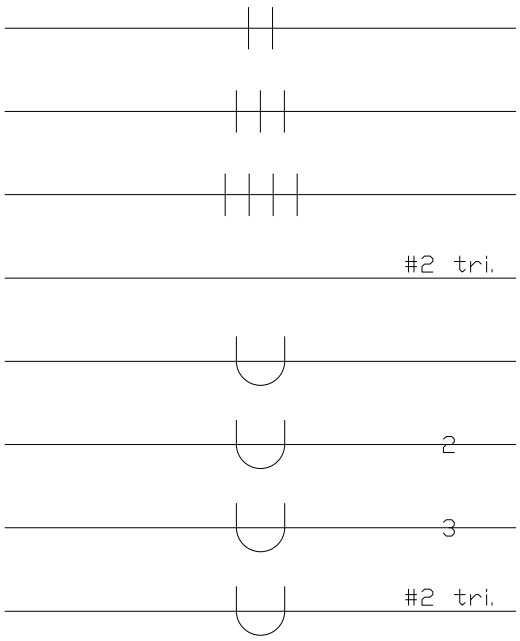
Forked Deer
Electric Cooperative Inc.

SPECIFICATIONS AND DRAWINGS
12.5/7.2 KV

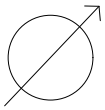
FORKED DEER ELECTRIC CO-OP
HALLS, TN
JOB NO: 81738
REVISED: SEPTEMBER 2018

Allen&Hoshall
engineers-architects-surveyors
1661 International Drive, Suite 100, Memphis, TN 38120

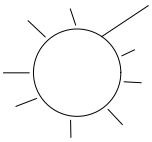


Transformer

Regulator



Yard Light

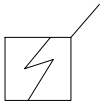


Solid Blade disconnect

Pad Mount Transformer

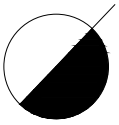
Fuse

Lightning Arrestor



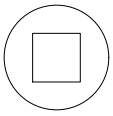
Gang Operated Switch

Recloser



Capacitors

UG Secondary pedestal

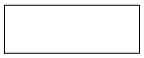


House

Sectionalizer

UG Primary junction box

Trailer



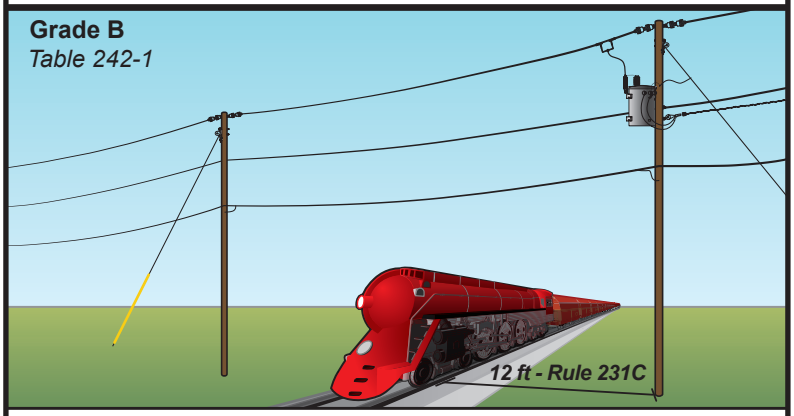
SYMBOLS

Sept. – 18

FDEC

Application Guide for 2017 NESC Table 232-1 *- see NESC for details and exceptions*

Railroads*

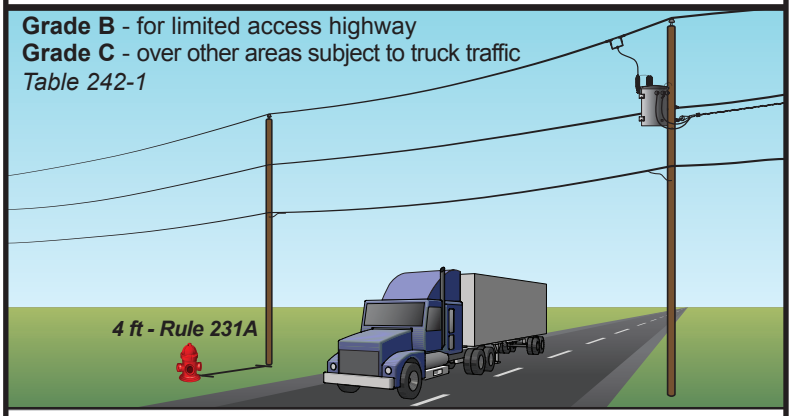


Vertical Clearance at Largest Vertical Sag *Table 232-1*

Neutral or Comm.	Grounded Span Guy	TPX	7.2/12.5 kV	14.4/25 kV	19.9/35 kV
23.5 ft		24.0 ft	26.5 ft		

**Railroad company may require greater clearance*

Trucks Over 8 Feet*

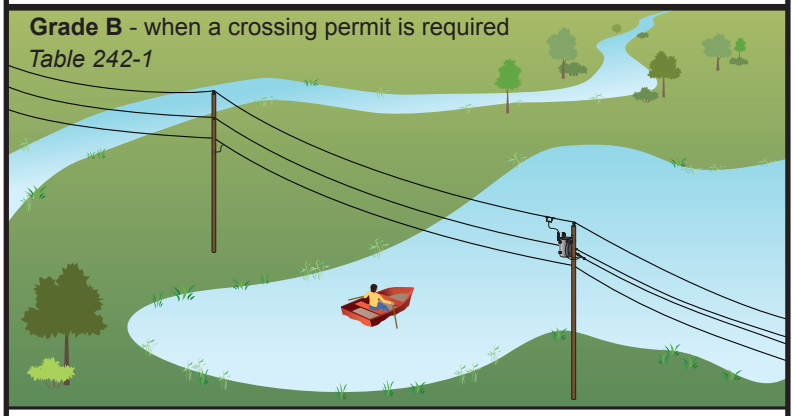


Vertical Clearance at Largest Vertical Sag *Table 232-1*

Neutral or Comm.	Grounded Span Guy	TPX	7.2/12.5 kV	14.4/25 kV	19.9/35 kV
15.5 ft		16.0 ft	18.5 ft		

**DOT may require greater clearance*

Water - No Sailboats



Vertical Clearance at Largest Vertical Sag *Table 232-1*

Neutral or Comm.	Grounded Span Guy	TPX	7.2/12.5 kV	14.4/25 kV	19.9/35 kV
14.0 ft		14.5 ft	17.0 ft		

**see NESC for sailboat clearances*

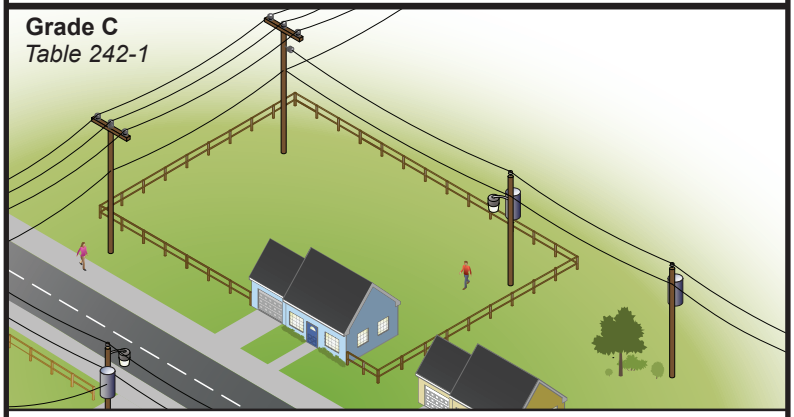
Over fields, orchards, forest, etc.

Vertical Clearance at Largest Vertical Sag *Table 232-1*

Neutral or Comm.	Grounded Span Guy	TPX	7.2/12.5 kV	14.4/25 kV	19.9/35 kV
15.5 ft		16.0 ft	18.5 ft		

**used by vehicles over 8 feet tall or riders on horseback*

Pedestrians Only*

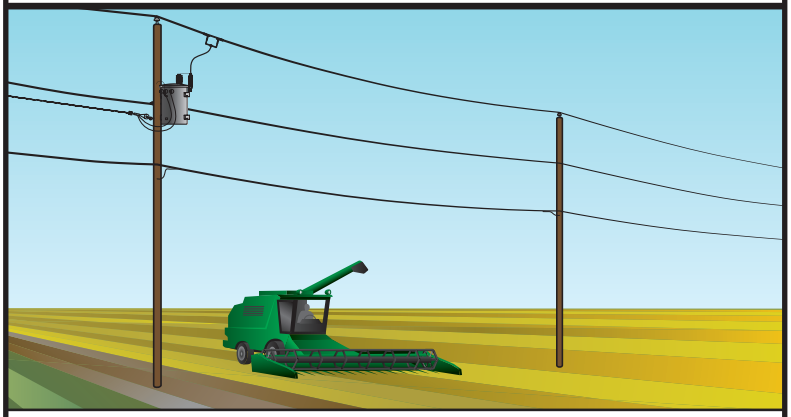


Vertical Clearance at Largest Vertical Sag *Table 232-1*

Neutral or Comm.	Grounded Span Guy	TPX	7.2/12.5 kV	14.4/25 kV	19.9/35 kV
9.5 ft		12.0 ft	14.5 ft		

**Not normally used by trucks or riders on horseback (very steep hills, swamps, etc.)*

Oversized Vehicles - greater than 14 feet in height



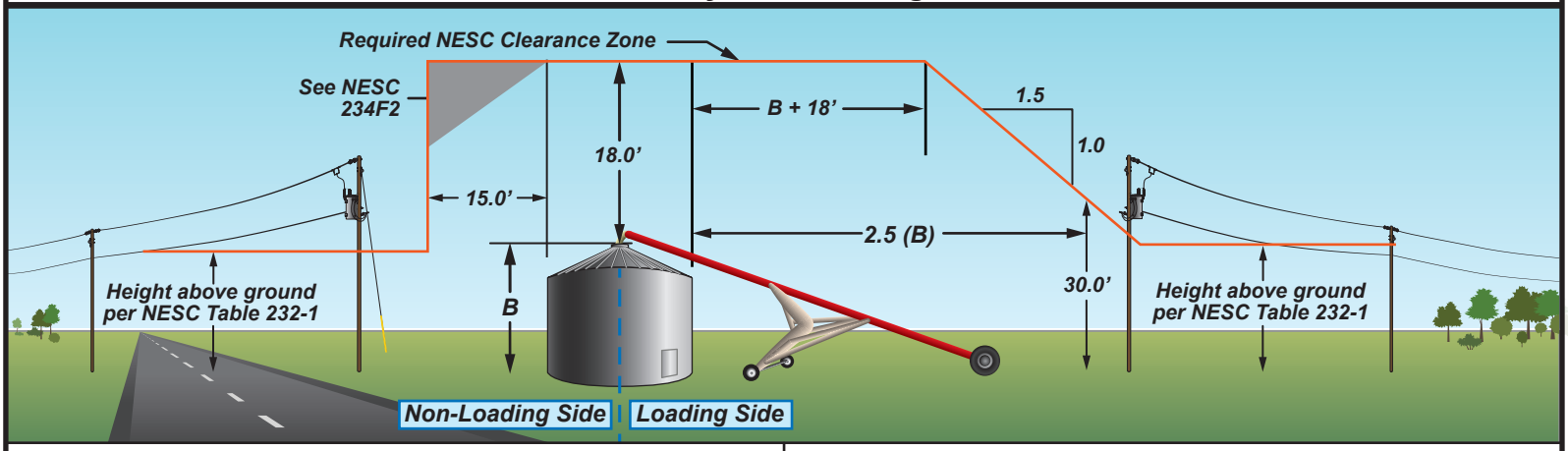
Vertical Clearance at Largest Vertical Sag *Table 232-1*

Neutral or Comm.	Grounded Span Guy	TPX	7.2/12.5 kV	14.4/25 kV	19.9/35 kV
X + 1.5 ft		X + 2 ft	X + 4.5 ft		

X = Known Height of oversized vehicle

Application Guide for 2017 NESC - *see NESC for details and exceptions*

Clearance Over* or Near Grain Bins Loaded by Portable Auger NESC 234F2



B = Vertical height to highest filling or probing port

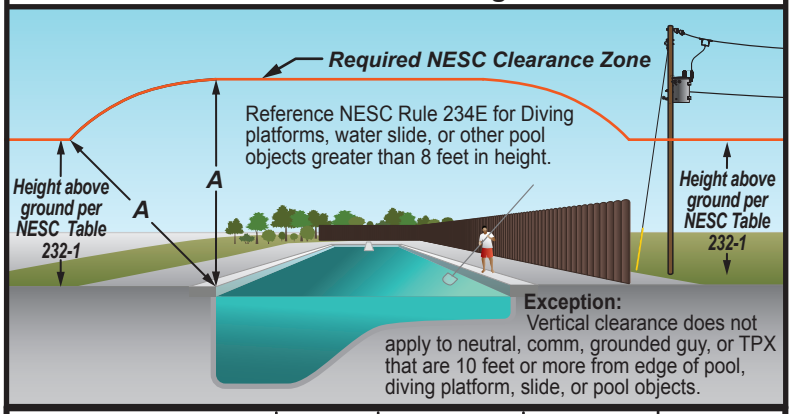
Note: If B > 12 feet, vertical height of conductors is 30 feet at a distance equal to 2.5 times B

*Largest vertical sag

Non-Loading Side is when use of portable auger is limited by:

1. Permanent building/structure
2. Physical obstruction
3. Public road or other right of way
4. Designation or agreement

Clearance Over* or Near Swimming Pools NESC 234E1

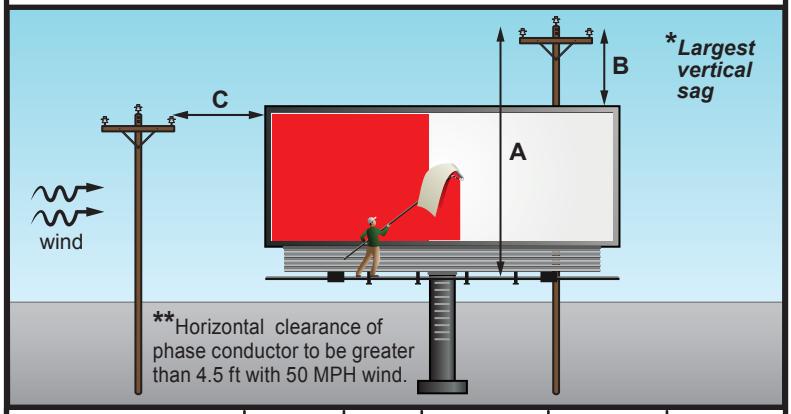


Neutral	TPX	7.2/12.5 kV	14.4/25 kV	19.9/35 kV
22.0 ft	22.5 ft	25.0 ft		

*Largest vertical sag

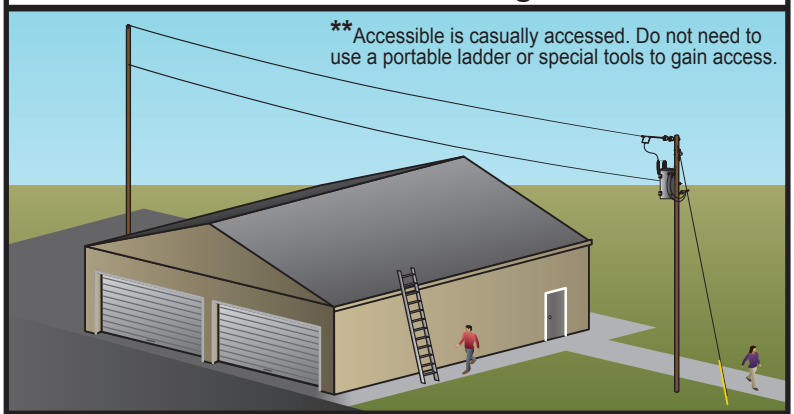
Aboveground pool with deck or ladder, clearance is from highest point upon which people can stand.

