FirstEnergy Statement No. 4-R

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Verizon Pennsylvania LLC and Verizon North LLC

v.

Metropolitan Edison Company, Pennsylvania Electric Company, and Pennsylvania Power Company
Docket No. C-2020-3019347

Rebuttal Testimony
of
Randal J. Coleman, P.E.

List of Topics Addressed

As-Found Construction of Verizon's Attachments to FirstEnergy's Poles

Costs to Remove FirstEnergy's Electric Facilities from Verizon's Poles

Physical Characteristics and Spacing of Verizon's Attachments to FirstEnergy's Poles

NON-PROPRIETARY VERSION

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REBUTTAL TESTIMONY
OF
RANDAL J. COLEMAN, P.E.

I. <u>INTRODUCTION AND PURPOSE</u>

Q. Please state your name and business address.

A. My name is Randal J. Coleman. My business address is 76 South Main, Akron, Ohio 44308.

Q. By whom are you employed and in what capacity?

A. I am the Manager, Distribution Standards at FirstEnergy Service Company.

Q. What are your duties as Manager, Distribution Standards?

A. In my current capacity, I oversee activities associated with the use of distribution poles owned and used by the above-named FirstEnergy operating utilities. My duties also include development and maintenance of construction standards, engineering practices, selection of materials and approved usage. The position requires a background in the National Electric Safety Code ("NESC") and application of this standard in addition to the safety guidelines and objectives of FirstEnergy.

Q. What is your educational background?

A. I am a Professional Engineer licensed in the state of Pennsylvania. I received by Bachelor of Science degree in Engineering in 1993 from Geneva College.

Q. Please describe your professional experience.

A. I have held my current position since June 2007. I have worked for FirstEnergy since April 25, 1979, and have more than 30 years of experience in electric distribution, principally in engineering and engineering-related areas. I am a member of the Southeastern Electrical Exchange NESC Advisory Committee and the National Electric Energy Testing, Research & Applications Center ("NEETRAC") Management Board. I also serve as an Advisor to the Electric Power Research Institute ("EPRI") Distribution Committee.

Q. Have you previously testified as a witness before the Pennsylvania Public Utility Commission ("Commission")?

A. No.

Q. What is the purpose your rebuttal testimony?

A. On behalf of Metropolitan Edison Company ("Met-Ed"), Pennsylvania Electric Company ("Penelec"), and Pennsylvania Power Company ("Penn Power") (collectively, "FirstEnergy" or the "Companies"), I will address: (1) instances where the as-found construction of Verizon Pennsylvania LLC's and Verizon North LLC's (collectively, "Verizon") attachments to FirstEnergy's poles did not match FirstEnergy's published construction standards; (2) the estimated costs to remove FirstEnergy's attachments from Verizon's poles and to construct duplicate facilities to house those attachments; and (3) the physical characteristics and spacing of Verizon's attachments on FirstEnergy's poles.

Q. Are you sponsoring any exhibits with your rebuttal testimony?

A. Yes, I am sponsoring FirstEnergy Exhibits RC-1 through RC-3.

II. AS-FOUND CONSTRUCTION OF VERIZON'S ATTACHMENTS TO FIRSTENERGY'S POLES

Q. Have all of Verizon's attachments to FirstEnergy's poles matched FirstEnergy's published construction standards?

A. No. Attached hereto as FirstEnergy Exhibit RC-1 are photographs of poles to which Verizon is attached and that I reviewed in support of FirstEnergy's Answer. In each case where the as-found construction did not match FirstEnergy's published construction standards, a corrective notion was added to reflect a change in alignment and the new power space. The space notation was based on FirstEnergy's construction standards in effect as of January 2020. This is the same process FirstEnergy regularly uses to make space accommodations for attaching parties.

Q. What FirstEnergy construction standards did you apply when calculating the corrected space requirements for these poles?

A. I applied the following FirstEnergy construction standards when calculating the corrected space requirements for 210 of the as-found pole images shown in FirstEnergy Exhibit RC-1: Section 6 (entire section); Section 7 (entire section); Section 08-010; Section 08-505; Section 11-115; Section 11-116; Section 12-606; Section14-210; and Section 16-100. These construction standards are attached hereto as FirstEnergy Exhibit RC-2.

Q. Please explain how these construction standards are relevant to the as-found pole images reflected in FirstEnergy Exhibit RC-1.

A. Each of the construction standards identifies the upper bounds of the communication zone on a pole, with 40 inches of separation between the lowest power device and the upper most communication attachment. The bottom space of the communication zone is bounded by the incumbent local exchange carrier ("ILEC"), while the remaining space (if any) is made available for competitive local exchange carrier ("CLEC") attachments.

III. COSTS TO REMOVE FIRSTENERGY'S ELECTRIC FACILITIES FROM VERIZON'S POLES

Q. Have you developed estimates of the costs to remove FirstEnergy's facilities from Verizon's poles?

A. Yes. Attached to my rebuttal testimony as FirstEnergy Exhibit RC-3[1] is a chart prepared in 2014 under my supervision, which explains certain costs associated with the removal of the electric facilities of FirstEnergy from poles owned by Verizon.

Specifically, the chart identifies the following costs that would be incurred by FirstEnergy to do the following:

a. Construct a new overhead pole line for the needs of FirstEnergy alone that would be adjacent to a line of poles owned by Verizon and then transfer the existing FirstEnergy electric facilities from the Verizon poles to the newly- constructed pole line. These costs are identified in Rows 3-10.

b. Construct a new overhead pole line for the needs of FirstEnergy alone that would be located across the street from a line of poles owned by Verizon, construct equivalent electric facilities for the use of FirstEnergy on that new pole line, and

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[1] Two versions of FirstEnergy Exhibit RC-3 are being provided: (1) a non-confidential version with the estimated cost information set forth in Column C redacted; and (2) a CONFIDENTIAL version that shows the estimated cost information set forth in Column C.

remove the existing FirstEnergy electric facilities from Verizon's poles. These costs are identified in Rows 12-19.

c. Construct underground facilities for the needs of FirstEnergy alone that would be located adjacent to a line of poles owned by Verizon and then transfer the existing FirstEnergy electric facilities from the Verizon poles to the newly-constructed underground facilities. These costs are identified in Rows 21-28, with additional per customer costs identified in Rows 30-31.

Q. Would those estimated costs vary depending on the electric facilities' complexity and geographic location?

A. Yes. As the chart indicates, the costs that would be incurred by FirstEnergy to perform such activities specified in points (a) through (c), above, would vary depending on the complexity of the electric facilities and whether the facilities are located in a "rural" or "congested" area.

Q. What complexities of the electric facilities are reflected in the chart's estimated costs?

A. The chart specifies different costs for 15 kilovolt ("kV"), single-phase equipment; 15kV, three-phase equipment; 35 kV, single-phase equipment; and 35kV, three-phase equipment. The difference between a 15kV line and a 35kV line is that a 35kV line holds more electric capacity. 15kV lines are much more common than 35kV lines. The difference between a single-phase and three-phase line is that a three-phase line has three current carrying conductors with a neutral and single-phase line has one current carrying conductor with a neutral. Three-phase lines are often required in commercial areas, while single-phase lines are often all that is required in residential areas.

Q. What geographical differences are reflected in the chart's estimated costs?

A. For "rural" areas, the calculations assumed that there are 20 customers per mile, 10 locations for transformer installations and, for three-phase scenarios, one location for a three-phase transformer installation. For "congested" areas, the calculations assumed that there are 120 customers per mile, 15 locations for transformer installations, and, for three-phase scenarios, five locations for three-phase transformer installations.

Q. Were there other assumptions made when you were developing the chart?

A. Yes. For all of the calculations on the chart, it was assumed that there were 30 poles per mile with a 175-foot ruling span of 1/0 aluminum-conductor steel-reinforced conductor ("ACSR"), which is FirstEnergy' s median conductor size. A length of 175 feet is the median ruling span for 1/0 ACSR.

Q. Could you please explain what is shown in Rows 30 and 31?

A. The costs in Rows 30-31 are the additional costs per customer that would be incurred to move facilities from overhead to underground. The cost in Row 30 is the cost per customer to remove an overhead triplex secondary conductor and install an underground triplex secondary conductor. The cost in Row 30 is the cost per customer to remove an overhead triplex secondary conductor and install an underground triplex secondary conductor, with the extra cost of performing a directional bore across a public right-of-way to provide secondary voltage.

Q. Based on the chart, how much would it cost FirstEnergy to construct a duplicate pole next to Verizon's existing pole and then transfer FirstEnergy's facilities to that newly-constructed duplicate pole?

A. Using the simplest 15kV, single-phase facilities in rural areas, the cost per mile would be **[BEGIN CONFIDENTIAL]** [redacted] **[END CONFIDENTIAL]**. In a congested area, the cost per mile would be **[BEGIN CONFIDENTIAL]** [redacted] **[END CONFIDENTIAL]**. (See FirstEnergy Exhibit RC-3 at Rows 7 and 13.)

For 35kV, three-phase facilities, the rural area and congested area per mile costs to construct a duplicate, adjacent pole line and transfer facilities would be **[BEGIN CONFIDENTIAL]** [redacted] **[END CONFIDENTIAL]**. (See FirstEnergy Exhibit RC-3 at Rows 10 and 6.)

These calculations for adjacent duplicate pole lines can be summarized as follows: **[BEGIN CONFIDENTIAL]**

[redacted]

[END CONFIDENTIAL]

Q. Would there always be room for FirstEnergy to construct a new pole next to Verizon's existing poles?

A. No. In many cases, there would be no room for a new pole line to be constructed adjacent to the existing pole line, and the new line must therefore be installed across the street. In that case, a simple transfer of facilities is not possible, so FirstEnergy would

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2 [redacted]

have to both construct the new pole line and rebuild its electric distribution facilities (and of course remove its existing facilities from Verizon's poles). In that event, the range of costs for duplicate pole lines across the street would be as follows: **[BEGIN CONFIDENTIAL]**

[redacted]

[END CONFIDENTIAL]

Q. If there is not room for FirstEnergy to construct a new pole next to Verizon's existing pole, would it be cheaper to relocate the facilities underground rather than constructing them above-ground across the street?

A. No. The cost of going underground is even higher. FirstEnergy would need to construct underground facilities for its own needs that would be located adjacent to a line of poles owned by Verizon and then transfer its existing electric facilities from the Verizon poles to the newly-constructed underground facilities. The range of such costs for FirstEnergy to go underground would be as follows: **[BEGIN CONFIDENTIAL]**

[redacted]

[END CONFIDENTIAL]

Q. What conclusions do you draw based upon these estimated costs?

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3 [redacted]
4 [redacted]

A. Assuming that FirstEnergy was able to construct duplicate pole lines, then some average of the per-mile costs associated with adjacent versus across the street pole lines, rural versus congested, 15kV vs. 35kV, and single-phase versus 3-phase would need to be calculated to determine the estimated per-mile cost for such an undertaking. That figure would likely be considerably higher than **[BEGIN CONFIDENTIAL]** [redacted] **[END CONFIDENTIAL]** per mile.

From an economic perspective, it makes no sense whatsoever for FirstEnergy to incur a minimum initial cost of **[BEGIN CONFIDENTIAL]** [redacted] **[END CONFIDENTIAL]** per mile and an annual cost thereafter of **[BEGIN CONFIDENTIAL]** [redacted] **[END CONFIDENTIAL]** per mile to create duplicate pole facilities when the alternative is to continue attaching to an existing pole line at a per mile cost of **[BEGIN CONFIDENTIAL]** [redacted] **[END CONFIDENTIAL]** per year.

Q. Are there any other considerations that affect whether it would be feasible to construct duplicate facilities to house FirstEnergy's attachments?

A. Yes. There are significant practical and physical barriers as to whether sufficient labor resources are available to build a duplicate pole distribution system, and how long it would take to accomplish such duplication. My best estimate is that it would take at least three years to accomplish any of the above alternatives.

IV. PHYSICAL CHARACTERISTICS AND SPACING OF VERIZON'S ATTACHMENTS TO FIRSTENERGY'S POLES

Q. What general differences are there between the attachments of cable companies and CLECs as compared to ILECs?

A. In my experience analyzing attachments made to the poles of FirstEnergy, cable companies and CLECs typically attach less equipment to utility poles than do ILECs, like Verizon. In addition, cable companies and CLECs both typically occupy the middle space on the pole above the ILEC attachments and below electric utility attachments.

Q. What mid-span clearance must ILECs maintain for their attachments?

A. Since the ILEC's attachments are the lowest attachments on the pole, the ILEC's attachments must maintain the mid-span clearance of 15.5 feet above the ground that is required by the NESC. FirstEnergy includes this mid-span clearance requirement in its engineering standards. To maintain this clearance mid-span, ILECs typically attach their facilities higher than the 18 feet above ground level.

Q. Is Verizon an exception to this general proposition?

A. No. Verizon is almost always the lowest attacher on its joint use poles that it shares with FirstEnergy, and its lowest attachments on these joint use poles are typically located higher than 18 feet above ground level, on average at 19.87 feet according to the statistically valid field audit FirstEnergy completed, as described by FirstEnergy Witness Scott Carlin in FirstEnergy Statement No. 6-R.

Q. Do Verizon's attachments weigh more than the attachments of cable companies and CLECs?

A. Yes. FirstEnergy's field audit shows that Verizon's facilities weigh much more than the facilities of other communications attachers, primarily because of the old copper wire that Verizon has not removed. This additional weight has several effects: (i) the load on the pole created by Verizon's attachments is greater than the load on the pole created by Verizon's competitors, especially when considering ice and wind conditions typically experienced in Pennsylvania; (ii) Verizon's attachments create more sag than do the attachments of Verizon's competitors thus requiring even more pole space; and (iii) newcomers to the pole are disadvantaged more by Verizon's attachments than by the attachments of other communications companies because Verizon's attachments use up more loading and space capacity, thus making it more likely the pole will lack available loading or space capacity and must be replaced with a taller or stronger pole by the new attacher.

Q. If Verizon were not the lowest attacher on the pole (*i.e.*, there were attachments below Verizon's attachments), how much higher would Verizon have to install its attachments above the lowest attacher's attachments?

A. In that scenario, Verizon' s attachments on average would need to be placed on the pole 3.5 feet above the lowest attacher or more. This is true because: (1) FirstEnergy's standards require six inches of separation between communications attachments mid-span; and (2) Verizon's sag requires such additional pole space in order to meet this mid-span clearance standard.

Q. Why do these physical characteristics of Verizon's attachments matter?

A. The sag of large copper cables pushes the Verizon attachment up the pole, thereby consuming more pole space, and causes future attachers to pay for pole replacements or other extreme measures.

