossing tracks, rails, streets, driveways, roads, or pathways.

14. Ungrounded guys and ungrounded portions of span guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to a slack conductor or guy.

15. Anchor guys insulated in accordance with these standards may have the same clearance as grounded guys.

17. For controlled impoundments, the surface area and corresponding clearances shall be based upon the design high-water level.

18. For uncontrolled water flow areas, the surface area shall be that enclosed by its annual high-water mark. Clearances shall be based on the normal flood level; if available, the 10-year flood level may be assumed as the normal flood level.

19. The clearance over rivers, streams, and canals shall be based upon the largest surface area of any 1 mile long segment that includes the crossing. The clearance over a canal, river, or stream normally used to provide access for sailboats to a larger body of water shall be the same as that required for the larger body of water.

20. Where an over-water obstruction restricts vessel height to less than the applicable reference height given in NESC Table 232-3, the required clearance may be reduced by the difference between the reference height and the over-water obstruction height, except that the reduced clearance shall not be less than that required for the surface area on the line crossing side of the obstruction.

7.6 CLEARANCE TO SWIMMING POOLS

Service drops or other supply wires and conductors should not pass over a swimming pool or the surrounding land within 25 feet around the edge of the pool. If such crossings cannot be avoided, the clearances shown below shall be obtained. For all spans, horizontal clearances must be increased as shown on Page 7-124. For information on other requirements and relocation policy refer to Specifications for Electrical Installations (ESB 750).

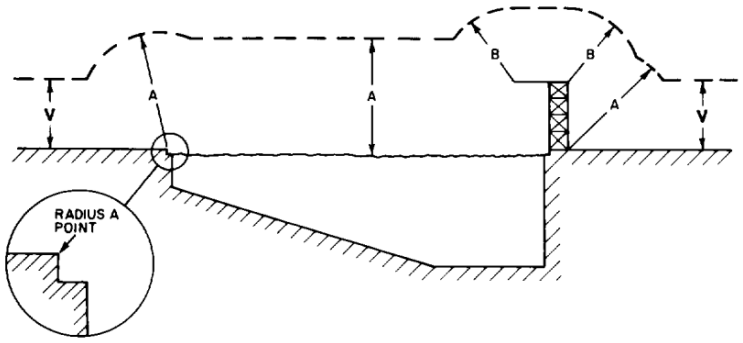


Figure 3

Supersedes 7/08 Issue – Editorial and paging revisions.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/08 Issue – Replaced footnote 7. Added footnote 8.

Table 4
Clearance to Swimming Pools
(Reference: NESC Table 234-3, Figure 234-3, Rules 232 and 234)

Column	Section Heading
1	Insulated communication conductors and cables; messengers; surge-protection wires; grounded guys; ungrounded guys exposed to 0-300 V[3]; neutral conductors that are effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1); lashed aerial cables (insulated and fully metallic shielded) installed according to these standards and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C1)
2	Unguarded rigid live parts, 0 to 750 V; non-insulated communication conductors; supply cables of 0 to 750 V that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C2 or 230C3); ungrounded guys exposed to open supply conductors of over 300 V to 750 V[2]
3	Supply cables over 750 V and under 5 kV phase-to-phase or 2.9 kV phase-to-ground that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C2 or 230C3); open supply conductors, 0 to 750 V
4	Unguarded rigid live parts over 750 V to 22 kV; ungrounded guys exposed to over 750 V to 22 kV[2]
5	Open supply conductors, over 750 V to 22 kV

	Column 1 (ft)[7]	Column 2 (ft)[8]	Column 3 (ft)	Column 4 (ft)	Column 5 (ft)
A. Clearance in any direction from the water level, edge of pool, base of diving platform, or anchored raft	22.0	22.5	23.0	24.5	25.0
B. Clearance in any direction to the diving platform, tower, water slide or other fixed pool-related structures	14.0	14.5	15.0	16.5	17.0
V. Vertical clearance to adjacent land	*Clearances specified in Section 7.4*				

FOOTNOTES:

1. For voltages over 22 kV and up to 50 kV increase specified clearance at a rate of 0.4 inches per kV over 22 kV.

2. Ungrounded guys and ungrounded portions of guys between insulators shall have clearances based on the highest voltage to which they may be exposed due to a slack conductor or guy.

3. Anchor guys insulated in accordance with these standards may have the same clearance as grounded guys.

4. Where wires, conductors, cables, or unguarded rigid live parts are over a swimming pool or the surrounding area, clearances in any direction shall be as shown in the Figure 3 and Table 4 on Page 7-10. This rule does not apply to a pool enclosed by a solid or screened permanent structure.

5. If rescue poles are not used by lifeguards on supervised beaches and waterways, the clearances in Table 3 on Page 7-8 for appropriate land/water body shall be used.

6. Use clearances in Table 3 on Page 7-8 for waterways subject to waterskiing.

7. These clearance requirements do not apply when these facilities are 10 ft or more horizontally from the edge of the pool, diving platform, diving tower, water slide, or other fixed, pool-related structures.

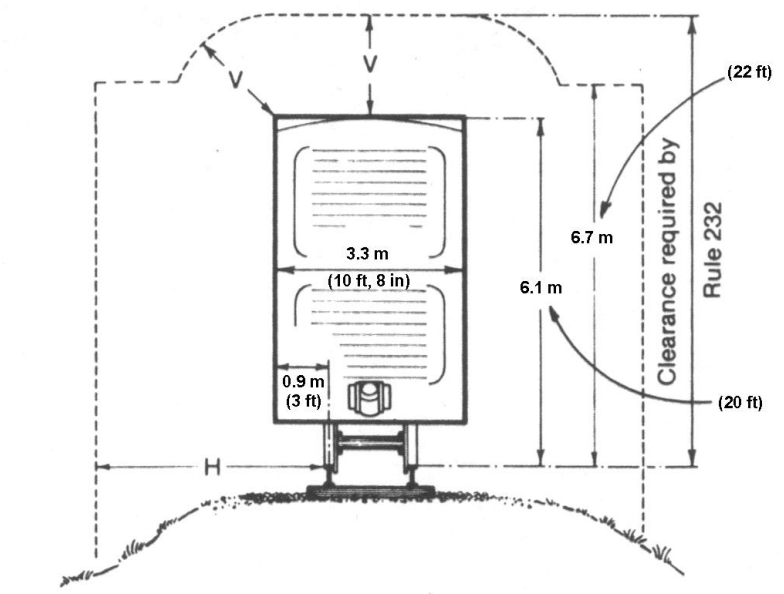
Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

8. These clearance requirements do not apply for non-insulated communication conductors; supply cables of 0 to 750 V that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C2 or 230C3); ungrounded guys exposed to open supply conductors of over 300 V to 750 V when these facilities are installed 10 ft or more horizontally from the edge of the pool, diving platform, diving tower, water slide, or other fixed, pool-related structures.

9. Use clearances in Table 3 on Page 7-8 for waterways subject to waterskiing.

7.7 VERTICAL & HORIZONTAL CLEARANCE OF WIRES, CONDUCTORS AND CABLES TO RAIL CARS

(Reference: NESC Rules 232, 234-1, 234l, Table 232-1, and Figure 234-5)



V = Vertical clearance above rails specified by Section 7.4 of these standards, minus 20 feet (height of rail car)
H = Horizontal clearance to nearest rail.

Overhead Wires, Conductors Or Cables	Clearance In Feet	
	V	H
Grounded Guys, Messengers, Surge Protection Wires, Grounded Neutrals, Shielded Supply Cables Supported By Grounded Messenger, Ungrounded Guys exposed to 0 to 300 V[(e)] And Insulated Communication Cables And Conductors	3.5	8.5
Non-shielded Supply Cables, 0 to 750 V, Supported By Grounded Messenger, Non-insulated Communication Conductors	4.0	9.0
Open Supply Conductors, 0 to 750 V, Non-shielded Supply Cables Supported By Grounded Messenger, Under 5 $kV_{\Phi-\Phi}$, or 2.9 $kV_{\Phi-g}$, Ungrounded Guys Exposed To Over 300 V to 750 V[(f)]	4.5	9.5
Open Supply Conductors Over 750 V to 22 kV; Ungrounded Guys Exposed To 750 V to 22 kV[(f)]	6.5	11.5

Supersedes 7/08 Issue – Modified footnote 7. Added footnote 8.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Notes:

(a) If the Railroad crossed requires greater clearances than detailed in this Standard, the Railroad clearances shall apply.

(b) Voltages are phase to ground for grounded circuits and those circuits where ground faults are cleared promptly by de-energizing the faulted section. For systems that are not effectively grounded, voltages are phase-to-phase.

(c) Anchor guys shall not be located less than 12 feet from the nearest track rail.

(d) Anchor guys insulated in accordance with these standards may have the same clearance as grounded guys.

(e) Ungrounded guys and ungrounded portions of span guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to slack conductor or guy.

Supersedes 1/06 Issue – Editorial and paging revisions.

7.8 VERTICAL CLEARANCE OF EQUIPMENT CASES AND RIGID LIVE PARTS OF EQUIPMENT MOUNTED ON STRUCTURES

Table 5
(Reference: NESC Rule 232B, Table 232-2)

Note - These vertical clearances above ground or roadway surfaces are for unguarded rigid live parts such as potheads, transformer bushings, surge arresters, and short lengths of connecting supply conductors which are not subject to variations in sag.

Column	Section Heading
1	Nonmetallic or effectively grounded support arms, switch handles, platforms, braces, and equipment cases
2	Unguarded rigid live parts of 0 to 750 V and ungrounded cases that contain equipment connected to circuits of not more than 750 V
3	Unguarded rigid live parts of over 750 V to 22 kV and ungrounded cases that contain equipment connected to circuits of over 750 V to 22 kV

Nature of Surface Below	Clearance Above Ground or Roadway		
	Column 1 (ft.)	Column 2 (ft.)	Column 3 (ft.)
1. Where rigid parts overhang:			
a. Roads, streets and other areas subject to truck traffic[4]	15.0	16.0	18.0
b. Driveways, parking lots and alleys	15.0	16.0[6]	18.0
c. Other land traversed by vehicles such as cultivated land, grazing land, forest, orchard, etc.	15.0[7]	16.0	18.0
d. Spaces and ways subject to pedestrians or restricted traffic only[5]	11.0[7]	12.0[1(b)]	14.0
2. Where rigid parts are along and within the limits of highways or other road rights-of-way but do not overhang the roadway			
a. Roads, streets and alleys	15.0[7]	16.0	18.0
b. Roads in rural districts where it is unlikely that vehicles will be crossing under the line	13.0[7]	14.0[2]	16.0

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

3. Water areas not suitable for sailboating or where sailboating in prohibited[9]	14.0	14.5	15.0

FOOTNOTES:

Note: Footnotes 3, 6, and 8 will not be used.

1. For insulated live parts limited to 150 V, this clearance may be reduced to 10 ft.

2. Where a supply line along a road is limited to 300 V to ground and is located relative to fences, ditches, embankments, etc., so that the ground under the line would not be expected to be traveled except by pedestrians, this clearance may be reduced to 12 feet.

4. For the purpose of this rule, trucks are defined as any vehicle exceeding 8 feet in height. Areas not subject to truck traffic are areas where truck traffic is not normally encountered nor reasonably anticipated.

5. Spaces and ways subject to pedestrians or restricted traffic only are those areas where riders on horseback or other large animals, vehicles or other mobile units exceeding 8 feet in height, are prohibited by regulation or permanent terrain configurations or are otherwise not normally encountered nor reasonably anticipated.

6. This clearance may be reduced to the following values for driveways, parking lots, and alleys not subject to truck traffic:

	(ft)
a. Insulated live parts limited to 300 V to ground	12
b. Insulated live parts limited to 150 V to ground	10

7. Effectively grounded switch handles and supply or communication equipment cases (such as fire alarm boxes, control boxes, communication terminals, meters, or similar equipment cases) may be mounted at a lower level for accessibility provided such cases do not unduly obstruct a walkway. Switch handles and supply or communications shall be located so as not to serve as a means of approach to unguarded live parts by unqualified persons.

9. Where the US Army Corps of Engineers, the state, or surrogate thereof has issued a crossing permit, clearance of that permit shall govern.

Supersedes 1/06 Issue – Added FN 6, added switch handles in FN 7.

7.9 CLEARANCE OF WIRES, CONDUCTORS, CABLES AND UNGUARDED LIVE PARTS TO BUILDINGS & OTHER INSTALLATIONS EXCEPT BRIDGES

Primary wires should not be installed over buildings. There are cases, however, especially for temporary work, where such construction cannot be avoided. The clearance of 300 V to 15,000 volt lines over or near buildings and appurtenances shall be as much as is practicable. In no case should it be less than shown below. Services may however, be attached to or run along, or over the building in accordance with accepted practices.

Minimum clearances for multiplex conductors attached to buildings are shown below as well.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

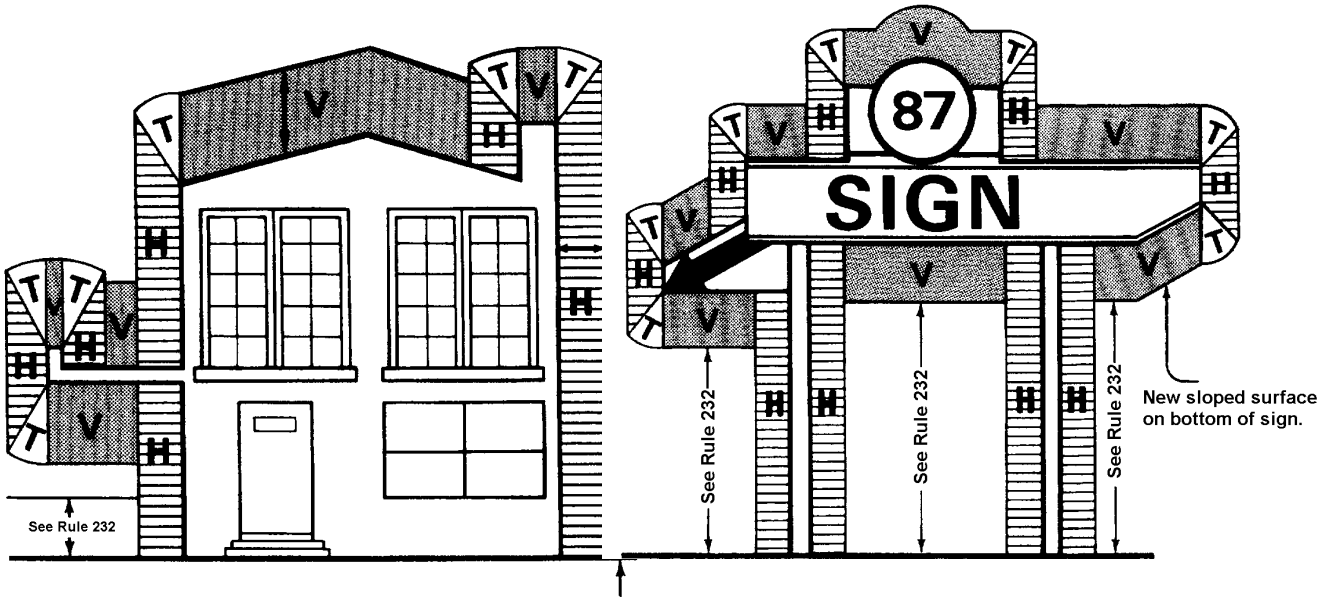


Figure 5

Regions Where Conductors Are Prohibited:
H = Horizontal; V = Vertical; T = Transitional = Vertical (Arc)

Table 6
Clearance of Wires, Conductors, Cables and Unguarded Live Parts to Buildings & Other Installations Except Bridges

(Reference: NESC Tables 234-1 and Rules 232 and 234)

Column	Section Heading
1	Grounded guys, messengers; surge protection wires; grounded neutrals; shielded supply cables supported by grounded messenger; ungrounded guys exposed to 0 to 300 V[13]; and insulated communication cables and conductors
2	Non-shielded supply cables 0 to 750 V, supported by grounded messenger
3	Unguarded rigid live parts 0 to 750 V; ungrounded equipment cases, 0-750 V; ungrounded guys exposed to open supply conductors of over 300 to 750 V[5], and non-insulated communication conductors
4	Open supply conductors 0-750 V; non-shielded supply cables supported by a grounded messenger, over 750 V and under 5 $kV_{\Phi-\Phi}$ or 2.9 $kV_{\Phi-G}$[18]
5	Unguarded rigid live parts, over 750 V-22 kV; ungrounded equipment cases, 750 V–22 kV; ungrounded guys exposed to over 750 V to 22 kV[5]
6	Open supply conductors, over 750 V to 22 kV

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Clearance of:	1 (Feet)	2 (Feet)	3 (Feet)	4 (Feet)	5 (Feet)	6 (Feet)
1. Buildings						
a. Horizontal						
(1) To walls, projections, and guarded windows	4.5[2,7]	5.0[2]	5.0[2]	5.5[2,9]	7.0[2]	7.5[2,10,11]
(2) To unguarded windows[8]	4.5	5.0	5.0	5.5[9]	7.0	7.5[10,11]
(3) To balconies and areas readily accessible to peedestrieans[3]	4.5	5.0	5.0	5.5[9]	7.0	7.5[10,11]
b. Vertical						
(1) Over/under roofs or projections not readily accessible to pedestrians	3.0	3.5	10.0	10.5	12.0	12.5
(2) Over/under balconies and roofs readily accessible to pedestrians[3]	10.5	11.0	11.0	11.5	13.0	13.5
(3) Over roofs accessible to vehicles but not subject to truck traffic[6]	10.5	11.0	11.0	11.5	13.0	13.5
(4) Over roofs accessible to truck traffic[6]	15.5	16.0	16.0	16.5	18.0	18.5
2. Signs, chimneys, billboards, radio and TV antennas, tanks, and other installations not classified as buildings or bridges						
a. Horizontal[4]						
(1) To portions that are readily accessible to pedestrians[3]	4.5	5.0	5.0[2]	5.5[9]	7.0[2]	7.5[10,11]
(2) To portions that are not readily accessible to pedestrians[3]	3.0	3.5	5.0[1,2]	5.5[2,9]	7.0[2]	7.5[2,10,11]
b. Vertical						
(1) Over/under catwalks and other surfaces upon which personnel walk	10.5	11.0	11.0	11.5	13.0	13.5
(2) Over/under other portions of such installations[4]	3.0	3.5	5.5	6.0	7.5	8.0
3. Clearance from other supporting structures[15]						
a. Horizontal (no wind)	5.0 [16]	5.0 [16]	5.0 [16]	5.0 [16]		5.0 [16]
b. Vertical	4.5 [17]	4.5 [17]	4.5 [17]	4.5 [17]		4.5 [17]

FOOTNOTES:

Footnotes 1 and 12 are not used

2. Where available space may not permit this value, the clearance may be reduced by 2 feet provided the wires, conductors, or cables, including splices and taps, and unguarded live parts have a covering that provides sufficient dielectric strength to limit the likelihood of a short circuit in case of momentary contact with a structure or building.

3. A roof, balcony, or area is considered readily accessible to pedestrians if it can be casually accessed through a doorway, ramp, window, stairway, or permanently mounted ladder by a person on foot who neither exerts extraordinary physical effort nor employs tools or devices to gain entry. A permanently mounted ladder is not considered a means of access if its bottom rung is 8 feet or more from the ground or other permanently installed accessible surface.

Supersedes 7/08 Issue – Deleted Footnote 1 and references to it to reflect 2017 NESC revisions.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 17/08 Issue – Revised FN7 to require guys to be effectively grounded, not just grounded, to allow reduced clearances.

4. The required clearances shall be to the closest approach of motorized signs or moving portions of installations (reference NESC rule 234C).

5. Ungrounded guys and ungrounded portion of guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed to a slack conductor or guy.

6. For purpose of this rule, trucks are defined as any vehicle exceeding 8 feet in height.

7. This clearance may be reduced to 3 inches for the effectively grounded portions of guys.

8. Windows not designed to open may have the clearances permitted for walls and projections.

9. The clearance at rest shall be not less than the value shown in this table. Also, when the conductor or cable is displaced by wind, the clearance shall be not less than 4.5 feet (reference NESC Rule 234C1b).

10. The clearance at rest shall be not less than the value shown in this table. Also, when the conductor or cable is displaced by wind, the clearance shall be not less than 4.5 feet (reference NESC Rule 234C1b).

11. Where available space will not permit this value, the clearance may be reduced to 7 feet for conductors limited to 8.7 kV to ground.

13. The anchor end of guys insulated in accordance with these standards may have the same clearance as grounded guys.

14. For clearances above railings, walls, or parapets around balconies or roofs, use the clearances required for roofs not accessible to pedestrians.

15. Support structures include those to which the conductor is not attached, such as lighting support, a traffic signal support, and a supporting structure of another line.

16. This may be reduced to 3 feet for effectively grounded guys and messengers, insulated communication conductors and cables, neutral conductors that are effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1), and supply cables of 300 V or less that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C1, 230C2 or 230C3).

17. This may be reduced to 2 feet for effectively grounded guys and messengers, insulated communication conductors and cables, neutral conductors that are effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1), and supply cables of 300 V or less that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C1, 230C2 or 230C3).

18. Does not include neutral conductors effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1).

Note:

For horizontal clearances under wind displacement conditions, reference the table found in 7.10 corresponding to minimal clearance values. Sample calculations for accounting for wind displacement can be referenced on Page 7-124.

7.10 CLEARANCE TO BRIDGES

The clearance of distribution conductors and cables to bridges shall not be less than those shown in Table 7 below. These are minimum values that should be increased wherever practicable. The clearance over pedestrian walks or over roadways on bridges shall meet the requirements of Table 2 on Page 7-6.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

For all spans, horizontal clearances must be increased as shown on Page 7-124.

Under wind displacement conditions, the following conductors and cables shall be in accordance with the below specified horizontal clearances to bridges. Sample calculations for increased clearances due to wind displacement can be referenced on Page 7-124.

Table 7
Horizontal Clearances Under Wind Displacement Conditions[2]
(Reference: NESC Rule 234D1b)

Conductor of Cable	Horizontal Clearance Required when Displaced by Wind (Feet)
Open Supply Conductor, 0 to 750 V[1]	3.5
230C2 Cable, Above 750 V	3.5
230C3 Cable, Above 750 V	3.5
Open Supply Conductor, over 750 V to 22 kV	4.5

FOOTNOTES:

1. Does not include neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1).
2. See Table 8 for clearances for conductors and cables at rest (not displaced by wind).

Table 8
Clearance of Wires, Conductors, Cables, and Unguarded Rigid Live Parts from Bridges
(Reference: NESC Table 234–2 and Rule 234D1a)

Column	Section Heading
1	Unguarded rigid live parts, 0 to 750 V; non-insulated communication conductors; supply cables of 0 to 750 V meeting Rules 230C2 or 230C3[7]; ungrounded equipment cases; 0 to 750 V; ungrounded guys exposed to open supply conductors over 300 V to 750 V[4]
2	Supply cables over 750 V meeting Rules 230C2 or 230C3[7]; open supply conductors, 0 to 750 V[10]
3	Open supply conductors, over 750 V to 22 kV
4	Unguarded rigid live parts, over 750 V to 22 kV; ungrounded equipment cases, 750 V to 22 kV; ungrounded guys exposed to open supply conductors of over 750 V to 22 kV[4]

	Column 1 (Feet)	Column 2 (Feet)	Column 3 (Feet)	Column 4 (Feet)
1. Clearance over bridges[1]				
a. Attached[3]	3.0	3.5	5.5	5.0
b. Not Attached	10.0	10.5	12.5	12.0
2. Clearance beside, under, or within bridge structure[6]				
a. Readily accessible portions of any bridge including wing, walls, and bridge attachments[1]				
(1) Attached[3]	3.0	3.5[8]	5.5[9]	5.0
(2) Not Attached	5.0	5.5[8]	7.5[9]	7.0
b. Ordinarily inaccessible portions of bridges (other than brick, concrete, or masonry) and from abutments[2]				
(1) Attached[3,5]	3.0	3.5[8]	5.5[9]	5.0
(2) Not Attached[4,5]	4.0	4.5[8]	6.5[9]	6.0

Supersedes 1/06 Issue – Added FNs 1 and 2.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

FOOTNOTES:

1. Where over traveled ways on or near bridges, the clearances of Section 7.4 also apply.

2. Bridge seats of steel bridges carried on masonry, brick, or concrete abutments that require frequent access for inspection shall be considered as readily accessible portions.

3. Clearance from supply conductors to supporting arms and brackets attached to bridges shall be the same as specified in Section 7.14 if the supporting arms and brackets are owned, operated, or maintained by the same utility.

4. Ungrounded guys and ungrounded portions of guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to a slack conductor or guy.

5. Where conductors passing under bridges are adequately guarded against contact by unauthorized persons and can be de-energized and appropriately grounded on each side of the work location for maintenance of the bridge, clearances of the conductors from the bridge, at any point, may have the clearances specified in Section 7.14 for clearance from surfaces of support arms plus one-half the final unloaded sag of the conductor at that point.

6. Where the bridge has moving parts, such as a lift bridge, the required clearances shall be maintained throughout the full range of movement of the bridge or any attachment thereto.

7. Where permitted by the bridge owner, supply cables may be run in rigid conduit attached directly to the bridge.

8. The clearance at rest shall not be less than the value shown in this Table. Also, when the conductor or cable is displaced by wind, the clearance shall be not less than 3.5 feet (reference NESC Rule 234D1b).

9. The clearance at rest shall be not less than the value shown in this Table. Also, when the conductor or cable is displaced by wind, the clearance shall be not less than 4.5 feet (reference NESC Rule 234D1b).

10. Does not include neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1).

Supersedes 7/08 Issue – Corrected page reference in 7.11.10.

7.11 SEPARATION OF CONDUCTORS AND SUPPORTS ON THE SAME POLE

7.11.10 General

Minimum recommended separations between supports and conductors on the same pole are shown in Table 9 on Page 7-20. These should be used on all poles for new lines. They shall generally be used for pole replacements. These should be used only when values recommended for new poles per the Drawings demonstrated in Section 9 - Primaries, are not practicable. As these values are suggesting minimum guidelines, clearances shall be increased to provide additional safety protection wherever possible.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Table 9
Vertical Clearance Between Conductors at Supports
(Reference: NESC Rules 235A, C and Table 235-5)

Column	Section Heading
1	Lashed aerial cables (insulated and fully metallic shielded) installed according to these standards and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C1); insulated, nonshielded cable operated at not over 5 kV phase to phase, or 2.9 kV phase to ground, supported on and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C3); neutral conductors that are effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1); and insulated communication cables, located in the supply space, supported by an effectively grounded messenger (i.e. meeting NESC Rule 224A2)
2	Open supply conductors, 0 to 8.7 kV[12]
3	Open supply conductors, over 8.7 kV to 50 kV, same utility[8]
4	Open supply conductors, over 8.7 kV to 50 kV, different utilities[8]

Conductors and Cables Usually at Lower Levels	Conductors and Cables Usually At Upper Levels							
	Column 1 (Inches)		Column 2[12] (Inches)		Column 3[8] (Inches)		Column 4[8] (Inches)	
	At Pole	Mid-Span	At Pole	Mid-Span	At Pole	Mid-Span	At Pole	Mid-Span
1. Communication Conductors and Cables								
a. Located in the communication space	40[1,5,6]	30[12]	40	30[13]	40	30	40+A[7]	See Note 15
b. Located in the supply space	16[9,10]	12	16[10]	12	40[10]	30	40+A[7]	See Note 15
2. Supply conductors and cables								
a. Open conductors 0 to 750 V; lashed aerial cables (insulated and fully metallic shielded) installed according to these standards and cabled together with an effectively grounded bare messenger or neutral; insulated, nonshielded cable operated at not over 5 kV phase to phase, or 2.9 kV phase to ground, supported on and cabled together with an effectively grounded bare messenger or neutral; and neutral conductors that are effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1)	16[9]	12	16[2]	12[14]	16+A[4,7]	See Note 15	40+A[7]	See Note 15
b. Open conductors over 750 V to 8.7 kV			16[2]	12	16+A[4,7]	See Note 15	40+A[7]	See Note 15
c. Open conductors over 8.7 to 22 kV								
(1) If worked on alive with live-line tools and adjacent circuits are neither de-energized nor covered with shields or protectors					16+A[7]	See Note 15	40+A[7]	See Note 15
(2) If not worked on alive except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by use of live-line tools not requiring line workers to go between live wires					16+A[3,7]	See Note 15	40+A[3,7]	See Note 15
d. Open conductors exceeding 22 kV , but not exceeding 50 kV					16+A[3,7]	See Note 15	40+A[3,7]	See Note 15

A = 0.4 inches per kV in excess of 8.7 kV

When using column and row headings, voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations.

Supersedes 7/08 Issue – Added new FN 6 & renumbered FNs 6 & 7.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/08 Issue – Revised FN 5, added new FN 6 & renumbered FNs 6 & 7.

FOOTNOTES:

1. Where supply circuits of 600 V or less, with transmitted power of 5,000 W or less, are run below communication circuits, the clearance may be reduced to 16 inches. This type of installation must be built following special requirements of NESC Rule 220B2. Distribution Standards Engineering should be consulted prior to making an installation of this type.

2. Where conductors are operated by different utilities, a vertical clearance of not less than 40 inches is recommended.

3. These values do not apply to conductors of the same circuit or circuits being carried on adjacent conductor supports.

4. May be reduced to 16 inches where conductors are not worked on live except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by the use of live line tools not requiring line workers to go between live wires.

5. May be reduced to 30 inches for neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1); fiber-optic cables installed in the supply space supported on a messenger that is effectively grounded throughout its length (i.e. meeting NESC Rule 230F1a); and entirely dielectric fiber-optic cables or fiber-optic cables supported on a messenger that is entirely dielectric and installed in the supply space (i.e. meeting NESC Rule 230F1b). Bonding is not required for entirely dielectric fiber-optic cables or fiber-optic cables supported on a messenger that is entirely dielectric and installed in the supply space (i.e. meeting NESC Rule 230F1b).

6. May be reduced to 30 inches for lashed aerial cables that are insulated, shielded and installed according to these standards where the supply neutral or messenger is bonded to the communication messenger (i.e. meeting NESC Rule 230C1), except that in accordance with the National Grid settlement agreement with Verizon, Verizon requires National Grid to maintain 40” clearance at the pole between lashed aerial cables and Verizon owned communication cables. Application of this exception for lashed aerial cables shall require approval from Overhead Distribution Standards.

7. The greater of phasor difference or phase-to-ground voltage (for more information see NESC Rule 235A3).

8. Example: For a 50 kV-to-ground conductor above a 22 kV-to-ground conductor, when the conductors are 180 degrees out of phase: A = (50 + 22 - 8.7) * 0.4 = 25.4 inches, then round A up to 26 inches.

9. No clearance is specified between neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1) and insulated communication cables located in the supply space and supported by an effectively grounded messenger (i.e. meeting NESC Rule 230F1a).

10. No clearance is specified between entirely dielectric fiber-optic cables or fiber-optic cables supported on a messenger that is entirely dielectric and installed in the supply space (i.e. meeting NESC Rule 230F1a) and supply cables and conductors.

11. Does not include neutral conductors effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

12. May be reduced to 12 inches for neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1); fiber-optic cables installed in the supply space supported on a messenger that is effectively grounded throughout its length (i.e. meeting NESC Rule 230F1a); entirely dielectric fiber-optic cables or fiber-optic cables supported on a messenger that is entirely dielectric and installed in the supply space (i.e. meeting NESC Rule 230F1b); and lashed aerial cables installed according to these standards where the supply neutral or messenger is bonded to the communication messenger (i.e. meeting NESC Rule 230C1). Bonding is not required for entirely dielectric fiber-optic cables or fiber-optic cables supported on a messenger that is entirely dielectric and installed in the supply space (i.e. meeting NESC Rule 230F1b).

13. Supply service drops of 0 to 750 volts, running above and parallel to communication service drops, may have a spacing of not less than 12 inches at any point in the span, including the point of their attachment to the building or structure being served provided the non-grounded conductors are insulated and that clearance as otherwise required by these standards is maintained between the two service drops at the pole.

14. Where conductors are operated by different utilities, a vertical clearance of not less than 30 inches is recommended.

15. 75% of clearance required at the pole.

Supersedes 7/08 Issue – Paging revisions.

7.11.20 Separation on Replaced Poles

In general, the separations on poles that are replaced shall conform to the requirements for new poles. In some special cases, separation may be reduced, but shall not be less than permitted on existing poles.

7.11.30 Reduction of Separation on Poles

Reduced separations of conductors and facilities may be used to accommodate other pole users but shall not be less than clearances required for 15 kV primary circuits.

7.11.40 Basic Impulse Level (BIL) & Air – Wood Spacing

BIL refers to the ability of the pole top design to resist flashovers caused by lightning or line surges.

Distribution pole tops are generally designed to provide 150 kV minimum BIL. This impulse strength shall be based entirely on the impulse flashover of 20 inches or more of wood. Where lightning arresters are used, the “inches of wood” requirement does not apply for the particular conductor having the arrester. In locations where sufficient wood separation is not obtainable due to guy attachment, the use of a fiberglass guy strain insulator will meet this requirement. Additionally, insulated pole top pins (P6B and P6C), long strain insulators (I2), guy strain insulator (TI95B, TI95C, TI95D), and wood braces (TB60 & B37B) may be used to provide the necessary separation if it cannot be met with standard hardware.

In design and construction of pole tops, avoid shorting out the insulation provided by air and wood with steel crossarm braces, steel hardware, ground wires, guy wires, etc. The total distance measured over insulators, wood, and air should be as great as possible.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

7.11.50 Climbing Space

Standard pole top designs shall meet or exceed code requirements for vertical or lateral clearance for line conductors at different levels attached to the same pole. When various designs are combined, however, or when work is done on an existing pole, care should be taken to provide good clearance and to maintain climbing and working space. Page 7-127 shows the NESC clearance required when workers must climb through energized conductors. This drawing should be used as a guide even when the conductors concerned are covered by protective equipment or otherwise guarded as an unvarying practice before personnel climb past them.

Those who install services and secondaries should provide enough space for the personnel who may have to climb through these services to work on the primaries above. Multiplex service taps made 3 feet or more away from the pole will help improve the climbing and working space (Reference Section 10-Secondaries, Construction Drawings).

The climbing space needs to be provided on one side or a corner of the support only.

Vertical runs physically protected by conduit or other protective covering securely attached without spacers to the surface of the pole are not considered to obstruct climbing space.

The climbing space shall extend vertically in the same position - 40 inches above and 40 inches below any wire attachment, but may otherwise be shifted to any other adjacent side or corner of the pole.

All voltages in Table 10 on Page 7-22 are between the two conductors bounding the climbing space, except for communications conductors, which are voltage to ground. Where two conductors are in different circuits, the voltage between conductors shall be the arithmetic sum of the voltages of each conductor to ground for a grounded circuit or phase to phase for an ungrounded circuit.

Supersedes 7/08 Issue – Paging revisions.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 07.00.001

Table 10
Horizontal Climbing Space Between Conductors
(Reference: NESC Rule 236 and Table 236-1)

Character of Conductors Adjacent to Climbing Space	Voltage of Conductors	Horizontal Clearance Between Conductors Bounding the Climbing Space[2]			
		On S.O. Structures used Solely By:		On J.O. Structures	
		Communication Conductors (Inches)	Supply Conductors (Inches)	Supply Conductors Above Communications Conductors (Inches)	Communication Conductors Above Supply Conductors[3] (Inches)
1. Communication conductors	0 to 150 V	No Requirements	--	See Footnote 1	No Requirements
	Over 150 V	24 Recommended	--	See Footnote 1	24 Recommended
2. Lashed aerial cables (insulated and shielded) installed according to these standards (i.e. meeting NESC Rule 230C1)	All	--	--	See Footnote 1	No Requirements
3. Insulated, nonshielded cable operated at not over 5 kV phase to phase, or 2.9 kV phase to ground, supported on and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C3).	All	--	24	24	30
4. Open supply line conductors and covered supply cables, including spacer cable and tree wire (i.e. meeting NESC Rule 230D)	0-750 V	--	24	24	30
	750 V-15 kV	--	30	30	30
	15 kV-28 kV	--	36	36	36
	28 kV-38 kV	--	40	40	
	38 kV-50 kV	--	46	46	
	50 kV-73 kV	--	54	54	
	Over 73 kV	--	>54		

Supersedes 7/08 Issue – Paging revisions.

FOOTNOTES:

1. Climbing space shall be the same as required for the supply conductors immediately above, with a maximum of 30 inches except that a climbing space of 16 inches across the line may be used for communication cables or conductors where the only supply conductors at a higher level are 0 to 750 V secondaries supplying airport or airway marker lights or crossing over the communication line and attached to the pole top or a pole-top extension fixture.

2. Attention is called to the operating requirements of NESC Rules 441A and 446C.

3. This relation of levels in general is not desirable and should be avoided.

4. The climbing space specified in Table 10 above shall be provided above the top support arm to the ridge pin conductor but need not be carried past it.

5. All supply equipment such as transformers, capacitors, cable terminations, switches, etc. when located below conductors or other attachments, shall be mounted outside the climbing space.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

7.12 CLEARANCE TO PROPERTY LINE

In general, conductors and supports shall not overhang property lines unless a right of way or easement has been obtained. In checking overhang, it should be assumed that conductors on rigid supports will be deflected by wind at the amount calculated on Page 7-124.

Plan for future buildings or structures along the property lines, or, if local ordinances specify, along the established building line. If it is probable that a structure will be erected in the foreseeable future, the right-of-way should be adequate to provide standard clearances to such a structure.

7.13 VERTICAL CLEARANCE BETWEEN WIRES, CONDUCTORS & CABLES AT POINT OF CROSSING DIFFERENT SUPPORTING STRUCTURES

It is generally undesirable to build a distribution line directly over or under another line. Where this cannot be avoided, clearance should be provided so that a worker on the top of a pole will be able to maintain adequate working clearances from conductors overhead. Six feet of clearance from the pole top to overhead distribution conductors at 60°F/15°C final sag is suggested as a minimum. See Sub-Transmission or Transmission Standards for voltages over 22 kV.

Supersedes 7/08 Issue – Paging revisions.

Table 11
Vertical Clearance Between Wires, Conductors, and Cables Carried on Different Supporting Structures
(Reference: NESC Rule 233, Table 233-1)

Column	Section Heading
1	Effectively grounded supply guys,[7] span wires and messengers, neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1), and overhead shield/surge-protection wires
2	Effectively grounded communication guys,[7] span wires and communication conductors and cables
3	Lashed aerial cables (insulated and shielded) installed according to these standards (i.e. meeting NESC Rule 230C1), and insulated supply cables of 0 to 750 V (i.e. meeting NESC Rule 230C2 or 230C3)
4	Open supply conductors 0 to 750 V,[6] and insulated supply cables over 750 V other than lashed aerial cables (i.e. meeting NESC Rule 230C2 or 230C3)
5	Open supply conductors over 750 V to 22 kV

	Upper Level				
Lower Level	**1 (ft)**	**2 (ft)**	**3 (ft)**	**4 (ft)**	**5 (ft)**
1. Effectively grounded supply guys,[7] span wires and messengers, neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground, and overhead shield/surge-protection wires	2[1,2]	2[1,2]	2[2]	2	2
2. Effectively grounded communication guys,[7] span wires and communication conductors and cables	2[1]	2[1,2]	2	4[8]	5[7]
3. Lashed aerial cables (insulated and shielded) installed according to these standards, and insulated supply cables of 0 to 750 V	2	2	2	2	2
4. Open supply conductors 0 to 750 V,[6] and insulated supply cables over 750 V other than lashed aerial cables	2	4[9]	2	2	2
5. Open supply conductors, 750 V to 22 kV	2	5[5,9]	2[9]	2[9]	2

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 07.00.001

FOOTNOTES:

Note: Footnotes 3, 4, 6, are not used.

1. No clearance is specified between guys or span wires that are electrically interconnected.

2. The clearance of communication conductors and their guy span, and messenger wires from each other in locations where no other classes of conductors are involved may be reduced by mutual consent of the parties concerned, subject to the approval of the regulatory body having jurisdiction, except for fire-alarm conductors and conductors used in the operation of railroads.

5. This clearance may be reduced to 4 feet where supply conductors of 750 V to 8.7 kV cross a communication line more than 6 feet horizontally from the communications structure.

6. Does not include neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1).

7. These clearances may be reduced by not more than 25% to a guy insulator, provided that full clearance is maintained to its metallic end fittings and the guy wires. The clearance to an insulated section of a guy between two insulators may be reduced by not more than 25% provided that full clearance is maintained to the uninsulated portion of the guy.

8. This clearance may be reduced to 2 feet for supply service drops.

9. In general, this type of crossing is not recommended.

7.14 CLEARANCES OF VERTICAL & LATERAL SUPPLY CONDUCTORS FROM OTHER WIRES & SURFACES OF THE SAME STRUCTURE

Table 12[1]
Clearance of Open Lateral[2] and Vertical Conductors (Inches)
(Reference: NESC Rule 239E, Tables 239-1)

	Phase to Phase Voltage				
Clearances of Open Vertical & Lateral Conductors	**0-8.7 kV (Inches)**	**8.7-15 kV (Inches)**	**15-25 kV (Inches**	**25-35 kV (Inches)**	**35-50 kV (Inches)**
From Surfaces of Supports	3[3]	5	7	9	12
From Span Guys and Messenger Wires[6]	6[4]	9	13	17	23
Anchor Guys	6	8	11	13	17

Table 13[5]
Clearances Between Open Vertical Conductors and Pole Surface (Figures 6 & 7)
(Reference: NESC Rule 239E, Tables 239-2)

Clearances of Open Vertical & Lateral Conductors	**Effectively Grounded Circuits (Φ-G) Voltage**	**Not Effectively Grounded Circuits (Φ-Φ) Voltage**	**A. Zones Above & Below Conductor Where Clearances May Apply**	**B. Minimum Clearance Between Vertical Conductor & Pole Center**
	(kV)	**(kV)**	**(Feet)**	**(Inches)**
From Surfaces of Supports	0 to 22	0 to 22	6	19
From Span, Guy and Messenger Wires[6]	22 to 30	22 to 30	6	22
Anchor Guys	30 to 50	30 to 50	6	30

Supersedes 7/08 Issue – Paging revisions.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

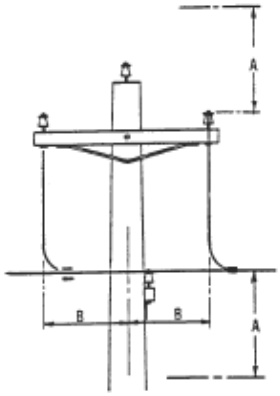


Figure 6

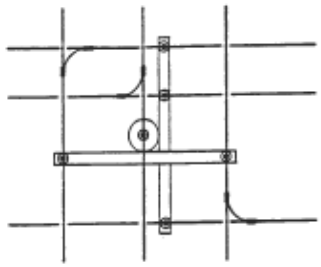


Figure 7

A = zone above and below conductor
B = distance between vertical wire and pole center

Supersedes 7/08 Issue – Paging revisions.

FOOTNOTES:

1. Table 12 applies to supply conductors on supply line structures or within the supply space of jointly used poles.

2. Lateral - A wire or cable extending in a general horizontal direction at an angle to the general direction of the line conductors.

3. Clearance may be reduced to 1 inch for supply circuits 0 to 750 volts. A neutral conductor may be attached directly to the structure surface.

4. Clearance may be reduced to 2 inches for insulated non-shielded cable operated at 0 to 750 volts and supported on and cabled together with an effectively grounded bare messenger.

5. If open wire conductors are within 4 feet of the pole, vertical conductors shall be run in one of the following ways:

    a. Open vertical conductors shall have the clearances given in Table 13 within the zone specified in the table.
    b. Within the zone above and below open supply conductors, as given in Table 13, vertical and lateral conductors may be enclosed in nonmetallic conduit or in cable protected by an insulated covering and may be run on the pole surface.
    c. Grounding conductors may be run on the pole surface without molding.

6. These clearances may be reduced by not more than 25% to a guy insulator, provided that full clearance is maintained to its metallic end fittings and the guy wires. The clearance to an insulated section of a guy between two insulators may be reduced by not more than 25% provided that full clearance is maintained to the uninsulated portion of the guy.

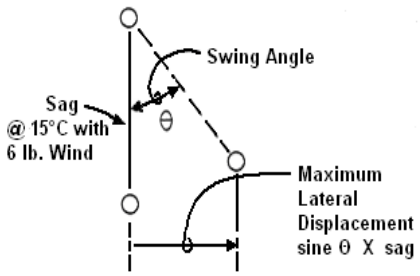
Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Basic HORIZONTAL clearances shown in Tables 2, 4, 6, 7, 8, and 11 must be increased as follows to allow for wind caused lateral conductor displacement. For horizontal adders between conductors carried on different poles (Table 11), apply adder for only one of the conductors.

The vertical sag at 60°F/15°C final with 6 lb. wind taken from Section 6-Primary Conductors for the subject conductor and span is multiplied by the sine of the conductor's swing angle to obtain maximum conductor horizontal movement.

The sine of the swing angle may be calculated or taken from the following table (rounding up to the next value shown).

Swing Angle (Θ)	Sine
25°	0.4226
30°	0.5000
35°	0.5736
40°	0.6428
45°	0.7071
50°	0.7660
55°	0.8192
60°	0.8660



Example:

For a 200 feet span of 336.4 kcm AAC 19 Strand Bare (Std. Item W20B)

1. Swing Angle = 46.5degrees (from Page 6-121)
2. Multiplier = 0.7660 (from table above for 50°)
3. Sag at 60°F/15°C, 6 lb. wind for 200 foot span = 48.36 inches (from Page 6-122)
4. Maximum Lateral Displacement = (48.36 inches) X (0.7660) = 37.04 inches

Note:

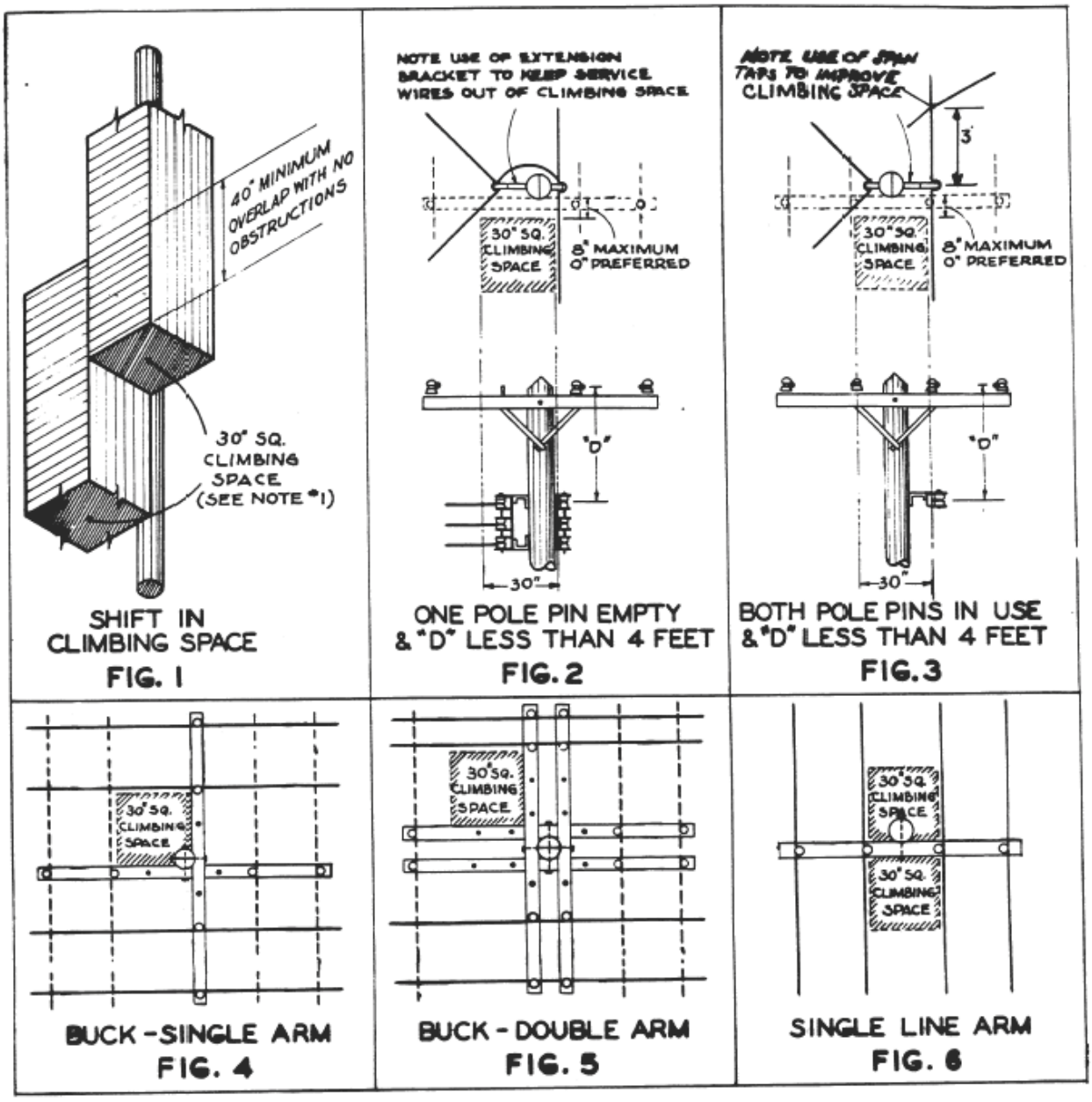
If point of conflict is not at point of maximum sag, the additional horizontal clearance may be reduced as follows:

If the distance between point of crossing or clearance and the nearest support is ___% of the total span, multiply additional clearance by the multiplier outlined below.

Percent of Span	Multiplier
5%	0.19
10%	0.36
15%	0.51
20%	0.64
25%	0.75
30%	0.84
35%	0.91
40%	0.96
45%	0.99
50%	1.00
*Interpolate for intermediate vales or use next higher multiplier.	

Supersedes 1/06 Issue – Corrected conductor information page references.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

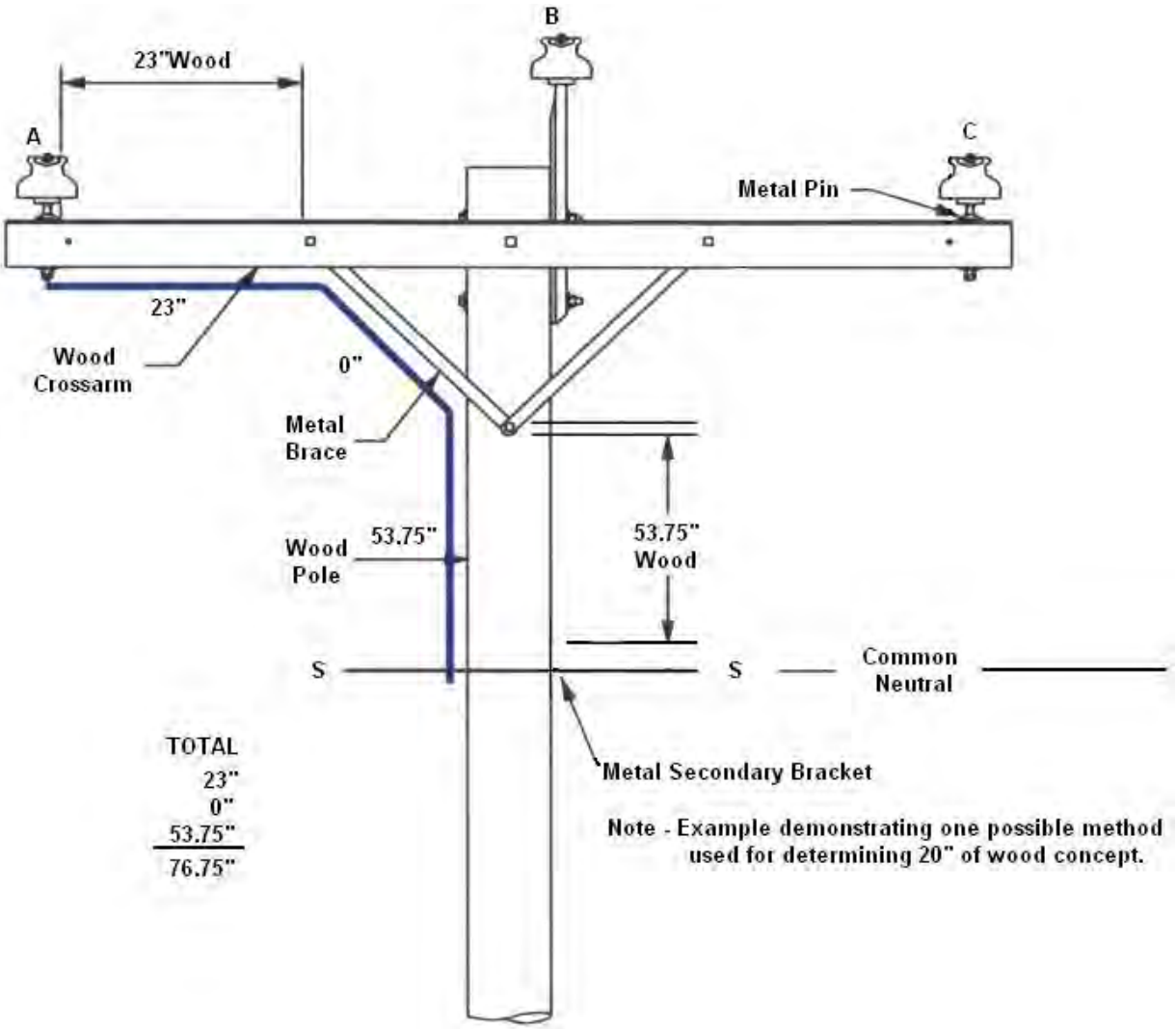


Notes:

1. The climbing space should preferably be continuous from the ground to beyond the top of the pole; but when necessary, it may be shifted from one quarter of the pole to another provided the sections overlap at least 40 inches and there are no obstructions between the two climbing space columns. The climbing space column should extend 40 inches above and below the limiting conductors, but need not extend above a pole top pin.

2. Climbing space should be located in the quarter of the pole not occupied by risers.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



To resist current leakage or electrical flashover a minimum amount of 20” of wood and effective insulation is needed. Non-conducting material such as air, wood, porcelain, or fiberglass is taken together to determine the insulation level.

Keep as much air, wood, porcelain and fiberglass between phase and ground and between phases as is practicable. The above drawing illustrates the 20 inches of wood concept.

Spacing can be increased by
:

1. Relocating hardware, pins, deadends, guy attachments, etc.
2. Using wood braces.
3. Using fiberglass pole top pin.
4. Using fiberglass guy insulator or extra insulators in deadends.

For applications where surge arresters are used, this 20 inches of wood requirement does not apply for the particular conductor having the arrester.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
8	07/19	• Added information about required clearances within state highway rights-of-way in new Section 7.4 on page 7-6.	G. Paul Anundson	J. P. Knauss, Director, Electrical Engineering
7	07/18	• Corrected page reference in Section 7.11.10 on page 7-19. • Corrected conductor information page references on page 7-124.	G. Paul Anundson	Jonathan Gonynor, Director T&D O&M Services
6	07/17	• Added "effectively" to "grounded guys" when allowing reduced clearances to guy wires – Table 6, FN7, page 7-17.	G. Paul Anundson	Jonathan Gonynor, Director T&D O&M Services
5	07/16	• Page 7-8 – revise Footnotes 7 and 8 to reflect 2017 NESC revisions. • Page 7-16 – delete Footnote 1 to reflect 2017 NESC revisions.	G. Paul Anundson	Jonathan Gonynor, Director T&D O&M Services
4	07/15	• Remove reference to nonexistent EOP from 7.0.30.	G. Paul Anundson	Jonathan Gonynor, Director T&D O&M Services
3	07/13	• Section 7.6 - Clearances to Swimming Pools: Revised text, modified FN 7 and added FN 8.	G. Paul Anundson	Cheryl Warren, VP of Asset Management
2	07/10	• Table 9: Revised FN 5, added new FN 6 and renumbered FNs 6 and 7 for Verizon clearances to PLAC at pole, per Verizon settlement agreement.	G. Paul Anundson	Al Chieco, Director of Distribution Standards and Work Methods
1	07/08	• Under 7.0.10, modified description of role of NESC & standard. • Under 7.11.10, modified description of MCOT. • Under 7.11.10.R, fiber-optic cable information updated • Clarified conductor type descriptions on page 7-8. • Modified wire type descriptions and added water slides in Table 4. • Added FN 6, added switch handles in FN 7 on page 7-14. • Revised FNs 16 through 18 on page 7-17. • Added FNs 1 and 2 under Table 7. • Added FN 10 under Table 8. • Modified column descriptions in Table 9. • Revised FNs 1, 5, 7, 9, 10, 11 and 12 under Table 9. • Revised Conductor Descriptions for Rows in Table 10. • Modified conductor descriptions in Table 11. • Added FN 6 under Table 11.	G. Paul Anundson	Al Chieco, Director of Distribution Standards and Work Methods

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SECTION	PAGE
• 8.0 GENERAL	8-1
• 8.1 CONSTRUCTION TYPE	8-1
• 8.2 CORROSION	8-1
o 8.2.10 TYPES OF CORROSION	8-1
o 8.2.11 OXIDATION CORROSION	8-1
o 8.2.12 COPPER OXIDATION	8-1
o 8.2.13 ALUMINUM OXIDATION	8-1
o 8.2.14 STEEL & IRON OXIDATION	8-2
o 8.2.15 GALVANIC CORROSION	8-2
• 8.3 CONSTRUCTION MATERIAL	8-3
o 8.3.10 ARRESTERS	8-3
o 8.3.11 CABLE	8-3
o 8.3.12 CONNECTORS	8-4
o 8.3.13 CUTOUTS	8-5
o 8.3.14 GUYING	8-6
o 8.3.15 INSULATORS AND COPPER DEADENDS	8-6
o 8.3.16 SWITCHGEAR	8-7
o 8.3.17 TRANSFORMERS	8-7 THRU 8-8
• 8.4 ADDITIONAL GUIDELINES REGARDING CONSTRUCTION IN SALT CONTAMINATED AREAS	8-9

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

8.0 GENERAL

This Section covers National Grid overhead distribution construction in "Coastline Areas" for secondary and primary voltages through 15 kV. A "Coastline Area" is all areas within 1/2 mile of a saltwater coastline and those areas beyond 1/2 mile from a saltwater coastline where experience shows that the area experiences heavy salt spray. **Note: This standard may also be applied where experience shows that the area experiences heavy road salt contamination.**

8.0.10 "Coastal" Environment

In the direct vicinity of the coastline, pollution is deposited onto insulators and equipment mainly by spray, wind and fog. The pollution build-up is generally rapid, especially during spray or salt fog conditions. A build-up of pollution over a longer term can also occur through a deposit of wind-borne particles, consisting of quick dissolving and inert components that vary depending on local soil characteristics. Natural cleaning of the insulators by rain is typically effective as the active component of the pollution consists mainly of fast dissolving salts. Reference IEC Standard 60815-1.

8.0.11 Approach

The following standard guidelines have been developed based on field experience in salt contaminated areas and the identification of equipment deterioration caused by tracking or corrosion. This is standard is a "working standard" meaning that it is under continuous development and new guidelines will be issued as additional information is received by Standards regarding equipment that has deteriorated due to salt contamination.

8.1 CONSTRUCTION TYPE

Overhead construction in "Coastline Areas" is generally the same as in other areas with the exception of some changes in the materials used. This standard identifies a list of materials to be used for **Standard Construction** (materials used in other areas) or **Coastline Construction** (materials used in Coastline Areas).

8.2 CORROSION

8.2.10 Types of Corrosion

There are two types of corrosion, Oxidation and Galvanic.

8.2.11 Oxidation Corrosion

Oxidation corrosion of metals occurs in the presence of oxygen with or without the presence of water. Metal oxides begin to form on the surface of metals as soon as they are exposed to air.

8.2.12 Copper Oxidation

On copper, a solid layer of copper oxides will form, providing some protection from additional oxidation corrosion and significantly reducing the electrical conductivity of the surface of the copper. The thickness of the oxide layer on copper will vary depending on the temperature of the copper and will appear as a black or green surface discoloration of the copper. Copper oxide layers will reduce the number and area of contacting points in a connection, thus increasing the contact resistance. Copper conductors must be cleaned prior to making a connection.

8.2.13 Aluminum Oxidation

On aluminum, a solid layer of aluminum oxides will form, providing protection from additional oxidation corrosion and significantly reducing the electrical conductivity of the surface of the aluminum. Oxide growth is self-limiting on aluminum (~2 nanometers thickness) and is usually

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

transparent to the eye. Oxide growth rate on aluminum depends on humidity and temperature. Aluminum oxide is a fast forming, hard, non-conductive coating that develops on the surface of aluminum conductors exposed to air. Unlike copper oxides, aluminum oxide is not visually obvious and should be assumed to exist in all cases of bare aluminum. Aluminum oxide must be removed from a conductor's surface prior to making a connection. **Wire brushing and the immediate application of an oxide inhibitor is required to prevent the reformation of this non-conductive oxide layer prior to connector installation.**

8.2.14 Steel & Iron Oxidation

A layer of iron oxides will form on steel or iron but will not become solid enough to protect the underlying metal from further oxidation. The underlying steel or iron will continue to be exposed to air and oxidation corrosion will continue until the iron or steel is fully consumed. To protect iron and steel from corrosion, the company normally uses either barrier coatings, such as paint, that protect the metal from exposure to air or galvanic coatings, such as zinc, that sacrifice themselves to protect the underlying metal.

8.2.15 Galvanic Corrosion

Galvanic corrosion is the electrolytic action of moisture and other elements of the atmosphere in conjunction with dissimilar metals. This will happen with the metals in electrical connections. Galvanic corrosion is a minor issue in copper or copper alloy connections; however, it is a significant issue if aluminum and copper are involved, unless moisture can be kept away from the connection.

Galvanic corrosion occurs when dissimilar metals are in the presence of an electrolyte with the metals acting as a battery. The metal with the more negative galvanic potential (the anode) loses electrons to the other metal (the cathode) releasing additional ions into the electrolyte and resulting in the loss of material from the anode. Like metals in direct contact are subject to minimal, if any, galvanic corrosion as an electric potential is difficult to establish.

In electrical connections between dissimilar metals (copper to aluminum) galvanic corrosion will occur when an electrolyte is present. Salt contamination on electrical facilities becomes a strong electrolyte when wet from drizzle, fog or high humidity that will promote galvanic corrosion at connections between dissimilar metals. In electrical connections between similar metals (copper to copper or aluminum to aluminum) little galvanic corrosion will occur.

Galvanic corrosion can be controlled in Coastal Areas by keeping electrolytes (salt and water) away from the electrical connection. This standard emphasizes the use of sealed piercing connectors, cold shrink and gel wrap covers and corrosion inhibitors as ways of keeping electrolytes away from electrical connections.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/14 Issue – Corrected section title numbering.

8.3 CONSTRUCTION MATERIAL

8.3.10 Arresters

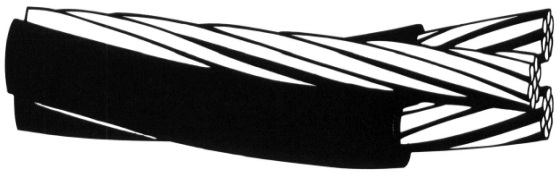
Riser Arresters – 12kV
Standard Construction – Use standard riser arresters.
Coastline Construction – Use extra creepage riser pole arrester

Standard Construction	Coastline Construction
12kV Arrester	12kV Arrester with extra creepage
Std Item L3ER	Std Item L3ERN
	

8.3.11 Cables

Aluminum secondary/service 600V insulated overhead cables can be used in a Coastal Area. To prevent galvanic corrosion, salt and water must not be able to penetrate the area between the phase conductor insulation and the conductor. Care must be taken during installation to avoid damaging the cable insulation. All phase conductor connections must be made with insulated piercing connectors. Bare aluminum neutrals can be connected with H-Tap connectors. **Be sure to wire brush the conductors first.** Exposed secondary cable phase conductor ends must be covered with cold shrink end caps (Std Item UC90C) to prevent salt contamination. In addition, the cold shrink end caps must be covered with one layer of vinyl plastic black insulating tape (Std Item T2W1) to protect it from ultraviolet (UV) light exposure.

Standard Construction – #2 or 1/0 Aluminum triplex cable
Coastline Construction – #2 or 1/0 Aluminum triplex cable
Coastline Construction – #4 or #2 Copper triplex service cable **(Nantucket only – Note: This exception is based on existing construction in Nantucket. Future use of aluminum overhead secondary/service cable in Nantucket will be investigated.)**

Standard Construction	Coastline Construction	Coastline Construction – Nantucket only
#2 Aluminum Triplex – Std Item W15B (500’ coil)	#2 Aluminum Triplex – Std Item W15B (500’ coil)	#4 Copper Triplex – Std Item W15F (1,000’ reel)
#2 Aluminum Triplex – Std Item W15B (1,200’ reel)	#2 Aluminum Triplex – Std Item W15B (1,200’ reel)	
1/0 Aluminum Triplex – Std Item W15C (500’ coil)	1/0 Aluminum Triplex – Std Item W15C (500’ coil)	#2 Copper Triplex – Std Item W15G 1,000’ reel)
1/0 Aluminum Triplex – Std Item W15C (1,000’ reel)	1/0 Aluminum Triplex – Std Item W15C (1,200’ reel)	
		

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

8.3.12 Connectors

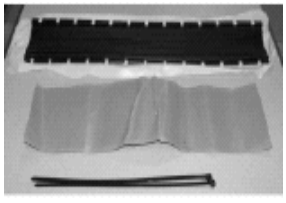
(A) Secondary/services connectors

Standard Construction - H-Tap compression connectors with plastic covers.
Coastline Construction – Weatherproof piercing connectors or H-tap with Gel-filled enclosure cover.

Standard Construction	Coastline Construction	
H-Tap Compression Connectors w/Covers	Weatherproof Piercing Connector	H-Tap compression connector with gel filled enclosure cover
Conductor Range #8 to 1/0 Al & Cu	Conductor Range #8 to 1/0 Al &Cu	Conductor Range #8 to 1/0 Al & Cu
Std Item S13	Std Item S5	Std Items C61A & C61B
		

(B) Primary connectors

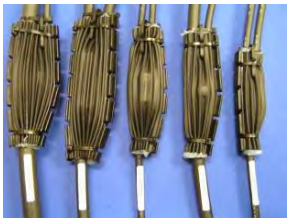
Spacer cable/Tree wire compression splice
Standard construction and Coastline construction on spacer cable/tree wire require that all splices be covered with cold shrink covers for new installations and Gelwrap covers for existing splices that were never covered but should be.

Standard & Coastline Construction
Splice with Cold shrink or Gelwrap waterproof cover
Conductor Range 1/0 thru 795kcmil
Cold Shrink cover – 336.4 thru 795kcmil (Not suitable for 1/0) Std Item S16
Gelwrap Cover 1/0 thru 556.4kcmil Std Item C62
Gelwrap Cover 336.4 thru 795kcmil Std Item C63
  

Supersedes 7/14 Issue – Corrected section numbering.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

(C) Spacer cable/Tree wire tap – Bolted Parallel groove connector
Standard Construction – Bolted parallel groove connector with no covering
Coastline Construction – Bolted parallel groove connector with Gelwrap waterproofing cover.

Standard Construction	Coastline Construction
Parallel Groove Connector - Bare	Parallel Groove Connector with Gelwrap cover
Conductor Range 1/0 thru 795kcmil	Conductor Range 1/0 thru 795kcmil
	For small 1 bolt connector Std Item C67
	For large 2 & 3 bolt connectors Std Item C68
	

8.3.13 Cutouts

15kV – 100 AMP
Standard Construction – Use standard 15kV polymer cutouts.
Coastline Construction – Use 27kV polymer cutouts for extra creepage distance.

Standard Construction	Coastline Construction
15kV Polymer Cutout	27kV Polymer Cutout
Std Item C43S10	Std Item C43S41
	

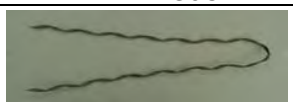
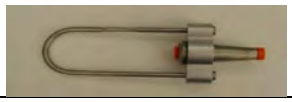
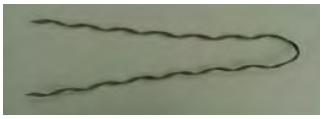
23kV – 35kV
Cutouts for this application are still under investigation for future incorporation into these Coastline Construction standards. Please contact Standards Engineering on a case-by-case basis for particular situations.

Supersedes 7/13 Issue – Corrected section numbering.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

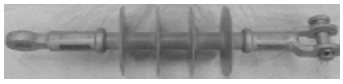
8.3.14 Guying

Guy Deadends (Down guys and span guys)
Standard Construction – Use a preformed guy deadend on one end of guy wire and an automatic deadend on the other end of guy wire for ease of deadending the guy wire.
Coastline Construction – Used a preformed guy deadend on both ends of the guy wire. Automatic deadends corrode and fail in service.

Standard Construction	Coastline Construction
Preformed and automatic deadend	Preformed deadend
12.5M Guy Wire	12.5M Guy Wire
12.5M Preformed Std Item P54E	12.5M Preformed Std Item P54E
12.5M Automatic (Short bail) Std Item G5C4	
12.5M Automatic (Long bail) Std Item G5C4L	
 	

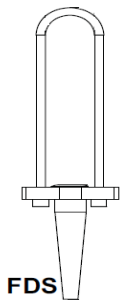
8.3.15 Insulators and Copper Automatic Deadends

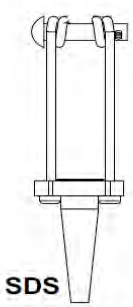
Dead End Insulators
Standard construction and Coastline construction use the same polymer deadend insulator because the creepage distance is adequate for both constructions.

Standard & Coastline Construction
Polymer Deadend Insulator
15kV Insulator Std Item I7PA
35kV Insulator Std Item I7PB


Copper Automatic Deadends
To be used on copper primary conductors in severe corrosion coastal environments.(**Nantucket Only**)

STD ITEM	CU Solid Range	CU 7-Strand Range	Type
D9A	#6	#8	FDS
D9A1	#4	#6	FDS
D9A2	#2 & #3	#3	SDS
D9A3	#2 & #3	#3	FDS
D9A4	#1	#2	FDS
D9A5	#1	#2	SDS
D9A6	2/0	1/0	SDS
D9A7	2/0	1/0	FDS
D9A8	3/0	2/0	SDS
D9A9	3/0	2/0	FDS





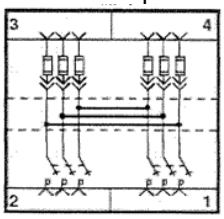
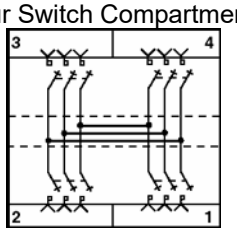
Supersedes 7/13 Issue – Corrected section numbering and table alignment.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/13 Issue – Revised Switchgear table to include currently used PME-9 and PME-10.

8.3.16 Switchgear

Three phase 14.4kV, 600A, low-profile, padmounted, outdoor, metal-enclosed switchgear containing gang operated loadbreak switches and S&C type SML-20 loadbreak power fuses.
Standard Construction – Steel Cabinet
Coastline Construction - Stainless Steel Cabinet

SWITCHGEAR – 14.4KV, 600 AMP.		
CONFIGURATION	Standards Construction STD ITEM	Coastline Construction STD ITEM
PME-9 Two Switch Compartments Two Fuse Compartments 	US45 Steel Cabinet	US45SS Stainless Steel Cabinet
PME-10 Four Switch Compartments 	US45A Steel Cabinet	US45ASS Stainless Steel Cabinet

8.3.17 Transformers

(A) Pole Type Transformers
Standard Construction – Use standard steel conventional transformers.
Coastline Construction – Use stainless steel conventional transformers.

TRANSFORMER, SINGLE – PHASE POLE TYPE						
			Standards Construction		Coastline Construction	
			Conventional Steel Transformer MS 2523		Stainless Steel Transformer MS 2526	
PRIMARY VOLTAGE	SECONDARY VOLTAGE	KVA	PHYSICAL DATA CODE	STD ITEM	PHYSICAL DATA CODE	STD ITEM
12470GrdY/7200	120 / 240	25 50	10-165-10-00-00	T91CB	11-165-10-00-00	T91CBS
13200GrdY/ 7620	120 / 240	10 25 50 75 100 167	10-167-10-00-00	T91DE	11-167-10-00-00	T91HPS
13800GrdY/7970	120 / 240	25 50	10-169-10-00-00	T91EB	11-169-10-00-00	T91HQS
4160GrdY/2400 X 13800GrdY/7970	120 / 240	25 50	10-317-33-00-00	T91HF3	11-317-10-00-00	T91AJS

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

(B) Single Phase Padmount (Minipad) Transformers
Standard Construction – Use standard steel conventional transformers.
Coastline Construction – Use stainless steel conventional transformers

TRANSFORMER, SINGLE – PHASE PADMOUNT (MINIPAD) TYPE

			Standards Construction		Coastline Construction	
			Conventional Steel Transformer MS 2561		Stainless Steel Transformer MS 2562	
PRIMARY VOLTAGE	SECONDARY VOLTAGE	KVA	PHYSICAL DATA CODE	STD ITEM	PHYSICAL DATA CODE	STD ITEM
4160GrdY/2400 X 13800GrdY/7970	240/120	25	30-317-16-00-05	UT31E	31-317-16-00-05	UT31ES
		50				
12470GrdY/7200	240/120	25	30-165-16-00-05	UT31G	31-165-16-00-05	UT31GS
		50				
13200GrdY/ 7620	240/120	25	30-167-16-00-05	UT31H	31-167-16-00-05	UT31HS
		50				
		75				
		100				
		167				
13800GrdY/7970	240/120	25	30-169-16-00-05	UT31J	31-169-16-00-05	UT31JS
		50				

TRANSFORMER, THREE – PHASE WYE-WYE PADMOUNT TYPE

			Standards Construction		Coastline Construction	
			Conventional Steel Transformer MS 2572		Stainless Steel Transformer MS 2575	
PRIMARY VOLTAGE	SECONDARY VOLTAGE	KVA	PHYSICAL DATA CODE	STD ITEM	PHYSICAL DATA CODE	STD ITEM
13200GrdY/ 7620	208Y/120	75	30-691-73-00-05	UT42H	31-691-73-00-05	UT42HS
		150				
		300				
		500				
13200GrdY/ 7620	480Y/277	75	30-691-74-00-05	UT47H	31-691-74-00-05	UT47HS
		150				
		300				
		500				
		750				

Supersedes 7/09 Issue – Removed Item ID's – see Section 22.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

8.4 ADDITIONAL GUIDELINES REGARDING CONSTRUCTION IN SALT CONTAMINATED AREAS

8.4.10 Conductors

- All bare aluminum alloy primary conductors (AAC & AAAC) are acceptable for use in Coastline Construction.
- Aluminum Conductor Steel Reinforced (ACSR) conductors are not an acceptable conductor for use in Coastline Construction due to the potential for corrosion between the steel and aluminum conductors.

8.4.11 Hardware

- Galvanized mild steel hardware corrodes badly and becomes unsightly in three to five years.
- Stainless steel, Duronze, and other metals all have excellent corrosion resistance.
- Aluminum hardware works well.
- Properly applied, aluminum hardware items show excellent resistance to marine corrosion and are expected to last as long as the pole on which they are installed. Their higher initial cost should be offset by drop in replacement costs.
- The following aluminum alloys are acceptable
  - Cast alloy ASTM 356-T6
  - Wrought alloys ASTM 6061-T6, 6151-T6, and 2024-T4.
  - Alloy ASTM 2024-T4 must have a minimum anodized coating of 0.0007-in. for exposure to a marine atmosphere.

8.4.12 Poles

Fill old bolt holes with Alvania No 2 grease before installing aluminum bolts (2024 or 6061-T6 Alloy) in creosoted poles. Otherwise, Poultice attack of the bolts will occur. This attack causes some corrosion where the bolt enters and exits the pole hole. Only minor corrosion occurs. Exposed portions of the aluminum bolts will remain in excellent condition.

Supersedes 7/13 Issue – Corrected section numbering.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
4	7/20	• Revised Switchgear table on page 8-7 to include currently used PME-9 and PME-10. • Revised numbering in index. • Corrected section numbering and table alignment on pages 8-3 through 8-6.	G. Paul Anundson	J.P. Knauss Director, Electrical Engineering
3	7/14	• Added H connector Gel covers for secondaries • Corrected table in 8.2.17	Dave Allen	Rob Sheridan Director – Utility of the Future
2	7/13	• Removed Item ID's from entire section. • Added Copper Deadends in Section 8.2.21 on Page 8-6	Dave Allen	Rob Sheridan Director – Utility of the Future
1	7/09	New Section	Joe Tumidajski	Al Chieco, Director of Distribution Standards and Work Methods

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/20 Issue – Corrected titles for 9-415F, 9-416F, and 9-417F.