Clearance Over* or Near Billboards NESC 234C



	Neutral	TPX	7.2/12.5kV	14.4/25kV	19.9/35kV
A-Where personnel walk	10.5 ft	11.0 ft	13.5 ft		
B - Other Surface	3.0 ft	3.5 ft	8.0 ft		
C - Horizontal**	4.5 ft	5.0 ft	7.5 ft		

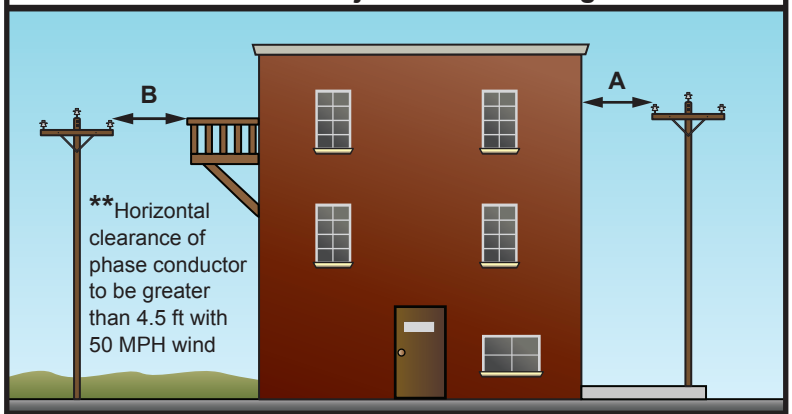
Vertical Clearance Over* Buildings NESC 234C



Roof	Neutral	TPX	7.2/12.5kV	14.4/25kV	19.9/35kV
Accessible**	10.5 ft	11.0 ft	13.5 ft		
Non-Accessible	3.0 ft	3.5 ft	12.5 ft		

*Largest vertical sag

Horizontal Clearance Adjacent to Buildings NESC 234C

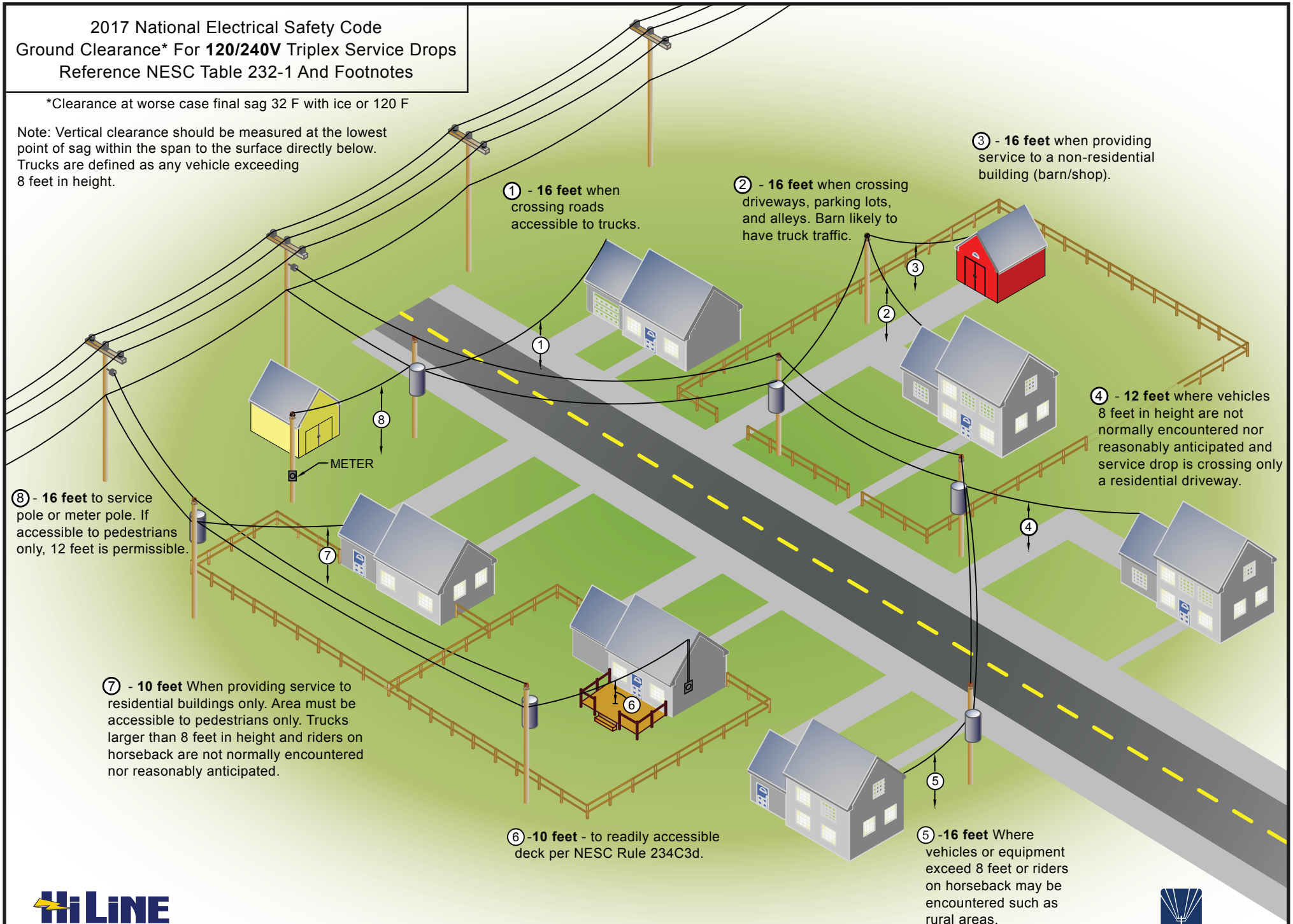


	Neutral	TPX	7.2/12.5kV	14.4/25kV	19.9/35kV
A-To Walls**	4.5 ft	5.0 ft	7.5 ft		
B - Accessible Areas**	4.5 ft	5.0 ft	7.5 ft		

2017 National Electrical Safety Code
Ground Clearance* For **120/240V** Triplex Service Drops
Reference NESC Table 232-1 And Footnotes

*Clearance at worse case final sag 32 F with ice or 120 F

Note: Vertical clearance should be measured at the lowest point of sag within the span to the surface directly below. Trucks are defined as any vehicle exceeding 8 feet in height.



(1) - **16 feet** when crossing roads accessible to trucks.

(2) - **16 feet** when crossing driveways, parking lots, and alleys. Barn likely to have truck traffic.

(3) - **16 feet** when providing service to a non-residential building (barn/shop).

(4) - **12 feet** where vehicles 8 feet in height are not normally encountered nor reasonably anticipated and service drop is crossing only a residential driveway.

(5) -**16 feet** Where vehicles or equipment exceed 8 feet or riders on horseback may be encountered such as rural areas.

(6) -**10 feet** - to readily accessible deck per NESC Rule 234C3d.

(7) - **10 feet** When providing service to residential buildings only. Area must be accessible to pedestrians only. Trucks larger than 8 feet in height and riders on horseback are not normally encountered nor reasonably anticipated.

(8) - **16 feet** to service pole or meter pole. If accessible to pedestrians only, 12 feet is permissible.

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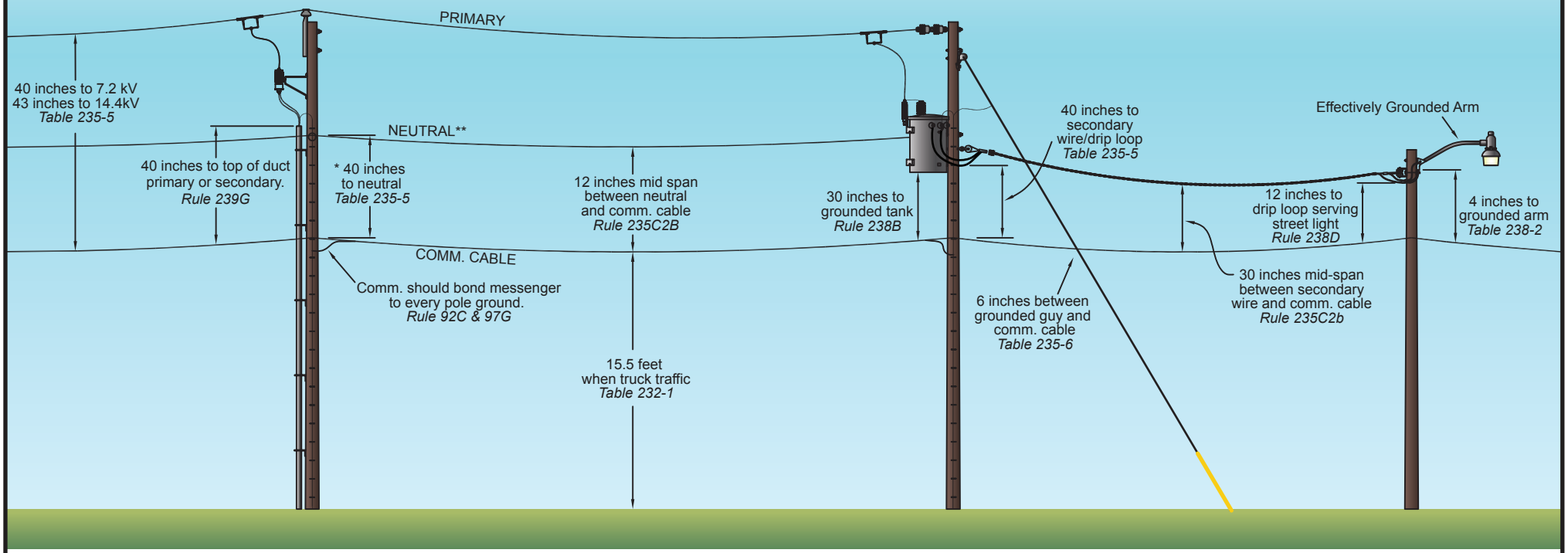
FEDERATED RURAL ELECTRIC INSURANCE EXCHANGE

Summary of NESC Clearances to Communication Cables *- see NESC for details and exceptions*



* 30 inches is allowed if the communication messenger is bonded to the neutral throughout the service area. *Table 235-5*

** Fiber Optic Cables in the supply space (*Rule 224A*) will have the same required clearance to communication cables in the communication space as a multi-grounded neutral (*Rule 235C*)

A **communication worker safety zone** is 40 inches of clearance between communication lines and supply lines/equipment per *Rule 235C4 & 238E*

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FEDERATED RURAL ELECTRIC INSURANCE EXCHANGE

Common Primary Overhead Conductors

Code Word	Size (AWG or kcmil)	Strand-ing (Al/Stl)	Diameter (ins.)				Weight Per 1000 ft. (lbs.)			Content (%)		Rated Strength (lbs.)	Resistance OHMS/1000 ft.		Allowable Ampacity + (Amps)
			Individual Wires		Steel Core	Complete Cable	Al	Stl	Total	Al	Stl		DC @ 20°C	AC @ 75°C	
			Al	Stl											
Sparrow	2	6/1	0.1052	0.1052	0.1052	0.316	62	29	91	67.9	32.1	2850	0.254	0.332	184
Raven	1/0	6/1	0.1327	0.1327	0.1327	0.398	99	47	145	67.89	32.11	4380	0.159	0.217	242
Pigeon	3/0	6/1	0.1672	0.1672	0.1672	0.502	156	74	230	67.87	32.13	6620	0.1	0.144	315
Merlin	336.4	18/1	0.1367	0.1367	0.1367	0.684	315	49	365	86.43	13.57	8680	0.051	0.0625	519
Pelican	477	18/1	0.1628	0.1628	0.1628	0.814	447	70	517	86.44	13.56	11800	0.036	0.0442	646
Coot	795	36/1	0.1486	0.1486	0.1486	1.04	745	58	804	92.72	7.28	16710	0.0217	0.0268	884

+Condoctor temperature of 75°C, ambient temperature 25°C, emissivity 0.5, wind 2ft./sec., in sun.

1 inch = 1000 mils

Common Secondary Overhead Conductors

Code* Word	Phase Conductor			Bare Neutral Messenger			Weight Per 1000 ft. (lbs.)		Allowable Ampacities+	
	Size (AWG or kcmil)	Strand-ing	Insul. Thick. ins.(mils)	Size (AWG or kcmil)	Strand-ing	Rated Strength (lbs.)	XLP	POLY	XLP	POLY
Duplex-ACSR Neutral-Messenger										
Shepherd	6	7	0.045 (45)	6	6/1	1190	75	75	85	70
Triplex-ACSR Neutral-Messenger										
Periwinkle	4	7	0.045 (45)	4	6/1	1860	172	172	115	90
Conch	2	7	0.045 (45)	2	6/1	2850	262	262	150	120
Triplex-ACSR Reduced Neutral-Messenger										
Janthina	1/0	7	0.060 (60)	2	6/1	2853	366	366	205	160
Cerapus	4/0	18	0.060 (60)	2/0	6/1	5310	681	681	315	245
Quadplex-ACSR Neutral-Messenger										
Palomino	2	7	0.045 (45)	2	6/1	2850	347	347	135	105
Costena	1/0	9	0.060 (60)	1/0	6/1	4380	549	549	180	140
Appaloosa	4/0	18	0.060 (60)	4/0	6/1	8350	1038	1038	275	210

*Code words for XLP insulated products are formed by adding "/XLP" to the conventional code words above.

+Conductor temperature of 90°C for XLP, 75°C for Poly: ambient temperature of 40°C: emissivity 0.9: 2 ft./sec/ wind in sun.

1 mil = 0.001 inches

SERVICE CONDUCTOR CHART

Cond–uctor	O.D inch	Base Factor	# per foot	Net Wt. per ft.	Pre–Design Span	Sag Adj.	Recommended Max. Span
6 DPX	.250	–.500	.081	.331	318.4'	–138"	180'
4 TPX	.500	–.250	.190	.565	186.5'	–36"	150'
2 TPX	.750	0.000	.281	.781	135.0'	––	135'
(Reduced Neutral) 1/0 TPX	Red. .875	Neu. +.125	.366	.929	113.5'	––	110'
(Full Neutral) 1/0 TPX	.947	+.187	.464	1.051	91.6'	––	90'
2/0 TPX	1.000	+.250	.569	1.194	88.2'	––	85'
4/0 TPX	1.250	+.500	.814	1.464	71.9'	––	70'
1/0 QPX	1.500	+.750	.610	1.493	70.5'	––	70'
4/0 QPX	2.000	+1.25	1.133	2.258	46.7'	––	45'

UNGUYED SPANS – TYPICAL SUPPORT ON BLDG. FOR CONDUCTOR

Chart is based on 2 TPX at 135' & 105.4 lbs.
Sag tension is assumed, based on approx. 30" of sag on 135' of 2 TPX.
If conductors are tensioned greater, additional guying or supports will be required.

FORMULA: Cwf + BF% + Iw = Nwf

(105.4 + Nwf) – sag adj. = Max design unguyed span.