V. <u>CONCLUSION</u>

Q. Does this conclude your rebuttal testimony?

A. Yes, it does.

FirstEnergy
Exhibit RC-1

PUBLIC VERSION

FE Poles Center
Scid: 1012
Page 1 of 4

POLE INFO
Pole Tag: Penn Power 95-811
Calculated Pole Length: 40
Latitude: 41.24196442299246
Longitude: -80.47423438252979

DAVEY Resource Group

POLE INFO

Pole Tag: Penn Power 94-854

Calculated Pole Length: 45

Latitude: 41.24227447208674

Longitude: -80.47424258747691

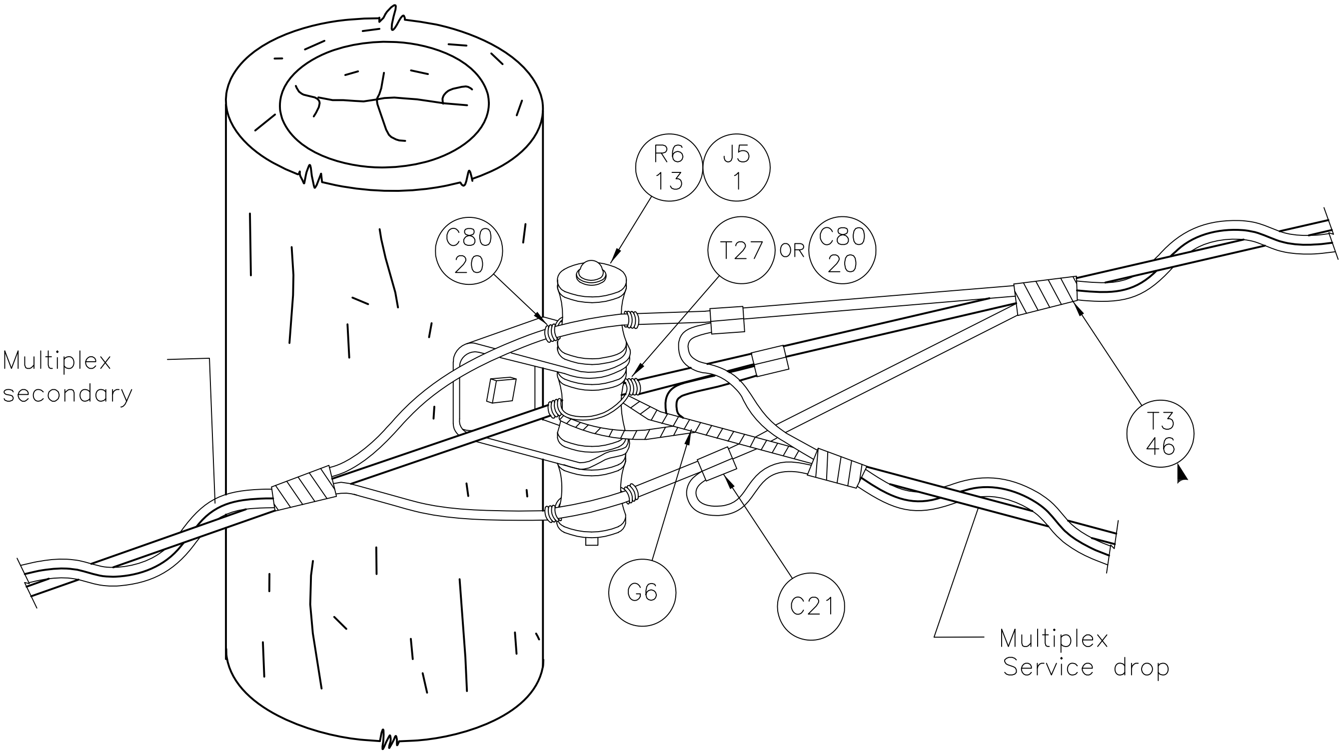
DAVEY Resource Group


646

FirstEnergy
Exhibit RC-2

Page Description	Page
Triplex Rack Installation Details	6-200
1-Wire Rack & Multiplex Spacers	6-210
Service Drop - Aluminum Multiplex, Splicing Details	6-211
Mid-Span Service Drops, Without Truck Access, #4 & 1/0 triplex & Quad	6-220

APPROVED BY: JAH/RJC



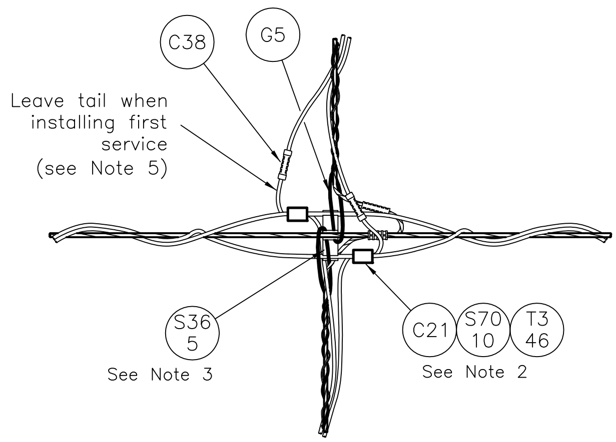
Notes:

1. For conductor tie details, see Standard 4-115.

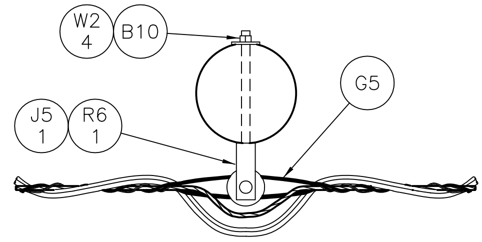
APPROVED BY: JAH/RJC

FirstEnergy

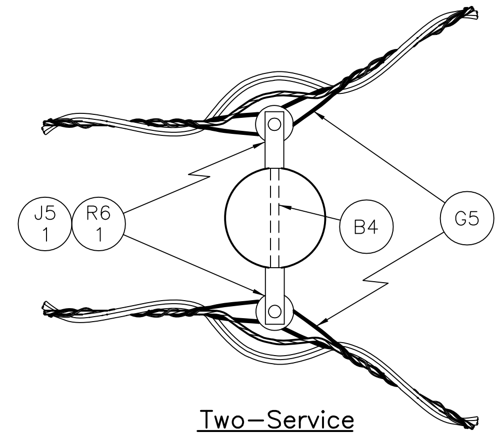
REV.	Construction Std.	Triplex Rack Installation Details
4		
DATE	6-200	
6/15		



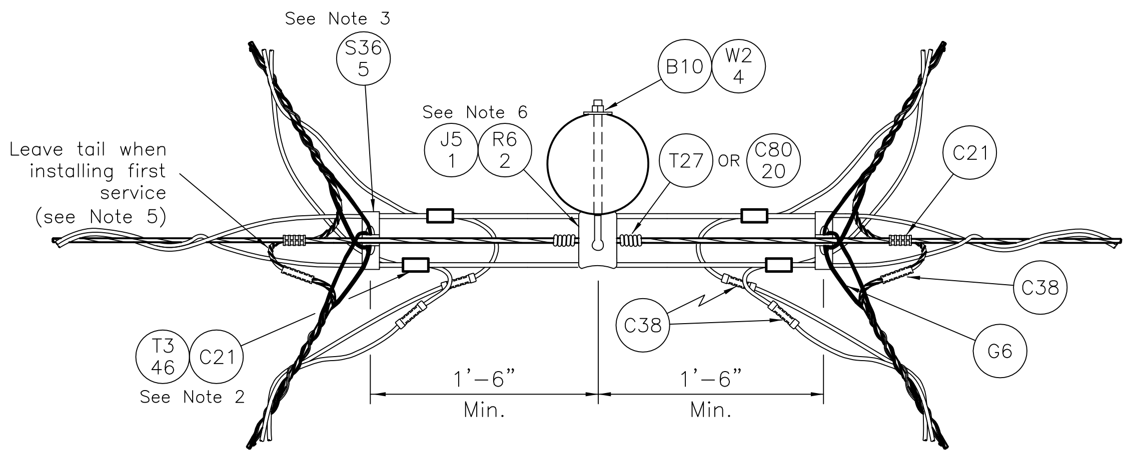
Mid–Span Service Take Off



One Service



Two–Service Clearance Poles



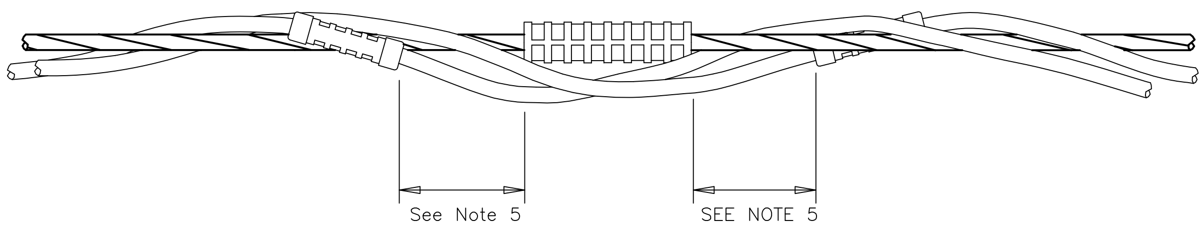
Notes:

1. For service drop splicing details, see Standard 6–211.
2. Insulate all line connections with electrical tape T3/46.
3. Use No. 4 Alum. tie wire on all spacers not secured to neutral with service grips.
4. Install no more than two mid–span services at any one location with no more than two locations per span.
5. Train, insulate, and secure the tail for future service taps when not used.
6. For conductor tie details, see Standard 4–115.

APPROVED BY: JAH/RJC

1–Wire Rack & Multiplex Spacer Installation

FirstEnergy	
Construction Std.	REV. 2
6–210	DATE 6/15



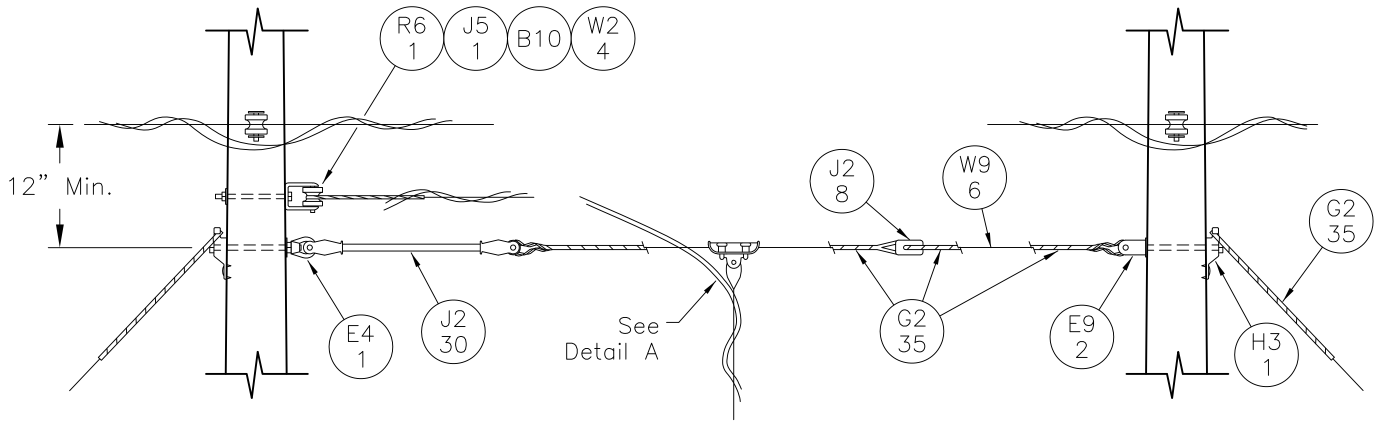
Multiplex Type	Neutral		Phase		
	Size	Conn. Id	Size	Bare Conn. Id	Insulated Conn. Id
#4 TPX	#4 ACSR	22212843	#4 AAC	22240703	22240623
1/0 Tpx, Quad	1/0 ACSR	22214113	1/0 AAC	22255653	22255493
2/0 Tpx, Quad	2/0 AAC	3517	2/0 AAC	3517	3162
2/0 Tpx, Quad	2/0 ACSR	22276151	2/0 AAC	3517	3162
3/0 Tpx, Quad	1/0 ACSR	22214113	3/0 AAC	22211523	95932844
4/0 TPX	2/0 ACSR	22276151	4/0 AAC	22211543	---
4/0 Quad	4/0 ACSR	20718006	4/0 AAC	22211543	---
336.4 Tpx, Quad	336.4 AAC	➤95919234	336.4 AAC	33217182	---

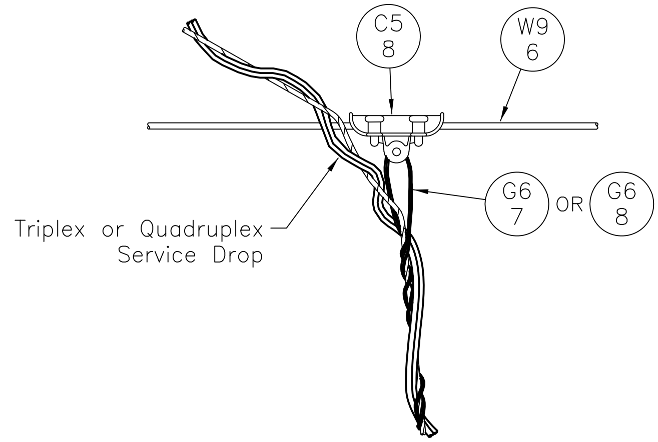
Notes:

1. Supporting messenger to be spliced approximately 2 inches shorter than the insulated conductors to avoid excessive tension in the insulated conductors.
2. File all sharp edges off tension compression sleeve after compressing.
3. Do not scrap cable lengths in excess of 50 feet.
4. For quadraplex service, one additional limited tension insulated compression sleeve is required.
5. Maintain a separation of 3 inches (min.) between connectors to prevent overlap.
6. Insulate bare sleeve by first applying four layers of half lapped high voltage splicing tape (sticky side up) to cover the connector and insulation then apply two layers of half-lapped PVC tape over high voltage splicing tape and extending 1 inch beyond the high voltage tape.

APPROVED BY:JAH/RJC

FirstEnergy		
REV. 2	Construction Std.	Service Drop — Aluminum Multiplex Splicing Details
DATE 3/03	6-211	





Detail A

Notes:

1. This installation is for an addition of a midspan tap without the use of a bucket truck or ladder at the midspan tap location.
2. Each pole shall be guyed for 3500 lbs.
3. Service drop installation tension @60° shall be in the 50#–60# range.
4. Clearance from communication, not spacing, shall be a minimum of 40 inches at the pole & 30 inches at the take–off point. The minimum clearances over ground shall exceed 3–015 or 3–016 by 6 inches to account for the increase from initial to final sag conditions in the service drop.
5. Midspan applications shall be limited to 175 ft spans between secondary poles and 125 ft for the service drop. Service drop lengths beyond 80 ft are not recommended because of excessive sag.
6. Electrical connections shall be made at the pole and not at the take–off point.

APPROVED BY: JAH/RJC

#4 & 1/0 Triplex & Quadruplex Mid–Span Service Drops (Locations without Truck Access)	FirstEnergy Construction Std. 6–220	REV. 2 DATE 2/15

FE00066

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Sidewalk Guy	7-050
Anchors Types & Sizes	7-105
Anchor Holding Strength & Torque Ratings	7-110
► Push Brace	7-120
Pole Blocking	7-140
Subtransmission & Transmission Guying	
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Span Guys, 13,500 lb. Max. Guy Strength	7-255
Down Guys, 13,500 lb. Max. Guy Strength, 10,000 lb. Vertical Pole Crushing Limit	7-260
Down Guys, 27,000 lb. Max. Guy Strength, 10,000 lb. Vertical Pole Crushing Limit	7-270
Down Guys, 27,000 lb. Max. Guy Strength, 20,000 lb. Vertical Pole Crushing Limit	7-280