SECTION	PAGE
• 9.0 GENERAL	9-1
• 9.1 DESIGN OF PRIMARY FEEDERS	9-1 THRU 9-3
• 9.2 POLE TOPS	9-3 THRU 9-5
• 9.3 TYPES OF CONDUCTORS	9-5 THRU 9-6
• 9.4 SEPARATION OF CONDUCTORS	9-6 THRU 9-7
• 9.5 OTHER	9-7 THRU 9-9
• 9.6 VOLTAGE CONVERSIONS	9-9
• CONSTRUCTION DRAWINGS	
o PHASE POSITIONS	9-105
o PRIMARY DEAD ENDS - DETAILS	9-115
o HAND WRAPPED TIES	9-118
o TIE CONDUCTORS	9-120
o SINGLE LOOP HOT LINE TIES	9-122
o DOUBLE LOOP HOT LINE TIES	9-124
o MAXIMUM SPANS	9-200 THRU 205
o SPACING	9-206
o ISOLATING CIRCUITS OF DIFFERENT VOLTAGES	9-207
o 1Φ (DELTA) AND 3Φ CROSSARM POLE TOP – 0-15 kV – 0° – 10°	9-411
o ALTERNATE 3Φ CROSSARM POLE TOP – 0-15 kV – 0° - 10 ° – (FOR USE WHEN POLE TOP IS UNAVAILABLE FOR CENTER PHASE)	9-411C
o FIBERGLASS 1Φ (DELTA) AND 3Φ CROSSARM POLE TOP – 0-15 kV – 0° – 10°	9-411F
o 1Φ (DELTA) AND 3Φ DOUBLE CROSSARM POLE TOP – 0-35 kV CROSSINGS AND ANGLES 0° – 10°	9-412
o 1Φ (DELTA) AND 3Φ CROSSARM POLE TOP – 0-15 kV – 11° – 20°	9-413
o FIBERGLASS 1Φ (DELTA) AND 3Φ CROSSARM POLE TOP – 0-15 kV – 11° – 20°	9-413F
o 1Φ (DELTA) AND 3Φ DOUBLE CROSSARM POLE TOP – 0-15 kV CROSSINGS 11° – 45° / ANGLES - 21° – 45°	9-414
o 1Φ (DELTA) AND 3Φ DEADEND CROSSARM POLE TOP – 0-15kV – 46°-60° ANGLES / BACK-TO-BACK DEADENDS	9-415
o FIBERGLASS POLE - 1Φ (DELTA) AND 3Φ CROSSARM POLE TOP – 0-15 kV CROSSINGS 0° – 60° / 21°– 60° ANGLES / BACK-TO-BACK DEADENDS (TANGENT)	9-415F
o 1Φ (DELTA) AND 3Φ FIBERGLASS DEADEND CROSSARM POLE TOP – 0-15 kV –ANGLES -61° – 90° AND DEADENDS	9-416
o FIBERGLASS POLE - 1Φ (DELTA) AND 3Φ FIBERGLASS DEADEND CROSSARM POLE TOP – 0-15 kV –ANGLES -61° – 90° AND DEADENDS	9-416F
o 1Φ (DELTA) AND 3Φ FIBERGLASS DEADEND CROSSARM POLE TOP – 0-15 kV DEADENDS	9-417
o FIBERGLASS POLE - 1Φ (DELTA) AND 3Φ FIBERGLASS DEADEND CROSSARM POLE TOP – 0-15 kV DEADENDS	9-417F

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SECTION	PAGE
o 3Φ CROSSARM POLE TOP – 0-15 kV (PREFERRED) 0° – 10° TAP TO 1Φ ARMLESS	9-419 FIG 1
o 3Φ CROSSARM POLE TOP – 0-15 kV (ALTERNATE) 0° – 10° TAP TO 1Φ ARMLESS –	9-419 FIG 2
o 3Φ CROSSARM POLE TOP – 0-15 kV (PREFERRED) 11° – 20° TAP TO 1Φ ARMLESS	9-421 FIG 1
o 3Φ CROSSARM POLE TOP – 0-15 kV (ALTERNATE) 11° – 20° TAP TO 1Φ ARMLESS	9-421 FIG 2
o 1Φ (DELTA) AND 3Φ (WYE) CROSSARM POLE TOP – 0-15 kV – TO 1Φ (DELTA) AND 2Φ (WYE) 11° – 20° TAP	9-422
o 3Φ DOUBLE CROSSARM POLE TOP – 0-15 kV (PREFERRED) - CROSSINGS 11° – 45° / ANGLES 21° – 45° - TAP TO 1Φ ARMLESS	9-423 FIG 1
o 3Φ DOUBLE CROSSARM POLE TOP – 0-15 kV (ALTERNATE) - CROSSINGS 11° – 45° / ANGLES 21° – 45° - TAP TO 1Φ ARMLESS	9-423 FIG 2
o 1Φ (DELTA) AND 3Φ DOUBLE CROSSARM POLE TOP – 0-15 kV CROSSINGS 11°–45° / ANGLES 21°–45° - TAP TO 1Φ (DELTA) AND 2Φ (WYE)	9-424
o 1Φ (DELTA) AND 3Φ CROSSARM POLE TOP – 0-15 kV – 0° – 10° TAP TO 1Φ (DELTA) OR 3Φ CROSSARM	9-435
o PRIMARY MIDSPAN TAP	9-436
1Φ (DELTA) AND 3Φ SINGLE ALLEY ARM POLE TOP – 0-15 kV – 0° – 10°	9-437
o 1Φ (DELTA) AND 3Φ DOUBLE ALLEY ARM POLE TOP – 0-15 kV CROSSINGS AND ANGLES 0° – 10°	9-438
1Φ (DELTA) AND 3Φ SINGLE ALLEY ARM POLE TOP – 0-15 kV – 11° – 20°	9-439
o 1Φ (DELTA) AND 3Φ DOUBLE ALLEY ARM POLE TOP – 0-15 kV CROSSINGS 11° – 60° / ANGLES 21° – 60°	9-440
o 1Φ (DELTA) AND 3Φ SINGLE ALLEY OFFSET POLE TOP – 0-15 kV – 0° – 10°	9-441
o ALTERNATE 3Φ CROSSARM POLE TOP – 0-15 kV – 0° - 10 ° –(FOR USE WITH POLE TOP MOUNTED ANTENNA)	9-450
o 1Φ ARMLESS POLE TOP – 0-15 kV – 0° – 20°	9-711
o 1Φ ARMLESS POLE TOP – 0-15 kV – 0° – 20° - DELTA	9-712
o 1Φ ARMLESS POLE TOP – 0-15 kV – 21° – 60°	9-713
o 1Φ ARMLESS POLE TOP – 0-15 kV – 21° – 60° - DELTA	9-714
o 1Φ ARMLESS POLE TOP – 0-15 kV – 61° – 90° AND DEADEND	9-715
o 1Φ DELTA / 2Φ WYE ARMLESS POLE TOP – 0-15 kV – 61° – 90° AND DEADEND	9-716
o 1Φ ARMLESS POLE TOP – 0-15 kV – 0° – 20° – TAP TO 1 Φ ARMLESS	9-719
o 1Φ ARMLESS POLE TOP – 0-15 kV – 0° – 20° – TAP TO 1 Φ ARMLESS - DELTA	9-720

Supersedes 7/19 Issue – Corrected title block text.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SECTION	PAGE
o 1Φ AND 3Φ ARMLESS POLE TOP – 0-15 kV – 0° – 20° (MAINTENANCE ONLY)	9-811
o 1Φ AND 3Φ ARMLESS POLE TOP – 0-15 kV – 0° – 20°	9-812
o 1Φ (DELTA) AND 3Φ (MAINTENANCE ONLY) ARMLESS POLE TOP – 0-15 kV – 21° – 60°	9-813
o 1Φ (DELTA) AND 3Φ (MAINTENANCE ONLY) ARMLESS POLE TOP – 0-15 kV – 61° – 90° AND DEADEND	9-814
o 3Φ ARMLESS POLE TOP – 0-15 kV (PREFERRED) – 0° – 20° – TAP TO 1 Φ ARMLESS	9-823
o 3Φ ARMLESS POLE TOP – 0-15 kV (ALTERNATE) – 0° – 20° – TAP TO 1 Φ ARMLESS	9-825
o 1Φ (DELTA) AND 3Φ ARMLESS POLE TOP – 0-15 kV – 0° – 20° – TAP TO 3 Φ FIBERGLASS DEADEND CROSSARM	9-835

Supersedes 7/16 Issue – Corrected title block text.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/16 Issue – Corrected title block text.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

9.0 GENERAL

This section includes the design and construction requirements necessary for overhead distribution lines in a crossarm or armless configuration and for single or multiple phases at 15kV primary distribution voltage levels and below. The following Standards shall be used for the design and construction of all new lines, line reconductoring projects, voltage conversion projects, and for pole replacements. Existing facilities should be modified to the current Standards when it is economically feasible to do so. For 25kV and 35kV class circuits, refer to Section 20 or Section 21 of the Overhead Standards book.

9.0.10 Voltage Classes

For the purpose of simplifying the terminology to be used in various descriptions of the following drawings, the voltage class designations are as follows:

5 kV - This designation is generally referred to primary circuit voltages of 5 kV and below regardless if the system is effectively grounded or non-effectively grounded.

15 kV - This designation is generally referred to primary circuit voltages of 15kV and below regardless if the system is effectively grounded or non-effectively grounded.

Refer to Pages 1-1 and 1-2 in the Overhead Standards book for specific voltages within the voltage classes used on the National Grid system.

9.0.20 Coordination With Other Parties

Contact shall occur with all necessary communication companies and municipalities during the initial planning stages so that all parties may properly coordinate their required activities. Construction shall be coordinated to allow for maximum system reliability and efficiency.

9.1 DESIGN OF PRIMARY FEEDERS

The standard 3 phase distribution feeder shall be 4 wire (three conductors, one neutral) multi-grounded wye. The objective is to design and safely construct distribution lines that will provide maximum service reliability at a reasonable cost. This can be attained by routing feeders through minimum tree and traffic exposure, employing the proper type of conductors for the conditions along the route, and providing circuit capacity for normal and reasonably probable contingency conditions, including anticipated load growth.

9.1.10 Routing

The route of the feeder should be such that normally only one distribution circuit is placed on a pole line. Where this is not possible, an effort should be made such that one feeder shall serve the local load while additional express feeders utilizing spacer cable or Preassembled Lashed Aerial Cable (PLAC) are carried through the area.

When feeder construction is necessary along the route of an existing subtransmission circuit, consider underbuilding the subtransmission circuit verses installing a duplicate pole line or major undergrounding. Underbuild of subtransmission can be used if the subtransmission is accessible by bucket truck for normal maintenance and can be taken out of service if required. Seven (7) foot minimum vertical clearance between upper and lower circuits is recommended for worker safety. Approval from the Transmission or Subtransmission Engineering Department is required.

Supersedes 7/07 Issue – Editorial changes.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

9.1.20 Basic Impulse Insulation Level (BIL)

BIL refers to the ability of the pole top design to resist flashovers caused by lightning or line surges. Surge arresters, coordinated to the BIL of the equipment, are installed to limit the overvoltages on equipment by discharging surge current to ground.

Pole tops are designed to provide a minimum of 150 kV insulation impulse withstand. This impulse level is based on the assumed impulse flashover strength of 20 inches or more of wood.

Where lightning arresters are used and where grounding conductors are installed, the 20 inches of wood requirement does not apply for the particular conductor having the arrester. In locations where sufficient wood separation is not obtainable, the use of fiberglass strain insulators shall be installed. Fiberglass guy strain insulators shall be installed onto all new primary guy installations maintaining BIL requirements - refer to Section 3 for guying requirements.

See Section 7 for additional BIL information and drawings.

9.1.30 Size and Loading of Conductors

The initial load on the conductors of the feeder main and taps/branches shall be limited to allow reasonable load growth before the maximum normal peak load limit is reached. This initial load value should allow for a minimum of 10 years of additional expected load growth. The current values for normal and emergency loads are based on consideration of economy with respect to losses and the thermal limits of the conductor. See Section 6 - Primary Conductors for more information on specific primary conductors.

A. Size of Main Line Conductors

15 kV new main line feeders shall utilize 336.4 kcmil or 477 kcmil All Aluminum Conductors (AAC) primary conductors however, upon Engineering approval, 795 kcmil AAC is available. Existing conductors of adequate size may serve for part of any feeder main (see Section 9.3.50) and use of any other conductor size for this purpose will be considered on a case-by-case basis. See Section 6 - Primary Conductors for additional information.

B. Size of Tap (Branch Line) Conductors

Three phase taps shall utilize 1/0 All Aluminum Alloy Conductor (AAAC), 336.4 kcmil AAC, or 477 kcmil AAC primary conductors.

Generally single phase taps shall utilize 1/0 AAAC conductor for expected loading up to 100A. Loadings above this value require the addition of one or more phases.

In existing taps that have a conductor smaller than #2 where it is not economically feasible to reconductor the line or convert it to a higher voltage, step down transformers should be installed.

C. Size of Grounded Neutral Conductors

Maintain a common neutral with minimum splices for effectively grounded circuits.
Note: See Sections 13.4 and 13.5 for information on the bonding of circuit neutrals.

All neutral conductors shall be 1/0 aluminum except when a larger size is either existing or necessary as part of a secondary system. Example: 4/0 AAAC is used with 336.4 kcmil multiplex. Use of a larger neutral conductor, or use of any other secondary cable

Supersedes 7/07 Issue – Editorial changes; text shift.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/11 Issue – In 9.1.40, updated NY voltage regulation requirements and deleted NH requirements.

configuration or size, requires that National Electric Safety Code (NESC) clearances for that particular construction be met.

Generally if existing primary conductors are **smaller** than 1/0 aluminum or equivalent and a neutral conductor exists, it should be used if it is equal size or larger than the primary conductor.

If existing primary conductors are equal to or **larger** than 1/0 aluminum or equivalent and a neutral conductor exists, it should be used if it is at least equivalent to 1/0 aluminum or #3 copper. #2 ACSR (aluminum cable, steel reinforced) is also acceptable.

Existing 7/16 inch CW (copperweld) or #1 AWAC 2/5 messenger may also be used as an effectively grounded neutral, but separate secondary neutrals shall be used with this type of construction.

9.1.40 Voltage Regulation and Flicker

It is suggested that a voltage profile be run for each feeder so that regulation can be reviewed. Contact Distribution Engineering.

Voltage regulation on the primary feeder shall be such that voltage to customers can be maintain to the following acceptable levels on a 120 V base:

Massachusetts - 126 V maximum, 114 V minimum.
New York - 123 V maximum, 114 V minimum.
Rhode Island - 126 V maximum, 114 V minimum.

The voltage is controlled by the station load tap changers (LTC) transformers or station regulators, line regulators, and capacitors. Methods of setting regulators are discussed in Electric & Gas System Bulletin #206 or the Engineering Department Procedures (EDP).

Voltages on lines serving loads such as motors, welders, etc., should be checked to see that any flicker does not exceed the limits given in Section 10. Loads that may cause excessive flicker should be referred to the Distribution Engineering Department.

9.1.50 Radio and Television Interference

Radio and television interference can be caused by loosely connected equipment and materials, which could cause arcing between parts. The higher the primary voltage, the greater the possibility of creating radio and television interference. This interference can be controlled by taking reasonable care to minimize the creation of sharp projections of energized parts by properly applying insulator ties, by making certain all bolted connections on structures are properly tightened, and by maintaining suitable clearances of pole hardware.

9.2 POLE TOPS

The following can be used for pole top constructions and pole considerations.

9.2.10 Selection of Sole Owned and Jointly Owned Poles

There is no standard pole height or class that can positively meet all construction conditions without causing unnecessary expense. Selection of pole height and class requires the

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

coordination of all pole users. Once the correct pole height and class is determined for the most common pole in the project, the remaining pole heights and classes should be easily determined with small changes made to the original calculations. See Section 2 for pole selection information.

Existing poles in sound condition and in the proper locations should be used if pole loading and minimum clearance requirements can be met for the facilities that are being installed.

Prior to changing a jointly owned pole, it should be determined that the communications company is not occupying the Company's space. If the pole must be replaced, or if new poles are to be installed, they shall be selected to provide clearances specified for present and future needs following the Joint Use Contractual Agreements. The Company may be entitled to reimbursement of transfer costs.

Whenever present and future construction requires more pole space, pole top extensions should be considered before a new, larger pole is installed.

Supersedes 7/17 Issue – Corrected reference to NESC rule.

9.2.20 Crossarm Construction

The standard primary 3 phase construction is bare wire on a crossarm, which, for a tangent pole, consists of a 6-pin-8 foot wood crossarm with wood braces, a 24 inch steel pole top pin, steel crossarm pins, and porcelain pin-type insulators for 15kV and below. This type of construction is also recommended for long span rural lines and for lines in heavy industrial areas. It may also be necessary to continue this type of construction on existing lines that are rebuilt to maintain consistency of existing crossarm construction.

Double crossarms are required at line angles over 20 degrees using pin insulators (refer to NESC Rule 261D5(c)), and at c rossings of railroads, limited access highways, and navigable waterways requiring waterway crossing permits (refer to NESC Table 242-1).

Other crossarm sizes and arrangements may be used as field conditions require. They are:

A. Two-Pin Crossarm (10 foot) – Use when specifically called for on individual standards or additional clearances are required.
B. Six -Pin Heavy Duty Crossarm (10 foot) – Use for 3000 lbs Deadend construction.
C. Extension Arms (Alley Arms) – Use when this is the only practical method of obtaining clearance from trees, buildings, etc., or for reducing or eliminating an angle in the line. In general, two or more adjacent poles with extension arms shall be used to reduce the excessive lateral stress, which may be caused by one extension arm in a straight line. Side guys or equivalent may be required to support the unbalanced load of a series of extension arms. (9-440 series)
D. Offset Arms – Use 6 pin with wood braces when the full offset of an extension arm (Alley Arm) is not required. Refer to Section 7 for adequate BIL separation. See 9-441 for Offset Arm construction drawings.
E. Fiberglass Crossarms – Fiberglass deadend crossarms are standard for most deadend applications (see individual structure drawings). Fiberglass tangent crossarms are used on fiberglass poles and when lifting weight of the arm is an issue or when strength is required without the use of crossarm braces.

9.2.30 Armless Construction

Three phase armless construction is available for distribution lines in urban and suburban residential districts for 15 kV and below if span limitations permit. It may also be considered in situations where tree trimming permission is restricted and spacer cable construction will be too costly. See drawings in the 9-800 series for armless construction details.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/15 Issue – Modified 9.3.30 – tree wire may be used with armless construction. Editorial changes in 9.3.20.

Single phase armless (vertical) construction, utilizing steel pole top pin, can be used for all voltages. The drawings in the 9-700 series have various diagrams pertaining to effectively grounded and noneffectively grounded circuits.

9.2.40 Spacer Cable Construction

Spacer Cable construction is preferred for distribution lines when NESC Clearances, Tree Trimming Clearances, and Right of Way Issues can not be resolved with the recommended crossarm or armless types of construction. It may also be selected for an additional express feeder purpose similar to preassembled lashed aerial cable (PLAC).

9.2.50 Phase Position

Circuits should hold the same relative phase position throughout their entire length as far as practicable following the guidelines shown on Page 9-105. Where there is an established policy on phase position in an operating area, it may be continued.

9.3 TYPES OF CONDUCTORS

The type of conductor shall be selected as follows:

9.3.10 Bare Conductors

Bare conductors are preferred over tree wire, spacer cable and preassembled lashed aerial cable due to the cost, construction/maintenance requirements and current carrying capacity. They shall be used in areas where there are no restrictions on tree trimming (local, state, or otherwise).

9.3.20 Covered Conductors

PE covered conductor is not approved for new installations but may be used for maintenance purposes only. This conductor is designed to withstand limited incidental tree contact.

9.3.30 Tree Wire

Tree wire is an approved conductor for new installations in open wire configurations, including crossarm construction, armless construction and single phase construction. This conductor is designed to withstand incidental tree contact, but is not designed to withstand extended tree contact, nor to be installed to permanently eliminate tree trimming. Tree wire may also be installed when local municipal ordinances mandate that covered primary conductors be installed.

Although tree wire offers some electrical protection, **it is not an insulated conductor**. It must be treated as a bare conductor during installation and maintenance.

Tree Wire contains a layer of semi-conducting material at the aluminum conductor surface. **WARNING: When skinning these conductor coverings, do not allow the removed covering to contact equipment grounds or adjacent live phase conductors as an electrical flash may result.**

9.3.40 Spacer Cable

Tree wire is the only wire to be used in a spacer cable configuration. Spacer cable configuration provides maximum reliability and is to be used in heavy tree areas, but is not designed to withstand extended tree contact, nor to be installed to permanently eliminate tree trimming. See Section 16-Aerial/Spacer Cable for more information and construction details. Tree wire in a

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

spacer cable configuration is also approved for express or multiple feeder installations on existing poles.

9.3.50 Preassembled Lashed Aerial Cable (PLAC)

Preassembled lashed aerial cable is approved for expressed or multiple feeder installations on existing poles. This eliminates the need for the installation of a second pole line. It can also be used to achieve NESC Clearance or Right of Way Issues. See Section 16 for more information on this conductor and construction details.

9.3.60 Existing Conductors

A. 5 kV - Existing conductors in good condition, may remain in place for 5kV operations. They may be repaired and maintained using the same or similar conductors. Non-standard conductors should not, however, be used for replacement of several spans, nor for adding a third phase to an existing line. When it is necessary to perform extensive repair work on an existing non-standard line, replacing it with standard conductors is required.

B. 15 kV - Do not use existing conductors smaller than #2 for 15kV effectively grounded systems. Refer to Section 14 regarding the installation of step-up/step-down transformers. Triple Braid Weatherproof (TBWP) insulated conductors should normally be replaced if it will be operating at 15 kV or above in the foreseeable future.

9.4 SEPARATION OF CONDUCTORS

9.4.10 General

Minimum recommended separations between supports and conductors on the same pole are shown on the construction drawings. These should be used on all poles for new lines. They are generally used for pole replacements.

9.4.20 Separation on New Poles

The vertical clearance between primary line conductors and neutral or secondary conductors at poles for new lines shall generally not be less than 56” for 0-15 kV. This distance allows work on the neutral or secondary while maintaining the NESC Phase to Ground Minimum Approach Distance (MAD), including a 30” dimension for “Reach” (based upon the average line worker’s extended reach from chest to finger tips of 30”).

Note: NESC Phase to Ground MAD for 15 kV = 26” + Reach of 30” = 56”

A. Primary Tangent Poles (where wires are on pin insulators and crossarms) – the vertical separation between the bolt for the primary crossarm and the secondary bracket shall be not less than 48” for 15 kV. This will allow 56” clearance between primary line conductors and the neutral or secondary conductors. The distance between the crossarm bolt and the top of the 15kV insulator holding the primary conductor is 8”. This distance plus the distance from the crossarm bolt to the secondary bracket (48”) will total a minimum of 56”.

B. Primary Deadend Poles - the vertical separation between the bolts for the primary crossarm and the secondary bracket shall be not less than 56” for 0-15 kV lines.

9.4.30 Separation on Existing Poles

When pole tops are being rearranged to accommodate additional facilities or when circuits are cut over to a higher voltage level, the recommended separations between primary line conductors and neutrals or secondaries for work on new poles **must** be used if possible. This

Supersedes 7/11 Issue - Editorial revision.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1. Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

will hold future work to a minimum and allow work on secondaries without covering the primaries (NESC Minimum Approach Distance). However, extensive work and pole change outs should not be undertaken solely to reduce work that might become necessary in the future.

When pole tops are rearranged to accommodate additional facilities on the pole, without regard to the owner of the new facilities:

A. If the vertical separation between the primary and the secondary/neutral is 56” or more at the pole, a minimum vertical separation of 56” shall be maintained. This allows qualified electrical line workers to maintain MAD from the primary wires while working on the secondary/neutral at the pole.

B. If the vertical separation between the primary and the secondary/neutral is less than 56”, NESC minimum vertical separations at the pole and in the span shall be maintained. See Section 7.11 (Separation of Conductors and Supports on the Same Pole) for information on these minimum clearance requirements.

9.4.40 Space Available on Jointly Owned Poles

Before replacing any jointly owned poles, be certain that communication company and other attachments cannot be rearranged to permit the desired construction.

9.4.50 Separation on Replaced Poles

The separations on poles that are replaced should conform to the requirements for new poles. In some special cases, separation may be reduced, but shall not be less than that permitted on existing poles.

9.4.60 Reduction of Separation on Poles

Reduced separations of conductors and facilities made to accommodate communication, CATV or other third party interest shall not be less than 15kV minimum requirements.

9.5 OTHER

9.5.10 Surge Arresters

See Section 13.6 (Lightning Protection) and Section 13.7 (Surge Arrester Application Table) for more information on when arresters are required and what type should be used.

9.5.20 Insulators

A. Bare Conductor – One piece radio free, pin type, porcelain insulators of the appropriate ANSI class shall be used to support the phase conductors. A one piece polymer deadend insulator of proper voltage rating shall be used to deadend the conductor.

B. Tree wire/spacer cable – A one piece, plain top, pin type, polyethylene insulator of the appropriate ANSI class shall be used to support the phase conductor. A one piece polymer deadend insulator of proper voltage rating shall be used to deadend the conductor. **Note:** do not remove conductor covering at insulator location. To maintain the integrity of the covering, it must remain intact.

9.5.30 Neutral Brackets

An uninsulated metal bracket shall be used to support the common neutral conductor in the secondary position. See Section 10 for information on Secondaries.

Supersedes 7/07 Issue - Editorial changes; text shift.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

9.5.40 Conductor Ties

Follow these guidelines to ensure the reliability of primary circuits and to reduce or eliminate interruptions caused by inadequate conductor tie practices. Line conductors are to be positioned on its insulators that will produce minimum strain on the tie wires. The function of the tie wire is only to hold the line conductor on its insulator. Conductor strain shall be taken by the insulator and pin.

Hand wrapped ties are to be used for all types of conductor within the 15 kV class. Ties are to be made by hand and without the use of pliers. A tie wire must be neatly and tightly wrapped around the insulator and conductor with free ends wrapped tightly around the conductor. On lines that may eventually be operated above 15 kV, the free ends shall be folded back on the conductor at a distance of 3 inches to facilitate the future removal of the tie with hot sticks.

Hot line ties are to be used when lines are being worked with hot sticks. These also need to be wrapped neatly and tightly around the insulator and conductor. Single loop ties are to be recommended for spans under 160 feet while double loop ties are recommended for conductors with spans of 160 feet and over.

Utilize preformed conductor ties (TT1) for 3000 lb construction.

Care shall be taken to use the proper length and size tie for each conductor specified in the tables on Page 9-120. Refer to Pages 9-118 thru 9-124 for diagrams and information on Hand Wrapped and Hot Line Ties.

9.5.50 Types of Ties –

A. Bridle tie shall be used for all bare and covered conductors larger than #4 AWG regardless of span length.

B. Looped Western Union and Cross Top Tie shall be used for all bare and covered conductors # 4 AWG or smaller (#4, #6,etc.).

C. Bare Conductor – Use bare tie wire. (W22A,W22BA,W22C)

D. Tree Wire – Use covered tie wire (W22D). **Note:** Do **not** use molded plastic ties. Do **not** remove tree wire covering at polyethylene pin type insulator.

E. Existing Polyethylene and Neoprene Covered Line - Wire to be converted to the 15 kV Voltage class – Install 15 kV pin type polyethylene insulator and tie with covered tie wire (W22D) where existing covering on conductor has not been previously removed. Where covering has been removed, use a pin type porcelain insulator and tie conductor to insulator with bare tie wire.

F. Existing Braid Covered (rubber) Line Wire (Maintenance Only) – Remove the covering at the insulators (30 inches on both sides of the insulator) and tie with bare tie wire of the same metal as the line conductor for all voltages.

G. Double insulators shall use ties for single insulators with each tie occupying one-half the available space between insulators – same number of turns with closer spacing.

9.5.60 Splices, Connectors, Taps, Etc.

See Section 5 (Connectors) for all information regarding choosing and installing splices, connectors, taps, deadend clamps, etc for bare or covered wire.

Supersedes 7/07 Issue - Removed splice/connector information (refer to Section 5); text shift.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

9.5.70 When Voltage Changes Along Line

When two sections of line with different voltages, both 15kV or below, come to the same poles, see page 9-207 for required line isolation by establishment of a de-energized span. This situation will typically occur at locations where a voltage conversion project ends and no tie through a step-down / step-up transformer is established or where line extensions of different voltages meet to serve all customers along a road.

9.6 VOLTAGE CONVERSIONS

All voltage conversions done on the National Grid distribution system must be done in accordance with EOP D010 - Primary Circuit/Transformer Voltage Conversion.

9.6.10 Material Requirements

Certain material items shall be replaced or added during a conversion. These include, but are not limited to, the following:

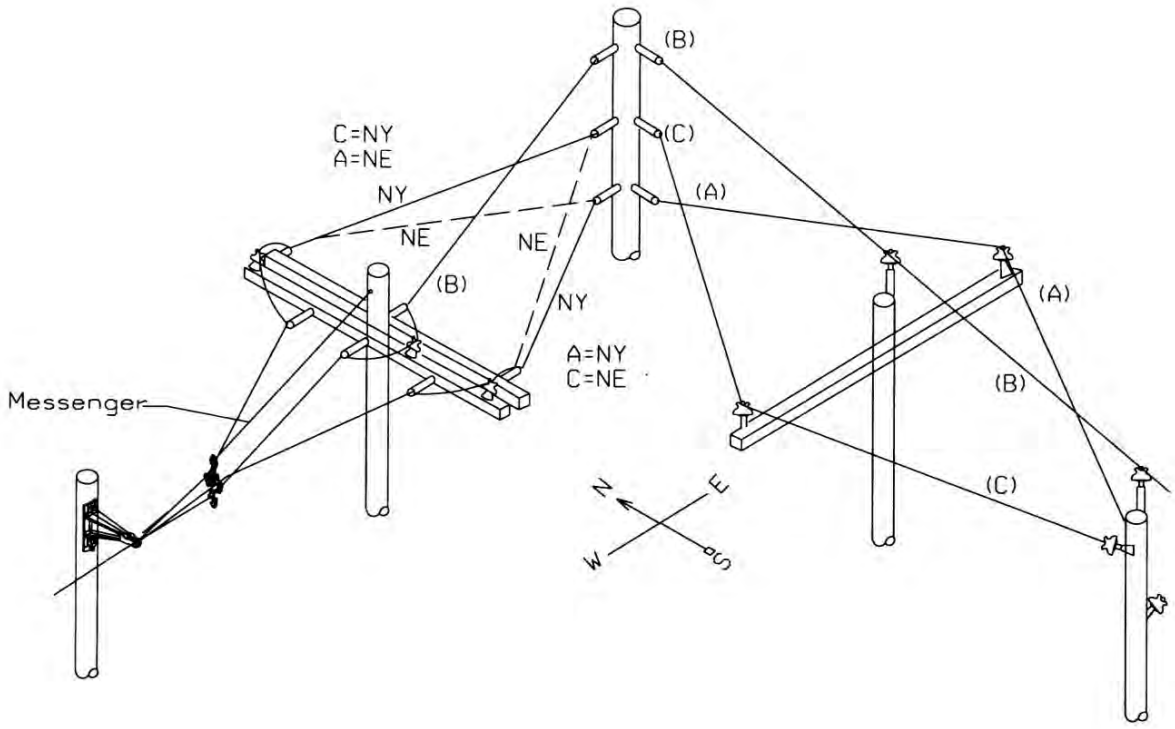
A. Wood insulator pins must be replaced with steel pins.
B. Correct insulation level must be in place: single bell insulators in deadends and 5kV pin insulators must be replaced.
C. Guy wires must be built to current standards - see Section 3.4.50 (Voltage Conversions) for details.
D. Primary taps shall be fused.
E. Arresters shall be installed per Section 13.6 (Lightning Protection).

Supersedes 7/15 Issue - Added section 9.5.70 requirement for lines of different voltages.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 1/06 Issue – 25-35 kV Construction Information is Relocated to New Section 20



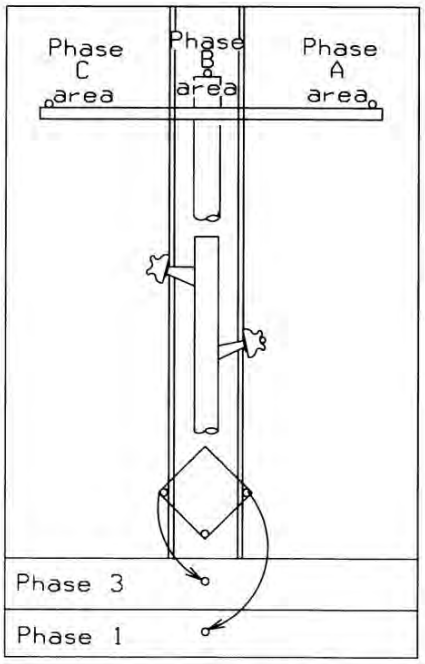
Notes:
If there are local rules that have been approved by the division superintendent, these should be followed where practicable. Otherwise use the rules below:

(1) New England - Put phase A on the northerly or easterly side for horizontal crossarm or spacer cable installations. Put phase A on the bottom for vertical construction.

New York - Put phase A on the southerly or easterly side for horizontal corssarm or spacer cable installations. Put phase A on the bottom for vertical construction.

(2) Put phase B in the middle or top positoin for horizontal crossarm or for vertical construction. Phase B shall occupy the middle and bottom position for spacer cable in triangular arrangments.

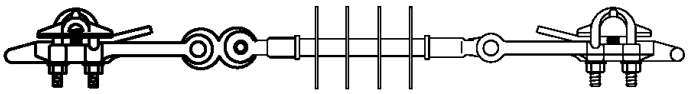
(3) Put phase C in the remaining position.



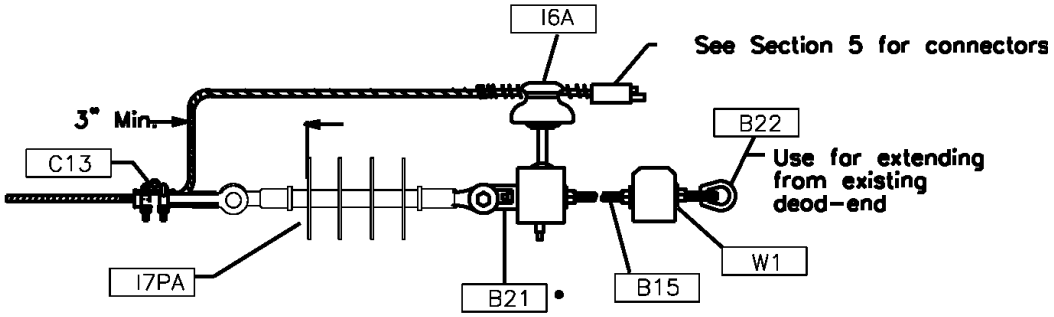
Look north = NE & NY
Look east = NY
Look west = NE

PHASE POSITIONS 15 kV DISTRIBUTION PRIMARY			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 9-105	ISSUE 7/07

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

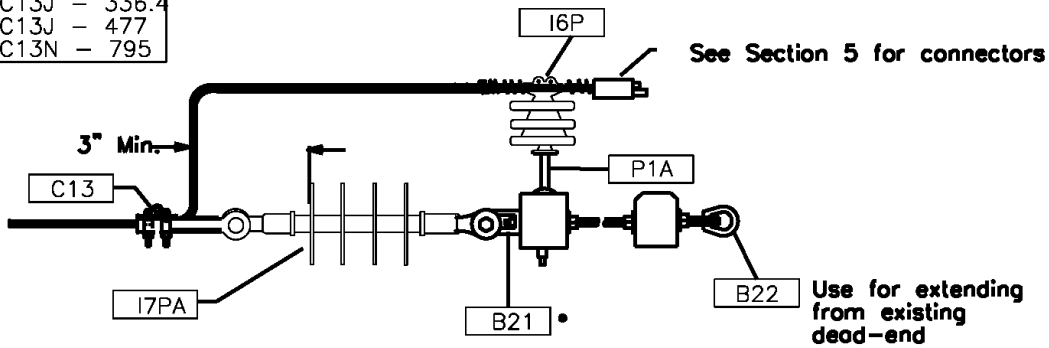


Inline Dead Ends



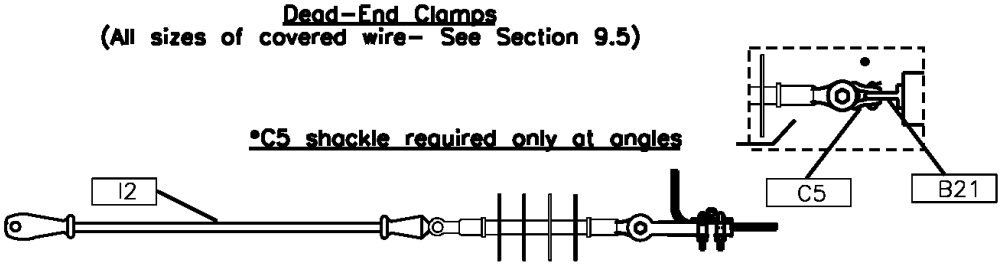
Dead-End Clamps
(All sizes of bare wire)

C13H – 1/0
C13J – 336.4
C13J – 477
C13N – 795



Dead-End Clamps
(All sizes of covered wire– See Section 9.5)

•C5 shackle required only at angles



Inline Dead Ends

Notes:

Maintain full impulse and flashover strength; see Section 7.
This drawing is for dead-ends on wood crossarms or wood poles.

See 2.8 for information on crossarm.
Use heavy duty crossarms(C31D) and braces(TB60) and gain plates(C37) for 3000 lb construction.

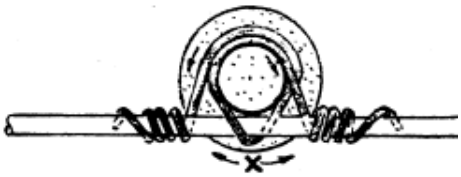
Supersedes 7/11 Issue – Corrected second and third drawings by removing the figure-8 link.

PRIMARY DEAD – ENDS 15 kV DISTRIBUTION PRIMARY			
ISSUE	**PAGE NUMBER**		
7/18	**9-115**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 1/06 Issue – 25-35 kV Construction Information is Relocated to New Section 20

HAND WRAPPED TIES



LOOPED WESTERN UNION (LWU) - SIDE GROOVE TIE
FIG I



CROSS TOP (CT) TOP GROOVE TIE
FIG II

FIG I & II TO BE USED FOR ALL BARE AND COVERED CONDUCTOR OF #4 AWG OR SMALLER.



BRIDLE TIE SIDE GROOVE
FIG III



BRIDLE TIE TOP GROOVE
FIG IV

FIG III & IV TO BE USED ON ALL COPPER & ALUMINUM CONDUCTORS LARGER THAN #4 AWG

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

TIE CONDUCTORS

TABLE I – LENGTH AND TYPE - FOR BARE LINE CONDUCTOR

Line Conductor Size AWG-kcmil	Tie Wire Size AWG	Std Item	Class 55-4 Insulator – 15kV			
			Side Groove		Top Groove	
			Length (Inches)	Type	Length (Inches)	Type
# 6 Cu	# 6 Cu	W22A	28	LWU	32	CT
# 6A CW &CCW	# 6 Cu	W22A	32	LWU	36	CT
# 4 Cu	# 6 Cu	W22A	38	LWU	40	CT
# 3 Cu	# 6 Cu	W22A	55	Bridle	46	Bridle
# 2 Cu	# 4 Cu	W22BA	62	Bridle	54	Bridle
# 1/0 Cu	# 4 Cu	W22BA	70	Bridle	60	Bridle
# 4/0 Cu	# 4 Cu	W22BA	76	Bridle	64	Bridle
Larger Cu	# 4 Cu	W22BA	-	Bridle	-	-
# 4 ACSR	#4 AL	W22C	38	LWU	40	CT
# 2 ACSR	#4 AL	W22C	62	Bridle	53	Bridle
# 1/0 ACSR	#4 AL	W22C	66	Bridle	56	Bridle
# 4/0 AAC	#4 AL	W22C	78	Bridle	66	Bridle
336.4 AAC	#4 AL	W22C	86	Bridle	74	Bridle
336.4 ACSR3000#	#4 AL	TT1B	Preform	Bridle	Preform	Bridle
477.0 AAC	#4 AL	W22C	105	Bridle	93	Bridle
477.0 ACSR	#4 AL	W22C	105	Bridle	93	Bridle
795 AAC	#4 AL	W22C	108	Bridle	96	Bridle

TABLE II – LENGTH AND TYPE - FOR COVERED AND TREE LINE CONDUCTOR

Note: If insulation is removed 30", use bare tie wire (see above)

Line Conductor Size AWG-kcmil	Tie Wire Size AWG	Std Item	Class 55-4 Insulator – 15kV			
			Side Groove		Top Groove	
			Length (Inches)	Type	Length (Inches)	Type
# 6 Cu	#4 AL TPR	W22D	28	LWU	32	CT
# 6A CW &CCW	#4 AL TPR	W22D	32	LWU	36	CT
# 4 Cu	#4 AL TPR	W22D	38	LWU	40	CT
# 3 Cu	#4 AL TPR	W22D	38	Bridle	50	Bridle
# 2 Cu	#4 AL TPR	W22D	62	Bridle	54	Bridle
# 1/0 Cu	#4 AL TPR	W22D	68	Bridle	60	Bridle
# 4/0 Cu	#4 AL TPR	W22D	77	Bridle	68	Bridle
Larger Cu	#4 AL TPR	W22D	-	Bridle	-	-
# 4 ACSR	#4 AL TPR	W22D	38	LWU	40	CT
# 2 ACSR	#4 AL TPR	W22D	62	Bridle	53	Bridle
# 1/0 ACSR	#4 AL TPR	W22D	66	Bridle	56	Bridle
# 4/0 AAC	#4 AL TPR	W22D	78	Bridle	66	Bridle
336.4 AAC	#4 AL TPR	W22D	86	Bridle	74	Bridle
477.0 AAC	#4 AL TPR	W22D	105	Bridle	93	Bridle
795 AAC	#4 AL TPR	W22D	108	Bridle	96	Bridle

Supersedes 1/06 Issue – 25-35 kV Construction Information is Relocated to New Section 20

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SINGLE LOOP HOT LINE TIES

1. **<u>USE SINGLE LOOP TIES FOR SPANS UNDER 160 FEET</u>**. where lines are to be worked hot. Use double ties for spans over 160 feet. and for all angle poles.

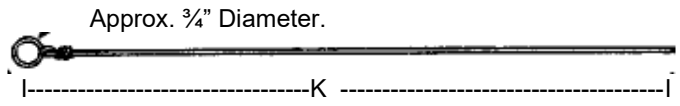


Figure A – Prepare Loop – Two Required



Figure B – Loops In Place On Insulator

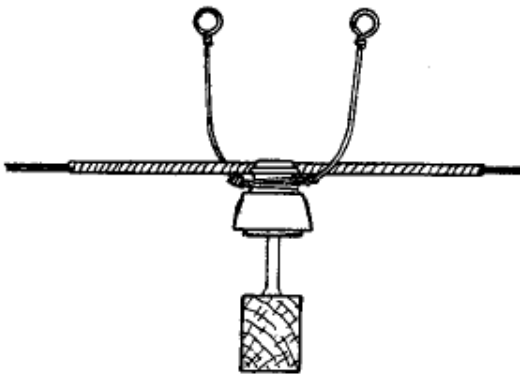


Figure C – Conductor In Place

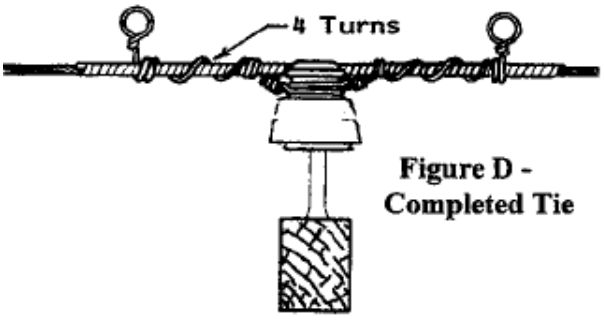


Figure D - Completed Tie

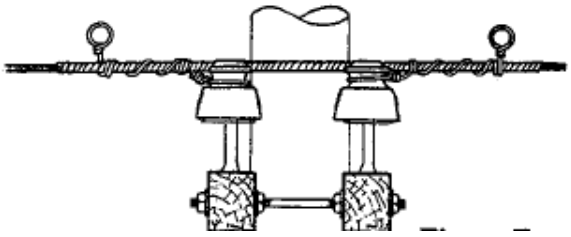


Figure E – On Double Arms

Line Wire Size AWG-kcmil	Tie Wire Size AWG-kcmil	Length "K" (Inches)			Line Wire Size AWG-kcmil	Tie Wire Size AWG-kcmil	Length "K" (Inches)
#3 Copper	#6 Copper	32			#1/0 6201 Al.	#4 Alum.	34
#1/0 Copper	#4 Copper	36			#4/0 6201 Al.	#4 Alum	40
#4/0 Copper	#4 Copper	40			336.4 ECA	#4 Alum	44
#4 ACSR	#4 Alum.	28			477.0 ECA	#4 Alum	46
#1/0 ACSR	#4 Alum.	34					

Supersedes 1/06 Issue – 25-35 kV Construction Information is Relocated to New Section 20

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

DOUBLE LOOP HOT LINE TIES

1. **USE DOUBLE LOOP TIES FOR SPANS OVER 160 FEET**. where lines are to be worked on hot and for all angle poles. Use single ties for spans under 160 feet.



Approx. ¾" Dia.
2 - Full Turns

Figure A- Prepare Loop – Two Required

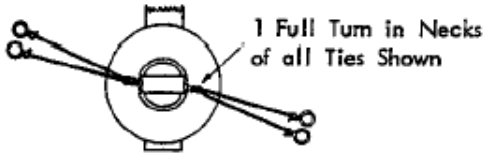


Figure B – Loops In Place On Insulator (Top View)

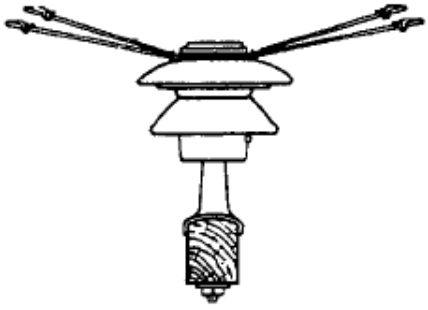


Figure C – Loops In Place On Insulator

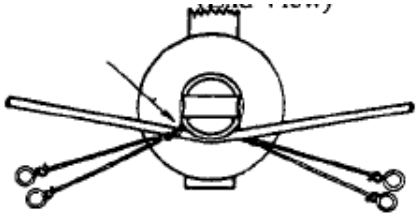


Figure D – Conductor In Place (In Side Groove For Angle In Line)

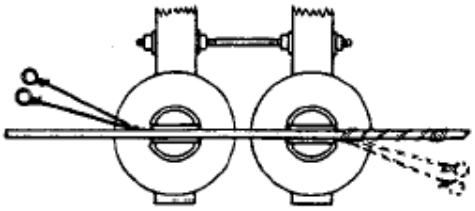


Figure E – Double Insulators Conductor In Place – Top Groove

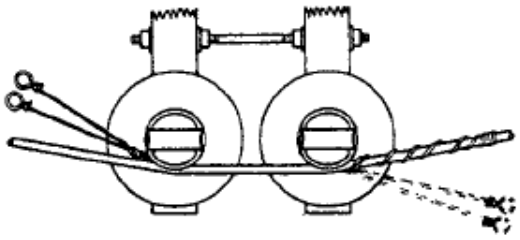


Figure F – Double Insulators Conductor In Place – Side Groove

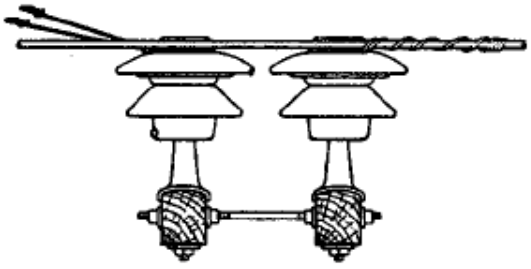


Figure G – Double Insulators Elevation

Supersedes 1/06 Issue – 25-35 kV Construction Information is Relocated to New Section 20

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/11 Issue – Revised Horizontal and Vertical Clearance Calculations.

Pole spans are limited primarily by the sag characteristics of the primary conductor relative to the horizontal and vertical separations provided by the standard pole top arrangement. Increases in separations at the pole may permit longer spans. Transverse wind loadings may not allow use of extremely long spans. Maximum spans are determined by the following criteria:

Horizontal Clearance (Distance between Phase Conductors at the same level)

Maximum spans are limited by the HORIZONTAL clearance of the primary conductors outlined in the NESC (National Electrical Safety Code) rule 235B.

The clearance at the supports of conductors shall not be less than the greater of the following:

- The clearance shown here (from NESC Table 235-1):
  - 12” for supply conductors with 0 to 8.7 kV between conductors of the same or different circuits.
  - 15” for supply conductors with 8.7 to 15 kV between conductors of the same or different circuits.
  - See NESC Rule 235B1a and Table 235-1 for other voltages.
- The clearance (in inches) given by one of the following formulas at a conductor temperature of 60°F (15°C), final unloaded sag with no wind:
  - For conductors smaller than AWG #2: $c = (0.3)(V) + 4.04\sqrt{s - 24}$.
  - For conductors of AWG #2 and larger: $= (0.3)(V) + 8\sqrt{\frac{s}{12}}$.

  Where,
  c = horizontal clearance between the primary conductors, in inches,
  V = voltage between the conductors, in kV, and
  s = sag of the conductor having the greater sag, in inches.

Clearances are between conductors located at approximately the same level.

Vertical Clearance (Primary to Secondary or Neutral)

Maximum spans are limited by the VERTICAL clearance between primary and secondary or neutral conductors outlined in NESC Rule 235C and Section 7.11 of these Standards. The separation shown on the pole top drawings in this section maintain the 12 inch minimum mid-span clearance. Clearances between conductors that are directly above and below each other are limited by the sag of the primary conductor and the sag of either secondary or neutral conductors.

A comparison of sags under two different operating conditions must be evaluated and the operating condition requiring the greatest separation at the structure must be used. These conditions are as follows:

- The upper conductor is at final sag at the greater of 120°F (50°C) or the maximum operating temperature for which the line is designed to operate and the lower conductor is at final sag at the same ambient conditions, 50°F (10°C), as the upper conductor without electrical loading, or
- The upper conductor is at final sag at 32°F (0°C)with ½” radial thickness of ice, and the lower conductor is at final sag without electrical or ice loading at the same ambient conditions, 32°F (0°C), as the upper conductor.

Generally, the sag of primary conductor (bare or tree wire) at its maximum operating temperature of 194°F (90°C) is greater than its sag under ice loaded conditions. Generally, the sag of a spacer cable messenger under ice loaded conditions is greater than its sag at its maximum operating temperature of 120°F (590°C). A comparison should, however, be made.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Primary conductors, bare or tree wire, are designed to limit the maximum conductor operating temperature to 194°F (90°C) with a summer ambient temperature of 100°F (37.7°C) and a winter ambient temperature of 50°F (10°C). The worst case maximum conductor operating temperature clearance condition will occur when the lower conductor, secondary or neutral, is at the winter ambient temperature of 50°F (10°C).

Sag charts for bare and tree wire primary conductors and neutrals is in Section 6-Primary Conductors. Sag charts for secondary wires are in Section 10-Secondaries.

An additional limit on span lengths comes from NESC Rule 235C2b(3). For span lengths in excess of 150', a supply conductor above 750V but less than 50kV shall not sag lower in the span than a straight line joining the points of support of the highest communication cable or conductor when the supply conductor is at a conductor temperature of 60°F (15°C), no wind displacement and final unloaded sag conditions. This requirement must be met whether or not there is a secondary or neutral wire below this primary conductor.

Vertical Clearance (Secondary to Communications)

Maximum spans are limited by the VERTICAL clearance between secondary or neutral conductors and communication conductors outlined in NESC Rule 235C and Section 7.11 of these Standards. The separation shown on the pole top drawings in this section maintain the 30 inch minimum mid-span clearance. Clearances between conductors that are above and below each other and are limited by the sag of the secondary or neutral conductors and the sag of the communication conductors.

A comparison of sags under two different operating conditions must be evaluated and the operating condition requiring the greatest separation at the structure must be used. These conditions are as follows:

- The upper conductor is at final sag at the greater of 120°F (50°C) or the maximum operating temperature for which the line is designed to operate and the lower conductor is at final sag at the same ambient conditions, 50°F (10°C), as the upper conductor without electrical loading, or
- The upper conductor is at final sag at 32°F (0°C) with ½" radial thickness of ice, and the lower conductor is at final sag without electrical or ice loading at the same ambient conditions, 32°F (0°C), as the upper conductor.

Generally, for secondary triplex or quadplex, the sag under ice loaded condition is greater than the sag at 120°F (50°C), the maximum operating temperature of the supporting neutral. A comparison should, however, be made.

Supersedes 7/11 Issue – Revised Horizontal and Vertical Clearance Calculations.

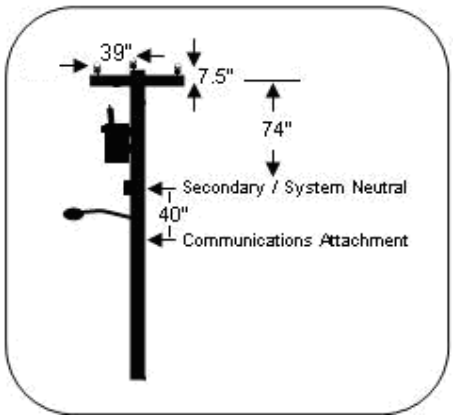
Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/11 Issue – Revised tHorizontal and Vertical Clearance Calculations.

EXAMPLE CALCULATION – MAXIMUM SPANS

Given:

15 kV class construction
Primary Voltage – 15kV effectively grounded
Pole Framed to 9-411A
Grade C construction
1 – 40 ft., class 3 wood pole JT NE (84” Allocated)
3 – 477 kcmil AAC bare conductors (W21BA)
1/0 AAAC triplex secondary cable (W15C)
Ø to Ø Primary Horizontal Separation = 39” (9-206)
Vertical Pole Spacing (74”+8” = 82”)
(8” = thru bolt of xarm to conductor on top of insulator)
40” Spacing (Bottom Secondary Bracket to top of comm.)
For 300’ Ruling Span
477 - Sag @ 60°F final, no wind, no ice = 114.40" (6-114).
For 135’ Span*
477 - Sag @ 194°F final, no wind, no ice = 50”
1/0 Triplex - Sag @ 50°F final, no wind, no ice = 11”
* = Calculated Values (Steps 5-7)



Maximum Span Based on Horizontal Separations Between Primary Conductors: Steps 1-2

Step	Action	Use
1	Determine maximum primary conductor sag based on 39” horizontal separation between primary conductors (see Page 9-200).	From above for #2 AWG and greater: $c = (0.3)(V) + 8\sqrt{\frac{s}{12}}$ where, s = Sag (inches) = unknown c = Primary phase to phase separation (inches) = 39” V = Circuit voltage, phase-to-phase (kV) = 15kV Therefore, $s = 12 * \left(\frac{c-0.3V}{8}\right)^2$ and $s = 12 * \left(\frac{39-0.3(15)}{8}\right)^2$ $s = 223.2"$

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Step	Action	Use
2	Determine the maximum span based on maximum primary conductor sag of 223" for 477kcmil AAC Bare Conductor.	$s_m = s_r * \left(\frac{L_m^2}{L_r^2}\right)$ Where, s_m = Maximum sag determined in Step 1 (inches) = 223.2" s_r = Ruling span sag (inches) = 114.4" L_m = Maximum span (feet) = unknown L_r = Ruling span (feet) = 300' Therefore, $L_m = L_r * \sqrt{\frac{s_m}{s_r}}$ and $L_m = L_r * \sqrt{\frac{s_m}{s_r}}$ $L_m = 300 * \sqrt{\frac{223.2}{114.4}}$ $L_m = 420'$

Determine Sag of Actual Span versus Ruling Span: Steps 3-7

Step	Action	Use
3	Determine Sags in "Other Span". (135' span)	$S_a = S_r * \left(\frac{L_a^2}{L_r^2}\right)$ Where, S_a = Sag of Actual Span (inches) S_r = Sag of Ruling Span (inches) L_a = Length of Actual Span (feet) L_r = Length of Ruling Span (feet)
4	Calculate sag for 135' span - 477 Sag @ 194°F (90°C) Final Unloaded (See 6-114)	S_a = Sag of Actual Span = Unknown S_r = Sag of Ruling Span = 42.96" (125' Ruling span) L_a = Length of Actual Span = 135' L_r = Length of Ruling Span = 125' $S_a = S_r * \left(\frac{L_a^2}{L_r^2}\right)$ $S_a = 42.96 * \left(\frac{135^2}{125^2}\right)$ $S_a = 50"$

Supersedes 7/11 Issue –Revised Horizontal and Vertical Clearance Calculations.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Step	Action	Use
5	Calculate sag for 135' span - 1/0 Triplex	S_a = Sag of Actual Span = Unknown L_a = Length of Actual Span = 135' L_r = Length of Ruling Span = 150'
	Sag @ 50°F (10°C), unloaded, initial (See 10-5)	S_r = Sag of Ruling Span = 13" (150' Ruling span) $S_a = S_r * \left(\frac{L_a^2}{L_r^2}\right)$ $S_a = 13 * \left(\frac{135^2}{150^2}\right)$ $S_a = 11"$
	Sag @ 32°F (0°C) , ½" ice, final (See 10-5)	S_r = Sag of Ruling Span = 13" (150' Ruling span) $S_a = S_r * \left(\frac{L_a^2}{L_r^2}\right)$ $S_a = 31 * \left(\frac{135^2}{150^2}\right)$ $S_a = 25"$

Supersedes 7/18 Issue – Corrected ruling span length and table reference in step 5.

Maximum Span Based on Vertical Separations between Primary, Secondary and Communication Conductors: Steps 8-10

Step	Action	Use
6	Calculate mid-span separation between primary and secondary	Vertical Spacing at Pole Primary to center of crossarm 8" Center of crossarm to secondary + 74" Total 82" Primary Conductor Sag - 50" Secondary Conductor Sag + 11" Mid-span vertical separation between primary and secondary 43" (12" minimum required per Section 7)
7	Calculate mid-span separation between secondary and communications	Vertical Spacing at Pole Secondary to communications 42" (40" + 2" from Sec cond to bottom of Sec Bracket) Secondary Conductor Sag - 25" Mid-span vertical separation between secondary and communications 17" (30" minimum required per Section 7) Note 1: To meet the required 30" mid-span clearance, the vertical spacing at the pole between secondary and communications would need to be increased to 55". Note 2: This calculation is conservative because it makes no allowance for communications cable sag. If the communications cable sag is known, it may be accounted for as the secondary sag is accounted for in Step 7 above.

Determine Clearance between Sagged Primary Conductor and Communication's In-Line-of-Site (>150' & >750V NESC Rule 235C.2b.3): Steps 11-12

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Step	Action	Use
8	Check whether sagged primary conductor is above or below communications line-of-sight.	Vertical Spacing at Pole Primary to center of crossarm 8” Center of crossarm to secondary 74” Secondary to communications + 55” Total 137” Primary Conductor Sag - 50” Sagged primary conductor **above** comm. line-of-sight 87” (0” minimum required per Section 7) Note: This NESC rule applies only for spans greater than 150’. The calculation is shown here as an example even though this span is less than 150’.

Conclusions:

Horizontal Clearances – The horizontal clearance of 39” will allow a maximum span of up to 420’ for 477 Bare AAC before mid span contact becomes an issue between primary conductors. This calculated value, per NESC guidelines, is well beyond the span of 135’ in the above example. (Steps 1 - 4)

Vertical Clearances – There are several vertical clearances that need to be evaluated regarding maximum spans. They are as follows:

` Primary to Secondary – The vertical mid-span clearance between the primary and secondary conductor was calculated to be 43” for a span of 135’ in the above example. The NESC minimum clearance shown in Section 7, Page 7-19 indicates 12” is the minimum required at mid span. Therefore, mid span contact between primary and the conductor in the secondary position is not an issue in the above example. (Steps 6 & 7)

Secondary to Communications

Span Requirements: The span of 135’ will not allow a vertical mid-span clearance of 30” between the secondary conductor (#1/0 Triplex) and the communications cable. This span can only be accommodated by increasing the at-pole separation between the secondary and communications by: (i) installing a taller pole, (ii) raising the secondary bracket to the minimum dimensions indicated in drawing (9-411A), (iii) requesting the communications company to lower their cable, or (iv) having the communications company sag their cable following the sag of the secondary conductor in the secondary position maintaining 30” mid span clearance.

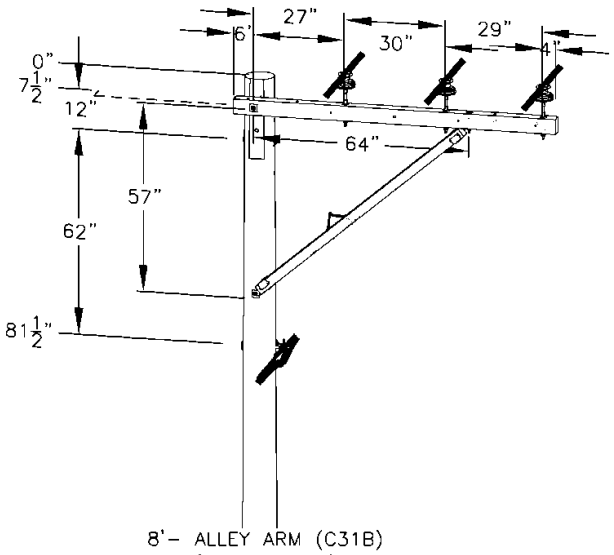
Ice Loaded Conditions: Sag information for Conductors in the Secondary Position should be shared with the various Communication Companies to assist them in evaluating their cable sag requirements to meet NESC codes. Both Electric and Communication companies are allocated their attachment space on poles; however, a mid span clearance of 30” must be maintained when ice loading conditions occur. (See Section 7)

Maximum spans are also limited by pole, crossarm, pin and insulator loadings and strengths. See Section 2.

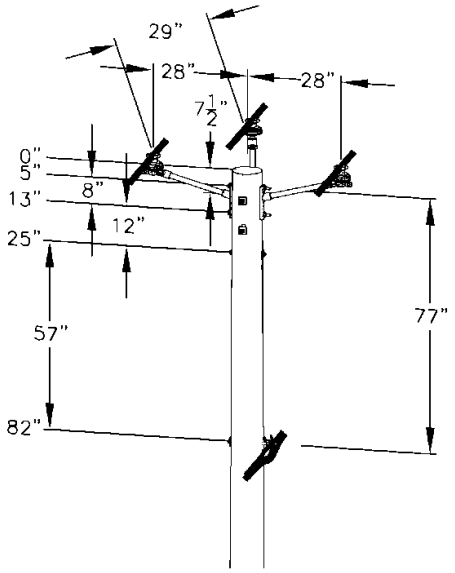
Supersedes 7/11 Issue – Revised Horizontal and Vertical Clearance Calculations.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

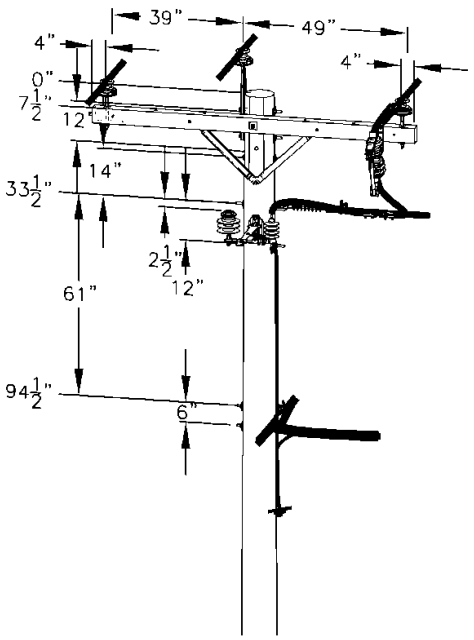
Supersedes 7/11 Issue – Update drawing with a 3-D rendering.



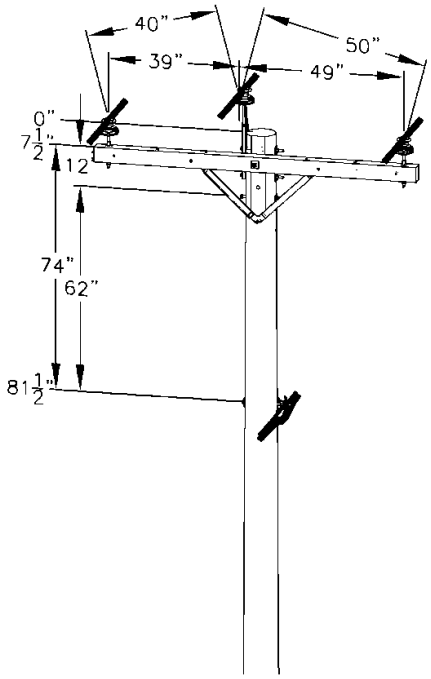
8'– ALLEY ARM (C31B)
(DWG. 9–437)



ARMLESS TANGENT OR ANGLE
(DWG. 9–812)



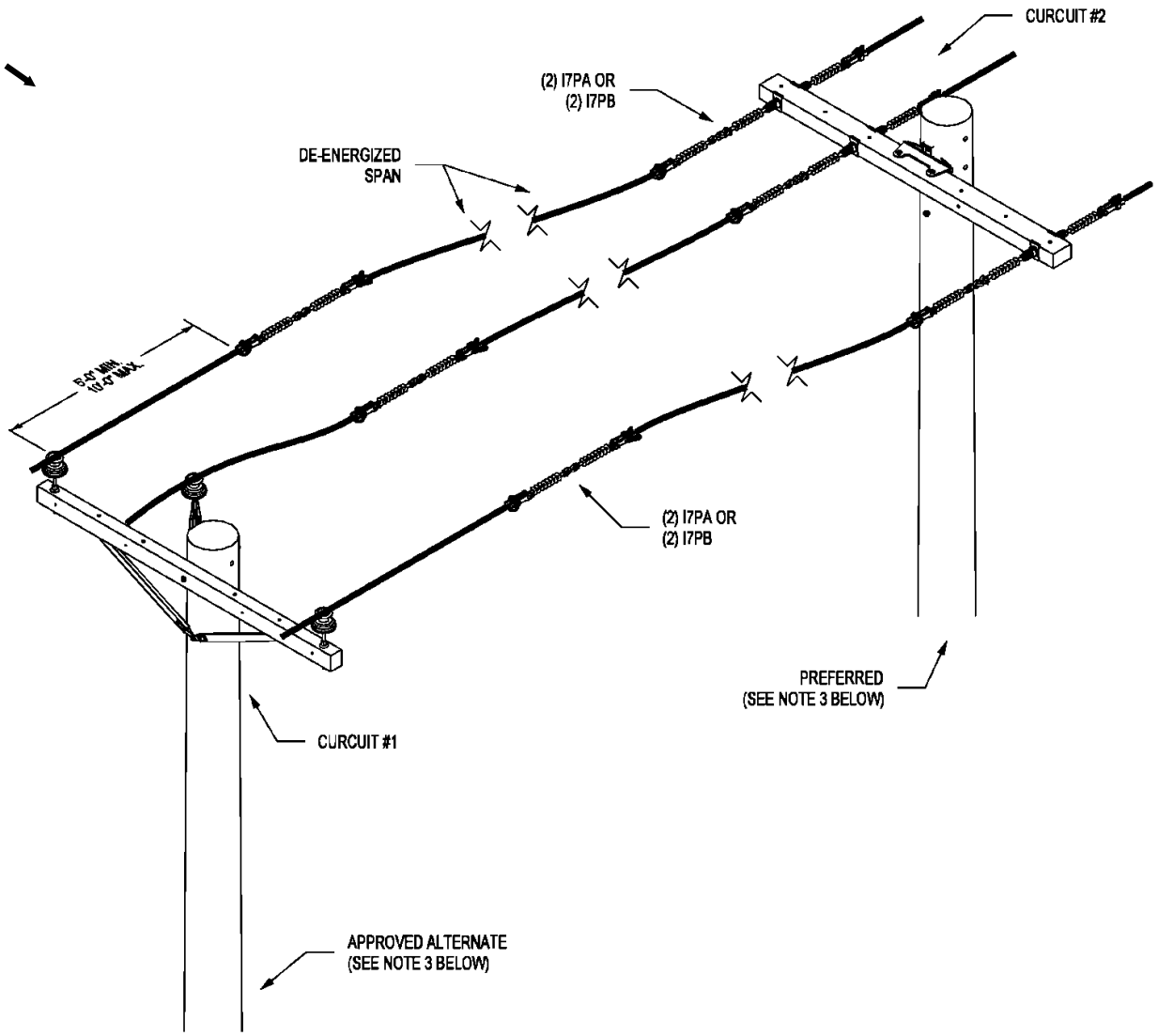
8'– DOUBLE CROSSARM (C31B)
DEADEND WITH TAP
(DWG. 9–419F1, 9–419F2)



8'– CROSSARM (C31B)
TANGENT
(DWG. 9–411)

NOTE:
–THESE DIMENSIONS ARE SHOWN AS GENERAL INFORMATION FOR STANDARD POLE TOPS USING STANDARD MATERIALS. REFER TO SECTION 9 PRIMARY DRAWINGS FOR OTHER ARRANGEMENTS.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



New page.

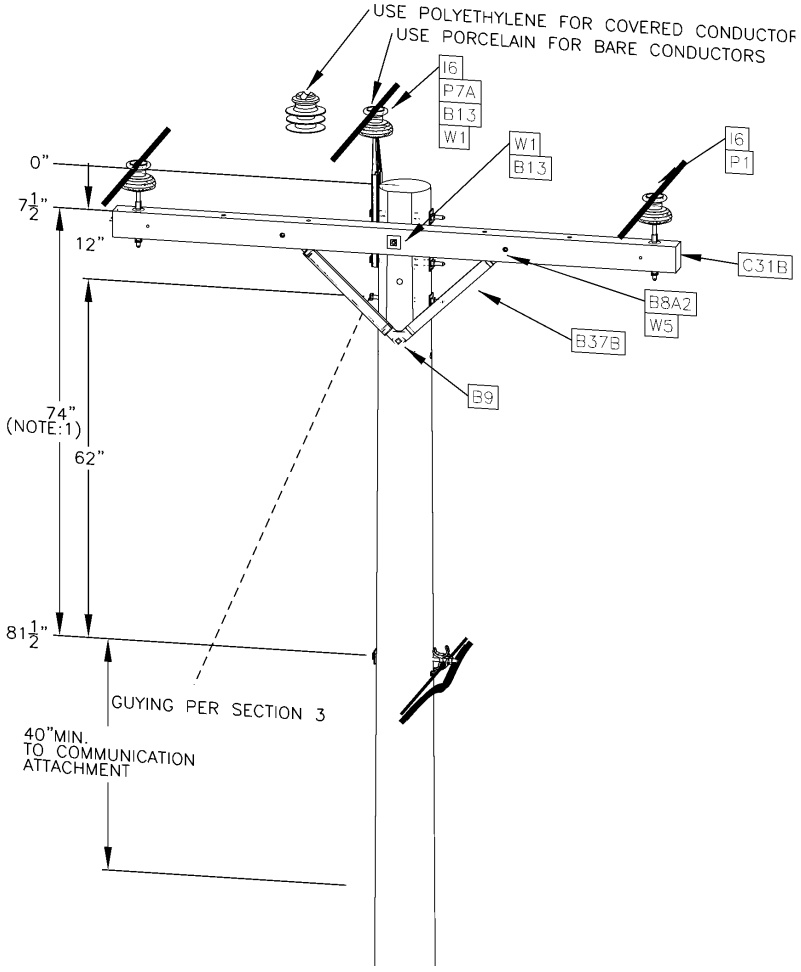
NOTES:

1. Install a de-energized span between circuits of different voltages. Do not connect the span conductors to either circuit. Do not ground span.
2. Use <u>two</u> polymer deadend insulators at either end of de-energized span. Use insulators appropriate for the higher voltage circuit at both ends.
3. Preferred construction for both ends of the de-energized span is to deadend the line conductors to a fiberglass deadend crossarm (see structure at right in figure above). A nonpreferred alternate is to installation double in-line insulators (see structure at left above). This alternate is allowed only when the conductors for both circuits are the same and deadending conductors to a crossarm is impractical.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-411A	0-15KV 3Φ - Bare	MU = @9-411ACL	0-15KV 3Φ - Covered
MU = @9-411B	0-15KV 1Φ - Bare	MU = @9-411BCL	0-15KV 1Φ - Covered

Supersedes 7/11 Issue – Update drawing with a 3-D rendering.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

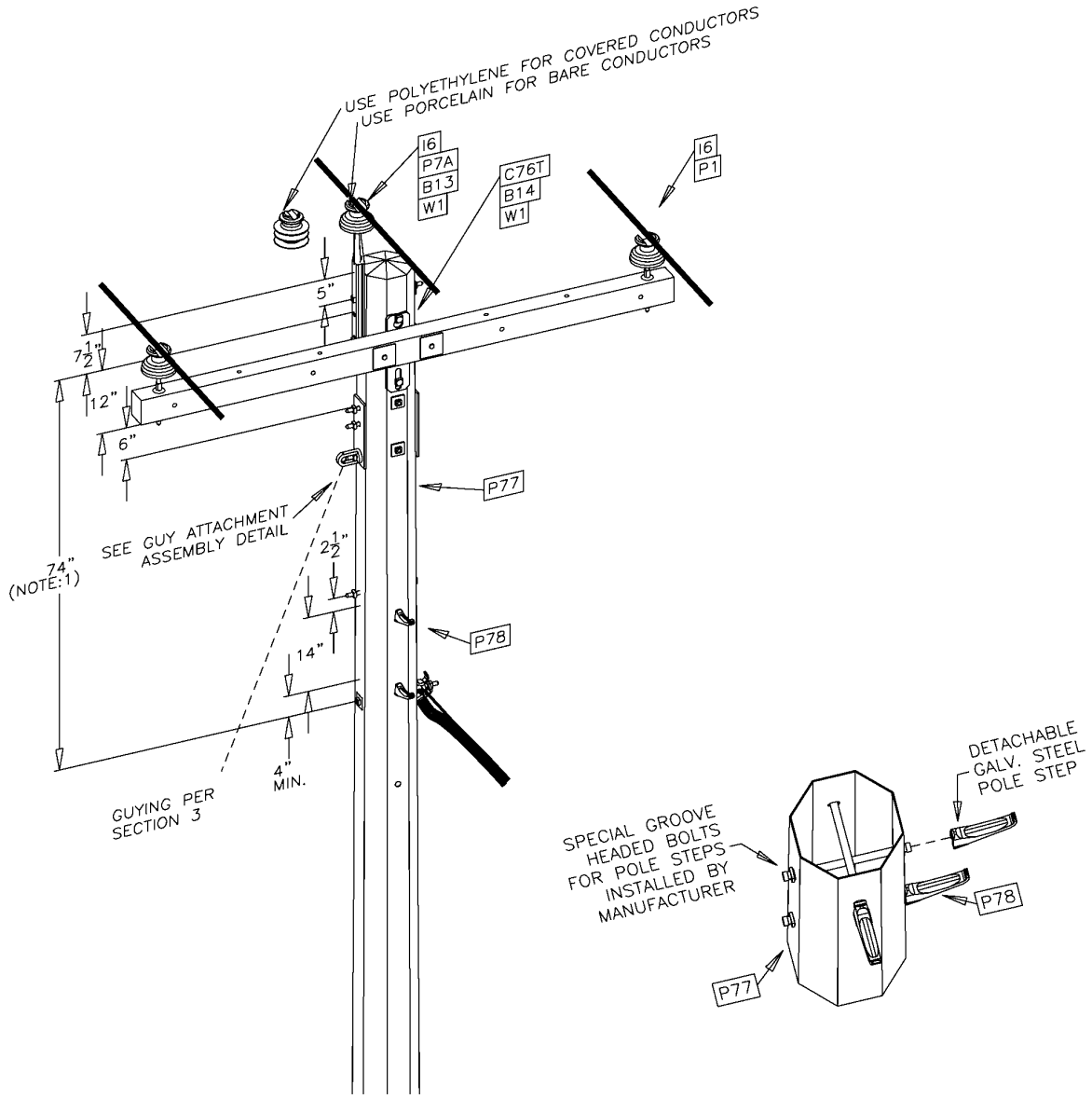
NOTES

1. This clearance can be reduced to a minimum of 48" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

1Φ (DELTA) AND 3Φ CROSSARM POLE TOP – 0-15 kV 0˚ - 10˚			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-411	7/16

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-411AF	0-15KV 3Φ - Bare	MU = @9-411AFCL	0-15KV 3Φ - Covered
MU = @9-411BF	0-15KV 1Φ - Bare	MU = @9-411BFCL	0-15KV 1Φ - Covered



NOTES:

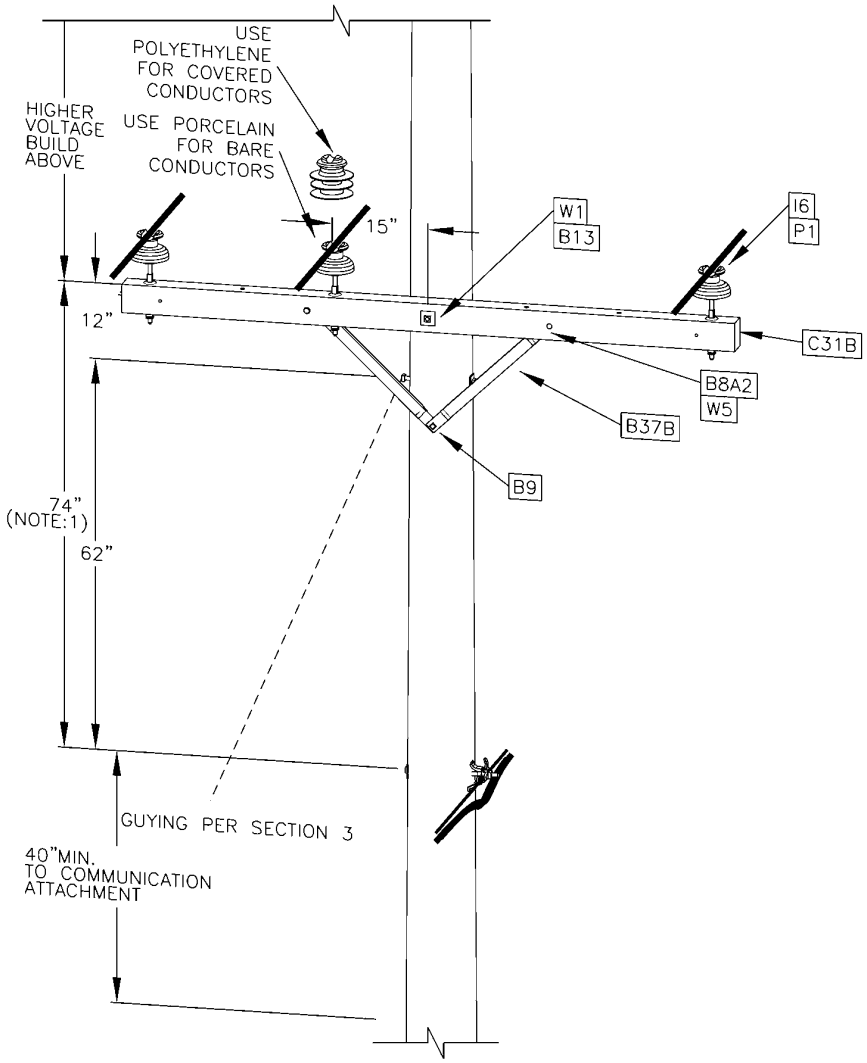
1. This clearance can be reduced to a minimum of 52” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. Detachable steel pole steps maybe left installed while maintaining an 8 foot minimum from ground level.
3. If grounding is necessary, install down ground & molding with appropriate grounding kit (Std Item S34) which includes nylon clips and self tapping screws. Place clips approximately 12”-18” apart.
4. Install 12.5M maximum guy wire. If 25M is required, install 2 separate 12.5M guys.
5. For single phase delta circuit construction, omit the center phase.

Supersedes 7161 Issue – Replaced guying detail with reference to Section for guying information.

FIBERGLASS 1Φ (DELTA) AND 3Φ CROSSARM POLE TOP – 0-15 kV 0° - 10°			
ISSUE	**PAGE NUMBER**		
7/20	**9-411F**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

New Page 7/19.