EXAMPLE: 1/0 TPX (full neutral)
.464 + .187 + .500 = 1.151
105.4 + 1.151 – 0 = 91.6'

Cwf = Conductor weight per ft.
IW = Ice & Wind loading – .500 lbs. per foot.
Bf = Base factor percentage to 2 TPX
Nwf = Net weight per ft.
105.4 = Net weight of 135' of 2 TPX
O.D. = Outsided diameter (in) of grouped conductors
Sag Adj. = Estimated additional tension–weight to conductor lenght, to sag conductor above 135'.

Ref. Cond. Wgts., Anderson Elect. Tech. Data

BULLETIN 1728F-804: INDEX

GENERAL CONSTRUCTION SPECIFICATIONS

All construction shall be performed in a safe, thorough, and skillful manner in accordance with the staking sheets, plans and specifications, and the construction drawings.

The provisions of 7 CFR 1724.50, "Compliance with National Electrical Safety Code (NESC)" apply to all borrower electric system facilities regardless of the source of financing. A borrower must ensure that its electric system including all distribution, transmission, and generating facilities, is designed, constructed, operated, and maintained in accordance with all of the applicable provisions of:

(1) the most current provisions of the NESC, and

(2) all applicable and current electrical and safety requirements of any State or local governmental entity.

Any electrical standard requirements established by RUS are in addition to, and not a substitution for nor modification of (1) and (2) listed immediately above.

The permitted loading, strength, and spacing (separation) of structures, assemblies and conductors shown on the assembly drawings in this bulletin are based on and are in compliance with the 2002 Edition of the NESC.

Copies of the NESC may be obtained from the Institute of Electrical and Electronics Engineers, Inc., (IEEE) at the following address:

IEEE Customer Service
445 Hoes Lane, PO Box 1331
Piscataway, NJ 08855-1331
Telephone: 1-800-678-4333

Overhead distribution circuits shall be constructed with not less than the Grade C strength requirements as described in section 26, Strength Requirements, of the NESC when subjected to the loads specified in NESC Section 25, Loadings for Grades B and C. Distribution lines that underbuild transmission circuits or that cross over limited access highways and railroad tracks shall be constructed with not less than the Grade B strength requirements as described in NESC Section 26.

The drawings of equipment and materials shown in the construction assemblies depict the general categories of items found in RUS Informational Publication 202-1, "List of Materials Acceptable for Use on Systems of RUS Electrification Borrowers" ("List of Materials"). Any drawing of any piece of equipment or material that resembles a specific product of a manufacturer is unintentional.

GENERAL CONSTRUCTION SPECIFICATIONS (Cont.)

Materials to be used for construction are designated by one or two lower-case alphabetic characters shown on the drawings and in the "ITEM" column in the drawing material blocks. For example, "b" designates a steel, pole top pin. A borrower shall use, at its discretion, any of the applicable pole top pins from category "b" of the "List of Materials

The drawings in this bulletin show the use of two, 4 1/4 inch, American National Standards Institute (ANSI) Class 52-9A suspension insulators for 12.47/7.2 kV primary deadends. However, borrowers may alternatively use two, 6-inch, ANSI Class 52-1 suspension insulators, or one polymer distribution insulator, all of which are contained in category "k" in the "List of Materials." In the case of polymer insulators, the quantity ("QTY") of the insulators to be used must be modified accordingly in the material blocks of the drawings.

Normally crossarm pins and post-type insulators come equipped with washers and locknuts. Thus, the washers and locknuts for crossarm pins are not tallied in the "QTY" (quantity) columns in the material boxes on the construction drawings. However, the crossarm pin washers and locknuts are shown on the construction drawings in parenthesis to depict proper construction. If crossarm pins or post type insulators are purchased without washers, locknuts or studs, the quantity totals in the material boxes on the construction drawings will need to be adjusted accordingly.

Locknuts shall be installed on all threaded material and hardware in addition to nuts and washers. The threads on installed bolts shall protrude past the lock washers a minimum of one inch but not more than two inches.

Sometimes it may be prudent or necessary to modify RUS standard distribution assemblies to solve encountered construction problems. For example, a standard C6.1 assembly may need to be modified with heavy-duty crossarm braces (assembly W3.2) to support large conductors. RUS has not produced the scores of new assemblies like the example because the resulting bulletin would be quite unwieldy. Therefore, borrowers themselves may develop and use assemblies similar to the example without additional RUS approval. Borrowers' assemblies not specifically approved by RUS shall not have component spacing less than, or permitted longitudinal loads (strengths) greater than those on correlated RUS standard assemblies. Borrowers need to properly account for the new assembly material and assign assembly numbers recognizably different than RUS standard assembly numbers.

RUS approval and assembly number changes are not required to add the following types of information to RUS assembly drawings: material inventory numbers, bolt lengths, jumper wire sizes, types of connectors, armor rods, etc.

CONDUCTOR INSTALLATION SPECIFICATIONS

Conductors shall be handled with care and shall not be trampled on or run over by vehicles. Each reel shall be examined and the wire shall be inspected for cuts, kinks, or other damage. Damaged portions shall be cut out and the conductor spliced. The conductors shall be pulled over suitable rollers or stringing blocks properly mounted on the pole or crossarm to prevent binding or damage while stringing.

Conductors shall be sagged evenly and in accordance with the conductor manufacturer's recommendations. The air temperature at the time and place of sagging shall be determined by the use of a certified thermometer. The sag of all conductors after stringing shall be in accordance with the engineer's instructions.

For new construction, splices shall be no closer than l,OOO feet from one another and there shall be no more than 3 splices per mile in any primary phase or neutral conductor. Furthermore, splices shall not be located within lO feet of any supporting structure. For all construction, splices shall not be located in Grade B crossing spans and preferably not in adjacent spans. Splices shall be installed in accordance with the manufacturer's specifications and recommendations.

All conductors shall be cleaned thoroughly by wirebrushing before splicing or installing connectors or clamps. A suitable oxidation inhibitor shall be applied before splicing or applying connectors over aluminum conductor.

CONSTRUCTION SPECIFICATIONS FOR POLE TOP ASSEMBLIES

The neutral conductor shall be installed on the same side (preferably the roadside) of all tangent and small angle poles throughout each line section. See "Construction Specifications for Poles and Crossarms" in Section W of this bulletin for additional pole and crossarm construction specifications.

Neutral attachments may be lowered on standard pole top assemblies a distance not exceeding 2 feet for the purpose of economically meeting conductor clearance requirements of the NESC.

Neutral attachments may be lowered on standard pole top assemblies a distance not exceeding an additional 6 feet for the purpose of performing construction and future line maintenance on these assemblies from bucket trucks designed for such work.

The conductor shall be tied to the top groove of pin-type or post-type insulators on tangent poles. On angle structures the conductor shall be tied on the side of the insulator opposite the direction of the strain. Pin-type and post-type insulators shall be tight on the pins and brackets, respectively, and the top groove shall be in line with the conductor after tying. Borrowers shall not allow any upstrain on pin-type or post-type insulators.

A 3 inch by 3 inch (minimum), square, curved washer (item "d") shall be used abutting the pole when installing primary deadend, neutral deadend and guy assemblies directly to the pole. These washers mitigate the crushing of wood fibers and facilitate the permitted longitudinal loads shown on the construction drawings.

A 2 ¼ inch (minimum) square washer shall be placed under the shoulder of 7.2 kV crossarm insulator pins whose surface area abutting the crossarm is less than 4 square inches. These washers mitigate the crushing of wood fibers and facilitate the permitted transverse loading shown in the maximum line angle tables in Exhibit 1.

The maximum line angles on tangent construction assemblies shall be limited to 5 degrees for small conductors and 2 degrees for conductors larger than # l/0 because of likely slippage of the neutral conductor off of a spool-type insulator. Furthermore, based on additional calculations by the design engineer, these maximum line angles may need to be reduced for NESC Grade B construction.

Deadend and suspension angle pole top assemblies attached directly to poles shall be designed to hold the sum of all expected loads multiplied by the appropriate overload factors of NESC Table 253-l.

RUS has applied the applicable strength factors for Grade C construction from NESC Table 26l-lA in the calculations for permitted longitudinal loading shown in the design parameters on the drawings. The permitted longitudinal loading on primary deadend assemblies attached directly to poles is based on 50 percent of the rated ultimate strength of the suspension insulators shown on the assembly drawings.

CONSTRUCTION SPECIFICATIONS FOR POLE TOP ASSEMBLIES (cont.)

The maximum line angles for pole top primary assemblies in the tables in Exhibit 1 are based on the RUS designated maximum load on crossarm insulator pins, post type insulators, or pole top pins and the assumed conductor tensions tabulated on page 1 of Exhibit 1. The applicable overload factors from NESC Table 253-1, for Grade C construction, have already been applied in the calculations for the maximum line angles. For large conductor sizes, the design engineer may need to calculate new (smaller) maximum line angles for NESC Grade B construction.

The permitted unbalanced conductor tensions on primary deadend assemblies attached to crossarms are based on the results of the equations and methodology explained in Exhibit 2 of this bulletin. RUS has applied the overload factors of NESC Table 253-1 and used the assumed conductor tensions tabulated on page 1 of Exhibit 1 to calculate the permitted unbalanced conductor tensions shown in Tables A and B of Exhibit 2 of this bulletin. The permitted unbalanced conductor tensions on crossarm assemblies shall be reduced by 40 percent for NESC Grade B construction.

RUS categorizes conductor sizes as follows:

- Small conductors are conductors with a rated breaking strength of less than 4,500 pounds (20,000 newtons), e.g., 1/0 Aluminum Conductor - Steel Reinforced (ACSR) and smaller.

- Large conductors are conductors with a rated breaking strength of 4,500 pounds (20,000 newtons) or greater but less than 10,000 pounds (45,000 newtons), e.g., 2/0 ACSR through 4/0 ACSR or 336.4 kcmil (18/1) ACSR.

- Extra large conductors are conductors with a rated breaking of 10,000 pounds (45,000 newtons) or greater, e.g., 266.8 kcmil (26/7) ACSR and larger.

Primary pole top assemblies identified as “large conductors” in the drawing titles shall be used to support large and extra large conductors. Large conductor assemblies may also be used for small conductors. Furthermore, large and extra large conductors may be installed on assemblies not designated as large conductors provided that the expected transverse or longitudinal loads (multiplied by the appropriate NESC overload factors) do not exceed the permitted loads or tensions shown on the design parameters of the drawings. For any conductor size, the horizontal, vertical or transverse loads shall not exceed the permitted strength of crossarms, crossarm pins, insulators, or insulator bracket assemblies. Usually, extra large conductors require that pin type and post type insulators have a “C” neck for conductor sizes up through 477.0 (18/1) ACSR and “J” necks for conductor sizes up to 795 kcmil, depending on the armor rods selected.

CONSTRUCTION SPECIFICATIONS FOR CONNECTORS, STIRRUPS, CLAMPS, TAPS, AND JUMPERS

Jumpers and other leads connected to line conductors shall have sufficient slack to allow free movement of the conductors without causing the jumpers to be pulled from their connectors. Even if not shown on the drawings, jumpers shall have at least two bends in a vertical plane, or one in a horizontal plane, or the equivalent.

All leads on equipment, such as transformers and reclosers, shall be a minimum of #6 copper conductivity. Where aluminum jumpers are used, a connection to unplated bronze terminals shall be made by splicing a short stub of copper to the aluminum jumpers using a compression connector suitable for the bimetallic connection.

Connectors and hot-line clamps suitable for the purpose shall be installed as shown on the drawings and also in accordance with the manufacturer's specifications and recommendations. On all hot-line clamp installations, the clamp and jumper shall be installed so that they are permanently bonded to the load side of the line, allowing the jumper to be de-energized when the clamp is disconnected.

Stirrups may be used to connect tap conductors (jumper wires) to primary conductors if the following criteria are met:

- The stirrup and hot line clamp are sized to meet or exceed the current carrying capacity of the tap conductor or equipment jumper;
- All stirrup conductors are made of copper or bronze;
- All stirrup conductors are made of #2 copper equivalent conductivity or larger;
- All-purpose or aluminum hot line clamps are not used with stirrups;
- All stirrups, connectors, and clamps are installed in accordance with the manufacturer’s specifications;
- Stirrups with two compression connectors are not used in areas prone to aeolian vibration;
- Stirrups are not used to connect main lines together or to connect heavily loaded tap lines to main lines.

Stirrups are not recommended to be used to connect reclosers, autotransformers, or line regulators to primary conductors. Stirrups and hot line clamps shall not be used for sectionalizing taps nor taps for main lines for operational or maintenance purposes. Permanent compression or bolted type connectors shall be used because of their better current carrying capabilities and reliability. Line switches, fused cutouts, or solid blade cutouts should be used at line locations where occasional line sectionalizing may be required.

At locations where permanent connections using compression or bolted type connectors are not desired, and where the installation of sectionalizing equipment is also not desired, hot line clamps (over armor rod on aluminum conductors) shall be installed.

CONSTRUCTION SPECIFICATIONS FOR POLES AND CROSSARMS

Large, dense poles that have no serious defects shall be used at transformer, deadend, angle, and corner locations.

Poles shall be set so that the crossarm gains face in opposite directions on every other pole. However at line deadends, the last two poles shall be set so that the pole gains face the deadend. On unusually long spans, the poles shall be set so that the crossarm is located on the side of the pole away from the long span. On lines that curve, the crossarms shall be installed on the side of the pole that faces the midpoint of the curve. On sloping terrain, the crossarms shall be installed on the uphill side of the pole. Pole top insulator brackets and pole top pins shall be installed on the opposite side of the pole from the gain.

At line angles and deadends, poles shall be set such that they lean away from the strain of the primary conductors. They shall be set such that the final rake is not less than 1 inch for each 10 feet of pole height above ground after the conductors are installed at the required tension.

Newly set poles shall be backfilled and tamped to the full depth. Excess dirt shall be banked around the base of the pole.

POLE SETTING DEPTHS

The minimum depth for setting poles is:

Length of Pole (Feet)	Setting in Soil (Feet)	Setting in All Solid Rock (Feet)
20	4.0	3.0
25	5.0	3.5
30	5.5	3.5
35	6.0	4.0
40	6.0	4.0
45	6.5	4.5
50	7.0	4.5
55	7.5	5.0
60	8.0	5.0

"Setting in Soil" depths apply where:

- Poles are set in soil;
- There is a layer of soil of more than two (2) feet in depth over solid rock; or
- The hole in solid rock is not substantially vertical or the diameter of the hole at the surface of the rock exceeds approximately twice the diameter of the pole at the same level.

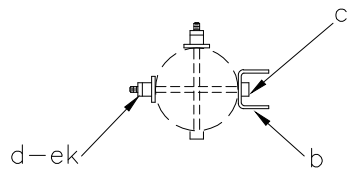
"Setting in All Solid Rock" depths shall apply where poles are set in solid rock and where the hole is substantially vertical, approximately uniform in diameter and large enough to permit the use of tamping bars the full depth of the hole.

Where there is a layer of soil two (2) feet or less in depth over solid rock, the depth of the hole shall be the depth of the soil in addition to the depth specified under "Setting in All Solid Rock" provided. However, this depth shall not exceed the depth specified under "Setting in Soil."