APPROVED BY: JAH/BJC

PUBLIC VERSION

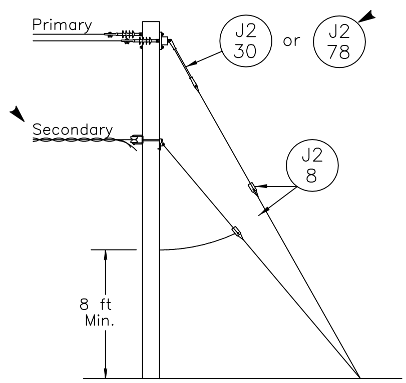


Fig. 1

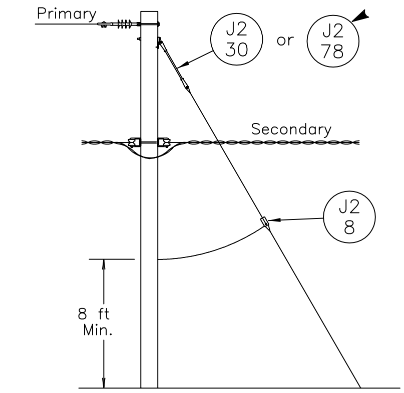


Fig. 2

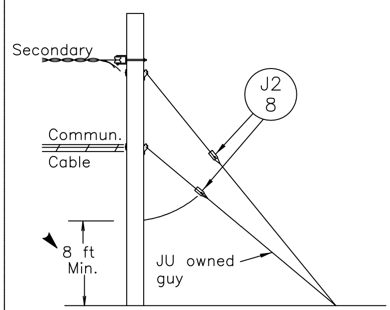


Fig. 3

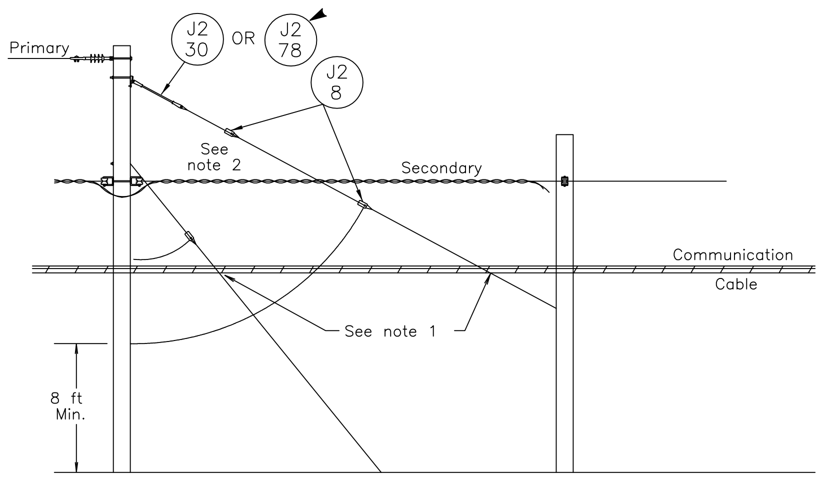


Fig. 4

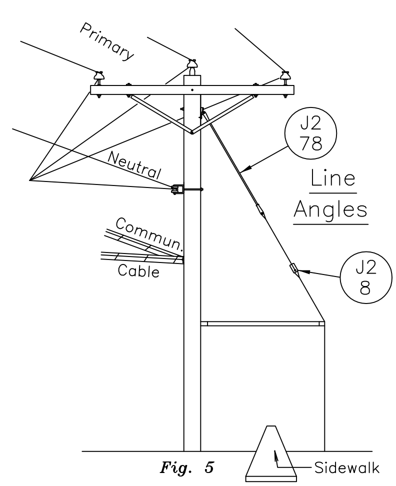


Fig. 5

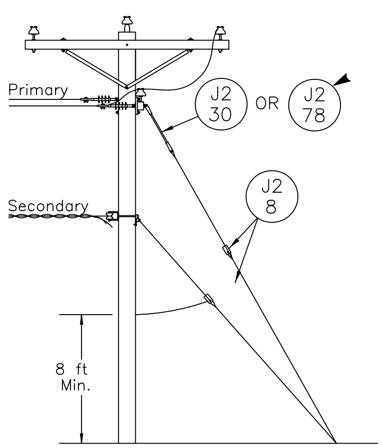


Fig. 6

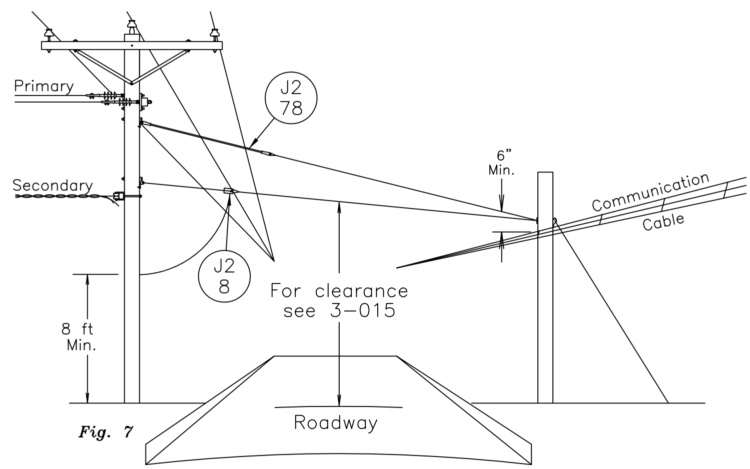


Fig. 7

NOTES:

➤ 1. When they are attached to the same structure. the minimum clearance between guy wire and communication cable is 6". The minimum clearance for anchor guys supported on different structures is 6". For span guys and neutrals, the minimum clearance is 24". Clearances are surface to surface.

2. If guy passes within 12" of secondary or within 12" of communication cable, it shall have an insulator as shown.

3. Guy insulators are placed to protect public and line workers in case the guy breaks, or goes slack, and makes contact with any energized conductor. A guy attached above primary conductors shall have an insulator placed so that if the guy breaks, there is an insulator at least 8 feet above ground and below all primary conductors. All guys are to have at least one insulator installed so that if the guy breaks, the insulator is at least 8 feet above the ground.

➤ 4. All sub-transmission and transmission construction requires fiberglass guy strain insulators be installed based on strength required for single or double down guy or head guying applications. Refer to Standard 7-040.

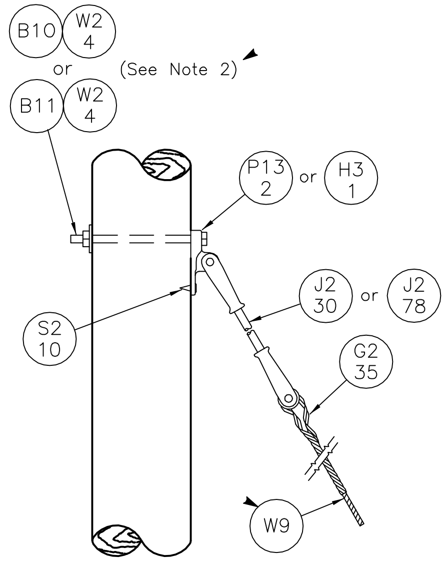
APPROVED BY: GLJ/RJC

FirstEnergy

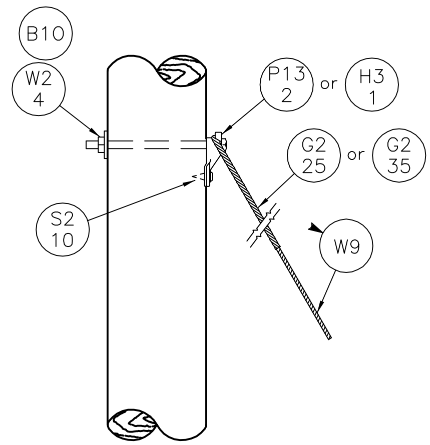
REV.	Construction Std.	Insulator Application Guying
3	7-010	
DATE		
12/14		

FE00068

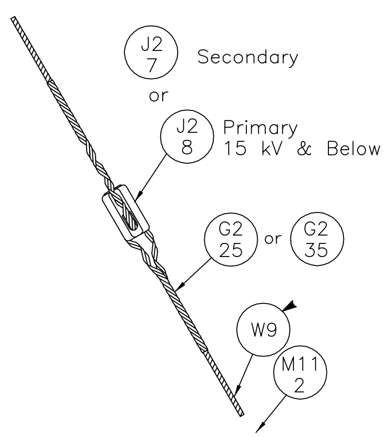
PUBLIC VERSION



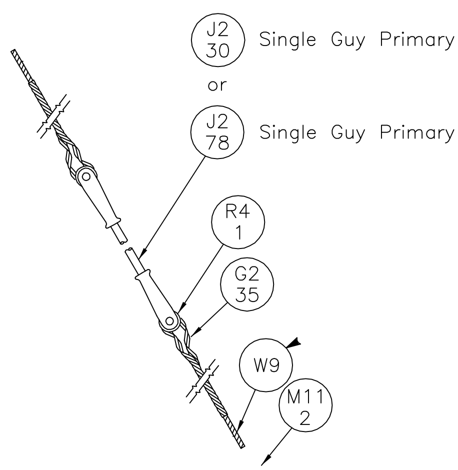
Primary Single Guy
Fig. 1



Secondary
Fig. 2



Mid-Lead Porcelain Insulator Assembly
Fig. 3



Mid-Lead Fiberglass Insulator Assembly
Fig. 4

Guy		Breaking Strength	Permitted Load (1)
W9/5	5M3	5,600#	5,040#
W9/7	12.5M	12,500#	11,250#
W9/8	20M	20,000#	18,000#
W9/9	25M	25,000#	22,500#

Notes:

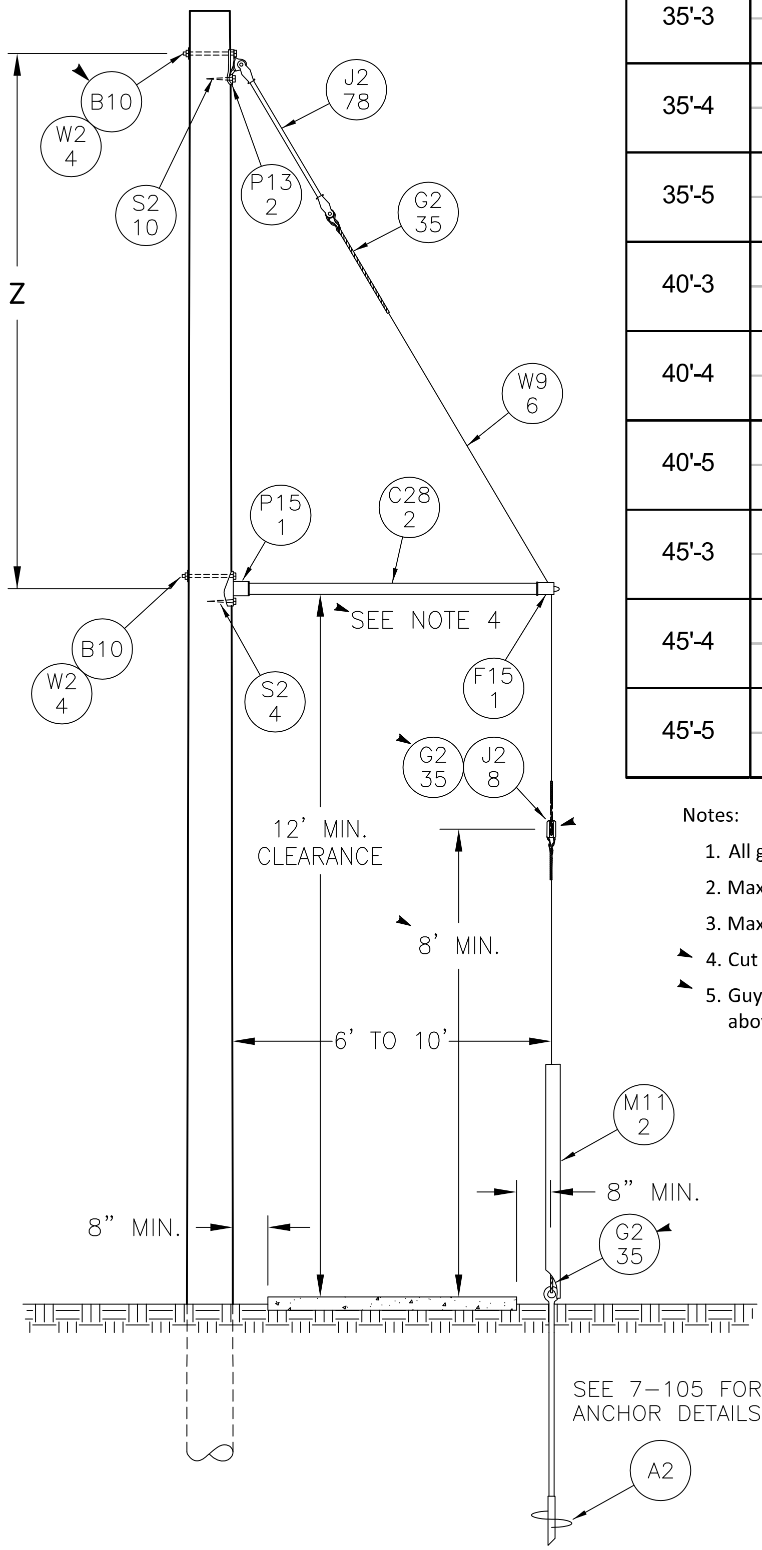
1. The permitted load is a 10% derating of the ultimate guy strength. The guy tension with NESC overload factors applied must not exceed the permitted load.
2. Use a 3/4" bolt (B11) when using 12.5M guy or larger for tension purposes.
3. Refer to Standard 7-010 for guy insulator application.
4. All sub-transmission and distribution construction greater than 15 kV require fiberglass guy strain insulators be installed based on strength required for down guy applications.
5. Install guy marker (M11/2) on the outer most down guy.

APPROVED BY: RWF/RJC

Distribution & Sub Transmission Down Guy Attachment Details

FirstEnergy

Construction Std.	REV.
	6
7-040	DATE
FE00069	09/19



POLE HEIGHT & CLASS	Z	Maximum Line Angle			
		1-1/0 PRI 1/0 TPX	3-1/0 PRI 1/0 TPX	1-336 PRI 1/0 TPX	3-336 PRI 1/0 TPX
35'-3	8'	30°	30°	20°	15°
	14'	30°	30°	30°	25°
35'-4	8'	30°	10°	30°	10°
	14'	30°	20°	30°	15°
35'-5	8'	25°	10°	20°	5°
	14'	30°	15°	30°	10°
40'-3	8'	30°	30°	15°	15°
	14'	30°	30°	25°	20°
40'-4	8'	30°	10°	25°	10°
	14'	30°	20°	30°	15°
40'-5	8'	25°	5°	20°	10°
	14'	30°	10°	30°	15°
45'-3	8'	30°	30°	15°	10°
	14'	30°	30°	20°	15°
45'-4	8'	30°	10°	25°	5°
	14'	30°	15°	30°	10°
45'-5	8'	20°	5°	20°	5°
	14'	30°	10°	25°	5°

Notes:

1. All guys to be 3/8" EHS.
2. Maximum design angle, of table, limited to 30°.
3. Maximum design span, of table, limited to 179 ft.
4. Cut steel conduit to required length for strut.
5. Guy insulators shall be paced to protect the general public at least 8 ft above ground level.