NOTES

1. This clearance can be reduced to a minimum of 48" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

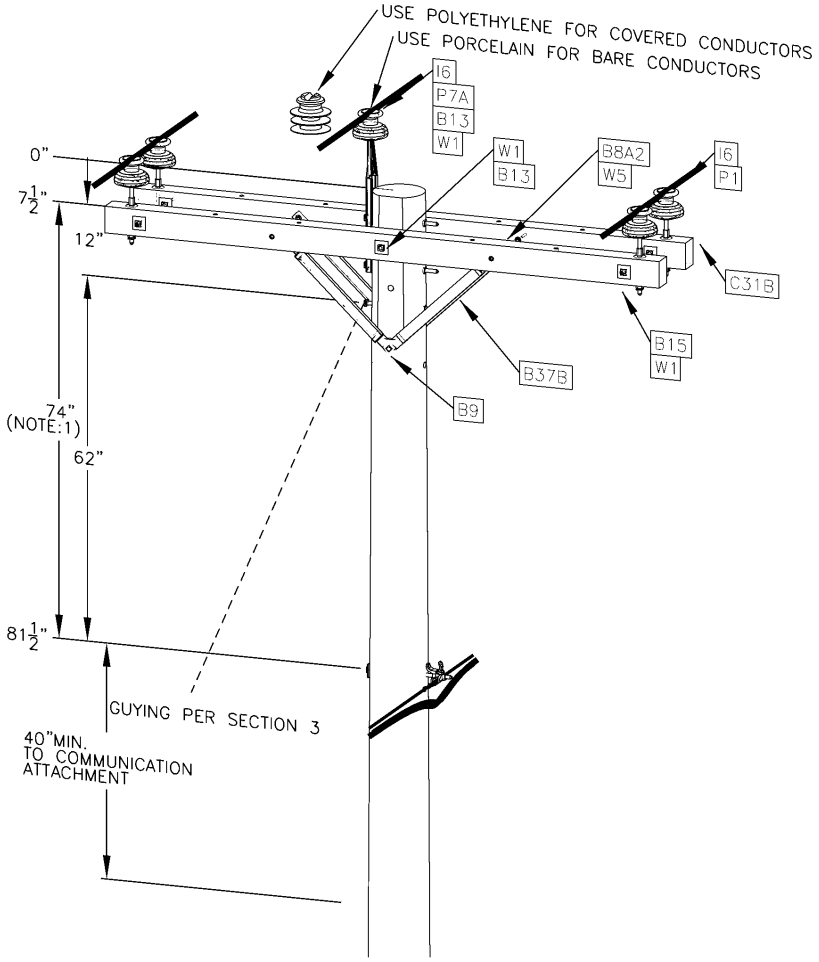
ALTERNATE 3Φ CROSSARM POLE TOP – 0-15 kV – 0° - 10° (FOR USE WHEN POLE TOP IS UNAVAILABLE FOR CENTER PHASE)			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-411C	7/19

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-412A	0-15KV 3Φ - Bare	MU = @9-412ACL	0-15KV 3Φ - Covered
MU = @9-412B	0-15KV 1Φ - Bare	MU = @9-412BCL	0-15KV 1Φ - Covered

Supersedes 7/11 Issue – Update drawing with a 3-D rendering.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

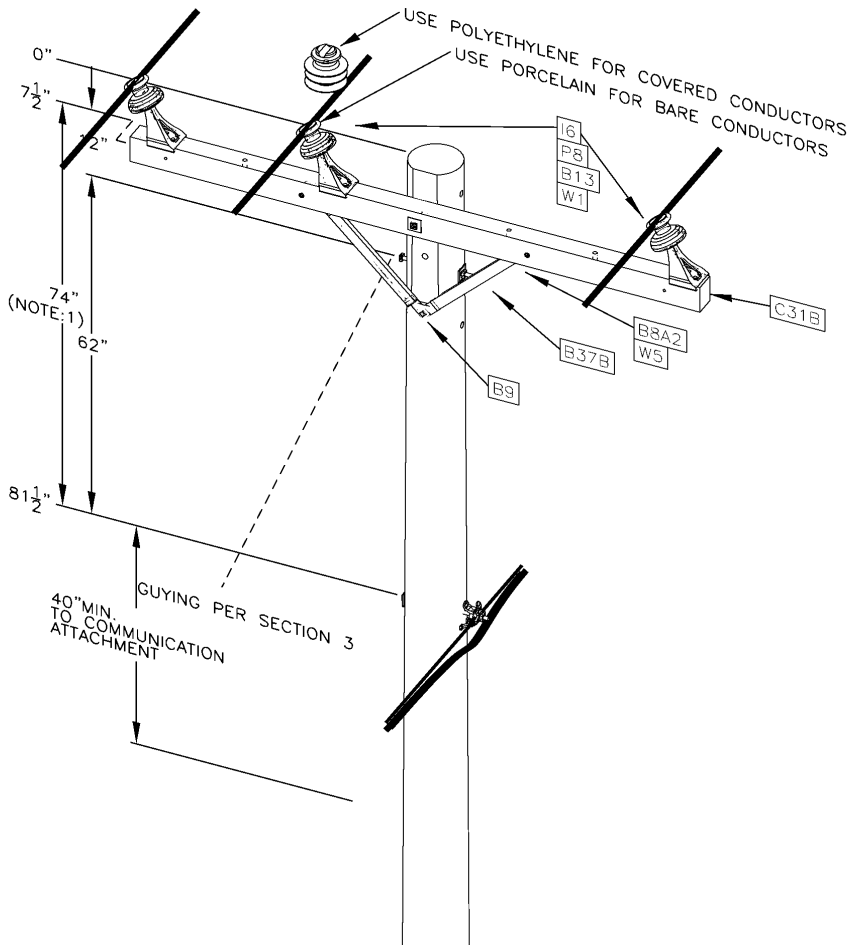
NOTES

1. This clearance can be reduced to a minimum of 48” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

1Φ (DELTA) AND 3Φ DOUBLE CROSSARM POLE TOP – 0-15 kV CROSSING AND ANGLES - 0˚ - 10˚			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-412	7/17

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-413A	0-15KV 3Φ - Bare	MU = @9-413ACL	0-15KV 3Φ - Covered
MU = @9-413B	0-15KV 1Φ - Bare	MU = @9-413BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES

1. This clearance can be reduced to a minimum of 48” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

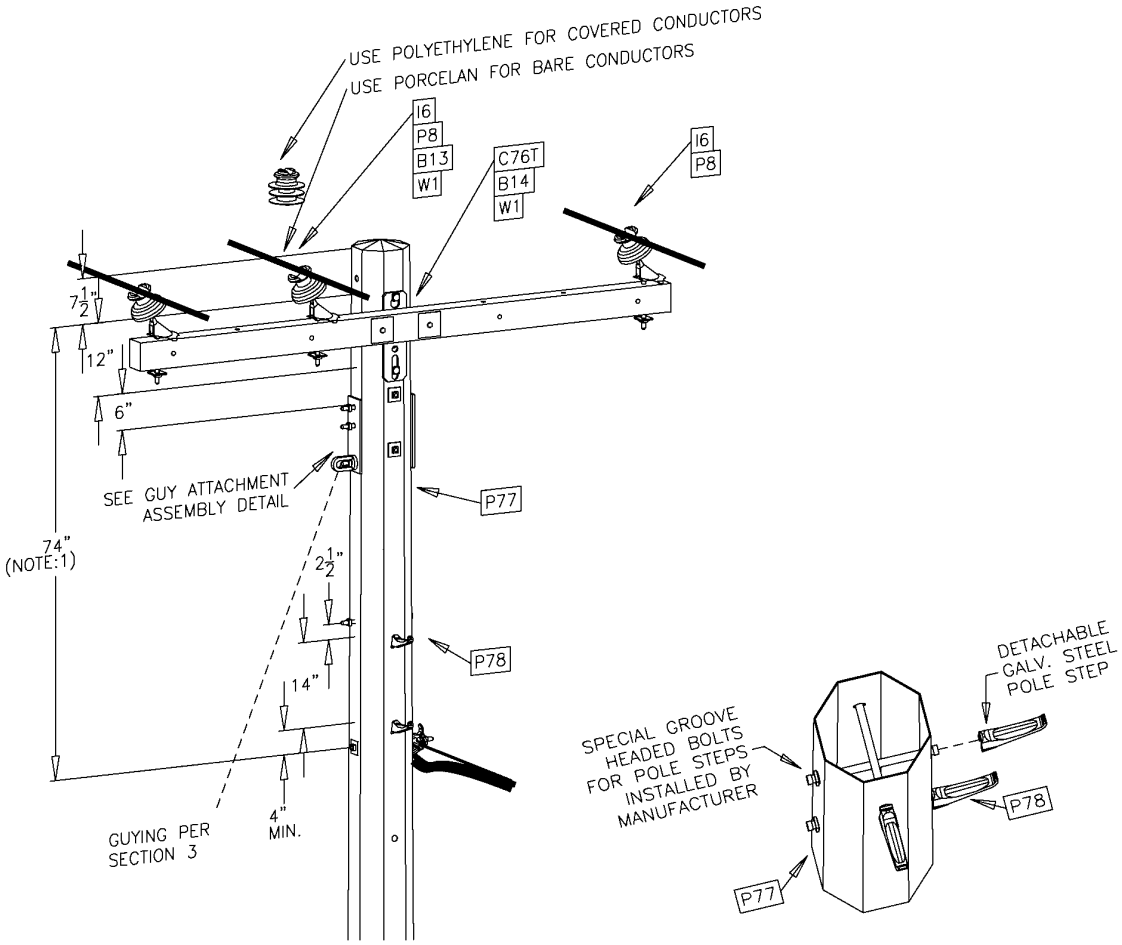
Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

1Φ (DELTA) AND 3Φ SINGLE CROSSARM POLE TOP – 0-15 kV 11˚ - 20˚			
ISSUE	**PAGE NUMBER**		
7/16	**9-413**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-413AF	0-15KV 3Φ - Bare	MU = @9-413AFCL	0-15KV 3Φ - Covered
MU = @9-413BF	0-15KV 1Φ - Bare	MU = @9-413BFCL	0-15KV 1Φ - Covered

Supersedes 7/19 Issue – Replace guying detail with reference to Section 3 for guying information.



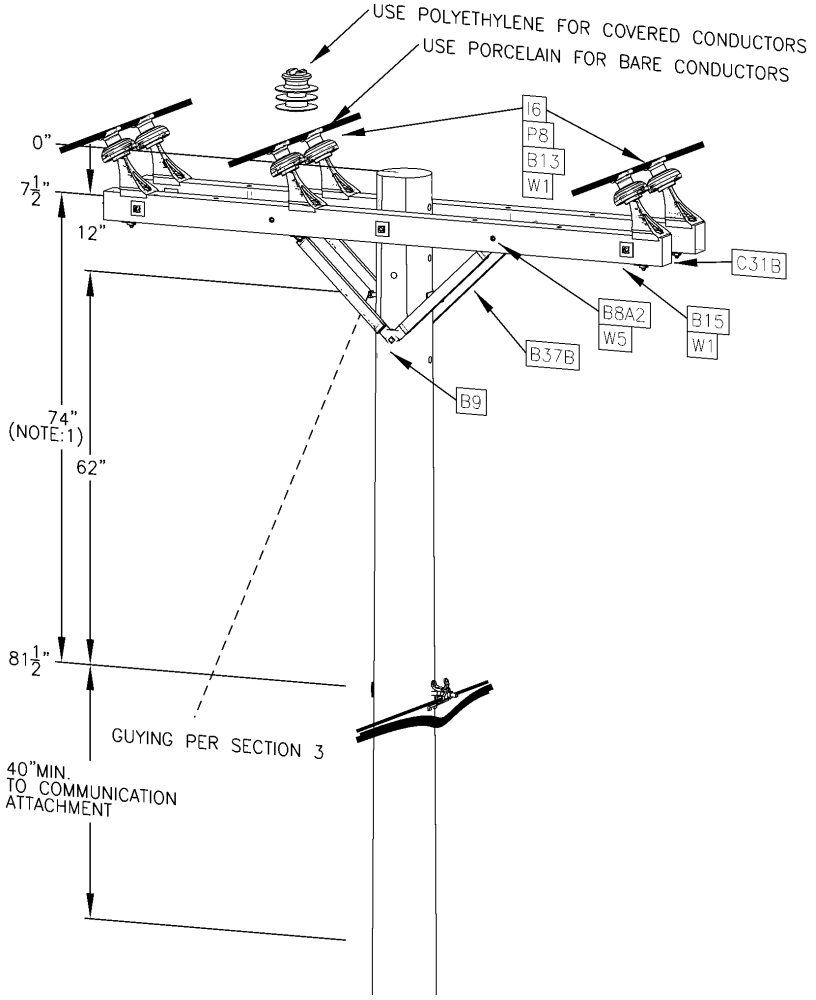
NOTES:

1. This clearance can be reduced to a minimum of 52” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. Detachable steel pole steps maybe left installed while maintaining an 8 foot minimum from ground level.
3. If grounding is necessary, install down ground & molding with appropriate grounding kit (Std Item S34) which includes nylon clips and self tapping screws. Place clips approximately 12”-18” apart.
4. Install 12.5M maximum guy wire. If 25M is required, install 2 separate 12.5M guys.
5. For single phase delta circuit construction, omit the center phase.

FIBERGLASS 1Φ (DELTA) AND 3Φ CROSSARM POLE TOP – 0-15 kV 11° - 20 °			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-413F	7/20

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-414A	0-15KV 3Φ - Bare	MU = @9-414ACL	0-15KV 3Φ - Covered
MU = @9-414B	0-15KV 1Φ - Bare	MU = @9-414BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES

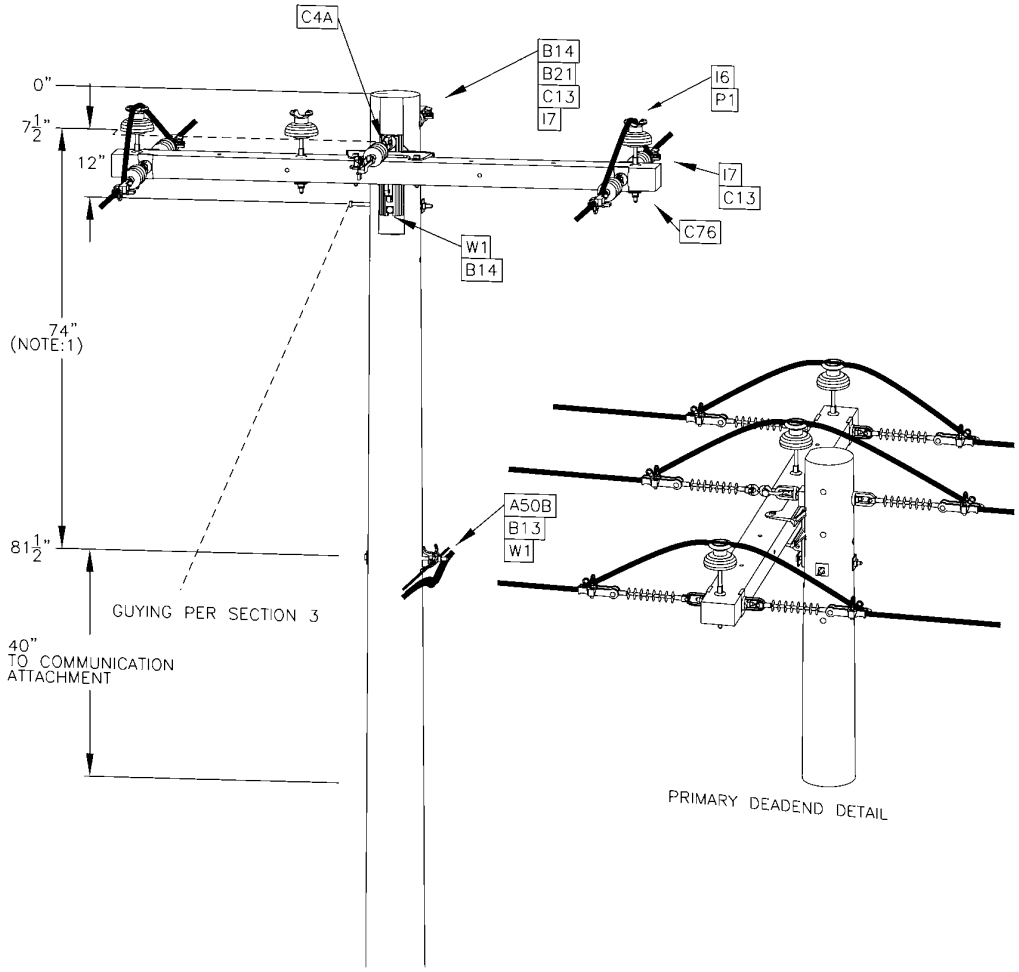
1. This clearance can be reduced to a minimum of 48" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

1Φ (DELTA) AND 3Φ DOUBLE CROSSARM POLE TOP – 0-15 kV CROSSINGS 11° - 45° / ANGLES - 21° - 45°			
ISSUE	**PAGE NUMBER**		
7/16	**9-414**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-415A	0-15KV 3Φ - Bare	MU = @9-415ACL	0-15KV 3Φ - Covered
MU = @9-415B	0-15KV 1Φ - Bare	MU = @9-415BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	45 JT-111"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	45 JT-111"	255	185	175
86	45 JT-111"	300	--	--
106	45 JT-111"	--	240	--
107	45 JT-111"	--	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

Supersedes 7/16 Issue – Modified center string attachment.

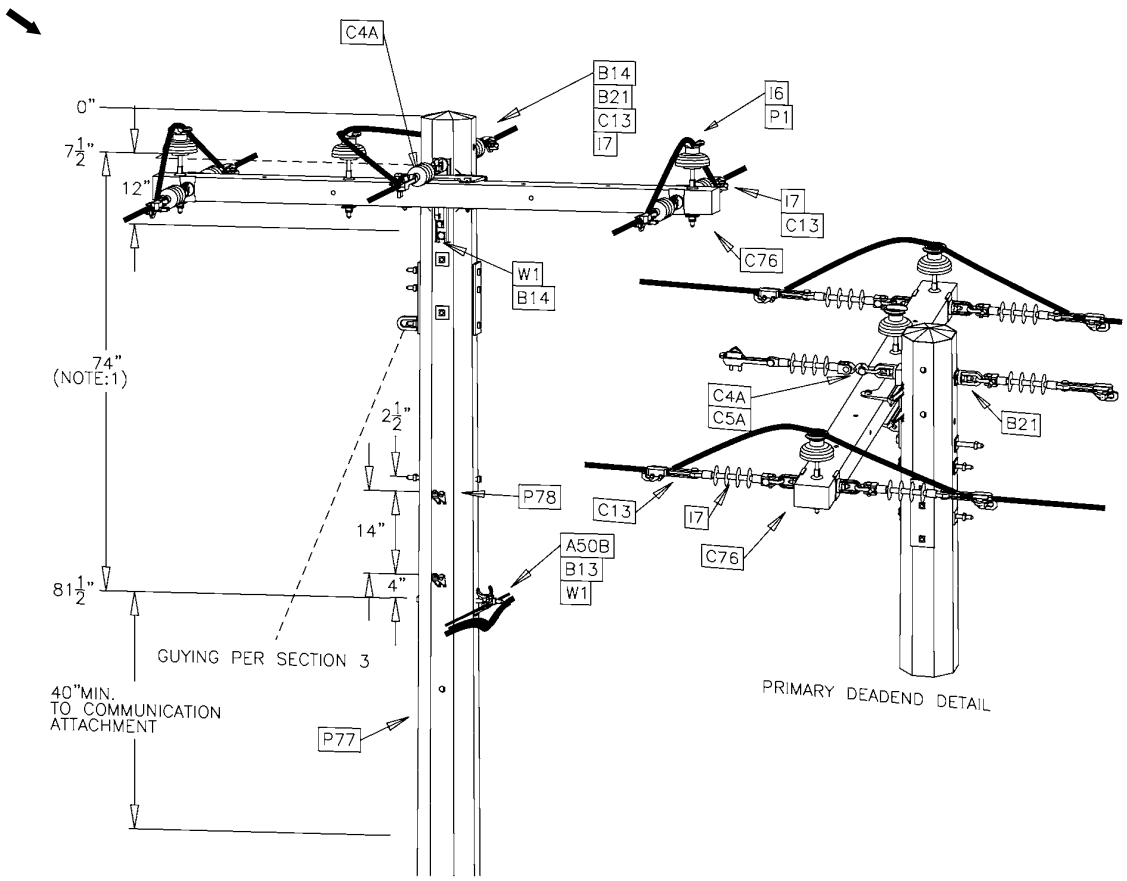
NOTES

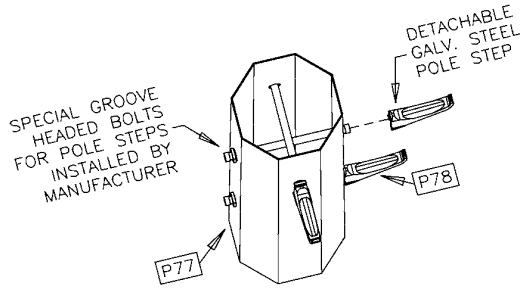
1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

1Φ (DELTA) AND 3Φ DEADEND CROSSARM POLE TOP – 0-15 kV 46˚ - 60˚ ANGLES / BACK-TO-BACK DEADENDS (TANGENT)			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-415	7/20

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 09.00.005

MU = @9-415AF	0-15KV 3Φ - Bare	MU = @9-415AFCL	0-15KV 3Φ - Covered
MU = @9-415BF	0-15KV 1Φ - Bare	MU = @9-415BFCL	0-15KV 1Φ - Covered





NOTES:

1. This clearance can be reduced to a minimum of 60” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. Detachable steel pole steps maybe left installed while maintaining an 8 foot minimum from ground level.
3. If grounding is necessary, install down ground & molding with appropriate grounding kit (Std Item S34) which includes nylon clips and self tapping screws. Place clips approximately 12”-18” apart.
4. Install 12.5M maximum guy wire. If 25M is required, install 2 separate 12.5M guys.
5. For single phase delta circuit construction, omit the center phase.

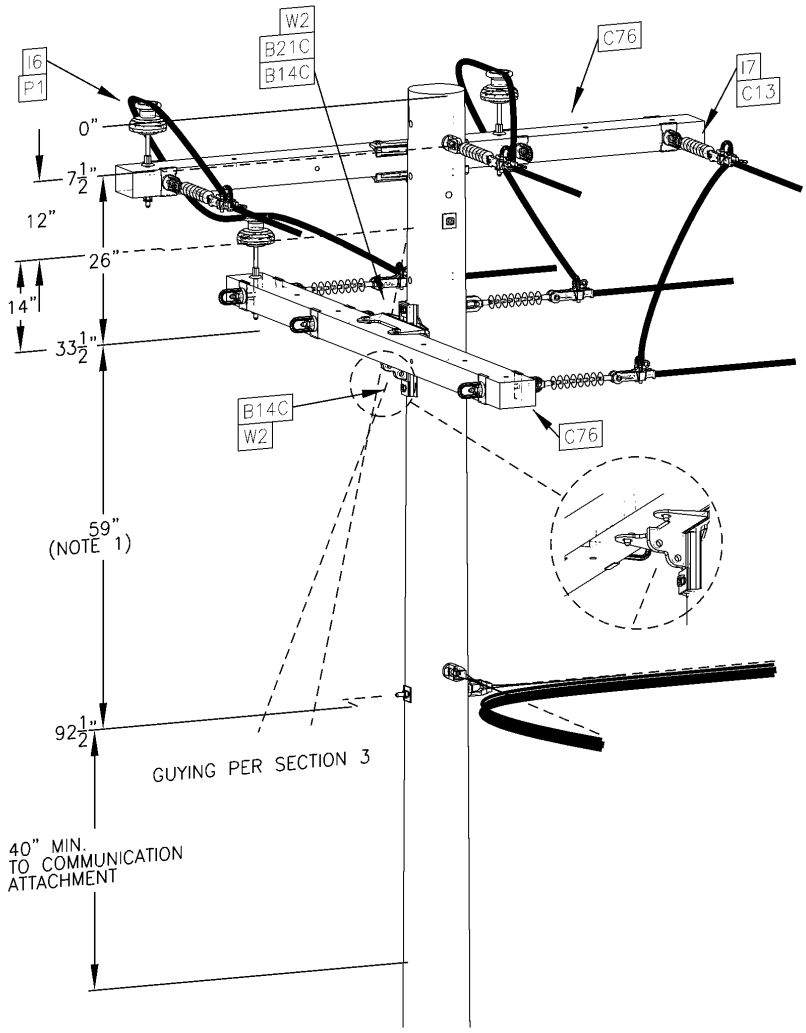
FIBERGLASS POLE - 1Φ (DELTA) AND 3Φ CROSSARM POLE TOP – 0-15 kV CROSSINGS - 0˚ - 60 ˚ / ANGLES 21˚ - 60 ˚ / BACK-TO-BACK DEADENDS (TANGENT)			
ISSUE	**PAGE NUMBER**		
7/21	**9-415F**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Supersedes 7/20 Issue – Corrected drawing title.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-416A	0-15KV 3Φ - Bare	MU = @9-416ACL	0-15KV 3Φ - Covered
MU = @9-416B	0-15KV 1Φ - Bare	MU = @9-416BCL	0-15KV 1Φ - Covered

Supersedes 7/14 Issue – Update drawing with a 3-D rendering.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
92.5	45 JT-111"	185	--	--
92.5	45 JT-111"	--	185	--
97.5	45 JT-111"	--	--	180
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
103.5	45 JT-111"	255	--	--
108.5	45 JT-111"	--	185	--
108.5	45 JT-111"	--	--	175
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

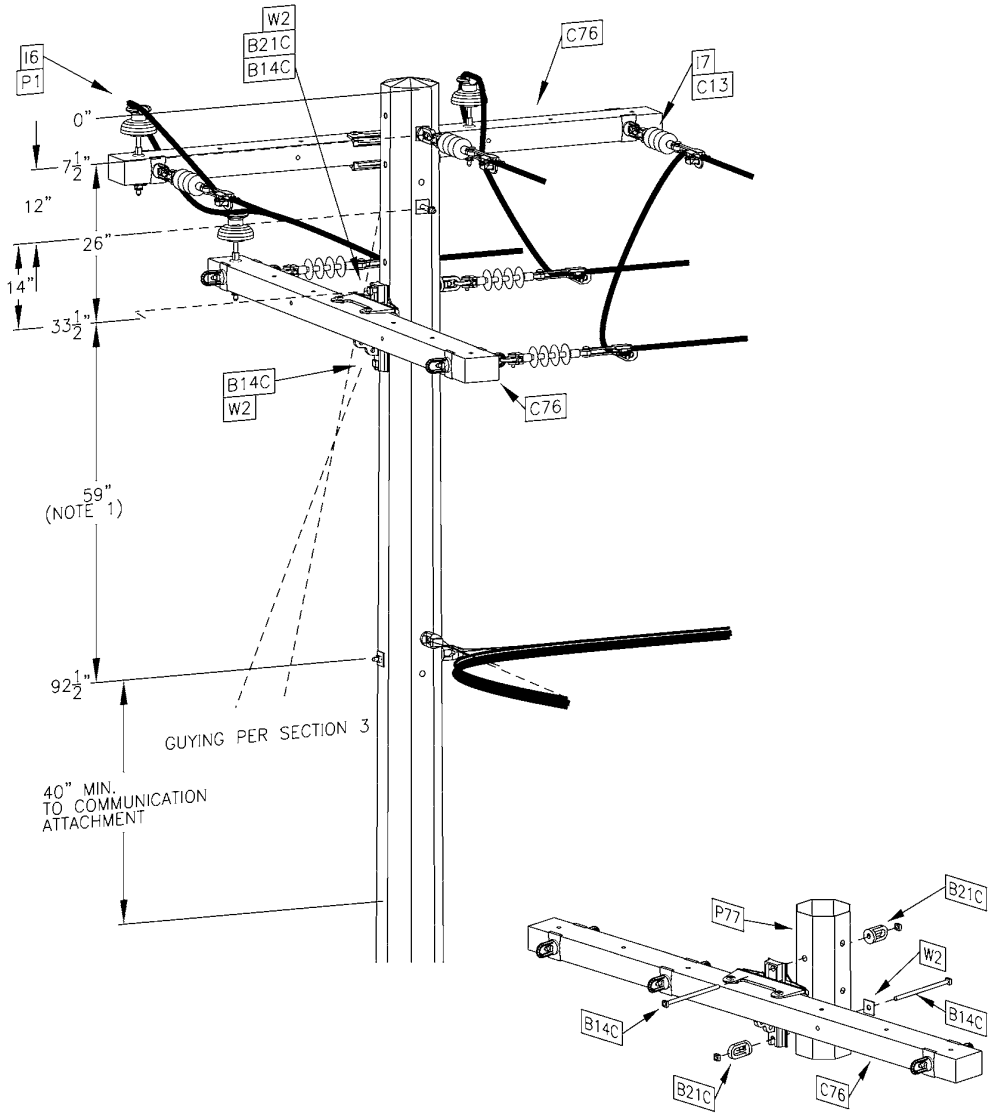
NOTES

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

1Φ (DELTA) AND 3Φ FIBERGLASS DEADEND CROSSARM POLE TOP – 0-15 kV ANGLES 61˚ - 90 ˚ AND DEADENDS			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-416	7/16

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-416AF	0-15KV 3Φ - Bare	MU = @9-416AFCL	0-15KV 3Φ - Covered
MU = @9-416BF	0-15KV 1Φ - Bare	MU = @9-416BFCL	0-15KV 1Φ - Covered



NOTES:

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. Detachable steel pole steps maybe left installed while maintaining an 8 foot minimum from ground level.
3. If grounding is necessary, install down ground & molding with appropriate grounding kit (Std Item S34) which includes nylon clips and self tapping screws. Place clips approximately 12”-18” apart.
4. Install 12.5M maximum guy wire. If 25M is required, install 2 separate 12.5M guys. The first guy in each direction can be placed on the crossarm bracket (see 9-417F for a side view of the fiberglass crossarm with a guy wire installed).
5. For single phase delta circuit construction, omit the center phase.

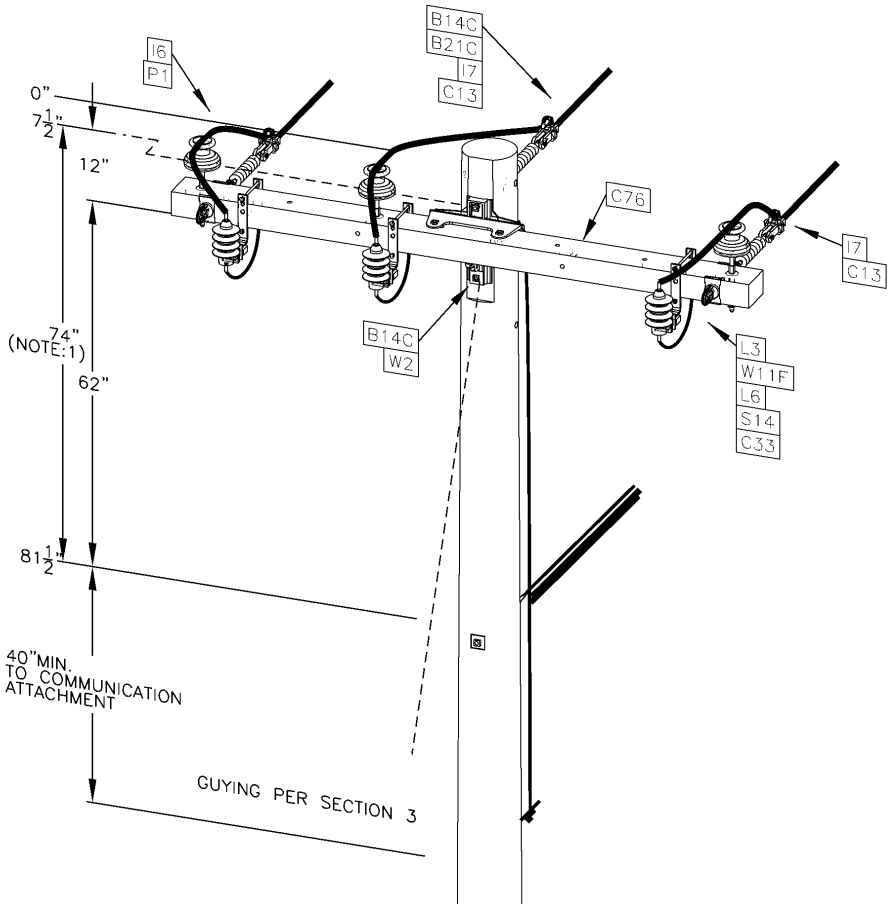
FIBERGLASS POLE - 1Φ (DELTA) AND 3Φ FIBERGLASS DEADEND CROSSARM POLE TOP – 0-15 kV - ANGLES - 61˚ - 90˚ AND DEADENDS			
ISSUE	**PAGE NUMBER**		
7/21	**9-416F**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Supersedes 7/20 Issue – Corrected drawing title.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-417A	0-15KV 3Φ - Bare	MU = @9-417ACL	0-15KV 3Φ - Covered
MU = @9-417B	0-15KV 1Φ - Bare	MU = @9-417BCL	0-15KV 1Φ - Covered

Supersedes 7/20 Issue – Corrected drawing title and page number.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	185	175
86	45 JT-111"	300	--	--
106	45 JT-111"	--	240	--
107	45 JT-111"	--	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

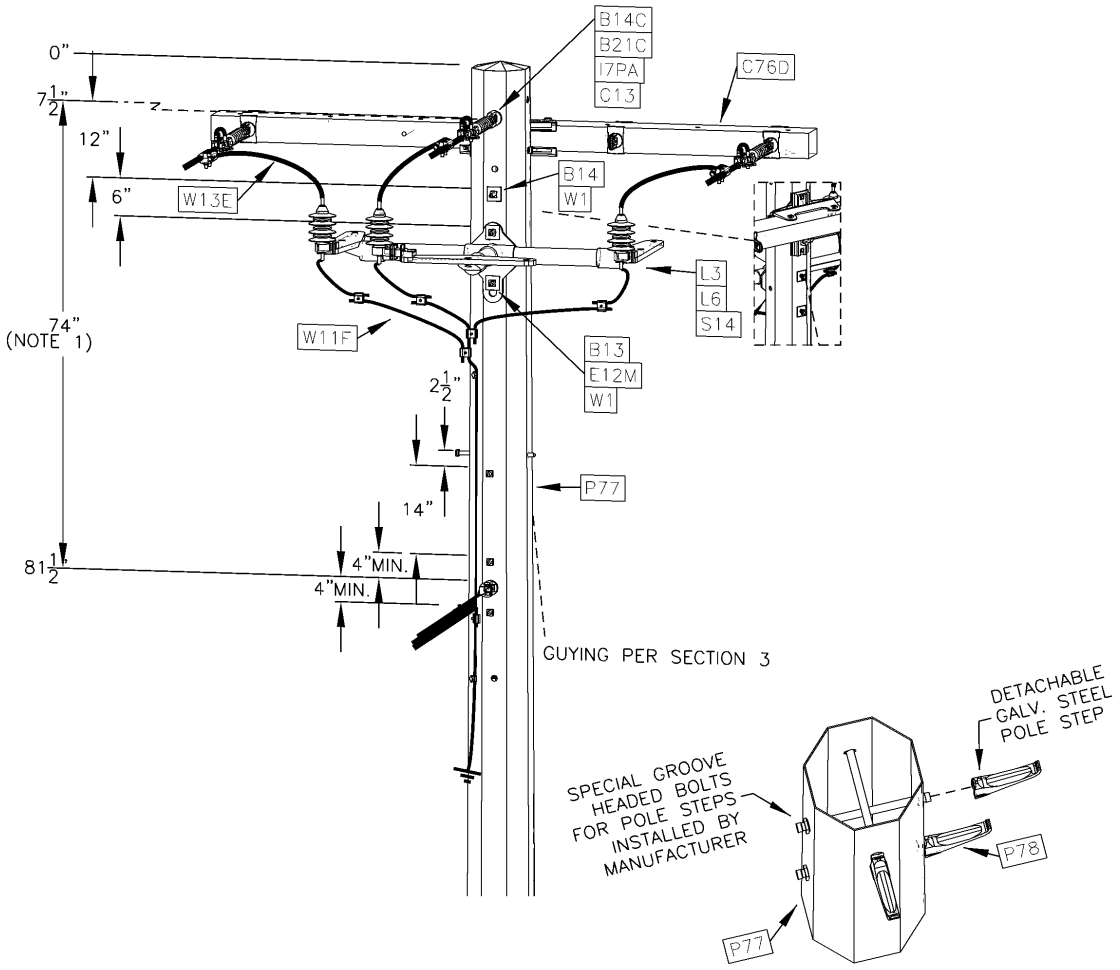
NOTES

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

1Φ (DELTA) AND 3Φ FIBERGLASS DEADEND CROSSARM POLE TOP – 0-15 kV DEADENDS			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-417	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-417AF	0-15KV 3Φ - Bare	MU = @9-417AFCL	0-15KV 3Φ - Covered
MU = @9-417BF	0-15KV 1Φ - Bare	MU = @9-417BFCL	0-15KV 1Φ - Covered



NOTES:

1. This clearance can be reduced to a minimum of 54” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. Detachable steel pole steps maybe left installed while maintaining an 8 foot minimum from ground level.
3. If grounding is necessary, install down ground & molding with appropriate grounding kit (Std Item S34) which includes nylon clips and self tapping screws. Place clips approximately 12”-18” apart.
4. Install 12.5M maximum guy wire. If 25M is required, install 2 separate 12.5M guys.
5. For single phase delta circuit construction, omit the center phase.

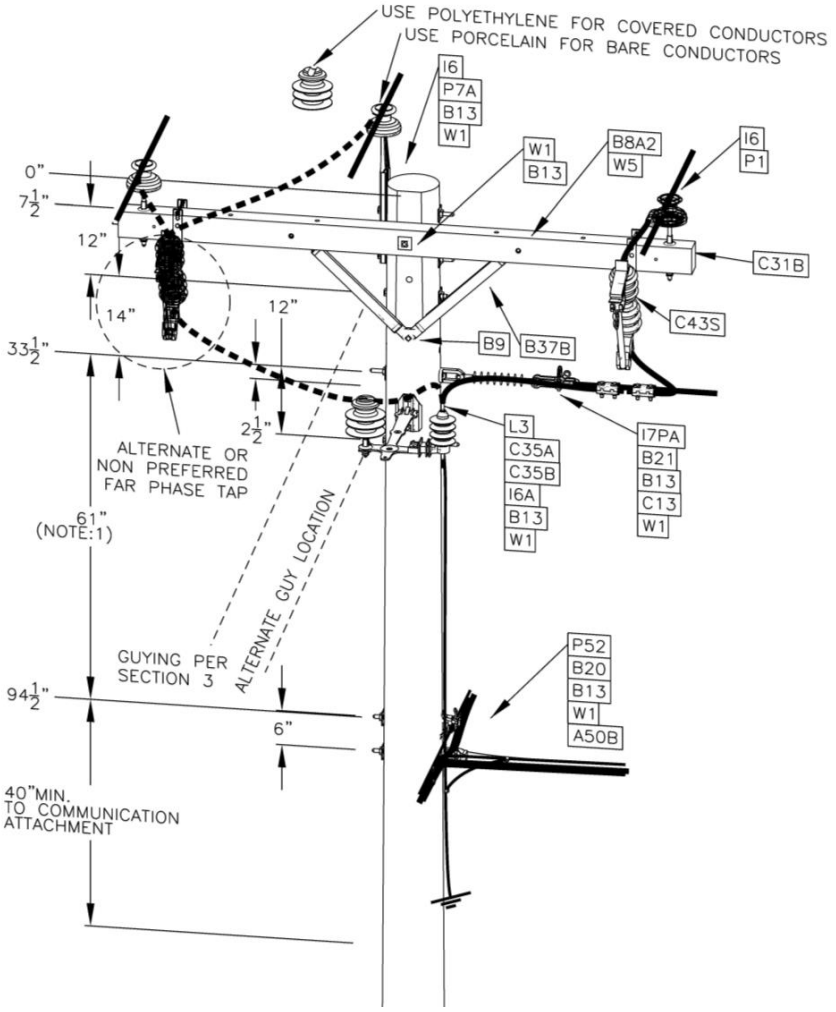
FIBERGLASS POLE - 1Φ (DELTA) AND 3Φ FIBERGLASS DEADEND CROSSARM POLE TOP – 0-15 kV - DEADENDS			
ISSUE	**PAGE NUMBER**		
7/21	**9-417F**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Supersedes 7/20 Issue – Corrected drawing title, page number and formatting.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-419F1A	0-15KV 3Φ - Bare	MU = @9-419F1ACL	0-15KV 3Φ - Covered
MU = @9-419F1B	0-15KV 1Φ - Bare	MU = @9-419F1BCL	0-15KV 1Φ - Covered

Supersedes 7/20 Issue – Corrected page number and formatting.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	180	180	180	180
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
94.5	45 JT-111"	--	--	--	207
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

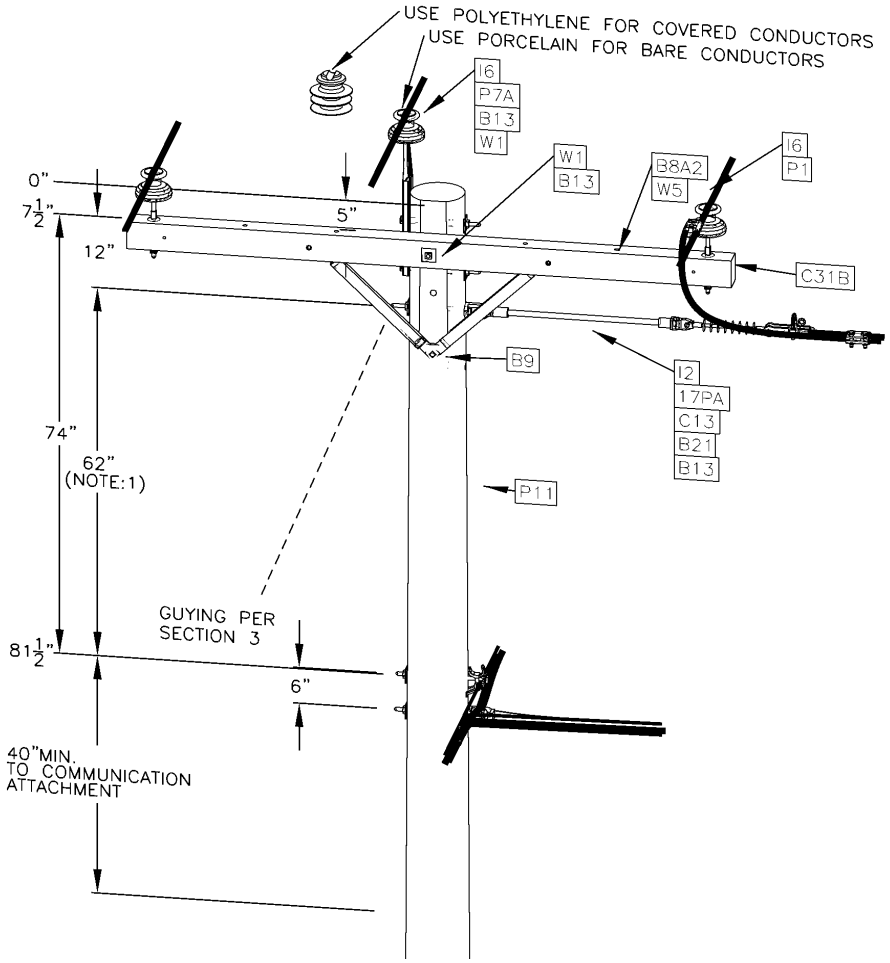
NOTES:

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

1Φ AND 3Φ CROSSARM POLE TOP – 0-15 kV – (PREFERRED) 0 ˚ - 10 ˚ – TAP TO 1Φ ARMLESS			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-419 FIG 1	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-419F2A	0-15KV 3Φ - Bare	MU = @9-419F2ACL	0-15KV 3Φ - Covered
MU = @9-419F2B	0-15KV 1Φ - Bare	MU = @9-419F2BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	135	135	135	135
81.5	45 JT-111"	220	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	225	195	186	210
81.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
81.5	45 JT-111"	--	--	--	210
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

NOTES:

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. If this configuration is needed, the fused cutout and arrester for the tap **must** be placed on the next pole down the tap. Otherwise, Drawing 9-419 FIG1 shall be used.

Supersedes 7/20 Issue – Corrected page number and formatting.

1Φ AND 3Φ CROSSARM POLE TOP – 0-15 kV – (ALTERNATE) 0˚ - 10˚ – TAP TO 1Φ ARMLESS			
ISSUE	**PAGE NUMBER**		
7/21	**9-419F2**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-420A	0-5KV 3Φ - Bare	MU = @9-420ACL	0-5KV 3Φ - Covered
MU = @9-420B	0-5KV 1Φ - Bare	MU = @9-420BCL	0-5KV 1Φ - Covered

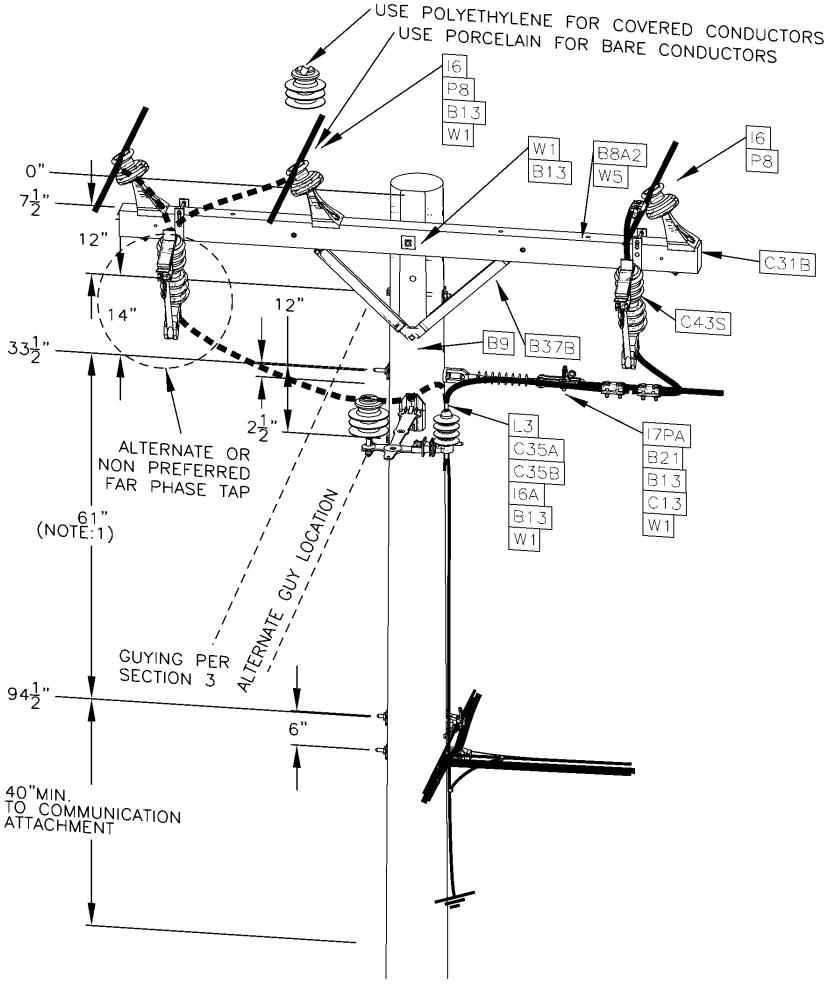
Supersedes 7/20 Issue – Corrected page formatting.

Drawing 9-420 has been removed.

Refer to Drawing 9-435.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-421F1A	0-15KV 3Φ - Bare	MU = @9-421F1ACL	0-15KV 3Φ - Covered
MU = @9-421F1B	0-15KV 1Φ - Bare	MU = @9-421F1BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	180	180	180	180
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
94.5	45 JT-111"	--	--	--	207
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

NOTES:

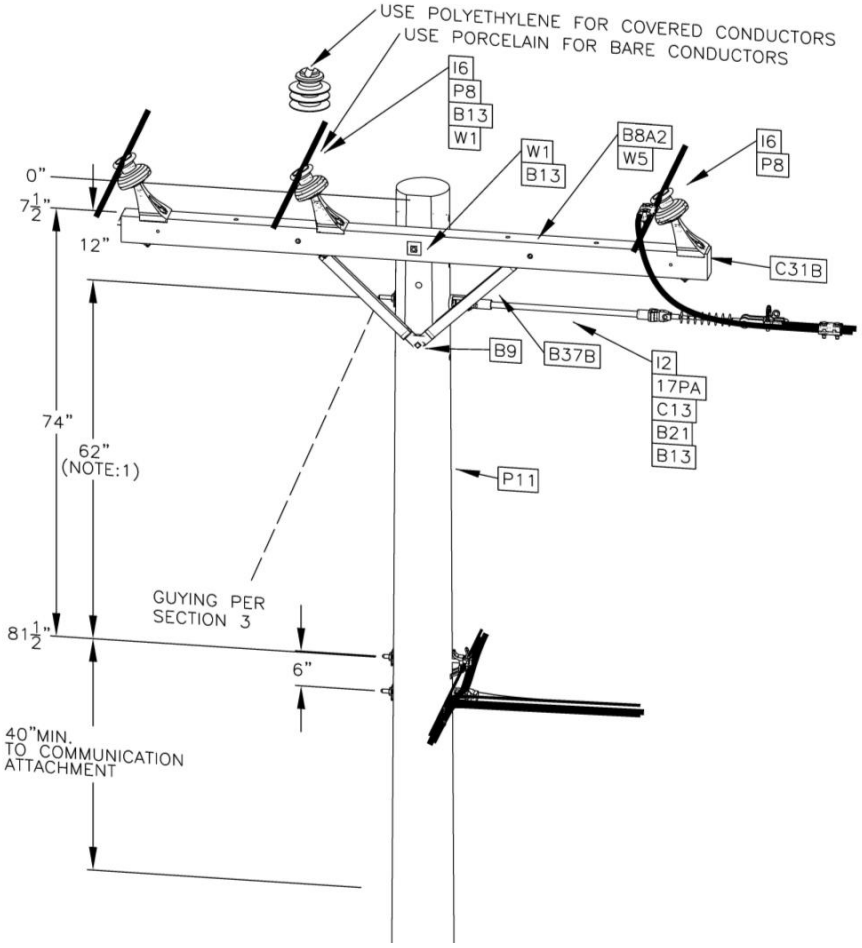
1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

1Φ AND 3Φ CROSSARM POLE TOP – 0-15 kV – (PREFERRED) 11˚ - 20˚ – TAP TO 1Φ ARMLESS			
ISSUE	**PAGE NUMBER**		
7/21	**9-421 FIG 1**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Supersedes 7/20 Issue – Corrected page formatting.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-421F2A	0-15KV 3Φ - Bare	MU = @9-421F2ACL	0-15KV 3Φ - Covered
MU = @9-421F2B	0-15KV 1Φ - Bare	MU = @9-421F2BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	135	135	135	135
81.5	45 JT-111"	220	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	225	195	186	210
81.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
81.5	45 JT-111"	--	--	--	210
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

NOTES: This clearance can be reduced to a minimum of 56" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

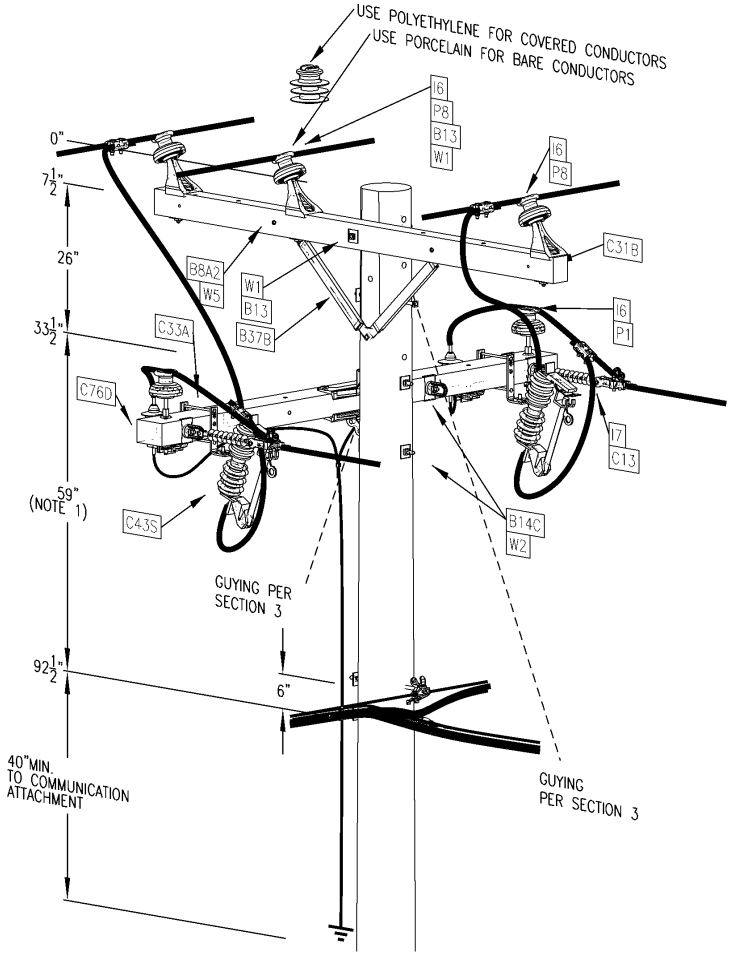
1. If this configuration is needed, the fused cutout and arrester for the tap **must** be placed on the next pole down the tap. Otherwise, Drawing 9-421 FIG1 shall be used.

Supersedes 7/20 Issue – Corrected page formatting.

1Φ AND 3Φ CROSSARM POLE TOP – 0-15 kV – (ALTERNATE) 11 ˚ - 20 ˚ – TAP TO 1Φ ARMLESS			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 9-421F2	ISSUE 7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-422A	**0-5KV 3Φ - Bare**	**MU = @9-422ACL**	**0-5KV 3Φ - Covered**
MU = @9-422B	**0-5KV 1Φ - Bare**	**MU = @9-422BCL**	**0-5KV 1Φ - Covered**



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS

SPANS WITH 1/0 TRIPLEX SEC

SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	135	135	135	100
81.5	45 JT-111"	220	220	220	100

SPANS WITH 1/0 AAAC NEUTRAL

SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	225	195	186	80
81.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
81.5	45 JT-111"	--	--	--	85

THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE

NOTES:

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta main line, omit center phase on top crossarm.

1Φ AND 3Φ CROSSARM POLE TOP – 0-15 kV
11 ° - 20 ° – TAP TO 1Φ ARMLESS - DELTA

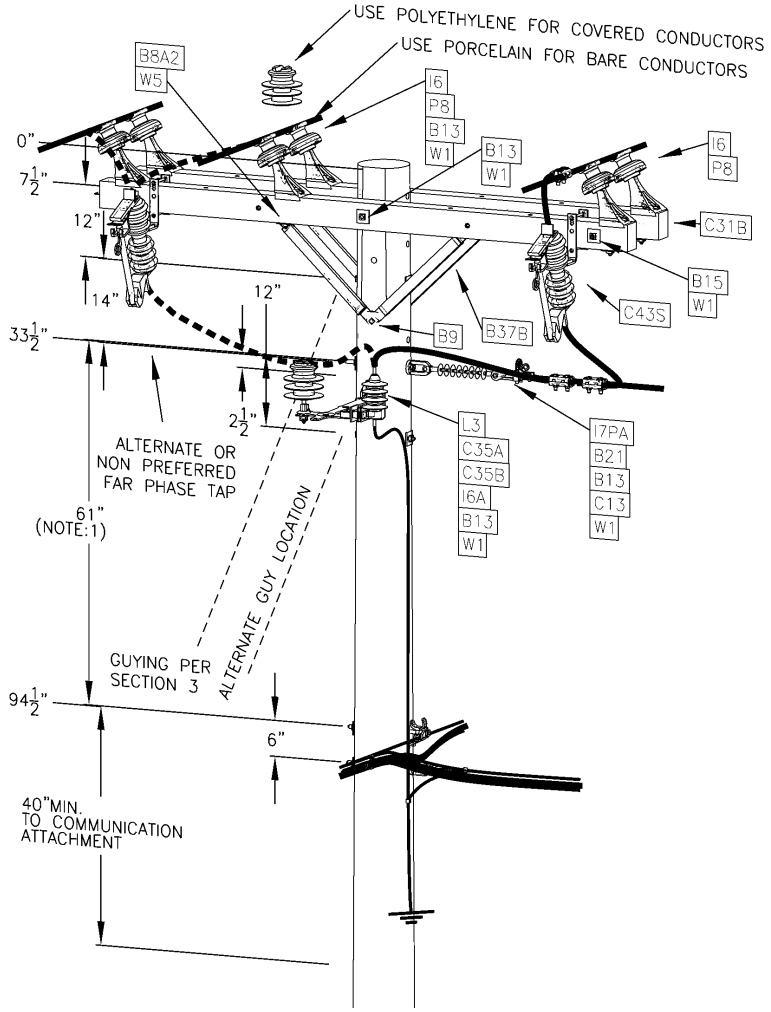
ISSUE	PAGE NUMBER		
7/21	**9-422**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Supersedes 7/20 Issue – Corrected page formatting.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-423F1A	**0-15KV 3Φ - Bare**	**MU = @9-423F1ACL**	**0-15KV 3Φ - Covered**
MU = @9-423F1B	**0-15KV 1Φ - Bare**	**MU = @9-423F1BCL**	**0-15KV 1Φ - Covered**

Supersedes 7/20 Issue – Corrected page formatting.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	180	180	180	180
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
94.5	45 JT-111"	--	--	--	207
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

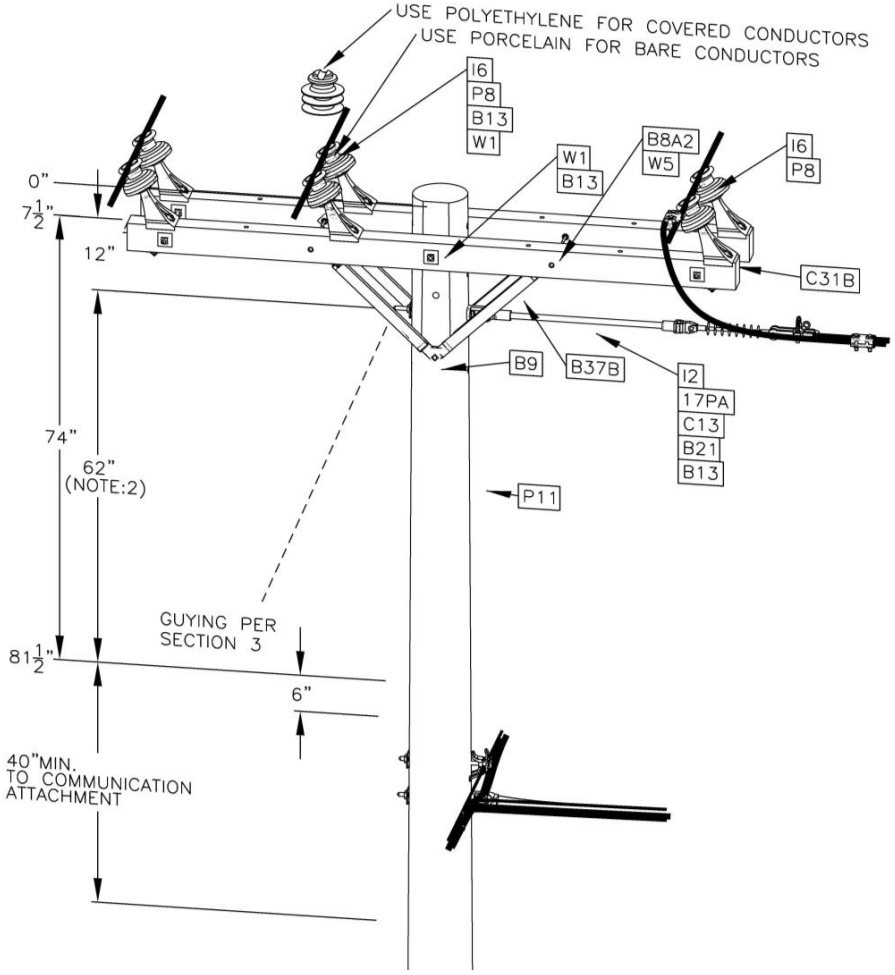
NOTES:

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

1Φ AND 3Φ DOUBLE CROSSARM POLE TOP – 0-15 kV (PREFERRED) CROSSINGS 11˚ - 45˚ / ANGLES - 21˚ - 45˚ – TAP TO 1Φ ARMLESS			
nationalgrid	**OVERHEAD CONSTRUCTION STANDARD**	**PAGE NUMBER**	**ISSUE**
		9-423 FIG 1	**7/21**

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-423F2A	0-15KV 3Φ - BARE	MU = @9-423F2ACL	0-15KV 3Φ - Covered
MU = @9-423F2B	0-15KV 1Φ - BARE	MU = @9-423F2BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	135	135	135	135
81.5	45 JT-111"	220	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	225	195	186	210
81.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
81.5	45 JT-111"	--	--	--	210
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

NOTES:

1. If this configuration is needed, the fused cutout and arrester for the tap **must** be placed on the next pole down the tap. Otherwise, Drawing 9-423 FIG1 shall be used.
2. This clearance can be reduced to a minimum of 56" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

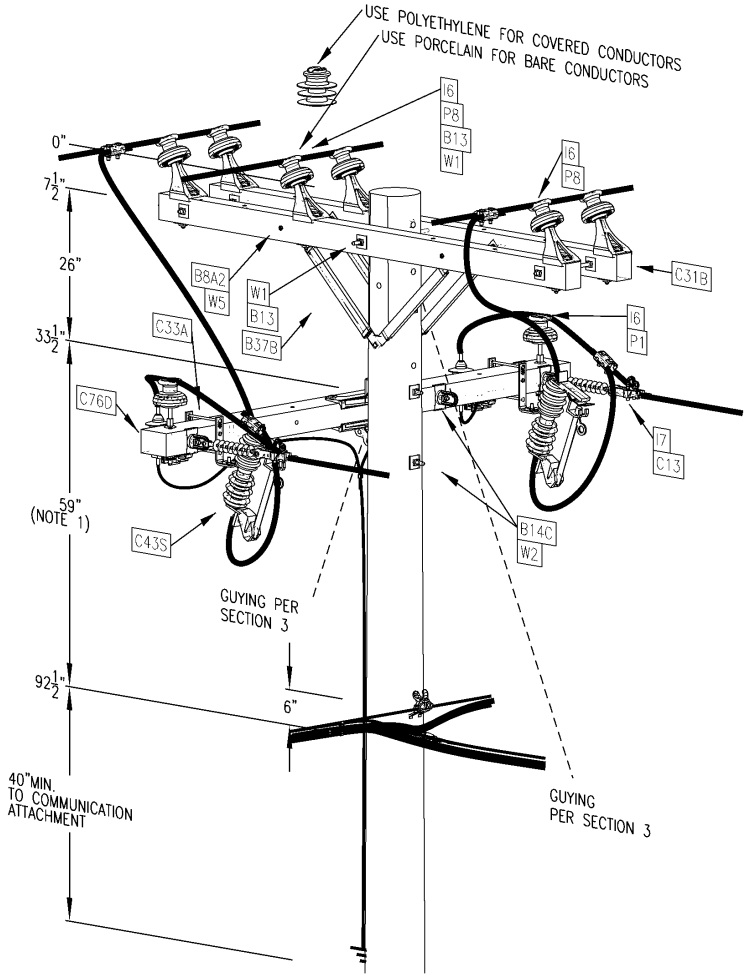
1Φ AND 3Φ DOUBLE CROSSARM POLE TOP – 0-15 kV (ALTERNATE) CROSSINGS 11° - 45° / ANGLES - 21° - 45° – TAP TO 1Φ ARMLESS			
ISSUE	**PAGE NUMBER**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid
7/21	**9-423F2**		

Supersedes 7/20 Issue – Corrected page formatting.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-424A	0-5KV 3Φ - Bare	MU = @9-424ACL	0-5KV 3Φ - Covered
MU = @9-424B	0-5KV 1Φ - Bare	MU = @9-424BCL	0-5KV 1Φ - Covered

Supersedes 7/20 Issue – Corrected page formatting.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS

SPANS WITH 1/0 TRIPLEX SEC

SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	135	135	135	100
81.5	45 JT-111"	220	220	220	100

SPANS WITH 1/0 AAAC NEUTRAL

SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	225	195	186	80
81.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
81.5	45 JT-111"	--	--	--	85

THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE

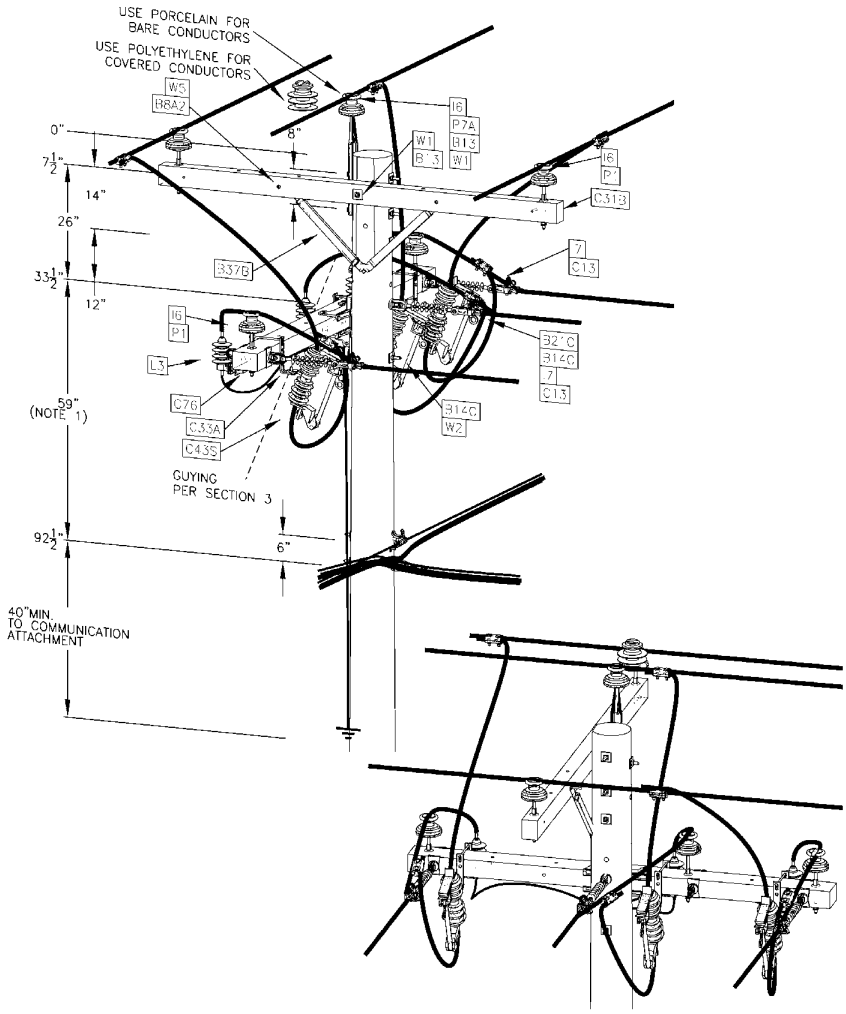
NOTES:

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta main line, omit center phase on top crossarm.

1Φ AND 3Φ DOUBLE CROSSARM POLE TOP – 0-15 kV CROSSINGS 11˚ - 45˚ / ANGLES - 21˚ - 45˚ – TAP TO 1Φ ARMLESS DELTA			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-424	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-435A	0-15KV 3Φ - Bare	MU = @9-435ACL	0-15KV 3Φ - Covered
MU = @9-435B	0-15KV 1Φ - Bare	MU = @9-435BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
92.5	45 JT-111"	185	--	--
92.5	45 JT-111"	--	185	--
97.5	45 JT-111"	--	--	180
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
103.5	45 JT-111"	255	--	--
108.5	45 JT-111"	--	185	--
108.5	45 JT-111"	--	--	175
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES

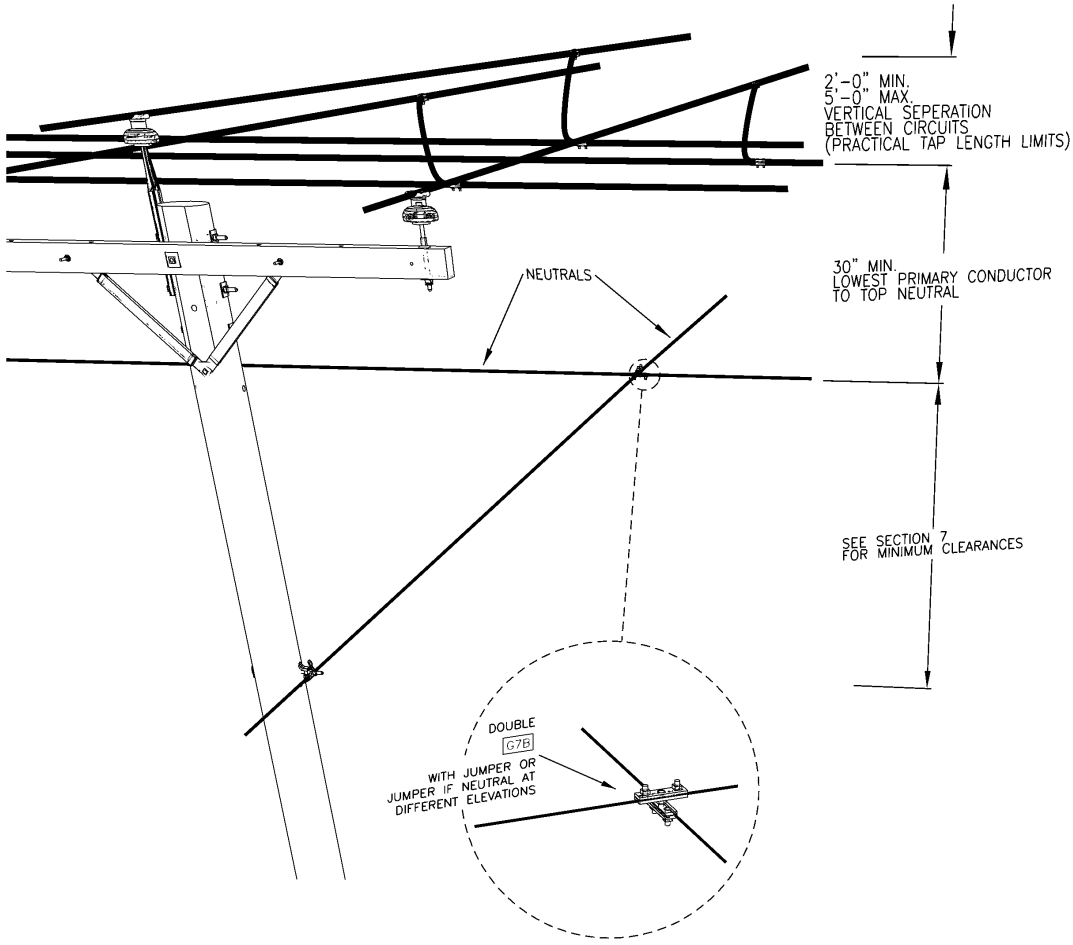
1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phases.

1Φ AND 3Φ CROSSARM POLE TOP – 0-15 kV 0 ˚ - 10 ˚ – TAP TO 1Φ OR 3Φ CROSSARM			
ISSUE	**PAGE NUMBER**		
7/21	**9-435**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Supersedes 7/20 Issue – Corrected page formatting.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/20 Issue – Corrected page formatting.



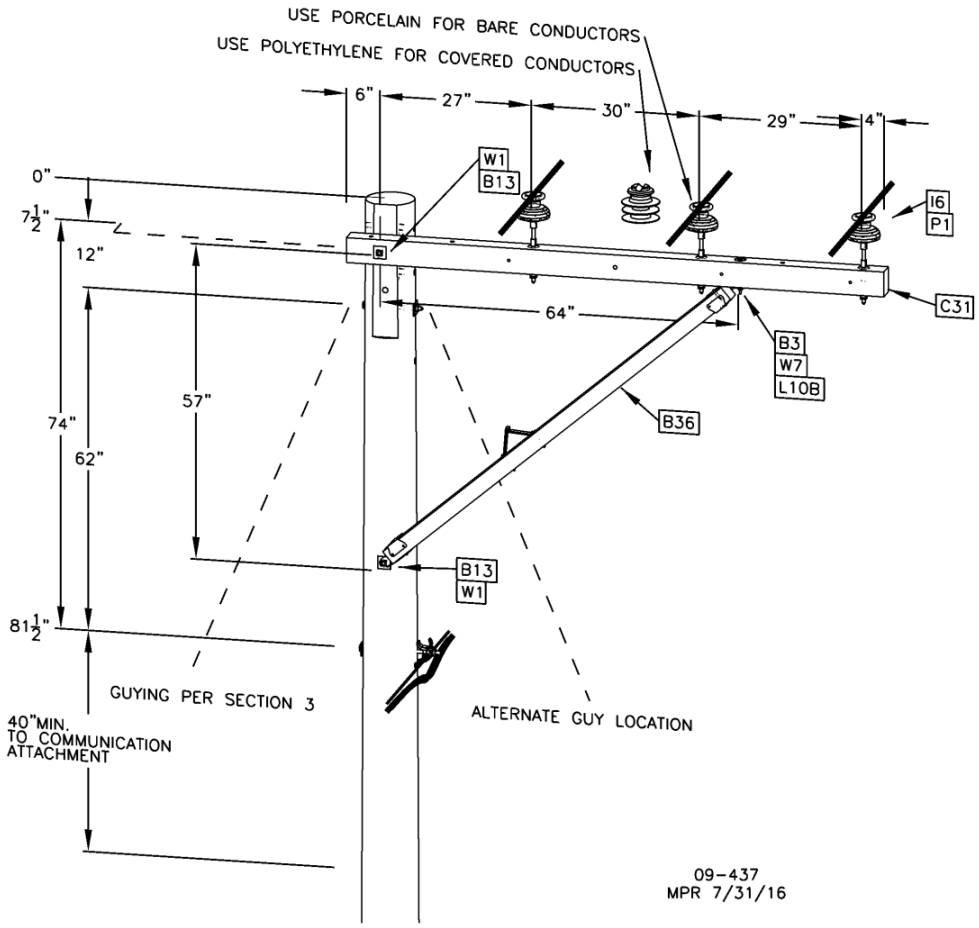
NOTES:

1. Midspan taps may be required where poles are set back at heavy intersections.
2. See Drawing 9-435 for standard 3-phase taps at the pole.
3. Refer to Page 9-105 for information on relative phase positioning.
4. Always wire brush the surface of conductors immediately before installing any type of connector.
5. See Section 5 for more details on connectors available.

PRIMARY MIDSPAN TAP			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-436	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-437A	0-15KV 3Φ - Bare	MU = @9-437ACL	0-15KV 3Φ - Covered
MU = @9-437B	0-15KV 1Φ - Bare	MU = @9-437BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:

1. Alley arm construction shall be used only as required for lateral clearance to avoid restricted tree trimming or to eliminate some offset line conditions.
2. For single phase delta, omit the center conductor.
3. Guying is not always necessary for in-line poles with offset arms unless calculated forces are exceeding pole strength (refer to Section 3 for guying information).
4. Two or more adjacent poles with extension arms shall be used to reduce the excessive lateral stress.

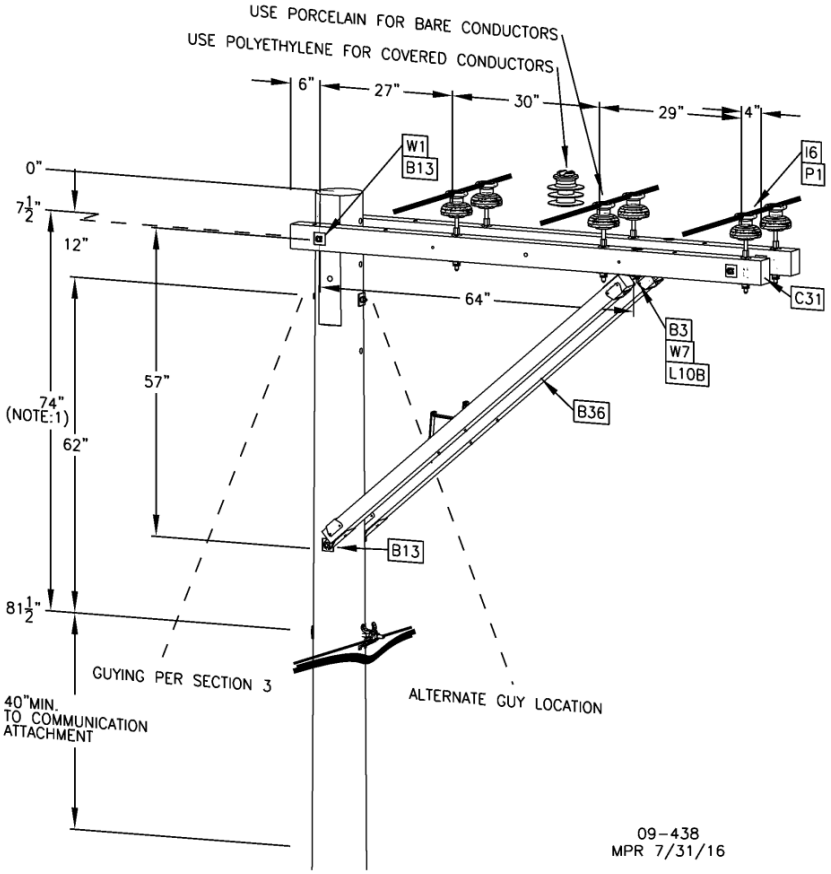
1Φ AND 3Φ SINGLE ALLEY ARM POLE TOP – 0-15 kV – 0˚ - 10˚			
ISSUE	**PAGE NUMBER**		
7/21	**9-437**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Supersedes 7/20 Issue – Corrected page formatting.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-438A	0-15KV 3Φ - Bare	MU = @9-438ACL	0-15KV 3Φ - Covered
MU = @9-438B	0-15KV 1Φ - Bare	MU = @9-438BCL	0-15KV 1Φ - Covered

Supersedes 7/20 Issue – Corrected page formatting.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

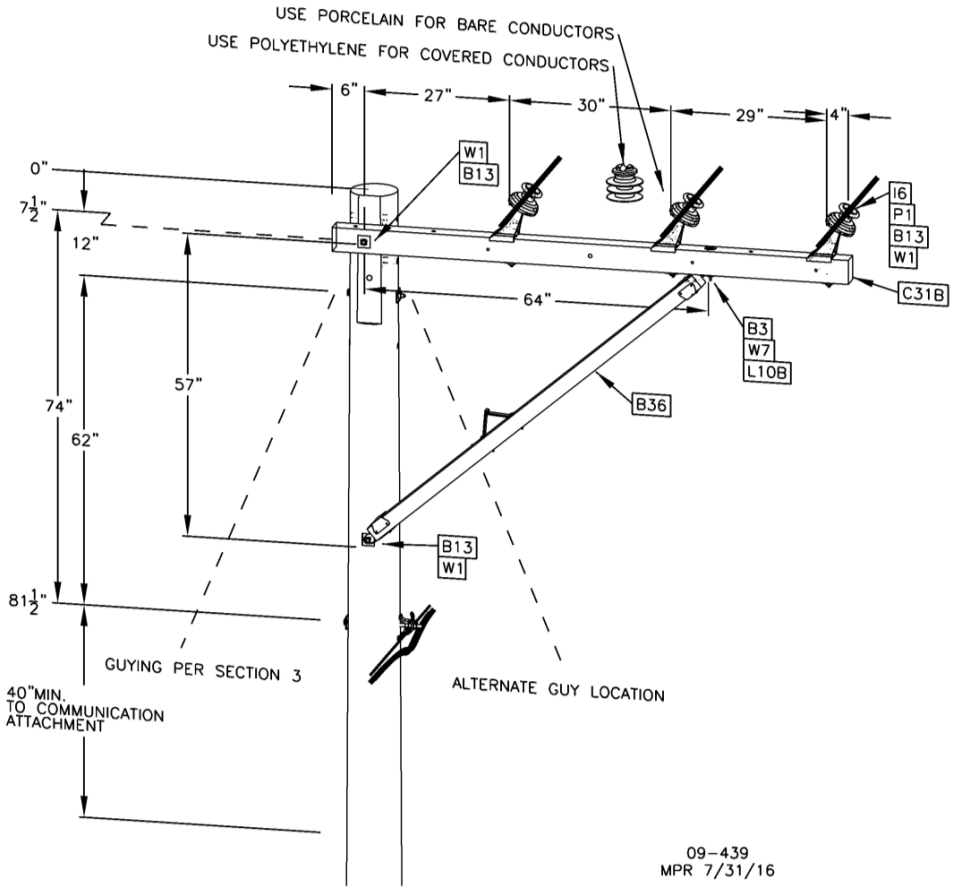
NOTES:

1. Alley arm construction shall be used only as required for lateral clearance to avoid restricted tree trimming or to eliminate some offset line conditions.
2. For single phase delta, omit the center conductor.
3. Guying is not always necessary for in-line poles with offset arms unless calculated forces are exceeding pole strength (refer to Section 3 for guying information).
4. Two or more adjacent poles with extension arms shall be used to reduce the excessive lateral stress.

1Φ AND 3Φ DOUBLE ALLEY ARM POLE TOP – 0-15 kV – CROSSING AND ANGLES - 0˚ - 10˚			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-438	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-439A	0-15KV 3Φ - Bare	MU = @9-439ACL	0-15KV 3Φ - Covered
MU = @9-439B	0-15KV 1Φ - Bare	MU = @9-439BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:

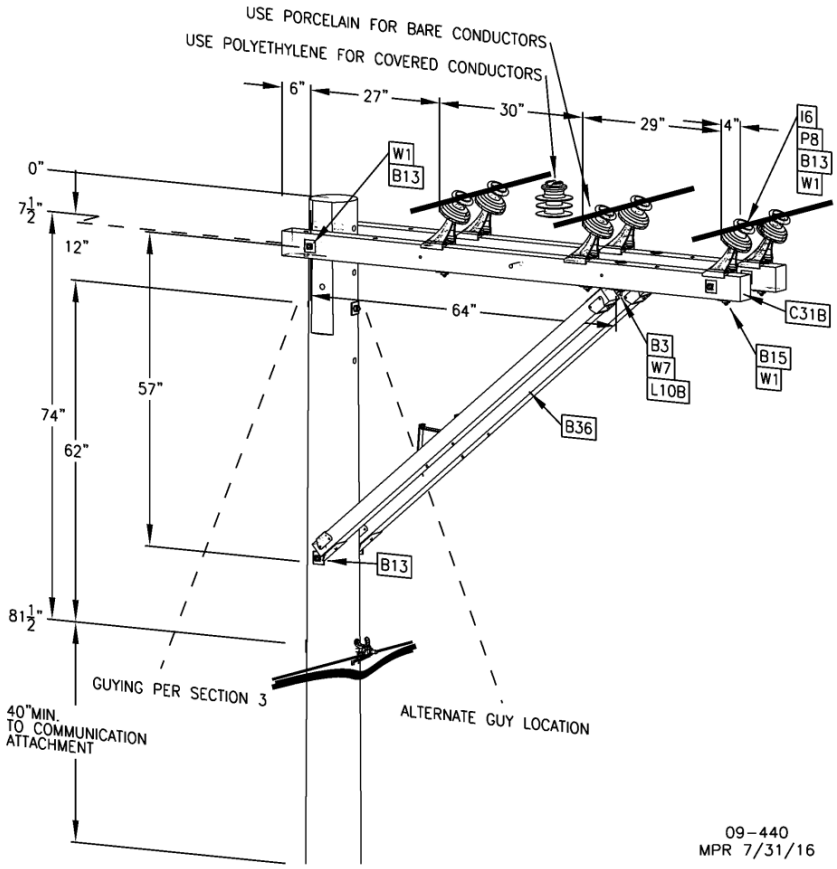
1. Alley arm construction shall be used only as required for lateral clearance to avoid restricted tree trimming or to eliminate some offset line conditions.
2. For single phase delta, omit the center conductor.
3. Guying is not always necessary for in-line poles with offset arms unless calculated forces are exceeding pole strength (refer to Section 3 for guying information).
4. Two or more adjacent poles with extension arms shall be used to reduce the excessive lateral stress.

Supersedes 7/20 Issue – Corrected page formatting.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-440A	0-15KV 3Φ - Bare	MU = @9-440ACL	0-15KV 3Φ - Covered
MU = @9-440B	0-15KV 1Φ - Bare	MU = @9-440BCL	0-15KV 1Φ - Covered

Supersedes 7/20 Issue – Corrected page formatting.