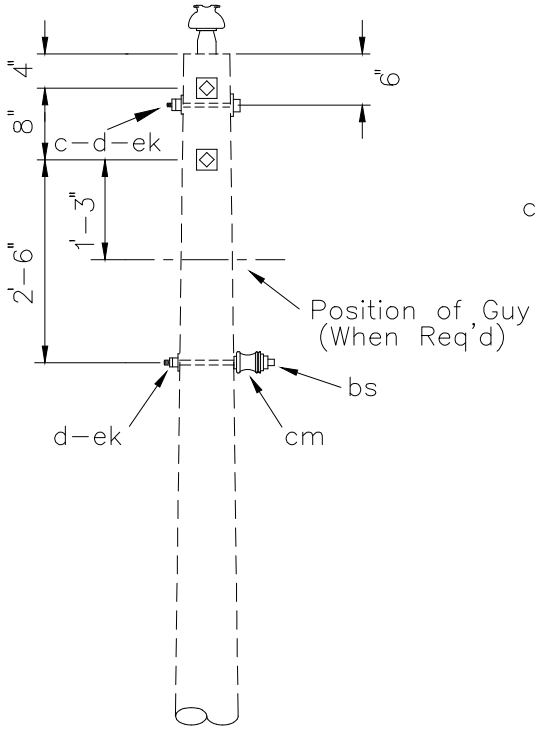
On sloping ground, the depth of the hole shall be measured from the low side of the hole.

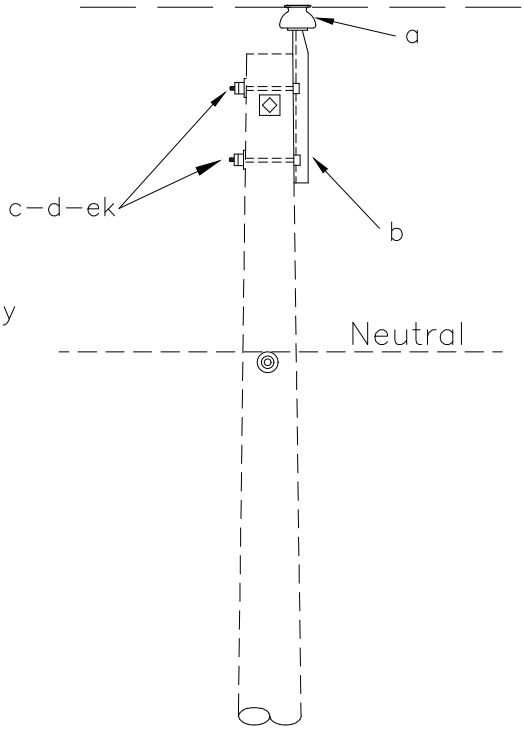
SINGLE-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
A1.1	(A1)	SINGLE SUPPORT (TANGENT)
A1.11	(A9-1)	SINGLE SUPPORT ON CROSSARM
A2.1	(A1-1)	DOUBLE SUPPORT (TANGENT)
A2.3	(A2)	DOUBLE SUPPORT
A3.4 A3.5 A3.6		SUSPENSION ANGLE
A4.1	(A4)	DEADEND ANGLE (90° - 150°)
A4.2		DEADEND ANGLE (15° - 90°)
A5.1 A5.2 A5.3	(A5) (A5-2)	SINGLE DEADENDS
A5.2G		SINGLE PHASE TAP GUIDE
A5.3NG		SINGLE PHASE TAP GUIDE – NARROW PROFILE
A5.21	(A7)	SINGLE DEADEND ON CROSSARMS
A6.1	(A6)	DOUBLE DEADEND (STRAIGHT)
A6.2		DOUBLE DEADEND (FEED THROUGH)
A6.21	(A8)	DOUBLE DEADEND ON CROSSARMS



PLAN





ASSEMBLY: A1.1

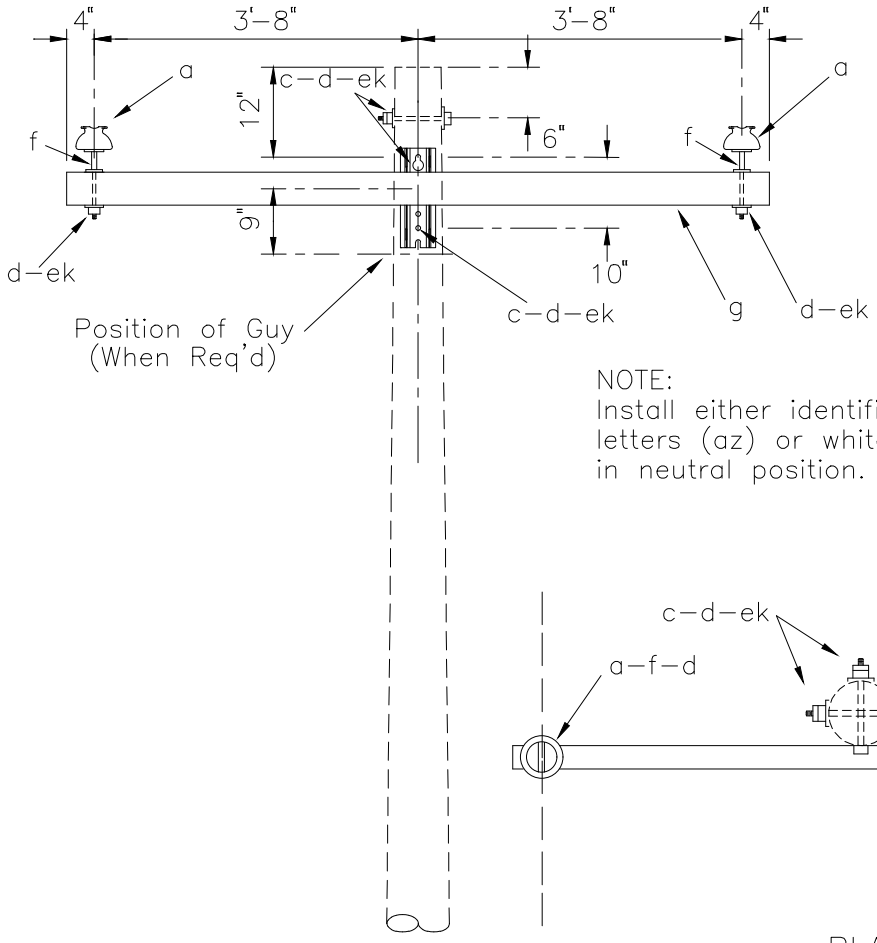
ITEM	MATERIAL	QTY	
a	Insulator, pin type (12.47/7.2 kV)	1	
b	Pin, pole top, 20"	1	
c	Bolt, machine, 5/8" x req'd length	3	
d	Washer, square 2 1/4"	5	
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	
ek	Locknuts	4	

DESIGN PARAMETERS:

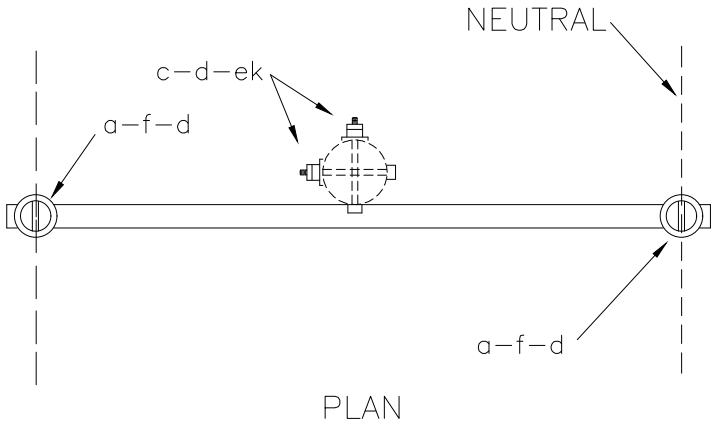
MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT (TANGENT)

September 18	1 – PHASE PRIMARY 12.47/7.2 kV	A1.1 (A1)
FDEC		



NOTE:
Install either identification letters (az) or white insulator in neutral position.



PLAN

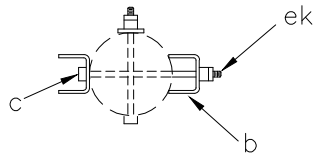
ITEM	QTY	MATERIAL
a	1	Insulator, pin type, 15 kV, white
a	1	Insulator, pin type (12.47/7.2 kV)
c	3	Bolt, machine, 5/8" x req'd length
d	6	Washer, square, 2 1/4"
f	2	Pin, crossarm, steel, 5/8" x 10 3/4"
g	1	Crossarm, Fiberglass, Braceless
ek	5	Locknuts

DESIGN PARAMETERS:

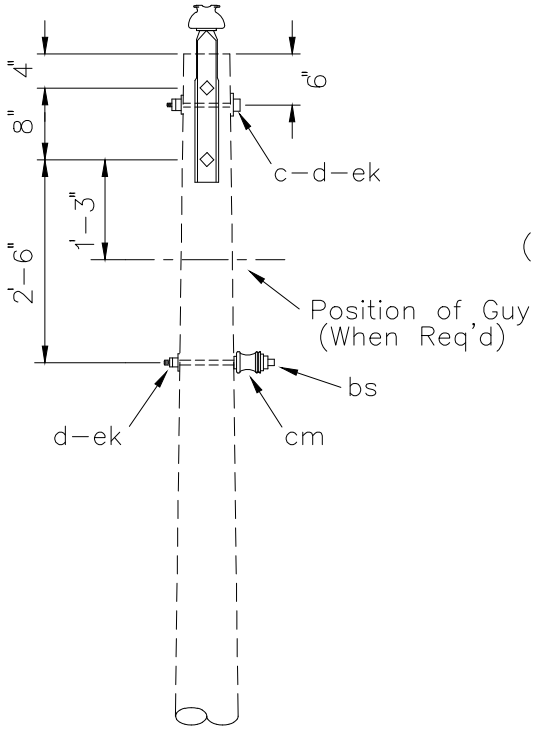
See TABLE II

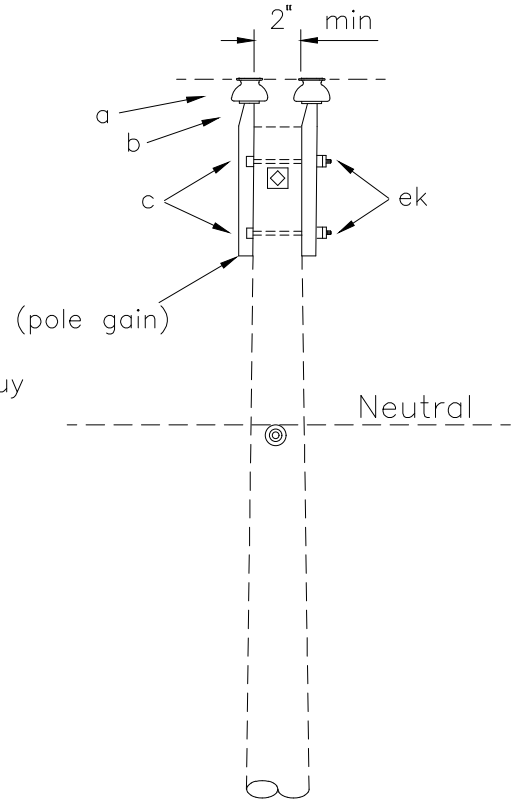
SINGLE SUPPORT ON CROSSARM

September 18	1 – PHASE PRIMARY 12.47/7.2 kV	
FDEC		A1.11 (A9–1)



PLAN





NOTE: These assemblies used for NESC Grade B construction.

ASSEMBLY: A2.1

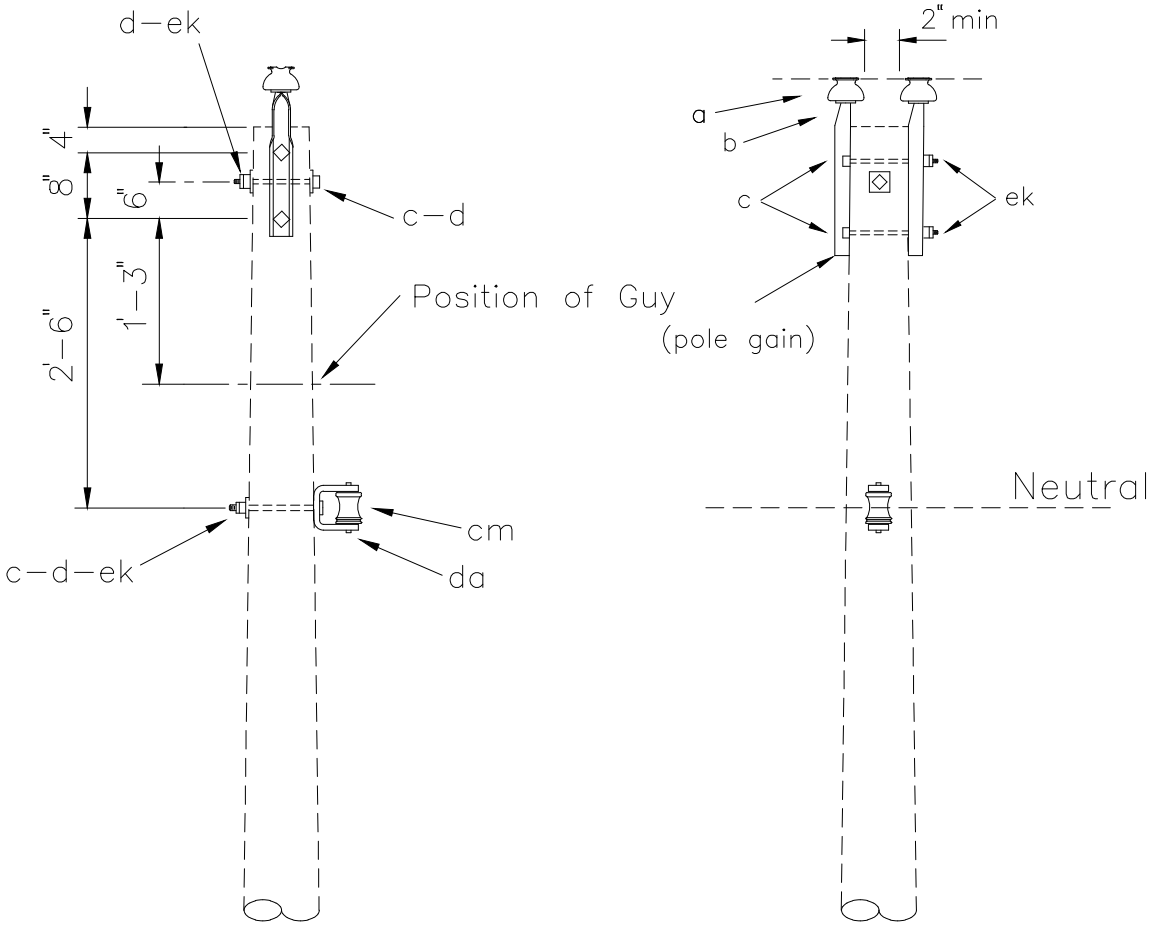
ITEM	MATERIAL	QTY	
a	Insulator, pin type (12.47/7.2 kV)	2	
b	Pin, pole top	2	
c	Bolt, machine, 5/8" x req'd length	3	
d	Washer, square 2 1/4"	3	
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	
ek	Locknuts	4	

DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

DOUBLE SUPPORT (TANGENT)