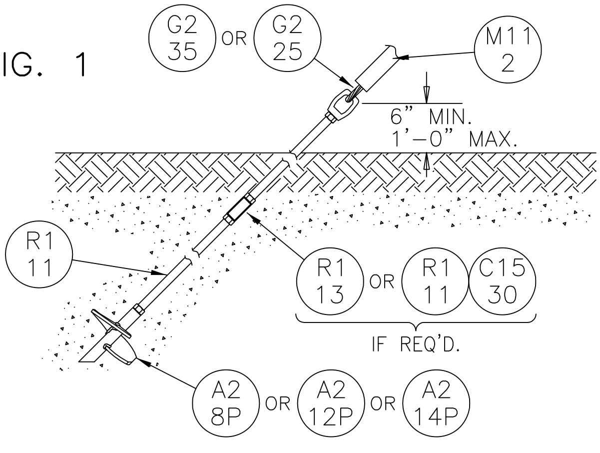
APPROVED BY: EDJ/RJC

FirstEnergy

REV.	Construction Std.
3	
DATE	7-050
6/15	

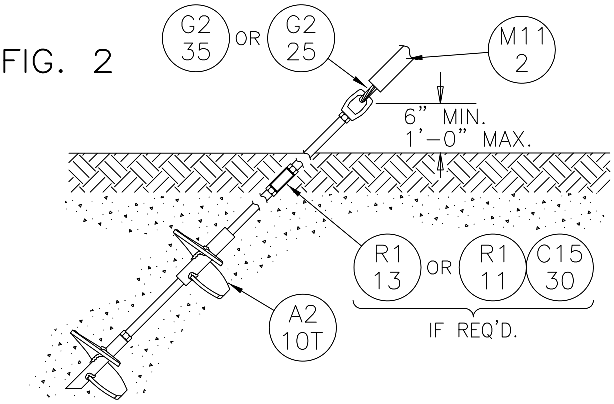
Sidewalk Guy

FIG. 1



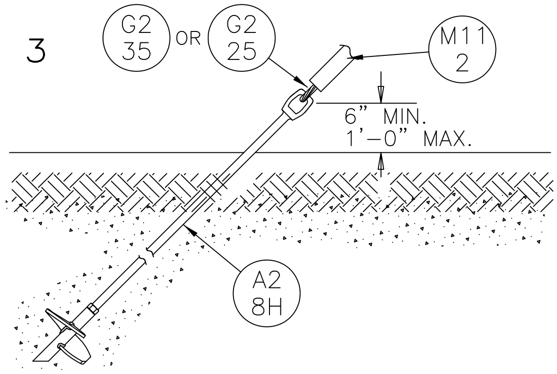
Power–Installed Screw Anchor
(PISA)

FIG. 2



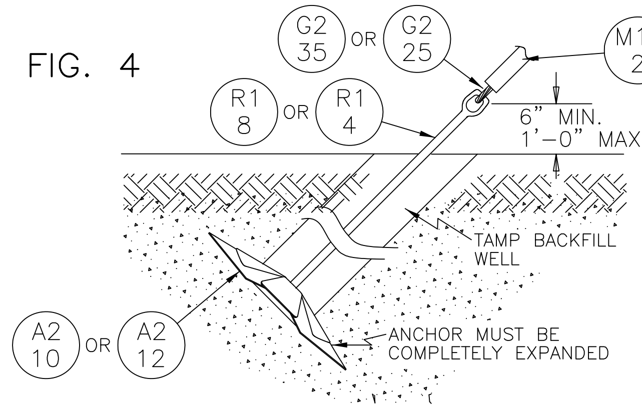
Multi–Helix Anchor
(PISA)

FIG. 3



No–Wrench Anchor
(hand or machine installed)

FIG. 4

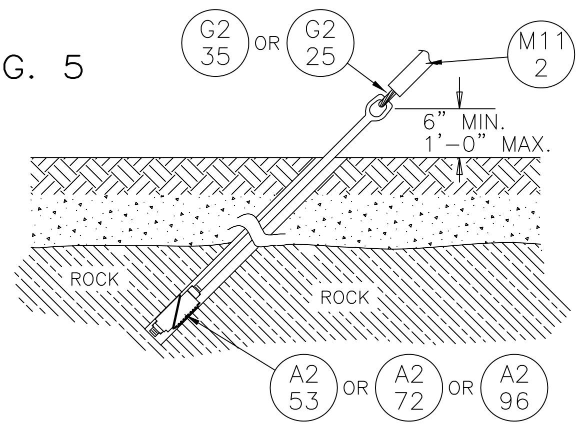


Expansion Anchor

NOTES:

1. (FIG. 1) Single–Helix power installed screw anchors are the preferred installation when applicable.
2. (FIG. 2) Multi–Helix anchors are used in areas where poor to medium soil conditions exist (i.e., swamp, sand, firm clay).
3. (FIG. 3) "No–Wrench" type anchors are used when temporary guying is required and for secondary conductor guying when soil conditions permit.
4. (FIG. 4) Expansion Anchors are used in areas that are not truck accessible or where other utilities may be in close proximity of anchor installation.
5. (FIG. 5) Rock Anchors, shall be set in holes 2–3/8" x 12" deep (min.) in rock, to develop full strength.
6. (FIGS. 1 & 2) Where soil conditions dictate that anchors be set more than one rod length deep, use an extension wrench to install second rod to gain adequate depth.
7. When more than one anchor is used to sustain the loads imposed on the pole, the anchors shall be spaced a minimum of five feet (5') apart. This separation is needed to prevent the reduction of the anchor holding strength.

FIG. 5



Rock Anchor

APPROVED BY:

Anchor Types & Sizes

FirstEnergy

Construction Std.	REV.
7–105	2
	DATE 1/15

FE00071

Table I

Symbol	Anchor Description	Fig.	Anchor Holding Strength (lbs.) by Soil Classification			
			Clay	Sand	Swamp	Rock
A 2/8P	8" P.I.S. Anchor, f/ 1" rod w/ triple eyenut	1	25,000	10,000	---	---
A 2/12P	12" P.I.S. Anchor, f/ 1" rod w/ triple eyenut	1	30,000	18,500	---	---
A 2/14P	14" P.I.S. Anchor, f/ 1" rod w/ triple eyenut	1	32,000	19,500	---	---
A 2/10T	10" Multi-Helix Anchor, f/ 1" rod w/ t-eyenut	2	30,000	22,500	17,500	---
A 2/8H	8" 'No Wrench' Anchor, w/ tripleye	3	6,000*	3,200	---	---
A 2/10	10" Exp. Anchor, f/ 3/4" rod w/ double eyenut	4	23,000*	18,800	---	---
A 2/12	12" Exp. Anchor, f/ 1" rod w/ triple eyenut	4	36,000*	24,000	---	---
A 2/53	53" Rock Anchor, w/ 1" rod & triple eyenut	5	---	---	---	36,000*
A 2/72	72" Rock Anchor, w/ 1" rod & triple eyenut	5	---	---	---	36,000*
A 2/96	96" Rock Anchor, w/ 1" rod & triple eyenut	5	---	---	---	36,000*

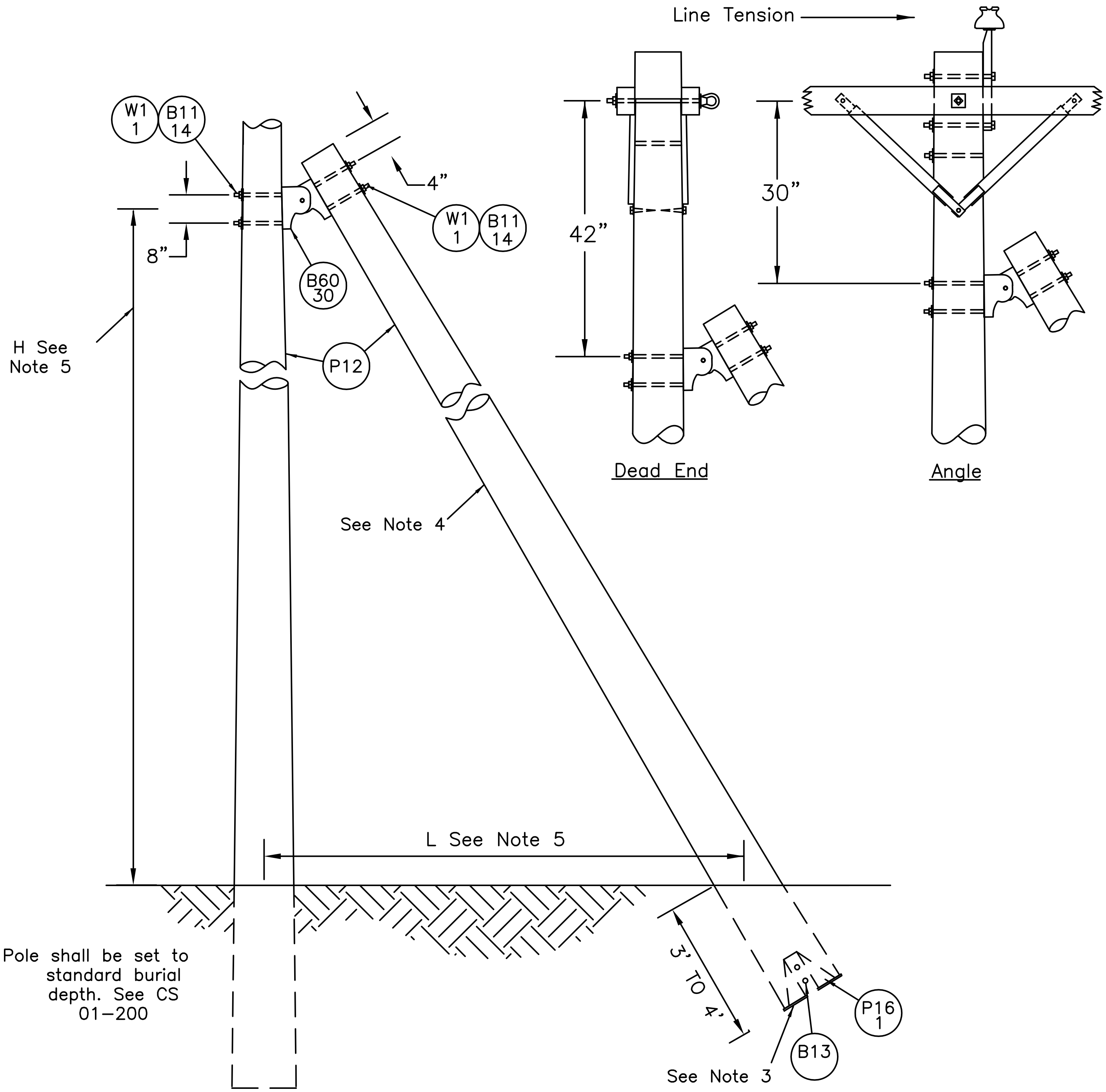
Table II

	Installation Torque (Ft-Lbs)										
	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000
Symbol	Estimated Holding Strength (Lbs)										
A 2/8P	7,000	9,500	12,000	15,000	18,000	20,000	22,000	23,500	25,000	---	---
A 2/12P	13,000	15,000	17,000	19,000	21,000	22,500	24,000	25,500	27,000	28,500	30,000
A 2/14P	15,500	17,200	19,000	21,000	23,000	24,500	26,000	28,000	30,000	31,000	32,000
A 2/10T	15,500	17,200	19,000	21,000	23,000	24,500	26,000	28,000	30,000	---	---
A 2/8H	6,000	---	---	---	---	---	---	---	---	---	---

Notes:

1. Holding strengths are **ultimate ratings**. Values **do not** include NESC safety factors for grades 'C' or 'B' construction.
2. Asterisk (*) values are limited by anchor rod strength.
3. The values listed in Table II should be used for applications where torque indicators are available.
4. When more than one anchor is used to sustain the loads imposed on the pole, the anchors shall be spaced a minimum of five feet (5') apart. This separation is needed to prevent the reduction of the anchor holding strength.

APPROVED BY: GEJ / RJP

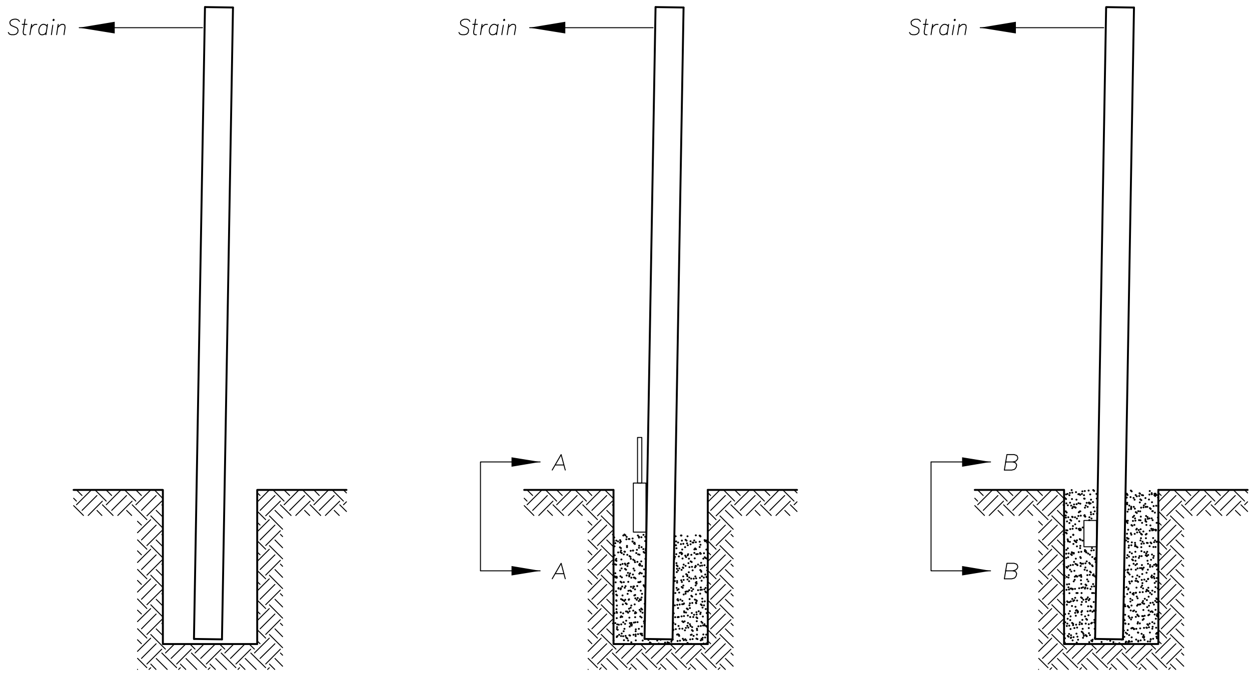


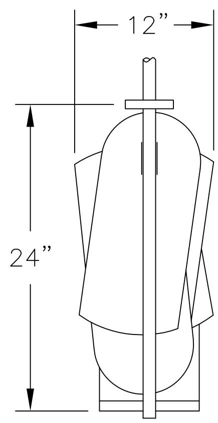
Notes:

1. Push brace shall be installed as a last resort only when normal guying cannot be used.
2. This construction is for distribution only.
3. Use one pair of bearing plates in soft soil (i.e., sand or loam). They should be orientaed as shown.
4. Push brace is normally the same size/class as the line pole.
5. The minimum lead "L" shall be half the above grade mounting height "H"

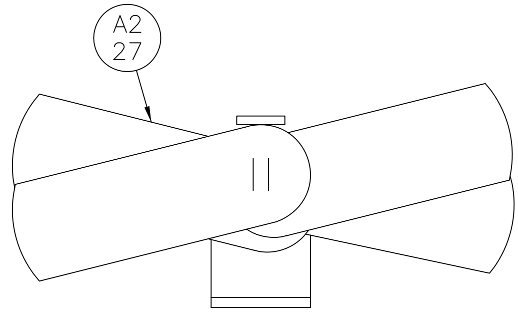
APPROVED BY: JAH/RJC

FirstEnergy		Push Brace
REV. 0	Construction Std.	
DATE 4/18	7-120	





Section A–A
POLE KEY CLOSED



Section B–B
POLE KEY EXPANDED

NOTES:

1. Pole blocking is for reduced tension span applications. See Section 8.
2. Set pole and rake 6" to 8", opposite direction of the strain.
3. Backfill and tamp within 18 inches of grade.
4. Thread rod on pole key and position in hole, in direction of strain.
5. Tamp the pole key until it is completely expanded. Remove rod and complete the backfill, tamping thoroughly.
6. For existing installations requiring pole blocking, excavate 18 inches below grade, in direction of the strain, and follow Notes 4 & 5.

APPROVED BY: GLJ/RJC

Pole Blocking

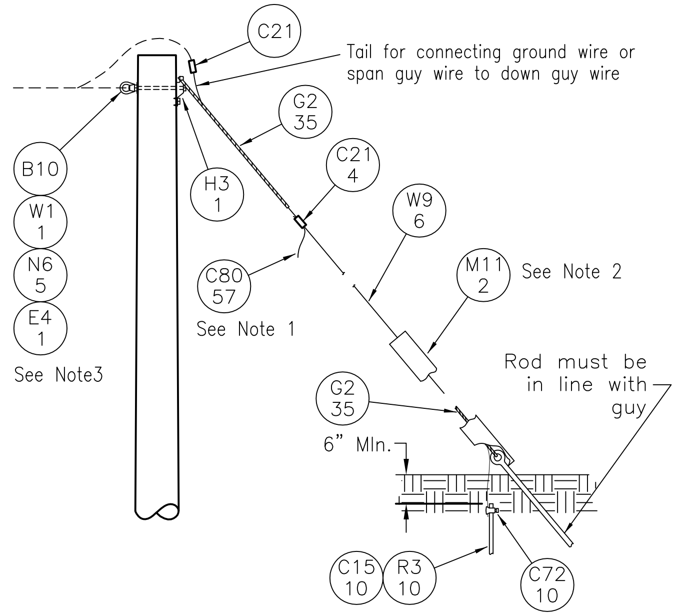
FirstEnergy

Construction Std.