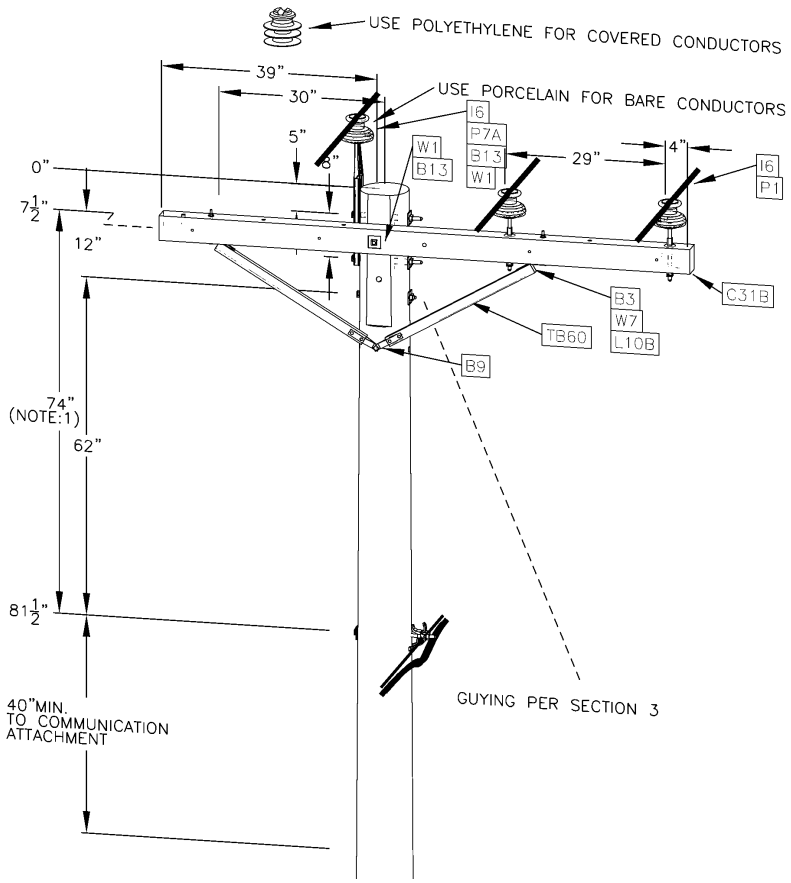
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:

1. Alley arm construction shall be used only as required for lateral clearance to avoid restricted tree trimming or to eliminate some offset line conditions.
2. For single phase delta, omit the center conductor.
3. Guying is not always necessary for in-line poles with offset arms unless calculated forces are exceeding pole strength (refer to Section 3 for guying information).
4. Two or more adjacent poles with extension arms shall be used to reduce the excessive lateral stress.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-441A	0-15KV 3Φ - Bare	MU = @9-441ACL	0-15KV 3Φ - Covered
MU = @9-441B	0-15KV 1Φ - Bare	MU = @9-441BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

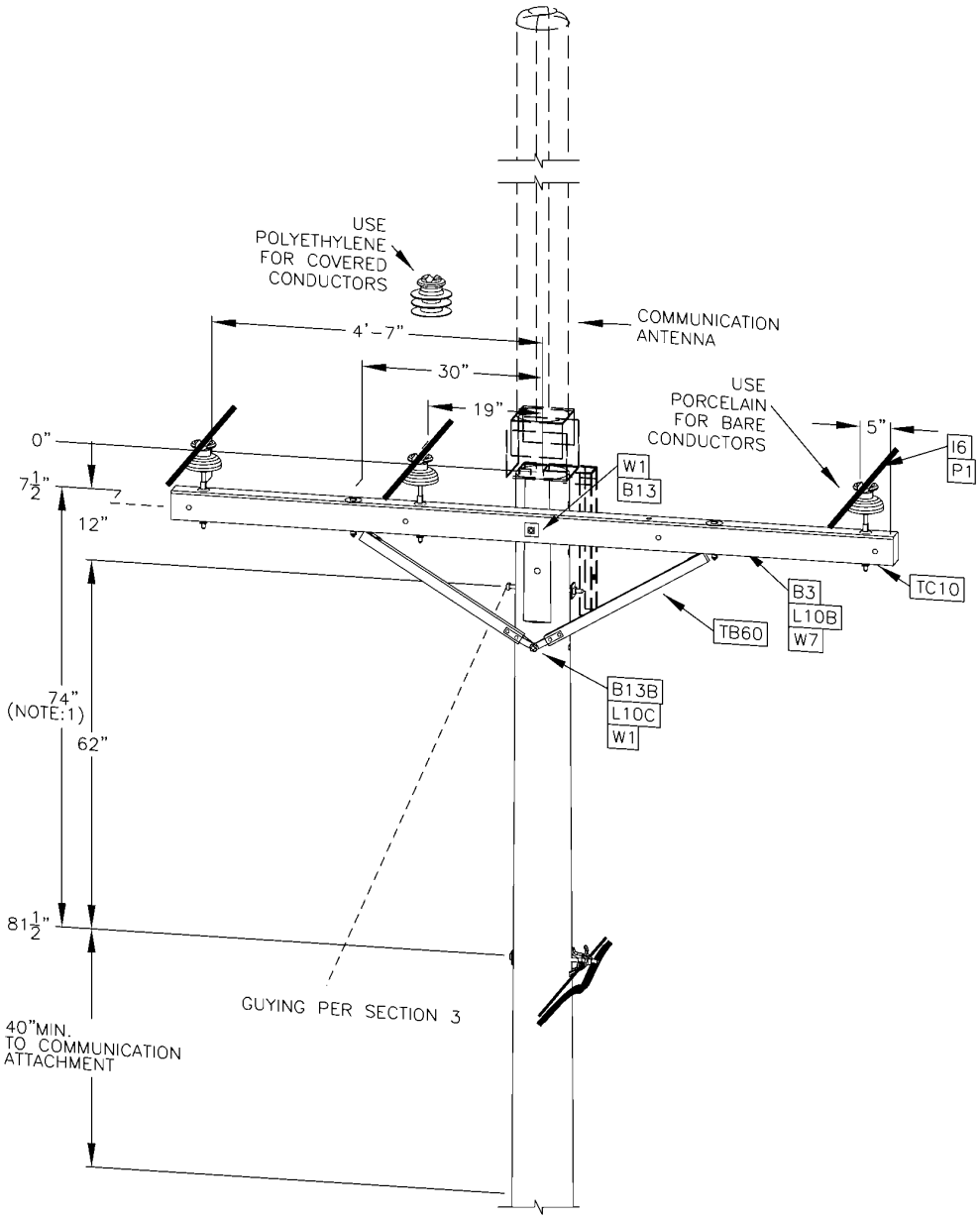
NOTES:

1. This clearance can be reduced to a minimum of 48" if needed.
2. Offset arm construction shall be used only as required for lateral clearance to avoid restricted tree trimming or to eliminate some offset line conditions.
3. For single phase delta, omit the center conductor.
4. Guying is not always necessary for in-line poles with offset arms unless calculated forces are exceeding pole strength (refer to Section 3 for guying information).

Supersedes 7/20 Issue – Corrected page formatting.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-450A	0-15KV 3Φ - Bare	MU = @9-450ACL	0-15KV 3Φ - Covered



Supersedes 7/20 Issue – Corrected page formatting.

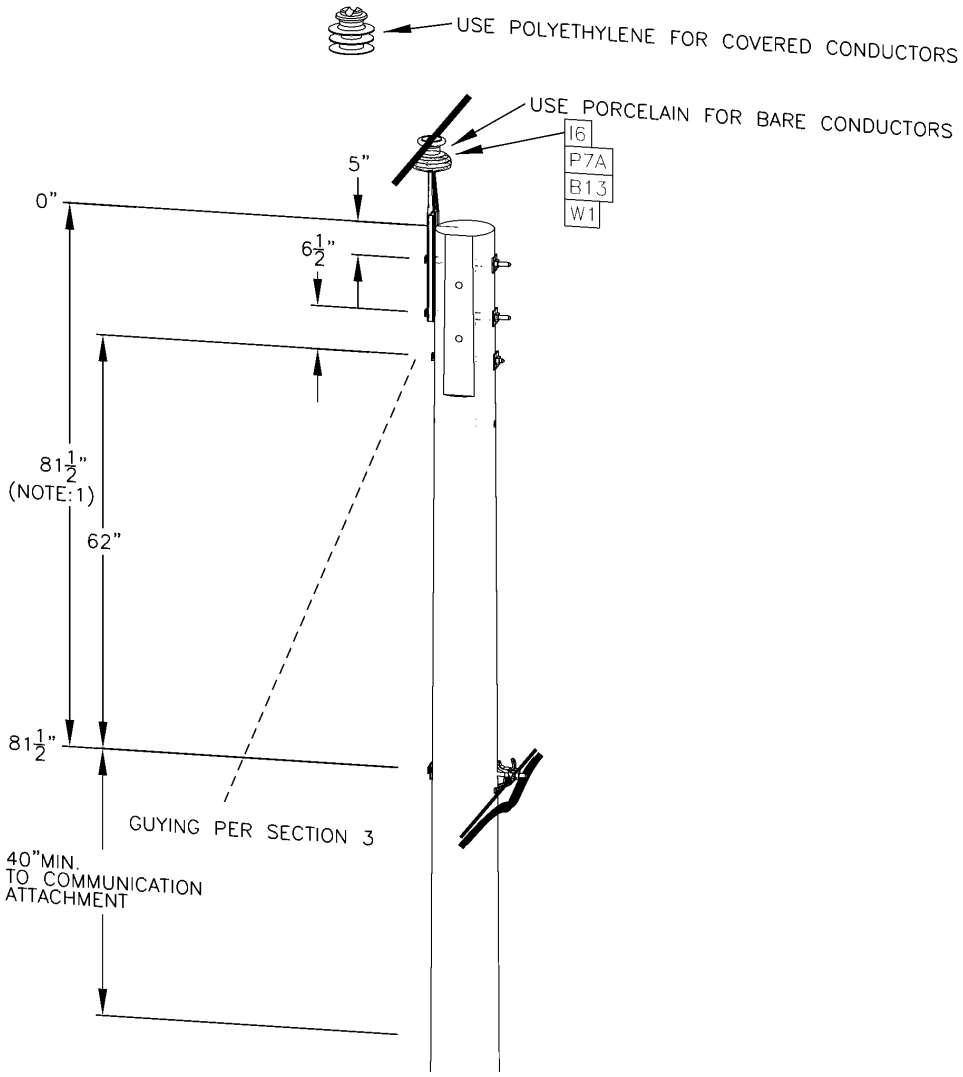
NOTES

1. This clearance can be reduced to a minimum of 48" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearance

ALTERNATE 3 Φ CROSSARM POLE TOP – 0-15kV - 0° - 10° (FOR USE WITH POLE TOP MOUNTED ANTENNA)			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-450	7/21

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-711	0-15KV 1Φ - Bare	MU = @9-711CL	0-15KV 1Φ - Covered	
MU = @9-711AF	0-15KV 1Φ - Bare	MU = @9-711AFCL	0-15KV 1Φ - Covered	Fiberglass pole



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:

1. This clearance can be reduced to a minimum of 48” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

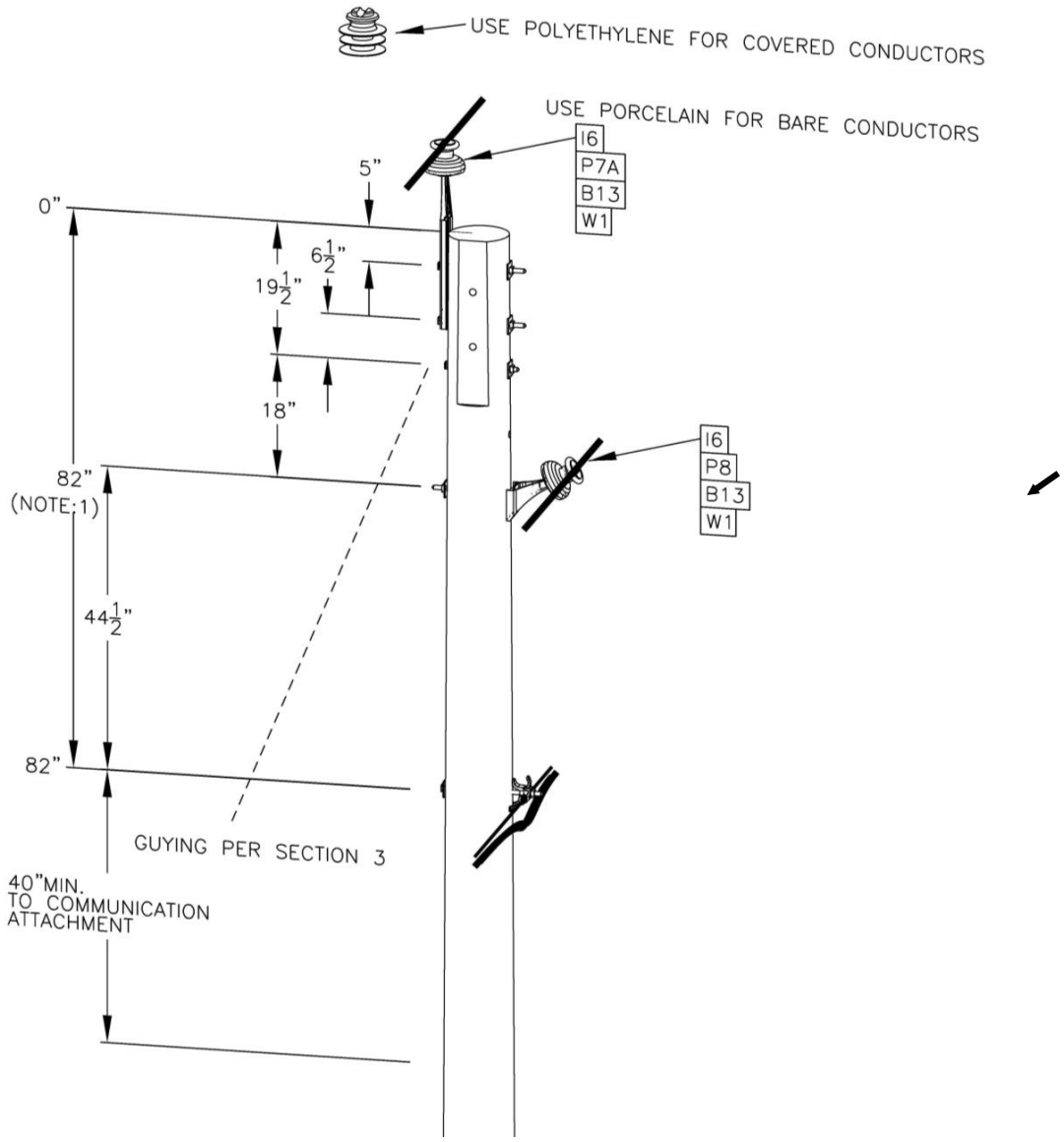
Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

1Φ ARMLESS POLE TOP – 0-15 kV 0˚ - 20˚			
ISSUE	**PAGE NUMBER**		
7/16	**9-711**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-712	0-5KV 1Φ - Bare	MU = @9-712CL	0-5KV 1Φ - Covered	
MU = @9-712F	0-5KV 1Φ - Bare	MU = @9-712FCL	0-5KV 1Φ - Covered	Fiberglass Pole

Supersedes 7/16 Issue – Corrected angle pin from P7A to P8.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS

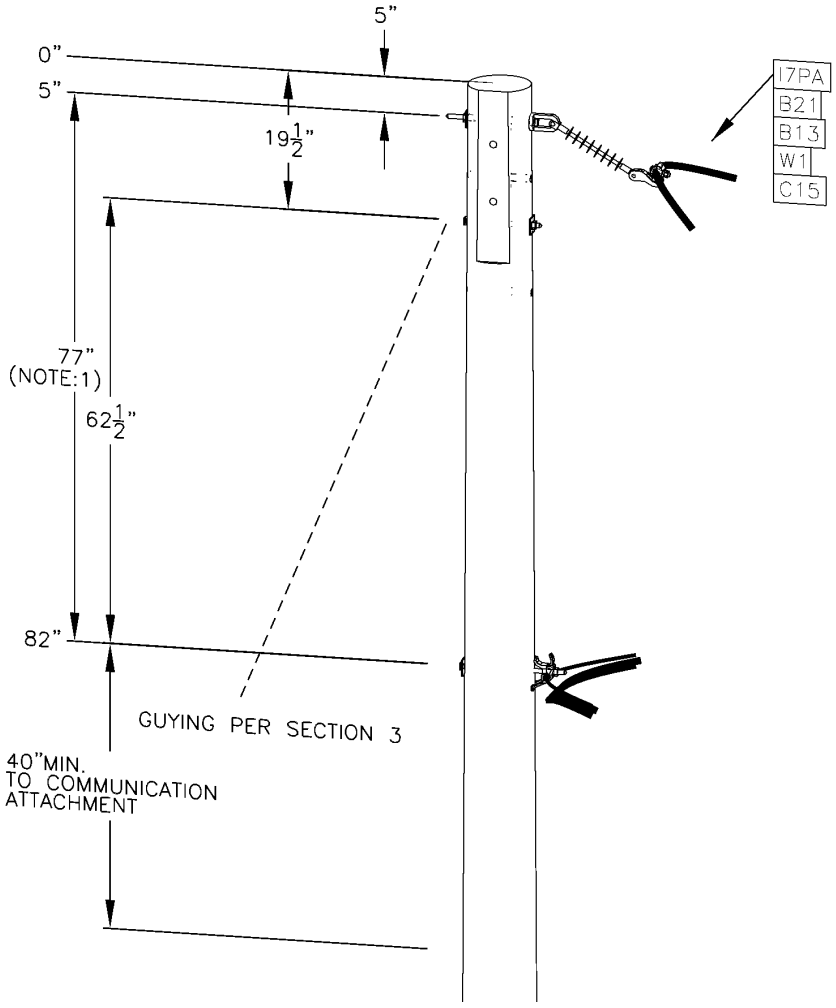
SPANS WITH 1/0 TRIPLEX SEC					SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC			1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	126	106	81.5	40 JT-84"	130	105	100
81.5	45 JT-111"	220	--	--	106	45 JT-111"	240	--	--
97	45 JT-111"	--	185	--	108	45 JT-111"	--	170	--
100	45 JT-111"	--	--	180	108	45 JT-111"	--	--	162

THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE

1Φ ARMLESS POLE TOP – 0-15 kV 0˚ - 20˚ - DELTA			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-712	7/17

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-713	0-15KV 1Φ - Bare	MU = @9-713CL	0-15KV 1Φ - Covered	
MU = @9-713F	0-15KV 1Φ - Bare	MU = @9-713FCL	0-15KV 1Φ - Covered	Fiberglass Pole



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	135	135	135
82	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	225	190	180
83	45 JT-111"	300	--	--
106	45 JT-111"	--	240	--
108	45 JT-111"	--	--	230
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:

1. This clearance can be reduced to a minimum of 65" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

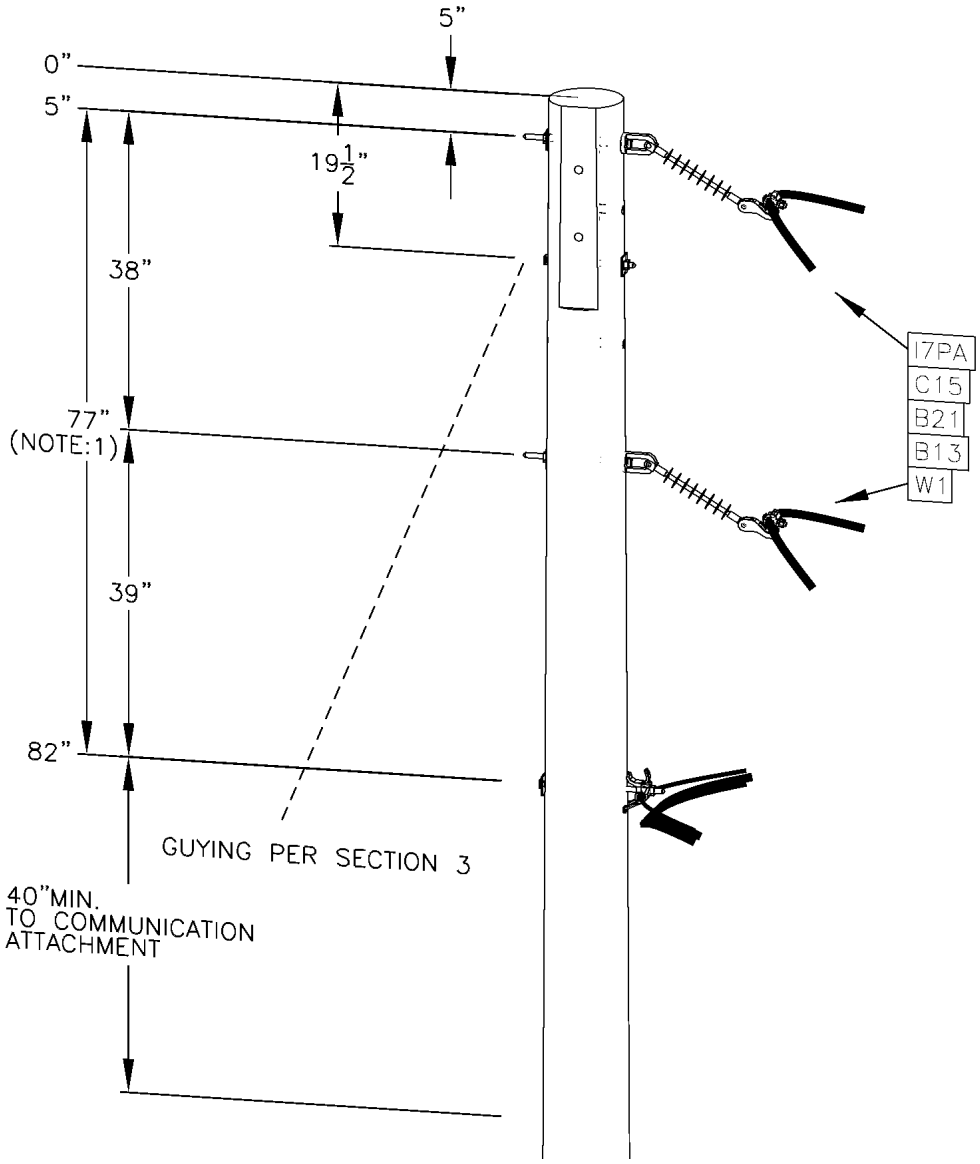
Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

1Φ ARMLESS POLE TOP – 0-15 kV 21˚ - 60˚			
ISSUE	**PAGE NUMBER**		
7/16	**9-713**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-714	0-5KV 1Φ - Bare	MU = @9-714CL	0-5KV 1Φ - Covered	
MU = @9-714F	0-5KV 1Φ - Bare	MU = @9-714FCL	0-5KV 1Φ - Covered	Fiberglass Pole

Supersedes 7/11 Issue – Update drawing with a 3-D rendering.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS

SPANS WITH 1/0 TRIPLEX SEC					SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC			1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	115	101	97	82	40 JT-84"	106	82	80
82	45 JT-111"	220	--	--	106	45 JT-111"	210	--	--
98	45 JT-111"	--	175	--	108	45 JT-111"	--	160	--
102	45 JT-111"	--	--	160	108	45 JT-111"	--	--	140

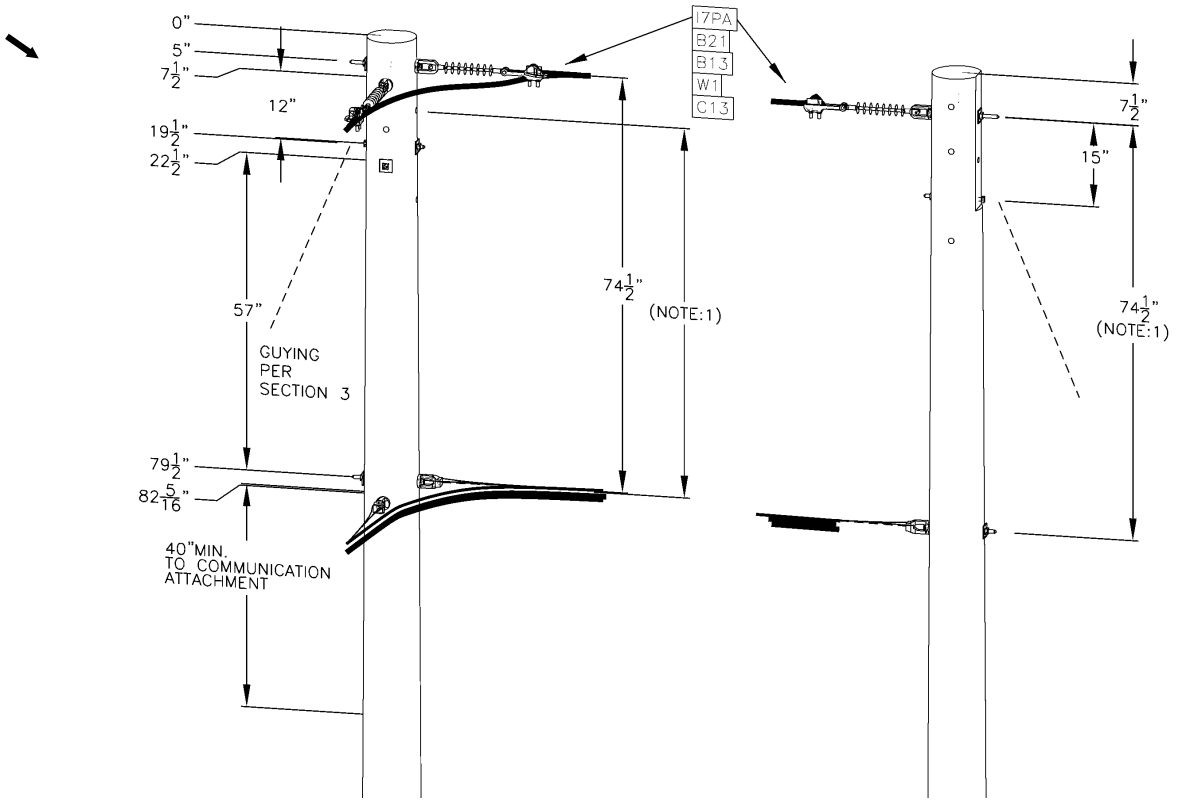
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE

1Φ ARMLESS POLE TOP – 0-15 kV
21˚ - 60˚ - DELTA

nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-714	7/16

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-715A	0-15KV 1Φ - Bare	MU = @9-715ACL	0-15KV 1Φ - Covered	
MU = @9-715B	0-15KV 1Φ DE- Bare	MU = @9-715BCL	0-15KV 1Φ DE- Covered	
MU = @9-715AF	0-15KV 1Φ - Bare	MU = @9-715AFCL	0-15KV 1Φ - Covered	Fiberglass Pole
MU = @9-715BF	0-15KV 1Φ DE- Bare	MU = @9-715BFCL	0-15KV 1Φ DE- Covered	Fiberglass Pole



New Pole
61° - 90°
Single Phase
(9-715A)

New Pole
Deadend
Single Phase
(9-715B)

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	135	135	135
82	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	225	185	175
86	45 JT-111"	300	--	--
105	45 JT-111"	--	235	--
107	45 JT-111"	--	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:

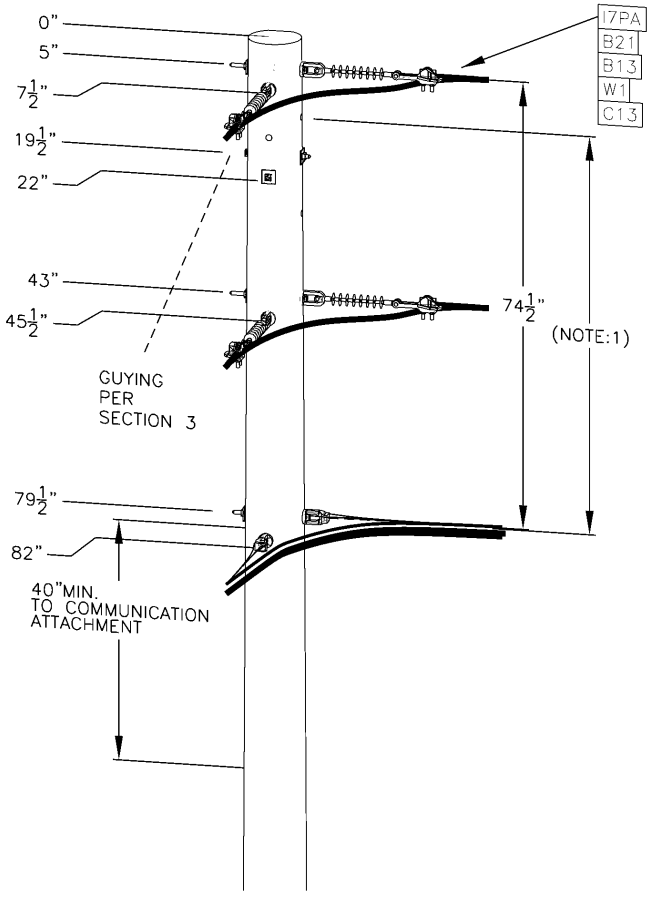
1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. This configuration can also be used for back-to-back (tangent) deadends.

Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

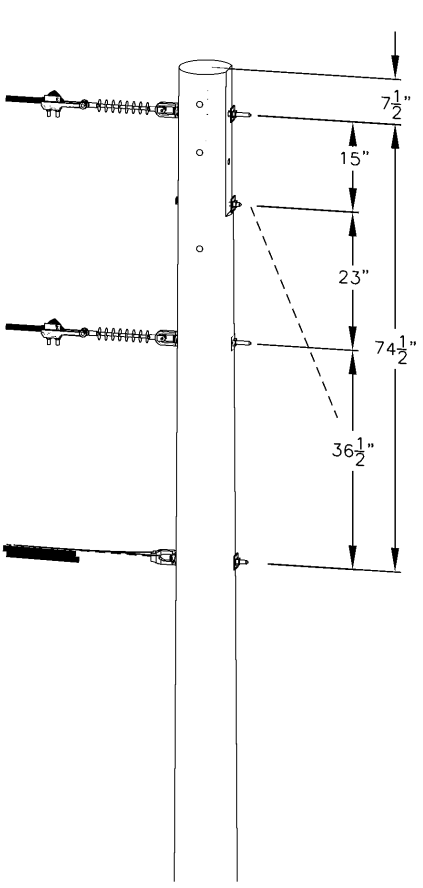
1Φ ARMLESS POLE TOP – 0-15 kV 61˚ - 90˚ AND DEADEND			
ISSUE	**PAGE NUMBER**		
7/16	**9-715**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-716A	0-5KV 1Φ - Bare	MU = @9-716ACL	0-5KV 1Φ - Covered	
MU = @9-716B	0-5KV 1Φ DE- Bare	MU = @9-716BCL	0-5KV 1Φ DE- Covered	
MU = @9-716AF	0-5KV 1Φ - Bare	MU = @9-716AFCL	0-5KV 1Φ - Covered	Fiberglass Pole
MU = @9-716BF	0-5KV 1Φ DE- Bare	MU = @9-716BFCL	0-5KV 1Φ DE- Covered	Fiberglass Pole



New Pole
61° - 90°
Single Phase
(Fig. 1A)



New Pole
Deadend
Single Phase
(Fig. 1B)

Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS

SPANS WITH 1/0 TRIPLEX SEC					SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC			1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	128	88	85	82	40 JT-84"	101	78	76
83	45 JT-111"	210	--	--	108	45 JT-111"	210	--	--
88	45 JT-111"	--	175	--	108	45 JT-111"	--	156	--
101	45 JT-111"	--	--	155	108	45 JT-111"	--	--	138

THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE

1Φ DELTA / 2Φ WYE ARMLESS POLE TOP – 0-15 kV 61˚ - 90˚ AND DEADEND

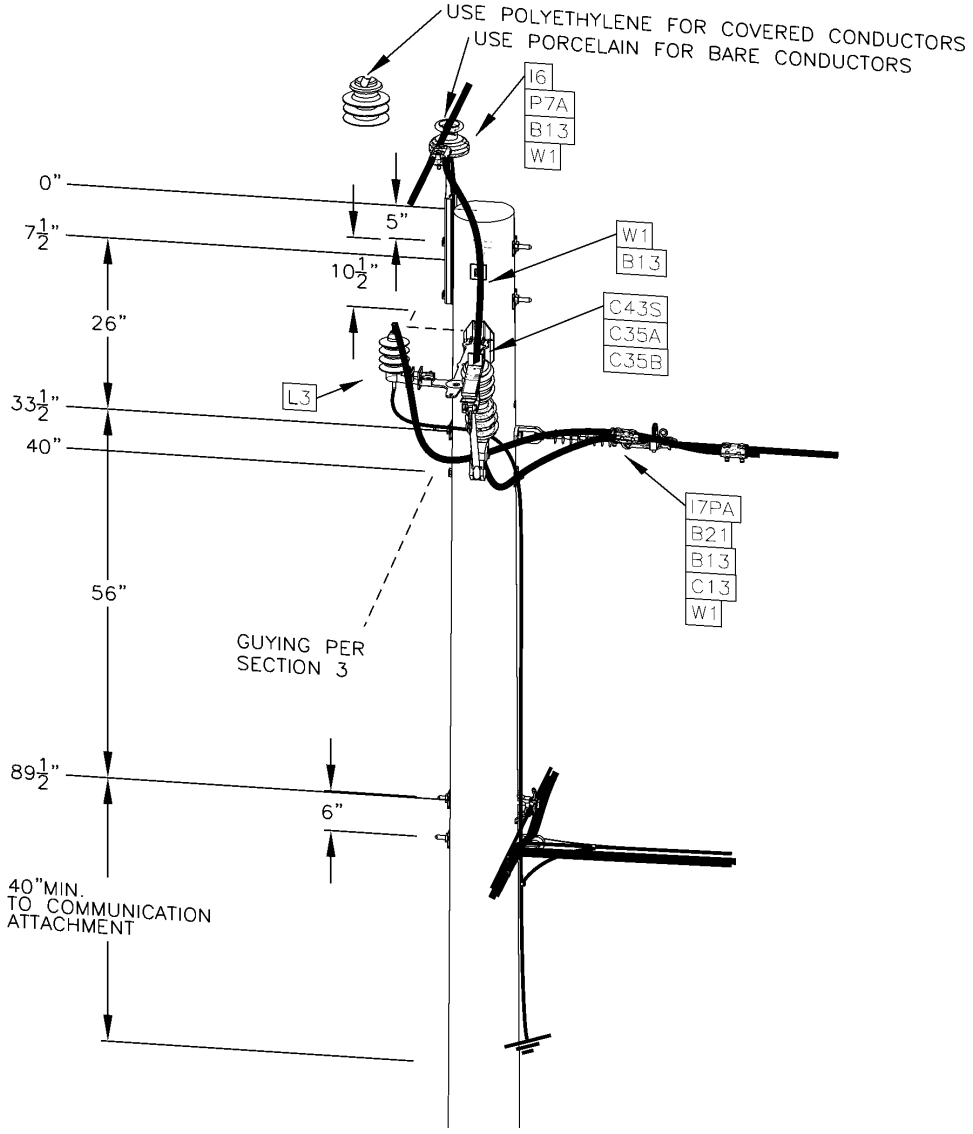
nationalgrid

OVERHEAD CONSTRUCTION STANDARD

PAGE NUMBER	ISSUE
9-716	**7/16**

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-719	0-15KV 1Φ - Bare	MU = @9-719CL	0-15KV 1Φ - Covered	
MU = @9-719F	0-15KV 1Φ - Bare	MU = @9-719FCL	0-15KV 1Φ - Covered	Fiberglass Pole



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
89.5	45 JT-111"	200	200	200	200
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
89.5	45 JT-111"	300	225	205	200
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

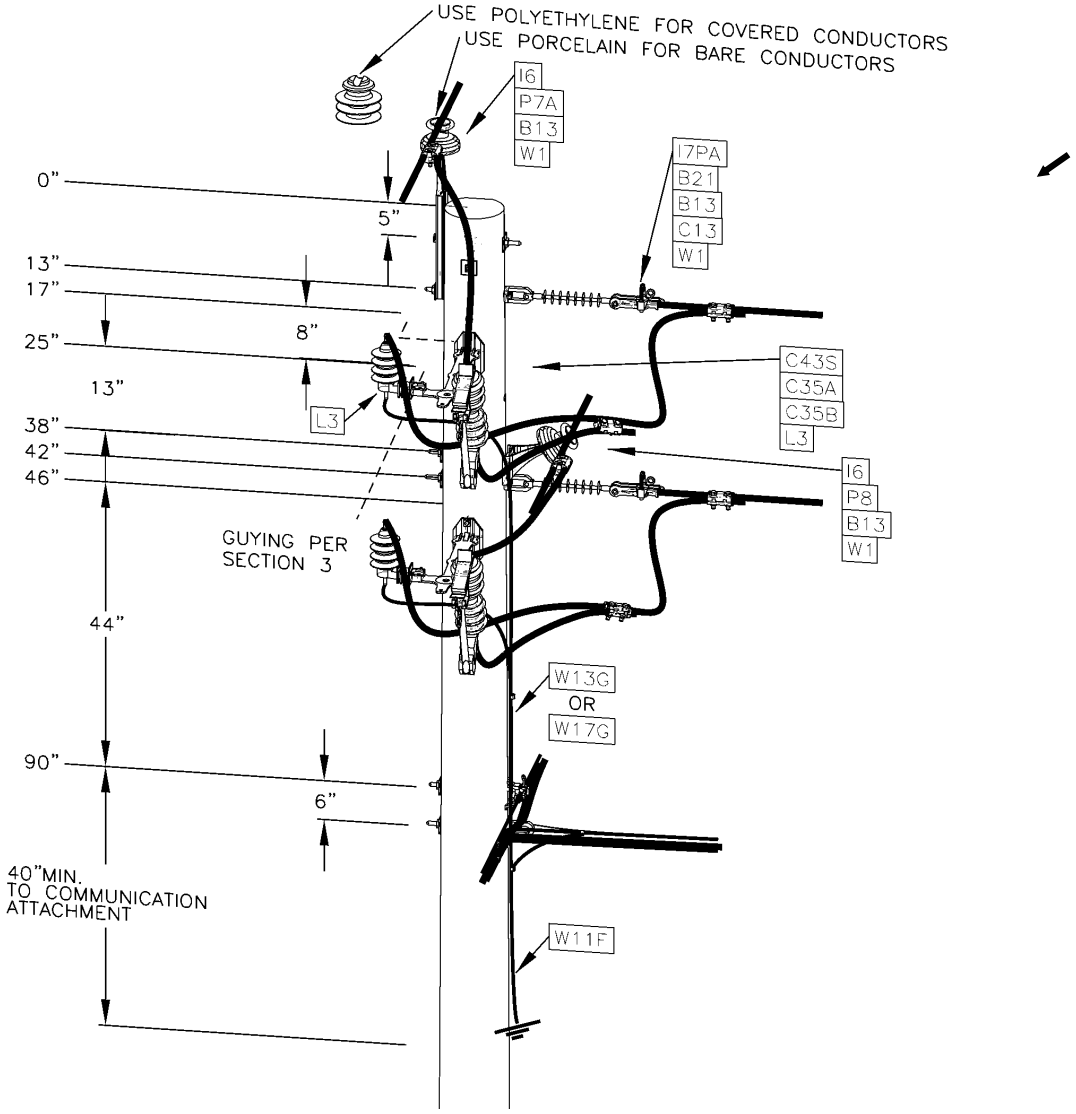
Supersedes 7/15 Issue – Update drawing with a 3-D rendering.

1Φ ARMLESS POLE TOP – 0-7.2 kV 0˚ - 20˚ – TAP TO 1Φ ARMLESS			
ISSUE	**PAGE NUMBER**		
7/16	**9-719**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-720	0-5KV 1Φ - Bare	MU = @9-720CL	0-5KV 1Φ - Covered	
MU = @9-720F	0-5KV 1Φ - Bare	MU = @9-720FCL	0-5KV 1Φ - Covered	Fiberglass Pole

Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

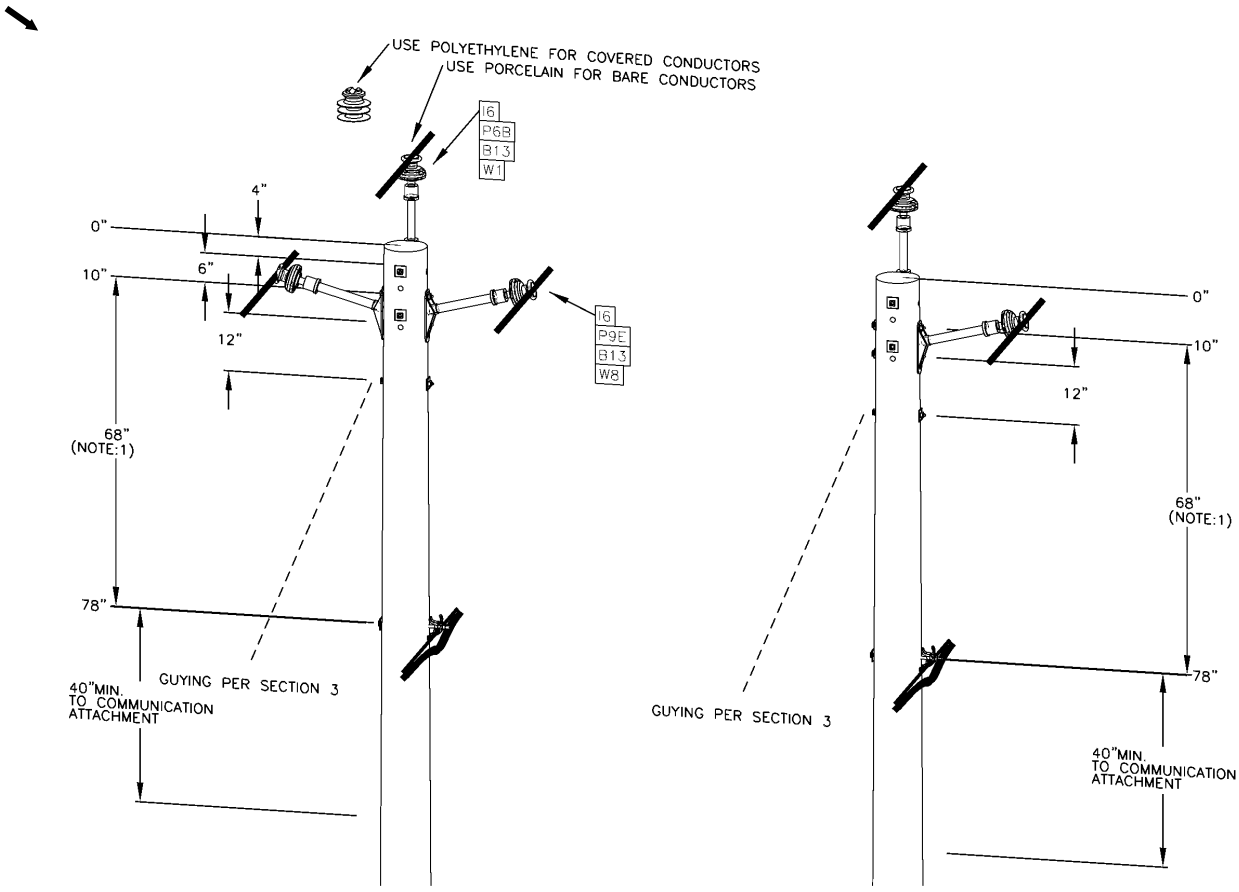


SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
82	40 JT-84"	131	127	121	131
82	45 JT-111"	218	--	--	--
98	45 JT-111"	--	185	--	--
98	45 JT-111"	--	--	175	--
82	45 JT-111"	--	--	--	157
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
82	40 JT-84"	132	102	100	107
107	45 JT-111"	240	--	--	--
109	45 JT-111"	--	180	--	--
109	45 JT-111"	--	--	162	--
107	45 JT-111"	--	--	--	230
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

1Φ ARMLESS POLE TOP – 0-15 kV
0˚ - 20˚ – TAP TO 1Φ ARMLESS - DELTA

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-811A	0-15KV 3Φ - Bare	MU = @9-811ACL	0-15KV 3Φ - Covered
MU = @9-811B	0-15KV 3Φ - Bare	MU = @9-811BCL	0-15KV 3Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
78	40 JT-84"	N/A	N/A	N/A
78	45 JT-111"	N/A	N/A	N/A
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
78	40 JT-84"	N/A	N/A	N/A
78	45 JT-111"	N/A	N/A	N/A
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

THIS DRAWING IS FOR MAINTENANCE PURPOSES ONLY

For new construction, see Drawing 9-812

NOTES:

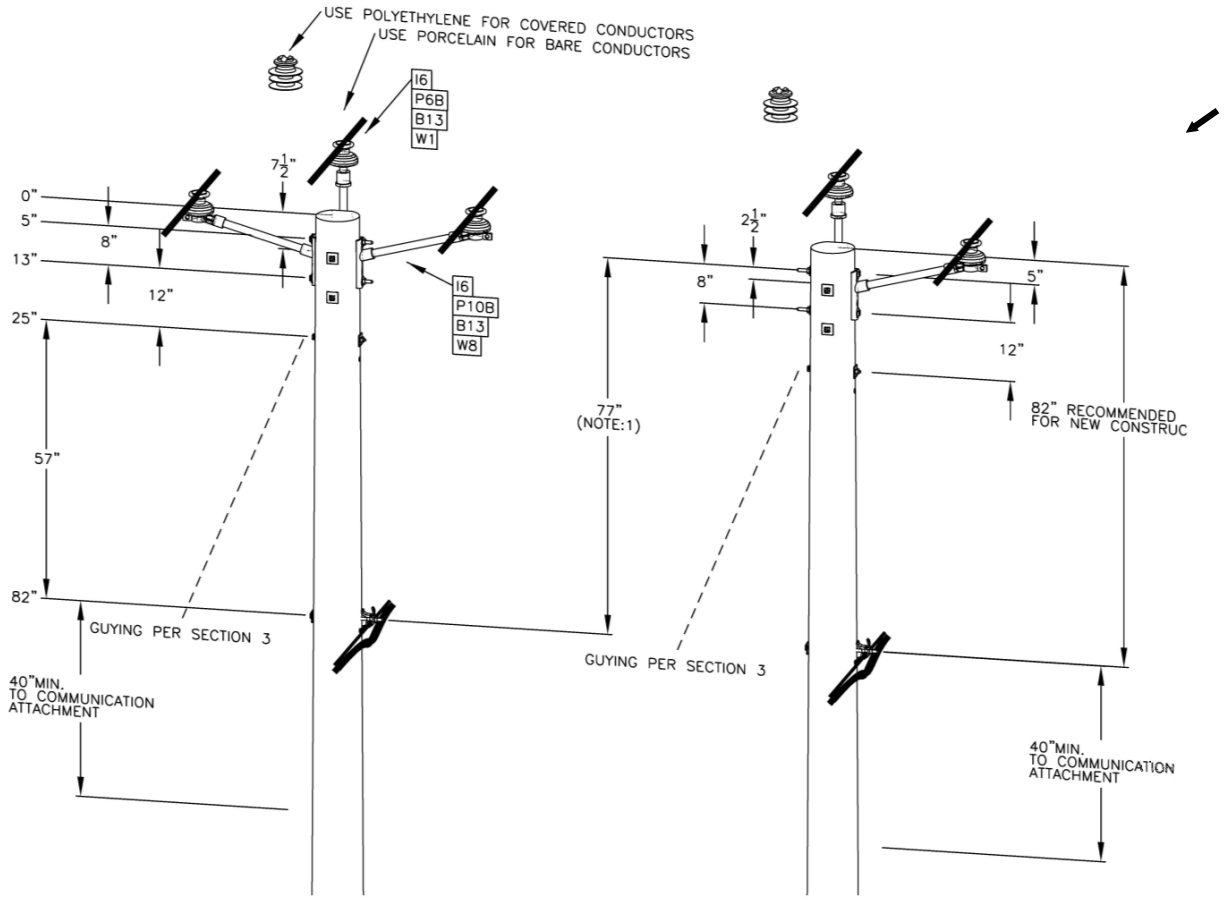
1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

1Φ AND 3Φ ARMLESS POLE TOP – 0-15 kV 0˚ - 20˚ (**MAINTANENCE ONLY**)			
ISSUE	**PAGE NUMBER**		
7/16	**9-811**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-812A	0-15KV 3Φ - Bare	MU = @9-812ACL	0-15KV 3Φ - Covered	
MU = @9-812B	0-15KV 1Φ - Bare	MU = @9-812BCL	0-15KV 1Φ - Covered	
MU = @9-812AF	0-15KV 3Φ - Bare	MU = @9-812AFCL	0-15KV 3Φ - Covered	Fiberglass Pole
MU = @9-812BF	0-15KV 1Φ - Bare	MU = @9-812BFCL	0-15KV 1Φ - Covered	Fiberglass Pole



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	131	131	131
82	45 JT-111"	218	218	218
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	221	206	187
82	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
107	45 JT-111"	--	--	235
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

Supersedes 7/16 Issue – Corrected standoff from P10E to P10B.

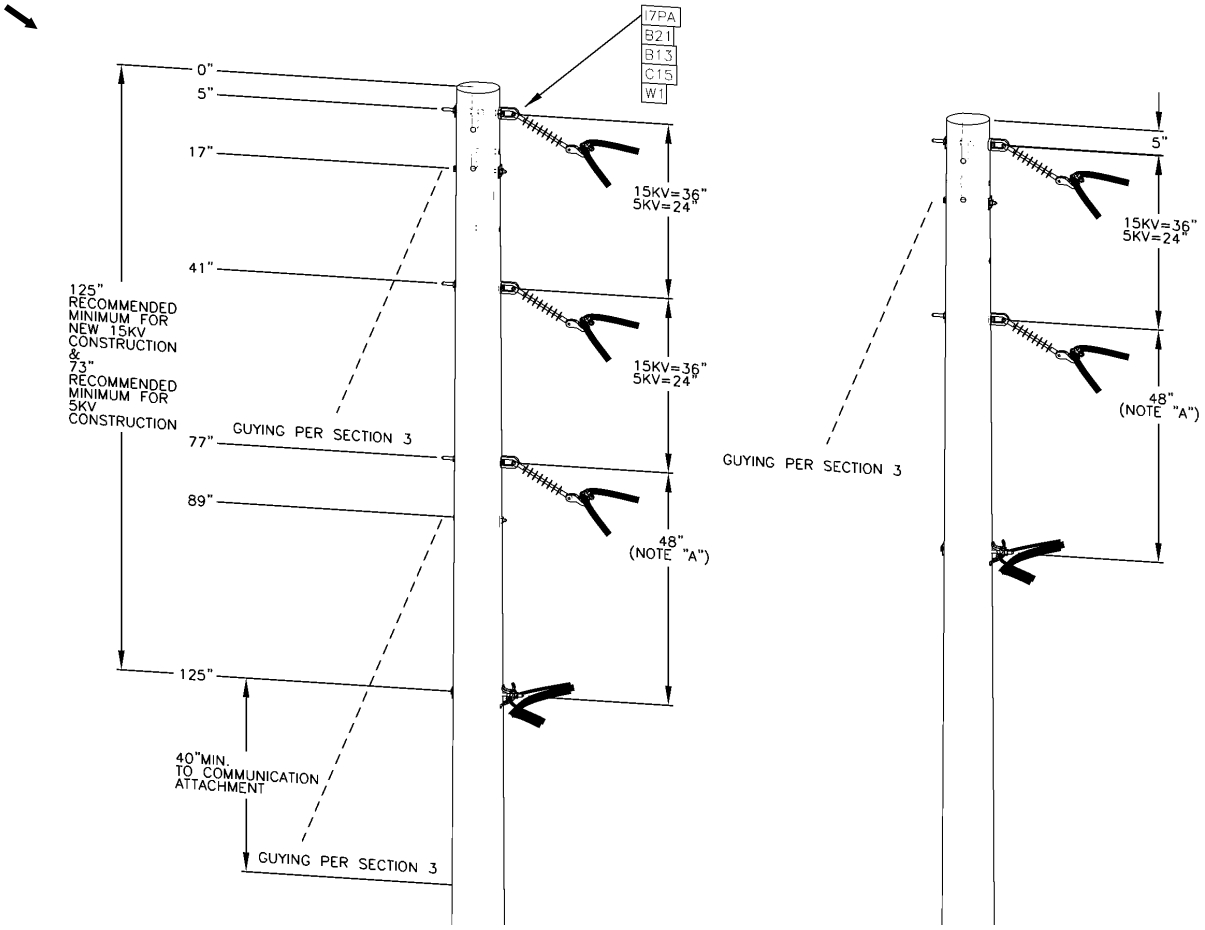
NOTES:

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

1Φ AND 3Φ ARMLESS POLE TOP – 0-15 kV 0˚ - 20˚			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-812	7/17

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-813A	0-15KV 3Φ - Bare	MU = @9-813ACL	0-15KV 3Φ - Covered	
MU = @9-813B	0-15KV 1Φ - Bare	MU = @9-813BCL	0-15KV 1Φ - Covered	
MU = @9-813AF	0-15KV 3Φ - Bare	MU = @9-813AFCL	0-15KV 3Φ - Covered	Fiberglass Pole
MU = @9-813BF	0-15KV 1Φ - Bare	MU = @9-813BFCL	0-15KV 1Φ - Covered	Fiberglass Pole



Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

MAINTENANCE PURPOSES ONLY

Three-phase vertical construction shown in the figure above is not the preferred construction method. New line construction (including line extensions and taps) shall use crossarms, epoxy standoff insulator pins, or spacer cable configuration. Single phase delta vertical construction may be used only when no other options are feasible.

Note A

MINIMUM DIMENSIONS	
5KV OPERATION	20"
NEUTRAL ONLY-15KV OPERATION	20"
600V SECONDARY-15KV	48"

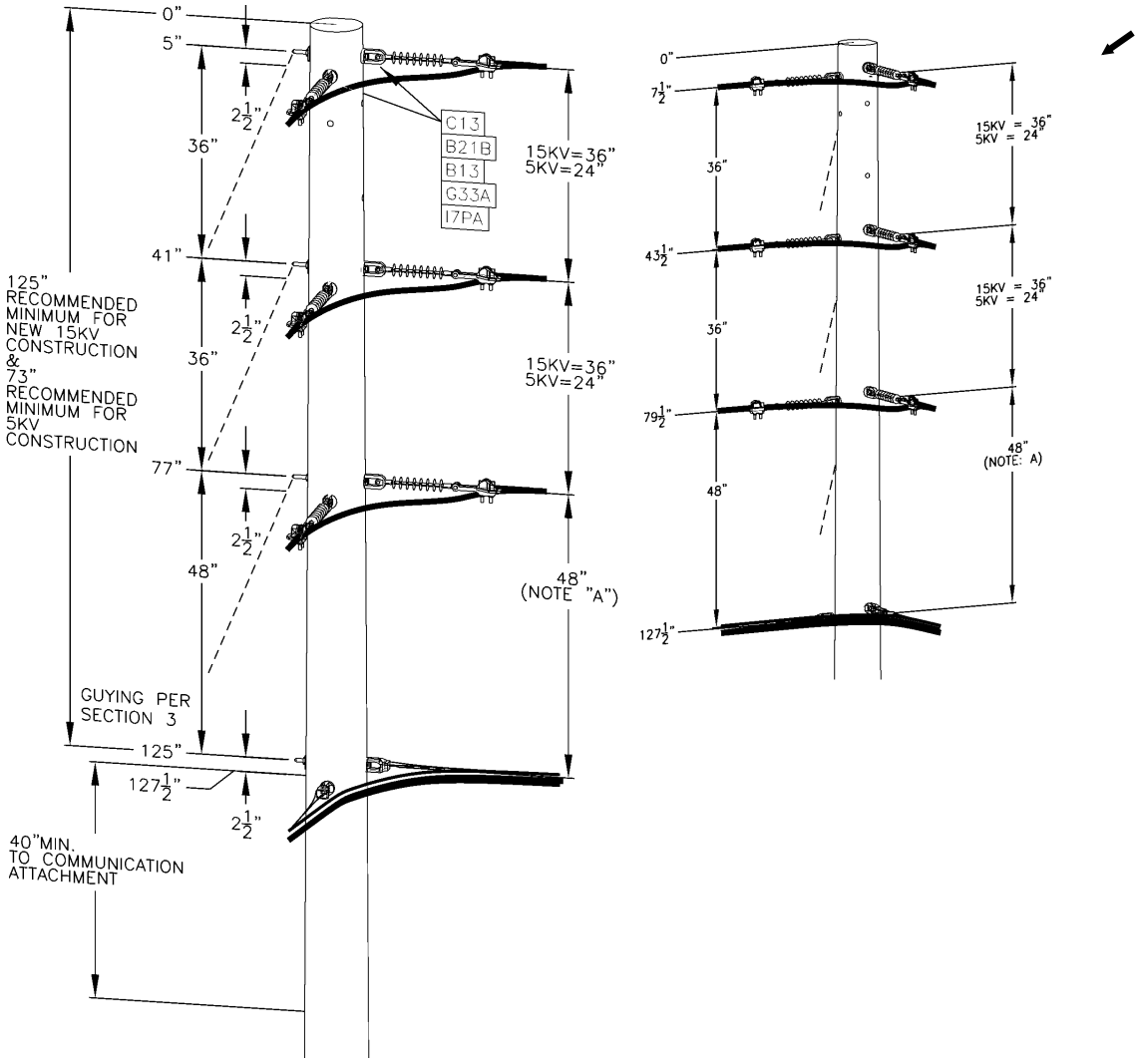
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
125	45 JT-125"	131	131	112
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
125	45 JT-125"	152	110	105
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

1Φ (DELTA) AND 3Φ **(MAINTENANCE ONLY)**ARMLESS POLE TOP – 0-15 kV 21°- 60°			
ISSUE	**PAGE NUMBER**		
7/16	**9-813**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-814A	0-15KV 3Φ - Bare	MU = @9-814ACL	0-15KV 3Φ - Covered	
MU = @9-814AF	0-15KV 3Φ - Bare	MU = @9-814AFCL	0-15KV 3Φ - Covered	Fiberglass Pole

Supersedes 7/17 Issue – Corrected MU names.



Note A

MINIMUM DIMENSIONS	
5KV OPERATION	20"
NEUTRAL ONLY-15KV OPERATION	20"
600V SECONDARY-15KV	48"

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
127.5	45 JT-127.5"	131	131	112
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
127.5	45 JT-127.5"	152	110	105
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

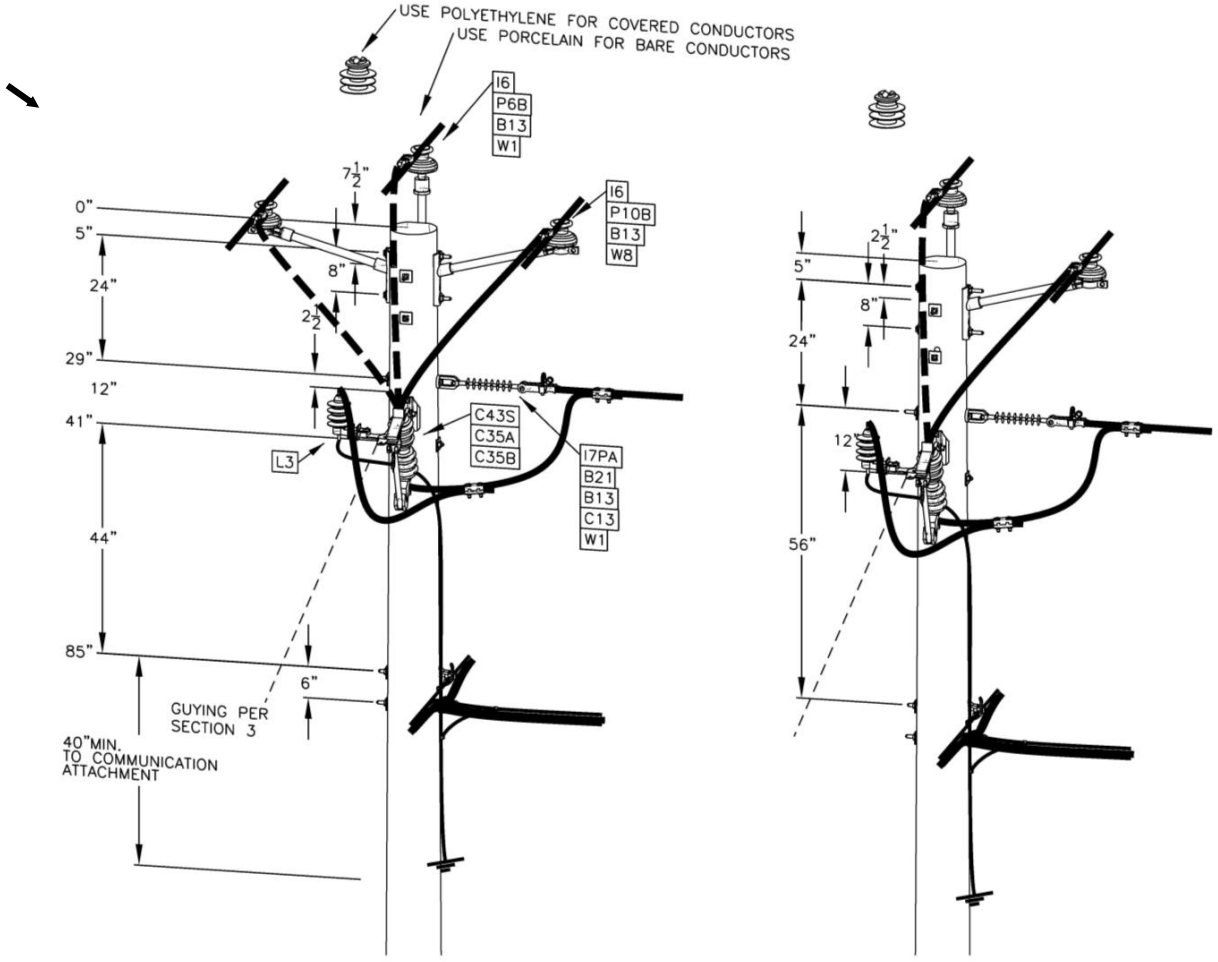
MAINTENANCE PURPOSES ONLY

Three-phase vertical construction shown on this drawing is not the preferred construction method. New line construction (including line extensions and taps) shall use crossarms, epoxy standoff insulator pins, or spacer cable configuration. Single phase delta vertical construction may be used only when no other options are feasible.

3Φ ARMLESS POLE TOP – 0-15 kV 61°- 90° AND DEADEND **(MAINTENANCE ONLY)**			
nationalgrid	**OVERHEAD CONSTRUCTION STANDARD**	**PAGE NUMBER**	**ISSUE**
		9-814	**7/19**

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-823A	0-15KV 3Φ - Bare	MU = @9-823ACL	0-15KV 3Φ - Covered	
MU = @9-823B	0-15KV 1Φ - Bare	MU = @9-823BCL	0-15KV 1Φ - Covered	
MU = @9-823AF	0-15KV 3Φ - Bare	MU = @9-823AFCL	0-15KV 3Φ - Covered	Fiberglass Pole
MU = @9-823BF	0-15KV 1Φ - Bare	MU = @9-823BFCL	0-15KV 1Φ - Covered	Fiberglass Pole



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
85	45 JT-111"	209	209	209	209
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
86	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
107	45 JT-111"	--	--	235	--
86	45 JT-111"	--	--	--	200
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

Supersedes 7/16 Issue – Corrected standoff from P10E to P10B.

3Φ ARMLESS POLE TOP – 0-15kV (PREFERRED) 0˚ - 20˚ – TAP TO 1Φ ARMLESS			
ISSUE	**PAGE NUMBER**		
7/17	**9-823**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

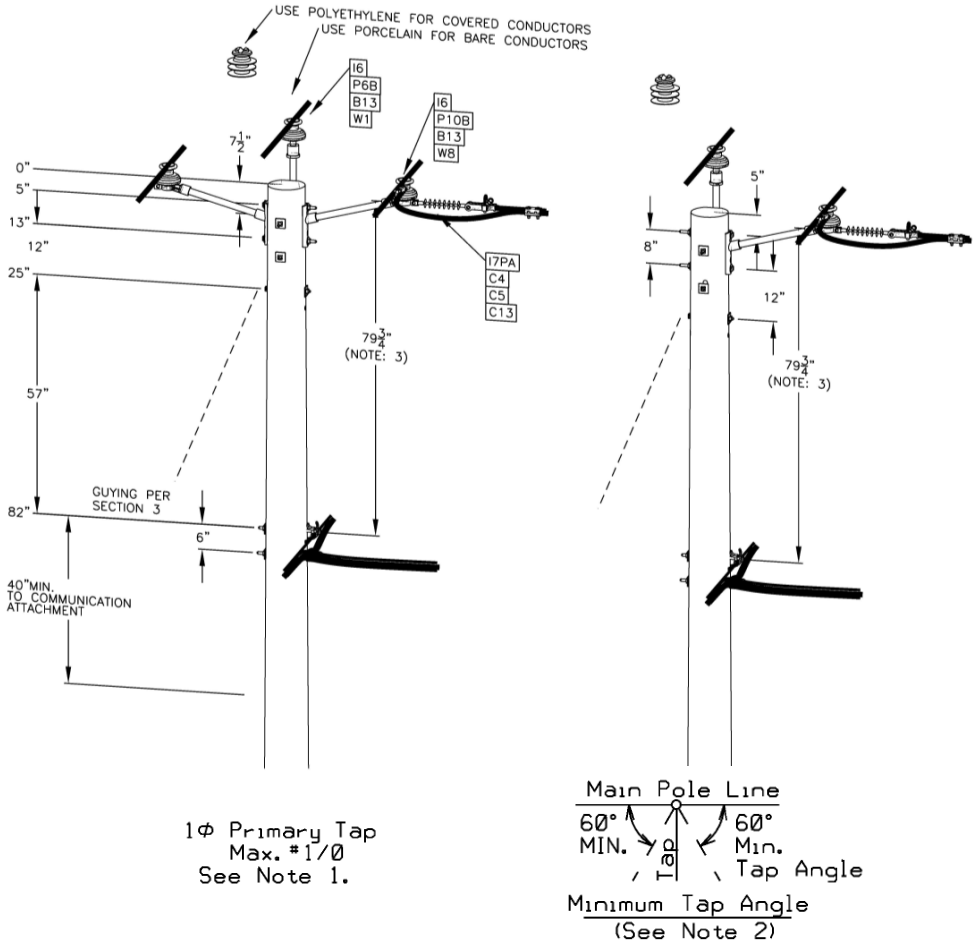
Supersedes 7/08 Issue - drawing no longer needed - refer to 9-835.

Drawing 9-824 has been removed.

Refer to Drawing 9-835.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-825A	0-15KV 3Φ - Bare	MU = @9-825ACL	0-15KV 3Φ - Covered	
MU = @9-825B	0-15KV 1Φ - Bare	MU = @9-825BCL	0-15KV 1Φ - Covered	
MU = @9-825AF	0-15KV 3Φ - Bare	MU = @9-825AFCL	0-15KV 3Φ - Covered	Fiberglass Pole
MU = @9-825BF	0-15KV 1Φ - Bare	MU = @9-825BFCL	0-15KV 1Φ - Covered	Fiberglass Pole



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
82	40 JT-84"	131	131	131	137
82	45 JT-111"	218	218	218	220
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
82	40 JT-84"	221	206	187	230
82	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
107	45 JT-111"	--	--	235	--
82	45 JT-111"	--	--	--	300
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

NOTES:

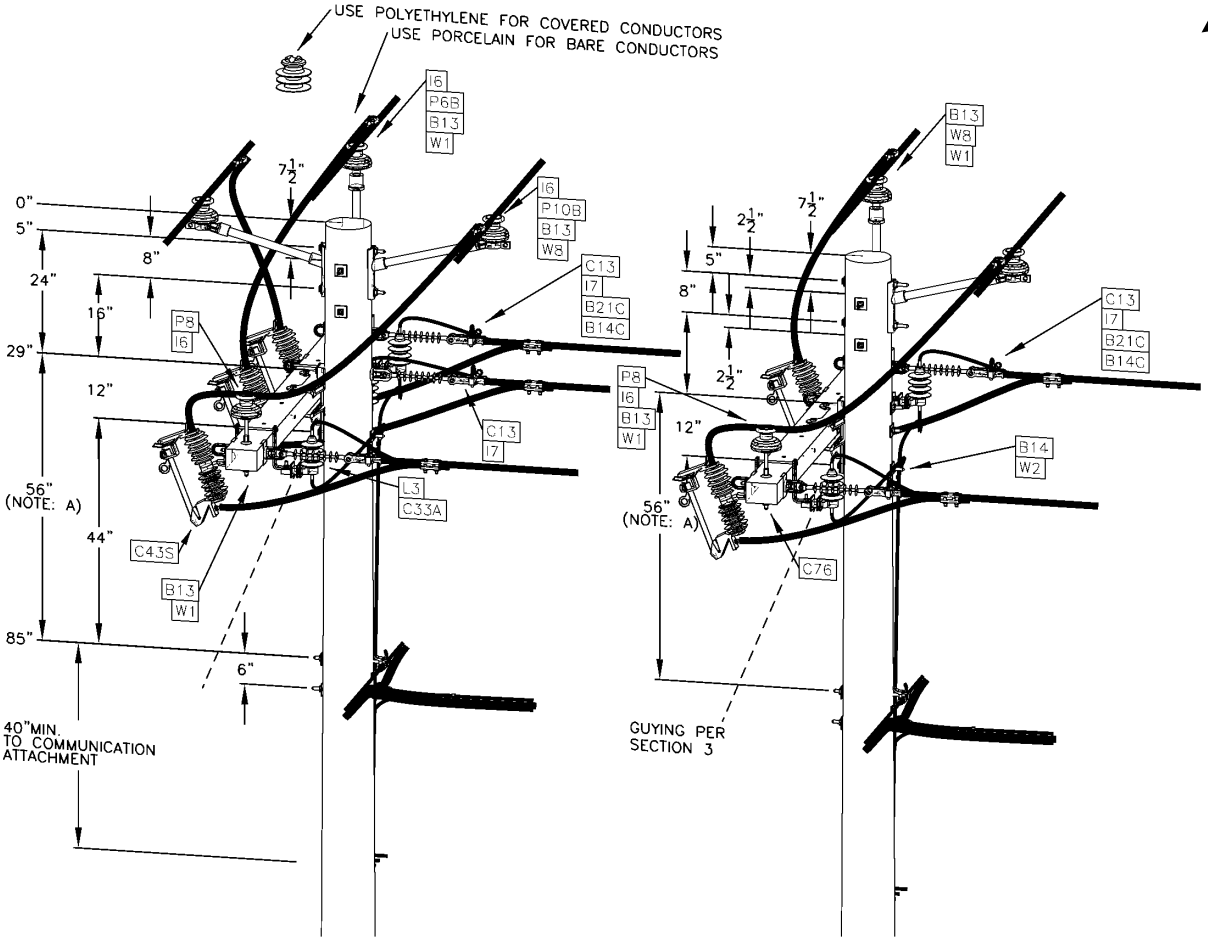
1. Tap shall be single-phase and have a 1/0 maximum conductor size.
2. Tap circuit angle shall be not less than 60° off main pole line (see detail above).
3. This clearance can be reduced to a minimum of 56" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
4. This configuration may only be used when the configuration of drawing 9-823 is not feasible. If this configuration is used, the fused cutout and arrester for the tap **must** be placed on the next pole down the tap.

Supersedes 7/16 Issue – Corrected standoff from P10E to P10B and corrected Note 4.

3Φ ARMLESS POLE TOP – 0-15 kV (ALTERNATE) 0˚ - 20˚ – TAP TO 1Φ ARMLESS			
ISSUE	**PAGE NUMBER**		
7/17	**9-825**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @9-835A	0-15KV 3Φ - Bare	MU = @9-835ACL	0-15KV 3Φ - Covered	
MU = @9-835B	0-15KV 1Φ - Bare	MU = @9-835BCL	0-15KV 1Φ - Covered	
MU = @9-835AF	0-15KV 3Φ - Bare	MU = @9-835AFCL	0-15KV 3Φ - Covered	Fiberglass Pole
MU = @9-835BF	0-15KV 1Φ - Bare	MU = @9-835BFCL	0-15KV 1Φ - Covered	Fiberglass Pole



Supersedes 7/14 Issue – Update drawing with a 3-D rendering.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
85	45 JT-111"	209	209	209	209
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
86	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
107	45 JT-111"	--	--	235	--
86	45 JT-111"	--	--	--	200
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

1Φ (DELTA) AND 3Φ ARMLESS POLE TOP – 0-15 kV
0˚ - 20˚ – TAP TO 1Φ (DELTA) AND 3Φ FIBERGLASS DEADEND CROSSARM

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
12	7/21	• Corrected drawing titles on pages 9-415F, 9-416F, 9-417, and 9-417F. • Corrected formatting on pages 9-413 through 9-450.	G. Paul Anundson	Director T&D Line Engineering & Standards
11	7/20	• Corrected reference to NESC rule in Section 9.2.20 • Moved guy details for fiberglass poles to Section 3 on drawings 9-411F, 9-413F, 9-415F, and 9-416F. • Modified center string deadend connection on drawings 9-415 and 9-415F.	G. Paul Anundson	J. P. Knauss, Director, Electrical Engineering
10	7/19	• Correct ruling span length and table reference in step 5 of sample calculations on page 9-204. • Added new drawing 9-411C. • Corrected MUs on 9-413F. • Added new drawing 9-450.	G. Paul Anundson	J. P. Knauss, Director, Electrical Engineering
9	7/18	• Editorial modifications in 9.3.20. • Revise 9.3.30 to allow tree wire with armless construction. • Correct 9-115 by removing figure-8 chain link in two figures. • Revise example calculations on pages 9-200 through 9-205.	G. Paul Anundson	Jonathan Gonynor, Director, T&D O&M Services
8	7/17	• In 9.2.20(E), revised the use of double wood crossarms and fiberglass crossarms. Revise • On 9-814, deleted single phase MUs. • On 9-825, corrected Note 4. • Corrected part call outs on 9-419 Fig 1, 9-421 Fig 2, 9-423 Fig 2, 9-812, 9-823 and 9-825.	G. Paul Anundson	Jonathan Gonynor, Director, T&D O&M Services
7	7/16	• Add information for isolating circuits of different voltages – new section 9.5.70 and new drawing 9-207. • Replace structure drawings with 3-D renderings. • Correct alley arm brace material call out on 9-437 through 9-440.	G. Paul Anundson	Jonathan Gonynor, Director, T&D O&M Services
6	7/15	• In 9.3.60, changed “#4 or smaller” to “smaller than #2” to match 9.1.30(B). • Information on insulator replacements during conversions was added to Section 9.6.10. • Corrected mounting bolt on 9-415, 9-415F, 9-417F, 9-419 and 9-421. • Corrected issue date on 9-435. • Corrected bracket location on 9-719.	G. Paul Anundson	Jonathan Gonynor, Director, T&D O&M Services

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
5	7/14	• In 9.1.40, corrected NY voltage regulation limits and deleted NH limits. • In 9.3.10, clarified text. • Replaced double wood deadend crossarms with fiberglass deadend crossarm assemblies in 9-415, 9-416, 9-417, 9-422, 9-424, 9-435 and 9-835. • Corrected materials in 9-416F. • Added I24 as spacer over deadend arm in 9-415F.	G. Paul Anundson	Robert Sheridan, Director, Utility of the Future
4	7/13	• Moved arresters to lower crossarms on 9-422, 9-424 and 9-435	G. Paul Anundson	Cheryl Warren, VP, Asset Management
3	7/12	• Updated voltage regulation limits in Section 9.1.40.	G. Paul Anundson	Susan Fleck, VP of Standards, Policies, & Code
2	7/11	• Added (required) cutout(s) and arrester(s) to most tap drawings • Removed guy wire materials - refer to Section 3 for guying materials and CUs • Removed Drawing 9-420 - refer to Drawing 9-435 for new construction. • Removed Drawing 9-824 - refer to Drawing 8-435 for new construction. • Corrected drawing titles of those showing single phase delta taps. • Labeled vertical construction drawings as “Maintenance Only” as this is not the preferred construction method for new lines.	Katie Croteau	Susan Fleck, VP of Standards, Policies, & Code
1	07/08	• New construction drawings for Fiberglass Construction: 9-411F, 9-413F, 9-415F, 9-417F. • Added fiberglass MU information: 9-711, 9-712, 9-713, 9-714, 9-715, 9-716, 9-719, 9-720, 9-812, 9-813, 9-814, 9-823, 9-824, 9-825, 9-835.	Jeff Steiner	Allen Chieco, Director of Distribution Standards and Work Methods

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SECTION	PAGE
• 10.0 GENERAL	10-1 THRU 10-2
• 10.1 SECONDARY CRIB DESIGN	10-2 THRU 10-4
• 10.2 SAG-TENSION TABLES	10-5 THRU 10-6
• 10.3 1/0 – 3C ALUMINUM MAINLINE CONDUCTOR SPLICING	10-7
• 10.4 FLICKER CHART	10-8
• 10.5 TRANSFORMER REGULATION	10-9
• 10.6 RESIDENTIAL TRANSFORMER LOADING	10-10 THRU 10-11
• CONSTRUCTION DRAWINGS AND GRAPHS	
o FIG. 1 STRAIGHT LINE POLE ATTACHMENT	10-100
o FIG. 2 ANGLE POLE ATTACHMENT	10-100
o FIG. 3 CORNER POLE ATTACHMENT	10-100
o FIG. 4 JUNCTION POLE ATTACHMENT	10-101
o FIG. 4a SECONDARY WIRE DETAIL	10-101
o FIG. 5 DEAD END POLE ATTACHMENT	10-101
o FIG. 6 TIE POINT	10-102
o FIG. 7 CONNECTION TO OPEN WIRE	10-102
o FIG. 8 TRANSFORMER POLE CONNECTION	10-103

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

10.0 GENERAL

The following STANDARDS section applies to new installation of overhead secondary conductors.

In cases where existing secondary conductors are deteriorated, clearances are doubtful, or poles need replacement, consideration should be given to rebuilding the entire secondary in accordance with these Standards.

10.0.10 Secondary "CRIB"

Secondary "CRIB" describes the overhead secondary supply conductors, typically 120/240 volt, that are supplied by a distribution transformer located near the load mid-point and that supply individual service drop cables along its route.

10.0.20 Secondary Voltages

See STANDARDS section 11 for available secondary voltages.

10.0.30 Conductors

The Standard single phase, secondary crib cable is a 1/0-3/C aluminum cable consisting of one base aluminum alloy neutral messenger and two aluminum cable covered conductors continuously wrapped around the neutral messenger. Applications for this cable include residential, industrial, commercial, and outdoor lighting.

Quadruplex cables shall be used for all 120/208 V, 277/480 V effectively grounded and 240 V and 480 V not effectively grounded secondaries.

For line currents greater than 245 amps., use 4/C 336.4 kCMIL secondary cable.

10.0.40 Conductor Location

In general, secondary conductors shall normally be installed on the street or highway side of the pole. On inside angles, it may be necessary or preferable to attach secondary conductors on the field side of the pole. "Boxing" in a pole by installing secondary cable on the opposite side from that of communication conductors should be avoided.

For rack construction, the neutral shall be located on the top spool of the rack. The grounded conductor of a 3 phase Delta secondary shall be installed in the top position on the power secondary rack. This grounded phase conductor shall not be used as a system neutral nor shall a system neutral be used as the grounded phase conductor.

When two or more secondary circuits are located on the same pole, the following order is recommended from the top: single phase secondary; 3-phase, 4 wire secondary; 3-phase, 3 wire secondary; and multiple street lighting.

All grounded neutrals (except secondary neutrals of not effectively grounded primary systems), located on the same pole shall be bonded together.

Supersedes 01/06 Issue – General Revision

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

10.0.50 Clearances

See Section 7-Clearances for specific details.

Span taps should be made where practical to provide adequate clearance, climbing, and working space on the pole. An extension bracket (Std. Item A50E) may be used with triplex to improve clearances and climbing space, or to avoid trees.

10.0.60 Sags and Tension

See Pages 10-5 and 10-6 for sags and tensions.

10.0.70 Taps and Connections

See STANDARDS Section 5-"Connectors" for taps, connections and methods of covering connections.

10.0.80 Tree Trimming

Although secondary cables require a relatively small clearance from trees, they are not designed to withstand abrasion from continual contact with tree limbs.

10.0.90 Secondary Cable Dimensions

See STANDARDS Section 11 – "Services" – page 11-62, for secondary and service drop cable dimensional data.

10.1 SECONDARY CRIB DESIGN

Good secondary crib design is dependent on knowledge of load. Actual load checks furnish the most accurate information about existing loads and should be used whenever practical. Other tools such as GIS data are also available to accurately estimate existing loads.

Good secondary crib design also includes provisions for future load growth. Adherences to the principles in this STANDARD will result in secondary that can grow substantially without major rebuilding.

Gaps between adjacent secondary cribs should be filled in with secondary cable when the gap is less than 400-feet in length. For longer gaps, install a standard 1/0 aluminum neutral conductor only, unless future load growth is expected within the area of the gap.