September 18	1 – PHASE PRIMARY 12.47/7.2 kV	A2.1 (A1–1)
FDEC		



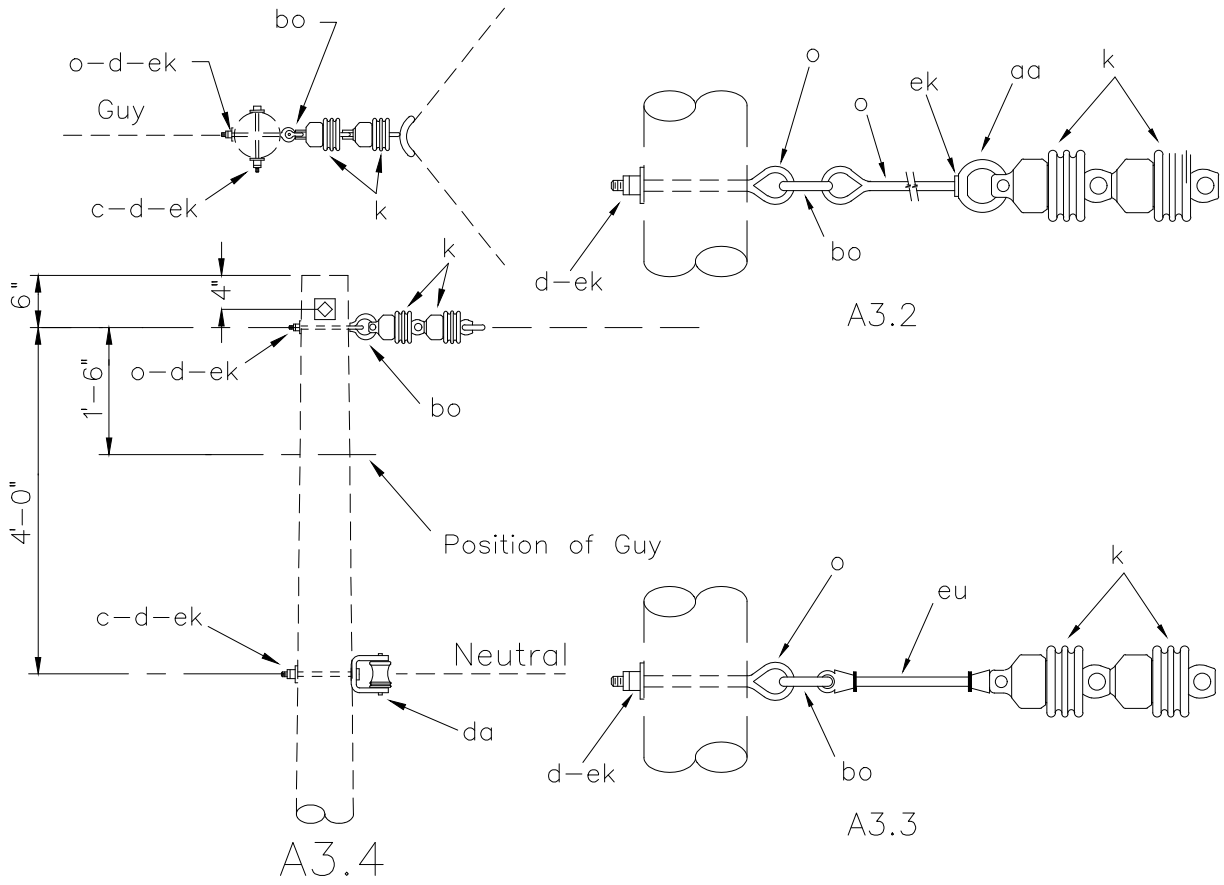
ITEM	QTY	MATERIAL
a	2	Insulator, pin type (12.47/7.2 kV)
b	2	Pin, pole top
c	4	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
d	1	Washer, curved, 3"
da	1	Bracket, insulated
cm	1	Insulator, spool, 3"
ek	4	Locknuts

DESIGN PARAMETERS:

See TABLE III

DOUBLE SUPPORT

September 18	1 – PHASE PRIMARY 12.47/7.2 kV	
FDEC		A2.3 (A2)



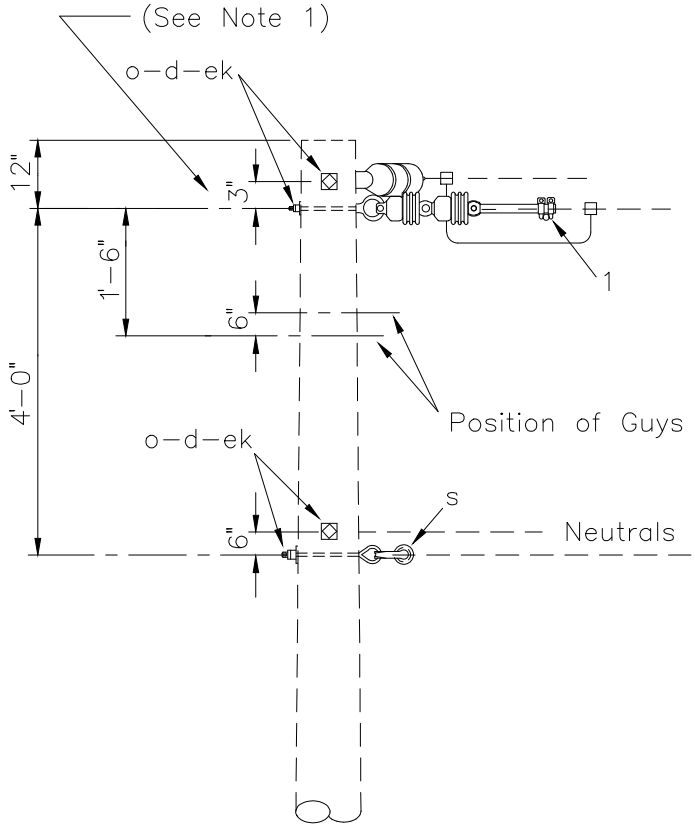
A3.5 = A3.4 neutral subassembly + A3.2 primary subassembly
A3.6 = A3.4 neutral subassembly + A3.3 primary subassembly

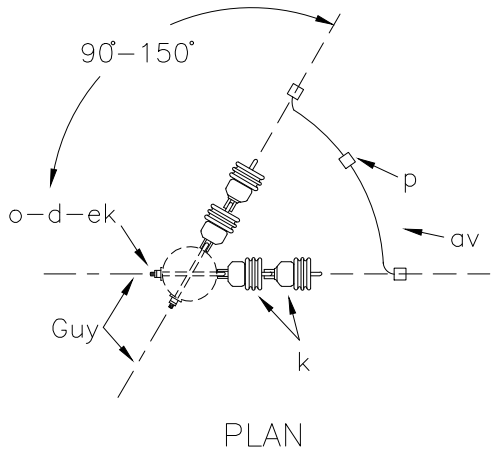
ASSEMBLY: A3		.4	.5	.6
ITEM	MATERIAL	QTY	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	2	2	2
d	Washer, square, 3", curved	2	2	2
d	Washer, square, 2 1/4"	2	2	2
k	Insulator, suspension, 4 1/4"	2	2	2
o	Bolt, eye, 5/8"x req'd length	1	2	1
aa	Nut, eye		1	
bo	Shackle, anchor	1	1	1
da	Braket, insulated	1	1	1
ek	Locknuts	3	4	3
eu (du)	Link, extension, insulated (Link, extension) – (optional)			1 (1)

DESIGN PARAMETERS:

SUSPENSION ANGLE

September 18	1 – PHASE PRIMARY	A3.4 – A3.6
FDEC	12.47/7.2 kV	





PLAN

NOTES:

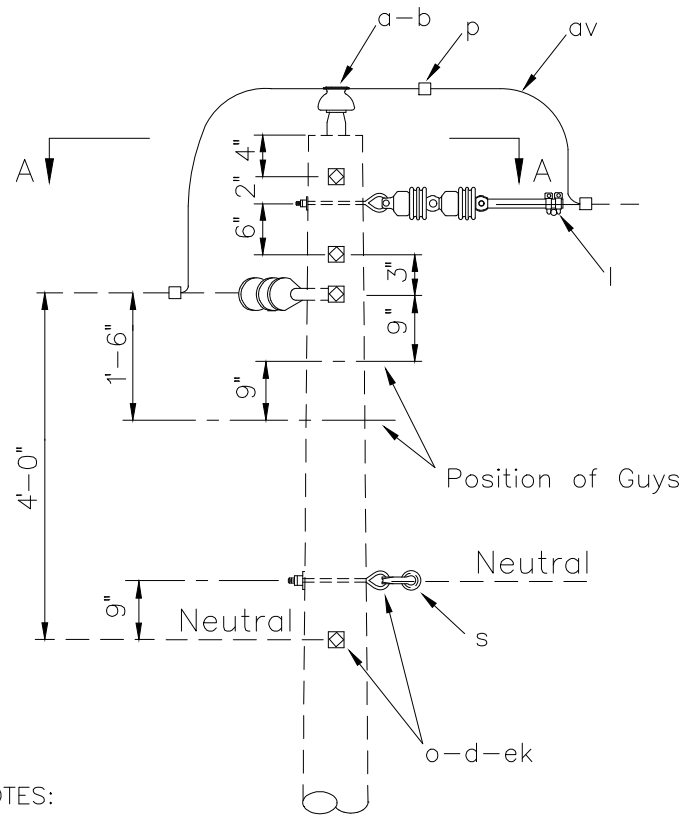
1, Separate 6" (top position only) when angle equals 90°.
2. Other combinations of deadend assemblies (A5.1 through A5.9) may be used, (e.g., two A5.3's; or one A5.1 plus one A5.7). Record alternative assemblies separately on staking sheets. CAUTION: Use the appropriate permitted longitudinal loads.

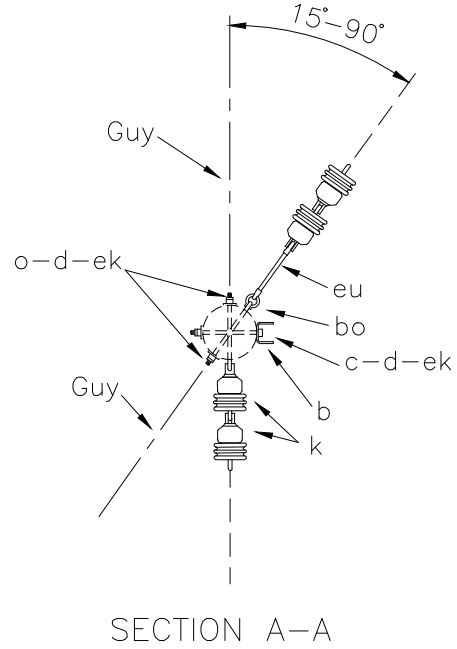
ITEM	QTY	MATERIAL
s	2	Clevis, secondary, swinging, insulated
d	4	Washer, square, 3", curved
k	4	Insulator, suspension, 4 1/4"
o	4	Bolt, eye, 5/8" x req'd length
p		Connectors, as req'd
av		Jumpers, as req'd
1	2	Clamp, dead–end
ek	4	Locknuts

DESIGN PARAMETERS:
PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

DEADEND ANGLE (90°–150°)

September 18	1 – PHASE PRIMARY 12.47/7.2 kV	
FDEC		A4.1 (A4)





SECTION A–A

NOTES:

1. Use 3" curved washers, "d", on eyebolts, "o".
2. Other combinations of deadend assemblies (A5.1 through A5.9) may be used, (e.g., one A1.01 plus two A5.3's; or one A1.01 plus one A5.1 plus one A5.7). Record alternative assemblies separately on staking sheets. CAUTION: Use the appropriate permitted longitudinal loads.

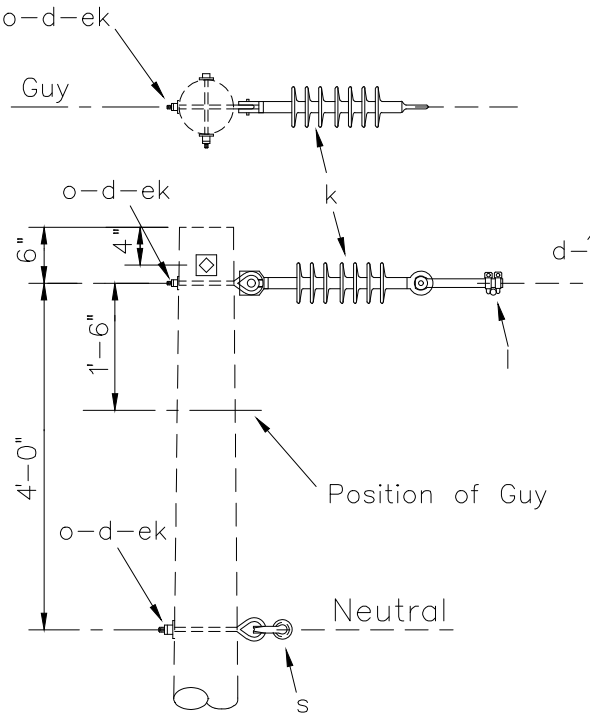
ITEM	QTY	MATERIAL
a	1	Insulator, pin type (12.47/7.2 kV)
b	1	Pin, pole top, 20"
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
d	4	Washer, square, 3", curved
k	4	Insulator, suspension, 4 1/4"
l	2	Clamp, dead–end
o	4	Bolt, eye, 5/8" x req'd length
p		Connectors, as req'd
s	2	Clevis, secondary, swinging, insulated
av		Jumpers, as req'd
bo	1	Shackle, anchor
ek	6	Locknuts
eu (du)	1 (1)	Link, extension, insulated (Link, Extension)(Optional)

DESIGN PARAMETERS:

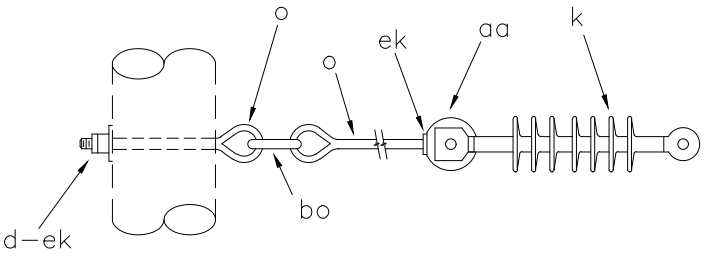
PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

DEADEND ANGLE (15°–90°)

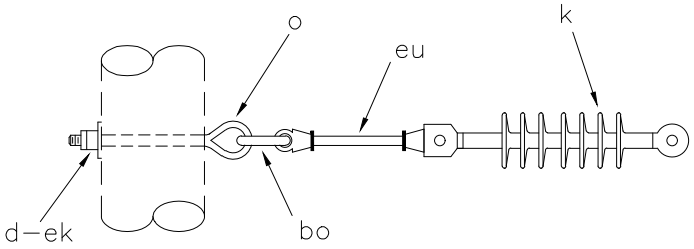
September 18	1 – PHASE PRIMARY 12.47/7.2 kV	
FDEC		A4.2