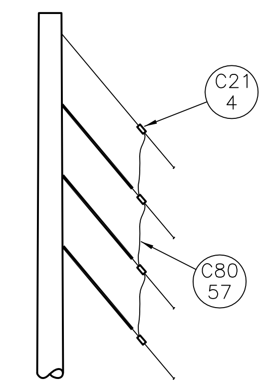
7–140

REV. 1

DATE 1/15

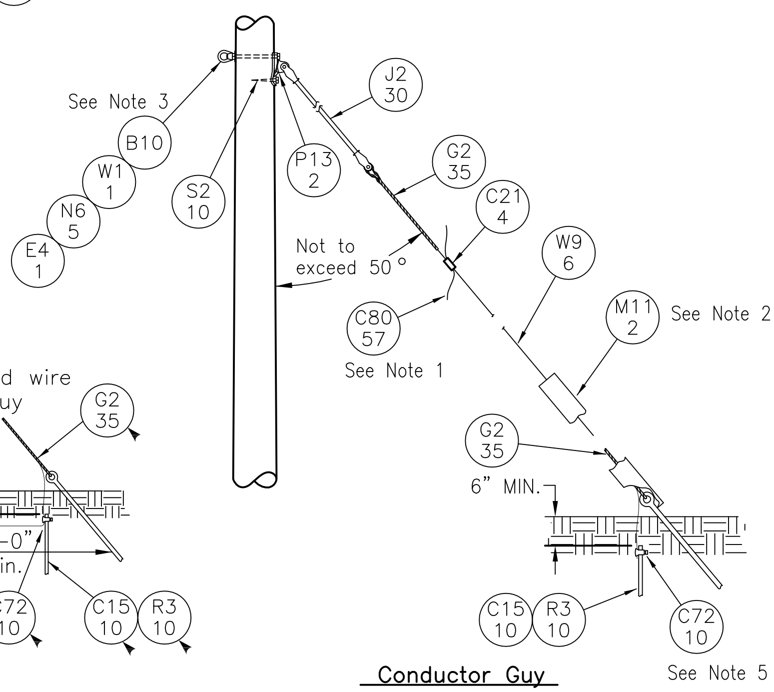


Ground Wire Guy

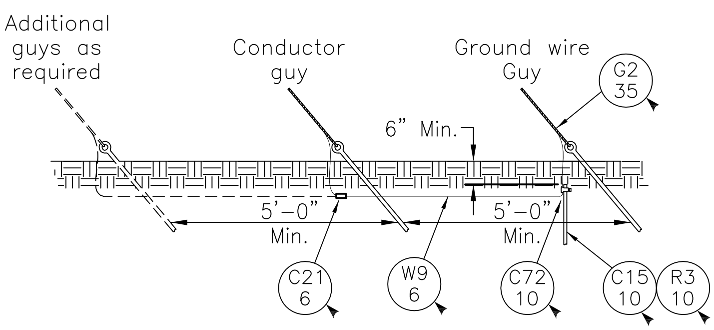


DETAIL "A"

Guy Wire Bonding



Conductor Guy



Multiple Guying

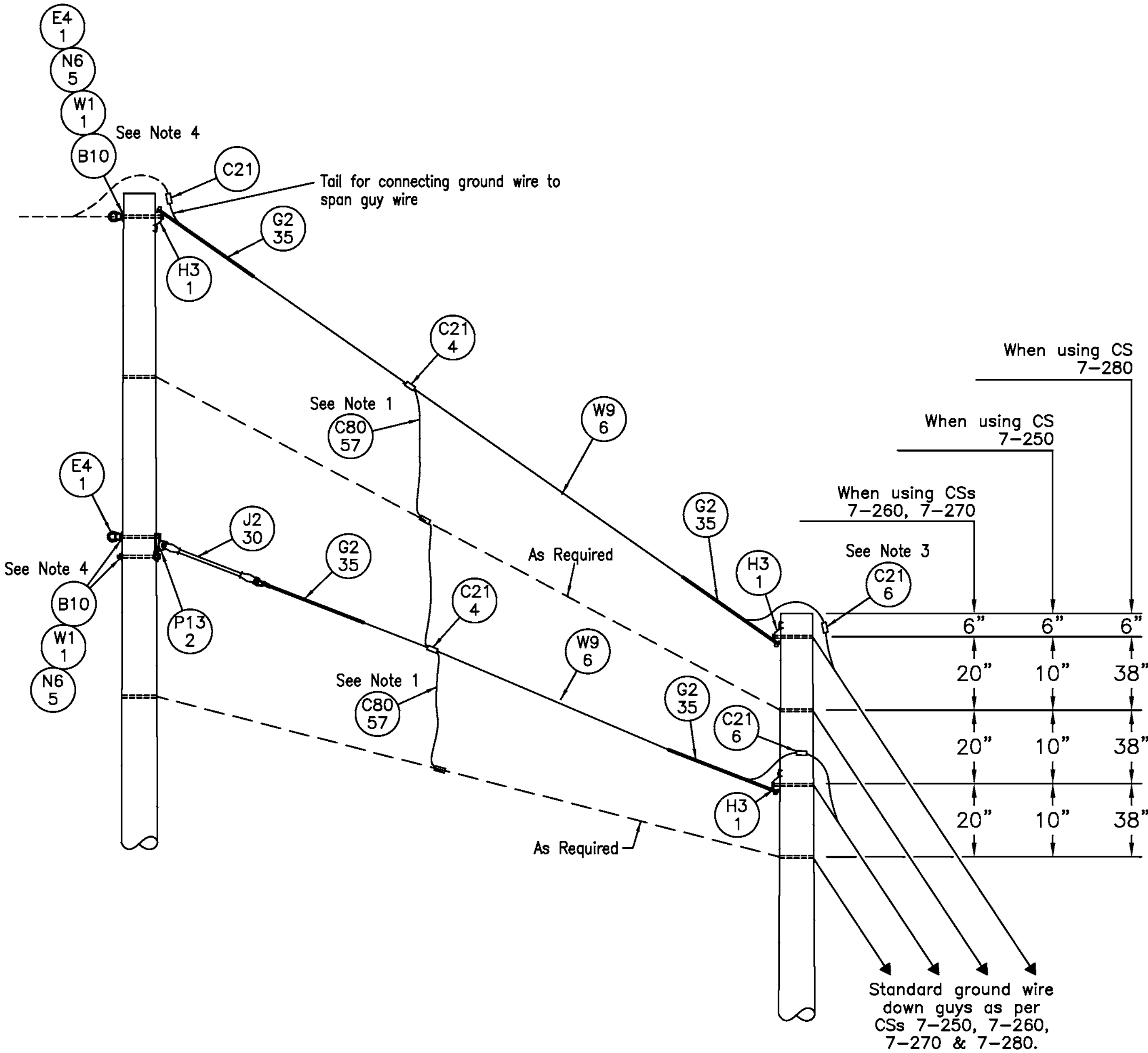
Notes:

1. Bond all guys to ground wire guy, using #4 solid soft drawn copper conductor. See detail "A"
2. Install guy marker on top guy at each anchor rod.
3. Install machine bolts with heads on guy pole eye plate side.
4. See Standard 7-105 for anchor details.
5. Ground rod not required at conductor guy if ground wire guy is installed. Install ground lead from ground wire guy to conductor guys, as shown in the "multiple guying" detail.
6. Guy design load is based on 90 percent of rated breaking strength, per NESC.
7. When calculating vertical pole crushing at the point of guy attachment, use actual load with no overload factor. This load not to exceed 5000 lbs. above 5000 lbs., see Standard 7-260.
8. When ground resistance of 10 ohms or less cannot be obtained by above methods, see Standard 5-050.
9. 3Ø medium angle 10 ft double arm / double post construction 34.5 kV.

APPROVED BY: EDJ/RJC

FirstEnergy	Transmission & Subtransmission Down Guys
REV. 1 / Construction Std.	13,500 Lbs. Maximum Guy Strength
DATE 6/15 / 7-250	5,000 Lbs. Vertical Pole Crushing Limit

FE00075



APPROVED BY: JAH/RJG

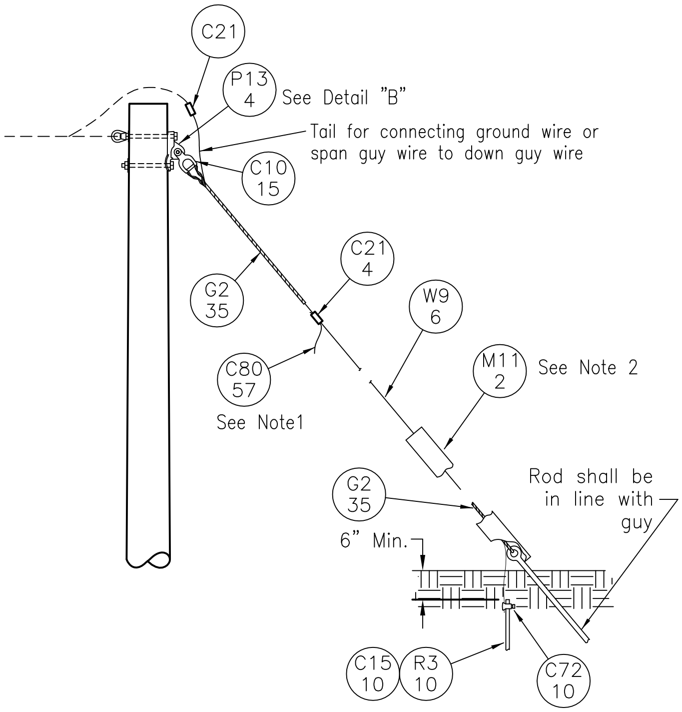
Notes:

1. Bond all guys to ground wire guy, using #4 solid soft drawn copper conductor.
2. Guy design load is based on 90 percent of rated breaking strength, per NESC.
3. Bond all ground wire and conductor span guys to down guys.
4. Install machine bolts with heads on guy pole eye plate side.

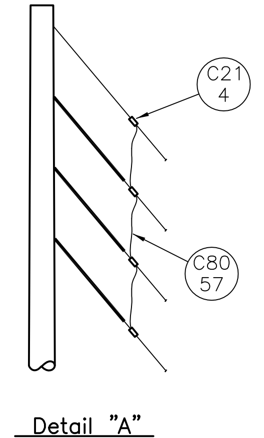
Transmission & Subtransmission Span Guys 13,500 Lbs Maximum Guy Strength

FirstEnergy	
Construction Std.	REV. 2
7-255	DATE 5/18

FE00076

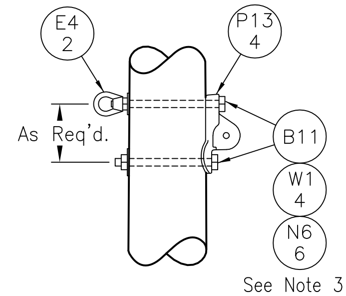


Ground Wire Guy

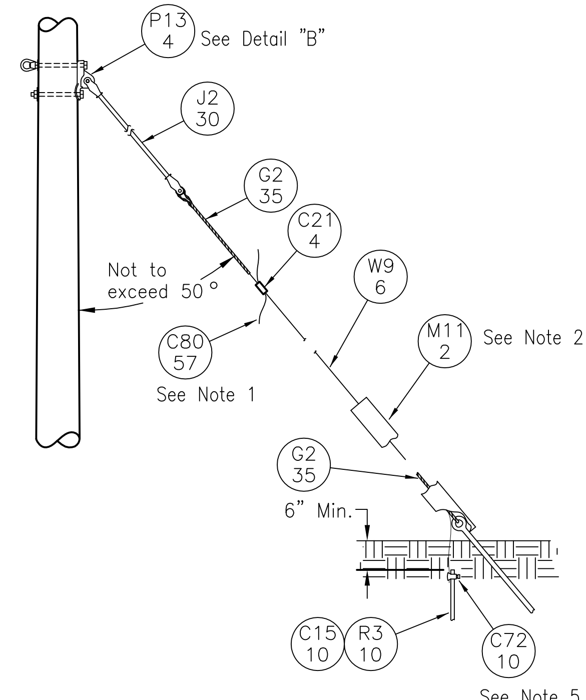


Detail "A"

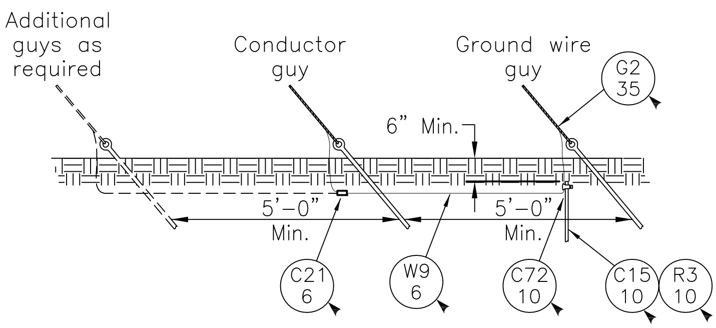
Guy wire bonding



Detail "B"



Conductor Guy



Multiple Guying

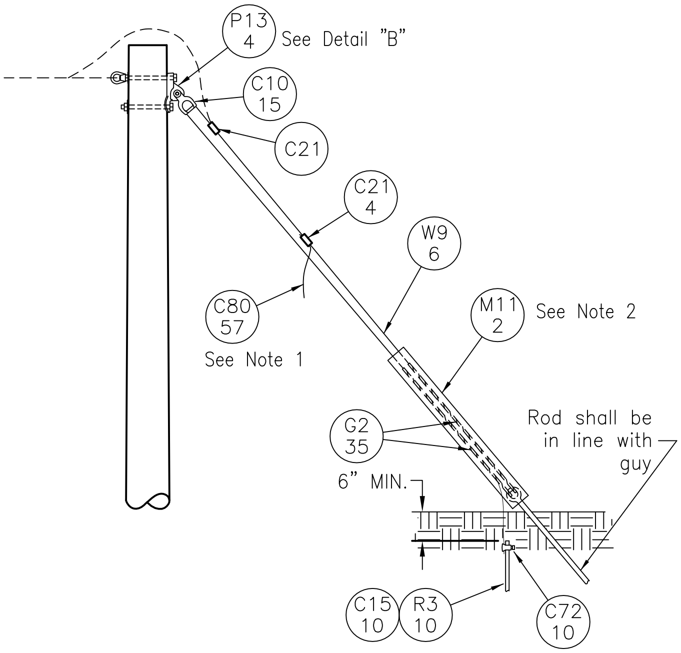
Notes:

1. Bond all guys to ground wire guy, using #4 solid soft drawn copper conductor. See Detail "A"
2. Install guy marker on top guy at each anchor rod.
3. Install machine bolts with heads on guy plate side.
4. See Standard 7-105 for anchor details.
5. Ground rod not required at conductor guy if ground wire guy is installed. Install ground lead from ground wire guy to conductor guys, as shown in the "Multiple Guying" Detail.
6. Guy design load is based on 90 percent of rated breaking strength, per NESC.
7. When ground resistance of 10 ohms or less cannot be obtained by above methods, see Standard 5-050.
8. When calculating vertical pole crushing at the point of guy attachment, use actual load with no overload factor. This load not to exceed 10,000 lbs above 10,000 lbs, see Standard 7-280.