Proper balance must be maintained between length of secondaries, size of conductors, loading of transformers, and overall voltage regulation in service drop, secondary, and transformer installations.

Proper secondary crib design will take into account all of the following:

10.1.10 Transformer Location – Good secondary crib design will place the distribution transformer in the physical center of the secondary crib run. Adjustments can be made to favor the electrical center of the load, or accommodate other existing pole top equipment.

10.1.20 Transformer KVA Size –A typical residential secondary crib will have one of three basic load profiles:
1. Oil or Gas Heat – 8kW diversified per residence (includes electric range, dryer, and window air conditioner units)
2. Oil or Gas Heat w/ Central Air – 10kW per residence

Supersedes 7/12 Issue – Revised 10.0.70 to taping connections option and renumbered 10.0.60 through 10.0.90.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

3. Electric Heat – 20kW per residence

The following Table provides a guide to determine the maximum number of residential customers that can be served by a secondary crib. (assumes single family homes less than 3,500 square feet and multi-family homes)

Table 1

Maximum Number of Residential Customers				
Transformer KVA Size	**Oil or Gas Heat**	**Oil or Gas Heat w/ Central Air**	**Electric Heat**	**50% Electric Heat 50% Oil/Gas Heat**
25 KVA	9	5	2	3
50 KVA	12	8	5	6

10.1.30 **Length of Secondary Crib -** Transformer KVA size, transformer location, secondary crib load, and voltage drop shall determine the length of secondary crib. For evenly distributed loads, the following Table serves as a guide to determine the approximate length of a straight, 2-way 1/0 triplex secondary to provide a 1.5% voltage drop at the ends with the transformer located in the center.

Table 2

Total KVA Load	Total Length of Secondary	Length of Secondary from Transformer to End
15 kVA	1000 feet	500 feet
25 kVA	700 feet	350 feet
50 kVA	350 feet	175 feet

10.1.40 **Voltage Drop** – Voltage drop in secondary cribs should be limited to 1.5% in areas where new load growth can reasonably be expected. In areas where new load growth is not expected, this may be increased to a maximum of 3% of nominal (120V). A voltage drop calculator is available on the National Grid Distribution Engineering Services website.

10.1.50 **Flicker** - Consider only the part of the secondary which is to be checked for flicker voltage drop. Determine the kW-Ft and the power factor for the fluctuating load. From the diagram on Page 10-9 determine the kW-Ft that will result in 1% drop.

Divide the kW-Ft by the value found and the quotient will be the percent drop as shown above. While this method is not strictly accurate, the error is in the safe side and it should serve for most problems. For more accurate results calculate load, power factor, and voltage drop before and after adding fluctuating load.

10.1.60 **Commercial or Industrial Secondaries**

In planning commercial and industrial secondaries, consider the overall voltage regulation in the service, secondary, transformer and primary rather than specifically limiting the drop in each of the parts.

The size of secondary and service wires should be determined by consideration of both voltage drop and current. Multiplex cables are recommended if current rating and voltage drops permit. Voltage drop on secondary and service should not exceed 3%. Current should not exceed the values shown in basic data for Section 6-Primary Conductors. It is generally economical to stay well below those values for everything except temporary work. In the case of intermittent loads, the above voltage limitations may be exceeded provided the resulting voltage is satisfactory.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Transformer loading should not exceed 100% of rating where the daily load factor is 100% and ambient temperature is 30°C/86°F or 0°C/32°F. However, loading may be increased 0.3% for each 1% decrease in load factor to a maximum of 115% of rating at 50% load factor. In addition, if peak loads occur at ambients other than 30°C/86°F or 0°C/32°F, loading may be increased 1% for each 1°C/34°F decrease or decreased 2% for each 1°C/34°F increase in ambient. The effects of load factor and temperature may be added to permit a maximum of 145% load with a load factor of 50% or less, at ambients of 0°C/32°F or below.

Starting currents and flicker voltage drops should be checked where applicable. Consult Pages 10-9 and 10-10 for further data on starting current and flicker limitations. Flicker should, in general, be kept below the borderline of irritation. However, avoid increasing the cost of an installation to reduce flicker if the customer should apply corrective measures to his load.

Supersedes 01/06 Issue – General Revision

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

3/c – 1/0 Aluminum Triplex Secondary Cable
Messenger 1/0 7 Strand 6201 or ACSR

TABLE 3
INITIAL SAGS AND TENSIONS – 150 FT. RULING SPAN – FOR INITIAL INSTALLATION ONLY

TEMP. (°F)	TENSION (LBS.)	SAG IN INCHES ACTUAL SPAN IN FEET				
		100	125	150	175	200
0	1495	4	7	10	13	17
30	1245	5	8	11	16	20
40	1165	5	9	12	17	22
50	1085	6	9	13	18	23
60	1010	6	10	14	19	25
70	940	7	11	15	21	27
80	875	7	11	16	22	29
90	805	8	12	18	24	31
100	745	8	13	19	26	34
120	640	10	15	22	30	39

MAXIMUM DESIGN SAGS AND TENSIONS – INITIAL

TEMP. (°F)	ICE (IN.)	WIND (PSF)	K (LF./FT.)	SAG (IN.)	TENSION (LBS.)
0	0.5	4.0	0.3	31	2000
32	0.5	0	0	29	1630
32	0	0	0	12	1225
120	0	0	0	22	640

TABLE 4
FINAL SAGS AND TENSIONS – 150 FT. RULING SPAN – FOR CLEARANCES PURPOSES ONLY

TEMP. (°F)	TENSION (LBS.)	SAG IN INCHES ACTUAL SPAN IN FEET				
		100	125	150	175	200
0	1250	5	8	11	15	20
30	975	6	10	15	20	26
40	895	7	11	16	22	29
50	820	8	12	18	24	31
60	745	8	13	19	26	34
70	690	9	14	21	28	37
80	635	10	16	23	31	40
90	580	11	17	24	33	44
100	535	12	18	26	36	47
120	470	13	21	30	41	54

MAXIMUM DESIGN SAGS AND TENSIONS – FINAL

TEMP. (°F)	ICE (IN.)	WIND (PSF)	K (LF./FT.)	SAG (IN.)	TENSION (LBS.)
0	0.5	4.0	0.3	32	1925
32	0.5	0	0	31	1505
32	0	0	0	15	955
120	0	0	0	30	470

Supersedes 01/06 Issue – Page shift due to general revisions.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

3/c – 1/0 Aluminum Triplex Secondary Cable
Messenger 1/0 7 Strand 6201 or ACSR

TABLE 5
INITIAL SAGS AND TENSIONS – 200 FT. RULING SPAN – FOR INITIAL INSTALLATION ONLY

TEMP. (°F)	TENSION (LBS.)	SAG IN INCHES ACTUAL SPAN IN FEET				
		150	175	200	225	250
0	1155	12	17	22	28	34
30	955	15	20	26	34	41
40	895	16	22	28	36	44
50	840	17	23	30	38	47
60	790	18	24	32	40	50
70	745	19	26	34	43	53
80	700	20	28	36	46	56
90	660	21	29	38	48	60
100	630	23	31	40	51	63
120	570	25	34	42	56	70

MAXIMUM DESIGN SAGS AND TENSIONS – INITIAL

TEMP. (°F)	ICE (IN.)	WIND (PSF)	K (LF./FT.)	SAG (IN.)	TENSION (LBS.)
0	0.5	4.0	0.3	56	2000
32	0.5	0	0	52	1600
32	0	0	0	26	955
120	0	0	0	45	570

TABLE 6
FINAL SAGS AND TENSIONS – 200 FT. RULING SPAN – FOR CLEARANCES PURPOSES ONLY

TEMP. (°F)	TENSION (LBS.)	SAG IN INCHES ACTUAL SPAN IN FEET				
		150	175	200	225	250
0	965	15	20	26	33	41
30	775	18	25	32	41	51
40	725	20	27	35	44	54
50	680	21	28	37	47	58
60	640	22	30	39	50	62
70	605	26	32	42	53	65
80	575	25	34	44	56	69
90	545	26	35	46	59	73
100	520	27	37	49	61	76
120	475	30	41	53	67	83

MAXIMUM DESIGN SAGS AND TENSIONS – FINAL

TEMP. (°F)	ICE (IN.)	WIND (PSF)	K (LF./FT.)	SAG (IN.)	TENSION (LBS.)
0	0.5	4.0	0.3	56	1975
32	0.5	0	0	54	1530
32	0	0	0	33	765
120	0	0	0	53	475

Supersedes 01/06 Issue – Page shift due to general revisions.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 07/09 Issue – Revised 10.3.30(D) to remove taping option for connectors.

10.3 1/0 - 3C ALUMINUM MAINLINE CONDUCTOR SPLICING

10.3.10 Application

This Section covers splicing 3/C – 1/0 secondary mains in the street. Splicing should not take place within 5 feet of any pole, to allow for multiple secondary services and streetlight.

10.3.20 Procedure – Initial Steps, Neutral Splicing

A. Cut conductors to give sleeve locations shown in Figure I below. **Note:** Total splicing length is about 36 inches.

B. Make certain ends are somewhat square and free of burrs.

C. Use **full tension automatic** splice**,** Std. Item S19K, on the neutral. **Make sure the neutral carries all the tension and the live legs are relatively slack when all splicing is complete.**

D. Follow manufacturer's splicing recommendations on splice packaging including wire brushing.

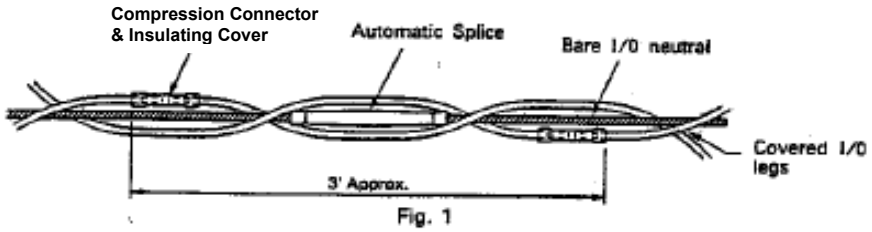
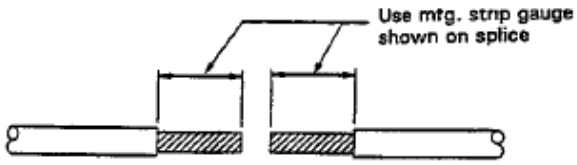


Fig. 1

10.3.30 Procedure – Leg Conductor Splicing



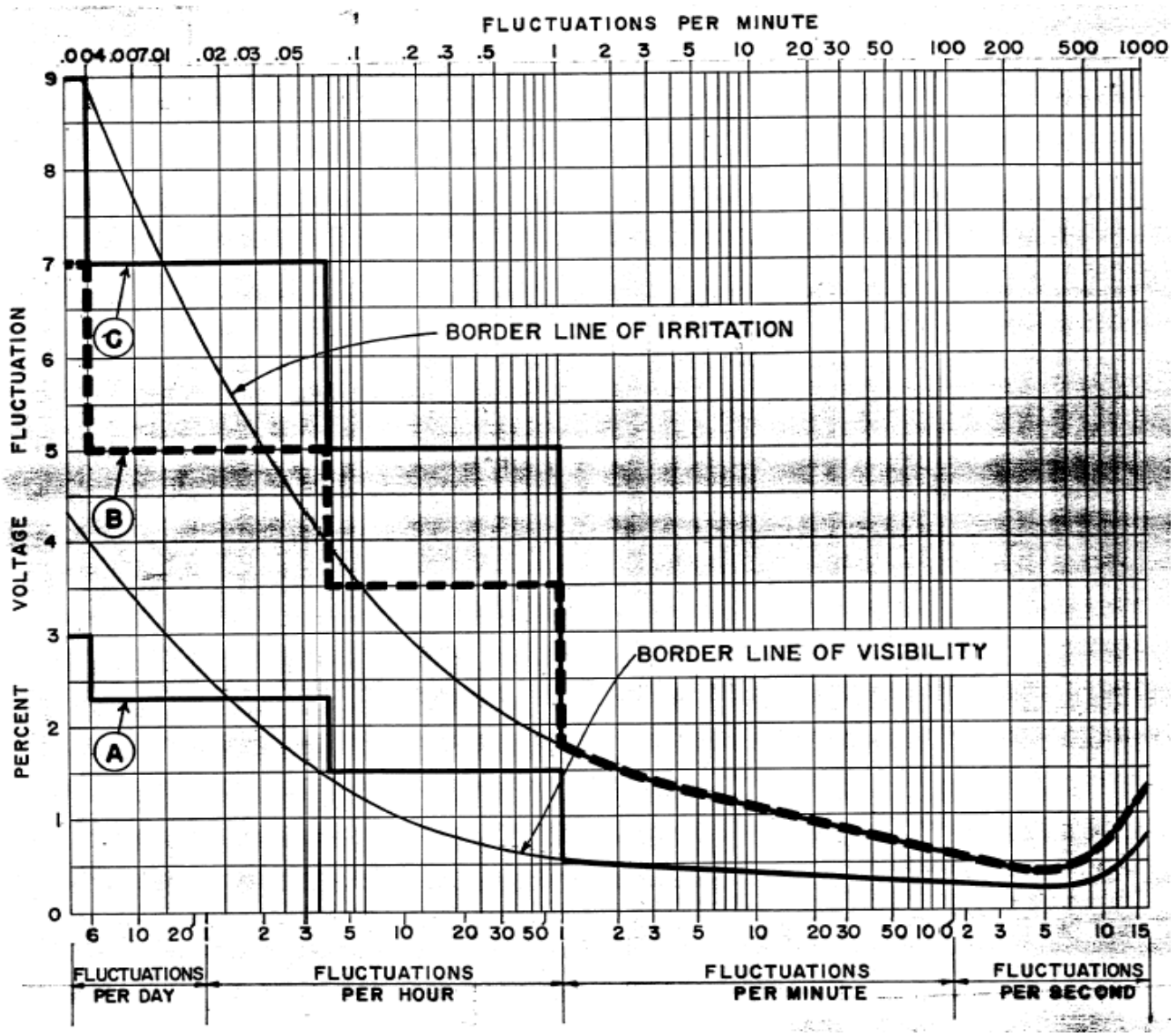
A) Use compression splice, Std. Item S26D on legs.

B) Strip covering from all leg conductors **using strip guide on Insulated splice.** Strip length is important to insure proper conductor insertion and to insure no exposed bare metal outside the splice housing.

C) Bring proper ends together, short conductor of left cable with long conductor of right cable, spiraling conductor around neutral to match lay of cable; and similarly with other two cable ends.

D) Insert skinned conductors into splice as far as barrier. No bare conductor should protrude from end of connector. Indent each splice in turn, making four crimps per side using the MD-6 or equivalent tool with W243 die, Item ID 6512709. Cover with poly cover. See Standards Section 5 – Connectors for information about covers.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



Supersedes 01/06 Issue – Page shift due to general revisions.

NOTES: For motor starting loads, the maximum percent voltage fluctuation allowable for each starting step shall be limited as follows:

a) On LVAC secondary network, at the service entrance equipment, or on the general system at the substation bus, *Curve A.*
b) On a primary feeder or secondary which can affect other customers, *Curve B.*
c) At service entrance on the radial service of the motor user, no limitations, but recommend voltage fluctuation not exceed, *Curve C.*

If the calculated fluctuation due to motor starting exceeds the above limitations the problem should be referred to the Engineering department. For other type of fluctuating loads, refer problem to the Engineering department.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 01/06 Issue – Page shift due to general revisions.

INDIVIDUAL TRANSFORMER RATING IN KVA	SINGLE PHASE LOAD IN KVA TO GIVE 1% REGULATION AT VARIOUS POWER FACTORS							THREE PHASE TRANSFORMER BANK RATING IN kVA	THREE PHASE LOAD IN KVA TO GIVE 1% REGULATION AT VARIOUS POWER FACTORS						
	100	95	90	85	80	60	35		100	95	90	85	80	60	35
NEW TRANSFORMERS (AFTER 1975)															
10	6.1	5.7	5.7	5.8	5.9	6.7	8.5	30.0	18.4	17.2	17.1	17.4	17.8	20.1	25.4
15	10.0	8.1	7.7	7.5	7.4	7.5	8.3	45.0	30.0	24.2	23.1	22.5	22.2	22.5	24.8
25	17.9	14.5	13.8	13.5	13.4	13.5	14.9	75.0	53.6	43.6	41.4	40.5	40.1	40.5	44.6
37.5	30.5	23.3	21.8	20.6	20.5	20.0	21.2	112.5	91.5	69.9	65.4	61.8	61.5	59.8	63.6
50	41.7	31.3	29.1	27.9	27.2	26.3	27.8	150.0	125	93.8	87.2	83.8	81.5	79.0	83.3
75	67.0	44.8	43.6	41.2	39.9	37.8	38.9	225.0	201	134	131	124	120	113	117
100	100	74	67	64	62	59	61	300.0	300	221	201	192	185	177	182
167	167	113	103	97	94	88	90	501.0	501	339	309	291	281	265	271
TRANSFORMERS (1960 THRU 1975)															
5	2.4	2.1	2.0	2.0	2.0	2.2	2.5	15	7.2	6.2	6.1	6.1	6.0	6.5	7.5
10	7.2	6.3	6.2	6.2	6.3	6.8	8.1	30	21.5	18.9	18.5	18.5	18.8	20.4	24.3
15	10.1	10.0	9.7	9.7	9.4	10.1	12.8	45	30.2	30	29.2	29.2	28.2	30.2	38.4
25	19.2	16.0	15.2	14.8	14.8	14.8	16.2	75	57.6	47.8	45.5	44.4	44.1	44.1	48.6
37.5	34.1	26.2	24.8	24.0	23.4	23.4	25.7	112.5	102	78.7	74.5	72.9	70.2	70.2	77.1
50	45.5	34.5	32.1	30.9	29.4	29.4	31.0	150	137	103	96.2	92.6	88.2	88.2	93
75	75.0	53.2	49.0	46.9	46.9	44.1	46.0	225	225	160	147	141	141	132	138
100	100	75	70	67	67	63	66	300	300	226	210	200	200	188	199
167	167	113	101	95	93	85	85	501	501	339	304	286	278	254	255
TRANSFORMERS (PRIOR TO 1960)															
5	2.3				1.7	1.7	1.9	15	6.8				5.0	5.0	5.5
10	4.8				3.5	3.5	3.7	30	14.3				10.4	10.4	11.1
15	7.1				4.8	4.8	5.0	45	21.4				14.5	14.5	15.0
25	14.3				8.3	8.1	8.3	75	42.9				25.0	24.2	25.0
37.5	23.4				12.5	11.4	11.4	112.5	70.2				37.5	34.2	34.2
50	34.5				17.2	15.6	15.6	150	103				51.6	46.8	46.8
75	53.6				22.7	20.3	19.7	225	161				68.1	60.9	59.1
100	74				31	27	26	300	222				94	81	79

The values for 60% and 35% P.F. are intended principally for use in motor starting problems. The 60% power factor is applicable to low starting current, high starting torque motors while the 35% power factor is applicable to high starting current, normal starting torque motors.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

10.6 RESIDENTIAL TRANSFORMER LOADING

The following loading schedules should be used as a guide for determining when to change a transformer and what size new transformer to install for residential load only. Peak month kWh data from GIS serves as a measurement of existing load. The table shown on Page 10-11 serves for estimating new customer's expected peak month kWh load.

The need for change outs due to new loads on existing transformers can be determined by kWh data and expected kWh loads. If the total of the two exceeds changeout loading criterion, a transformer change is warranted. If it exceeds the maximum install loading but not the changeout loading, change of the transformer should be avoided unless significant load growth or voltage problems are anticipated.

If the existing peak month kWh loads from GIS exceed transformer peak month changeout loading, change transformer and size as shown below.

New transformer installations should be sized in accordance with the install loading table, with consideration for adjacent building lots if development is anticipated within 3 years. Refer to Electrical Service Information and Requirements Handbook and local city/town ordinances for information on and mandates to locate certain residential electric facilities underground.

Engineers and planners must exercise good judgment in selecting transformers, taking probable load growth, economy, and performance into consideration.

	SUMMER CRITICAL		WINTER CRITICAL	
Transformer Nameplate	**Changeout Loading (Peak Month kWh)**	**Install Loading (Peak Month Kwh)**	**Changeout Loading (Peak Month kWh)**	**Install Loading (Peak Month kWh)**
5 *	1,800	001 to 1,300	2,500	001 to 1,500
10	4,100	1,300 to 3,200	5,500	1,500 to 4,000
15 *	7,300	3,200 to 5,000	9,500	4,000 to 5,000
25	13,700	5,000 to 10,500	17,000	5,000 to 12,000
37 ½ *	20,500	10,500 to 17,000	27,000	12,000 to 18,000
50	27,500	17,000 to 26,500	38,000	18,000 to 30,000
75	41,000	26,500 to 35,000	60,000	30,000 to 39,000
100	55,000	35,000 to 53,000	82,000	39,000 to 70,000
167	92,000	53,000 to 83,000	140,000	70,000 to 110,000

* No longer National Grid standard transformer kVA sizes

The schedule for summer critical loading of pole mounted transformers is based on an expected 5% annual load growth and approximately 160% peak one-half hour demand at changeout.

The schedule for winter critical pole mounted transformer loading is based on an expected 5% annual load growth and approximately 200% peak one-half hour demand at changeout.

If a transformer is suspected of supplying appreciable air conditioning load, the 160% summer loading design criteria does not apply and field testing should be utilized.

Supersedes 7/09 issue – New page. Added residential transformer loading information and table.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

When new residential customers are to be serviced and no kWh data is available the following figures may be used as expected peak month kWh consumption to add to other known kWh load for determining required transformer capacity.

Expected Load			
Connected Load	**(Peak Month kWh)**		
	Single Family	**Multifamily Family Dwelling Units**	**Mobile Homes Permanent Residence**
Less than 800 square feet, no heat		600 *	
More than 800 square feet, no heat		800 *	
No heat	900 *		800 *
Up to 5 kW heat	2800	1600	2500
Up to 10 kW heat	4300	2500	3500
Up to 15 kW heat	5800	3500	4500
Up to 20 kW heat	6300	4200	
Up to 25 kW heat	6800	4800	
Up to 30 kW heat	7300		
Up to 35 kW heat	7800		

Where connected load includes range, water heater and/or dryer, add applicable kWh shown below to the living unit expected load (Peak Month kWh).

Where connected load includes air conditioning, add applicable kWh to only those living units that do not have heat (e.g. living units designated *).

add: 100 kWh for Range
100 kWh for Dryer
400 kWh for Water Heater
* Air conditioning
600 kWh for 1-ton Window Unit
2000 kWh for 5-ton Central

To determine transformer size for overhead pole mounted transformers having connected load of both electric heat and air conditioning, the summer and winter peaks must be evaluated separately. The transformer Peak Month Kwh for each condition must be applied to respective load schedule (Summer Critical & Winter Critical) to determine which loading schedule is applicable.

Distributed Generation (DG) Loading Requirement

A DG system is designed to produce electrical energy. A comprehensive understanding of its impact to residential loading must be considered. Photovoltaic (PV) is typical type of generation which includes panels which themselves cannot be “turned off”. As long as sun is shinning on the modules, DC current can flow to concentrators or combiner boxes, and/or inverters. Therefore, it is very important to identify it’s impacts on residential transformer loading.

Supersedes 7/10 issue – Added DG Loading requirements.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

This page intentionally left blank.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = PR1STS	Sec. Clamp
CU = PR1SSA	Sec. Clamp Angle
CU = PR1SSA2	Sec. DE Angle 61°-90°

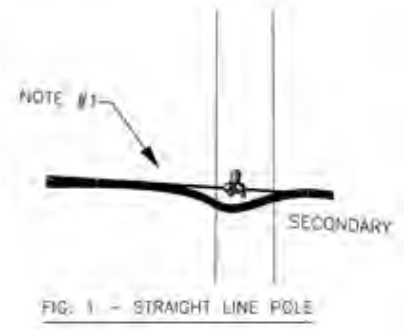


FIG. 1 – STRAIGHT LINE POLE

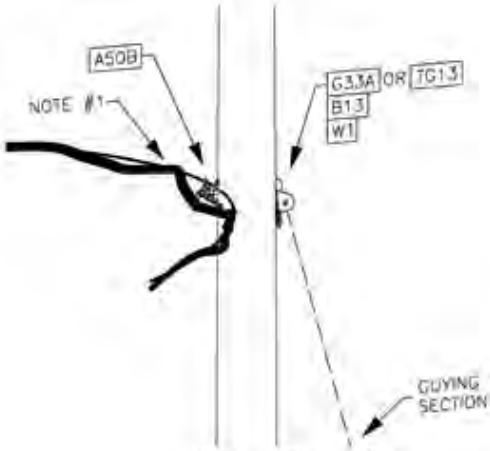


FIG. 2 – ANGLE POLE
1°–10° LINE ANGLE

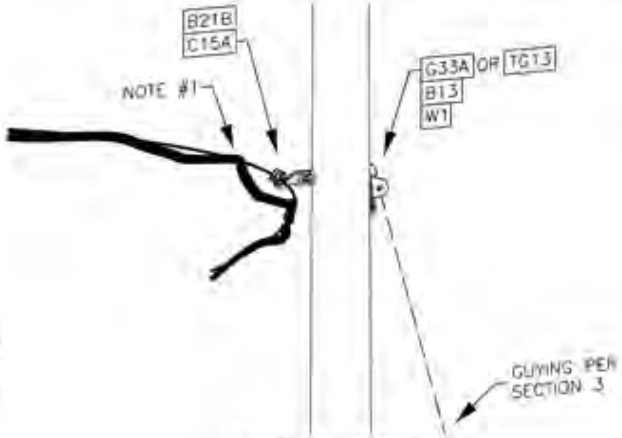


FIG. 2A – ANGLE POLE
11°–60° LINE ANGLE

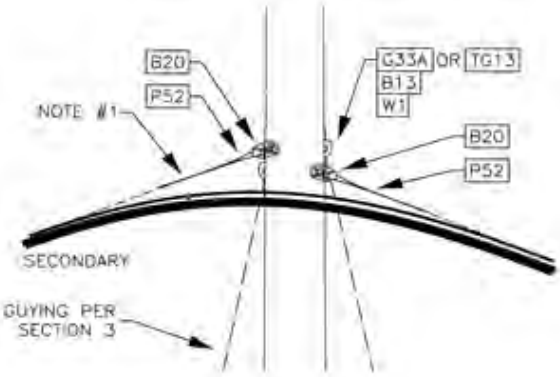


FIG. 3 – CORNER POLE
61° & GREATER LINE ANGLE



FIG. 3A – ELEVATION
SHOWING BOLT SEPERATION

NOTE:
1. TRAIN CABLES NEATLY AND KEEP APPROXIMATELY 2" AWAY FROM POLE.

Supersedes 7/10 Issue – Added Fig. 2A and updated drawings to 3-D.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = PR1STAP	Deadend Sec. Tap
CU = PR1SSADE	Deadend Sec.

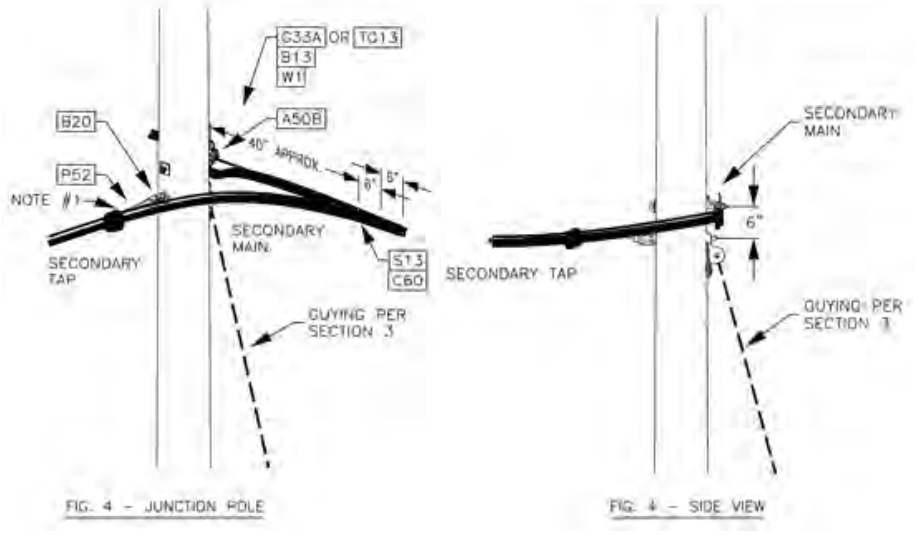


FIG. 4 – JUNCTION POLE

FIG. 4 – SIDE VIEW

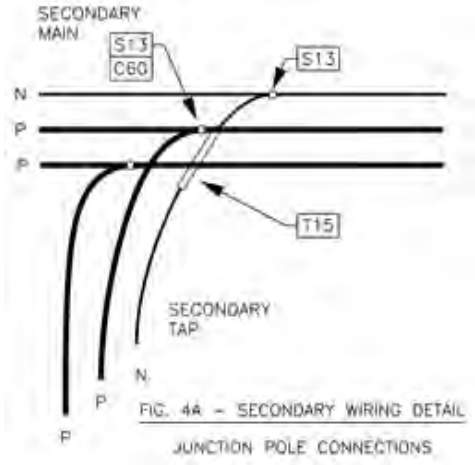


FIG. 4A – SECONDARY WIRING DETAIL
JUNCTION POLE CONNECTIONS

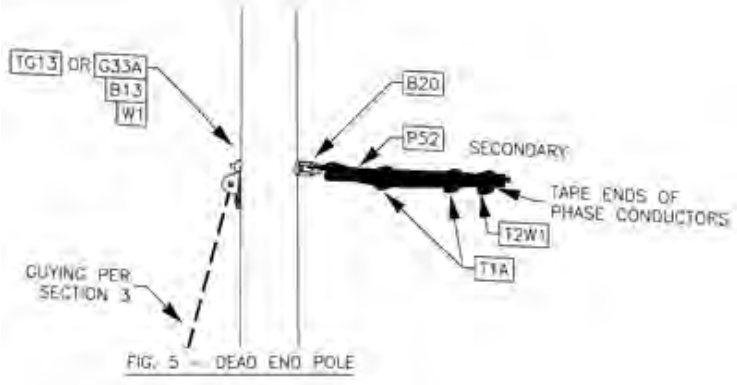


FIG. 5 – DEAD END POLE

Supersedes 7/10 Issue – Updated Drawings to 3-D.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = CNCUT	Sec. Crib Cut/Splice	PR1STS	Sec. Clamp 0° - 60°
CU = PR3SS	3-Spool Sec. Rack	PR1STRAP	Sec. Tap Triplex Bolteye
CU = CCTPS	Reconnect Sec. Taps		

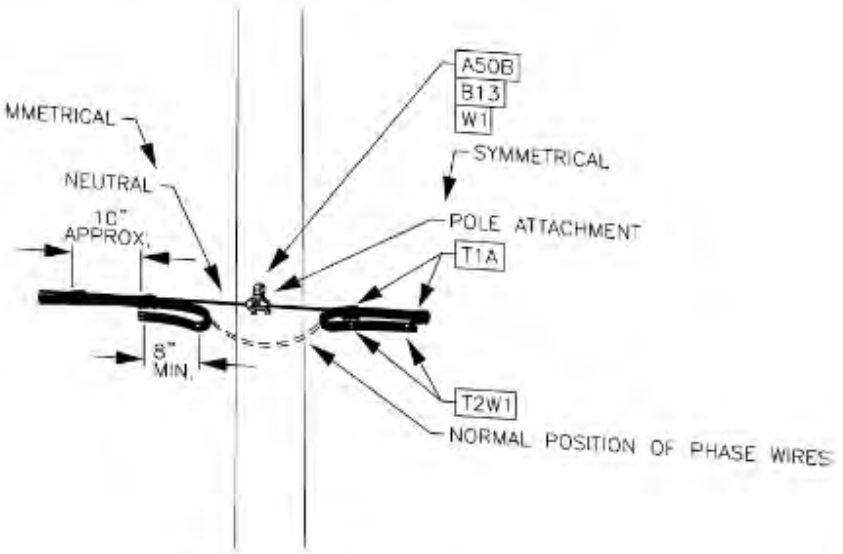


FIG. 6 – TIE POINT

PROCEED AS FOLLOWS:
1. TAPE TRIPLEX CABLE IN PLACE AT TWO POINTS EACH SIDE OF POLE BEFORE CUTTING PHASE CABLE.
2. CUT PHASE CABLES AT EACH SIDE OF POLE.
3. TAPE ENDS AND BEND BACK APPROXIMATELY TO POSITION SHOWN.

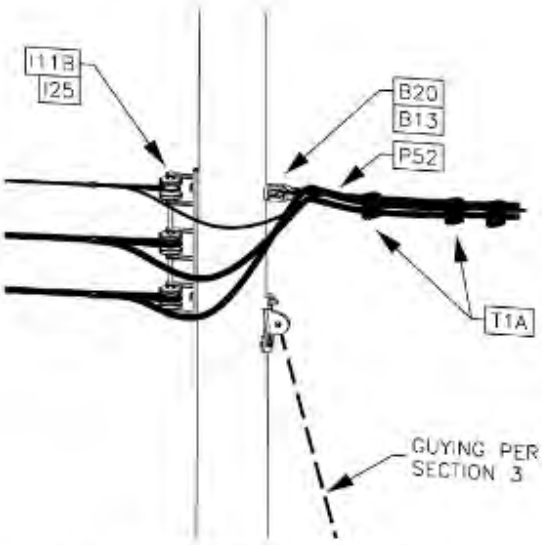


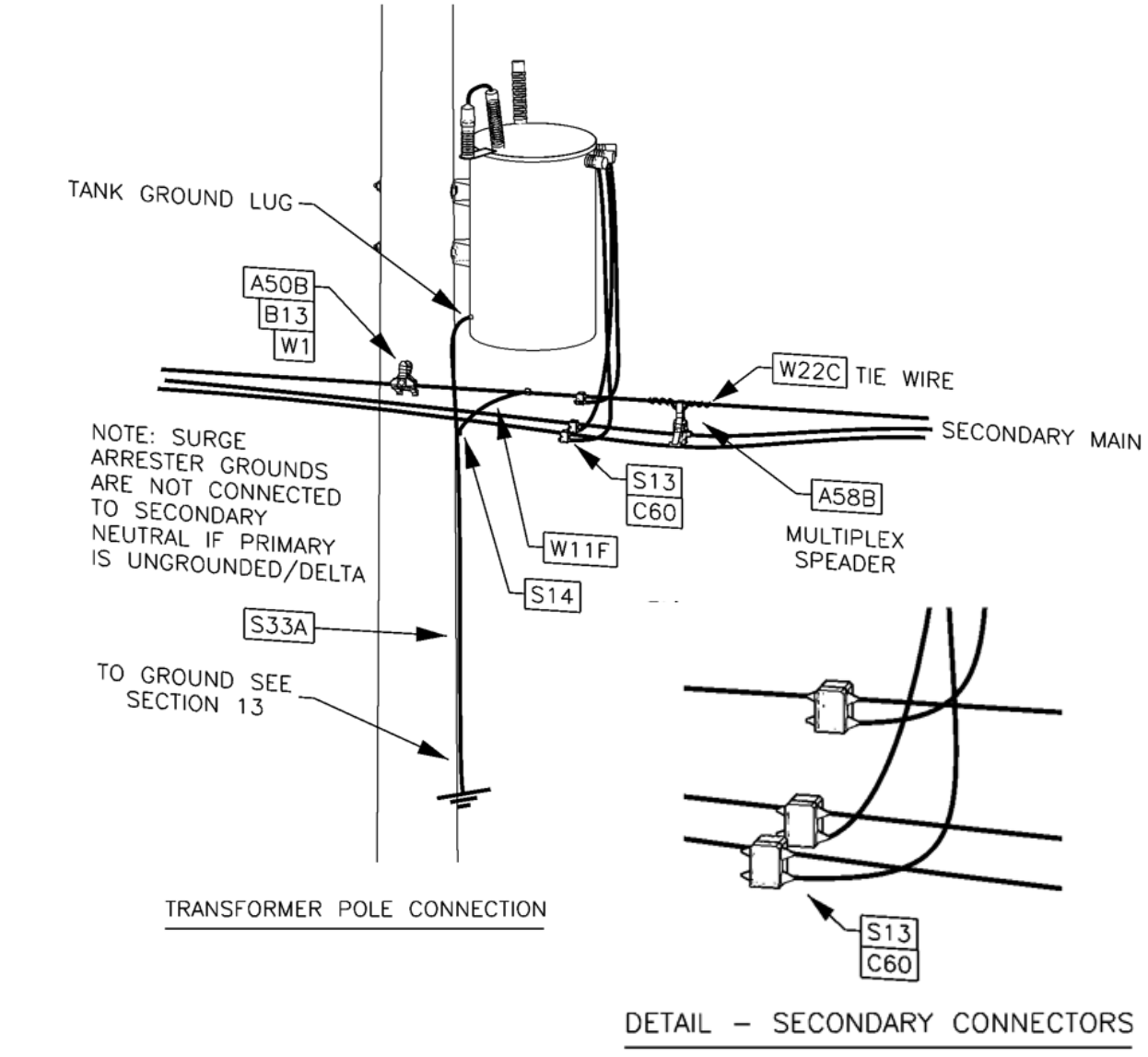
FIG. 7 – CONNECTION TO OPEN WIRE

VERTICAL RACK ILLUSTRATED

Supersedes 7/09 Issue – Updated drawings to 3-D.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = CSTQS	Sec. Multiplex Spacer



NOTE:
1. FOR ELECTRICAL WIRING DIAGRAMS SEE TRANSFORMERS SECTION 14 DRAWINGS.
2. COPPER TAP CONDUCTOR SHALL BE PLACED IN CONNECTOR BOTTOM POSITION.

Supersedes 7/17 Issue – Cleared up blurry drawing.

Figure 8 – Transformer Pole Connection

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
7	7/20	• Added verbiage on 10-11	Cheng Lin	J. P. Knauss Director of Electric Engineering
6	7/18	• Cleared up blurry drawing on page 10-103.	G. Paul Anundson	Jonathan Gonynor, Director, T&D Services
5	7/17	• Added Figure 2a on page 10-100. • Updated drawings to 3-D on pages 10-100 through 10-103.	G. Paul Anundson	Jonathan Gonynor, Director, T&D Services
4	7/16	• Revised 10.0.30(D) and 10.0.70 to eliminate taping connectors option. • Corrected paragraph numbering of 10.0.60 through 10.0.90.	G. Paul Anundson	Jonathan Gonynor, Director, T&D Services
3	7/12	• Added paragraph 10.0.70 – Secondary Cable Dimensions	Frederick Kippen	Susan Fleck, VP of Standards, Policies, & Codes
2	7/10	• Updated Std Item #s on Drawings 10-100 and 10-101. • Added side view of Figure 4 on Drawing 10-101 to show elevation difference between two bolts. • Added Section 10.6	Katie Croteau Frederick Kippen	Allen Chieco, Director of Distribution Standards and Work Methods
1	07/09	• General revision of entire section. • Added CUs to drawings/figures.	Frederick Kippen	Allen Chieco, Director of Distribution Standards and Work Methods

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SECTION	PAGE
• 11.0 GENERAL	11-1
• 11.1 CONDUCTORS	11-1 THRU 11-2
• 11.2 CONNECTIONS TO SECONDARIES	11-2
• 11.3 CONNECTIONS TO BUILDINGS	11-2
• 11.4 CLEARANCES FROM GROUND, SWIMMING POOLS AND STRUCTURES	11-2
• 11.5 SURGE ARRESTERS	11-3
• 11.6 GUYING	11-3
• 11.7 GROUNDING AND BONDING	11-3
• 11.8 TYPICAL 100 AMPERE OVERHEAD TEMORARY SERVICE STRUCTURE WHERE SERVICE DROP DOES NOT CROSS OVER A HIGHWAY	11-3
• CONSTRUCTION DRAWINGS	
o SERVICE CONDUCTOR SAG & TENSION	11-61
o SERVICE CONDUCTOR DATA	11-62
o MULTIPLEX SECONDARY AND SERVICE TAPS FROM MULTIPLEX SECONDARIES	11-115
o MIDSPAN SERVICE TAP	11-115A
o MULTIPLEX SERVICE BUILDING ATTACHMENT	11-121
o INSTALLATION OF CONVENIENCE OUTLET ON DISTRIBUTION POLE WITH SECONDARY	11-122
o 400 A AND 800 A MULTIPEX SERVICE POLE AND TRANSFORMER CONNECTION	11-141
o TYPICAL 100 A OVERHEAD TEMPORARY SERVICE STRUCTURE	11-151
o DISTRIBUTION SUPPLY-TRANSMISSION SWITCH MOTOR CONTROL	11-161

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/07 Issue – Added reference to new Note 6 in Table 1.

11.0 GENERAL

These standards cover overhead services of less than 600 V and only that portion of each service that is to be installed by National Grid. See Section 10, Secondaries, for sizing conductors and transformers. Normally, overhead secondary services shall be offered in the following voltages:

120/240 V Single Phase - 3 wire (for load not exceeding 100 kVA)
208Y/120 Three Phase - 4 wire (for non-residential only)
480Y/277 Three Phase - 4 wire (available by special arrangement and approval only)
240 V and 480 V delta services are not available for new installations

The Service Drop or Lateral is the overhead conductor between the last pole or other aerial support on the primary line and the first point of attachment to a building. The Service Entrance is the conductor between the service drop/lateral and the service entrance switch.

The Company will attach the service drop/lateral to the Customer's structure at the service bracket (supplied by and installed by the customer). See the "**Information and Requirements for Electric Service**" handbook in New England and "**Specifications for Electric Installations**" handbook in New York for metering and details of the Customer's installation.

CAUTION: 18 inches of clearance should be maintained between any gas regulator vent and the socket of an electric meter.

11.1 CONDUCTORS

11.1.10 Selection of Conductors

Aluminum multiplex conductors shall be installed for all new and replacement overhead services unless otherwise noted. For new construction, conductor size selected from Table 1 below will be determined by the Customer service entrance rating. Use triplex conductors for single-phase services and quadruplex for 3-phase, 4-wire services. Aluminum service cable #2 and 1/0 triplex and 1/0 and 336.4 kcmil quadruplex shall be used in accordance with information below and the standards that follow in this section. In general, #2 triplex cable shall be used for dwellings up to and including three family where the service load could be supplied by a 15 kVA transformer. This will include all but a very few large "all electric" homes. 1/0 Triplex service cable shall be used for large residential services where #2 cable is inadequate. Cable loads should be within limits shown on Table 2 on Page 11-2. If the length of service is such that the voltage drop may exceed 1%, a larger conductor should be used.
When a customer upgraded a service, the existing service cable can stay in service unless voltage drop or flicker will affect the customer.

TABLE 1

SERVICE ENTRANCE		RECOMMENDED CONDUCTOR		
TYPE	**MAX. AMPACITY**	**SIZE AND TYPE**	**STD. ITEM**	**ITEM ID**
SINGLE PHASE	100 A.[1]	#2 TRIPLEX	W15B	4003306
	150 or 2 100 A.	#2 TRIPLEX	W15B	4003306
	200 A.[4]	1/0 TRIPLEX	W15C	4003310
	400 A.	336.4 QUADRUPLEX[2, 6]	W16E	4004436
THREE PHASE	150 A.	1/0 QUADRUPLEX	W16C	4004410
	400 A.	336.4 QUADRUPLEX	W16E	4004436
	800 A.[3]	(2) 336.4 QUADRUPLEX[2]	W16E	4004436
	800 A.	(8) #4/0 CU.[2]	W33C	4020111

Notes:

1. New single-phase service entrances shall have a capacity of not less than 100 A for a single meter or not less than 150 A for more than one meter.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

2. #4/0 CU (W33C) may be substituted for 336.4 kcmil multiplex for short runs directly from transformer to service entrance.
3. See Page 11-141 for 400 A and 800 A services.
4. If loads are likely to exceed 25 kW, use 336.4 kcmil quadruplex.
5. Quadruplex cable shall be used for 240 V and 480 V delta services.
6. When using quadruplex cable for a single phase service, leave the extra phase conductor and at each end, bend the end back and tape it to itself.

TABLE 2

SIZE AND TYPE CONDUCTOR		CAPACITY IN AMPERES		
LIVE LEG	MESSENGER	SINGLE CONDUCTOR	TRIPLEX	QUADRUPLEX
#4 Solid AAC*	#4 - 7 Strand AAAC	150	130	115
#2 – 7 Strand AAC	#2 – 7 Strand AAAC or ACSR	200	175	150
1/0 – 7 Strand AAC	1/0 – Strand AAAC or ACSR	270	245	210
4/0 – 7 Strand AAC*	4/0 – 7 Strand AAAC	415	380	-
336.4 – 19 Strand AAC	4/0 – 7 Strand AAAC or ACSR	550	515	445
795 – 37 Strand AAC*	336.4 – 19 Strand AAC	935	900	825
350 – 37 Strand CU		705	-	-
500 – 37 Strand CU		890	-	-

*Nonstandard – Values are given for comparison and special installations
The above is based on 100^0F/37.7^0C ambient and 194^0F/90^0C continuous operation with 3 feet per second wind velocity – also standard cable with cross-linked polyethylene insulation. The values should be reduced 20% for polyethylene insulation.

11.1.20 Sag

Sag service wire to the values shown on Page 11-61. It is often necessary to make some variations in sags to balance loads on service wires. Good judgment shall be used when making such variations.

11.2 CONNECTIONS TO SECONDARIES

Taps from multiplex secondaries should be located approximately 3 feet from the pole as shown on Page 11-115 (to minimize pole congestion). Taps may also be made elsewhere in the span if there are right-of-way or clearance problems. Balance the service wire tension at each tap when practicable.

See Section 5, Connectors, for service/secondary connectors and splices.

See Section 48 (Underground – Risers)) for connection to underground service laterals. Use compression type connectors for service connections whenever possible. Cover connections on covered conductors.

11.3 CONNECTIONS AT BUILDINGS

See 11-121 for multiplex service attachments at the building.

11.4 CLEARANCE FROM GROUND, SWIMMING POOLS, AND STRUCTURES

Adequate clearances shall be maintained. See Section 7 and also the "**Information and Requirements for Electric Service**" handbook in New England and "**Specifications for Electric Installations**" handbook in New York. Where it is necessary, an intermediate pole or a riser on the building shall be installed. Reference should be made to the above handbooks for a division of cost for such supports, or for long service drops/laterals on private property. Adjacent buildings not on property being served shall not be used to support service wire.

Supersedes 7/18 Issue – Revised 11.2.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Services should not be installed over swimming pools or surrounding areas extending 25 feet horizontally from the pool edge. If crossing cannot be avoided, see Section 7 for clearance.

1.5 SURGE ARRESTERS

Surge arresters shall not be installed on services. Where customers desire protection against induced lightning surges, they may install an arrester in the service entrance box on the load side of the meter.

1.6 GUYING

It is recommended that guys be installed on poles with heavy unbalanced services, particularly when all services are taken off from the same side of a line of poles.

Supersedes 1/06 Issue – Repaging because of additions on previous page.

1.7 GROUNDING AND BONDING

The messenger of multiplex cables shall be connected to the grounded secondary neutral at the pole. It shall also be connected to the Customer's neutral for 120/240 V, 120/208 V, or other grounded neutral service. The messenger shall be bonded to the metal mast or riser at the building.

One of the three insulated conductors of a 240 V delta service may be grounded at the pole and at the service entrance box.

1.8 TYPICAL 100 AMPERE OVERHEAD TEMPORARY SERVICE STRUCTURE WHERE SERVICE DROP DOES NOT CROSS OVER A HIGHWAY

11.8.10 Application

The following are details for a 100 A, 120/240 V, single phase overhead temporary service. Temporary service is considered a service that will generally be in use for less that one year. Use of this installation as a permanent service basis shall not be permitted. Additional clearances per latest National Electrical Safety Code (NESC) must be incorporated with this design should a communication company attach to this structure.

11.8.20 Division of Responsibility (See Page 11-151)

Location of temporary service shall be specified by the Company.
The CUSTOMER and CONTRACTOR shall:

A. Furnish, install, maintain, and remove:
   1. Wood structure, braces, and stakes as shown.
   2. Weatherproof meter socket and disconnect including waterproof entrance fittings.
   3. GFCI protected polarized receptacles.
   4. SE cable, staples and weatherhead
   5. Ground rods, ground conductor, ground molding, staples and ground rod connector.
   6. Obtain inspection and approval from local wire inspector.

The Company shall:

A. Furnish, install, maintain and remove:
   1. Overhead service drop from pole to temporary service structure.
   2. Overhead service drop connectors and attaching hardware.
   3. Secondary meter.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

11.8.30 Notes

A. Where it is necessary to cross a roadway or highway with the overhead service drop conductors, distribution line construction as specified by the Company shall be used.
B. Service drop conductors shall meet all overhead clearance requirements of the latest issue of the NESC.
C. Service drop conductors shall be installed in accordance with sag/tension tables within these construction standards.
D. All post, brace, and stake wood members shall be “nominal”, and those routinely available from lumber yard stock. Pressure treated lumber is recommended.
E. The customer, or the customer’s contractor, shall meet all clearances and construction requirements set forth in the latest edition of the National Electrical Code (NEC) and as required by local authorities and the local Wire Inspector.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

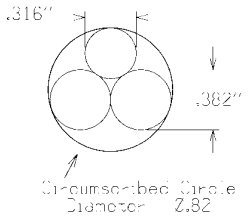
		INITIAL SAG (INCHES)			
	SPAN (FEET)	#2 AAC TRIPLEX (W15B)	1/0 AAC TRIPLEX (W15C)	1/0 AAC QUADRUPLEX (W16C)	336.4 AAC QUADRUPLEX (W16E)
TEMP. OF 32°F	50	3	8	9	14
	60	6	12	14	20
	70	10	18	19	27
	80	15	24	26	34
	90	21	31	34	43
	100	27	39	42	53
	110	34	47	52	64
	120	43	57	62	76
TEMP. OF 60°F	50	5	10	11	16
	60	8	15	16	22
	70	13	20	22	28
	80	18	26	28	36
	90	24	33	36	45
	100	30	41	44	55
	110	37	50	54	66
	120	45	59	64	78
TEMP. OF 90°F	50	7	12	13	17
	60	11	17	18	23
	70	16	22	24	30
	80	21	28	30	38
	90	27	35	38	47
	100	33	43	46	57
	110	40	52	60	68
	120	49	62	66	80

		FINAL SAG (INCHES) @MAXIMUM DESIGN TENSION			
	SPAN (FEET)	#2 AAC TRIPLEX (W15B) 650 LBS	1/0 AAC TRIPLEX (W15C) 650 LBS	1/0 AAC QUADRUPLEX (W16C) 680 LBS	336.4 AAC QUADRUPLEX (W16E) 1,000 LBS
TEMP. OF 90°F	50	10	14	14	18
	60	14	19	19	24
	70	19	24	25	31
	80	24	30	32	39
	90	30	37	40	48
	100	36	45	48	58
	110	43	54	58	69
	120	52	64	68	81

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

#2 AWG Triplex Service Cable – "SHRIMP/XLP" (W15B)

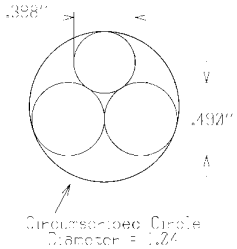
One - #2 AWG, 6201-T81, 7 strand AAAC Messenger Diameter = .316 inches
Two - #2 AWG, 1350-H19, 7 strand AAC Phase Conductor Diameter
with 45 mils of XLP = .382 inches



LOADING	
DEADEND	650 LBS
TRANSVERSE	.590 LBS./FT.
VERTICAL	1.04 LBS./FT.
TOTAL	1.496 LBS./FT.
SWING ANGLE	57.0^0

1/0 AWG Triplex Service Cable – "GAMMARUS/XLP" (W15C)

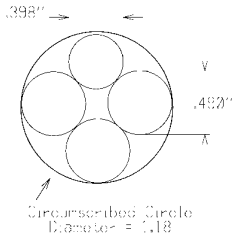
One - 1/0 AWG, 6201-T81, 7 strand AAAC Messenger Diameter = .398 inches
Two - 1/0 AWG, 1350-H19, 7 strand AAC Phase Conductor Diameter
with 60 mils of XLP = .490 inches



LOADING	
DEADEND	650 LBS
TRANSVERSE	.666 LBS./FT.
VERTICAL	1.318 LBS./FT.
TOTAL	1.774 LBS./FT.
SWING ANGLE	51.0^0

1/0 AWG, Quadruplex Service Cable – "SHETLAND/XLP" (W16C)

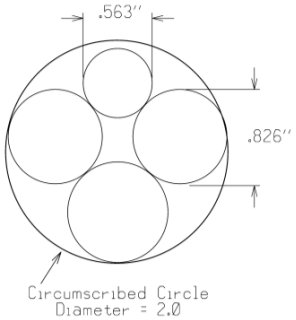
One - 1/0 AWG, 6201-T81, AAAC Messenger Diameter = .398 inches
Three - 1/0 AWG, 1350-H19, AAC Phase Conductor Diameter
with 60 mils of XLP = .490 inches



LOADING	
DEADEND	680 LBS
TRANSVERSE	.707 LBS./FT.
VERTICAL	1.568 LBS./FT.
TOTAL	2.020 LBS./FT.
SWING ANGLE	45.0^0

336.4 KCMIL Quadruplex Service Cable – "EXMOOR/XLP" (W16E)

One - 4/0 AWG, 6201-T81, 7 strand AAAC Messenger Diameter = .563 inches
Three – 336.4 KCMIL, 1350-H19, 19 strand AAC Phase Conductor Diameter
with 80 mils of XLP = .826 inches

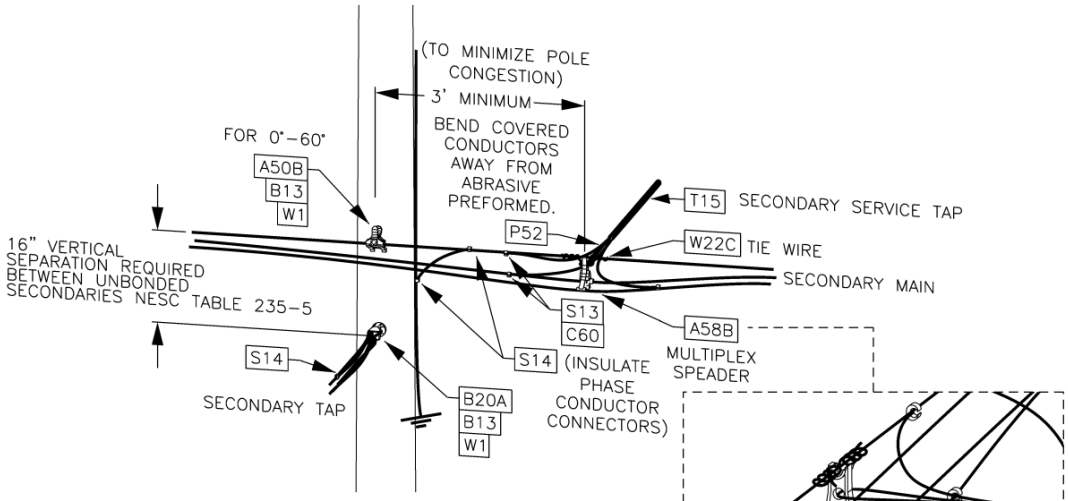


LOADING	
DEADEND	1,000 LBS
TRANSVERSE	.973 LBS./FT.
VERTICAL	3.00 LBS./FT.
TOTAL	3.452 LBS./FT.
SWING ANGLE	32.5^0

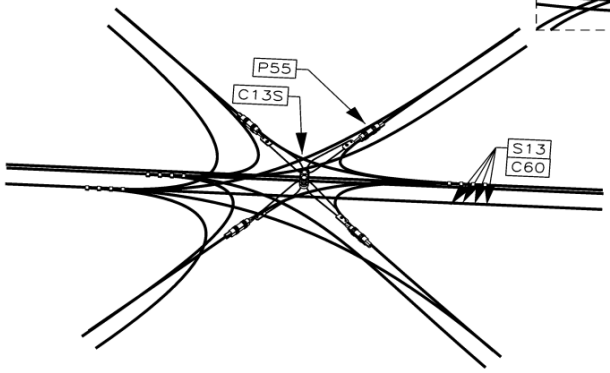
Supersedes 01/06 Issue – Revised circumscribed circle dimensions.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/17 – Updated Note 8.



TYPICAL MULTIPLEX MIDSPAN TAP



FOR A SINGLE OR MULTIPLE MIDSPAN SERVICE TAP
FROM PARALLEL LAY SECONDARY OR FROM A POLE TO POLE GUY.

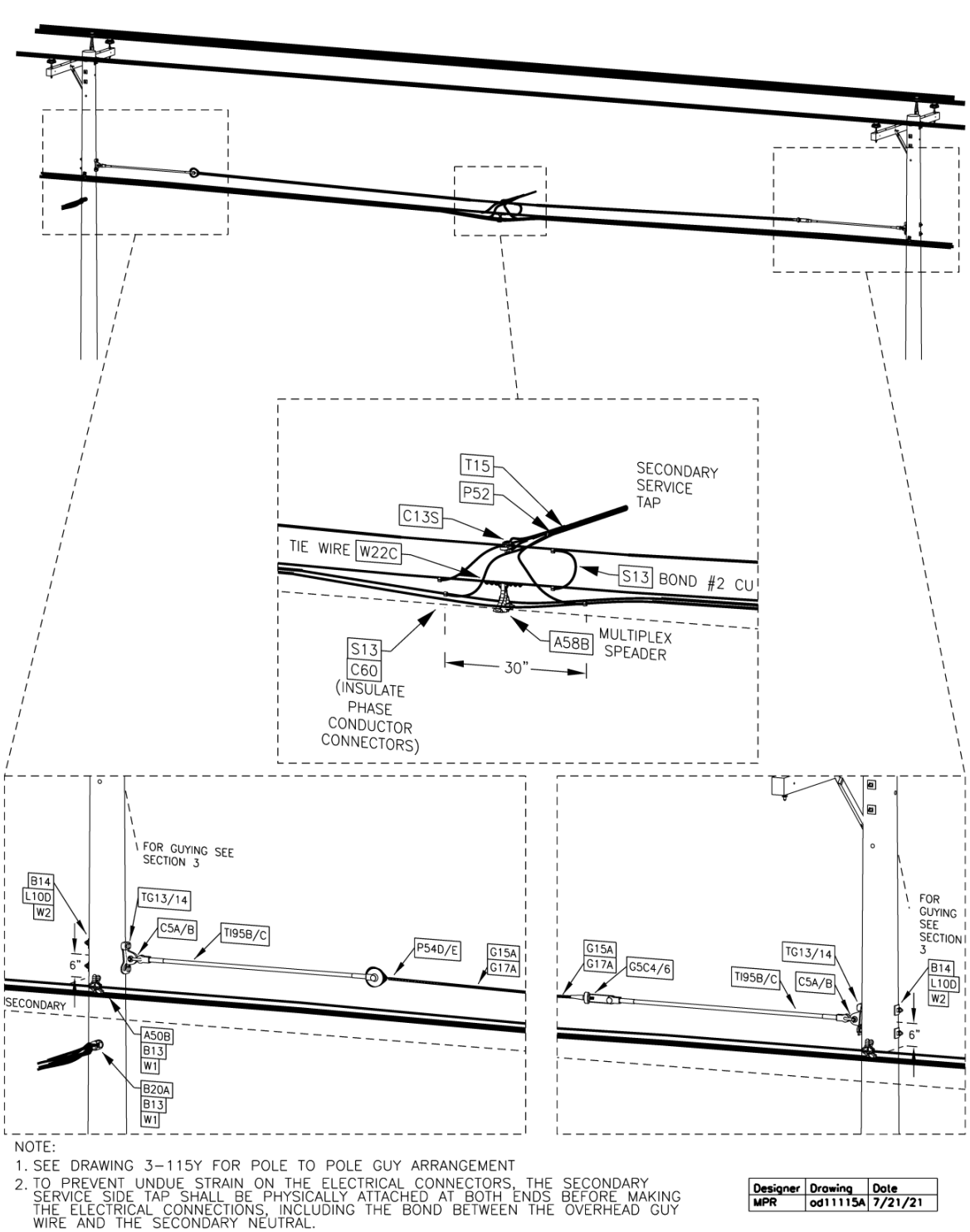
NOTE:
1. MULTIPLEX SPREADER (A58B) IS HELD INTO PLACE BY TIE WIRE (W22C), ATTACHED THROUGH TOP SPACER HOLE AND WIRED TO THE MESSENGER.
2. SEE PAGE 11–1 FOR CONDUCTOR SIZE SELECTION.
3. SEE SECTION 5 FOR CONNECTOR DETAILS.
4. INSULATE ALL COVERED CONDUCTOR CONNECTIONS.
5. ALWAYS POSITION COPPER CONDUCTORS BELOW ALUMINUM IN CONNECTORS.
6. REFER TP PAGE 11.2 FOR NOTES ON LOCATION AND BALANCING OF TAPS.
7. SEE GUYING STATEMENT ON PAGE 11–3.
8. TO AVOID EXCESSIVE SECONDARY CABLE OFFET DUE TO AN UNBALANCED MID–SPAN SERVICE, INSTALL A POLE TO POLE GUY, ATTACH THE MID–SPAN CLAMP (C13S) TO THE GUY AND BOND THE SECONDARY NEUTRAL TO THE POLE TO POLE GUY. **SEE PAGE 11–115A**

Designer	Drawing	Date
MPR	od11115	7/19/21

MULTIPLEX SECONDARY AND SERVICE TAPS FROM MULTIPLEX SECONDARIES			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		11-115	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

7/21 – New standard.



NOTE:

1. SEE DRAWING 3–115Y FOR POLE TO POLE GUY ARRANGEMENT
2. TO PREVENT UNDUE STRAIN ON THE ELECTRICAL CONNECTORS, THE SECONDARY SERVICE SIDE TAP SHALL BE PHYSICALLY ATTACHED AT BOTH ENDS BEFORE MAKING THE ELECTRICAL CONNECTIONS, INCLUDING THE BOND BETWEEN THE OVERHEAD GUY WIRE AND THE SECONDARY NEUTRAL.

Designer	Drawing	Date
MPR	od11115A	7/21/21

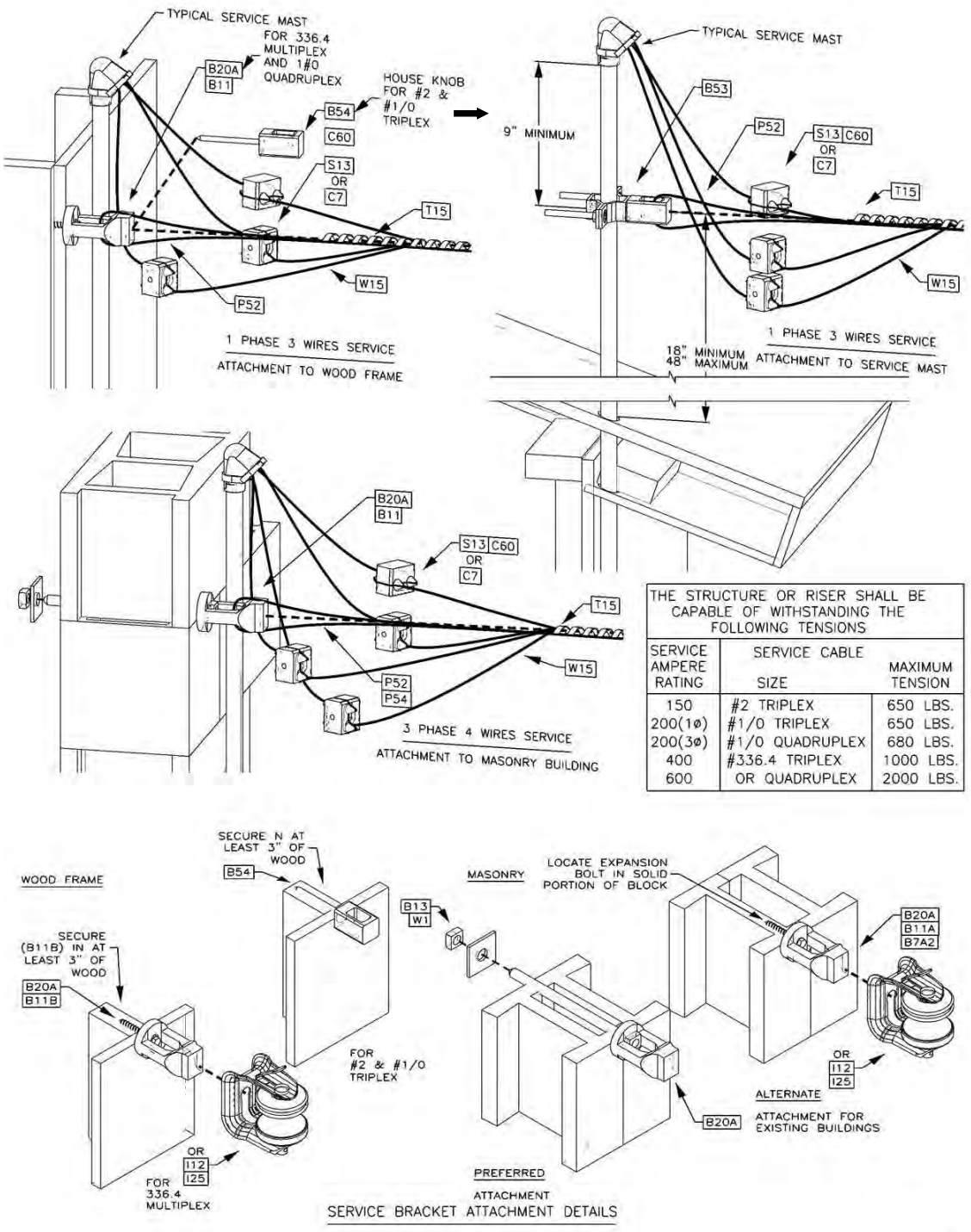
MAINTENANCE BACKYARD CONSTRUCTION ONLY

MIDSPAN SERVICE TAP

ISSUE	PAGE NUMBER		
7/21	11-115A	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/17 Issue – Updated to 3-D drawings.

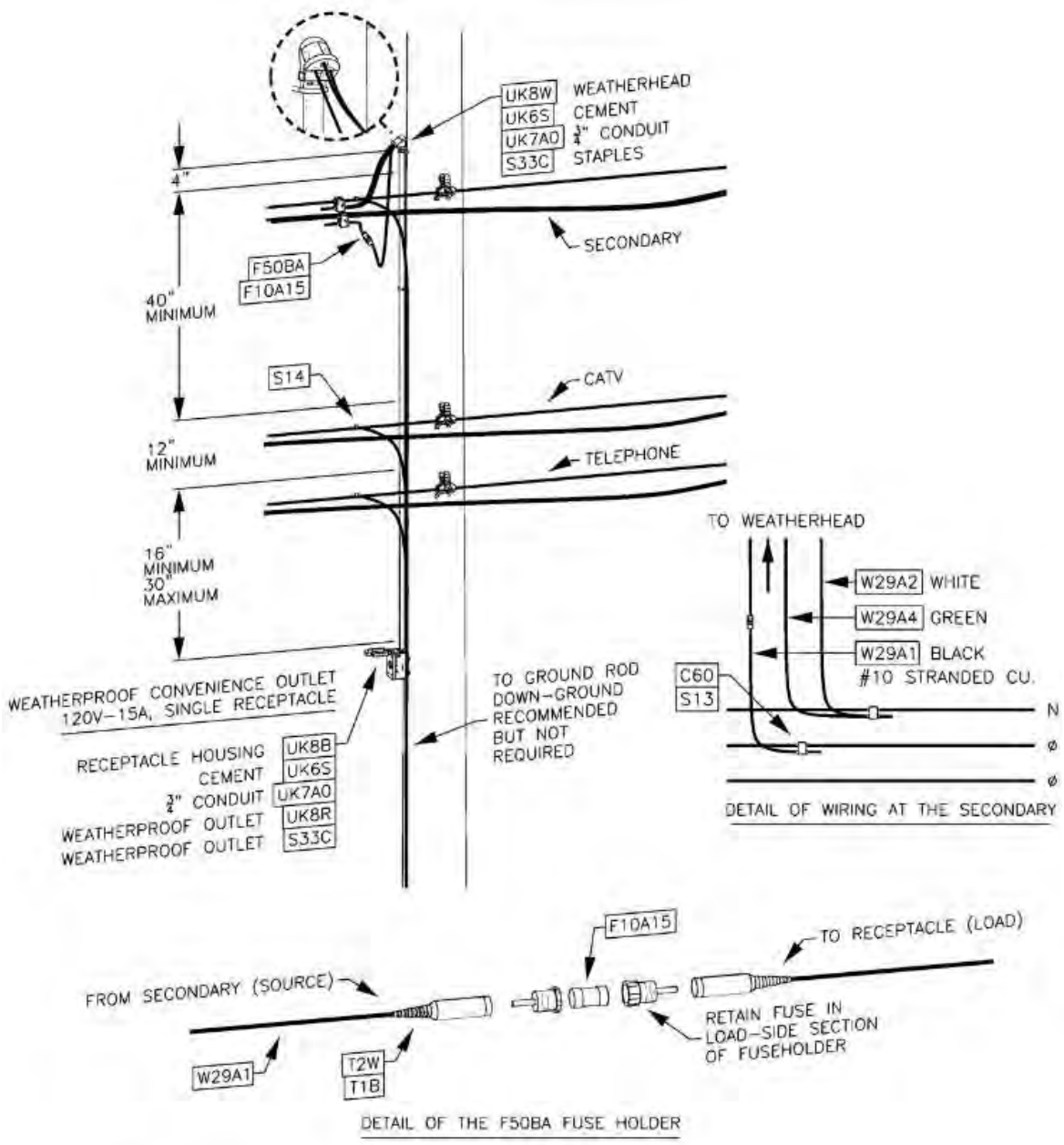


THE STRUCTURE OR RISER SHALL BE CAPABLE OF WITHSTANDING THE FOLLOWING TENSIONS		
SERVICE AMPERE RATING	SERVICE CABLE SIZE	MAXIMUM TENSION
150	#2 TRIPLEX	650 LBS.
200(1ø)	#1/0 TRIPLEX	650 LBS.
200(3ø)	#1/0 QUADRUPLEX	680 LBS.
400	#336.4 TRIPLEX	1000 LBS.
600	OR QUADRUPLEX	2000 LBS.

MULTIPLEX SERVICE BUILDING ATTACHMENT

nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		11-121	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

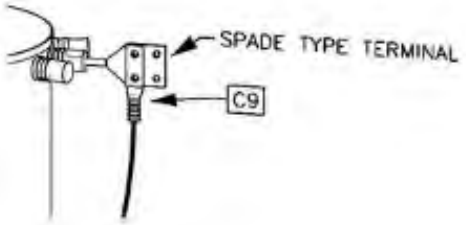


Supersedes 1/06 – Updated to 3-D drawings.

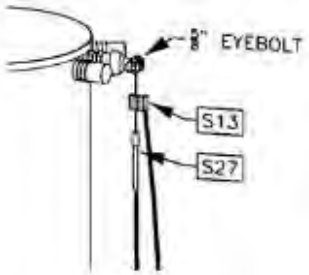
INSTALLATION OF CONVENIENCE OUTLET ON DISTRIBUTION POLE WITH SECONDARY			
ISSUE	**PAGE NUMBER**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid
7/21	**11-122**		

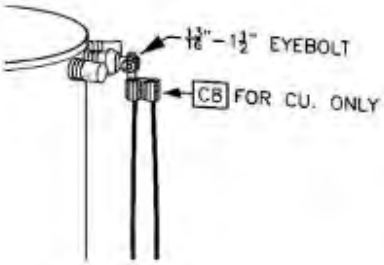
Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

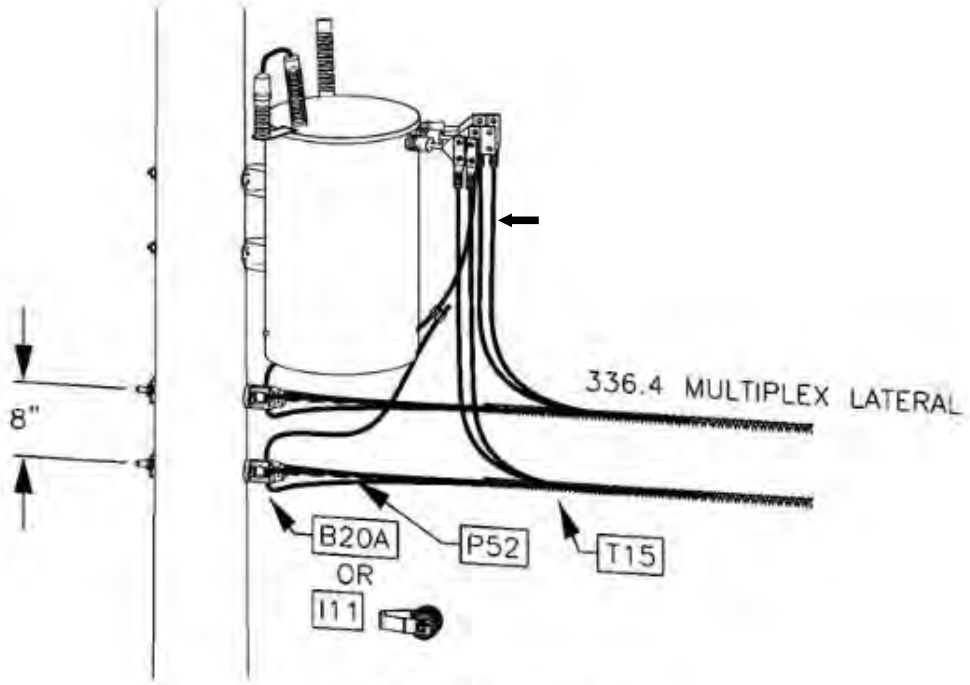
167KVA TRANSFORMERS



100KVA TRANSFORMERS AND BELOW





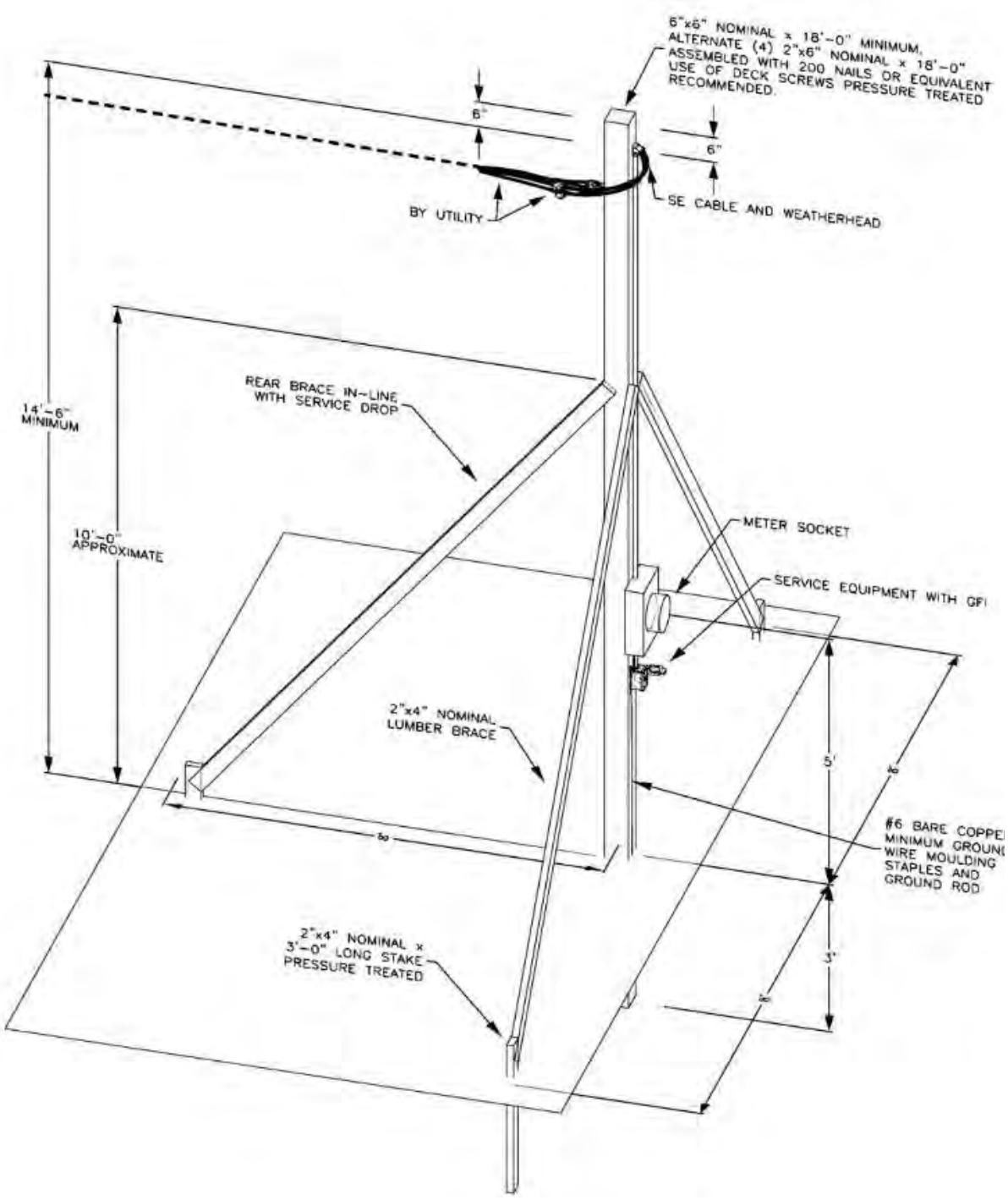


LOW VOLTAGE TERMINAL DETAILS

Supersedes 1/07 Issue – Updated to 3-D drawings.

400A AND 800A MULTIPLES SERVICE POLE AND TRANFORMER CONNECTION			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		11-141	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

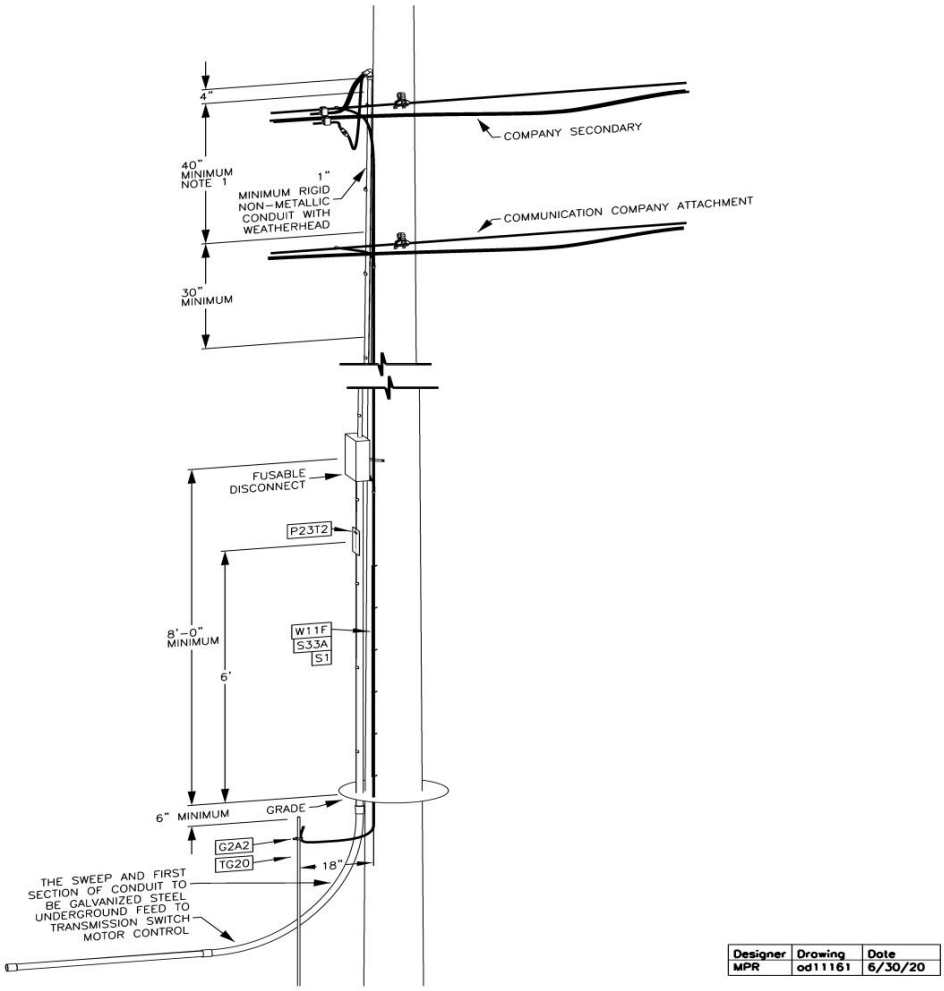


Supersedes 1/07 – Updated to 3-D drawings.