A5.1



A5.2



A5.3

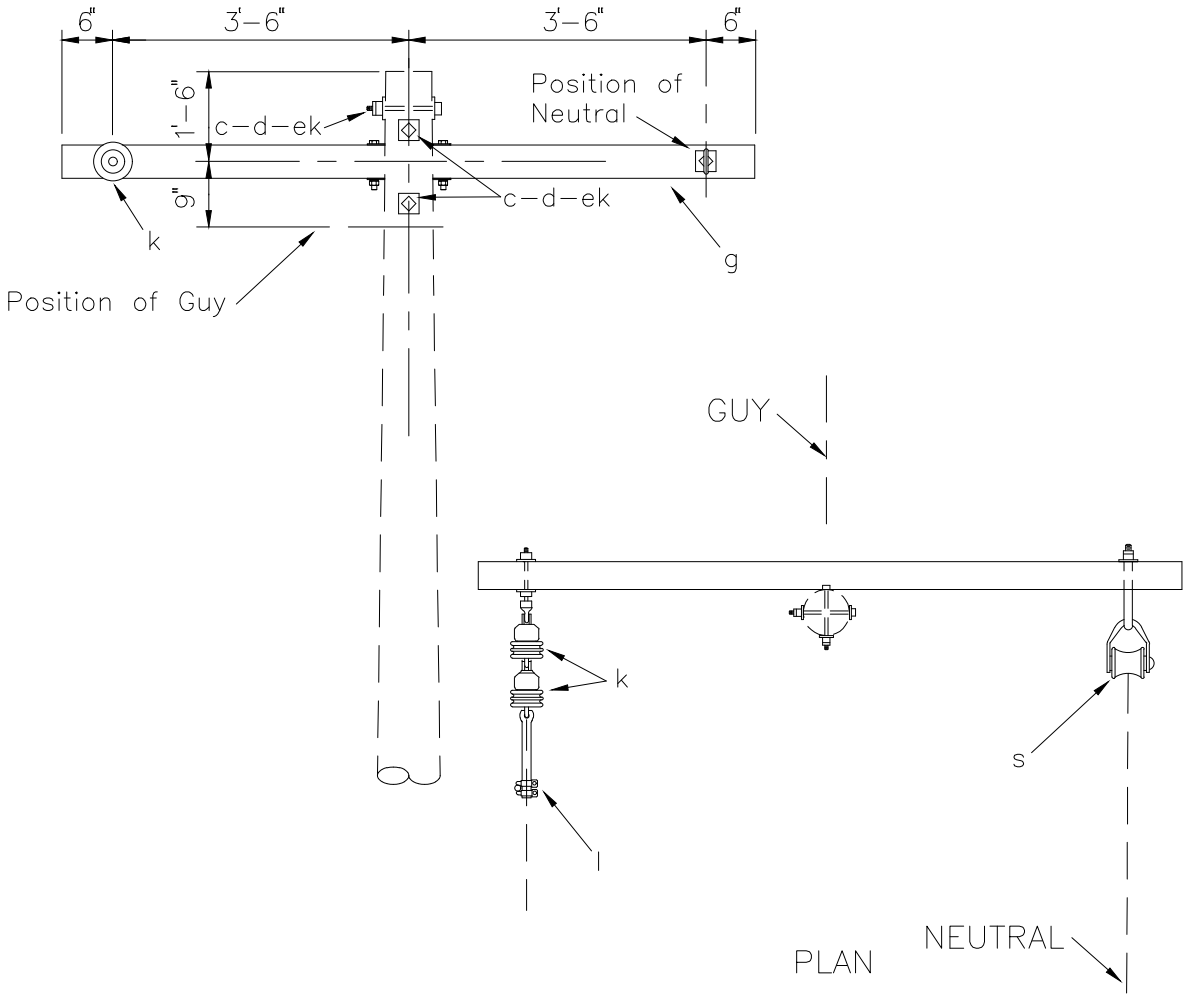
NOTE: When connecting to existing bolt end, use eyenut "aa" and locknut "ek" instead of eyebolt subassembly "o–d–ek".

ASSEMBLY: A5		.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
d	Washer, square, 2 1/4"	2	2	2
d	Washer, square, 3", curved	2	2	2
k	Insulator, epoxilator	1	1	1
o	Bolt, eye, 5/8"x req'd length	2	3	2
c	Bolt, machine, 5/8"x req'd length	1	1	1
p	Connectors, as req'd			
l	Primary deadend	1	1	1
s	Clevis, swinging, insulated	1	1	1
aa	Nut, eye		1	
av	Jumper's, as req'd			
bo	Shackle, anchor		1	1
ek	Locknuts	3	4	3
eu (du)	Link, extension, insulated (Link, extension) – (optional)			1 (1)

DESIGN PARAMETERS:
PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

SINGLE DEADENDS

September 18	1 – PHASE PRIMARY	A5.1,A5.2,A5.3
FDEC	12.47/7.2 kV	(A5),(A5–2)



NOTES:

1. Other neutral assemblies may be used. See Section N. Adjust material as needed.

ITEM	QTY	MATERIAL
l	1	Clamp, dead–end
s	1	Clevis, secondary, swinging, insulated
d	2	Washer, square, 2 1/4"
d	2	Washer, square, 3", curved
k	2	Insulator, suspension, 4 1/4"
ek	3	Locknuts
c	3	Bolt, machine, 5/8" x req'd length
g	1	Crossarm, fiberglass, deadend, 8'

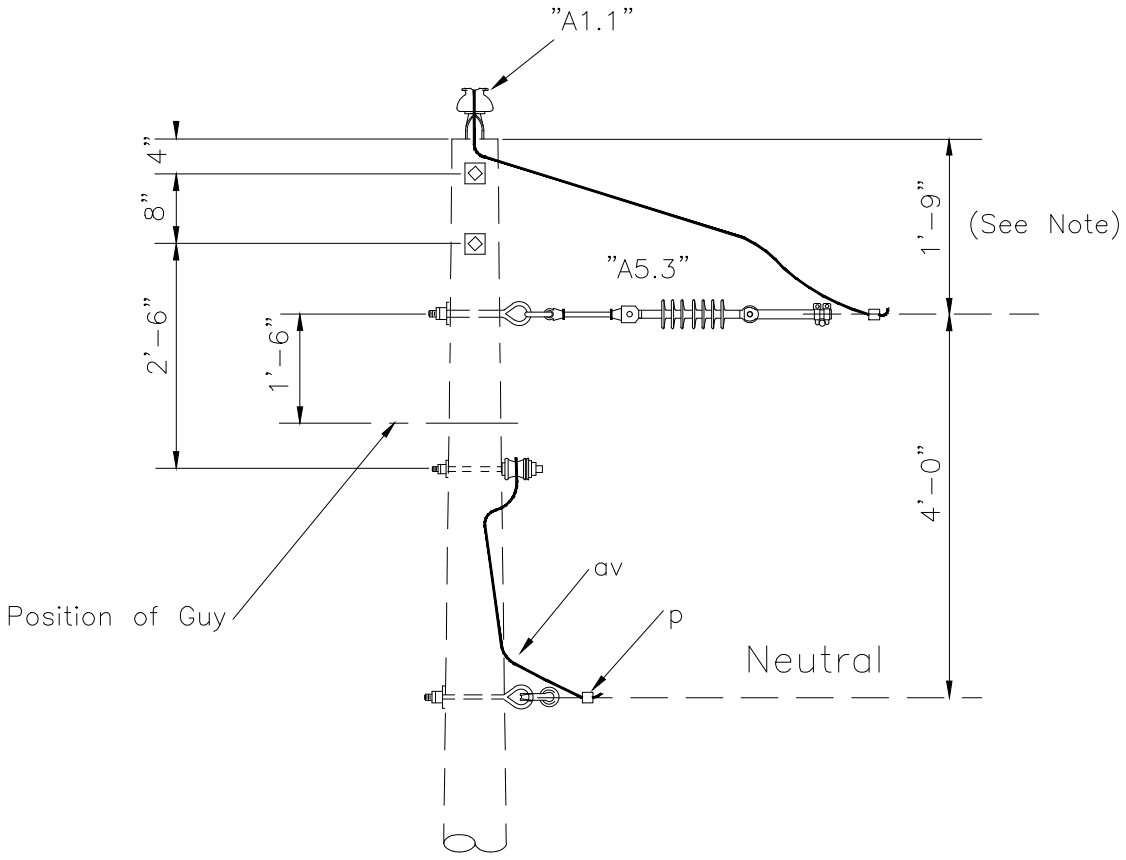
DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:

See Table A (Exhibit 2)

SINGLE DEADEND ON CROSSARMS

September 18	1 – PHASE PRIMARY	A5.21 (A7)
FDEC	12.47/7.2 kV	



NOTES:

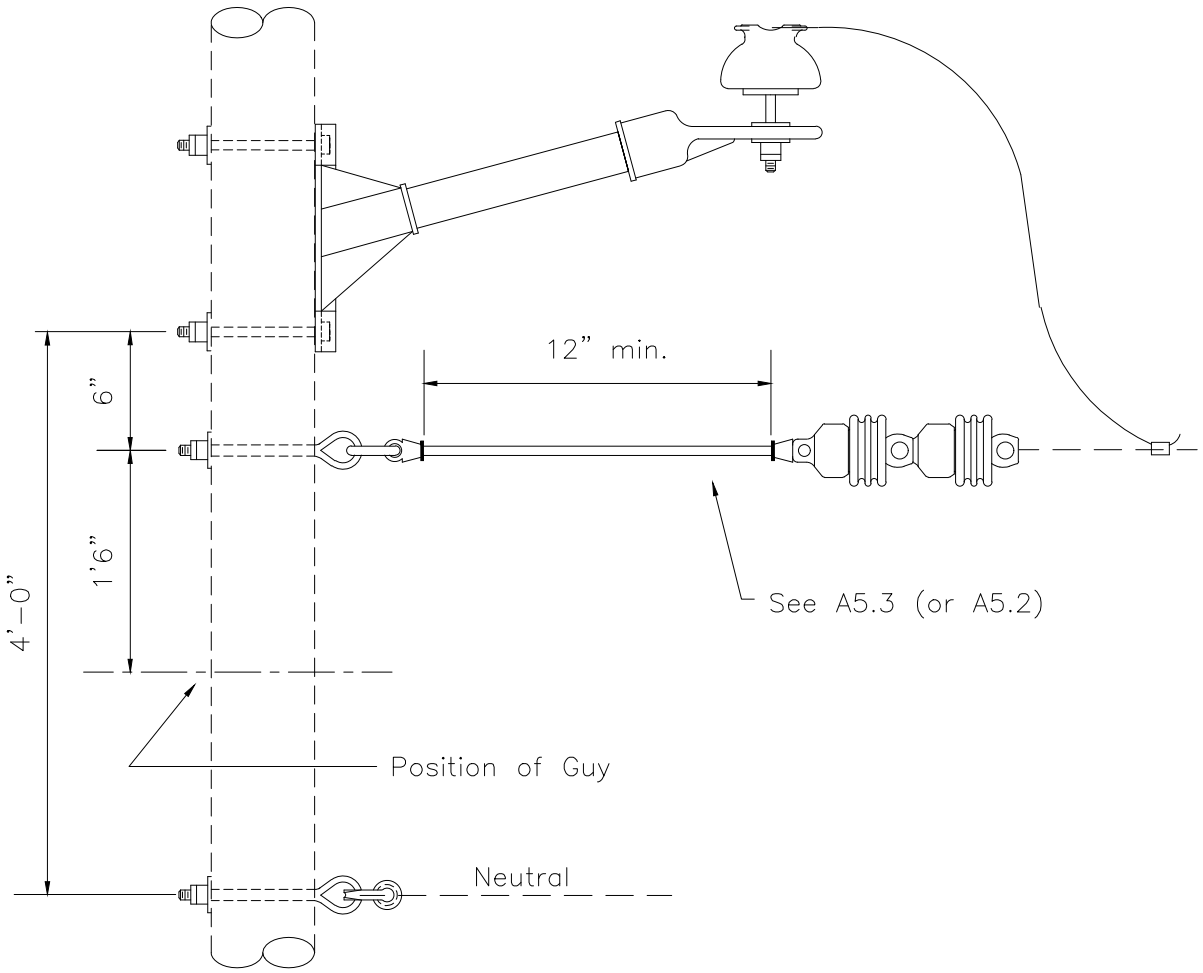
1. Tap assembly may be installed 6" from top of pole when perpendicular to line. Raise neutral and guy attachemnt 15" also.
2. Any deadend assembly, A5.1 through A5.9, may be used.

ITEM	QTY	MATERIAL
	(1)	(A1.1 Primary Assembly)
	1	A5.3 Primary Assembly
p		Connectors, as req'd
av		Jumpers, as req'd

DESIGN PARAMETERS:
PERMITTED LONGITUDINAL
LOAD = 5000 lbs./Conductor

SINGLE PHASE TAP GUIDE

September 18	1 – PHASE PRIMARY 12.47/7.2 kV	
FDEC		A5.3G



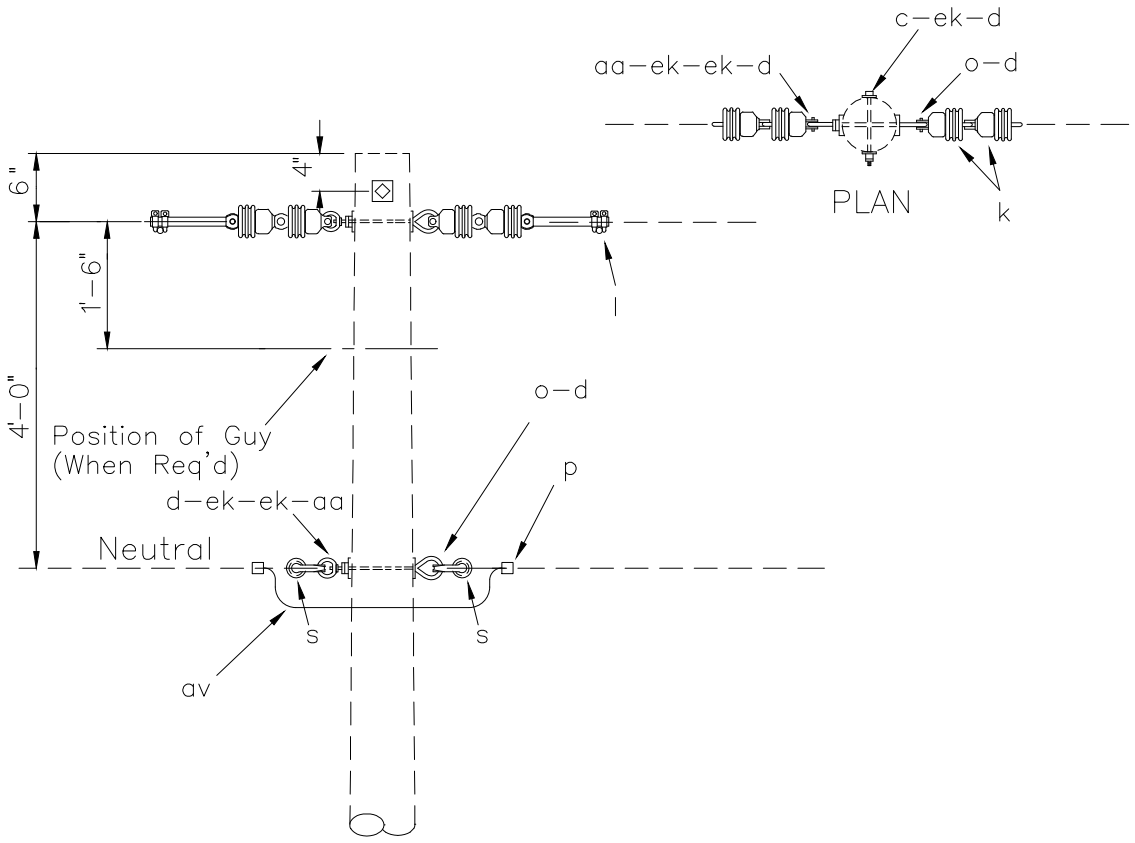
ITEM	MATERIAL	QTY
	A1.04N Primary Assembly (Narrow Profile)	1
	A5.3 Primary Assembly	1
p	Connectors, as req'd	
av	Jumpers, as req'd	

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

SINGLE PHASE TAP GUIDE

September 18 FDEC	1 – PHASE PRIMARY 12.47/7.2 kV	A5.3NG



NOTES:

1. Single deadend assemblies A5.02 or A5.03 may optionally be installed
2. Maximum line angle may be increased to 15° by installing anchor shakles, item "bo", to (horizontal) eyenuts and installing side guy as req'd.