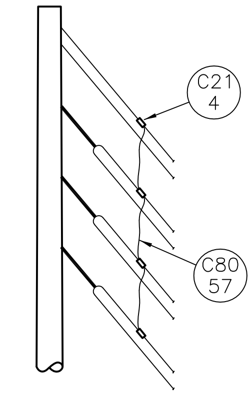
APPROVED BY: EDJ/RJC

FirstEnergy	Transmission & Subtransmission Down Guys
REV. 1 / Construction Std.	13,500 Lbs Maximum Guy Strength
DATE 6/15 / 7-260	10,000 Lbs Vertical Pole Crushing Limit

PUBLIC VERSION

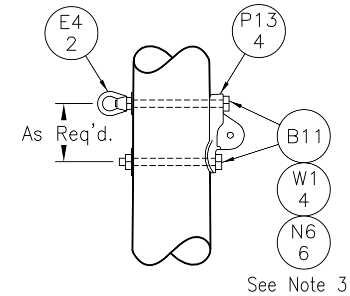


Ground Wire Guy

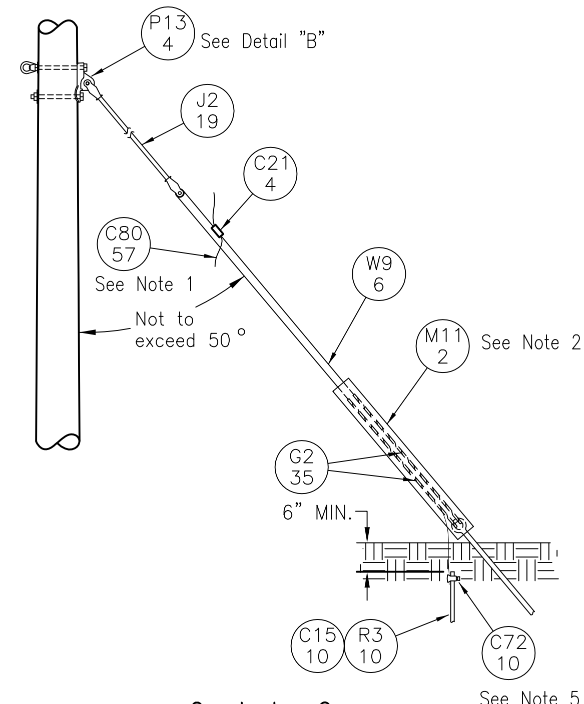


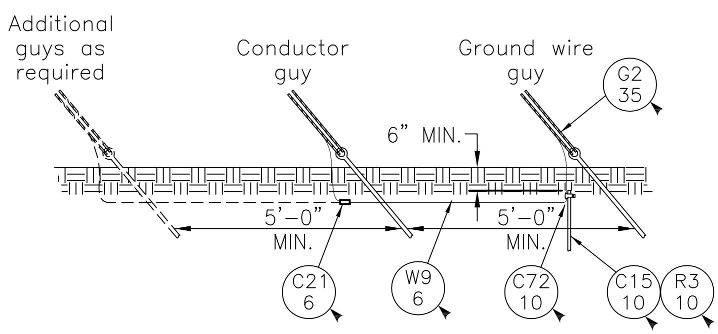
Detail "A"

Guy wire bonding



Detail "B"





Multiple Guying

Conductor Guy

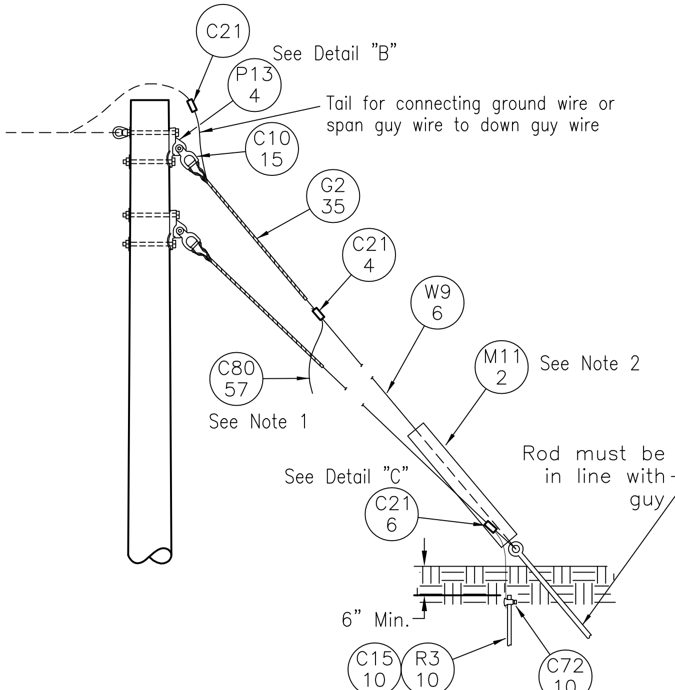
Notes:

1. Bond all guys to ground wire guy, using #4 solid soft drawn copper conductor. See Detail "A"
2. Install guy marker on top guy at each anchor rod.
3. Install machine bolts with heads on guy plate side.
4. See Standard 7-105 for anchor details.
5. Ground rod not required at conductor guy if ground wire guy is installed. Install ground lead from ground wire guy to conductor guys, as shown in the "Multiple Guying" detail.
6. Guy design load is based on 90 percent of rated breaking strength, per NESC
7. When ground resistance of 10 ohms or less cannot be obtained by above methods, see Standard 5-050.
8. When calculating vertical pole crushing at the point of guy attachment, use actual load with no overload factor. This load not to exceed 10,000 lbs. Above 10,000 lbs., see Standard 7-280.

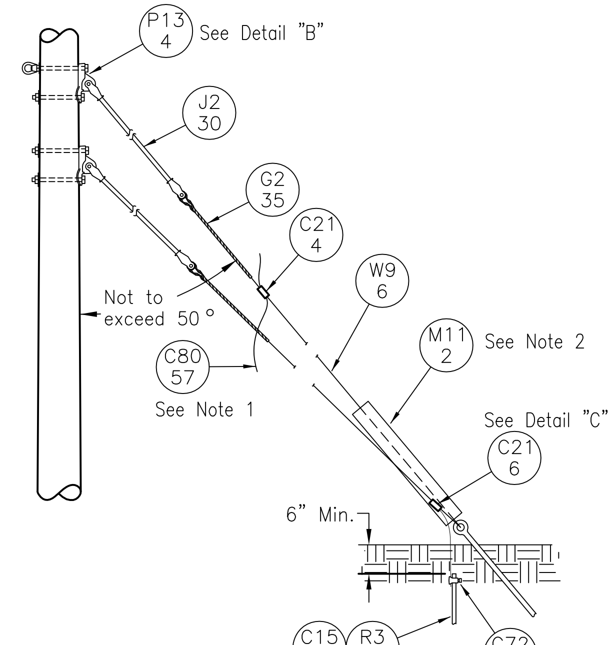
APPROVED BY: EDJ/RJC

Transmission & Subtransmission Down Guys 27,000 Lbs Maximum Guy Strength 10,000 Lbs Vertical Pole Crushing Limit	FirstEnergy Construction Std. 7–270	REV. 1 DATE 6/15

FE00078

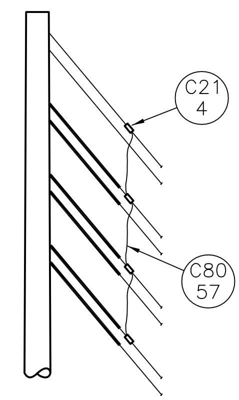


Ground Wire Guy



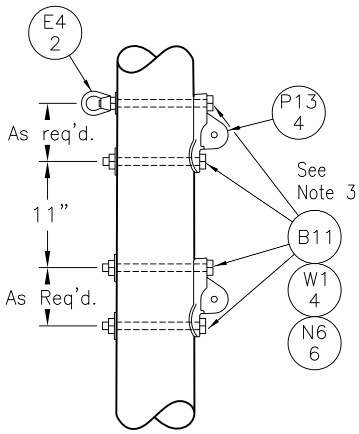
Conductor Guy

See Note 5

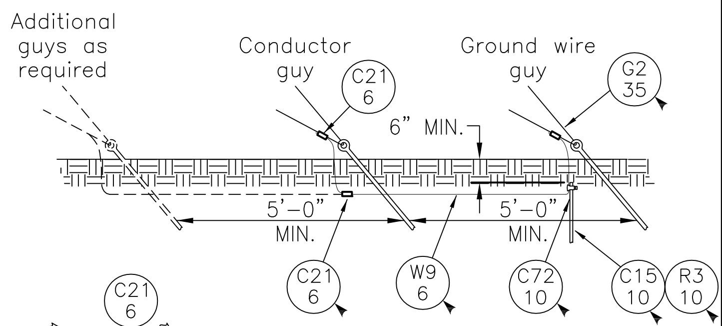


Detail "A"

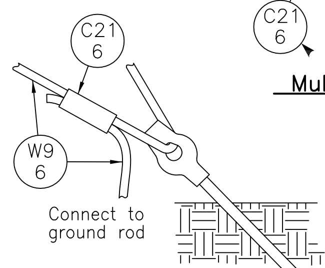
Guy wire bonding



Detail "B"



Multiple Guying



Detail "C"

Notes:

1. Bond all guys to ground wire guy, using #4 solid soft drawn copper conductor. See Detail "A"
2. Install guy marker on top guy at each anchor rod.
3. Install machine bolts with heads on guy plate side.
4. See Standard 7-105 for anchor details.
5. Ground rod not required at conductor guy if ground wire guy is installed. Install ground lead from ground wire guy to conductor guys, as shown in the "Multiple Guying" detail.
6. Guy design load is based on 90 percent of rated breaking strength, per NESC.
7. When ground resistance of 10 ohms or less cannot be obtained by above methods, see Standard 5-050.
8. When calculating vertical pole crushing at the point of guy attachment, use actual load with no overload factor. This load not to exceed 10,000 lbs. Above 10,000 lbs at any one guy plate.

APPROVED BY: EDJ/RJC

FirstEnergy	Transmission & Subtransmission Down Guys 27,000 Lbs Maximum Guy Strength 20,000 Lbs Vertical Pole Crushing Limit
REV. 1 / DATE 6/15 — Construction Std. 7–280	

APPROVED BY: WHH / JFM

PUBLIC VERSION

Maximum Span Lengths for Tangent or Angle Construction With a Bare Neutral

8 Ft. Tangent Crossarms for 15kV & 25kV

Primary Conductor			4 ACSR	1/0 ACSR	336 AAC	636 AAC
► Neutral Conductor			4 ACSR	1/0 ACSR	1/0 ACSR	1/0 ACSR ◄
15kV	25kV	35kV				
42"	45"	N/A	245'	310' ◄	160'	155'
60"	63"	N/A	270'	350'	245'	220'
78"	81"	N/A	300'	---	325'	280'

4 & 10 Ft. (15 kV) and 10 Ft. (25 & 35kV) Tangent Crossarms

Primary Conductor			4 ACSR	1/0 ACSR	336 AAC	636 AAC
► Neutral Conductor			4 ACSR	1/0 ACSR	1/0 ACSR	1/0 ACSR ◄
15kV	25kV	35kV				
42"	45"	48"	210'	295'	145'	140'
60"	63"	66"	225'	325'	235'	175'
78"	81"	84"	---	---	325'	240'

Maximum Span Lengths for Tangent or Angle Construction With a 1/0 ACSR Triplex Secondary

8 Ft. Tangent Crossarms for 15kV & 25kV

Primary Conductor				4 ACSR	1/0 ACSR	336 AAC	636 AAC
Secondary Conductor				1/0 Tpx	1/0 Tpx	1/0 Tpx	1/0 Tpx
Pri. Voltage	15kV	25kV	35kV				
Xarm to Sec. Space	42"	45"	N/A	215'	330'	175"	235'
	60"	63"	N/A	250'	350'	350'	300'
	78"	81"	N/A	275'	---	---	330'

4 & 10 Ft. (15 kV) and 10 Ft. (25 & 35kV) Tangent Crossarms

Primary Conductor				4 ACSR	1/0 ACSR	336 AAC	636 AAC
Secondary Conductor				1/0 Tpx	1/0 Tpx	1/0 Tpx	1/0 Tpx
Pri. Voltage	15kV	25kV	35kV				
Xarm to Sec. Space	42"	45"	48"	205'	315'	175"	170'
	60"	63"	66"	225'	325'	325"	275'

Maximum Span Lengths for Deadend Construction With a Bare Neutral

4, 8, & 10 Ft. (15kV), 8 & 10 Ft. (25kV), and 10 Ft. (35kV)

Primary Conductor			4 ACSR	1/0 ACSR	336 AAC	636 AAC
► Neutral Conductor			4 ACSR	1/0 ACSR	1/0 ACSR	1/0 ACSR ◄
15kV	25kV	35kV				
42"	45"	48"	195'	275'	130'	130'
60"	63"	66"	225'	325'	170'	165'
78"	81"	84"	---	---	310'	230'

Maximum Span Lengths for Deadend Construction With a 1/0 ACSR Triplex Secondary

4, 8, & 10 Ft. (15kV), 8 & 10 Ft. (25kV), and 10 Ft. (35kV)

Primary Conductor				4 ACSR	1/0 ACSR	336 AAC	636 AAC
Secondary Conductor				1/0 Tpx	1/0 Tpx	1/0 Tpx	1/0 Tpx
Pri. Voltage	15kV	25kV	35kV				
Xarm to Sec. Space	42"	45"	48"	190'	295'	160'	150'
	60"	63"	66"	225'	325'	325'	275'

NOTES:

1. Spans of multiplex over 250 ft. are not recommended because of excessive sag.
2. Spans are limited by 25% conductor movement overlap, for galloping prone areas, contact Regional Engineering.
3. All standard spans are limited to 350'
4. Table span limits are consolidated; for specific case analysis, contact Regional Engineering.

SPAN LENGTH LIMITATIONS FOR VARIOUS PRIMARY TO SECONDARY SPACINGS

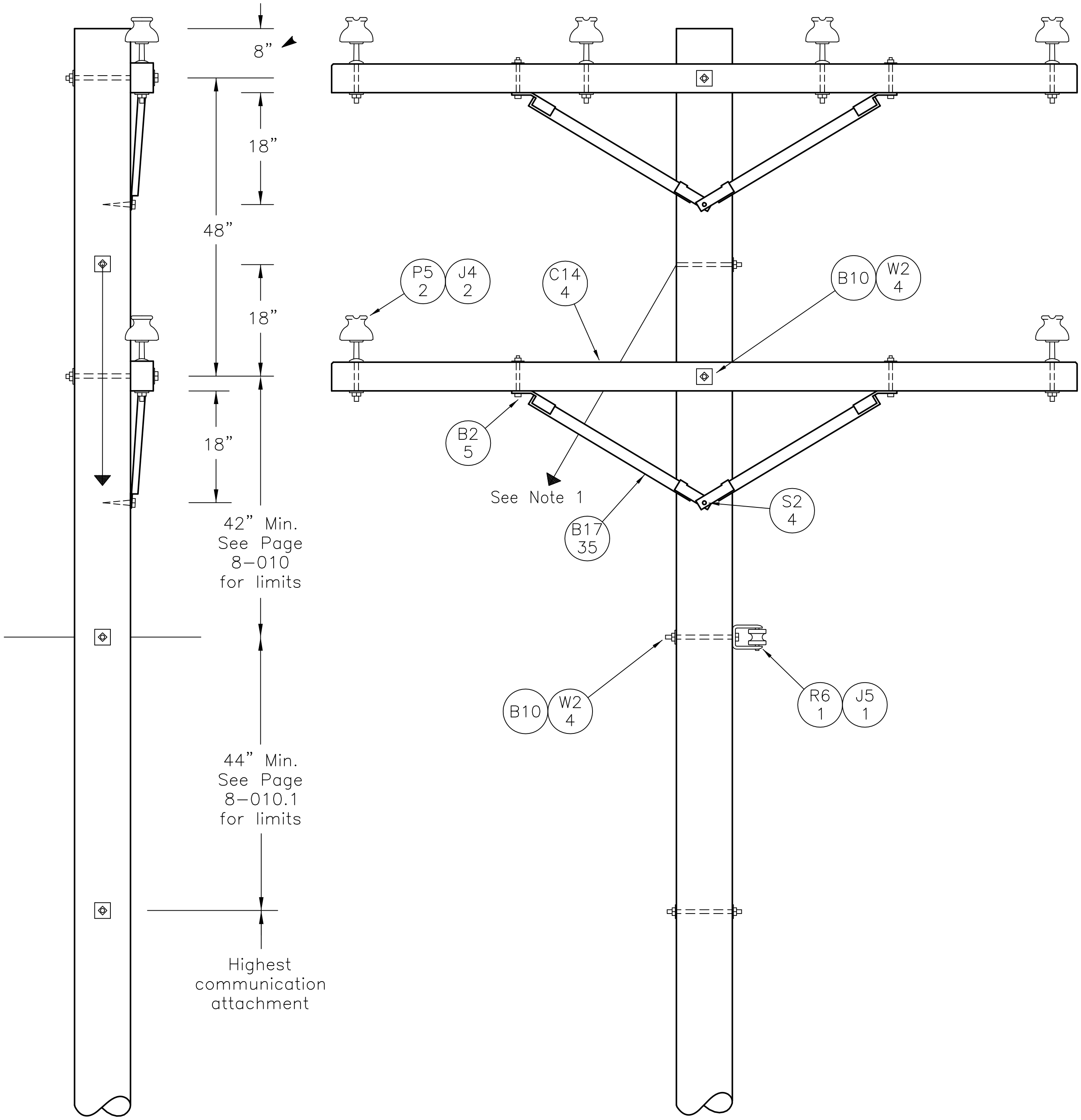
FirstEnergy

Construction Std.