TYPICAL 100A OVERHEAD TEMPORARY SERVICE STRUCTURE

ISSUE	PAGE NUMBER		
7/21	11-151	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



NOTES:

1. This arrangement is representative of a typical installation near a transmission structure. Additional poles and overhead construction by Distribution Line Department may be required to reach and supply riser pole
2. Environmental permitting for this type of construction is the responsibility of Transmission Line Services
3. Riser pole shall be located at the edge of the right of way near the transmission structure.
4. Underground conduit and conductors from the secondary riser to the transmission structure and connection of motor control are the responsibility of Transmission Line Services
5. Riser conduit, if metallic, shall be bonded to system neutral or a down ground
6. Fusible disconnect to be fused at 30A for a 120V service to the motor control

DISTRIBUTION SUPPLY – TRANSMISSION SWITCH MOTOR CONTROL			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		11-161	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
8	7/21	• Add new page 11-115A Midspan service tap	Cheng Lin	Director, T&D Line Engineering & Standards
7	7/20	• Add new Page 11-161 Distribution Supply to Transmission Switch Motor Control	Hernan Yepez	J.P. Knauss Director of Electric Engineering
6	7/19	• Revised Section 11.2 (page 11-2) to eliminate deadended at the pole.	Cheng Lin	J.P. Knauss Director of Electric Engineering
5	7/18	• Add new Note 6 in Table 1 about the use of quadruplex cable in single phase services.	G. Paul Anundson	Jonathan Gonynor, Director, T&D Services
4	7/17	• Updated drawings 11-115, 11-121, 11-122, 11-141, and 11-151 to #-D.	G. Paul Anundson	Jonathan Gonynor, Director, T&D Services
3	7/16	• Revised Section 11.2 (page 11-2) and drawing 11-121 to eliminate the option of taping secondary service connectors.	G. Paul Anundson	Jonathan Gonynor, Director, T&D Services
2	7/12	• Revised circumscribed circle dimensions on page 11-62.	Fred Kippen	Susan Fleck, VP of Standards, Policies, & Codes

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes Issue 7/18 – Update page numbers 12-15 through 12-21 and add page 12-146.

SECTION	PAGE
• 12.0 GENERAL	12-1
• 12.1 FUSE RATING	12-1 THRU 12-2
• 12.2 CONTINUOUS RATING	12-2
• 12.3 DISCONNECT RATING	12-2
• 12.4 INTERRUPTING RATING	12-2 THRU 12-4
• 12.5 SELECTION GUIDE	12-4 THRU 12-15
• 12.6 FAULT CIRCUIT INDICATORS (FCI'S)	12-16 THRU 12-17
• 12.7 INSTALLATION – CUTOUTS & DISCONNECTING DEVICES	12-17
o K Fuse Link Selection Guide For Overhead Transformers	12-18
o T Fuse Link Selection Guide For Overhead Transformers	12-19
o K Fuse Link Selection Guide For Overhead Capacitors	12-20
o K Fuse Link Coordination For Single Phase CSP Transformers	12-21
• CONSTRUCTION DRAWINGS	
o Current Limiting Fuse Installation (Retrofitting) On CSP Transformer 15 kV	12-127
o Current Limiting Fuse Installation On Conventional Transformer 15-35 kV	12-128
o 1Φ Primary With 1Φ Fused Tap 15-35 kV	12-129
o 3Φ Primary With 1Φ Fused Tap 15-35 kV	12-130
o 3Φ Primary Sectionalizing 5 kV (Maintenance Only)	12-131
o 1Φ Primary Sectionalizing 15-35 kV	12-132
o 3Φ Primary Sectionalizing 15-35 kV	12-133A THRU 12-133B
o 3Φ Primary With 3Φ Fused Tap 15-35 kV	12-134
o Underslung Disconnect Switch Tangent Line Angles 0˚-10˚ - 15-35 kV	12-135A
o Underslung Disconnect Switch Tangent Line Angles 11˚- 20˚ - 15-35 kV	12-135B
o Underslung Disconnect Switch Tangent Line Angles 21˚-60˚ - 15-35 kV	12-136
o Vertical Disconnect Switch Tangent Line Angles 0˚-20˚ - 15-35 kV	12-137A
o Vertical Disconnect Switch Tangent Line Angles 0˚-20˚ - 15-35 kV	12-137B
o Installation of In-Line Switches 15-35 kV	12-138
o Underslung Disconnect Switches – On Switcharms 15-35 kV	12-139
o Vertical Disconnect Switches – On Switcharms 15-35 kV	12-140
o 3Φ Primary Sectionalizing - Loadbreak Switch Below Crossarm Installation 15-35 kV	12-141
o 3Φ Primary Sectionalizing – Conductor Deadend On Loadbreak Switch Installation 15-35 kV	12-142
o 3Φ Primary Sectionalizing – Loadbreak Switch with Shunt Cutouts Installation 15-35 kV	12-143
o 3Φ Primary Sectionalizing – Hook Stick Loadbreak Switch Below Crossarm Installation 15kV	12-144
o 3Φ Primary Sectionalizing – Hook Stick Loadbreak Conductor Deadend On Switch Installation 15kV	12-145
o 3Φ Primary Sectionalizing – Hook Stick Loadbreak Switch with Shunt Cutouts – 15kV	12-146

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SECTION		PAGE
o	Single Phase Vacuum Operated Cutout Mounted Recloser – Single Phase Tap Inline –Tangent and Deadend. Installations	12-328
o	Single Phase Vacuum Operated Cutout Mounted Recloser Installation – Single Phase Tap Installation.	12-329
o	Single Phase Vacuum Operated Cutout Mounted Recloser – Three Phase Tap Installation.	12-330
o	Single Phase Vacuum Operated Cutout Mounted Recloser – Three Phase Inline Tangent. Installation	12-331
o	Single Phase Vacuum Operated Cutout Mounted Recloser – Three Phase Deadend Inline Installation	12-332
o	3Φ Recloser Effectively Grounded Installation 15-35 kV	12-333
o	3Φ Recloser Installation Wiring Details and Noneffectively Grounded Circuit Grounding 15-35 kV	12-334
o	3Φ Recloser Installation 5-35 kV Effectively Grounded, Non-Effectively Grounded, & Delta Systems	12-335
o	3Φ Recloser Installation 15-35 kV Distributed Generation PCC 5-35KV	12-335A
o	3Φ Recloser Installation Wiring Details 5-35kV Radial Applications	12-336
o	3Φ Recloser Effectively Grounded Installation 12.47 kV, 13.2 kV, 13.8 kV Applications with Frame Mounted PT's	12-338
o	3Φ Recloser Installation 12.47 kV, 13.2 kV, 13.8 kV Applications with Frame Mounted PT's DG PCC	12-338A
o	3Φ Recloser Installation Wiring Detail 12.47 kV, 13.2 kV, 13.8 kV Radial Applications with Frame Mounted PT's	12-339
o	1Φ Recloser Effectively Grounded Installation 15-35kV	12-341
o	Eaton NOVA NX-T 3ϕ Recloser Effectively Grounded Installation 5KV, 12.47KV, 13.2KV, 13.8KV Applications with Frame Mounted PT's	12-350
o	Eaton NOVA NX-T 3ϕ Recloser Installation Wiring Details 5-15 KV Radial Applications	12-351
o	Notes for Drawings 12-335, 12-335A, 12-338, 12-338A, 12-350 and 12-360	12-352
o	3Φ Recloser Installation 15 KV On Spacer Cable with External Mounted PTs	12-360
o	Indicator – Fault Circuit – Distribution	12-650A
o	Smart Indicator – Fault Circuit – Distribution	12-650B
o	Protection – Overhead Subtransmission Section	12-900
o	Indicator – Fault Circuit – Sub-Transmission	12-905A
o	Smart Indicator – Fault Circuit – Sub-Transmission	12-905B
o	Sub-Transmission - 23-34.5kV Horizontal Upright Loadbreak	12-911A
o	Sub-Transmission - 46kV Horizontal Upright Loadbreak	12-911B
o	Sub-Transmission - 46kV Side Break Loadbreak	12-912
o	Sub-Transmission - 23-34.5kV Phase over Phase Loadbreak	12-913A
o	Sub-Transmission – 23-34.5kV Loadbreak Switch for 795 kCMIL & 1113 kCMILConductors	12-914
o	Sub-Transmission – 35 KV max Inline Switches	12-938
o	Sub-Transmission – 35 KV Sectionalizer	12-950
o	Sub-Transmission 35 KV Recloser Installation Distributed Generation PCC	12-950A
o	3Φ Sub-Transmission 35 KV Sectionalizer Installation Wiring Details	12-951
o	3Φ Sub-Transmission 35 KV Sectionalizer Installation Wiring Details with External Mounted PTs	12-952
o	Eaton NOVA NX-T 3ϕ Recloser Installation 38KV with External Mounted PT's	12-960
o	Eaton NOVA NX-T 3ϕ Recloser Installation Wiring Details 38KV with External Mounted PT's	12-961

Supersedes 7/20 Issue – Added pages 12-352, 12-360, 12-650A/B, and 12-905A/B.

Copyright 2017 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

12.0 GENERAL

Short circuits, the uncontrolled flow of electricity from energized conductors or equipment to a neutral or ground, occur in power systems when insulation fails or is bypassed due to; system overvoltages caused by lightning, switching surges, insulation contamination, mechanical failures, conductive materials crossing conductors, or other natural causes. These are also referred to as “faults” and the current flow is referred to as “fault current”. The number of short circuits and the magnitude of the current flow can be minimized with proper design, operation, and maintenance of overhead distribution systems.

12.1 FUSE RATING

Type K expulsion fuse links (F1K), per ANSI C37.42, are the standard fuse links for use in enclosed and open type fuse cutouts on the Company system. K link fuses provide improved coordination with station equipment and a greater range of coordination between fuses. Type T expulsion fuse links (F1T), per ANSI C37.42, are for use in enclosed and open type fuse cutouts on the Brockton distribution system only. All of these tin element links will carry continuous current up to 1½ times their nominal rating; above 1½ times, or 150% the "Minimum Melt" threshold, melting of the fuse link will start to occur with eventual blowing of the fuse, or weakening of the fuse link causing unpredictable operation in the future. Fuse links rated up to and including 100K or 100T shall only be used in cutouts rated 100 A. Fuse links rated above 100K or 100T up to 200K or 200T shall only be used in cutouts rated 200 A.

Supersedes 7/17 Issue – Updated page references

12.1.10 Fuse Sizes For Transformers

In general, transformer installations are fused for short circuit rather than overload protection. Three-phase fusing is based on motor loads with incidental lighting, with no motor having a horsepower rating greater than 50% of the total transformer bank capacity in kVA. Special cases, such as exceptionally large motors, may require the next size primary fuse to withstand excessive current drawn during start up.

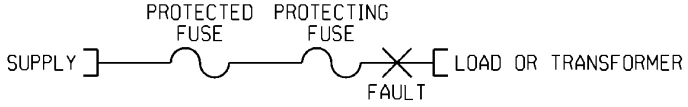
Recommended fuse sizes are shown on Page 12-17 & 12-18. In addition, CSP transformers shall be considered as conventional transformers and fused per Page 12-17 & 12-18 which may aid in increased sectionalization opportunities.

12.1.20 Fuse Sizes For Capacitors

In selecting fuse sizes for capacitors, links with adequate continuous overcurrent ratings were chosen to provide roughly, a minimum capacity of 135% of the group total and to carry excessive currents caused by overvoltage, harmonics, and inrush. Recommended fuse sizes for capacitors are given on Page 12-19.

12.1.30 Fuse Sizes For Line Coordination

Where two adjacent fuses operate in series, the “protected fuse” is on the supply side and the “protecting fuse” is on the load side. If a fault develops beyond the protecting fuse, it should clear before the protected fuse has reached 75% of its melting time. This condition can be realized only for most values of short circuit current. Large fuses with high coordinating values are used near the supply end of distribution feeders and must coordinate properly with station protective devices. Transformer fuses always are protecting fuses. Table 1 below shows coordination that can be expected between standard K link fuse sizes.



Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Table 1

Protecting	Protected Fuse Size					
Fuse Size	**15**	**25**	**40**	**65**	**100**	**140**
	Maximum Fault Current for Coordination					
10	430	840	1350	2200	3900	5800
15		500	1350	2200	3900	5800
20			1200	200	3900	5800
25			700	2200	3900	5800
30				1800	3900	5800
40				1300	3900	5800
50					3500	5800
65					2400	5800
80						4500
100						2000

Special fuses and fuseholders should generally be avoided. However, it may be necessary to specify them for certain applications. For example, at locations where fault current is in excess of 16,000 amperes asymmetrical, the use of standard item C47A will need to be used. If there are a number of applications, the power fuses and holders will be kept in Stores.

12.2 CONTINUOUS RATING

All devices have a continuous rating for current carrying capacity in the closed position. This rating is not to be interpreted as the disconnecting rating.

Devices used for line fuses, disconnects, and primary services shall be selected so that the anticipated load will not exceed the continuous current rating of the device. It is recommended in those areas exhibiting a past pattern of growth that the device be selected so that its initial loading will not exceed two-thirds of the continuous rating, thereby permitting a margin for growth.

12.3 DISCONNECTING RATING

The ability to disconnect load is dependent upon operating voltage, separation of contacts, power factor, atmospheric conditions, the exact instant of break point in respect to the 60 cycle wave, and other factors beyond the control of the operator.

There is no official recognition that cutouts, fused or solid blade, have the ability to disconnect load (ANSI C37.40). All cutouts and disconnects include loadbuster hooks for the use of the loadbuster tool. When the loadbuster tool is used, loads up to the continuous rating of the device, but not to exceed 600 A, may be interrupted.

Cutouts shall be selected so that they will not be required to open loads in excess of the values shown in Table 2 on Page 12-3, except cutouts for capacitor applications.

12.4 INTERRUPTING RATING

12.4.10 Cutout

The maximum fault current that a cutout can successfully perform circuit interruption is known as the interrupting rating of the cutout. It is expressed in root mean square (rms) asymmetric amperes.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Proper application of fused cutouts require selection of an interrupting rating greater than the available fault current at the given location. Interrupting ratings of cutouts are shown in Table 2 below.

The available fault current, which a fused device is required to interrupt, is dependent upon many factors including:
1. Impedance at the fault.
2. Available fault current at the substation bus.
3. Size, type, and configuration of conductor supplying the fault.
4. Distance from the substation bus.
5. Point on voltage wave at the instant of the fault,
6. Fault duration.

Short circuit analysis is used for determining available fault current values.

Table 2

CUTOUT & DISCONNECT SELECTION & RATING TABLE

PRIMARY CIRCUIT VOLTAGE	STANDARD ITEM #	DESCRIPTION	RATINGS			
			CONTINUOUS CURRENT AMPS	INTERRUPTING RMS AMPS		DISCON. AMPS
				SYM	ASSYM	EXPERIENCE BASED
5kV CIRCUITS ONLY	C41B1	H.D. enclosed cutout – fused	50	4000	5000	15
	C41D1	EHD enclosed cutout – fused	100	8000	10000	20
	C41D2	Enclosed cutout w/ solid blade	200	------	------	20
	D1C	Enclosed disconnect switch	600	------	------	35
0-15kV CIRCUITS	C43S10	Open type cutout w/ 100A fuse tube	100	7500	10000	------
	C43S20	Open type cutout w/ 200A fuse tube	200	8600	12000	------
	C43S30	Open type cutout w/ 300A solid blade	300	------	12000M	------
	C47A	EHD open type cutout	200	12500*	20000	------
	D5D	Open disconnect switch	600	------	------	------
25&35kV CIRCUITS	C43S41	Open type cutout w/ 100A fuse tube	100	5100	8000	------

*** - Based on X/R ratio of 20** **M – Momentary Rating**

Supersedes 1/06 Issue – Table 2 C43S30 Description Change

12.4.20 Partial Range Current Limiting Fuses (CLFs)

In areas of high fault currents, an energy limiting device may be required to limit let-through short circuit current to a level that will minimize disruptive failures to transformers and other distribution equipment. High fault currents can exceed the interrupting capabilities of standard overhead protective devices (cutout fuse link or CSP internal fuse).

The add-on partial limiting CLFs (F7A), when properly matched and used in series with overhead protective devices (cutout fuse links or CSP internal fuses), will operate only at the higher fault currents ensuring a successful interruption (up to 50,000 A symmetrical).

CLFs will activate within the first 1/2 cycle during high current faults, and they will limit the overcurrent let-through to allow fuse links or internal fuses to operate concurrently.

The cutout fuse link will operate normally upon low current faults and current-limited faults. The size of the fuse link cannot be larger than the rating of the CLF, which requires proper coordination.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

The CLF may become weakened by the lower magnitude faults that normally cause operation of standard fuse links. Replacing the current limiting device in conjunction with the transformer protective link may prevent a later outage that would be caused when a weakened CLF completes its internal meltdown under normal load.

CLFs shall be installed on 15, 25, and 35 kV circuits where the calculated symmetrical fault current warrants such installations.

12.4.30 Reclosers

Reclosers shall be selected so that the calculated symmetrical fault current will not exceed the nameplate interrupting rating of the recloser. Vacuum reclosers with increase fault current capabilities can be purchased for particular installations.

12.5 SELECTION GUIDE

Cutouts, CLFs, and disconnecting devices shall be selected as follows:

12.5.10 Line and Riser Cutouts

A. On all Feeders

Open-type cutouts (C43S) with loadbuster hooks shall be used as line and riser fuses where the calculated symmetrical fault current is less than 7500 A, and where it is anticipated to remain less than 7500 A for at least 5 years. For high fault current line installations, see Section 12.5.10.B.

B. In High Fault Current Areas (Above 7500 A)

Heavy-duty power-fuse cutouts (C47) shall be used on all circuits where the calculated symmetrical fault current is 7500 to 12,500 A, and where fusing above 40 A (e.g. line fuses) may be needed. On circuits where calculated symmetrical fault current exceeds 7500 A, but fusing requirements will not exceed 40 A (e.g. transformers), a standard open-type cutout (C43S) shall be used in series with a coordinated CLF (F7A).

At junction pole locations where sectionalizing is necessary, line fuses can be installed on the first pole in or at the junction pole depending upon existing clearances and construction involved.

12.5.20 Overhead Transformer Cutouts

A. Conventional Transformers

Cutouts for overhead transformers should be selected in accordance with Table 2 on Page 12-3. Transformer cutouts can be located at the tap pole for fuse coordination or bucket accessibility purposes provided they feed a single transformer.

B. Conventional Transformers in High Fault Current Areas (Above 7500 A)

New installations and conversions involving transformers thru 167 kVA on feeders where calculated symmetrical fault current exceeds 7500 A shall be equipped with a cutout (C43S) mounted in series with a coordinated CLF (F7A). Reclosers or special fuses may be required for very large banks.

C. CSP Transformers in High Fault Current Areas (Above 3500 A)
All existing installations or conversions involving CSP transformers on 15 kV feeders where calculated symmetrical fault current exceeds 3500 A shall be equipped with CLFs.

Supersedes 1/06 Issue – Removed Voltage Designations Under 12.5.10, 12.5.20. Added Cutouts At Tap Pole For Single Transformers 12.5.20A

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/11 Issue – changed F in 12-5.50 and added Storm Hardening criteria to 12.5.50

12.5.30 Overhead Capacitor Cutouts

A. Capacitors

Cutouts for overhead capacitors should be selected in accordance with Table 2 on Page 12-3.

B. 100 kVAR Units and Above in High Fault Current Areas (Above 5000 A)

New installations on feeders where calculated symmetrical fault current exceeds 5000 A shall be equipped with a cutout (C43S) mounted in series with a coordinated CLF (F7A).

C. 50 kVAR Units and Below in High Fault Current Areas (Above 4000 A)

New installations on feeders where calculated symmetrical fault current exceeds 4000 A shall be equipped with a cutout (C43S) mounted in series with a coordinated CLF (F7A).

12.5.40 Line Switches - Single Blade

Open-type cutouts with a solid blade (C43S) are recommended for 5 kV circuits. Open-type cutouts or disconnect switches (C43S or D5D) depending upon load characteristics with loadbuster hooks shall be used on 15 kV circuits or 5 kV circuits that will be converted in the near future. In-line disconnect switches as shown on Page 12-138, are recommended where clearances will not allow switch installation on crossarms.

In order to provide superior customer service, avoid the single-phasing of loads, and minimize the possibility of ferroresonance when energizing unloaded transformer banks, individually operated, single phase line switches should not be used on three phase lines.

12.5.50 Loadbreak Switches - Group Operated

In order to provide superior customer service, eliminate the effects of ferroresonance, improve upon interruption duration indexes and simplify operating requirements on critical feeder sections, the use of group operated loadbreak switch devices is recommended on three phase lines.

Generally, the appropriate use of three phase reclosers at major feeder bifurcation points and beyond critical loads should adequately segment the feeder load into reasonable load groups, 2.5MVA or less. Group operated loadbreak switch devices should be used in the following circumstances:

A. Normally open tie points between feeders fed from two sources.
B. Long three phase underground and/or delta circuits.
C. Critical load (e.g. hospitals, prisons, shopping centers, ect.) that can be fed from two alternative sources with normally open ties.
D. Key tie points that are frequently utilized (two or more times a year).
E. First switch away from substation riser pole.
F. On the delta side of a floating wye-delta step-down bank.

Operating mechanism shall be locked in the open or closed position.

All new Loadbreak Switch installations are to be installed on a Class H1 pole with a Fiberglass double deadended crossarm or adjacent poles must be upgraded to meet the Requirements of Section 4 – Storm Hardening. Refer to Standards 12-141 to 12-145.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

12.5.60 Regulator By-pass Switch

A non-loadbreak, sequenced, make-before-break switch, designed to by-pass and safely disconnect a regulator from the line once the regulator is in the neutral position. See Section 15 for construction details.

12.5.70 Line Breakers

A. Three Phase Reclosers

Line reclosers enhance safety, improve customer reliability, and offer load side fault protection. Their general function is to sense and interrupt fault current, re-energize the line if the fault is of a temporary nature, and sectionalize non self-clearing faulted sections of distribution circuits. They may also be installed in loop sectionalizing applications or be supervisory controlled to improve distribution system reliability.

The SEL-651R control is specified for use with the G&W Viper-S recloser head. There is one SEL-651R control that can be applied to: radial installations; sectionalizing and tie reclosers in loop scheme configurations; and automatic source transfer applications. Separate controls are no longer needed for different system applications. Recloser control cabinets shall include proper identification including documentation on the inside door and appropriate labeling on the outside door.

All new 3 Phase Reclosers are to be installed on a Class H1 pole or adjacent poles upgraded to H1 poles with fiberglass double deadends to meet the requirements of Section 4 – Storm Hardening

1. Radial Recloser Applications

Radial reclosers operate as overcurrent protective devices. Radial applications require a 120 V supply from the source side for control and closing functions. In addition, the control can also accommodate a 120 V supply from the load side for AC transfer capability. The load side supply shall be connected when practical or as required (e.g. back-feeds, reliability). The 120 V supplies shall be connected to the X1 leg to assure correct 3 phase power analog values.

General 15kV and 35kV class recloser packages are furnished by the manufacturer as pre-wired, site ready units. These recloser packages require Company supplied transformation to meet the recloser and control power requirements. If Company owned secondary exists on a structure where a radial recloser is to be installed, the existing secondary may be used to meet the power requirements. If a possibility of backfeed exists, control requires both source and load side single phase secondary supplies. Therefore, the secondary crib must be split at the recloser structure. Both source and load side secondary supplies can be fed from any phase; however, phasing must be noted and accounted for in the control settings. It is not necessary for these 120 V secondary supplies to be in phase due to the break-before-make nature of the AC transfer switch.

Voltage specific recloser packages are available for 12.47 kV, 13.2 kV and 13.8 kV applications. These packages are furnished by the manufacturer as pre-wired, site ready units and include two frame mounted potential transformers to meet the recloser and control power requirements. As such, voltage specific recloser packages do not require additional Company supplied transformation.

Figure 1 shows a typical application for radial recloser controls.

Supersedes 7/14 Issue – Updated Titles to reflect Three Phase Reclosers

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

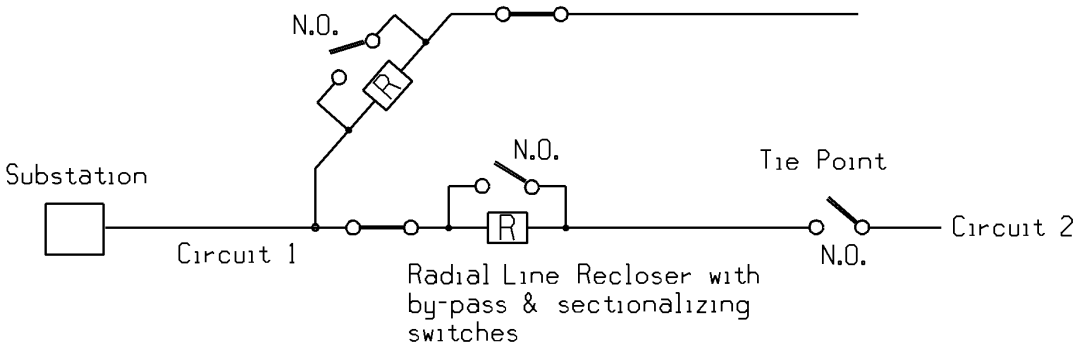


Figure 1 – Radial Application

2. Loop Scheme Recloser Applications

Loop scheme reclosers protect against overcurrent and automatically isolate the faulted section of a feeder, minimizing the outage duration for customers not directly affected. Reconfiguration is done based on loss of voltage detection, and it does not require any type of remote communications to function. These applications automatically isolate a faulted section of a feeder and restore power to the unaffected sections of the feeder, normally within one minute. Since most faults are transient in nature, loop sectionalizing applications must be programmed to only function when the substation breakers or line reclosers trip to lockout indicating a permanent fault has occurred.

The SEL-651R control requires a 3 phase 120 V supply for the control and closing functions on both sides of the tie recloser and on the source side of the sectionalizing recloser. In addition, the sectionalizing recloser requires 120 V supply on the load side.

General 15kV and 35kV class recloser packages are furnished by the manufacturer as pre-wired, site ready units. Loop scheme sectionalizing recloser applications require dedicated Company supplied three phase, source side transformation for both voltage sensing and control power. In addition, the sectionalizing recloser requires a single phase 120 V supply on the load side. This load side secondary supply can be fed from any phase; however, phasing must be noted and accounted for in the control settings. Loop scheme tie recloser applications require dedicated Company supplied three phase transformation on both the Source 1 (“line”) and Source 2 (“load”) sides of the recloser.

Voltage specific recloser packages are available for 12.47 kV, 13.2 kV and 13.8 kV applications. These packages are furnished by the manufacturer as pre-wired, site ready units and include two frame mounted potential transformers to meet the recloser and control power requirements, as well as three phase integrated voltage sensing on the Source 1 (“line”), horizontal bushings. As such, these voltage specific recloser packages do not require additional Company supplied transformation for loop scheme sectionalizing applications. However, a tie recloser application requires additional Company supplied three phase transformation on the Source 2 (”load”) side to accommodate voltage sensing capability on both sides of the device.

Figure 2 shows a typical application for loop recloser controls.

Copyright 2016 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.
Doc. # ST. 12.00.002

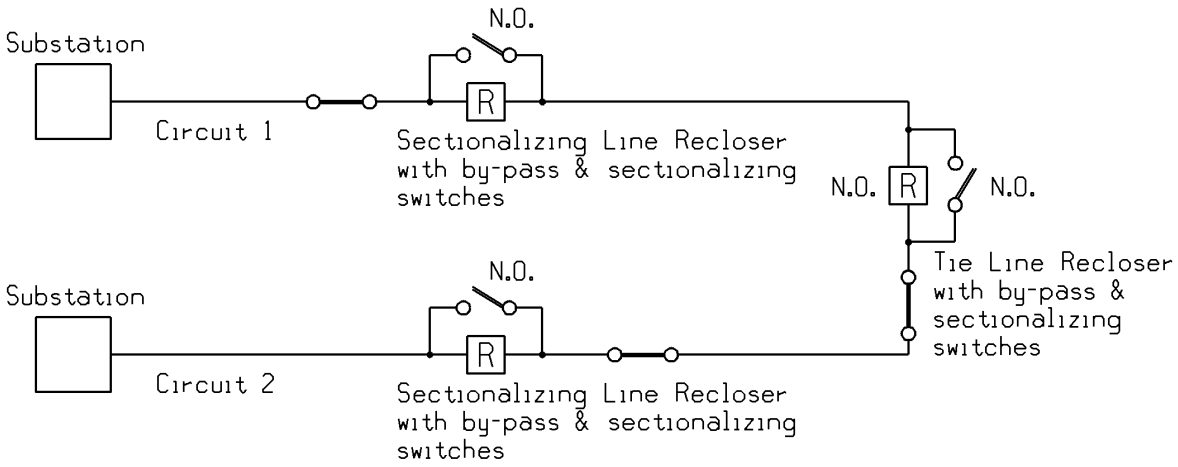


Figure 2 – Loop Application

Note: Alternate controls in-service may differ from current standard. Some include Cooper DC Nova, Cooper 3A, Cooper 4C, Cooper F5, Cooper F6, Joslyn Faultmaster, and Schweitzer 351R. The operation of all these alternatives achieves the same result.

3. Recloser Junction Box

The junction box is supplied pre-wired and includes Source 1 and Source 2 120 V input cables as well as a 19-position AC supply cable and 14-position control cable for bringing the signals to the control cabinet and recloser head. All power and control cables are provided and shall be connected as shown in the drawings. The junction box wiring diagrams indicate connections for radial, sectionalizing, and tie recloser applications, which require 120 V supply for control and closing. Radial applications that utilize single phase 120 V for control and closing, shall have 2-conductor Source 1 and Source 2 secondary supply cables where the black (120 V) and the white (neutral) wires shall be connected to the 120 V supply or supplies. General loop scheme applications shall have 4-conductor Source 1 and Source 2 secondary supply cables and may not require that all four conductors be connected on the Source 2 side (e.g., sectionalizing applications). Therefore, the red conductor should be connected and the unused black and orange conductors taped back at the supply cable breakout coming from the junction box.

B. Sectionalizers

Use of sectionalizers on the Company distribution system is not recommended. They shall be restricted to those few locations where coordination of a recloser cannot be obtained.

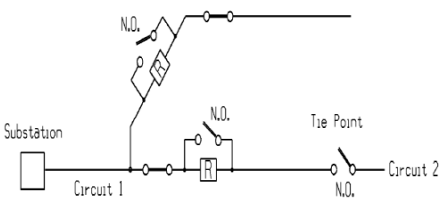
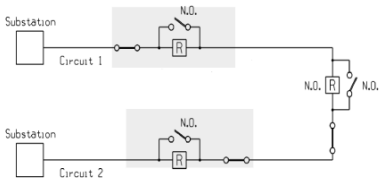
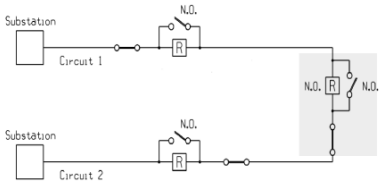
Sectionalizers are designed to isolate permanent faults involving primary circuits while allowing an upstream device to clear transient faults. The sectionalizer detects loss of line voltage and will either open or close, as required, after a programmed outage interval.

Supersedes 1/09 Issue – Edited ' Recloser Junction Box' Section to Incorporate New 800A G&W Recloser Junction Box

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/15 Issue – Corrected typos in three locations.

G&W Viper Recloser Application Table

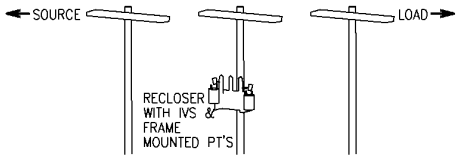
Application	Type	Requirements	Std Item
Radial 	General Recloser Package	120V 1P supply from the **line** side for control and closing functions. Optional: **load** side 120V 1P supply for back-feeds and reliability.	R50AA R50FF R50FS
	Voltage Specific Package	12.47/13.2/13.8kV have 2 frame mtd PT's- requires no Company supplied transformation.	R50A1, R50A2, R50A3
Loop Scheme Sectionalizing 	General Recloser Package	Requires dedicated Company supplied 3 phase **line** side transformation for voltage sensing and control power. Requires Company supplied 120 volt 1P supply on the **load** side.	R50EE R50GG R50GS
	Voltage Specific Package	12.47/13.2/13.8kV have 2 frame mtd PT's and 3 phase Integrated Voltage sensing on the **Line** side. No Company supplied transformation required.	R50E1, R50E2, R50E3
Loop Scheme Tie 	General Recloser Package	Requires dedicated Company supplied 3 phase **line** side and **load** side transformation for voltage sensing and control power.	R50EE R50GG R50GS
	Voltage Specific Package	12.47/13.2/13.8kV have 2 frame mtd PT's and 3 phase Integrated Voltage sensing on the on the **line** side. Company supplied 3P transformation on the **load** side is required. Requires an additional 15' - 4 conductor cable (R52D or R52C).	R50E1, R50E2, R50E3
Sub T Sectionalizer	35kV Recloser Package	35kV with 3 phase Integrated Voltage sensing on the line and load side. Requires Company supplied 120 volt 1P supply on the line and load side for the control.	R50HA

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

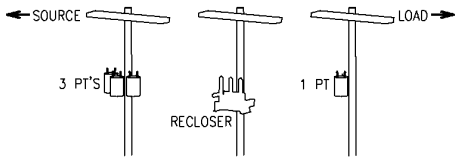
G&W VIPER RECLOSER APPLICATION GUIDE

NGRID SYSTEM VOLTAGES	OLD STD ITEMS	CT RATIO	PACKAGE	MECHANISM STD ID	CT RATIO	PACKAGE	MECHANISM STD ID	RADIAL MIDLINE LOOP SCHEME PHYSICAL	RADIAL MIDLINE LOOP SCHEME WIRING	PCC PHYSICAL	PCC WIRING	PCC ONE LINE NY	PCC ONE LINE NE
3,740GRDY/2160 4,160GRDY/2,400	R50AA / R50EE R50AA / R50EE	1000/500:1	D	R50S15B	–	–	–	12-338	12-339	12-338A	12-339	12-11	12-11A
12,470GRDY/7,200 13,200GRDY/7,6DD 13,800GRDY/7,960	R50A1 / R50E1 R50A2 / R50E2 R50A3 / R50E3	1000/500:1	C	R50S15C	400/200:1	F	R50S15C1	12-338	12-339	12-338A	12-339	12-11	12-11A
24,940GRDY/14,400 34,500GRDY/19,900 23,000Y 34,500Y	R50FF / R50GG / R50HA R50FF / R50GG / R50HA R50FF / R50GG / R50HA R50FF / R50GG / R50HA	1000/500:1	E	R50S38A	400/200:1	H	R50S38A1	12-950	12-951	12-950A	12-951	12-12	12-12A
2,400Δ 8,320GRDY/4,800 4,800Δ 7,200Δ 11,000Δ 12,000Δ 13,800Δ	R50AA / R50EE R50AA / R50EE R50AA / R50EE R50AA / R50EE R50AA / R50EE R50AA / R50EE R50AA / R50EE	1000/500:1	A	R50S15A	400/200:1	G	R50S15A1	12-335	12-336	12-335A	12-336	12-10	12-10A
23,000Δ 34,500Δ	R50FS / R50GS R50FS / R50GS	1000/500:1	B	R50S38B	400/200:1	J	R50S38B1	12-950	12-952	12-950A	12-952	12-13	12-13A

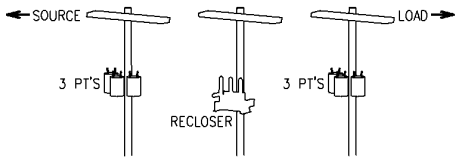
PACKAGE C D F
GENERAL ARRANGEMENT FOR 3ø RECLOSER INSTALLATION
DETAILS 15KV WITH IVS AND FRAME MOUNTED PT'S



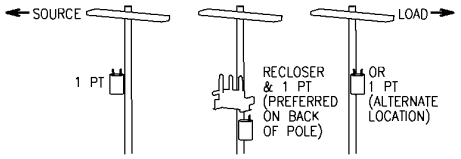
PACKAGE A AND G
RADIAL/PCC/LOOP SCHEME SECTIONALIZER
ARRANGEMENT FOR 3ø RECLOSER INSTALLATION
DETAILS 15kV WITH EXTERNAL MOUNTED PT'S



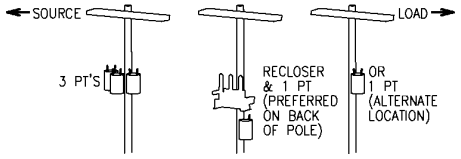
PACKAGE A AND G
MIDLINE/LOOP SCHEME TIE ARRANGEMENT
FOR 3ø RECLOSER INSTALLATION DETAILS
15kV WITH EXTERNAL MOUNTED PT'S



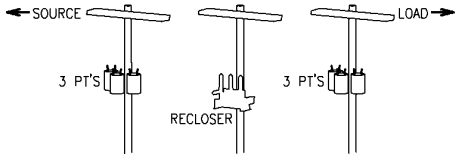
PACKAGE E AND H
GENERAL ARRANGEMENT FOR 3ø
RECLOSER INSTALLATION DETAILS 38kV
WITH IVS AND EXTERNAL MOUNTED PT'S



PACKAGE B AND J
RADIAL/PCC/LOOP SCHEME SECTIONALIZER
ARRANGEMENT FOR 3ø RECLOSER INSTALLATION
DETAILS 38kV WITH EXTERNAL MOUNTED PT'S



PACKAGE B AND J
MIDLINE/LOOP SCHEME TIE ARRANGEMENT
FOR 3ø RECLOSER INSTALLATION DETAILS
38kV WITH EXTERNAL MOUNTED PT'S



Designer	Drawing	Date
MPR	cad1209A	7/15/19

New page.

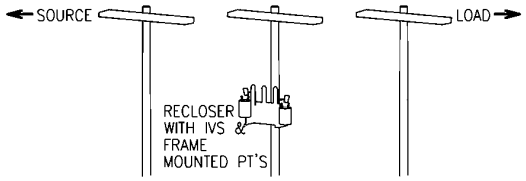
Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

COOPER/EATON NOVA NX-T RECLOSER APPLICATION GUIDE

NGRID SYSTEM VOLTAGES	CT RATIO	PACKAGE	MECHANISM STD ID	PHYSICAL	WIRING
3,740GRDY/2160 4,160GRDY/2,400	1000/500:1	P	R50SE15B	12-350	12-351
12,470GRDY/7,200 13,200GRDY/7,600 13,800GRDY/7,960	1000/500:1	Q	R50SE15C	12-350	12-351
24,940GRDY/14,400 34,500GRDY/19,900 23,000Y 34,500Y	1000/500:1	R	R50SE38A	12-960	12-961

PACKAGE P Q

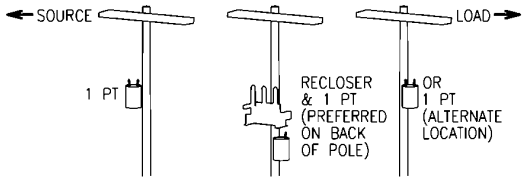
GENERAL ARRANGEMENT FOR 3ø RECLOSER INSTALLATION DETAILS 15KV WITH IVS AND FRAME MOUNTED PT'S



7/20 - New page

PACKAGE R

GENERAL ARRANGEMENT FOR 3ø RECLOSER INSTALLATION DETAILS 38kV WITH IVS AND EXTERNAL MOUNTED PT'S

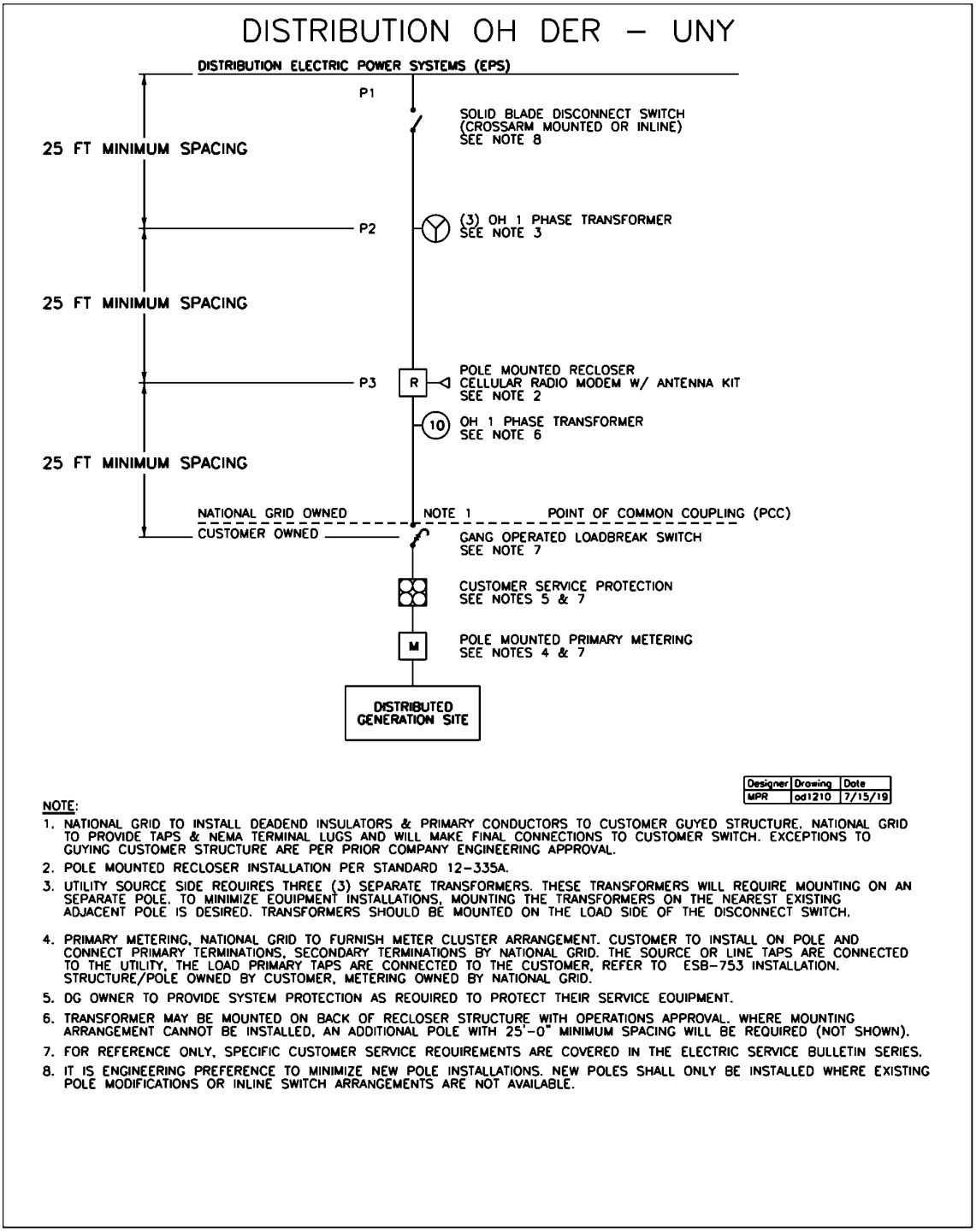


Designer	Drawing	Date
MPR	cad12098	4/17/20

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

C. Distributed Generation Installations

TYPICAL LARGE DISTRIBUTED GENERATION INTERCONNECTION DESIGNS



NOTE:

1. NATIONAL GRID TO INSTALL DEADEND INSULATORS & PRIMARY CONDUCTORS TO CUSTOMER GUYED STRUCTURE. NATIONAL GRID TO PROVIDE TAPS & NEMA TERMINAL LUGS AND WILL MAKE FINAL CONNECTIONS TO CUSTOMER SWITCH. EXCEPTIONS TO GUYING CUSTOMER STRUCTURE ARE PER PRIOR COMPANY ENGINEERING APPROVAL.
2. POLE MOUNTED RECLOSER INSTALLATION PER STANDARD 12-335A.
3. UTILITY SOURCE SIDE REQUIRES THREE (3) SEPARATE TRANSFORMERS. THESE TRANSFORMERS WILL REQUIRE MOUNTING ON AN SEPARATE POLE. TO MINIMIZE EQUIPMENT INSTALLATIONS, MOUNTING THE TRANSFORMERS ON THE NEAREST EXISTING ADJACENT POLE IS DESIRED. TRANSFORMERS SHOULD BE MOUNTED ON THE LOAD SIDE OF THE DISCONNECT SWITCH.
4. PRIMARY METERING, NATIONAL GRID TO FURNISH METER CLUSTER ARRANGEMENT. CUSTOMER TO INSTALL ON POLE AND CONNECT PRIMARY TERMINATIONS, SECONDARY TERMINATIONS BY NATIONAL GRID. THE SOURCE OR LINE TAPS ARE CONNECTED TO THE UTILITY. THE LOAD PRIMARY TAPS ARE CONNECTED TO THE CUSTOMER, REFER TO ESB-753 INSTALLATION. STRUCTURE/POLE OWNED BY CUSTOMER, METERING OWNED BY NATIONAL GRID.
5. DG OWNER TO PROVIDE SYSTEM PROTECTION AS REQUIRED TO PROTECT THEIR SERVICE EQUIPMENT.
6. TRANSFORMER MAY BE MOUNTED ON BACK OF RECLOSER STRUCTURE WITH OPERATIONS APPROVAL. WHERE MOUNTING ARRANGEMENT CANNOT BE INSTALLED, AN ADDITIONAL POLE WITH 25'-0" MINIMUM SPACING WILL BE REQUIRED (NOT SHOWN).
7. FOR REFERENCE ONLY, SPECIFIC CUSTOMER SERVICE REQUIREMENTS ARE COVERED IN THE ELECTRIC SERVICE BULLETIN SERIES.
8. IT IS ENGINEERING PREFERENCE TO MINIMIZE NEW POLE INSTALLATIONS. NEW POLES SHALL ONLY BE INSTALLED WHERE EXISTING POLE MODIFICATIONS OR INLINE SWITCH ARRANGEMENTS ARE NOT AVAILABLE.

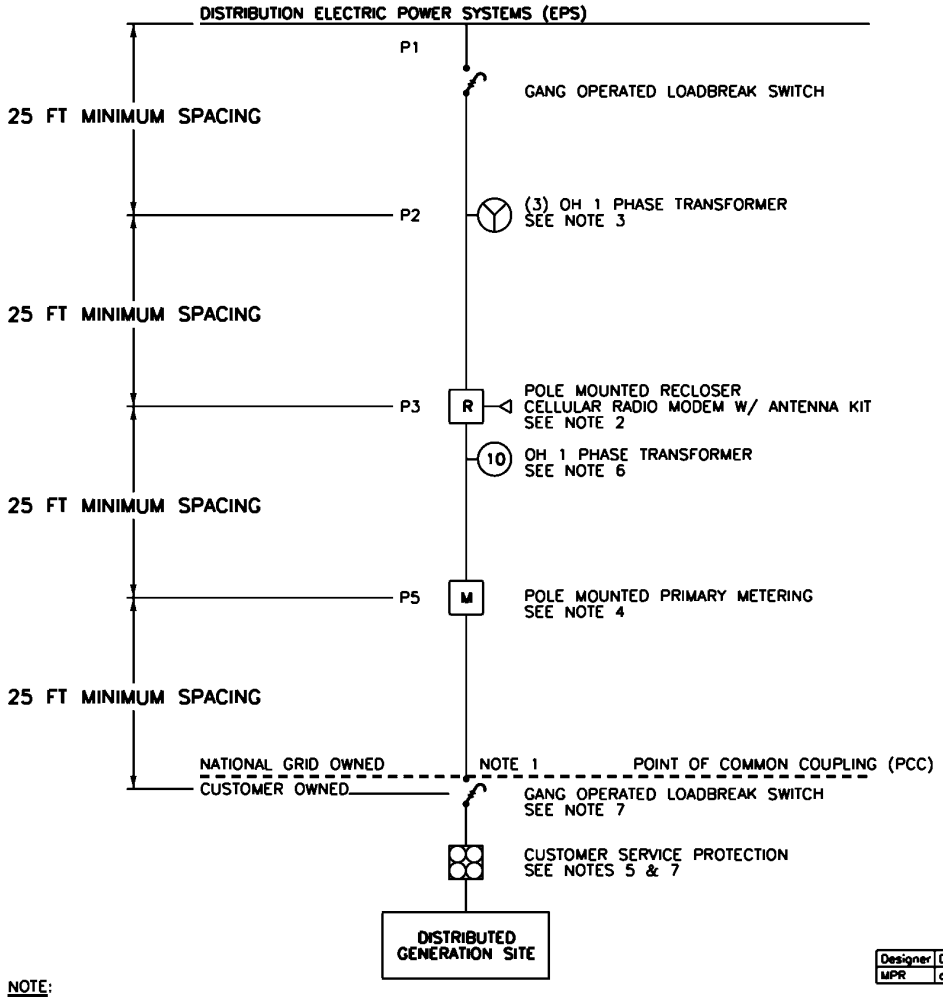
Supersedes 7/18 Issue-Revised drawing description and title.

DISTRIBUTION OH DER – UNY WITH EXTERNAL MOUNTED PTs			
ISSUE	**PAGE NUMBER**		
7/19	**12-10**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/18 Issue-Revised drawing description and title.

DISTRIBUTION OH DER – NE



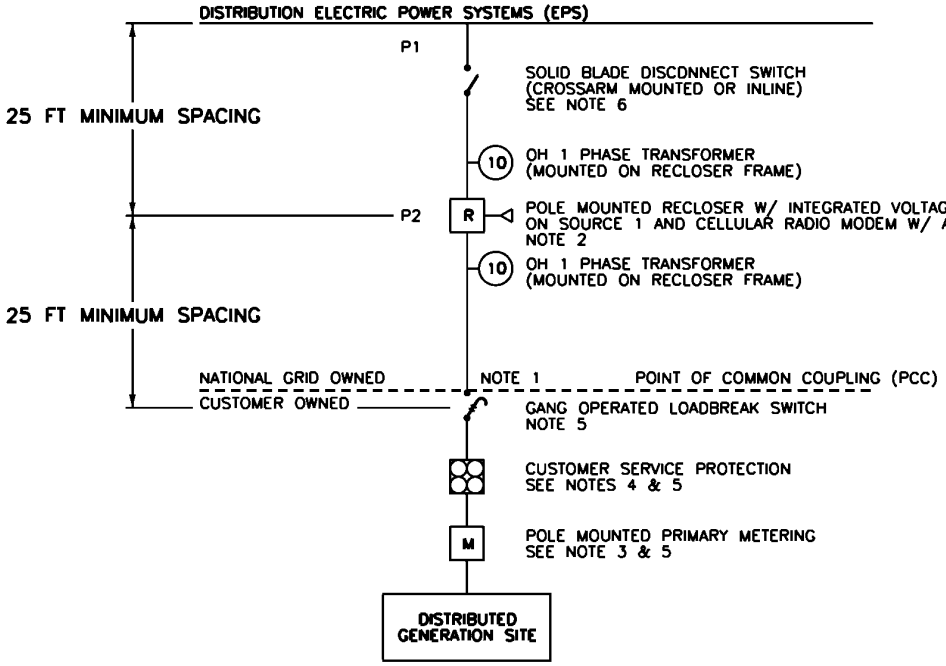
Designer	Drawing	Date
MPR	od1210A	7/15/19

NOTE:

1. NATIONAL GRID TO INSTALL DEADEND INSULATORS & PRIMARY CONDUCTORS TO CUSTOMER GUYED STRUCTURE. NATIONAL GRID TO PROVIDE TAPS & NEMA TERMINAL LUGS AND WILL MAKE FINAL CONNECTIONS TO CUSTOMER SWITCH. EXCEPTIONS TO GUYING CUSTOMER STRUCTURE ARE PER PRIOR COMPANY ENGINEERING APPROVAL.
2. POLE MOUNTED RECLOSER INSTALLATION PER STANDARD 12-335A.
3. UTILITY SOURCE SIDE REQUIRES THREE (3) SEPARATE TRANSFORMERS. THESE TRANSFORMERS WILL REQUIRE MOUNTING ON AN SEPARATE POLE. TO MINIMIZE EQUIPMENT INSTALLATIONS, MOUNTING THE TRANSFORMERS ON THE NEAREST EXISTING ADJACENT POLE IS DESIRED. TRANSFORMERS SHOULD BE MOUNTED ON THE LOAD SIDE OF THE GANG OPERATED SWITCH.
4. PRIMARY METERING, NATIONAL GRID TO FURNISH AND INSTALL METER CLUSTER ARRANGEMENT. THE CUSTOMER MUST PROVIDE SUFFICIENT CONDUCTOR TO ALLOW THE COMPANY TO MAKE FINAL CONNECTIONS AT THE METER POLE. THE COMPANY WILL PROVIDE FINAL CONNECTION OF THE CUSTOMER CONDUCTORS TO THE COMPANY METER. PRIMARY METERING, STRUCTURE/ POLE OWNED BY NATIONAL GRID.
5. DG OWNER TO PROVIDE SYSTEM PROTECTION AS REQUIRED TO PROTECT THEIR SERVICE EQUIPMENT.
6. TRANSFORMER MAY BE MOUNTED ON BACK OF RECLOSER STRUCTURE WITH OPERATIONS APPROVAL. WHERE MOUNTING ARRANGEMENT CANNOT BE INSTALLED, AN ADDITIONAL POLE WITH 25'-0" MINIMUM SPACING WILL BE REQUIRED (NOT SHOWN).
7. FOR REFERENCE ONLY, SPECIFIC CUSTOMER SERVICE REQUIREMENTS ARE COVERED IN THE ELECTRIC SERVICE BULLETIN SERIES.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

DISTRIBUTION OH DER – UNY



Designer	Drawing	Date
MPR	od1211	7/15/19

NOTE:

1. NATIONAL GRID TO INSTALL DEADEND INSULATORS & PRIMARY CONDUCTORS TO CUSTOMER GUYED STRUCTURE. NATIONAL GRID TO PROVIDE TAPS & NEMA TERMINAL LUGS AND WILL MAKE FINAL CONNECTIONS TO CUSTOMER SWITCH. EXCEPTIONS TO GUYING CUSTOMER STRUCTURE ARE PER PRIOR COMPANY ENGINEERING APPROVAL.
2. POLE MOUNTED RECLOSER INSTALLATION PER STANDARD 12-338A.
3. PRIMARY METERING, NATIONAL GRID TO FURNISH METER CLUSTER ARRANGEMENT. CUSTOMER TO INSTALL ON POLE AND CONNECT PRIMARY TERMINATIONS, SECONDARY TERMINATIONS BY NATIONAL GRID. THE SOURCE OR LINE TAPS ARE CONNECTED TO THE UTILITY. THE LOAD PRIMARY TAPS ARE CONNECTED TO THE CUSTOMER, REFER TO ESB-753 INSTALLATION. STRUCTURE/POLE OWNED BY CUSTOMER, METERING OWNED BY NATIONAL GRID.
4. DG OWNER TO PROVIDE SYSTEM PROTECTION AS REQUIRED TO PROTECT THEIR SERVICE EQUIPMENT.
5. FOR REFERENCE ONLY, SPECIFIC CUSTOMER SERVICE REQUIREMENTS ARE COVERED IN THE ELECTRIC SERVICE BULLETIN SERIES.
6. IT IS ENGINEERING PREFERENCE TO MINIMIZE NEW POLE INSTALLATIONS. NEW POLES SHALL ONLY BE INSTALLED WHERE EXISTING POLE MODIFICATIONS OR INLINE SWITCH ARRANGEMENTS ARE NOT AVAILABLE.

DISTRIBUTION OH DER – UNY WITH IVS AND FRAME MOUNTED PTs

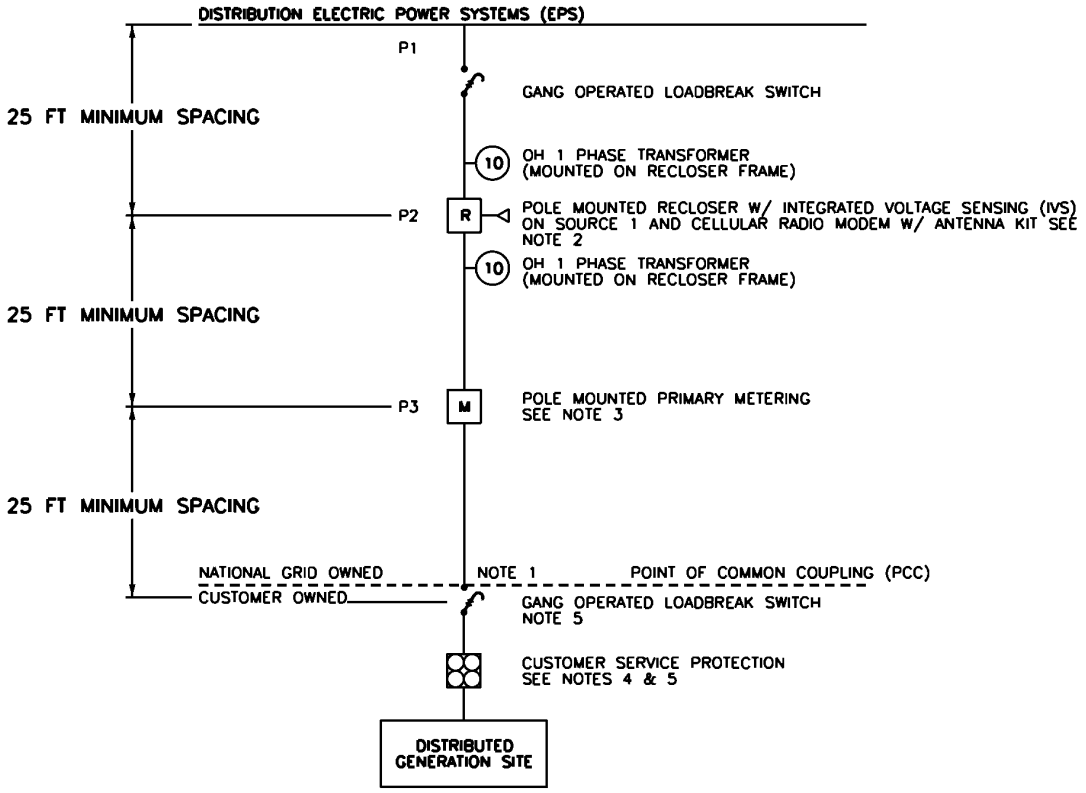
ISSUE	PAGE NUMBER		
7/19	12-11	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Supersedes 7/18 Issue-Revised drawing description and title.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/18 Issue-Revised drawing description and title.

DISTRIBUTION OH DER – NE



Designer	Drawing	Date
MPR	od1211A	7/15/19

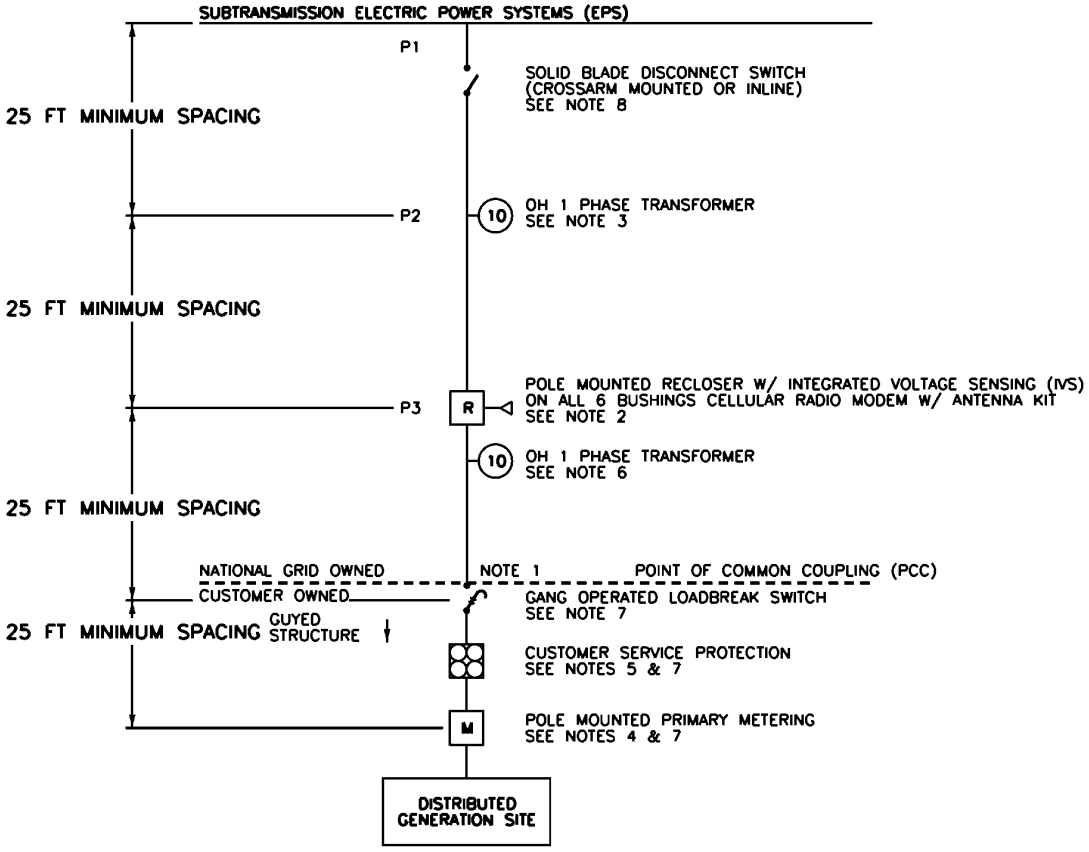
NOTE:

1. NATIONAL GRID TO INSTALL DEADEND INSULATORS & PRIMARY CONDUCTORS TO CUSTOMER GUYED STRUCTURE. NATIONAL GRID TO PROVIDE TAPS & NEMA TERMINAL LUGS AND WILL MAKE FINAL CONNECTIONS TO CUSTOMER SWITCH. EXCEPTIONS TO GUYING CUSTOMER STRUCTURE ARE PER PRIOR COMPANY ENGINEERING APPROVAL.
2. POLE MOUNTED RECLOSER INSTALLATION PER STANDARD 12-338A.
3. PRIMARY METERING, NATIONAL GRID TO FURNISH AND INSTALL METER CLUSTER ARRANGEMENT.
4. DG OWNER TO PROVIDE SYSTEM PROTECTION AS REQUIRED TO PROTECT THEIR SERVICE EQUIPMENT.
5. FOR REFERENCE ONLY, SPECIFIC CUSTOMER SERVICE REQUIREMENTS ARE COVERED IN THE ELECTRIC SERVICE BULLETIN SERIES.

DISTRIBUTION OH – NE WITH IVS AND FRAME MOUNTED PTs			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-11A	7/19

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SUBTRANSMISSION OH DER – UNY



Designer	Drawing	Date
MPR	cd1212	7/15/19

NOTE:

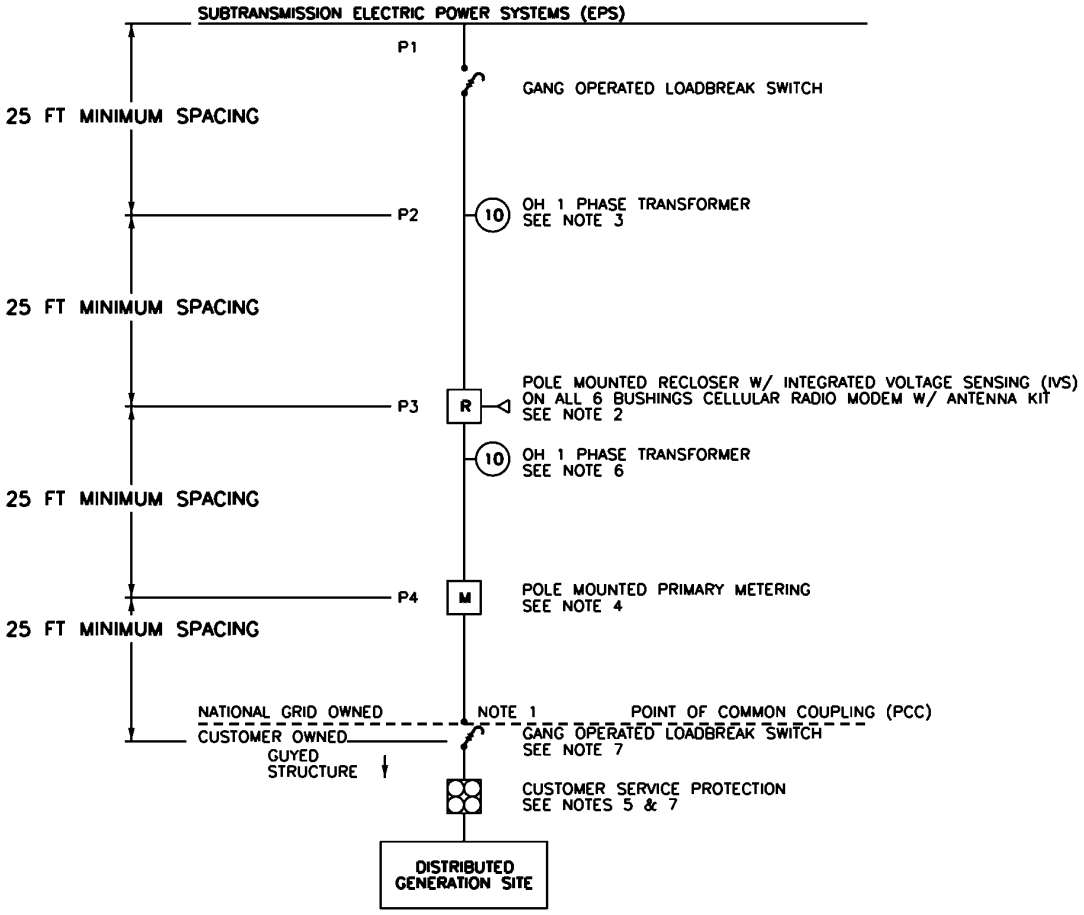
1. NATIONAL GRID TO INSTALL DEADEND INSULATORS & PRIMARY CONDUCTORS TO CUSTOMER GUYED STRUCTURE. NATIONAL GRID TO PROVIDE TAPS & NEMA TERMINAL LUGS AND MAKE FINAL CONNECTIONS TO CUSTOMER SWITCH. EXCEPTIONS TO GUYING CUSTOMER STRUCTURE ARE PER PRIOR COMPANY ENGINEERING APPROVAL.
2. POLE MOUNTED RECLOSER INSTALLATION PER STANDARD 12-950A.
3. UTILITY SOURCE SIDE REQUIRES ONE (1) EXTERNAL TRANSFORMER MOUNTed ON A SEPARATE POLE. TO MINIMIZE EQUIPMENT INSTALLATIONS, MOUNTING THE TRANSFORMER ON THE NEAREST EXISTING ADJACENT POLE IS DESIRED. TRANSFORMER SHOULD BE MOUNTED ON LOAD SIDE DISCONNECT SWITCH.
4. PRIMARY METERING, NATIONAL GRID TO FURNISH METER CLUSTER ARRANGEMENT. CUSTOMER TO INSTALL ON POLE AND CONNECT PRIMARY TERMINATIONS, SECONDARY TERMINATIONS BY NATIONAL GRID. THE SOURCE OR LINE TAPS ARE CONNECTED TO THE UTILITY, THE LOAD PRIMARY TAPS ARE CONNECTED TO THE CUSTOMER, REFER TO ESB-753 INSTALLATION. STRUCTURE/POLE OWNED BY CUSTOMER, METERING OWNED BY NATIONAL GRID.
5. DG OWNER TO PROVIDE SYSTEM PROTECTION AS REQUIRED TO PROTECT THEIR SERVICE EQUIPMENT.
6. IT IS ENGINEERING PREFERENCE TO MOUNT TRANSFORMER ON BACK OF RECLOSER STRUCTURE WITH OPERATIONS APPROVAL. WHERE MOUNTING ARRANGEMENT CANNOT BE INSTALLED, AN ADDITIONAL POLE WITH 25'-0" MINIMUM SPACING WILL BE REQUIRED (NOT SHOWN).
7. FOR REFERENCE ONLY, SPECIFIC CUSTOMER SERVICE REQUIREMENTS ARE COVERED IN THE ELECTRIC SERVICE BULLETIN SERIES.
8. IT IS ENGINEERING PREFERENCE TO MINIMIZE NEW POLE INSTALLATIONS. NEW POLES SHALL ONLY BE INSTALLED WHERE EXISTING POLE MODIFICATIONS OR INLINE SWITCH ARRANGEMENTS ARE NOT AVAILABLE.
9. MINIMUM POLE SPACING IS 25' ALONG A CENTERLINE WITH A 37.5' RIGHT OF WAY ON EACH SIDE.

Supersedes 7/18 Issue-Revised drawing description and title.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/18 Issue-Revised drawing description and title.

SUBTRANSMISSION OH DER – NE



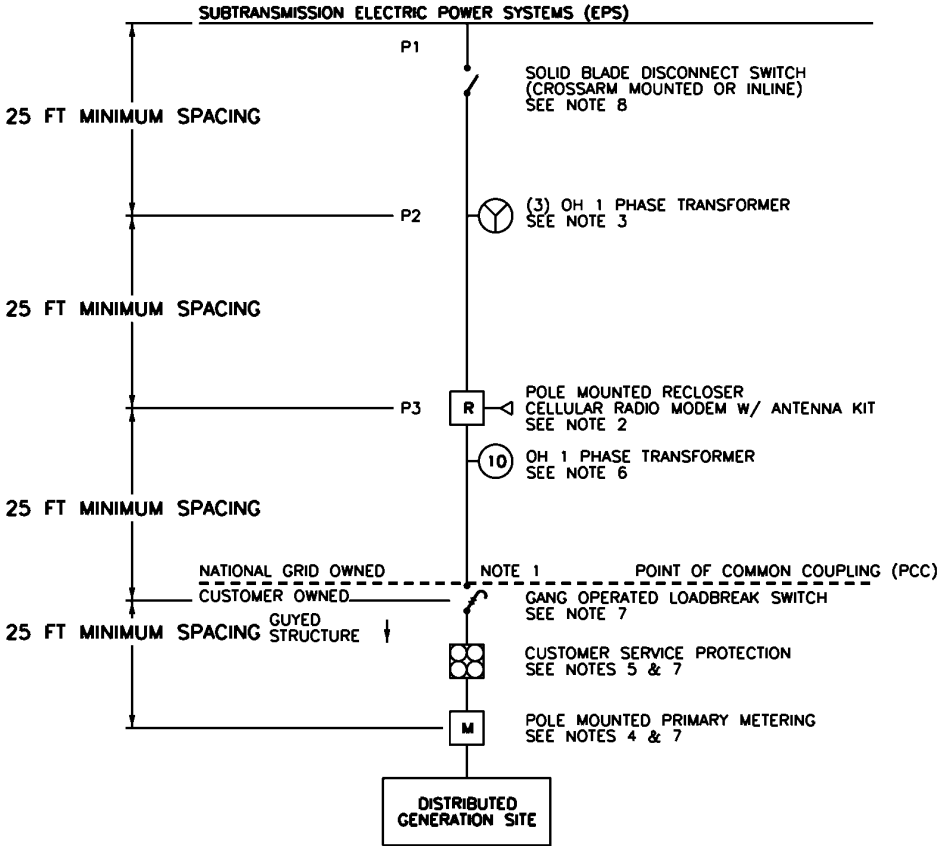
Designer	Drawing	Date
MPR	od1212A	7/15/19

NOTE:

1. NATIONAL GRID TO INSTALL DEADEND INSULATORS & PRIMARY CONDUCTORS TO CUSTOMER GUYED STRUCTURE. NATIONAL GRID TO PROVIDE TAPS & NEMA TERMINAL LUGS AND MAKE FINAL CONNECTIONS TO CUSTOMER SWITCH. EXCEPTIONS TO GUYING CUSTOMER STRUCTURE ARE PER PRIOR COMPANY ENGINEERING APPROVAL.
2. POLE MOUNTED RECLOSER INSTALLATION PER STANDARD 12-950A.
3. UTILITY SOURCE SIDE REQUIRES ONE (1) EXTERNAL TRANSFORMER (34500 GRD Y/19920=120/240). THE UTILITY SIDE TRANSFORMER WILL REQUIRE MOUNTING ON A SEPARATE POLE. TO MINIMIZE EQUIPMENT INSTALLATIONS, MOUNTING THE TRANSFORMER ON THE NEAREST EXISTING ADJACENT POLE IS DESIRED. IDEALLY THE TRANSFORMER WOULD BE MOUNTED AS TO BE WITHIN THE RECLOSER ZONE OF ISOLATION, ALTHOUGH THIS IS NOT NECESSARY AS THE TRANSFORMER CAN BE ISOLATED VIA FUSE HOLDER.
4. PRIMARY METERING, NATIONAL GRID TO FURNISH AND INSTALL METER CLUSTER ARRANGEMENT.
5. DG OWNER TO PROVIDE SYSTEM PROTECTION AS REQUIRED TO PROTECT THEIR SERVICE EQUIPMENT.
6. IT IS ENGINEERING PREFERENCE TO MOUNT TRANSFORMER ON BACK OF RECLOSER STRUCTURE WITH OPERATIONS APPROVAL. WHERE MOUNTING ARRANGEMENT CANNOT BE INSTALLED, AN ADDITIONAL POLE WITH 25'-0" MINIMUM SPACING WILL BE REQUIRED (NOT SHOWN).
7. FOR REFERENCE ONLY, SPECIFIC CUSTOMER SERVICE REQUIREMENTS ARE COVERED IN THE ELECTRIC SERVICE BULLETIN SERIES.
8. MINIMUM POLE SPACING IS 25' ALONG A CENTERLINE WITH A 37.5' RIGHT OF WAY ON EACH SIDE.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SUBTRANSMISSION OH DER – UNY



Designer	Drawing	Date
MPR	cd1213	7/15/19

NOTE:

1. NATIONAL GRID TO INSTALL DEADEND INSULATORS & PRIMARY CONDUCTORS TO CUSTOMER GUYED STRUCTURE. NATIONAL GRID TO PROVIDE TAPS & NEMA TERMINAL LUGS AND MAKE FINAL CONNECTIONS TO CUSTOMER SWITCH. EXCEPTIONS TO GUYING CUSTOMER STRUCTURE ARE PER PRIOR COMPANY ENGINEERING APPROVAL.
2. POLE MOUNTED RECLOSER INSTALLATION PER STANDARD 12-950A.
3. UTILITY SOURCE SIDE REQUIRES THREE (3) SEPARATE TRANSFORMERS. THESE TRANSFORMERS WILL REQUIRE MOUNTING ON AN SEPARATE POLE. TO MINIMIZE EQUIPMENT INSTALLATIONS, MOUNTING THE TRANSFORMERS ON THE NEAREST EXISTING ADJACENT POLE IS DESIRED. TRANSFORMERS SHOULD BE MOUNTED ON THE LOAD SIDE OF THE DISCONNECT SWITCH.
4. PRIMARY METERING, NATIONAL GRID TO FURNISH METER CLUSTER ARRANGEMENT. CUSTOMER TO INSTALL ON POLE AND CONNECT PRIMARY TERMINATIONS, SECONDARY TERMINATIONS BY NATIONAL GRID. THE SOURCE OR LINE TAPS ARE CONNECTED TO THE UTILITY, THE LOAD PRIMARY TAPS ARE CONNECTED TO THE CUSTOMER, REFER TO ESB-753 INSTALLATION. STRUCTURE/POLE OWNED BY CUSTOMER, METERING OWNED BY NATIONAL GRID.
5. DG OWNER TO PROVIDE SYSTEM PROTECTION AS REQUIRED TO PROTECT THEIR SERVICE EQUIPMENT.
6. IT IS ENGINEERING PREFERENCE TO MOUNT TRANSFORMER ON BACK OF RECLOSER STRUCTURE WITH OPERATIONS APPROVAL. WHERE MOUNTING ARRANGEMENT CANNOT BE INSTALLED, AN ADDITIONAL POLE WITH 25'-0" MINIMUM SPACING WILL BE REQUIRED (NOT SHOWN).
7. FOR REFERENCE ONLY, SPECIFIC CUSTOMER SERVICE REQUIREMENTS ARE COVERED IN THE ELECTRIC SERVICE BULLETIN SERIES.
8. IT IS ENGINEERING PREFERENCE TO MINIMIZE NEW POLE INSTALLATIONS. NEW POLES SHALL ONLY BE INSTALLED WHERE EXISTING POLE MODIFICATIONS OR INLINE SWITCH ARRANGEMENTS ARE NOT AVAILABLE.
9. MINIMUM POLE SPACING IS 25' ALONG A CENTERLINE WITH A 37.5' RIGHT OF WAY ON EACH SIDE.

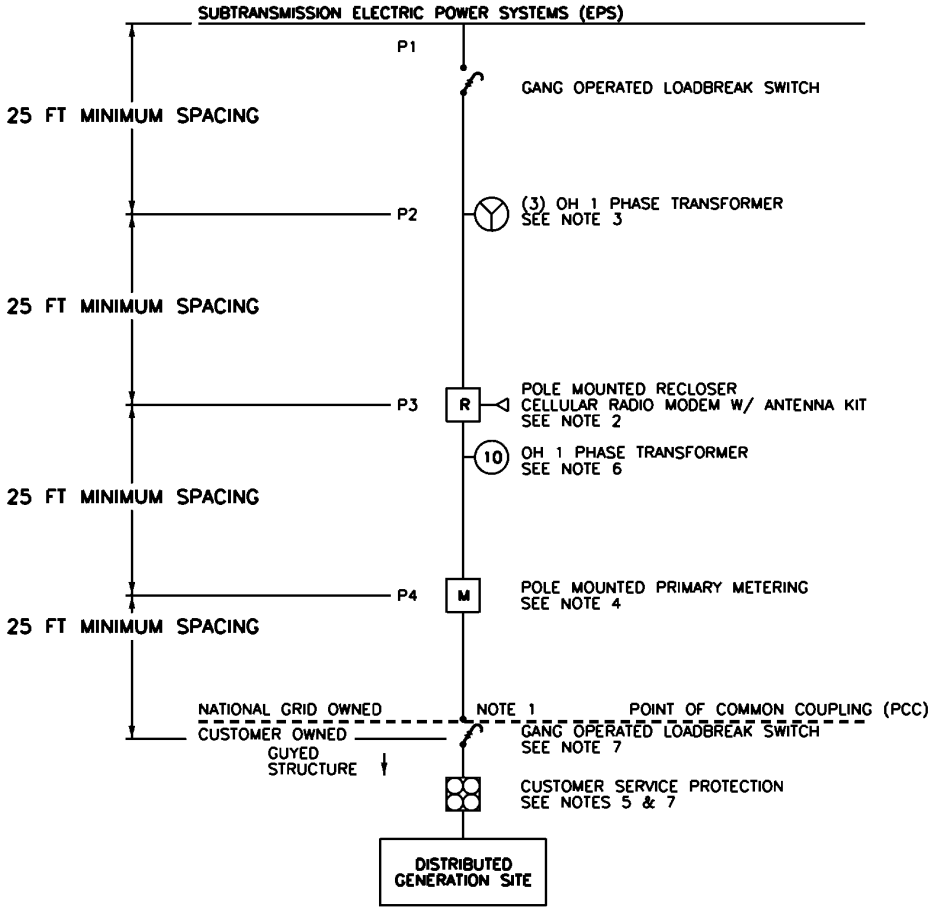
New drawing.

SUBTRANSMISSION OH DER – UNY WITH EXTERNAL MOUNTED PTs			
ISSUE	**PAGE NUMBER**		
7/19	**12-13**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

New drawing.