ITEM	QTY	MATERIAL
o	2	Bolt, eye, 5/8" x req'd length
c	1	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 3, curved
d	2	Washer, square, 2 1/4"
k	4	Insulator, suspension, 4 1/4"
s	2	Clevis, swing, insulated
p		Connectors, as req'd
aa	2	Nut, eye, 5/8" (or as req'd)
l	2	Clamp, dead–end
av		Jumpers, as req'd
ek	5	Locknuts (or as req'd)

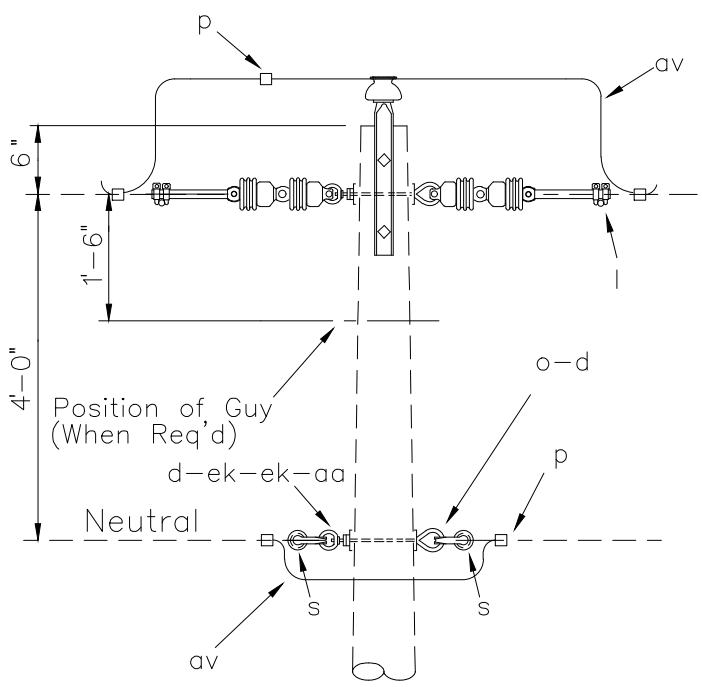
DESIGN PARAMETERS:

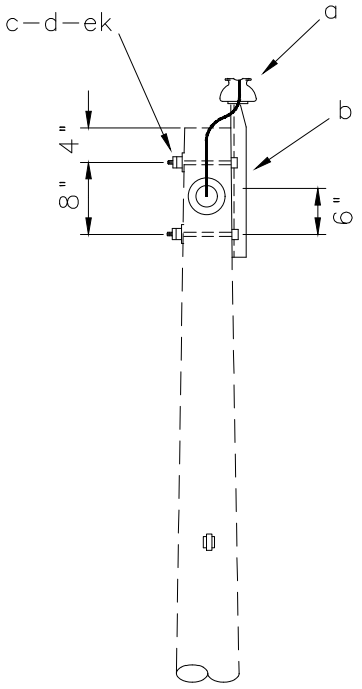
PERMITTED LONGITUDINAL LOAD= 5000 lbs./Conductor

MAXIMUM LINE ANGLE = 5° (See Note)

DOUBLE DEADEND (STRAIGHT)

September 18	1 – PHASE PRIMARY 12.47/7.2 kV	
FDEC		A6.1 (A6)





NOTES:

1. Single deadend assemblies A5.02 or A5.03 may optionally be installed.
2. Maximum line angle may be increased to 15° by installing anchor shakles, item "bo", to (horizontal) eyenuts and installing side guy as req'd.

ITEM	QTY	MATERIAL
a	1	Insulator, pin type (12.47/7.2 kV)
b	1	Pin, pole top, 20"
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
d	4	Washer, square, 3," curved
k	4	Insulator, suspension, 4 1/4"
o	2	Bolt, eye, 5/8' x req'd length
p		Connectors, as req'd
aa	2	Nut, eye, 5/8"
l	2	Clamp, dead-end
s	2	Clevis, swing, insulated
av		Jumpers, as req'd
ek	6	Locknuts

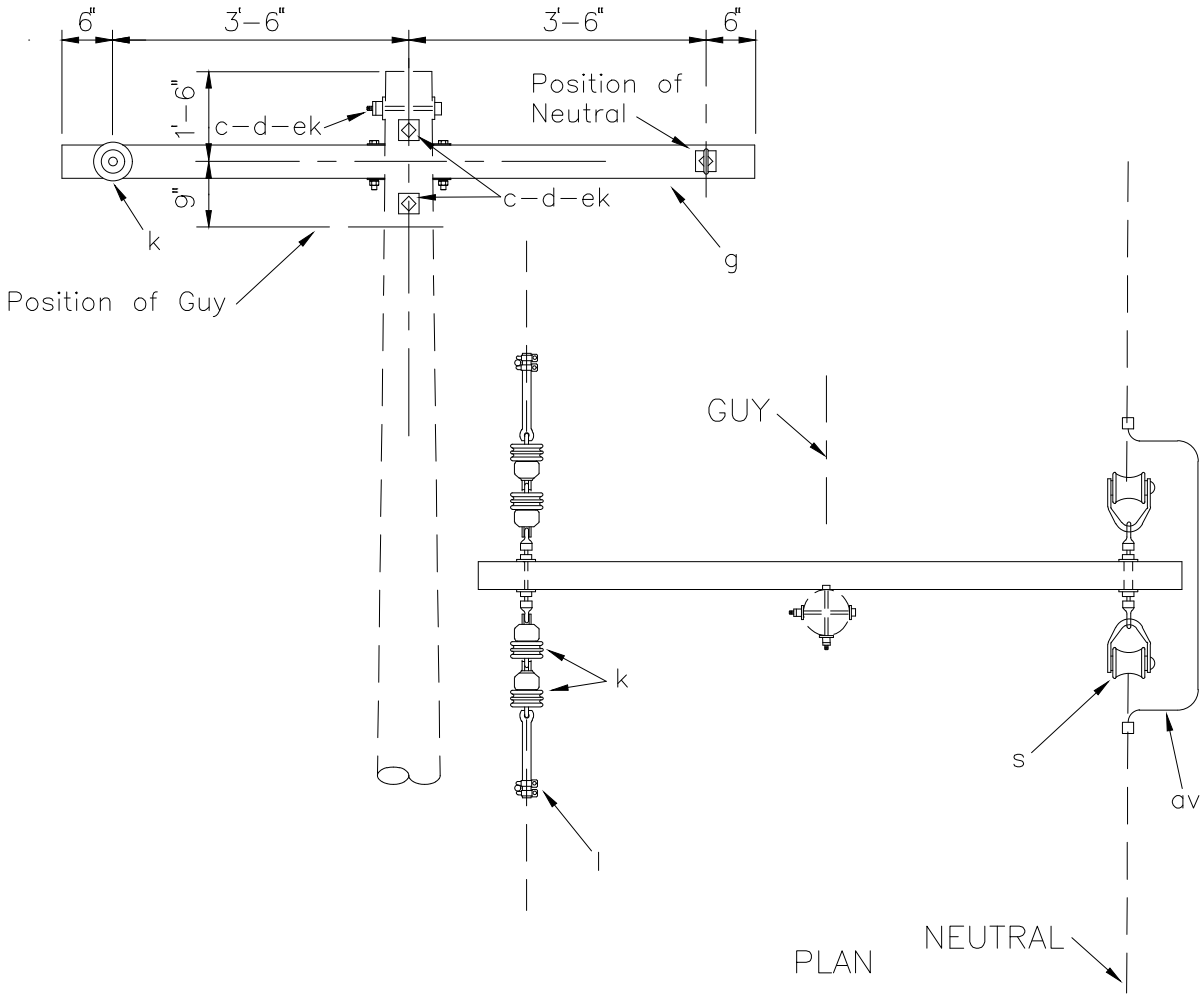
DESIGN PARAMETERS:

PERMITTED
LONGITUDINAL LOAD=
5000 lbs./Conductor

MAXIMUM LINE
ANGLE = 5° (See Note)

DOUBLE DEADEND (FEED THROUGH)

September 18	1 - PHASE PRIMARY 12.47/7.2 kV	
FDEC		A6.2



ITEM	QTY	MATERIAL
d	2	Washer, square, 2 1/4"
d	2	Washer, square, 3", curved
g	1	Crossarm, fiberglass, deadend, 8'
l	2	Clamp, dead–end
s	2	Clevis, secondary, swinging, insulated
k	4	Insulator, suspension, 4 1/4"
p		Connectors, as req'd
av		Jumpers, as req'd
c	3	Bolts, machine, 5/8" x req'd length
ek	3	Locknuts

DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:
See Table A (Exhibit 2)

MAXIMUM ALLOWABLE LINE ANGLE = 5° (See Note 2)

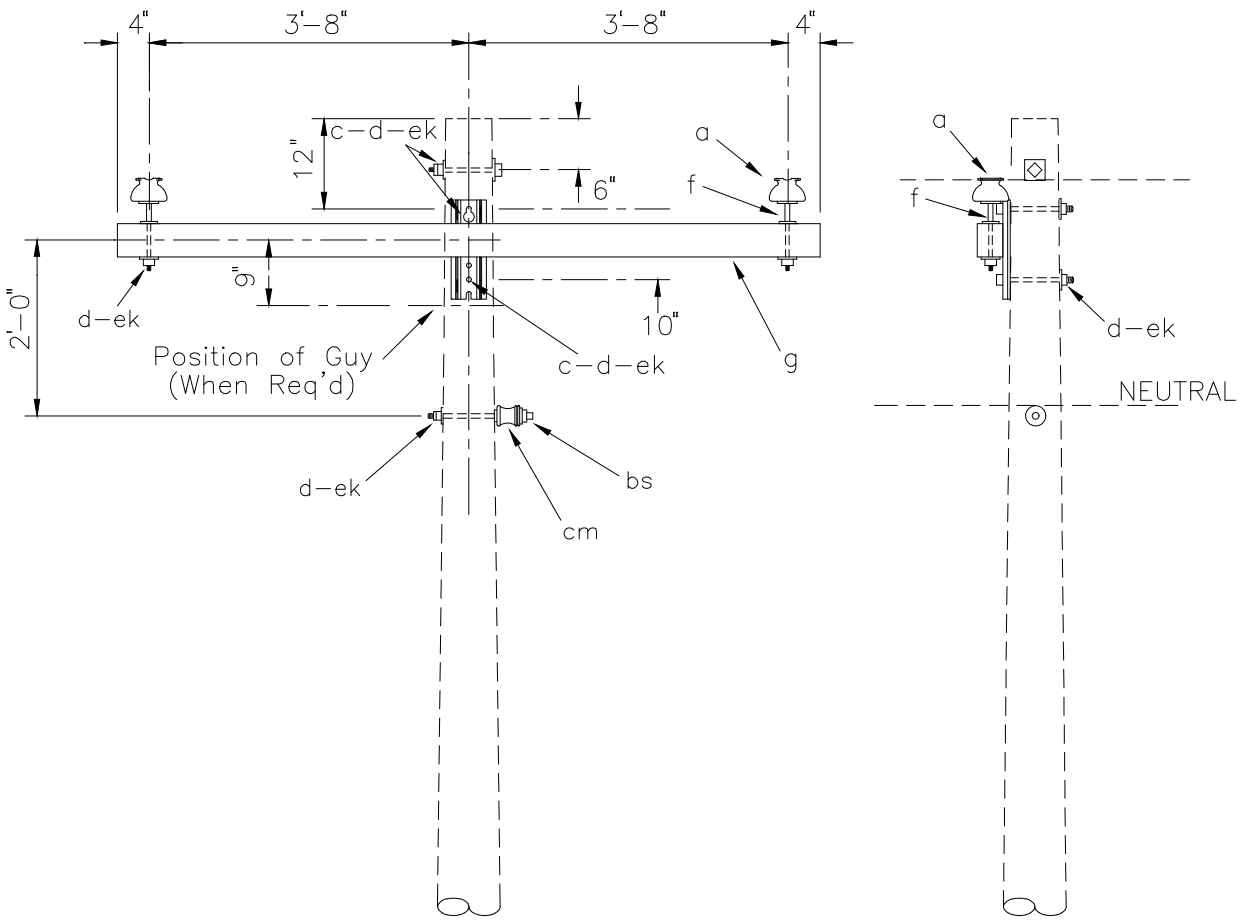
DOUBLE DEADEND ON CROSSARMS

September 18	1 – PHASE PRIMARY 12.47/7.2 kV	
FDEC		A6.21 (A8)

INDEX B

TWO-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
B1.11	(B1)	SINGLE SUPPORT ON CROSSARM (TANGENT)
B1.13		SINGLE SUPPORT ON CROSSARM
B3.4 B3.5 B3.6		SUSPENSION ANGLE
B4.1G	((B4-1))	DEADEND ANGLE GUIDE (90^o – 150^o)
B4.2G		DEADEND ANGLE GUIDE (15^o – 90^o)
B5.1 B5.2 B5.3	(B5-1)	SINGLE DEADENDS
B5.21	(B7)	SINGLE DEADEND ON CROSSARMS
B6.21	(B8)	DOUBLE DEADEND CROSSARMS