8 -010 E-00080

Rev. 2

Date 2/04

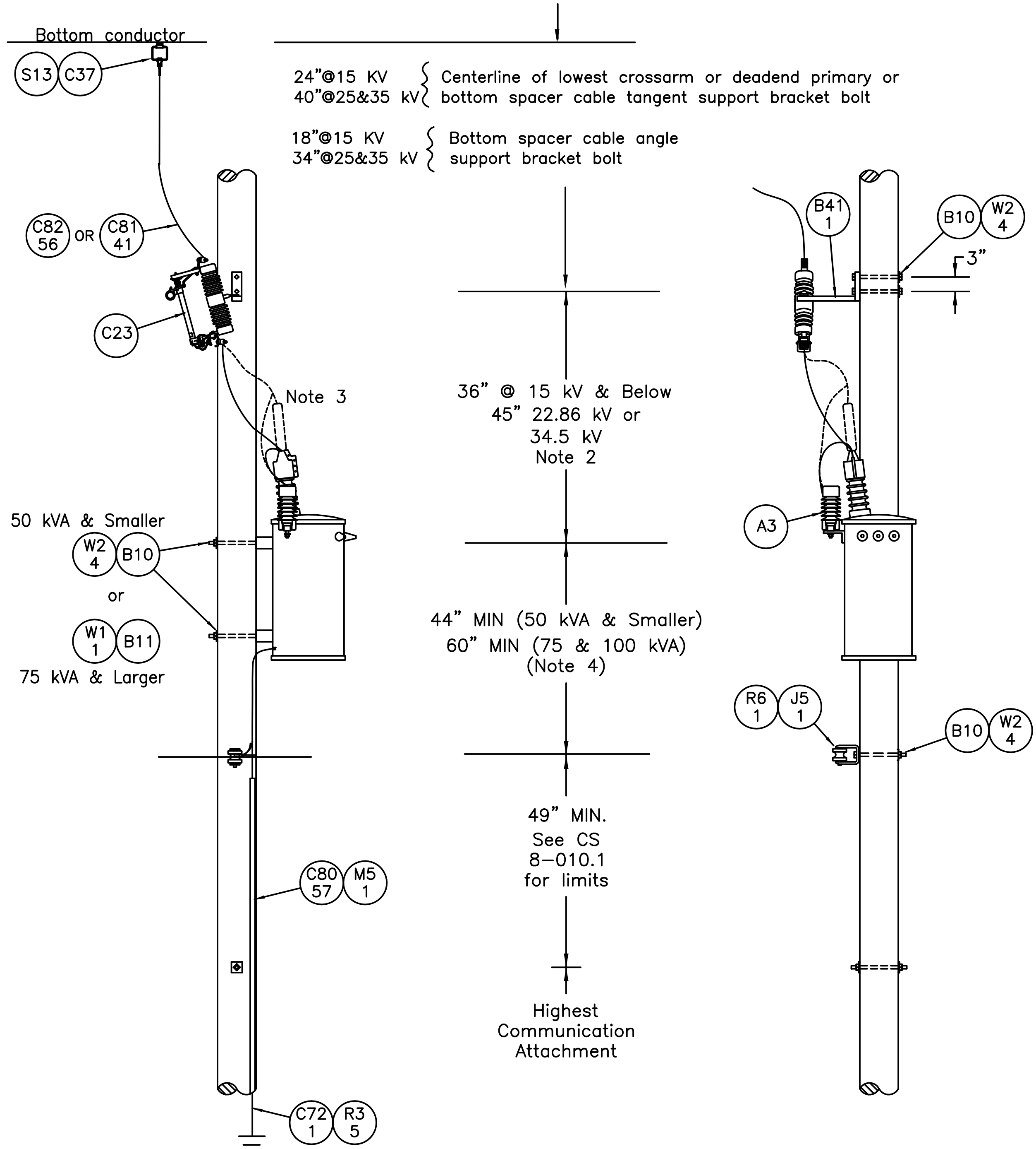


APPROVED BY: EDJ/RJC

NOTE:
1. Guying as required. See Section 7 for details.
2. Refer to Standard 8-030 for maximum angles for various conductors using using single pin construction.

3Ø Double Circuit Single Pin 10 Ft Crossarm Construction 15 kV Class	FirstEnergy Construction Std. 8-505	REV. 3 DATE 6/15

PUBLIC VERSION



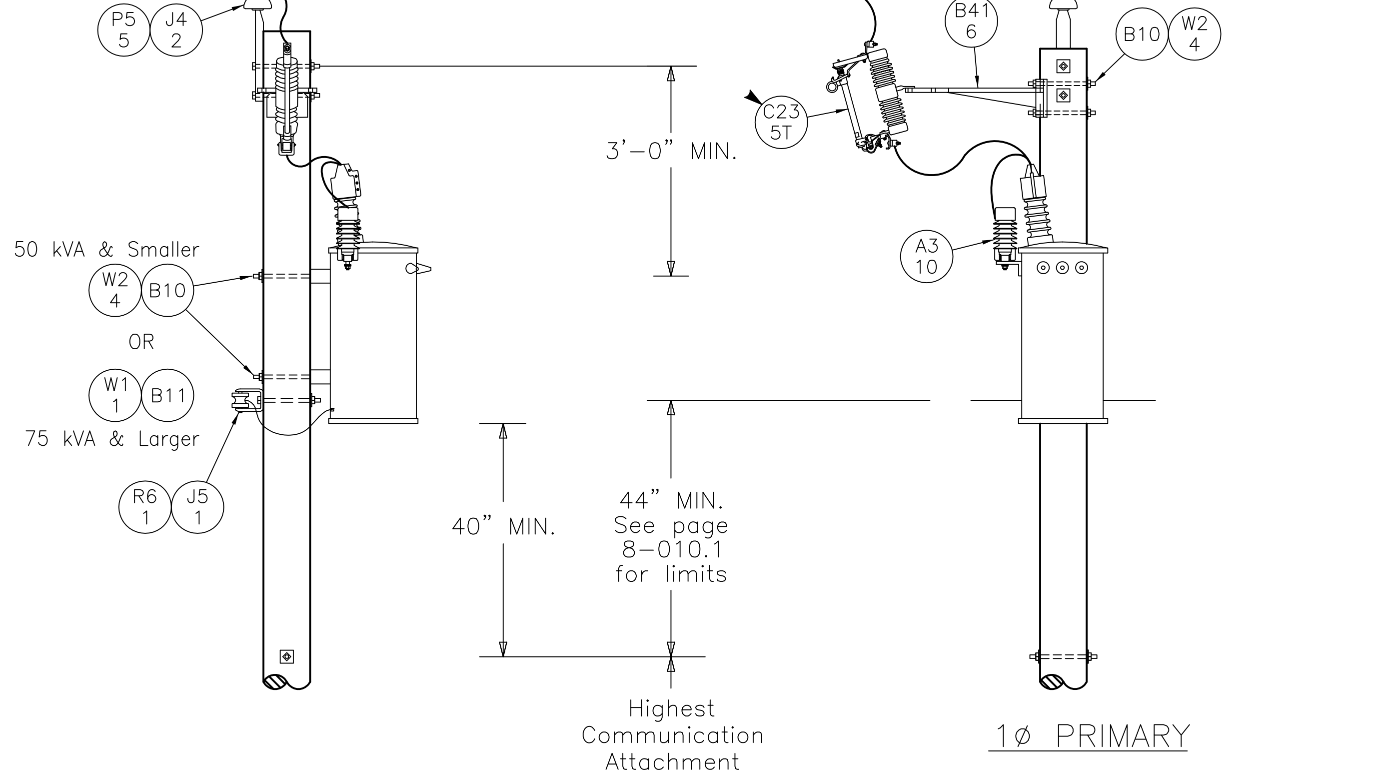
Notes:

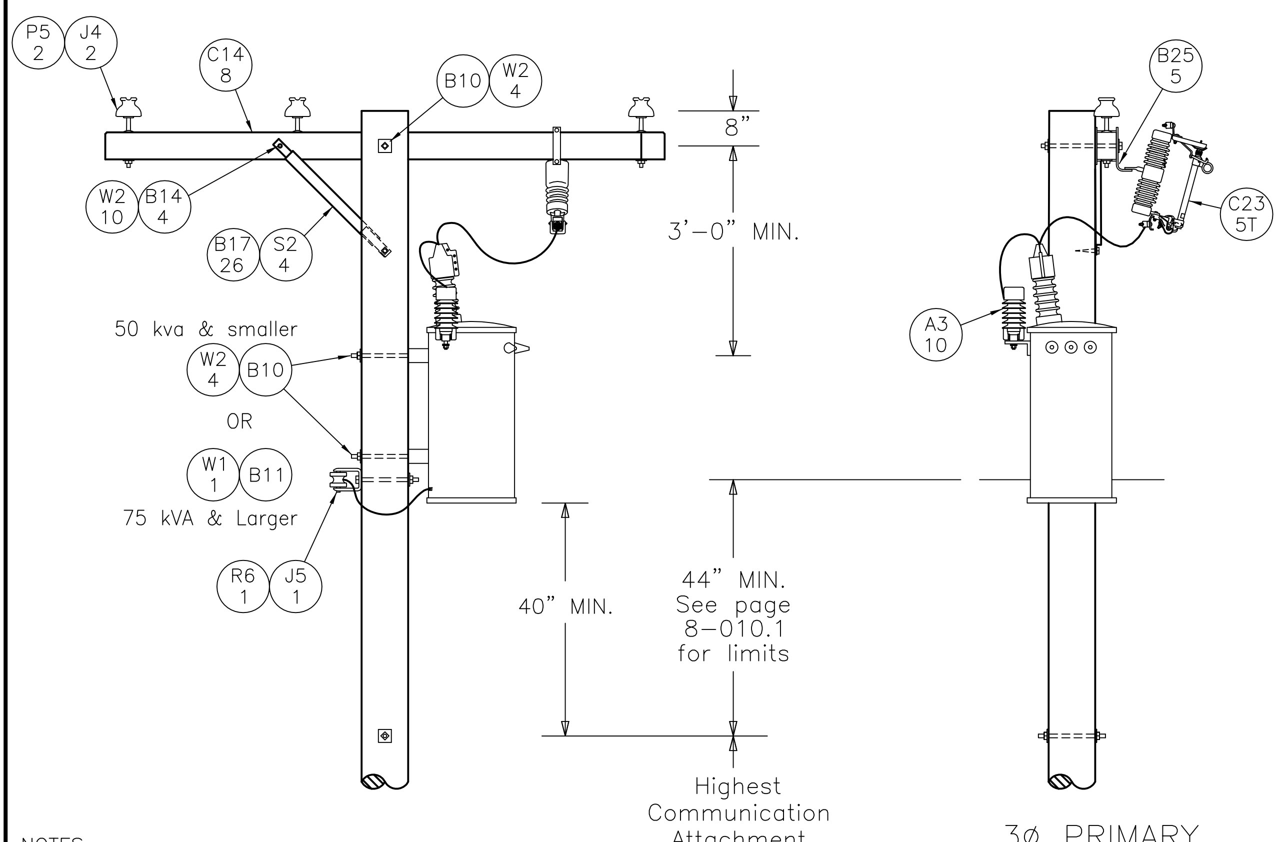
1. Two bushing transformers require ground lead to be taken to the H2 bushing.
2. IF the location is likely to have a cluster installation in the future, use 48" spacing @ 15 kV & 60" for 22.86 kV, & 34.5 kV. Add 18" If external current limiting fuse is used.
3. Current limiting fuse shall be installed on transformers used on the 22.86 kV and 34.5 kV systems where the nameplate does not indicate an internal current limiting fuse or any 15 kV transformer where the available asymmetric fault current exceeds 10 kA.
4. If open wire rack (R6/3) is used in place of single wire rack (R6/1), use the spacings shown on CS 11–120 for both transformer to secondary and for secondary to communication.

APPROVED BY: JAH/RJC

FirstEnergy.		1Ø Conventional Transformer Installation Wye Primary Distribution
REV. 6	Construction Std.	
DATE 10/18	11–115	

FE00082





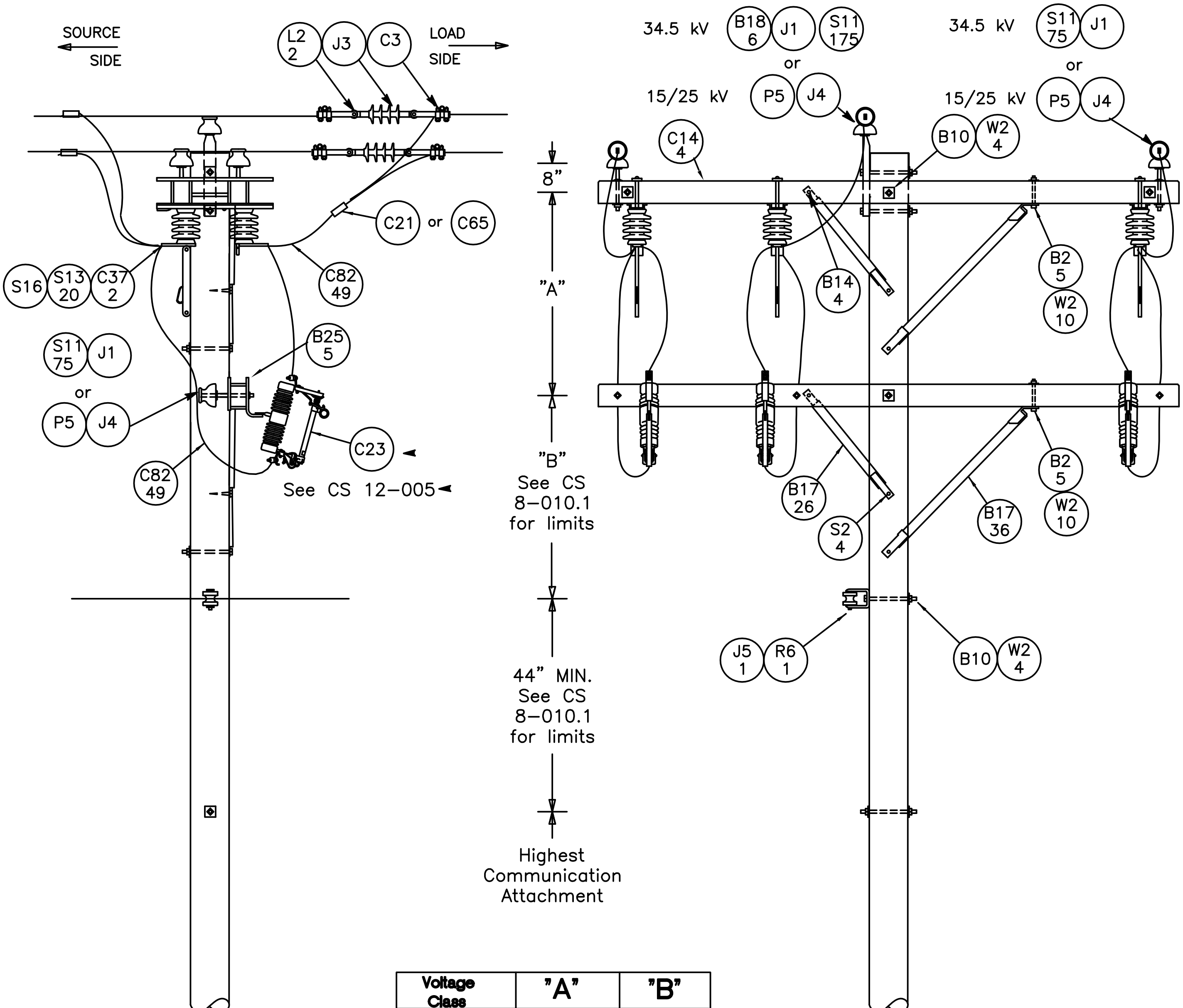
APPROVED BY: EDJ/RJC

NOTES:

1. Transformers shall be rotated at least 45 degrees from centerline of primary conductor.
2. This configuration shall be used only when the addition of a transformer to an existing pole per page 11–115, would result in the replacement of the pole.