SUBTRANSMISSION OH DER – NE



Designer	Drawing	Date
MPR	cad1213A	6/3/19

NOTE:

1. NATIONAL GRID TO INSTALL DEADEND INSULATORS & PRIMARY CONDUCTORS TO CUSTOMER GUYED STRUCTURE. NATIONAL GRID TO PROVIDE TAPS & NEMA TERMINAL LUGS AND MAKE FINAL CONNECTIONS TO CUSTOMER SWITCH. EXCEPTIONS TO GUYING CUSTOMER STRUCTURE ARE PER PRIOR COMPANY ENGINEERING APPROVAL.
2. POLE MOUNTED RECLOSER INSTALLATION PER STANDARD 12-950A.
3. UTILITY SOURCE SIDE REQUIRES THREE (3) SEPARATE TRANSFORMERS. THESE TRANSFORMERS WILL REQUIRE MOUNTING ON AN SEPARATE POLE. TO MINIMIZE EQUIPMENT INSTALLATIONS, MOUNTING THE TRANSFORMERS ON THE NEAREST EXISTING ADJACENT POLE IS DESIRED. TRANSFORMERS SHOULD BE MOUNTED ON THE LOAD SIDE OF THE DISCONNECT SWITCH.
4. PRIMARY METERING, NATIONAL GRID TO FURNISH AND INSTALL METER CLUSTER ARRANGEMENT.
5. DG OWNER TO PROVIDE SYSTEM PROTECTION AS REQUIRED TO PROTECT THEIR SERVICE EQUIPMENT.
6. IT IS ENGINEERING PREFERENCE TO MOUNT TRANSFORMER ON BACK OF RECLOSER STRUCTURE WITH OPERATIONS APPROVAL. WHERE MOUNTING ARRANGEMENT CANNOT BE INSTALLED, AN ADDITIONAL POLE WITH 25'-0" MINIMUM SPACING WILL BE REQUIRED (NOT SHOWN).
7. FOR REFERENCE ONLY, SPECIFIC CUSTOMER SERVICE REQUIREMENTS ARE COVERED IN THE ELECTRIC SERVICE BULLETIN SERIES.
8. MINIMUM POLE SPACING IS 25' ALONG A CENTERLINE WITH A 37.5' RIGHT OF WAY ON EACH SIDE.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

D. Single Phase Radial Recloser

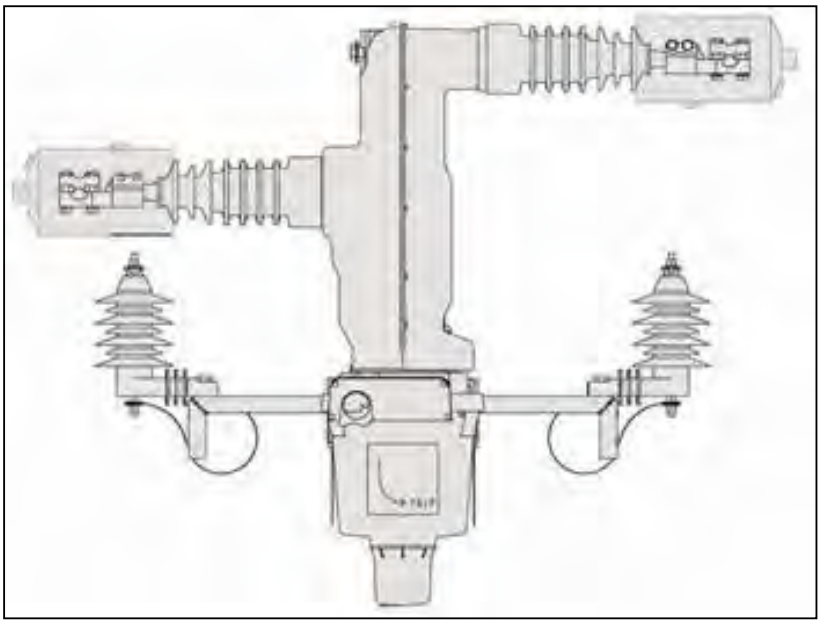
Single Phase Radial reclosers operate as overcurrent protective devices for locations where the Cutout Mounted Recloser is not an option such as high fault current areas or single phase loads over 100 amps.

The recloser is designed for automatic or manual operation providing overcurrent protection for up to15kV single phase systems, 110 kV BIL, 800A continuous current, and 12.5kA rms symmetrical interrupting.

The Single Phase Recloser requires a Schweitzer SEL-351RS Kestrel control mounted on the pole. The control requires a 120 V supply from the source side for control and closing functions.

Units are shipped Site-ready with all accessories including bracket, arresters and control with control and power wiring. A 200amp cutout shall be used as a bypass. Cutout body shall be stapled to the pole when not in bypass mode. A sectionalizing switch shall be installed on an adjacent source side pole or inline.

Z Configuration Single Phase Recloser



Repaging.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

E. Cutout-Mounted Recloser

The cutout mounted recloser is a self-powered, electronically controlled, single phase, vacuum fault interrupter mounted with the included factory shipped fuse cutout.The sole approved manufacturer requires the unit to be mounted in an MacLean Power Systems Type XS fuse cutout mounting (Poly type - factory shipped with the unit)

Application:

- 15kV and below circuits (Single phase or Three Phase fuse taps)
- Basic Insulation Level (BIL) of 110kV.
- The maximum continuous current carrying capability is 100 amperes.
- The maximum continuous current carrying capability for 140T unit is 200 amperes.
- Symmetrical Interrupting rating is 6300 amperes.
- To be installed on single crossarms or a C35 bracket.
- Tag Holder to be installed on pole.

Operating Sequence:

- All units are factory programmed for seven fuse size curves – 40K, 65K, 100K, 40T, 65T, 100T, 140T with one reclose.
- New York units have an initial fast curve for fuse saving feature.
- T factory programmed units are New England only.
- The opening interval between operations is 5 seconds. The interrupter resets 2 seconds after dropping open. The operator can then reclose the unit back into the mounting.
- The device must be opened manually with a Loadbuster tool.

NOTE: Limited amounts of the original cutout-mount recloser may still be installed in isolated areas. They do not have the LED indicator screen that indicates the status of life left for operation. When they have reached their limit they will not close and can be replaced with the current available cutout-mount recloser.

Location, Application and Setup of this device must be done under direction of Electric Operations Engineering.

Supersedes 7/19 Issue – Update text

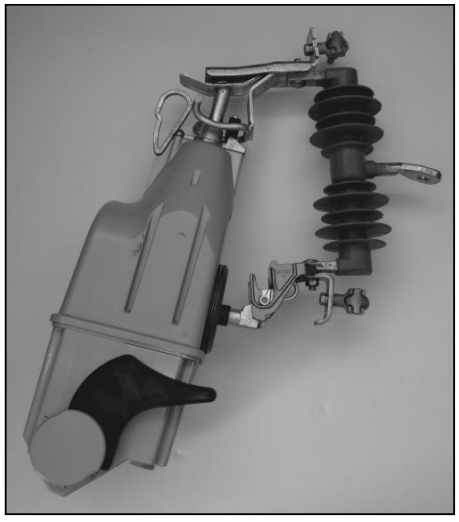


Figure 3 – Cutout Mounted Recloser

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



12.6 FAULT CIRCUIT INDICATORS (FCI's)

Automatic reset type Fault Circuit Indicators (FCI) are available and are used in an attempt to reduce operating call out time by helping to pinpoint circuit faults. If a fault occurs, a target on the indicator appears or changes color. The Fault Indicators have an automatic load leveling with load memory that enables the unit to automatically set the fault trip threshold in relation to the peak load current.

There are various types of FCIs installed onto the Company's overhead distribution system, which operate as follows:

Automatic Reset - If there is a fault, the red indicating target gives the device a strikingly different appearance. When the line is re-energized with the fault removed, the red indicating target will reset instantaneously.

Repaging.

Time Delay Reset - If there is a fault, the red and yellow indicating targets give the device a strikingly different appearance. When the line is re-energized, with the fault removed, the red indicating target will reset while the yellow indicating target resets within a prescribed time delay. The time delay is identified on the unit and is not adjustable.

Manual Reset - If there is a fault, the red indicating target gives the device a strikingly different appearance. When the line is re-energized, with the fault removed, the red indicating target will remain until it is manually reset with the magnetic reset tool (F2T) by the line worker.

12.6.10 Radial Applications

FCI's should be used at selected locations such as:

A. Unfused 3 phase lines.
B. Unfused single phase lines.
C. Load side of 3 phase switches.
D. Load side of 3 phase sectionalizers.
E. Locations not easily accessible by line worker personnel (e.g. rights-of-way, campgrounds, etc.)

Note: When the time delay reset type FCIs are first installed, and there is more current then the minimum trip setting, the FCI needs to adjust and then will begin to flash. The red LEDs will turn off within 1 minute if there is no fault current, and the yellow LEDs will turn off in 4, 8 or 24 hour (depending on time reset).

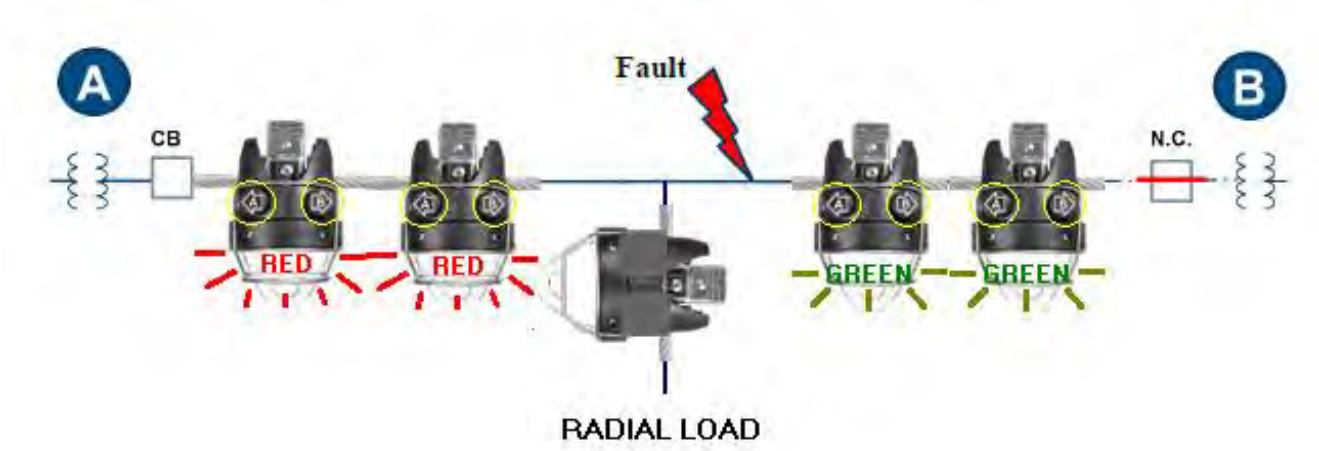
Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

12.6.20 Network Applications

Directional Fault indicators are to be used on “Network” circuits with multiple Fault Indicator site installations. The Source A and Source B must be determined. All of the indicators must be oriented such that the “A” marking faces toward the Source A and the “B” marking faces toward the Source B. Failure to properly orient the indicators will result in false readings during a fault. Engineering will create a “Fault Indicator Guide” identifying the locations of the Fault Indicators on each feeder to assist with locating the fault on “Network” feeders.

EXAMPLE OF A NETWORK APPLICATION

Proper installation of Directional Fault indicators (Note the A & B indicators on the units should be pointing to the source).
Fault location can be identified between the Red and Green blinking indicators on a “Network” circuit.



7/20 Added Smart Indicators

12.6.30 Smart Indicators – Fault Circuit

Smart Indicators can be used as a stand-alone device on circuits up to 161 kV or can be integrated into an existing Smart Grid System leveraging various communications environments for OMS and SCADA Applications. Requires the use of a collector box to collect and manage data from the Smart Indicators via a local RF connection, as an access point into a communication network. Up to 12 Smart Indicators can communicate to one collector box within 100’ line of sight.

12.7 INSTALLATION - CUTOUTS & DISCONNECTING DEVICES

Typical installations are shown on Pages 12-127 through 12-333. Cutouts should be turned toward the pole for easier opening. Disconnect switches should be installed so that normally the blade opens away from the circuit source. In addition, the location of all disconnecting devices shall be chosen to minimize the possibility of an arc flaring up, or being blown into other circuits.

All mainline switching devices shall be properly numbered and located per construction drawing requirements.

Conductors inserted into the terminals of cutouts and disconnects shall be copper or electrically equivalent aluminum. Hyseal plugs (S27H or S27J) are available for terminating aluminum conductors in cutouts.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CONVENTIONAL TRANSFORMER FUSING – SINGLE PHASE INSTALLATIONS															
PRIMARY CIRCUIT VOLTAGE	EACH TRANSFORMER TANK KVA SIZE														
	10	15	25	37	50	75	100	150	167	200	250	333	500	667	833
	ANSI TYPE_K FUSE LINK AMPERE RATING (F1K)														
2400 delta 2400/4160 Grd. Y	10	15	25	40	40	65	65	100	100		140				
4160 Ungrd. Y	6	10	15	25	25	40	40	65	65		100	140			
4800 delta 4800/8320 Grd. Y	6	10	15	25	25	40	40	65	65		100	140			
7200 delta 7200/12470 Grd. Y 7620/13200 Grd. Y 7970/13800 Grd. Y	3	6	10	10	15	25	25	40	40		65	65	100	140	200
12000 delta 13200 Ungrd. Y 13800 Ungrd. Y 13200/22860 Grd. Y 13800/23900 Grd. Y 14400/24900 Grd. Y	3	3	3	6	10	15	15	25	25		40	40	65	100	
23000 delta 19920/34500 Grd. Y	3	3	3	6	6	10	10	15	15		25	25	40	65	65

CONVENTIONAL TRANSFORMER FUSING – THREE PHASE INSTALLATIONS															
PRIMARY CIRCUIT VOLTAGE	EACH TRANSFORMER TANK KVA SIZE														
	10	15	25	37	50	75	100	150	167	200	250	333	500	667	833
	ANSI TYPE_K FUSE LINK AMPERE RATING (F1K)														
2400 delta	15	25	40	65	65	100	100	140	140	200	200				
2400/4160 Grd. Y 4160 Ungrd. Y	10	15	25	40	40	65	65	100	100	140	140	200			
4800 delta	10	15	25	40	40	65	65	100	100	100	140	140			
4800/8320 Grd. Y	6	10	15	25	25	40	40	65	65	65	100	140			
7200 delta 7200/12470 Grd. Y 7620/13200 Grd. Y 7970/13800 Grd. Y 12000 delta 13200 Ungrd. Y 13800 Ungrd. Y	3	6	10	10	15	25	25	40	40	40	65	65	100	140	200
13200/22860 Grd. Y 13800/23900 Grd. Y 14400/24900 Grd. Y 23000 delta	3	3	3	6	10	15	15	25	25		40	40	65	100	
19920/34500 Grd. Y	3	3	3	6	6	10	10	15	15		25	25	40	65	65

Repaging.

1. For open delta or Scott connections, fuse individual transformers the same as for single phase.
2. All fuses in standard three phase (3Φ) banks (same kVA ratings) shall be of the same rating maintaining consistent operating characteristics. Three phase (3Φ) transformers (T-T winding) are fused the same as an equivalent transformer bank of three single-phase transformers.
3. For non-standard banks (unlike kVA ratings) ONLY, fuse as follows:
   a. For wye or open delta, fuse individual transformers the same as for single phase.
   b. For closed delta banks, the two fuses feeding the larger transformer shall be fused for the size and voltage rating of the larger transformer. The fuse common to the smaller transformers shall be fused for the size and voltage rating of the smaller transformer.

Non-standard Company application. If necessary, consult Standards Engineering

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CONVENTIONAL TRANSFORMER FUSING – SINGLE PHASE INSTALLATIONS															
PRIMARY CIRCUIT VOLTAGE	EACH TRANSFORMER TANK KVA SIZE														
	10	15	25	37	50	75	100	150	167	200	250	333	500	667	833
	ANSI TYPE_T FUSE LINK AMPERE RATING (F1T)														
2400 delta 2400/4160 Grd. Y	6	10	15	25	40	40	65	100	100						
7200 delta 7200/12470 Grd. Y 7620/13200 Grd. Y 7970/13800 Grd. Y	3	3	6	10	10	10	15	25	25		40	65	100		

CONVENTIONAL TRANSFORMER FUSING – THREE PHASE INSTALLATIONS															
PRIMARY CIRCUIT VOLTAGE	EACH TRANSFORMER TANK KVA SIZE														
	10	15	25	37	50	75	100	150	167	200	250	333	500	667	833
	ANSI TYPE_T FUSE LINK AMPERE RATING (F1T)														
2400/4160 Grd. Y	6	10	15	25	40	40	65	100	100						
7200 delta 7200/12470 Grd. Y 7620/13200 Grd. Y 7970/13800 Grd. Y	3	3	6	10	10	10	15	25	25		40	65	100		

Repaging.

1. For open delta or Scott connections, fuse individual transformers the same as for single phase.
2. All fuses in standard three phase (3Φ) banks (same kVA ratings) shall be of the same rating maintaining consistent operating characteristics.
3. Three phase (3Φ) transformers (T-T winding) are fused the same as an equivalent transformer bank of three single-phase transformers.
4. For non-standard banks (unlike kVA ratings) ONLY, fuse as follows:
   c. For wye or open delta, fuse individual transformers the same as for single phase
   d. For closed delta banks, the two fuses feeding the larger transformer shall be fused for the size and voltage rating of the larger transformer. The fuse common to the smaller transformers shall be fused for the size and voltage rating of the smaller transformer.

Non-standard Company application. If necessary, consult Standards Engineering

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

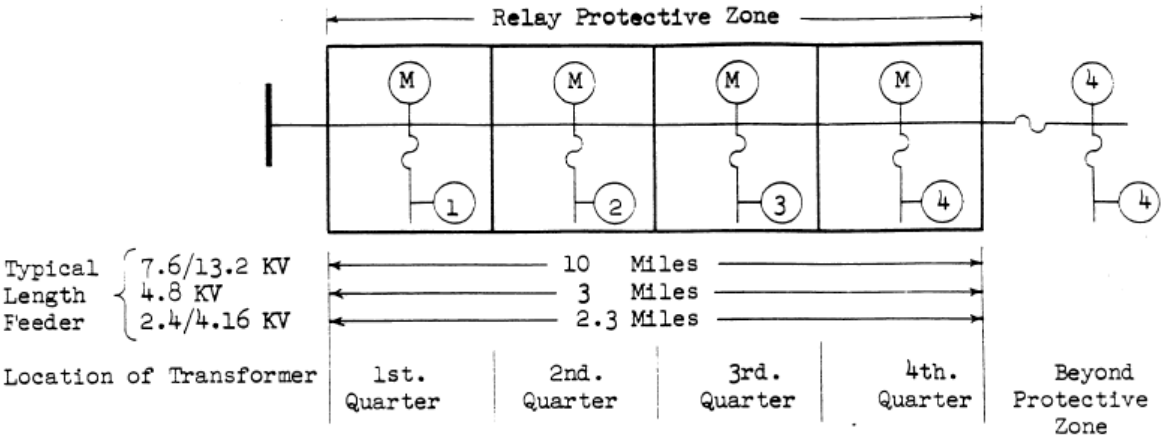
CAPACITOR FUSING – 3Φ AND 1Φ PHASE INSTALLATIONS									
PRIMARY CIRCUIT VOLTAGE	CAP (KV)	KVAR PER 3Φ/1Φ							
		150/50	300/100	450/150	600/200	900/300	1200/400	1800/600	2700/900
		CAPACITOR VOLTAGE (KV)							
		ANSI TYPE_K FUSE LINK AMPERE RATING (F1K)							
2400 delta	2.4	40	80						
2400/4160 Grd. Y 4160 Ungrd. Y	2.4 4.16	20	40	65					
4800 delta	4.8	20	40	50	65				
4800/8320 Grd. Y	4.8	10	25	40	40	65			
6900 Ungrd. Y 7200 delta 7200/12470 Grd. Y 7620/13200 Grd. Y 7970/13800 Grd. Y	6.64 7.2 7.6 7.9	10	15	20	30	40	65		
13200 Ungrd. Y 13800 Ungrd. Y 13200/22860 Grd. Y	13.2 13.8				15	25	40	50	65
13800/23900 Grd. Y 14400/24900 Grd. Y	14.4				15	25	40	40	65
19920/34500 Grd. Y	19.9					15	25	40	50
		ANSI TYPE_K FUSE LINK AMPERE RATING (F6K)							
23000 delta	23							50	80

1. Table is applicable for three phase (3Φ) & single phase (1Φ) installations.
2. This See C40 for standard capacitors & C36 for standard capacitor racks
3. Three phase (3Φ) capacitor units are fused the same as individual units utilizing the kVAR per three phase (3Φ) values above.

Repaging.

Non-standard Company application. If necessary, consult distribution engineering

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



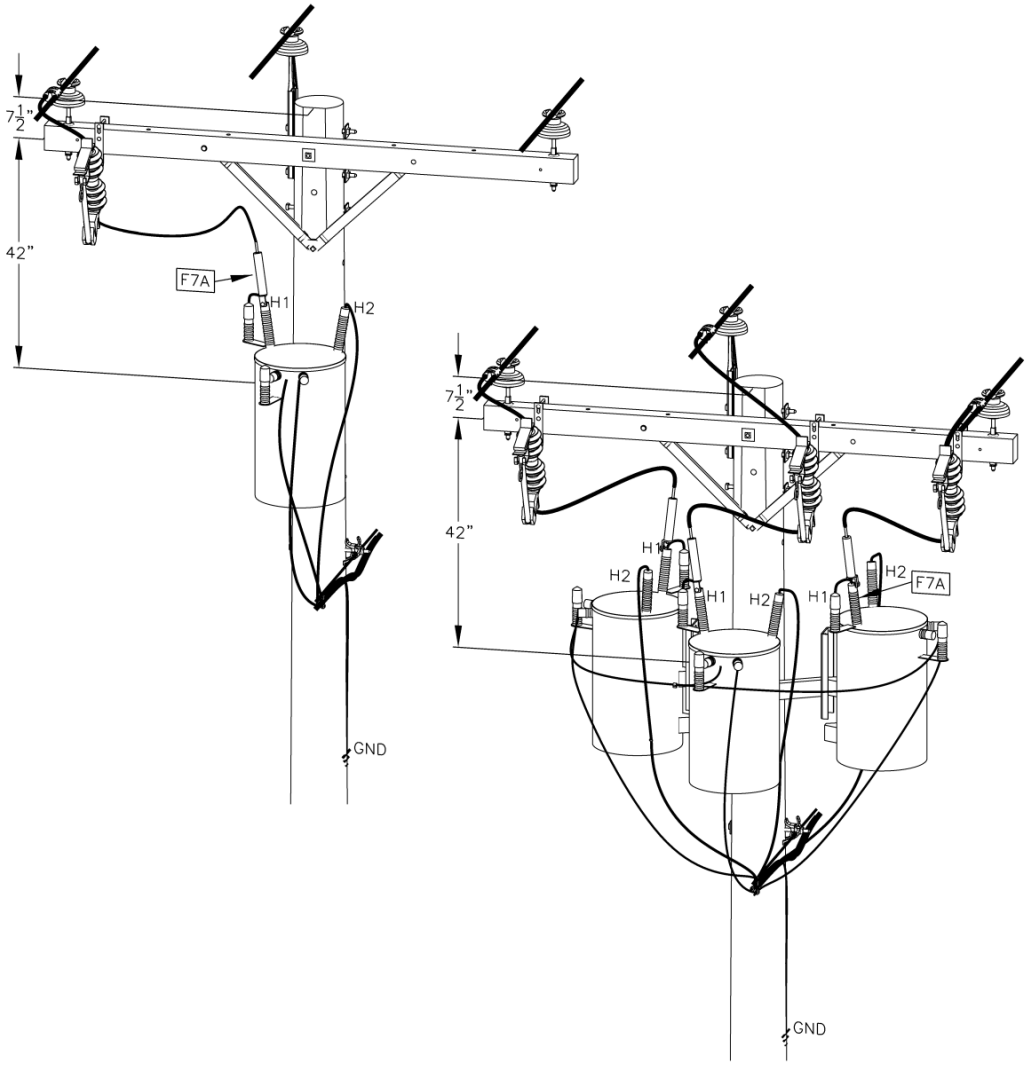
Repaging.

ANSI TYPE_K FUSE LINK AMPERE RATING (F1K)							
SIZE CSP TRANS.	LOCATION	2.4/4.16 KV		4.8 KV		7.6/13.2 KV	
		REC.	MIN.	REC.	MIN.	REC.	MIN.
5	1	100		100		100	
5	2	65		50		50	
5	3	50		40		40	
5	4	50	40	40	25	40	25
10	1	100		100		100	
10	2	65		50		50	
10	3	65		40		40	
10	4	65	40	40	25	40	25
15	1	100		100		100	
15	2	65		65		50	
15	3	65		50		40	
15	4	65	65	50	40	40	25
25	1	140		100		100	
25	2	100		65		65	
25	3	100		50		50	
25	4	100	100	50	40	40	40
37.5	1	200		140		100	
37.5	2	200		100		65	
37.5	3	200		100		65	
37.5	4	200	140	100	100	65	65
50	1-4	200	200	140	140	140	100
75	1-4	200	200	200	200	140	100
5-75	M	----------STATION BREAKER---------					

If CSP transformers are installed behind minimum size line fuses, there is a calculated risk that a fault in one of the transformers will cause the line fuse to blow.

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = TFC5	25 A Current Limiting Fuse
CU = TFC7	40 A Current Limiting Fuse



NOTES:
1. THIS CONFIGURATION IS TYPICAL FOR 1Ø OR 3Ø STRAIGHT OR DUAL VOLTAGE CSP TRANSFORMER INSTALLATIONS WHICH HAVE BEEN RETROFITTED WITH FUSED CUTOUTS. ALL STANDARD POLE TOP ARRANGEMENTS ARE APPLICABLE AND CAN BE FITTED IN THE SAME MANNER.
2. SEE SECTION 12.5.20 FOR CL FUSE SELECTION.
3. SEE TRANSFORMER SECTION 14 FOR ADDITIONAL TRANSFORMER INFORMATION.

Designer	Drawing	Date
MPR	od12127	7/3/18

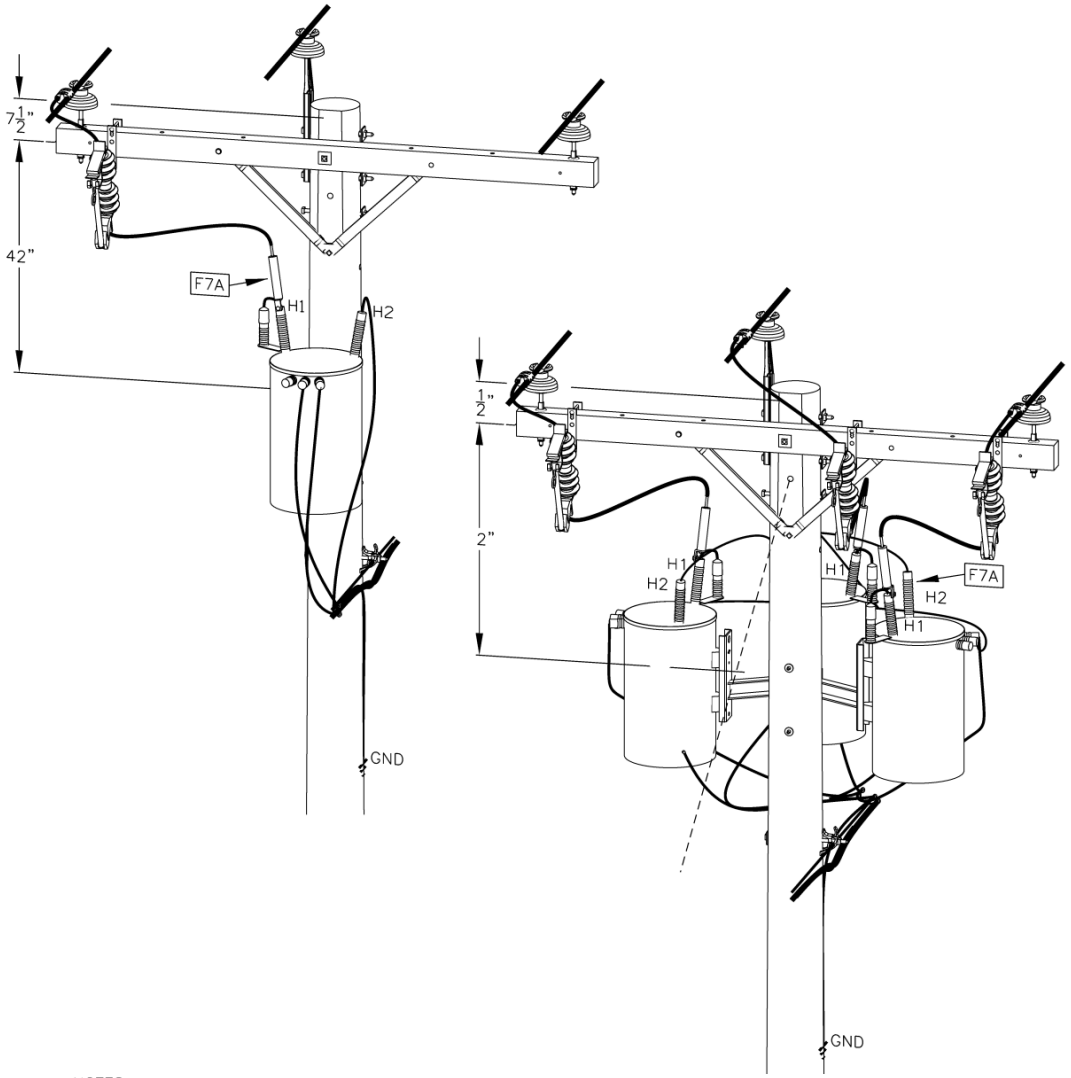
Supersedes 7/17 Issue – Updated Drawing

CURRENT LIMITING FUSE INSTALLATION (RETROFITTING) ON CSP TRANSFORMER 15KV			
ISSUE	**PAGE NUMBER**		
7/18	**12-127**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = TFC5	25 A Current Limiting Fuse
CU = TFC7	40 A Current Limiting Fuse

Supersedes 7/17 Issue – Updated Drawing



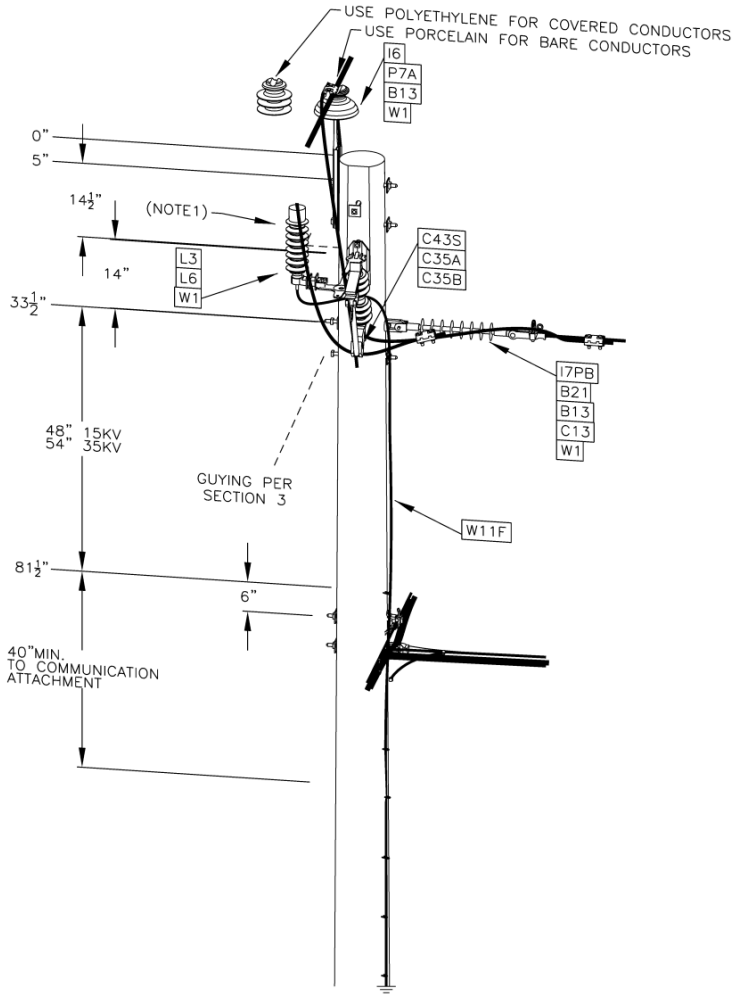
NOTES:
1. THIS CONFIGURATION IS TYPICAL FOR 1Ø OR 3Ø STRAIGHT OR DUAL VOLTAGE CONVENTIONAL TRANSFORMER INSTALLATIONS. ALL STANDARD POLE TOP ARRANGEMENTS ARE APPLICABLE AND CAN BE FITTED IN THE SAME MANNER.
2. SEE SECTION 12.5.20 FOR CL FUSE SELECTION.
3. SEE TRANSFORMER SECTION 14 FOR ADDITIONAL TRANSFORMER INFORMATION.

Designer	Drawing	Date
MPR	od12128	7/3/18

CURRENT LIMITING FUSE INSTALLATION ON CONVENTIONAL TRANSFORMER 15-35KV			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-128	7/18

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = CC15K(I)	15 kV Cutout & Fuse Holder, (I) = S1-100 A, S2-200 A, S3S-300 A	CU = CFLK(P)	15 kV Fuse, (P) = Fuse Rating
CU = CC27KS1	27 kV Cutout & Fuse Holder (NE)	CU = CFLK35(P)	35 kV Fuse, (P) = Fuse Rating
CU = CAL(X)K	Arrester, Lightning, (X) = Duty Cycle Rating kV	CU = PBCA	Cutout Bracket, Crossarm
CU = PABCA	Bracket for Cutout/Arrester 1 Position		
CU = PABCA3	Bracket for Cutout/Arrester 3 Position		
CU = CSVGLA	Single Vertical Ground for Lightning Arrester		



NOTES:
1. SEE OH STANDARDS SECTION 13.6 FOR APPLICATION OF SURGE ARRESTERS.

Designer	Drawing	Date
MPR	od12129	7/3118

Supersedes 7/17 Issue – Updated Drawing

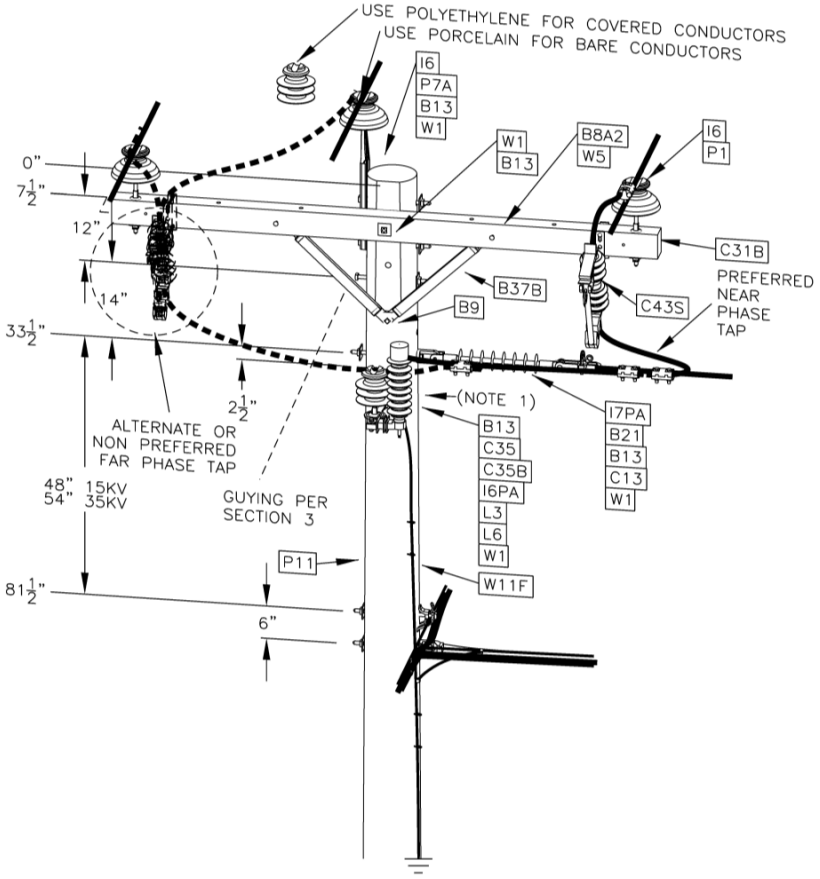
1Φ PRIMARY WITH 1Φ FUSED TAP 15-35 KV

ISSUE	PAGE NUMBER		
7/18	12-129	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Doc. # ST. 12.00.002

CU = CC15K(I)	15 kV Cutout & Fuse Holder, (I) = S1-100 A, S2-200 A, S3S-300 A	CU = CFLK(P)	15 kV Fuse, (P) = Fuse Rating
CU = CC27KS1	27 kV Cutout & Fuse Holder (NE)	CU = CFLK35(P)	35 kV Fuse, (P) = Fuse Rating
CU = CAL(X)K	Arrester, Lightning, (X) = Duty Cycle Rating kV	CU = PBCA	Cutout Bracket, Crossarm
CU = PABCA	Bracket for Cutout/Arrester 1 Position		
CU = PABCA3	Bracket for Cutout/Arrester 3 Position		
CU = CSVGLA	Single Vertical Ground for Lightning Arrester		



NOTES:
1. SEE OH STANDARDS SECTION 13.6 FOR APPLICATION OF SURGE ARRESTERS.
2. CAN USE 3 POSITION BRACKET (C35A) INSTEAD OF CUTOUT ON ARM.

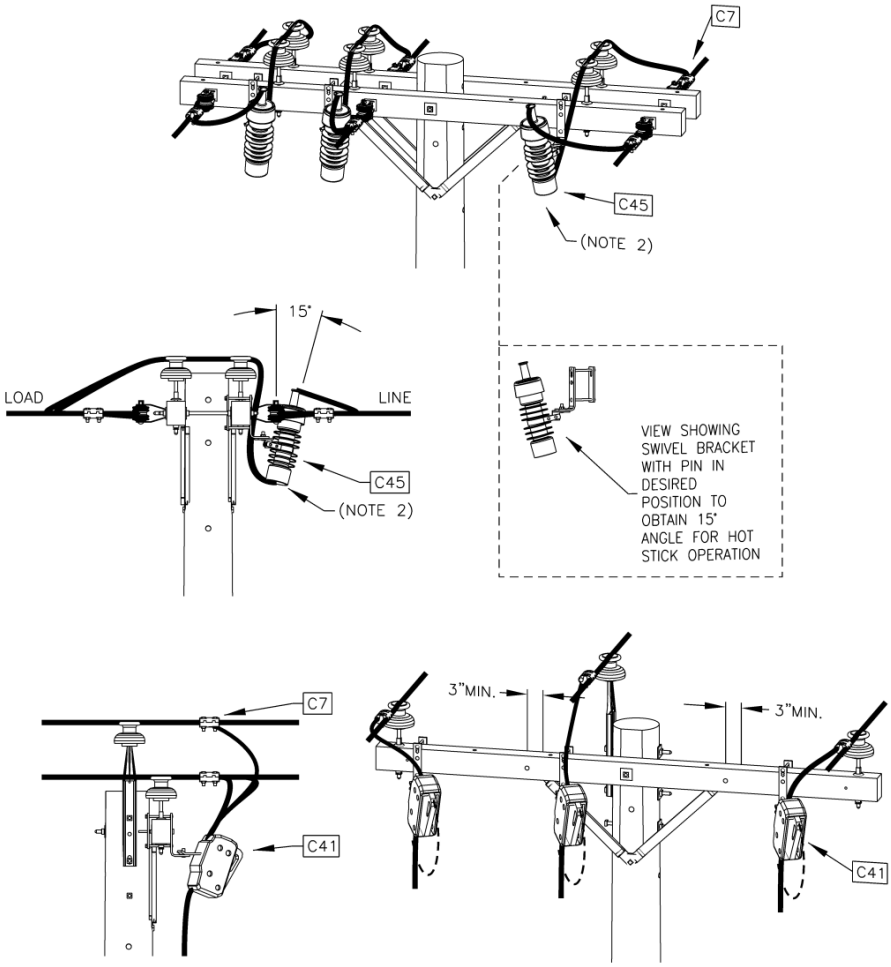
Designer	Drawing	Date
MPR	od12130	7/3/18

Supersedes 7/17Issue – Updated Drawing

3Φ PRIMARY WITH 1Φ FUSED TAP 15-35 KV			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-130	7/18

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = CC5K**L**	5 kV Cutout, **L** = Cutout Box Size
CU = CFLK**P**	Fuse Size, **P** = Fuse Rating



INFORMATION ONLY – USE OPEN–TYPE CUTOUTS

NOTES:
1. THE LOCATION OF ALL DISCONNECTING DEVICES MUST BE CHOSEN TO MINIMIZE POSSIBILITY OF AN ARC FLARING UP INTO, OR BEING BLOWN INTO OTHER CIRCUITS.
2. CONDUCTORS INSERTED INTO THE TERMINALS OF CUTOUTS AND DISCONNECTS SHALL BE COPPER.

Designer	Drawing	Date
MPR	od12131	7/3/18

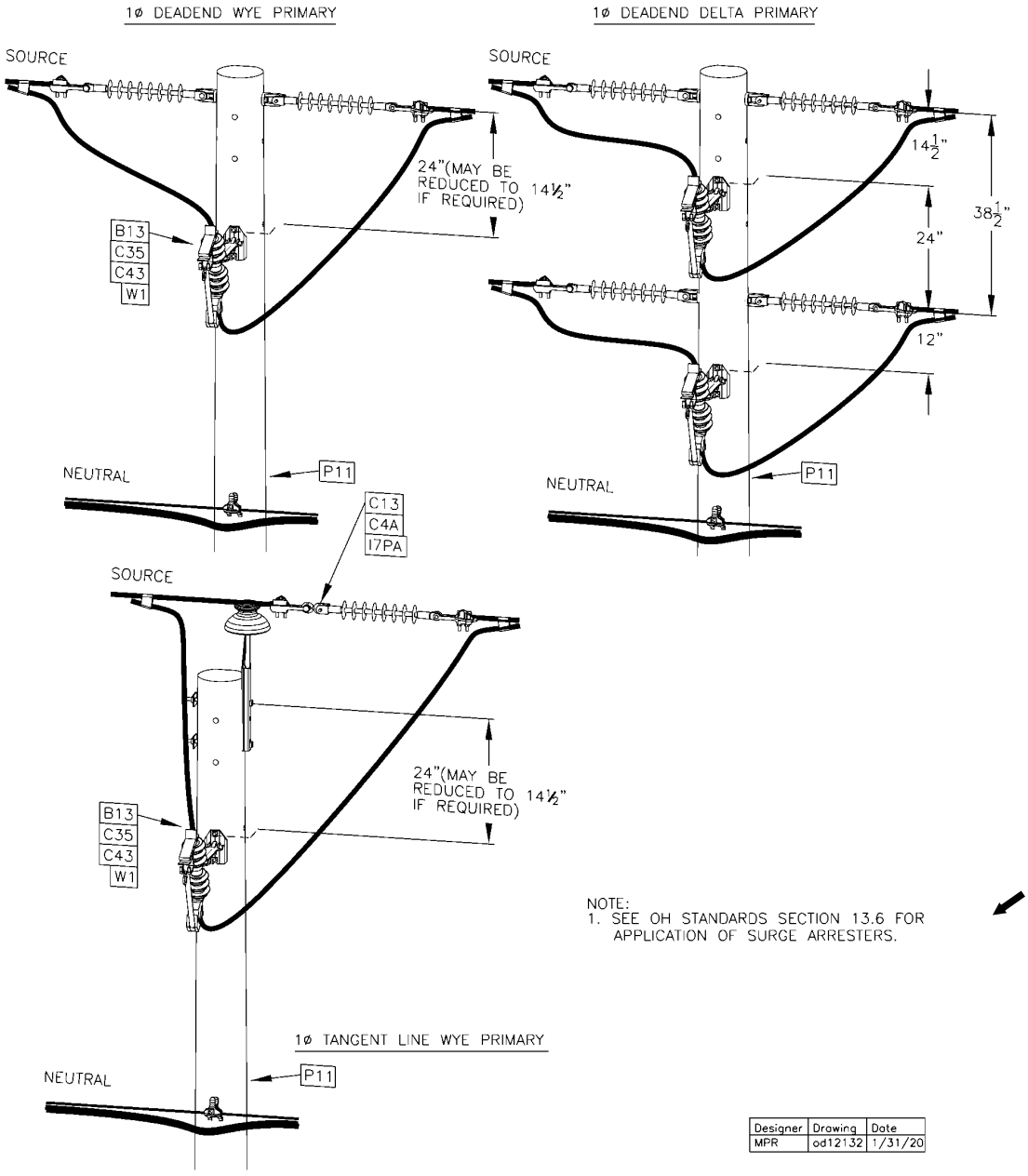
Supersedes 1/06 Issue – Updated Drawing to 3D

3Φ PRIMARY SECTIONALIZING 5 KV (MAINTENANCE)			
ISSUE	**PAGE NUMBER**		
7/18	**12-131**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @C15KCO**P**	15 kV Cutout, **P** = Fuse Rating
MU = @C35KCO**P**	27 kV Cutout, **P** = Fuse Rating

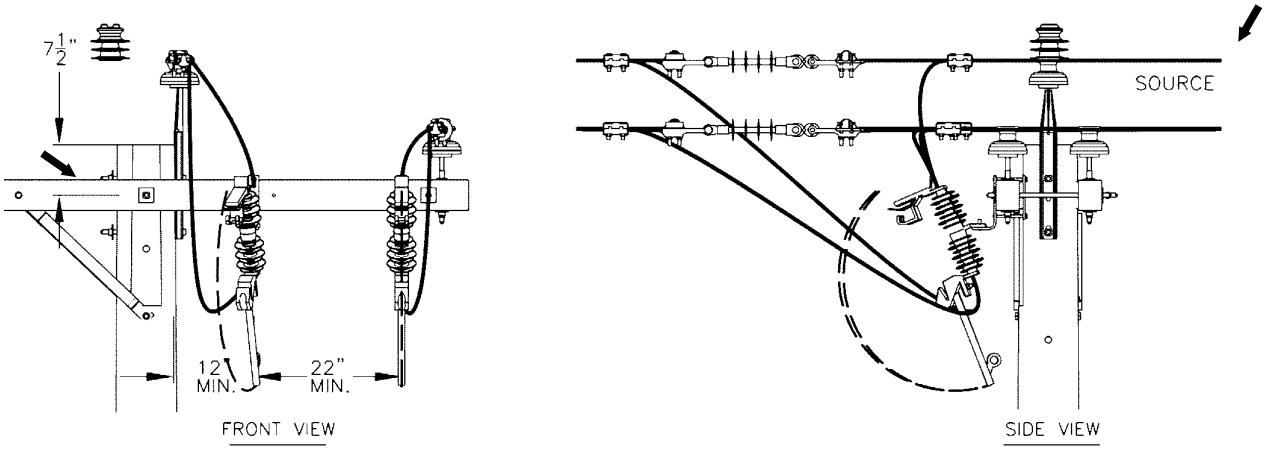
Supersedes 7/19 Issue –Updated drawing.

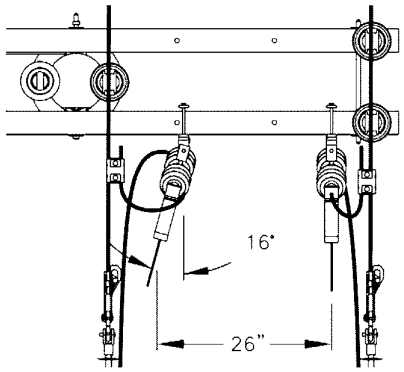


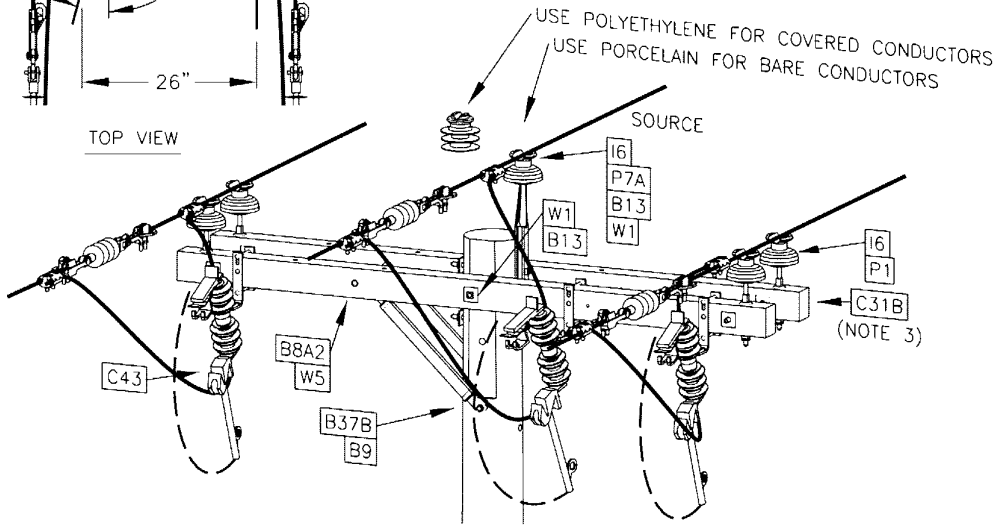
1Φ PRIMARY SECTIONALIZING 15-35 KV			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-132	7/21

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @C3COTL(I)K	15 kV 3 Phase Tangent Line, (I) = CO Body Size: S1-100, S2-200 K Link
MU = @C3COTL35K(I)K	27 kV 3 Phase Tangent Line, (I) = CO Body Size 35 kV: S41-100 (NE)







NOTES:
1. COVERED–WIRE TAPS MAY REQUIRE STRIPPING TO PROVIDE 6" BARE WIRE FOR OPERATIONAL GROUNDING NEAR THE CUTOUT TERMINALS.
2. USE DOUBLE PINS AND INSULATORS ON ARM FOR ANGLES 11°TO 20° AND PUT CONDUCTOR IN SIDE GROOVE.
3. USE ITEM C31B (8FT CROSSARM) WITH B37B BRACE FOR 15KV CONSTRUCTION AND ITEM TC10 (10FT CROSSARM) WITH TB60 BRACE FOR 35KV CONSTRUCTION.
4. SEE OH STANDARDS SECTION 13.6 FOR APPLICATION OF SURGE ARRESTERS.

Designer	Drawing	Date
MPR	od12133A	3/15/19

Supersedes 7/18 Issue – Added note 4 to drawing

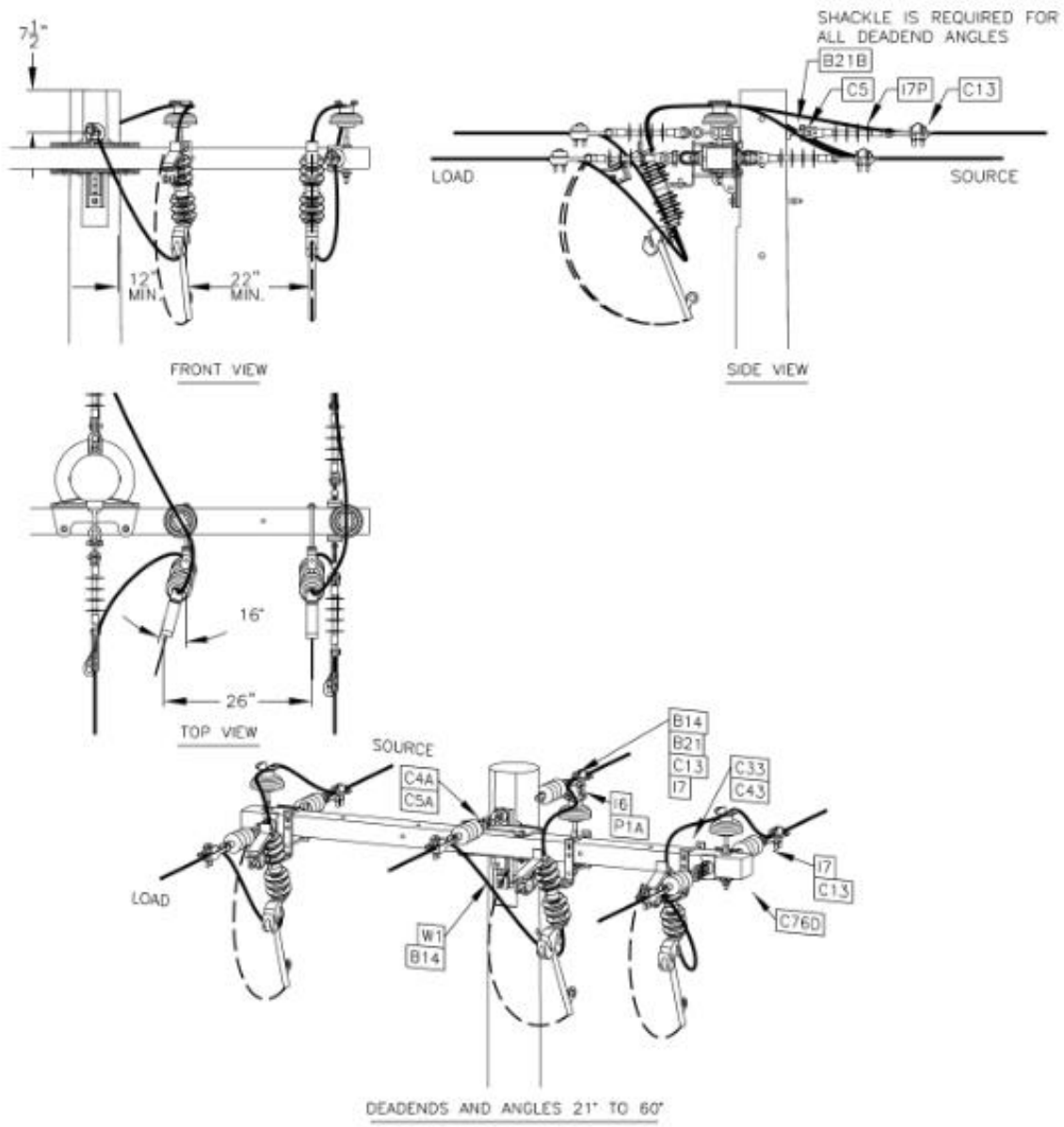
3Φ PRIMARY SECTIONALIZING 15-35 KV

ISSUE	PAGE NUMBER		
7/19	12-133A	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @C3CODE(I)K	15 kV 3 Phase Deadend, (I) = CO Body Size: S1-100, S2-200 K Link
MU = @C3CODE35K(I)K	27 kV 3 Phase Deadend, (I) = CO Body Size 35 kV: S41-100 (NE)

Supersedes 7/19 Issue – Added material IDs.

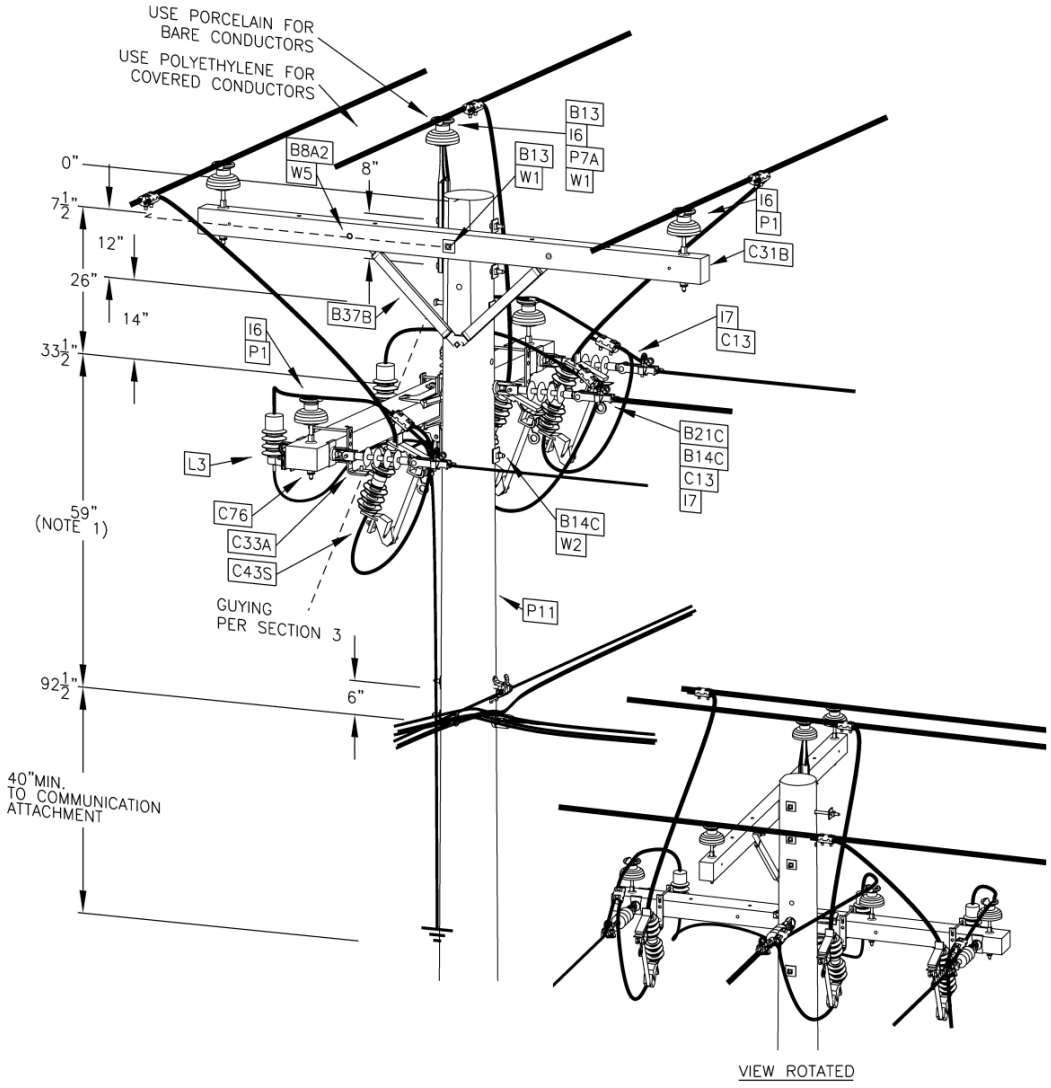


NOTES:
1. COVERED-WIRE TAPS MAY REQUIRE STRIPPING TO PROVIDE 6" BARE WIRE FOR OPERATIONAL GROUNDING NEAR THE CUTOUT TERMINALS.
2. USE DOUBLE PINS AND INSULATORS ON ARM FOR ANGLES 11°TO 20° AND PUT CONDUCTOR IN SIDE GROOVE.
3. USE ITEM TC10 (10FT CROSSARM) WITH TB60 BRACE FOR 35KV CONSTRUCTION.
4. SEE OH STANDARDS SECTION 13.6 FOR APPLICATION OF SURGE ARRESTERS.

Designer	Drawing	Date
MPR	od121338	1/15/21

3 Φ PRIMARY SECTIONALIZING 15-35 KV LINE ANGLES 0˚-20˚			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-133B	7/21

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



NOTES:
1. FIBERGLASS CROSS ARM TO MEET THE REQUIREMENTS OF SECTION 4 – STORM HARDENING.

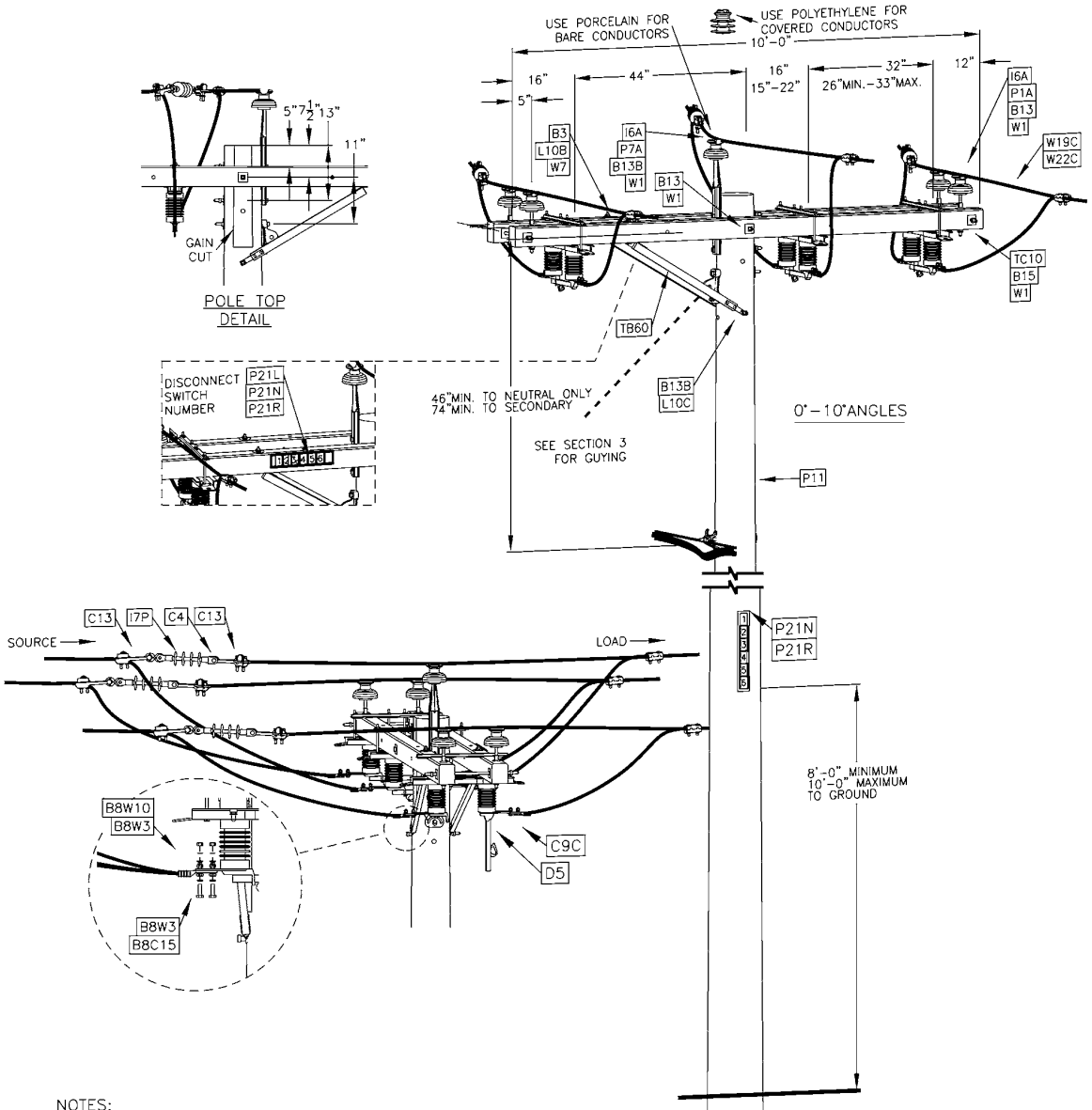
Designer	Drawing	Date
MPR	od12134	7/3/18

Supersedes 7/17 Issue – Updated Drawing

3Φ PRIMARY SECTIONALIZING 15-35 KV			
ISSUE	**PAGE NUMBER**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid
7/18	**12-134**		

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @12-13510D15K	15 kV 3 phase Disconnect 0°-10°
MU = @12-13510D35K	35 kV 3 phase Disconnect 0°-10° (NE)



NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE-ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. SEE DRAWINGS 12-139 AND 12-140 FOR SWITCH INSTALLATIONS ON SEPARATE SWITCH ARMS.
6. DISCONNECT SWITCH NUMBER MOUNTED VERTICALLY FACING TOWARD ONCOMING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

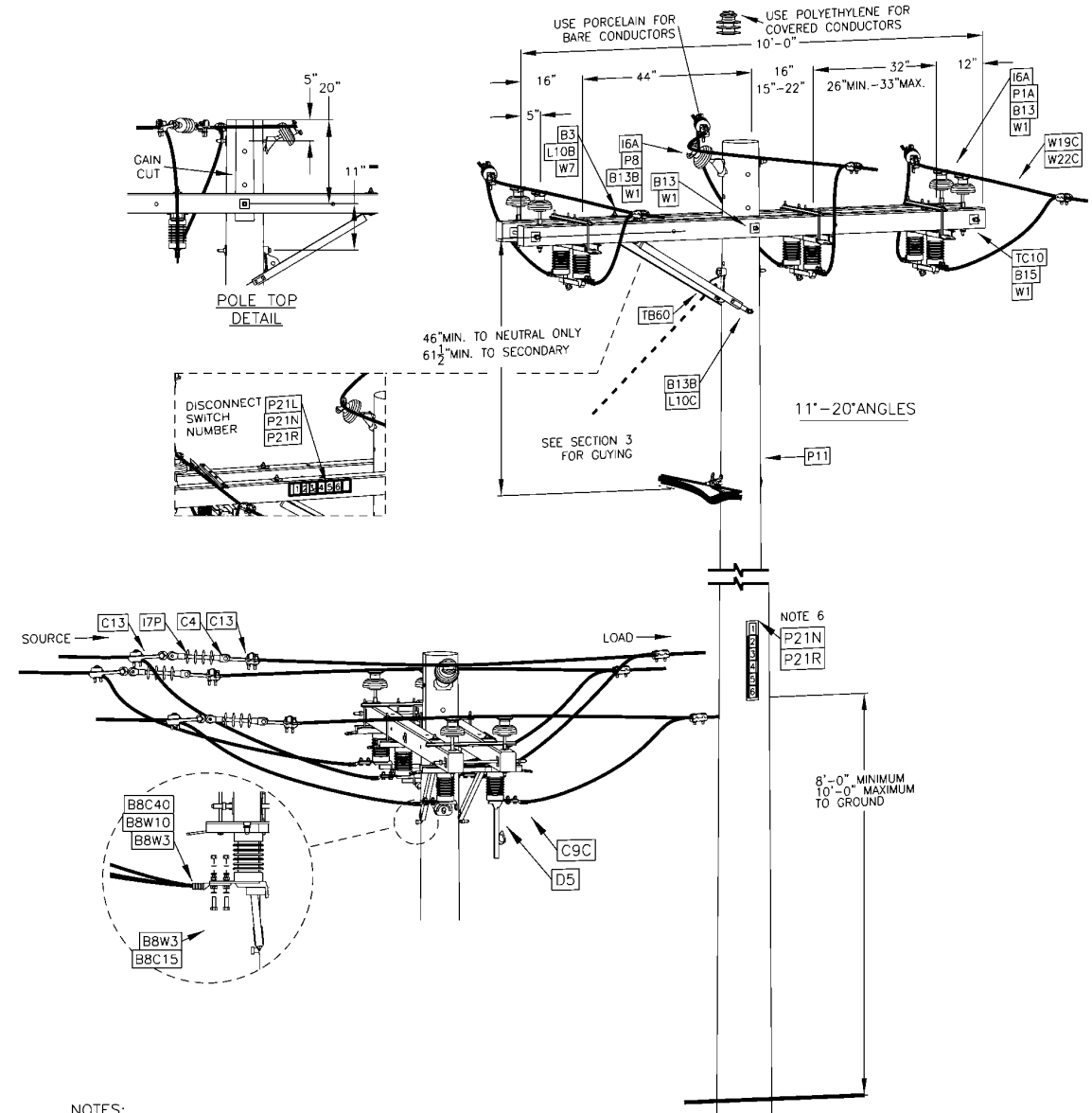
Designer	Drawing	Date
MPR	od12135A	6/30/20

UNDERSLUNG DISCONNECT SWITCH TANGENT LINE ANGLES 0˚-10˚ 15-35 KV

nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-135A	7/20

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @12-1351120D15K	15 kV 3 phase Disconnect 11°-20°
MU = @12-1351120D35K	35 kV 3 phase Disconnect 11°-20° (NE)



NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE– ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. SEE DRAWINGS 12–139 AND 12–140 FOR SWITCH INSTALLATIONS ON SEPARATE SWITCH ARMS.
6. SWITCH IDENTIFICATION NUMBER MOUNTED VERTICALLY FACING TOWARD TRAFFIC PROVIDING MAXIMUM VISIBILITY.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od121358	6/30/20

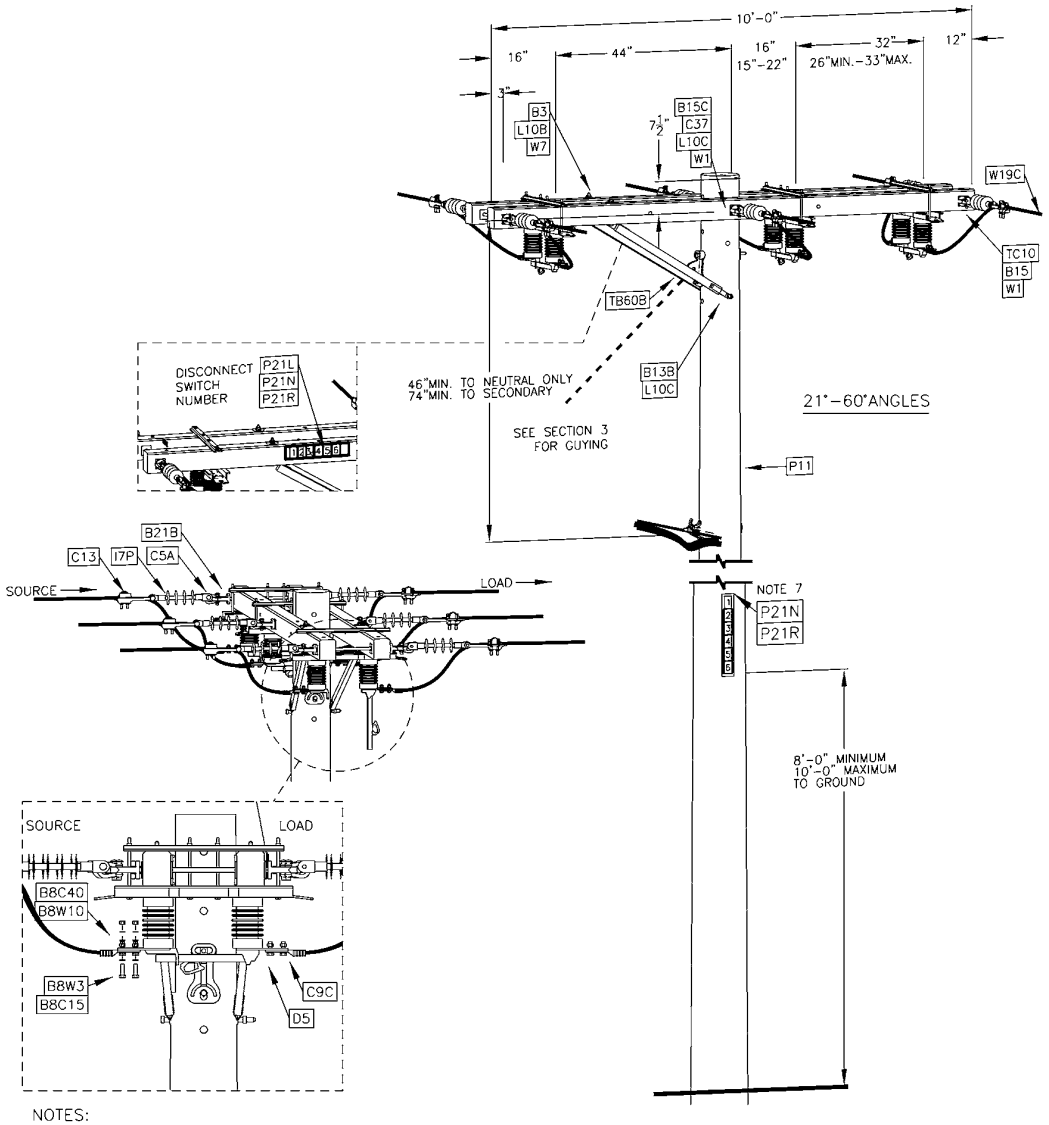
UNDERSLUNG DISCONNECT SWITCH TANGENT LINE ANGLES 11°-20° 15-35 KV

ISSUE	PAGE NUMBER		
7/20	12-135B	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Supersedes 7/18 Issue – Updated Drawing

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @12-1362160D15K	15 kV 3 Phase Disconnect
MU = @12-1362160D35K	35 kV 3 Phase Disconnect (NE)



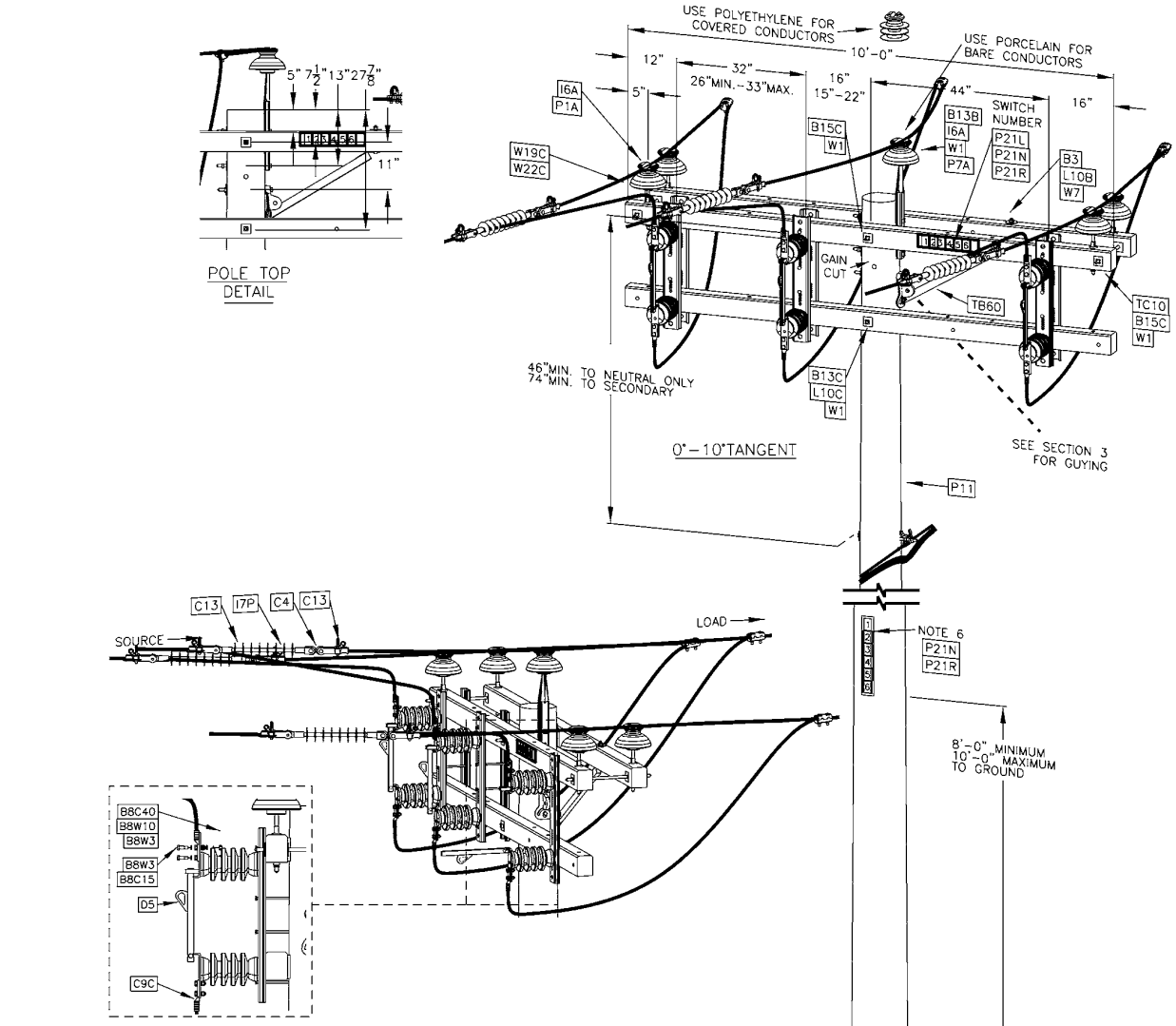
NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. SEE DRAWINGS 12-139 AND 12-140 FOR SWITCH INSTALLATIONS ON SEPARATE SWITCH ARMS.
6. SEE DRAWING 12-135 FOR CONDUCTORS ON PINS AND ANGLES 0° TO 20°.
7. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TOWARD TRAFFIC PROVIDING MAXIMUM VISIBILITY.
8. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od12136	6/30/20

UNDERSLUNG DISCONNECT SWITCH 3Φ LINE ANGLES 21°-60° - CROSSARM DEADEND 15 KV

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 31.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @DISWCH15K	15 kV 3 Phase Disconnect Vertical



NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE-ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. SEE DRAWINGS 12-139 AND 12-140 FOR SWITCH INSTALLATIONS ON SEPARATE SWITCH ARMS.
6. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TOWARD TRAFFIC PROVIDING MAXIMUM VISIBILITY.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

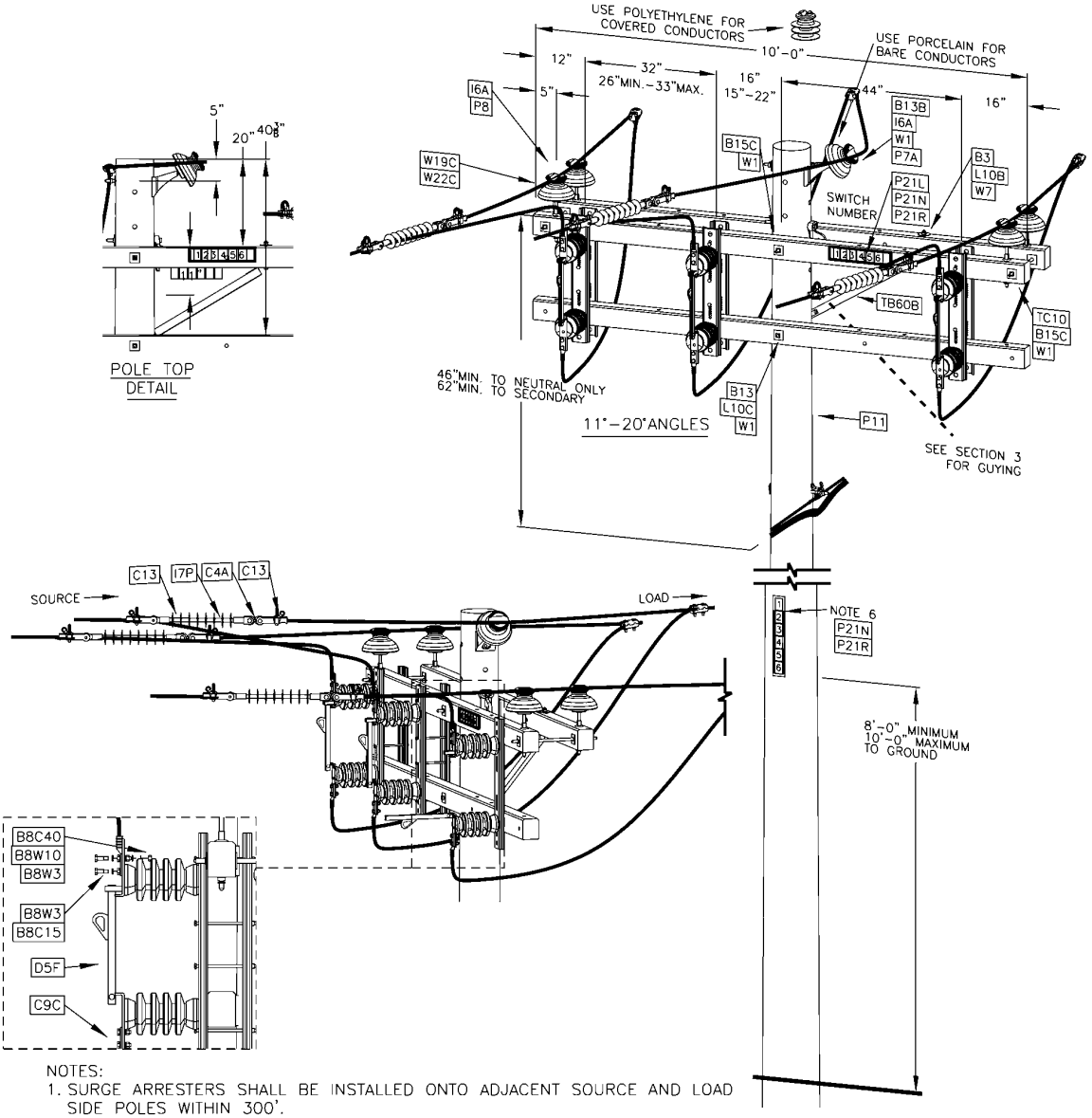
Designer	Drawing	Date
MPR	od12137A	6/30/20

UNDERSLUNG DISCONNECT SWITCH TANGENT LINE ANGLES 0°-10° 15-35 KV			
ISSUE	**PAGE NUMBER**		
7/20	**12-137A**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Supersedes 7/18 Issue – Updated Drawing

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = CDS15KIL	15 kV In-Line Switch (1)



NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE-ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. SEE DRAWINGS 12-139 AND 12-140 FOR SWITCH INSTALLATIONS ON SEPARATE SWITCH ARMS.
6. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TOWARD TRAFFIC PROVIDING MAXIMUM VISIBILITY.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

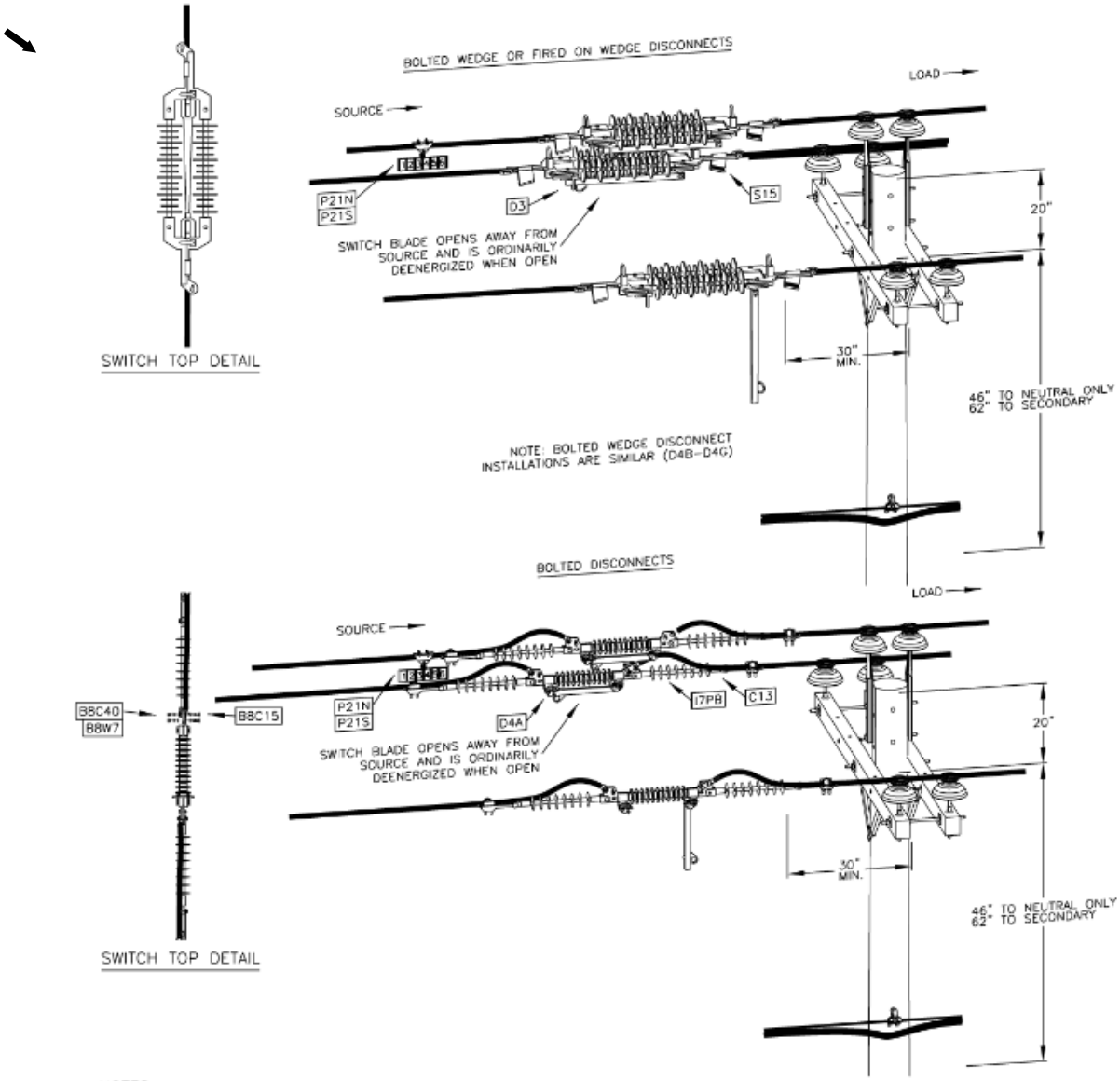
Designer	Drawing	Date
MPR	od121378	6/30/20

UNDERSLUNG DISCONNECT SWITCH TANGENT LINE ANGLES 11°-20° 15-35 KV

nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-137B	07/20

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

CU = CDS(X)K(Y)AIL	Fired-On Wedge In-Line Switch, (X) = Nominal Voltage, (Y) = Wire Size
CU = CDS(X)K(Y)IL	Bolted In-Line Switch, (X) = Nominal Voltage, (Y) = Wire Size



NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. USE THE IN–LINE SWITCH ARRANGEMENT ONLY WHEN CLEARANCES WILL NOT ALLOW SWITCH INSTALLATIONS ON CROSSARMS (SEE DRAWINGS 12–135, 136, 137, 139 AND 140).
3. THIS ARRANGEMENT MAY BE APPLIED TO OTHER TYPES OF OPEN TYPES OF OPEN WIRE POLE TOPS INCLUDING RECLOSER INSTALLATIONS.
4. FOR POLE TOP CONFIGURATIONS, DOUBLE INSULATOR TIE POINTS ARE REQUIRED TO REDUCE THE STRAIN UNDER SWITCH OPERATION.
5. SWITCH IDENTIFICATION SHALL BE INSTALLED ON THE CONDUCTOR MIDDLE PHASE USING THE P21S HANGER.
6. DO NOT INSTALL IN LINE SWITCHES ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20 DEGREES.
7. THE PREFERRED BOLTED SWITCH IS THE BOLTED WEDGE STYLE SWITCH (STD ITEMS D4B–D4G). USE THE D4A SWITCH FOR COPPER CONDUCTORS OR CONDUCTOR SIZES THAT ARE OUTSIDE THE RANGE OF D4B–D4G.
8. SEE OH STANDARDS SECTION 13.6 FOR APPLICATION OF SURGE ARRESTERS.

Designer	Drawing	Date
MPR	acd12138	1/31/20

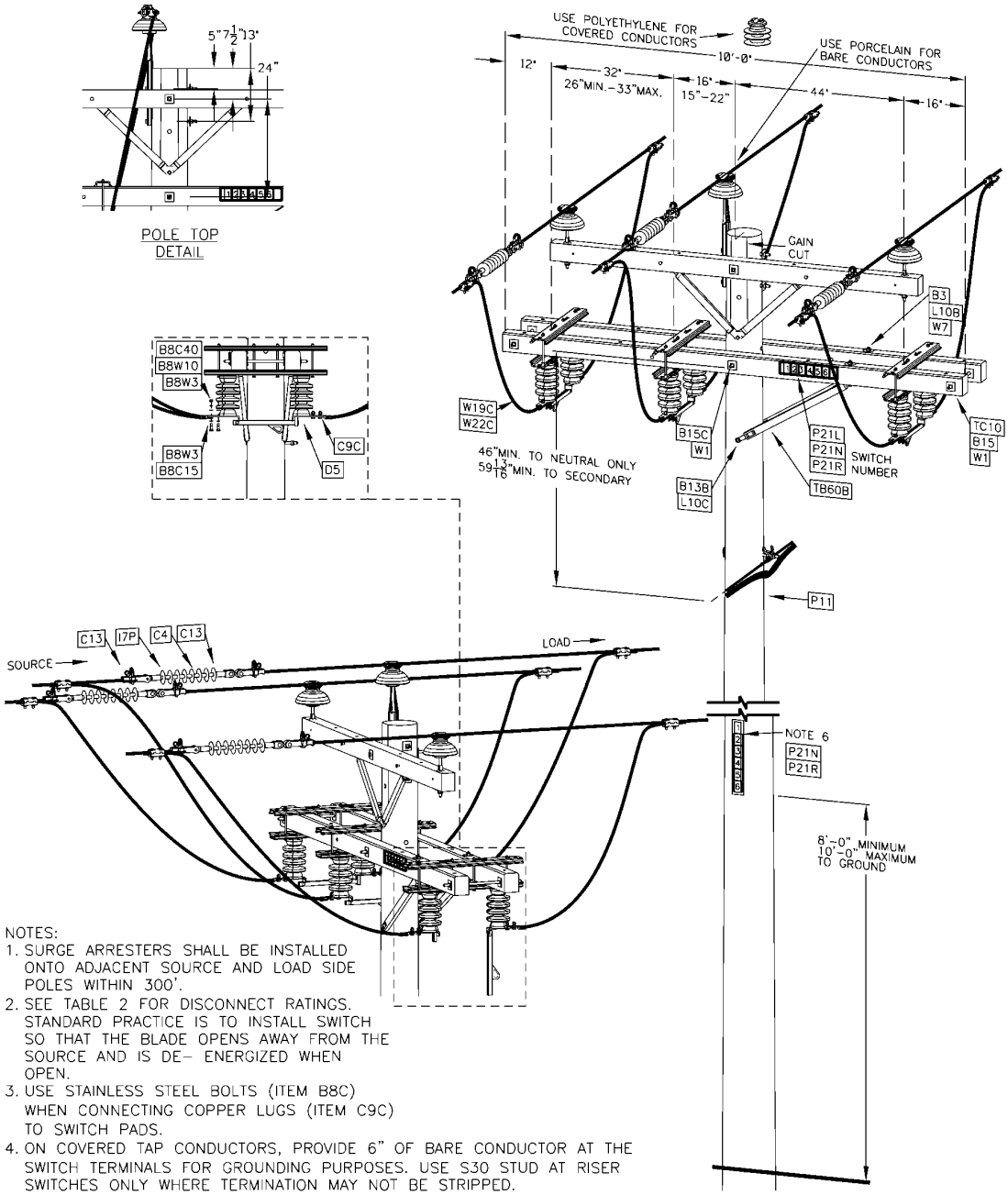
Supersedes 7/19 Issue – Revised drawing.

INSTALLATION OF IN-LINE SWITCHES 15-35 KV			
ISSUE	**PAGE NUMBER**		
7/21	**12-138**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @12-13910D15K	15 kV 3 Phase Disconnect Underslung
MU = @12-13910D35K	35 kV 3 Phase Disconnect Underslung (NE)

Supersedes 7/18 Issue – Updated Drawing



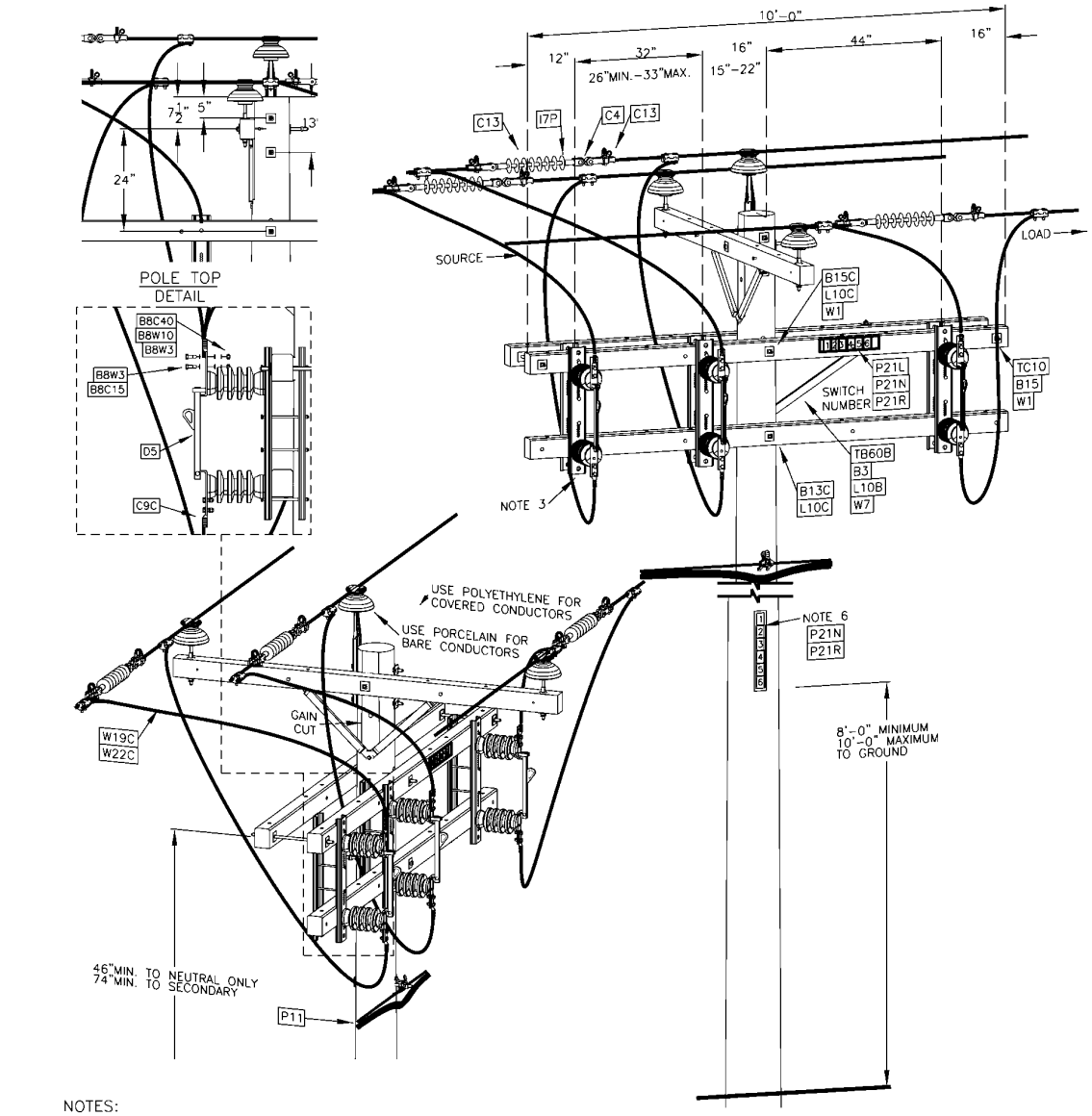
NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE- ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. THIS ARRANGEMENT IS AN ALTERNATE TO DRAWING 12-135, 0°-10°ANGLE DRAWING SHOWN. SEE DRAWING 12-140 FOR VERTICAL DISCONNECTS ON SWITCHARMS. (DISCONNECTS INSTALLED DIRECTLY TO THE DOUBLE 10' PRIMARY CROSSARMS)
6. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TOWARD TRAFFIC PROVIDING MAXIMUM VISIBILITY.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od12139	6/30/20

UNDERSLUNG DISCONNECT SWITCHES – ON SWITCHARMS 15-35 KV

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @12-14010D15K	15 kV 3 Phase Disconnect Vertical
MU = @12-14010D35K	35 kV 3 Phase Disconnect Vertical (NE)



NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE– ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. THIS ARRANGEMENT IS AN ALTERNATE TO DRAWING 12–137, 0'–10"ANGLE DRAWING SHOWN. SEE DRAWING 12–139 FOR HORIZONTAL UNDERHUNG DISCONNECTS ON SWITCH ARMS. SWITCH ARMS ARE ORIENTED PARALLEL TO POLE LINE FOR OPERATOR ACCESSABILITY.(DISCONNECTS INSTALLED DIRECTLY TO THE DOUBLE 10' PRIMARY CROSS ARMS)
6. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od12140	6/30/20

VERTICAL DISCONNECT SWITCHES – ON SWITCHARMS 15-35 KV

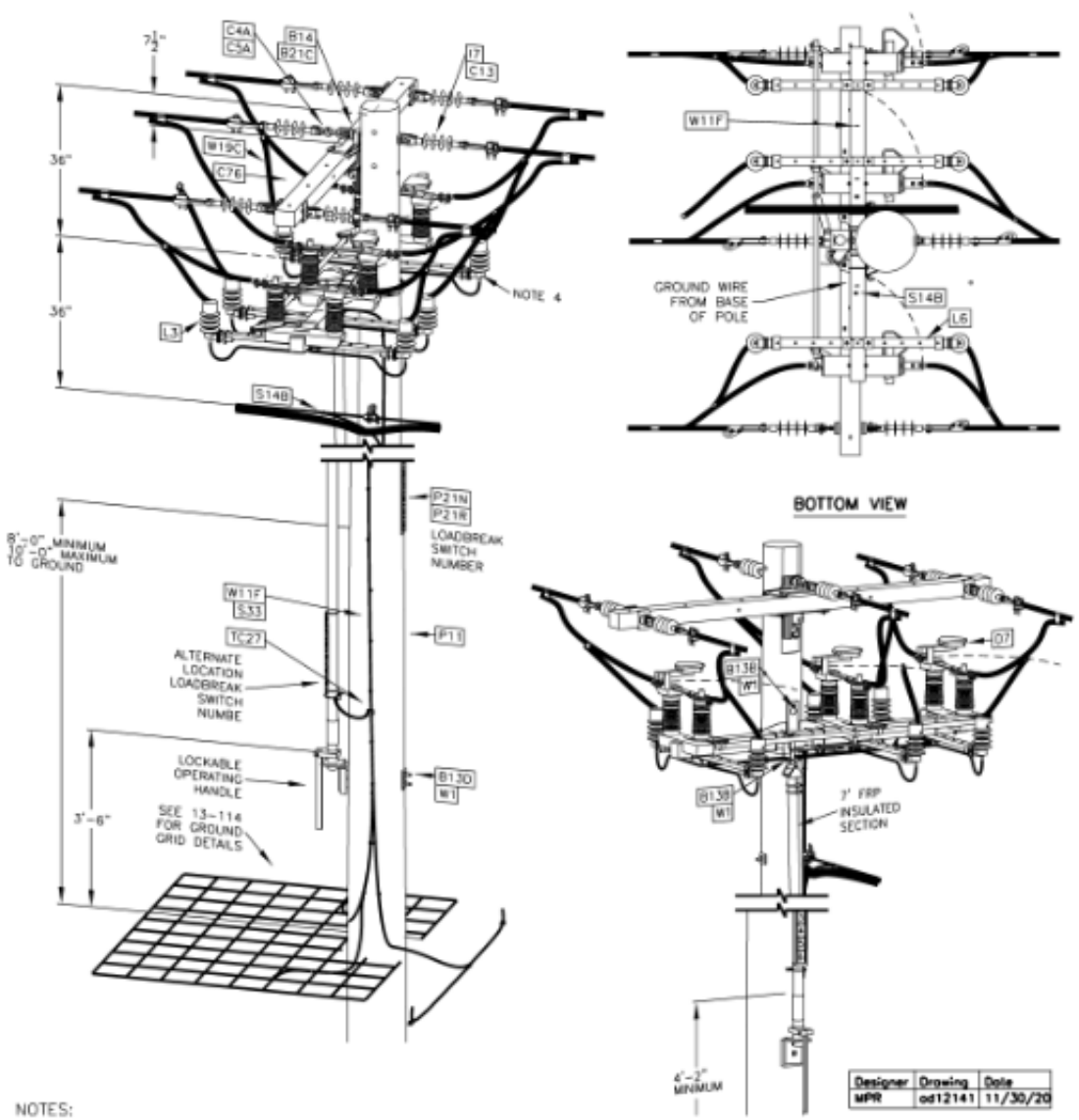
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	nationalgrid
7/20	12-140		

Supersedes 7/18 Issue – Updated Drawing

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @12-141LBSW15KVWXA	15 kV 3 Phase Loadbreak Switch)
MU = @12-141LBSW35KVWXA	35 kV 3 Phase Loadbreak Switch (NE)

Supersedes 7/20 Issue – Updated material IDs.



Designer	Drawing	Date
MPR	cd12141	11/30/20

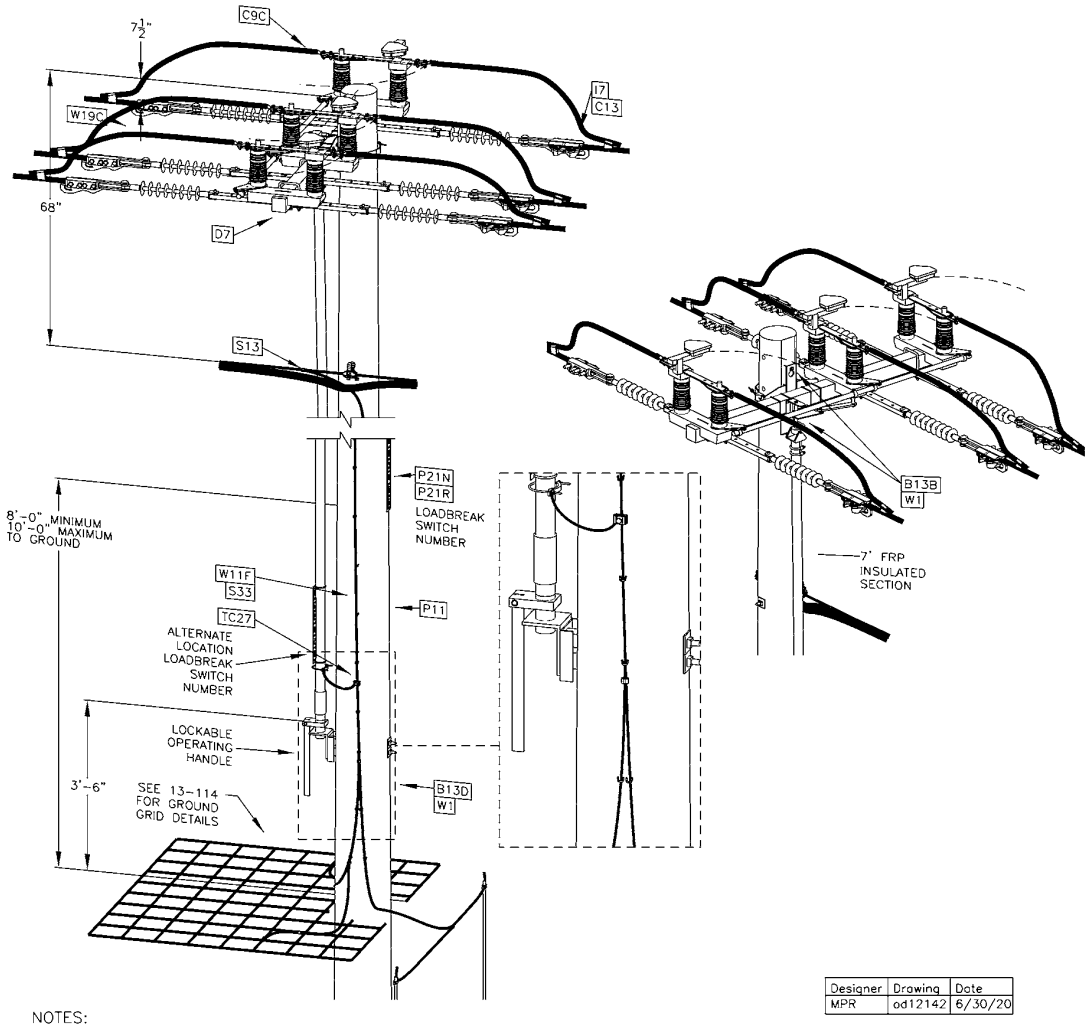
NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO THE LOAD BREAK ARRESTOR PROVISIONS PROVIDED OR ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'. (ARRESTERS MUST BE INSTALLED VERTICALLY AS SHOWN)
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
4. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
5. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING IS SHOWN.
6. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
7. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
8. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
9. ALL LOAD BREAKS TO BE INSTALLED ON A H1 CLASS POLE AND DOUBLE DEAD ENDED ON A FIBERGLASS CROSS ARM PER SECTION 4 – STORM HARDENING.
10. USE UC5G(500KCMIL CU TAP WIRE) WITH D7G(35KV 1200AMP LOADBREAK). UC5G CAN BE FOUND IN THE UG STANDARDS BOOK.
11. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

3Φ PRIMARY SECTIONALIZING - LOADBREAK SWITCH BELOW CROSSARM INSTALLATION 15-35 KV

nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-141	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @12-142LBSW15KV	15 kV 3 Ph LB Sw	MU = @12-142LBSW1120D35KV	35 kV 3 Ph LB Sw 11-20 Deg. (NE)
MU = @12-142LBSW35KV	35 kV 3 Ph LB Sw (NE)	MU = @12-142LBSWUNK15KV	35 kV 3 Ph LB Sw Unk Deg.
MU = @12-142LBSW1120D15KV	15 kV 3 Ph LB Sw 11-20 Deg.	MU = @12-142LBSWUNK35KV	35 kV 3 Ph LB Sw Unk Deg. (NE)



Designer	Drawing	Date
MPR	od12142	6/30/20

NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ONTO THE ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
4. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEAD END LOADING WILL BE EXCEEDED.
5. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING IS SHOWN.
6. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
7. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
8. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
9. STANDARD 12-141 IS THE PREFERRED METHOD OVER DEAD ENDING ON THE SWITCH. THIS STANDARD MAY BE USED IF ADJACENT POLES ARE UPGRADED TO A CLASS H1 WITH DOUBLE DEAD -ENDED FIBERGLASS CROSS ARMS PER SECTION 4 - STORM HARDENING.
10. USE UC5G(500KCMIL CU TAP WIRE) WITH D7G(35KV 1200AMP LOADBREAK). UC5G CAN BE FOUND IN THE UG STANDARDS BOOK.
11. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

3Φ PRIMARY SECTIONALIZING – CONDUCTOR DEADEND ON LOADBREAK SWITCH INSTALLATION 15-35 KV

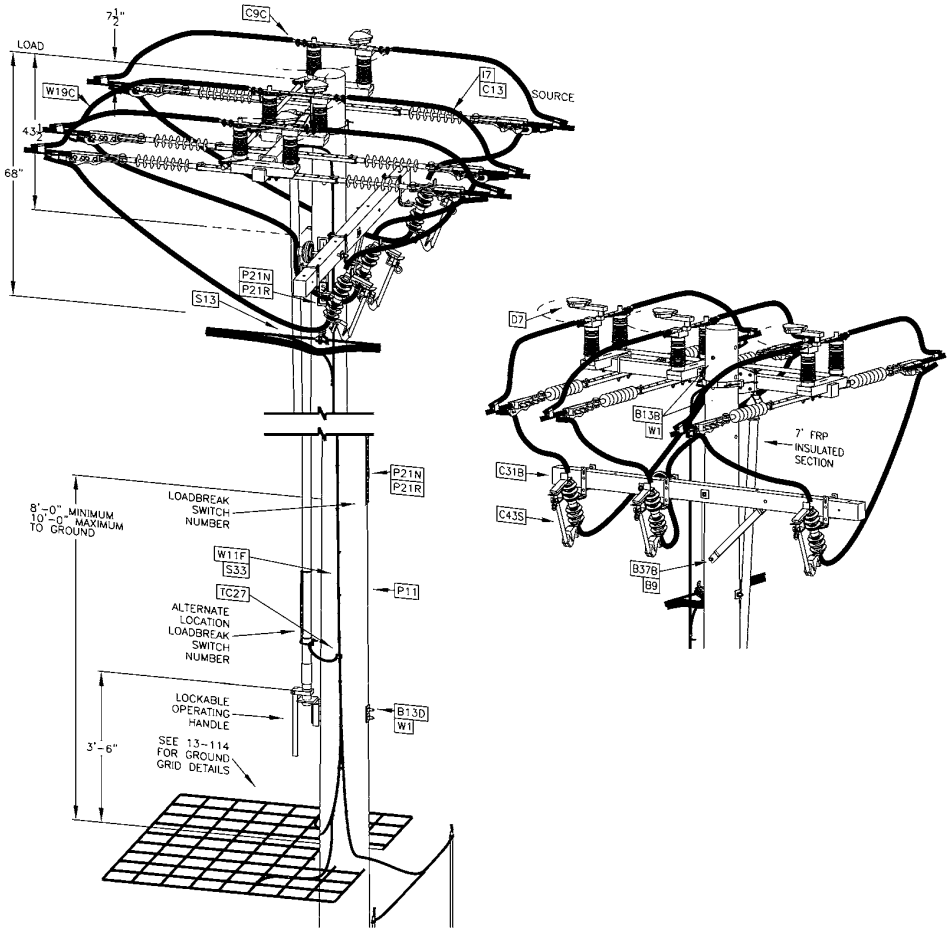
ISSUE	PAGE NUMBER		
7/21	12-142	OVERHEAD CONSTRUCTION STANDARD	nationalgrid

Supersedes 7/18 Issue – Updated Drawing.

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

MU = @12-143LBSW15KVWCO	15 kV 3 Phase Loadbreak Switch (NE), Plus Cutout MUs
MU = @12-143LBSW35KVWCO	35 kV 3 Phase Loadbreak Switch (NE), Plus Cutout MUs

Supersedes 7/19 Issue – Updated Drawing



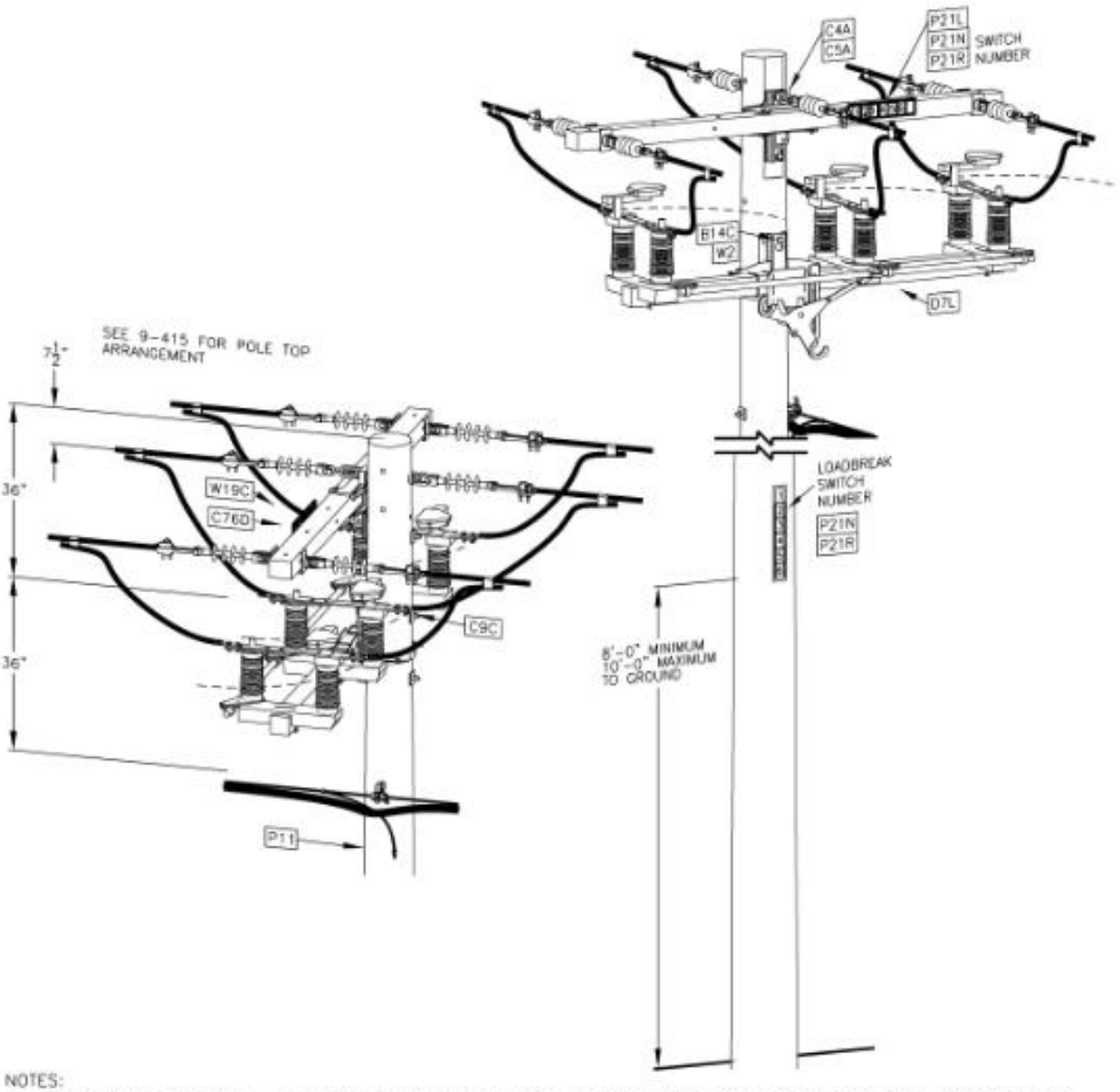
Designer	Drawing	Date
MPR	od12143	6/30/20

NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ONTO THE ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SHUNT FUSE CUTOUTS SHALL BE INSTALLED BELOW THE LOADBREAK SWITCH ONTO A 8' CROSSARM.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
6. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING IS SHOWN.
7. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
8. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
9. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
10. THIS STANDARD MAY BE USED IF ADJACENT POLES ARE UPGRADED TO A CLASS H1 WITH DOUBLE DEADENDED FIBERGLASS CROSSARMS PER SECTION 4 – STORM HARDENING.
11. USE UC5G(500KCMIL CU TAP WIRE) WITH D7G(35KV 1200AMP LOADBREAK). UC5G CAN BE FOUND IN THE UG STANDARDS BOOK.
12. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

3Φ PRIMARY SECTIONALIZING – LOADBREAK SWITCH WITH SHUNT CUTOUTS INSTALLATION 15-35 KV			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-143	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ON ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'. DOWN GROUND AND/OR SURGE ARRESTERS SHALL NOT BE INSTALLED ON THE SAME POLE AS THE SWITCH INSTALLATION.
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
4. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING IS SHOWN.
5. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
6. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
7. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
8. ALL LOAD BREAKS WITH EXCEPTION TO HOOKSTICK SWITCH TO BE INSTALLED ON A H1 CLASS POLE AND DOUBLE DEAD ENDED ON A FIBERGLASS CROSS ARM PER SECTION 4 – STORM HARDENING.
9. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

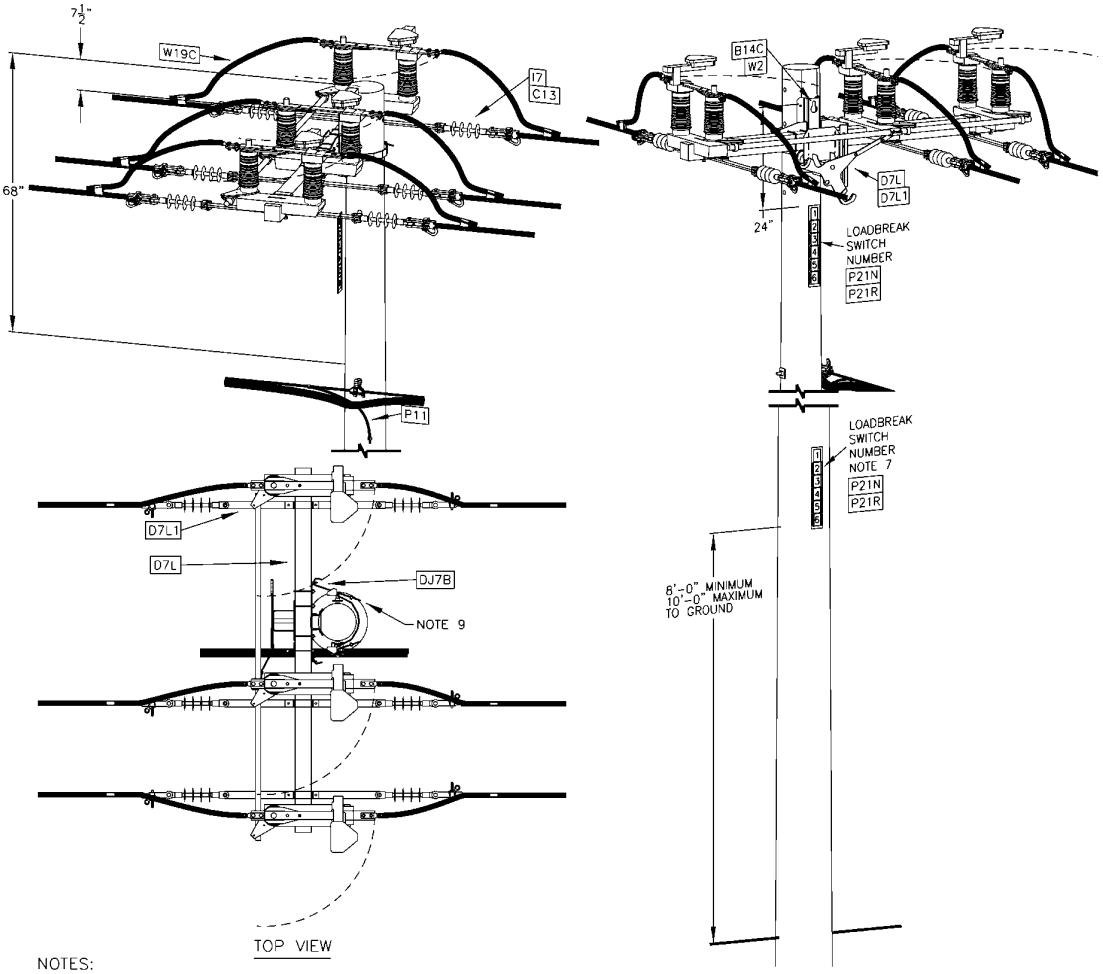
Designer	Drawing	Date
MPR	ad12144	11/30/20

Supersedes 7/20 Issue – Updated Drawing.

3Φ PRIMARY SECTIONALIZING – HOOK STICK LOADBREAK SWITCH BELOW CROSSARM INSTALLATION 15 KV			
ISSUE	**PAGE NUMBER**		
7/21	**12-144**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/19 Issue – Added top view and note 9



NOTES:

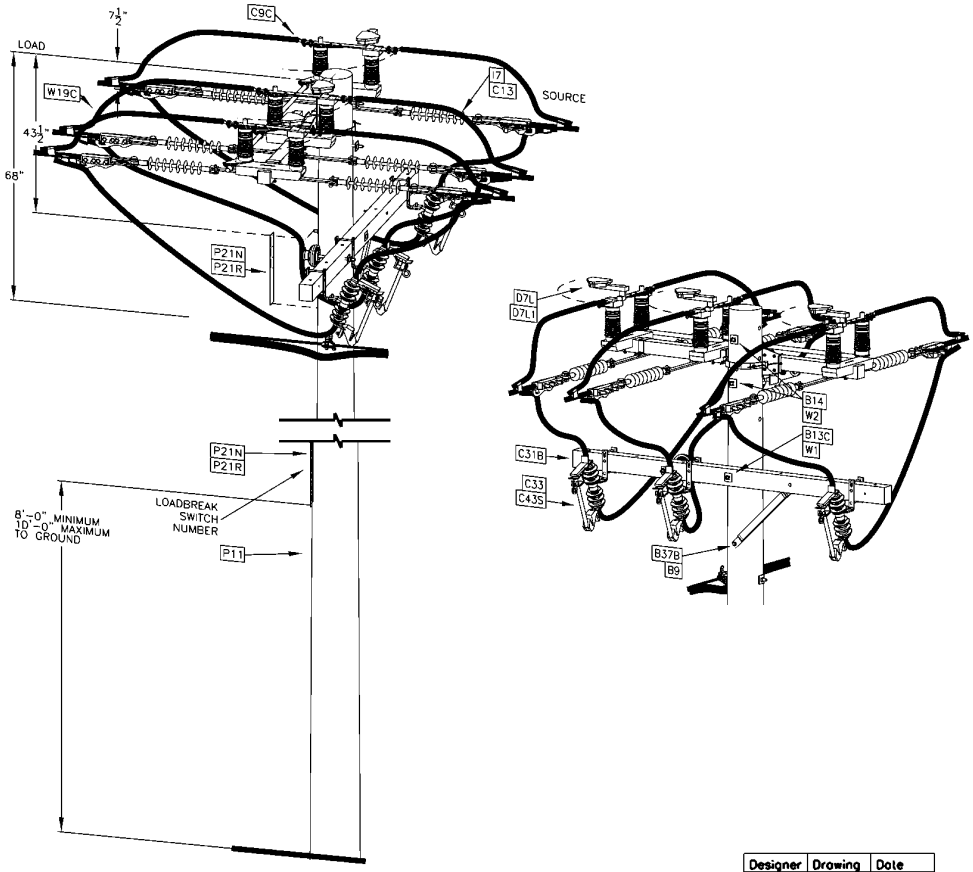
1. SURGE ARRESTERS SHALL BE INSTALLED ON ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'. DOWN GROUND AND/OR SURGE ARRESTERS SHALL NOT BE INSTALLED ON THE SAME POLE AS THE SWITCH INSTALLATION.
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
4. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
5. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING IS SHOWN.
6. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
7. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
8. STANDARD 12–144 IS THE PREFERRED METHOD OVER DEAD ENDING ON THE SWITCH. THIS STANDARD MAY BE USED IF ADJACENT POLES ARE UPGRADED TO A H1 CLASS POLE WITH DOUBLE DEAD ENDED FIBERGLASS CROSS ARMS PER SECTION 4 – STORM HARDENING.
9. ALL LOADBREAK SWITCHES COME WITH STANDARD LENGTH J–BOLTS AND POLE BANDS FOR 61#2" TO 14"ø POLES, TO BE USED WHERE DEADENDING CONDUCTORS ON THE SWITCH. EXTENDED LENGTH 201#4" J–BOLTS ARE AVAILABLE FOR LARGER H1 POLES.
10. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od12145	6/30/20

3Φ PRIMARY SECTIONALIZING – HOOK STICK LOADBREAK SWITCH CONDUCTOR DEADEND ON SWITCH INSTALLATION 15 KV

nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-145	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



Designer	Drawing	Date
MPR	od12146	6/30/20

NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ONTO THE ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SHUNT FUSE CUTOUTS SHALL BE INSTALLED BELOW THE LOADBREAK SWITCH ONTO A 8' CROSSARM.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
6. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING IS SHOWN.
7. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
8. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
9. THIS STANDARD MAY BE USED IF ADJACENT POLES ARE UPGRADED TO A CLASS H1 WITH DOUBLE DEADENDED FIBERGLASS CROSSARMS PER SECTION 4 – STORM HARDENING.
10. USE UC5G (500KCMIL CU TAP WIRE) WITH D7G(35KV 1200AMP LOADBREAK). UC5G CAN BE FOUND IN THE UG STANDARDS BOOK.
11. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

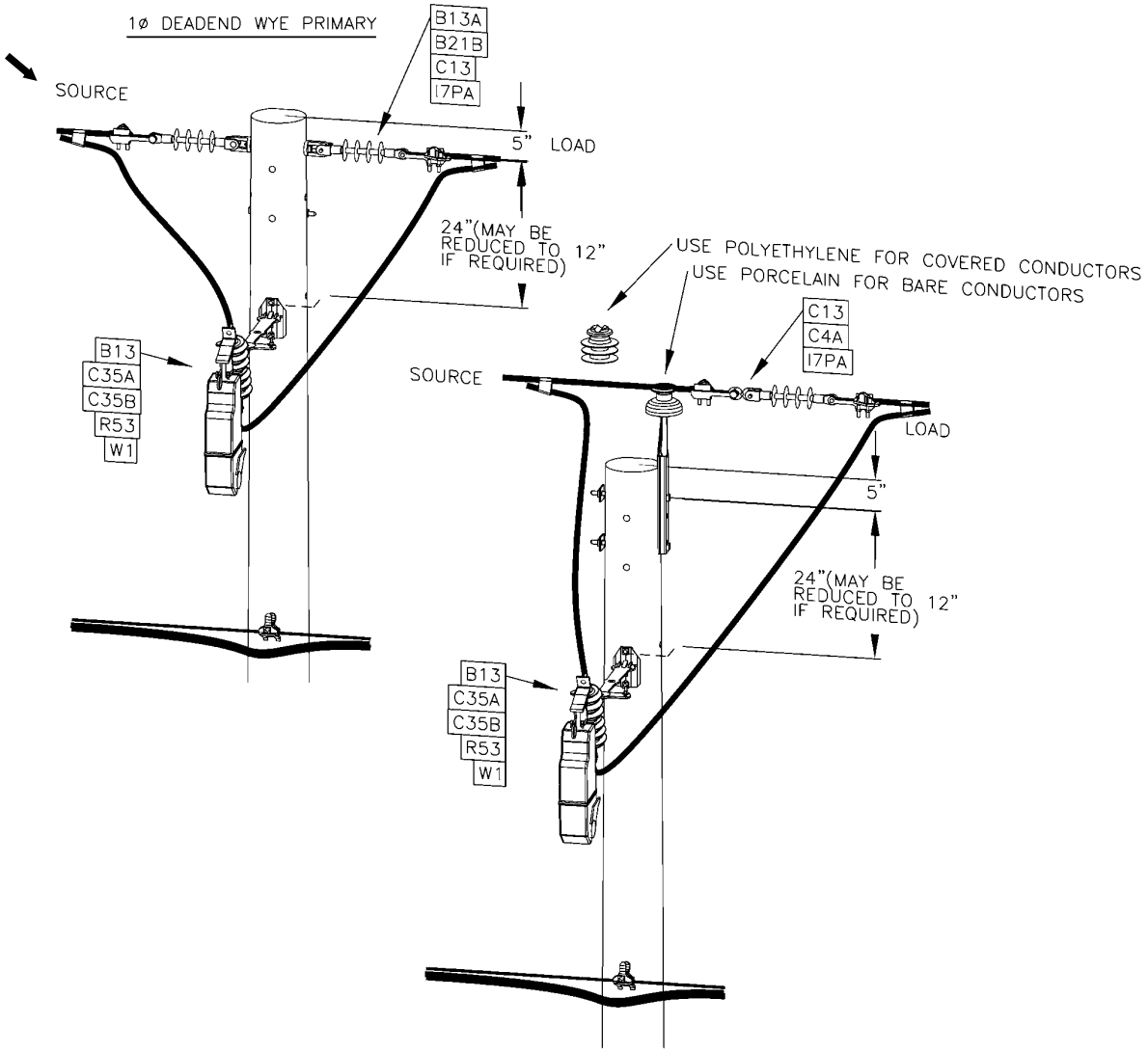
Supersedes 7/19 Issue – Updated drawing.

3Φ PRIMARY SECTIONALIZING – HOOK STICK LOADBREAK SWITCH WITH SHUNT CUTOUTS – 15 kV			
ISSUE	**PAGE NUMBER**		
7/21	**12-146**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

7/19 - New Page.

Copyright 2020 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

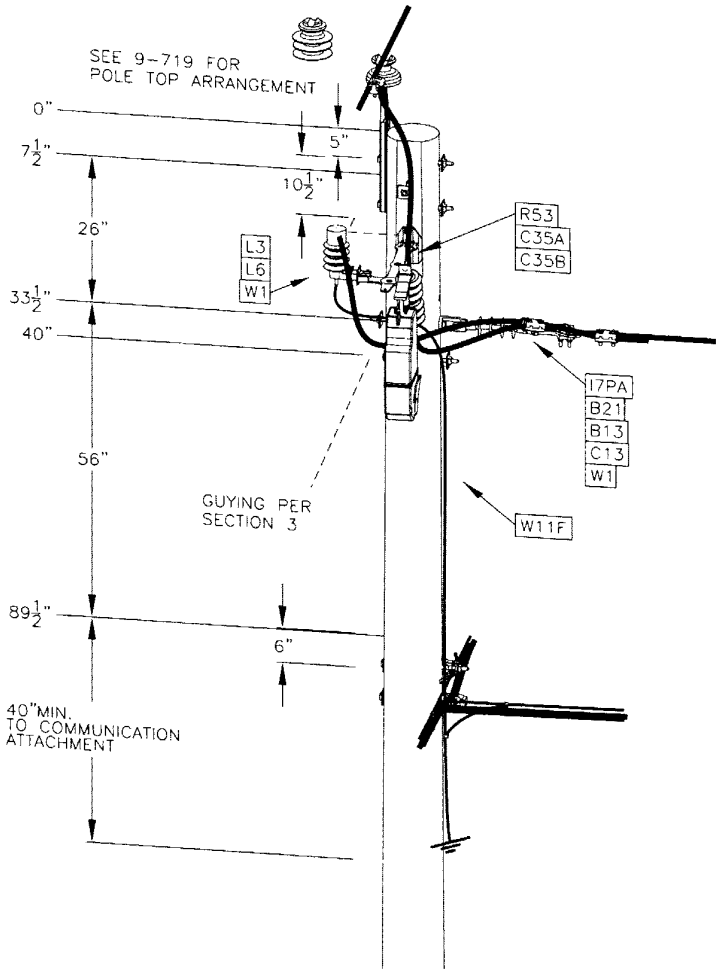


NOTES:
1. RECLOSERS MUST BE INSTALLED IN A 100AMP MACLEAN POWER SYSTEMS TYPE XS FUSE CUTOUT MOUNTING (INCLUDED WITH UNIT).
2. INSTALL TAG HOLDER (STANDARD ITEM P23E) ON POLE – 8' UP FROM GROUND LEVEL.
3. PROVIDE SUFFICIENT CLEARANCE FOR OPERATION, INSTALLATION AND REMOVAL OF UNIT.
4. INSTALL ARRESTERS ON LOAD SIDE OF RECLOSER ON SAME POLE OR ADJACENT POLES WITHIN 300'. (REFER TO SECTION 13.6.40A)
5. LOCATION, APPLICATION AND SETUP OF THIS DEVICE MUST BE DONE UNDER THE DIRECTION OF ELECTRIC OPERATIONS ENGINEERING.

SINGLE PHASE VACUUM OPERATED CUTOUT MOUNTED RECLOSER – SINGLE PHASE TAP INLINE TANGENT AND DEADEND INSTALLATIONS 15KV MAX			
ISSUE	**PAGE NUMBER**		
7/20	**12-328**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Supersedes 7/18 Issue – Corrected typo in drawing.

Copyright 2019 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



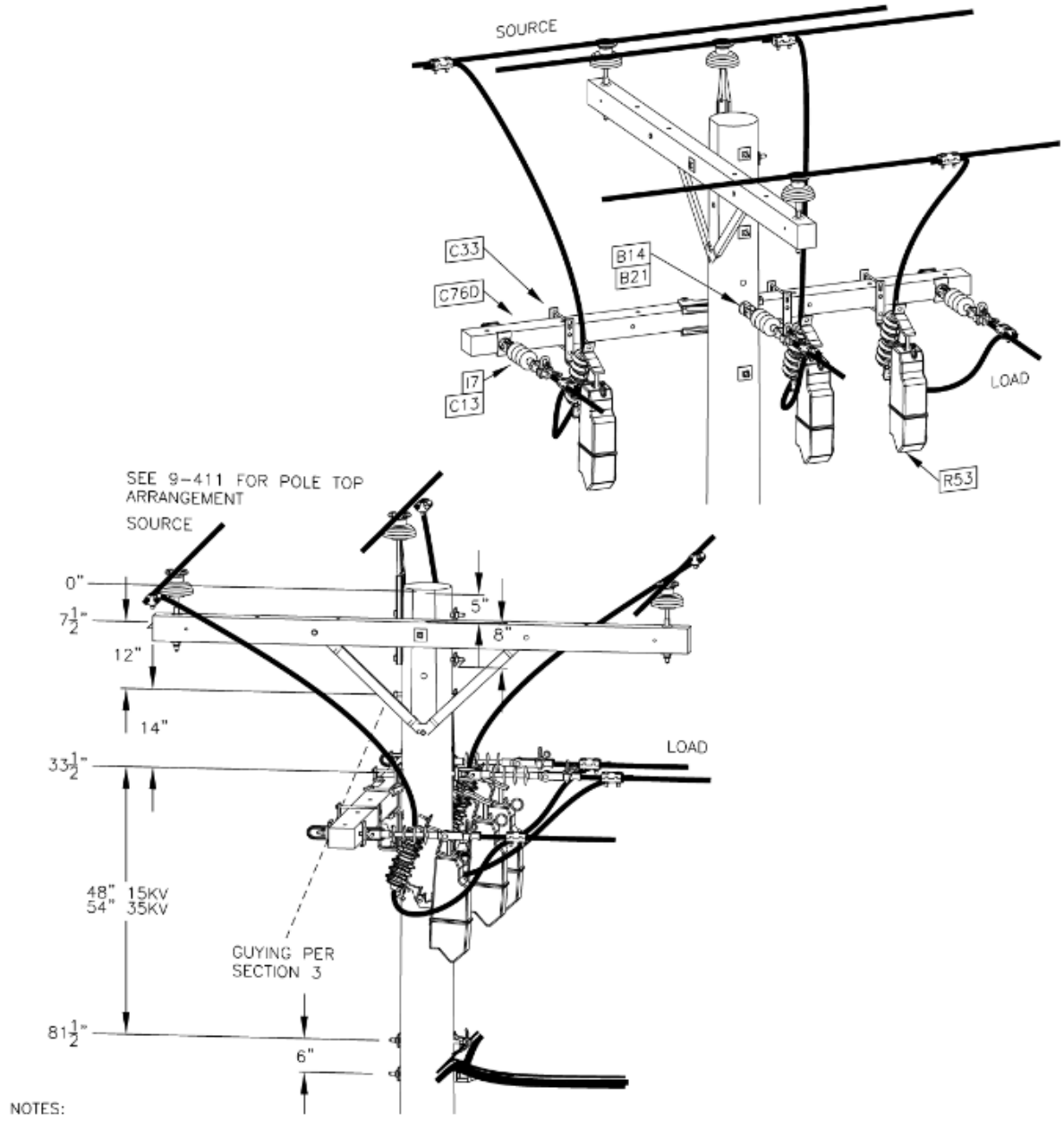
NOTES:
1. RECLOSERS MUST BE INSTALLED IN A 100AMP MACLEAN POWER SYSTEMS TYPE XS FUSE CUTOUT MOUNTING (INCLUDED WITH UNIT).
2. INSTALL TAG HOLDER (STANDARD ITEM P23E) ON POLE – 8' UP FROM GROUND LEVEL.
3. PROVIDE SUFFICIENT CLEARANCE FOR OPERATION, INSTALLATION AND REMOVAL OF UNIT.
4. INSTALL ARRESTERS ON LOAD SIDE OF RECLOSER ON SAME POLE OR ADJACENT POLES WITHIN 300'. (REFER TO SECTION 13.6.40A)
5. LOCATION, APPLICATION AND SETUP OF THIS DEVICE MUST BE DONE UNDER THE DIRECTION OF ELECTRIC OPERATIONS ENGINEERING.

Designer	Drawing	Date
MPR	od12329	3/15/19

SINGLE PHASE VACUUM OPERATED CUTOUT MOUNTED RECLOSER SINGLE PHASE TAP INSTALLATION 15KV MAX

nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-329	7/19

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.



NOTES:

1. RECLOSURES MUST BE INSTALLED IN A 100AMP MACLEAN POWER TYPE XS FUSE CUTOUT MOUNTING. (INCLUDED WITH UNIT)
2. INSTALL TAG HOLDER (STANDARD ITEM P23E) ON POLE – 8' UP FROM GROUND LEVEL.
3. PROVIDE SUFFICIENT CLEARANCE FOR OPERATION, INSTALLATION AND REMOVAL OF UNIT.
4. INSTALL ARRESTERS ON LOAD SIDE OF RECLOSER ON SAME POLE OR ADJACENT POLES WITHIN 300'. (REFER TO SECTION 13.6.40A)
5. LOCATION, APPLICATION AND SETUP OF THIS DEVICE MUST BE DONE UNDER THE DIRECTION OD ELECTRIC OPERATIONS ENGINEERING.

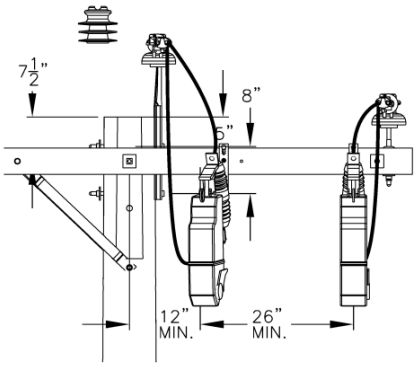
Designer	Drawing	Date
MPR	od12330	1/15/21

Supersedes 7/19 Issue – Updated material IDs.

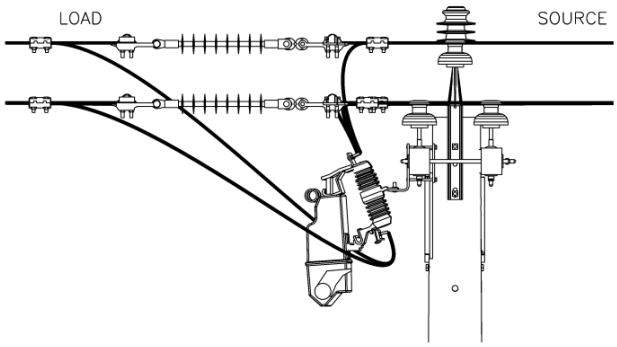
SINGLE PHASE VACUUM OPERATED CUTOUT MOUNTED RECLOSER– THREE PHASE TAP INSTALLATION 15kV MAX			
ISSUE	**PAGE NUMBER**		
7/21	**12-330**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2018 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

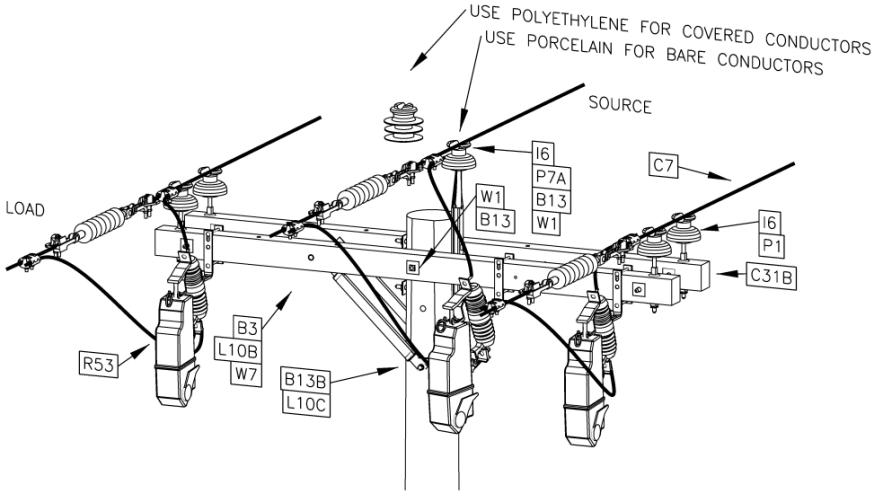
Supersedes 7/17 Issue – Updated Drawing



POLE TOP DETAIL



SIDE VIEW



0°–10°ANGLES

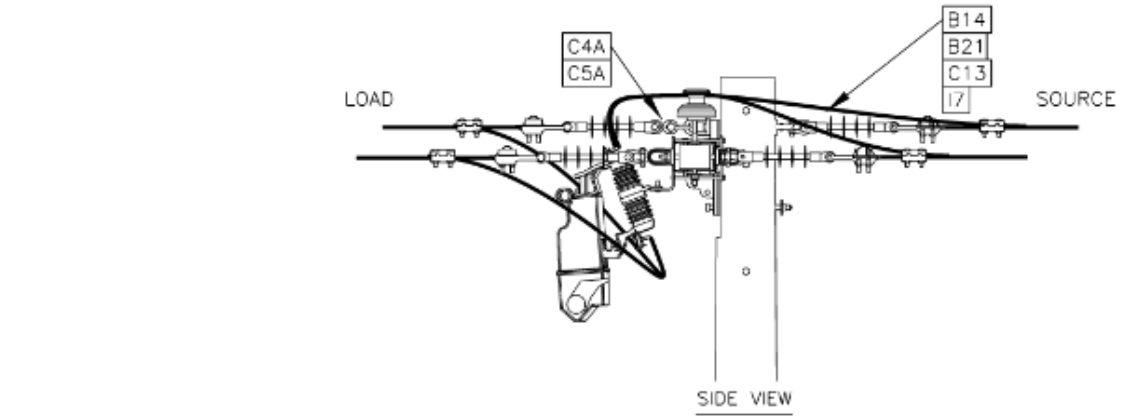
NOTES:

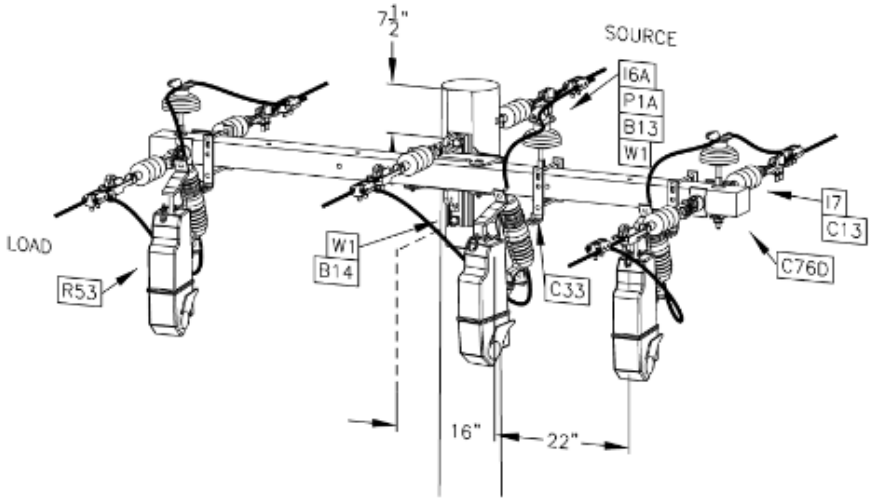
1. RECLOSERS MUST BE INSTALLED IN A 100AMP MACLEAN POWER SYSTEM TYPE XS FUSE CUTOUT MOUNTING. (INCLUDED WITH UNIT)
2. INSTALL TAG HOLDER (STANDARD ITEM P23E) ON POLE – 8' UP FROM GROUND LEVEL.
3. PROVIDE SUFFICIENT CLEARANCE FOR OPERATION, INSTALLATION AND REMOVAL OF UNIT.
4. INSTALL ARRESTERS ON LOAD SIDE OF RECLOSER ON SAME POLE OR ADJACENT POLES WITHIN 300'. (REFER TO SECTION 13.6.40A)
5. LOCATION, APPLICATION AND SETUP OF THIS DEVICE MUST BE DONE UNDER THE DIRECTION OF ELECTRIC OPERATIONS ENGINEERING.
6. USE DOUBLE PINS AND INSULATORS ON CROSS ARMS FOR ANGLES 11°TO 20° AND ATTACH CONDUCTOR TO SIDE GROOVE OF INSULATORS.

Designer	Drawing	Date
MPR	od12331	7/3/18

SINGLE PHASE VACUUM OPERATED CUTOUT MOUNTED RECLOSER THREE PHASE TANGENT INLINE INSTALLATION 15kV MAX

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.





DEADENDS AND ANGLES 21° TO 60°

Supersedes 7/19 Issue – Updated material IDs.

NOTES:

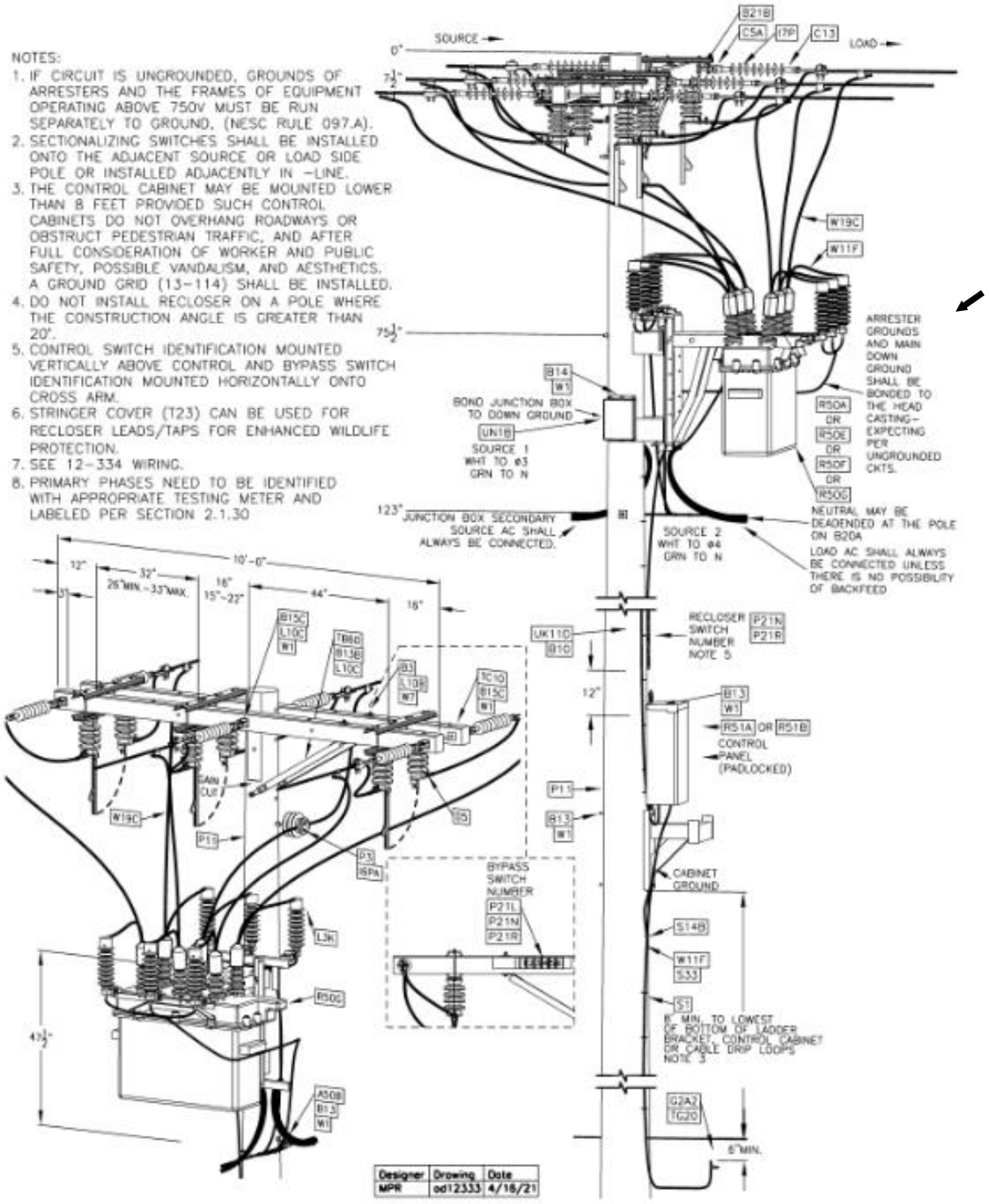
1. RECLOSERS MUST BE INSTALLED IN A 100AMP MACLEAN POWER SYSTEM TYPE XS FUSE CUTOUT MOUNTING. (INCLUDED WITH UNIT)
2. INSTALL TAG HOLDER (STANDARD ITEM P23E) ON POLE – 8' UP FROM GROUND LEVEL.
3. PROVIDE SUFFICIENT CLEARANCE FOR OPERATION, INSTALLATION AND REMOVAL OF UNIT.
4. INSTALL ARRESTERS ON LOAD SIDE OF RECLOSER ON SAME POLE OR ADJACENT POLES WITHIN 300'. (REFER TO SECTION 13.6.40A)
5. LOCATION, APPLICATION AND SETUP OF THIS DEVICE MUST BE DONE UNDER THE DIRECTION OF ELECTRIC OPERATIONS ENGINEERING.

Designer	Drawing	Date
MPR	od12332	1/15/21

SINGLE PHASE VACUUM OPERATED CUTOUT MOUNTED RECLOSER– THREE PHASE TAP INSTALLATION 15kV MAX			
ISSUE	**PAGE NUMBER**		
7/21	**12-332**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

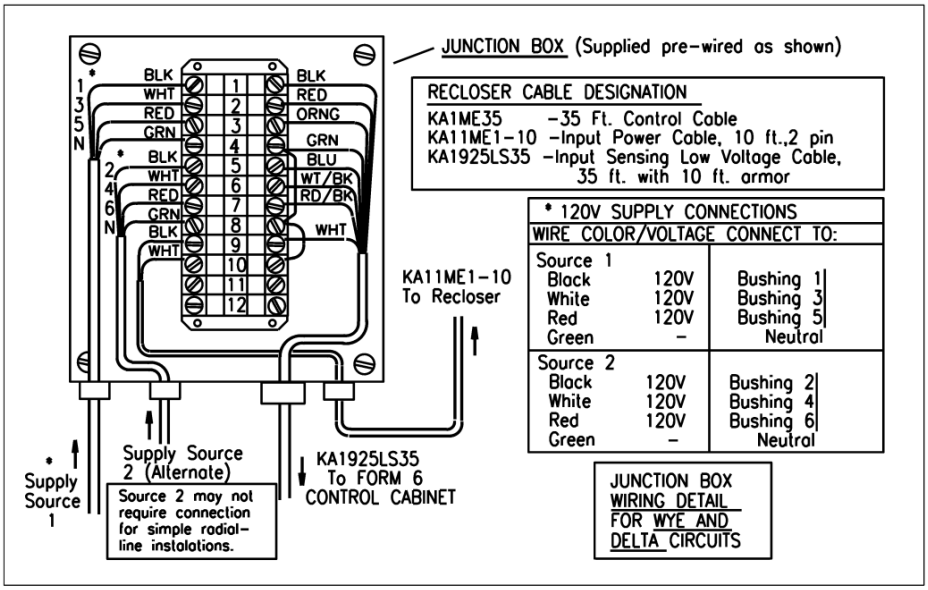
Supersedes 7/20 Issue – Updated material IDs.

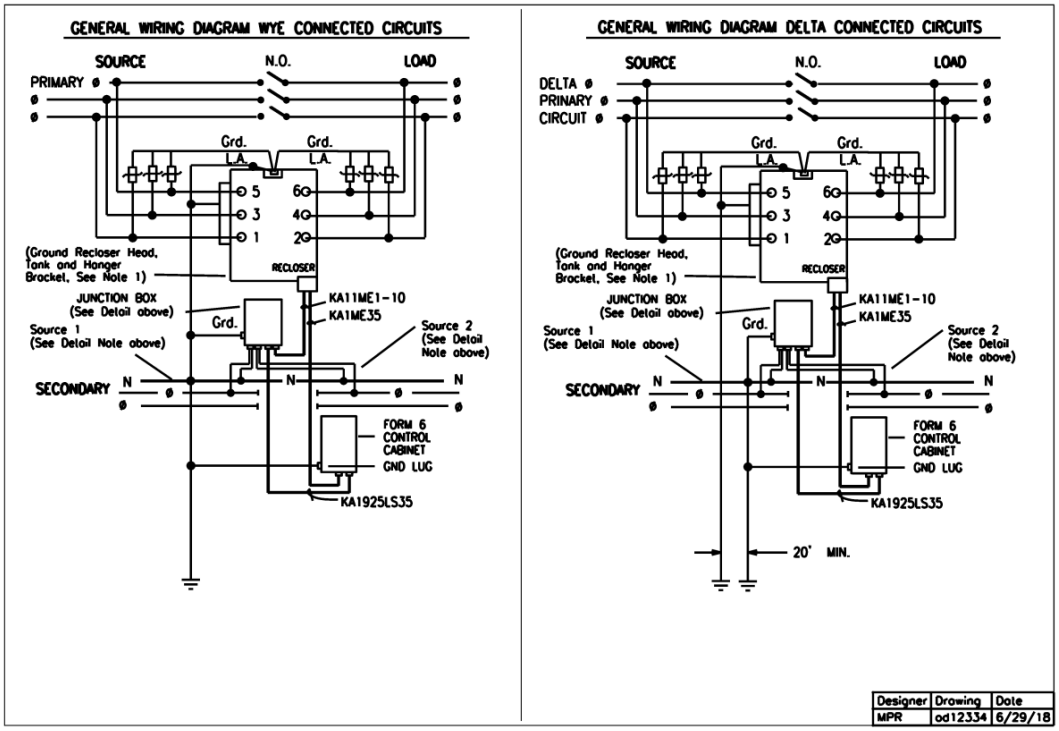


Φ RECLOSER EFFECTIVELY GROUNDED INSTALLATION 15-35 KV

nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-333	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.





Supersedes 7/18 Issue – Corrected drawing title.

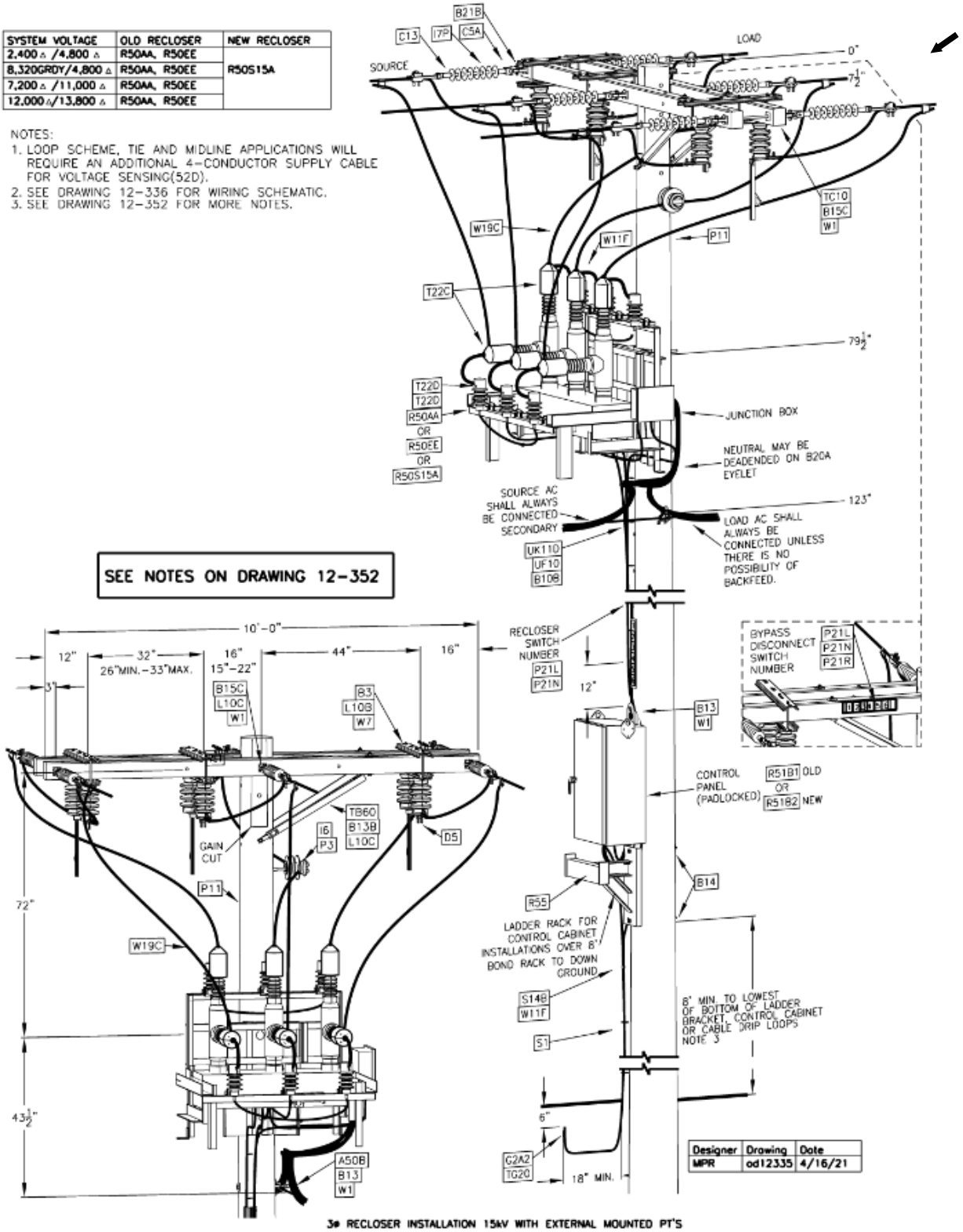
3Φ RECLOSER INSTALLATION WIRING DETAILS AND NONEFFECTIVELY GROUNDED CIRCUIT GROUNDING 15-35 KV			
ISSUE	**PAGE NUMBER**		
7/21	**12-334**	**OVERHEAD CONSTRUCTION STANDARD**	nationalgrid

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

Supersedes 7/20 Issue – Update notes and material IDs.

SYSTEM VOLTAGE	OLD RECLOSER	NEW RECLOSER
2,400 Δ /4,800 Δ	R50AA, R50EE	R50S15A
8,320GRDY/4,800 Δ	R50AA, R50EE	
7,200 Δ /11,000 Δ	R50AA, R50EE	
12,000 Δ/13,800 Δ	R50AA, R50EE	

NOTES:
1. LOOP SCHEME, TIE AND MIDLINE APPLICATIONS WILL REQUIRE AN ADDITIONAL 4-CONDUCTOR SUPPLY CABLE FOR VOLTAGE SENSING(52D).
2. SEE DRAWING 12-336 FOR WIRING SCHEMATIC.
3. SEE DRAWING 12-352 FOR MORE NOTES.



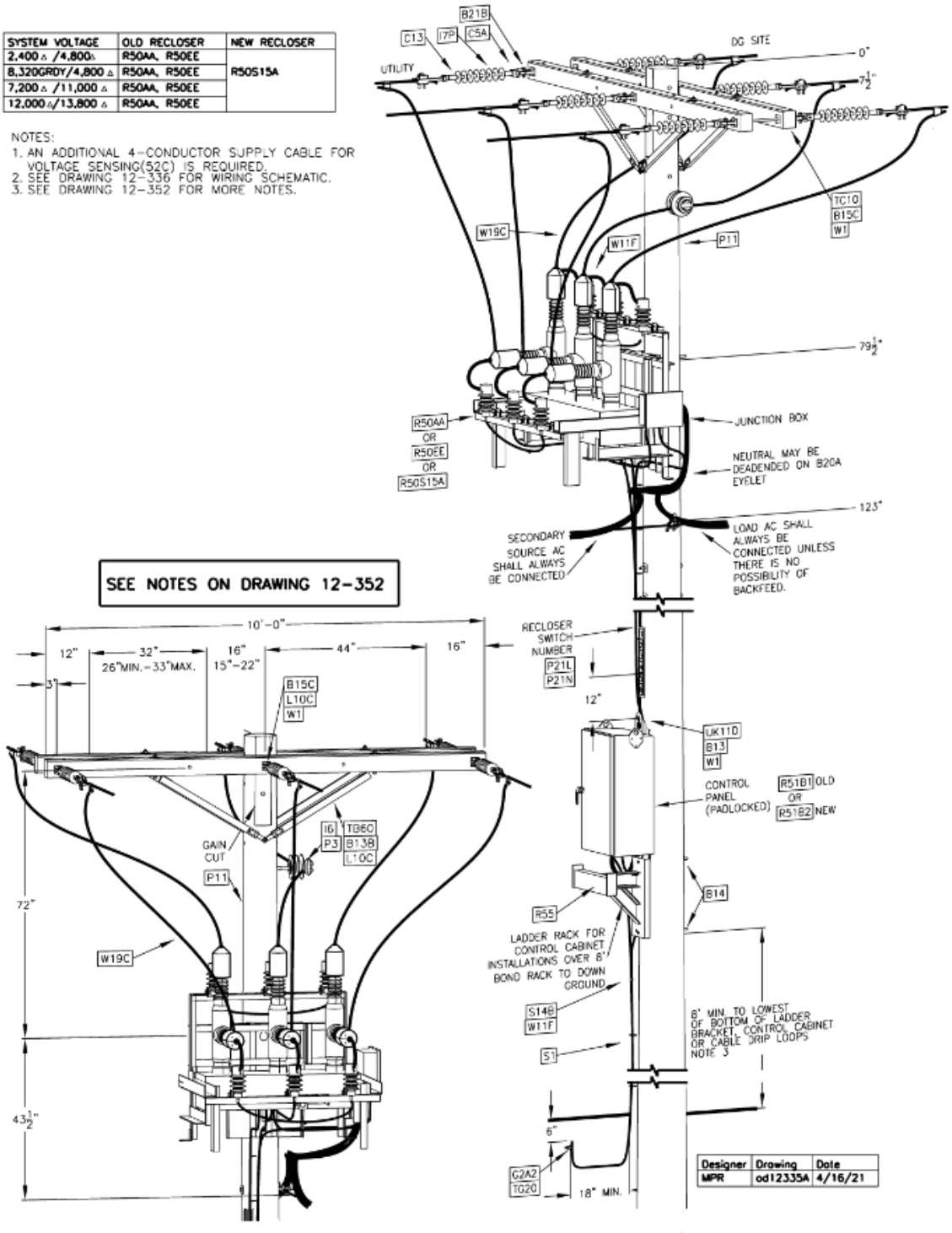
3Φ RECLOSER INSTALLATION 15kV WITH EXTERNAL MOUNTED PT'S

3Φ RECLOSER INSTALLATION 5-35 KV EFFECTIVELY GROUNDED, NON-EFFECTIVELY GROUNDED, & DELTA SYSTEMS			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-335	7/21

Copyright 2021 National Grid. For information regarding property rights, confidentiality and use see Section 1.
Printed copies of this document are not document controlled. Refer to the National Grid INFONET, Distribution Engineering Services website, for the latest version. Controlled copies are maintained in Documentum.

SYSTEM VOLTAGE	OLD RECLOSER	NEW RECLOSER
2,400 Δ /4,800 Δ	R50AA, R50EE	R50S15A
8,320GRDY/4,800 Δ	R50AA, R50EE	
7,200 Δ /11,000 Δ	R50AA, R50EE	
12,000 Δ/13,800 Δ	R50AA, R50EE	

NOTES:
1. AN ADDITIONAL 4-CONDUCTOR SUPPLY CABLE FOR VOLTAGE SENSING(52C) IS REQUIRED.
2. SEE DRAWING 12-336 FOR WIRING SCHEMATIC.
3. SEE DRAWING 12-352 FOR MORE NOTES.



3Φ RECLOSER INSTALLATION 15kV WITH EXTERNAL MOUNTED PT'S FOR DISTRIBUTED GENERATION PCC

Supersedes 7/20 Issue – Update notes and material IDs.

3Φ RECLOSER INSTALLATION DISTRIBUTED GENERATION PCC 5-35 KV			
ISSUE	**PAGE NUMBER**		
7/21	**12-335A**	OVERHEAD CONSTRUCTION STANDARD	nationalgrid