METHODS FOR OBTAINING ADDITIONAL SECONDARY HEIGHT SINGLE–PHASE WYE CIRCUITS TRANSFORMERS 15 KV CLASS	FirstEnergy	
	Construction Std.	REV. 3
	11–116	DATE 10/14

FE00083



Voltage Class	"A"	"B"
15 kV	42"	42"
25 kV	45"	45"
35 kV	48"	48"

Notes:

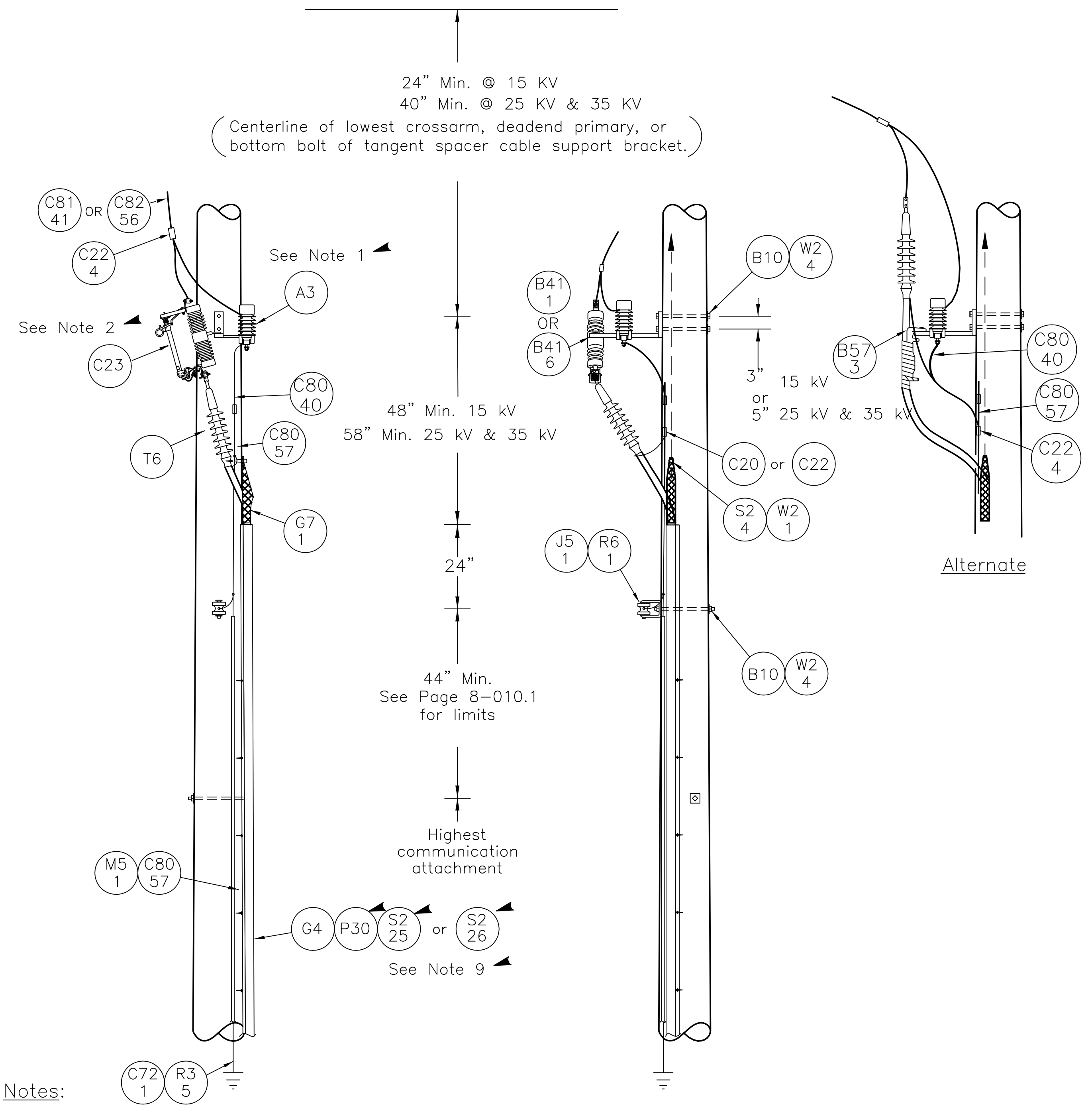
1. Guy as required. See CS Section 7 for details.
2. Caution – over tightening of disconnect bolts can result in misalignment of blade.
3. Open and remove fuseholders when not in use.
4. This installation is only used when a normally fused portion of a circuit may be tied to another circuit with more than a 300 amp total load.

APPROVED BY: JAH/RJC

FirstEnergy.

REV.	Construction Std.	3Ø Line Sectionalizing Using Cutouts & Disconnects 34.5 /19.9 kV or Below
4	12–606	
DATE 05/18		

FE00084



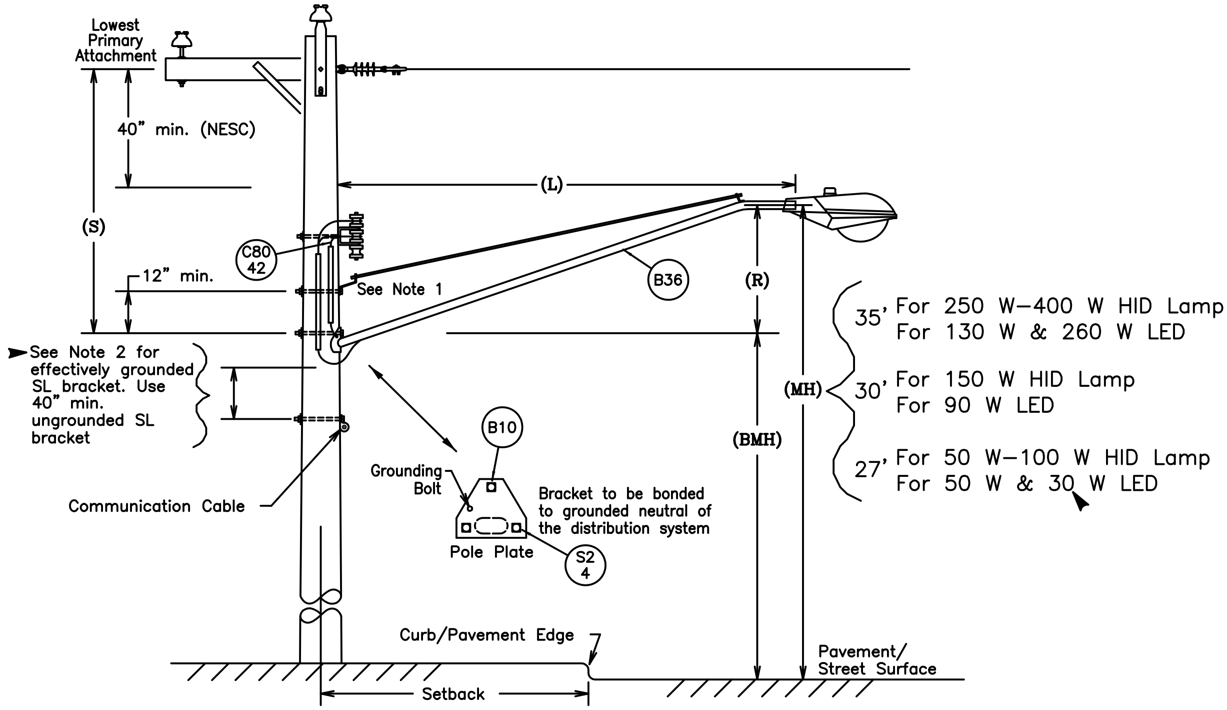
Notes:

1. Voltage dependent – Refer to Standard 5–350 for proper arrester application.
2. Voltage dependent – Refer to Standard 12–005 for proper cutout application and Standard 14–100 for proper riser fuse coordination.
3. Minimize bending of terminator.
4. Arresters must be grounded before energizing, due to small current drain when energized.
5. Alternate mounting is used when the fused protection is on the tap pole across the road.
6. See Standard 14–125 for riser pole grounding and neutral schematic.
7. Bend terminator pin to move terminator away from fuse holder exhaust.
8. For spacer cable construction, mount equipment on opposite side of pole from spacer cable.
9. Every pre-drilled hole on U-guard shall contain a lag screw.

APPROVED BY: JAH/RJC

Single–Phase Riser Pole #2 Thru 1/0 AL Jacketed Cable 34,500Y/19,900 V & Below	FirstEnergy Construction Std. 14–210	REV. 8 DATE 1/15

FE00085



Installation Guide					
Nominal Bracket Length	Nominal Bracket Rise From Lower Thru–Bolt	Minimum Spacing Lowest Primary Attachment to Bracket Mounting Thru–Bolt	Bracket Mounting Heights (BMH)		
			70 W–100 W HID Lamp 30 W & 50 W LED	150 W HID Lamp 90 W LED	250 W–400 W HID Lamp 130 W & 260 W LED
(L)	(R)	(S)	Height to Thru–Bolt (BMH)	Height to Thru–Bolt (BMH)	Height to Thru–Bolt (BMH)
2.5'	18"	5.5'	25.5'	28.5'	33.5'
6'	24"	6.0'	25.0'	28.0'	33.0'
12'	42"	7.5'	23.5'	26.5'	31.5'
16'	54"	8.5'	22.5'	25.5'	30.5'
20'	66"	9.5'	21.5'	24.5'	29.5

Bracket Selection Guide				
	Pavement Width			
	Under 24' (2 Lanes)	24' to 36' (2–3 Lanes)	36' to 48' (3–4 Lanes)	48' to 60' (5+ Lanes)
Pole Setback From Edge of Pavement (Feet)	Lamp Bracket Length (Feet)			
0 to 8	2.5 or 6	6	12	12
9 to 14	12	12	16	16
15 to 18	16	16	20	20
19 to 22	20	20	20	20

*For setbacks over 22', contact ED Operations Services.

Notes:

1. Bracket may be installed above, below, or straddle secondary equipment.
2. Clearance to wood communication support arms is 20" min. for effectively grounded brackets. Clearance to communication cables, terminal boxes, brackets, and drive hooks is 4" for effectively grounded brackets.

APPROVED BY: JCK/RJC

Luminaire Brackets, Wood Pole

FirstEnergy

Construction Std. 16–100

REV. 4

DATE 12/19

FirstEnergy
Exhibit RC-3
(Non-Confidential Version)

	A	B	C
1	ACTIVITY	POLES AND LOCATION	ESTIMATED COST
2			
3	CONSTRUCT DUPLICATE POLE LINE & TRANSFER ELECTRIC FROM FRONTIER POLES	15 kV Class - 1PH - Congested Area	[redacted]
4	CONSTRUCT DUPLICATE POLE LINE & TRANSFER ELECTRIC FROM FRONTIER POLES	15 kV Class - 3PH - Congested Area	[redacted]
5	CONSTRUCT DUPLICATE POLE LINE & TRANSFER ELECTRIC FROM FRONTIER POLES	35 kV Class - 1PH - Congested Area	[redacted]
6	CONSTRUCT DUPLICATE POLE LINE & TRANSFER ELECTRIC FROM FRONTIER POLES	35 kV Class - 3PH - Congested Area	[redacted]
7	CONSTRUCT DUPLICATE POLE LINE & TRANSFER ELECTRIC FROM FRONTIER POLES	15 kV Class - 1PH - Rural Area	[redacted]
8	CONSTRUCT DUPLICATE POLE LINE & TRANSFER ELECTRIC FROM FRONTIER POLES	15 kV Class - 3PH - Rural Area	[redacted]
9	CONSTRUCT DUPLICATE POLE LINE & TRANSFER ELECTRIC FROM FRONTIER POLES	35 kV Class - 1PH - Rural Area	[redacted]
10	CONSTRUCT DUPLICATE POLE LINE & TRANSFER ELECTRIC FROM FRONTIER POLES	35 kV Class - 3PH - Rural Area	[redacted]
11			[redacted]
12	CONSTRUCT NEW POLE LINE/DISTRIBUTION SYSTEM & REMOVE ELECTRIC FROM FRONTIER POLES	15 kV Class - 1PH - Congested Area	[redacted]
13	CONSTRUCT NEW POLE LINE/DISTRIBUTION SYSTEM & REMOVE ELECTRIC FROM FRONTIER POLES	15 kV Class - 3PH - Congested Area	[redacted]
14	CONSTRUCT NEW POLE LINE/DISTRIBUTION SYSTEM & REMOVE ELECTRIC FROM FRONTIER POLES	35 kV Class - 1PH - Congested Area	[redacted]
15	CONSTRUCT NEW POLE LINE/DISTRIBUTION SYSTEM & REMOVE ELECTRIC FROM FRONTIER POLES	35 kV Class - 3PH - Congested Area	[redacted]
16	CONSTRUCT NEW POLE LINE/DISTRIBUTION SYSTEM & REMOVE ELECTRIC FROM FRONTIER POLES	15 kV Class - 1PH - Rural Area	[redacted]
17	CONSTRUCT NEW POLE LINE/DISTRIBUTION SYSTEM & REMOVE ELECTRIC FROM FRONTIER POLES	15 kV Class - 3PH - Rural Area	[redacted]
18	CONSTRUCT NEW POLE LINE/DISTRIBUTION SYSTEM & REMOVE ELECTRIC FROM FRONTIER POLES	35 kV Class - 1PH - Rural Area	[redacted]
19	CONSTRUCT NEW POLE LINE/DISTRIBUTION SYSTEM & REMOVE ELECTRIC FROM FRONTIER POLES	35 kV Class - 3PH - Rural Area	[redacted]
20			[redacted]
21	CONSTRUCT UNDERGROUND & TRANSFER ELECTRIC FROM FRONTIER POLES	15 kV Class Underground - 1PH - Congested Area	[redacted]
22	CONSTRUCT UNDERGROUND & TRANSFER ELECTRIC FROM FRONTIER POLES	15 kV Class Underground - 3PH - Congested Area	[redacted]
23	CONSTRUCT UNDERGROUND & TRANSFER ELECTRIC FROM FRONTIER POLES	35 kV Class Underground - 1PH - Congested Area	[redacted]
24	CONSTRUCT UNDERGROUND & TRANSFER ELECTRIC FROM FRONTIER POLES	35 kV Class Underground - 3PH - Congested Area	[redacted]
25	CONSTRUCT UNDERGROUND & TRANSFER ELECTRIC FROM FRONTIER POLES	15 kV Class Underground - 1PH - Rural Area	[redacted]
26	CONSTRUCT UNDERGROUND & TRANSFER ELECTRIC FROM FRONTIER POLES	15 kV Class Underground - 3PH - Rural Area	[redacted]
27	CONSTRUCT UNDERGROUND & TRANSFER ELECTRIC FROM FRONTIER POLES	35 kV Class Underground - 1PH - Rural Area	[redacted]
28	CONSTRUCT UNDERGROUND & TRANSFER ELECTRIC FROM FRONTIER POLES	35 kV Class Underground - 3PH - Rural Area	[redacted]
29			[redacted]
30	ADDITIONAL PER CUSTOMER CHARGE TO MOVE UNDERGROUND	Underground Without Directional Boring	[redacted]
31	ADDITIONAL PER CUSTOMER CHARGE TO MOVE UNDERGROUND	Underground With Directional Boring	[redacted]