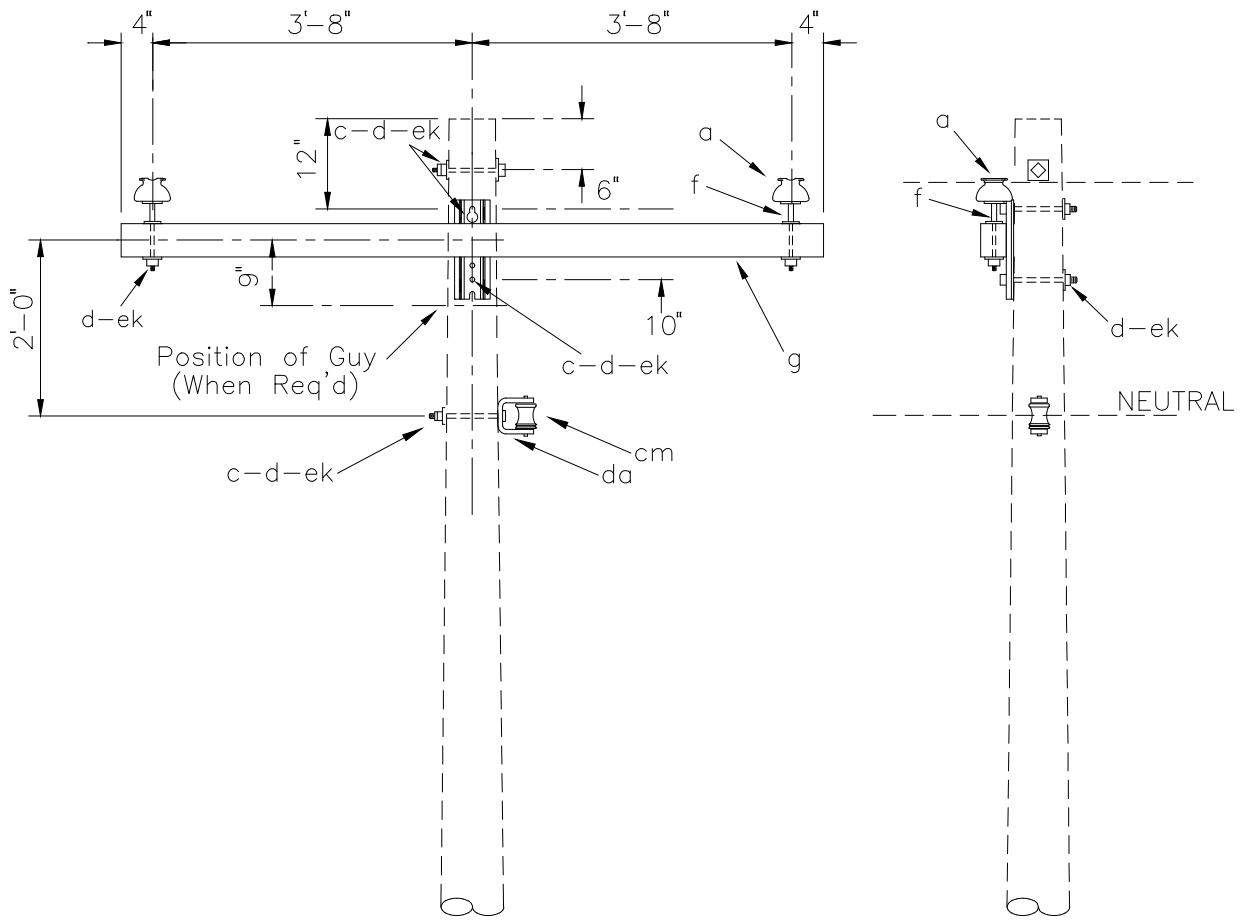
ASSEMBLY: B1.		11	
ITEM	MATERIAL	QTY	
a	Insulator, pin type (12.47/7.2 kV)	2	
c	Bolt, machine, 5/8" x req'd length	3	
d	Washer, square, 2 1/4"	5	
d	Washer, square, 3", curved	2	
f	Pin, crossarm steel, 5/8" x 10 3/4"	2	
g	Crossarm, fiberglass, tangent, 8'	1	
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	
ek	Locknuts	4	

DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT ON CROSSARM (TANGENT)

September 18	2 – PHASE PRIMARY 12.47/7.2 kV	B1.11 (B1)
FDEC		



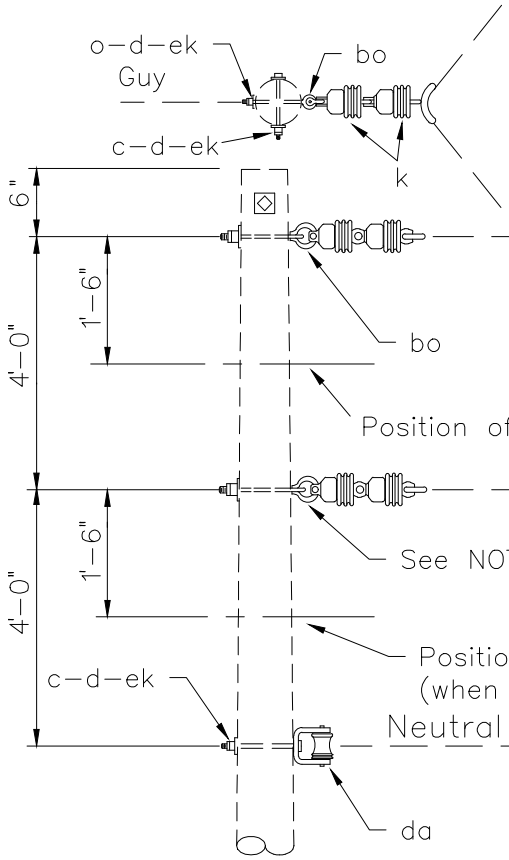
ASSEMBLY: B1.		13	
ITEM	MATERIAL	QTY	
a	Insulator, pin type (12.47/7.2 kV)	2	
c	Bolt, machine, 5/8" x req'd length	4	
d	Washer, square, 2 1/4"	4	
d	Washer, square, 3", curved	3	
f	Pin, crossarm steel, 5/8" x 10 3/4"	2	
g	Crossarm, fiberglass, tangent, 8'	1	
da	Bracket, insulated	1	
cm	Insulator, spool, 3"	1	
ek	Locknuts	4	

DESIGN PARAMETERS:

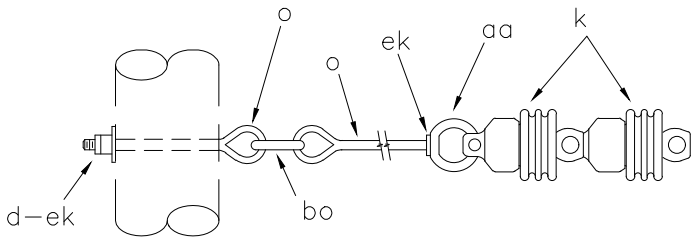
See TABLE II

SINGLE SUPPORT ON CROSSARM

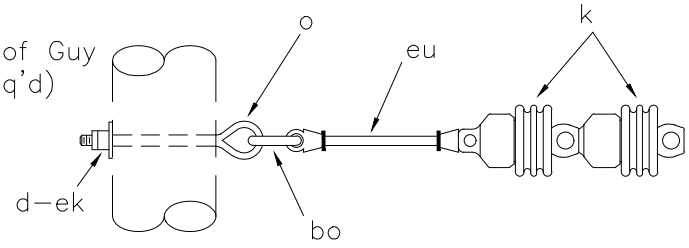
September 18	2 – PHASE PRIMARY 12.47/7.2 kV	
FDEC		B1.13



B3.4



B3.2



B3.3

B3.5 = B3.4 neutral assembly + B3.2 primary subassembly
B3.6 = B3.4 neutral assembly + B3.3 primary subassembly

NOTE: Extension link (item "eu" or "du") or eye bolt (item "o"), eye nut (item "aa") and locknut (item "ek") may be installed in lower primary position. Adjust material as required.

ASSEMBLY: B3		.4	.5	.6
ITEM	MATERIAL	QTY	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	2	2	2
d	Washer, square, 3", curved	3	3	3
d	Washer, square, 2 1/4"	2	2	2
k	Insulator, suspension, 4 1/4"	4	4	4
o	Bolt, eye, 5/8"x req'd length	2	4	2
aa	Nut, eye		2	
bo	Shackle, anchor	2	2	2
da	Bracket, insulated	1	1	1
ek	Locknuts	4	6	4
eu (du)	Link, extension, insulated (Link, extension) – (optional)			2 (2)

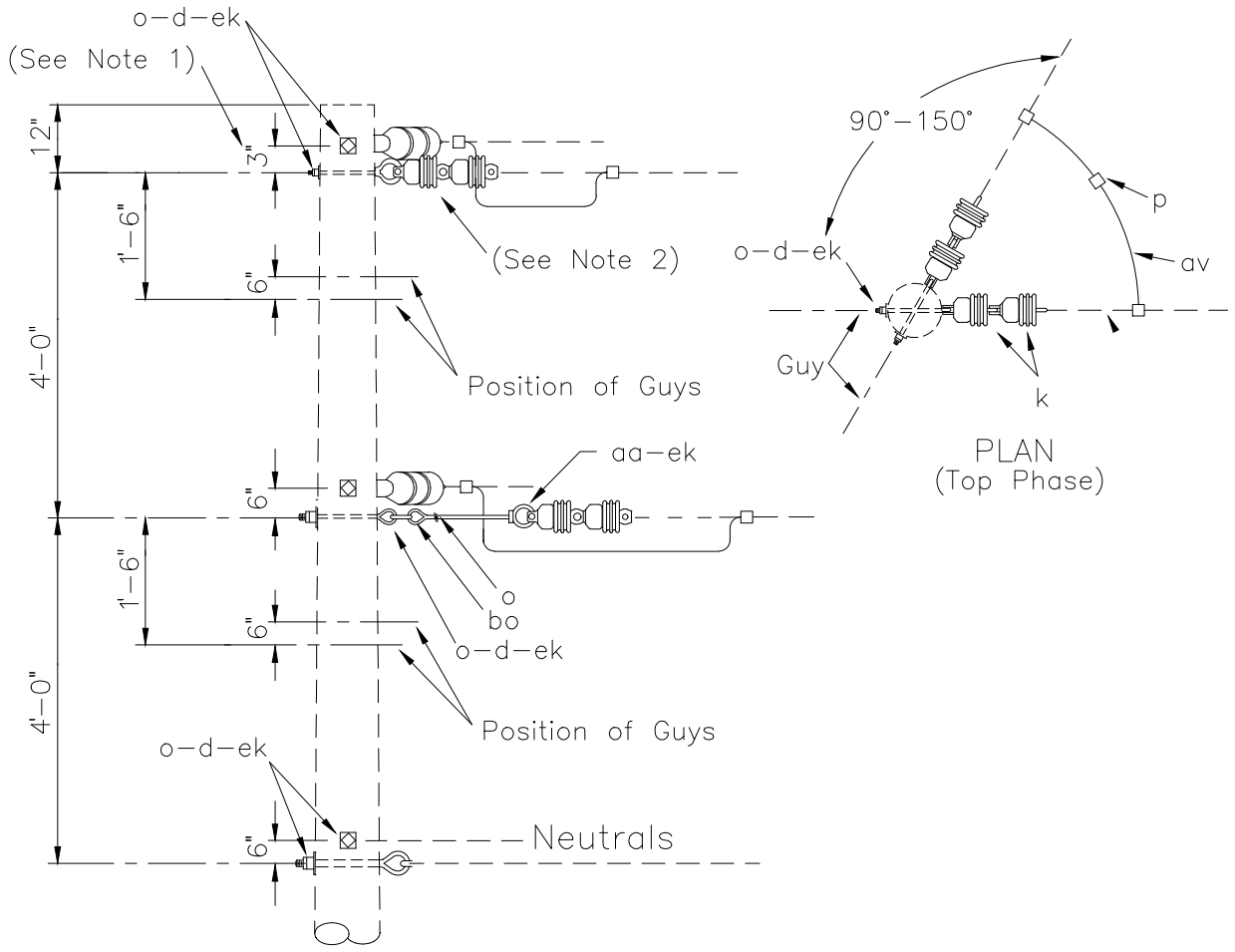
DESIGN PARAMETERS:

For ANSI Class 53–2 Spool Insulator (1 3/4") See Table VI

For ANSI Class 53–4 Spool Insulator (3") See Table VII

SUSPENSION ANGLE

September 18	2 – PHASE PRIMARY 12.47/7.2 kV	B3.4 – B3.6
FDEC		



NOTES:

1. Separate 6" (top position only) when angle equals 90°.
2. This drawing shows two A5.1 plus two A5.02 assemblies and their material as an example. Any combination of B5.1 – B5.9, A4.1 – A5.9 and A5.03 assemblies may be installed. Record assemblies separately on staking sheets. CAUTION: Use the appropriate permitted longitudinal loads.

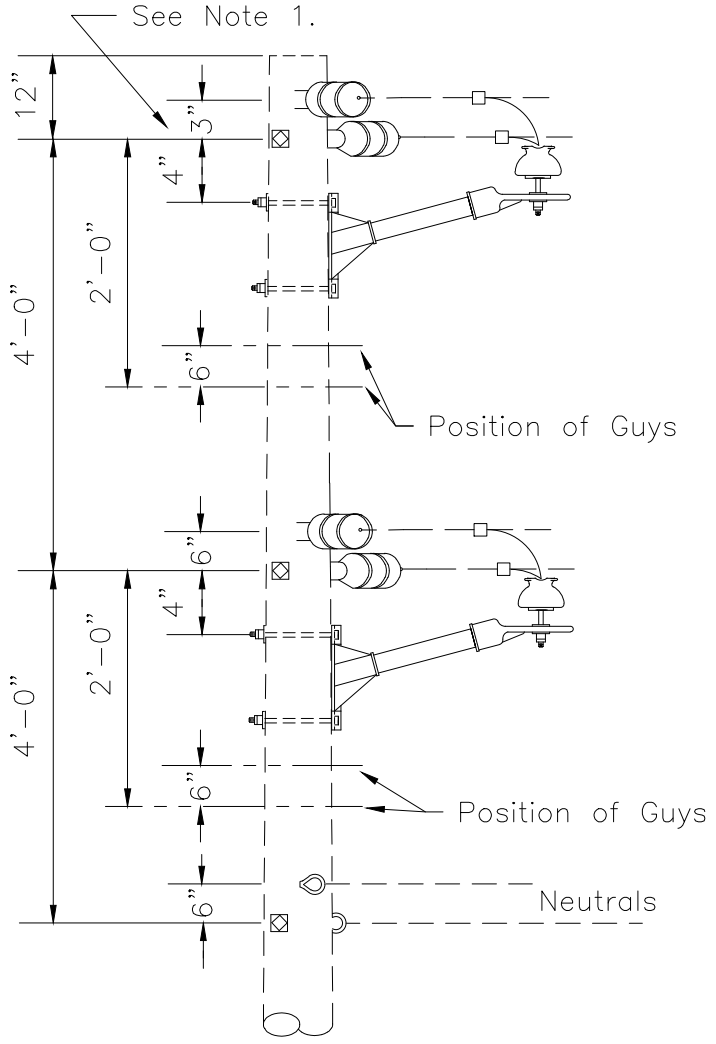
ITEM	QTY	MATERIAL
		Primary Assemblies, as req'd (See Note 2)
p		Connectors, as req'd
av		Jumpers, as req'd

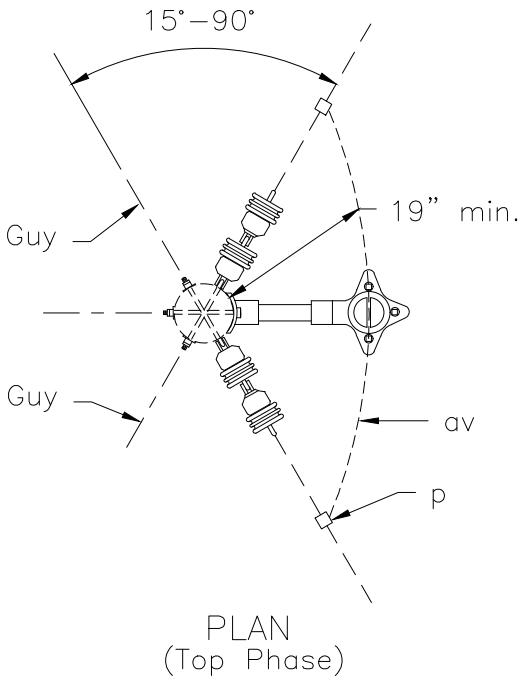
DESIGN PARAMETERS:

PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

DEADEND ANGLE GUIDE (90°–150°)

September 18	2 – PHASE PRIMARY 12.47/7.2 kV	B4.1G (B4–1)
FDEC		





PLAN
(Top Phase)

NOTES:

1. Separate 6" (top position only) when angle equals 90°.
2. This drawing shows two B5.1 and two A1.04N assemblies as an example. Any combination of two A1.04N plus B5.1 – B5.9, A5.1 – A5.9 and A5.01 – A5.03 assemblies may be installed. Record assemblies separately on staking sheets. CAUTION: Use the appropriate permitted longitudinal loads.

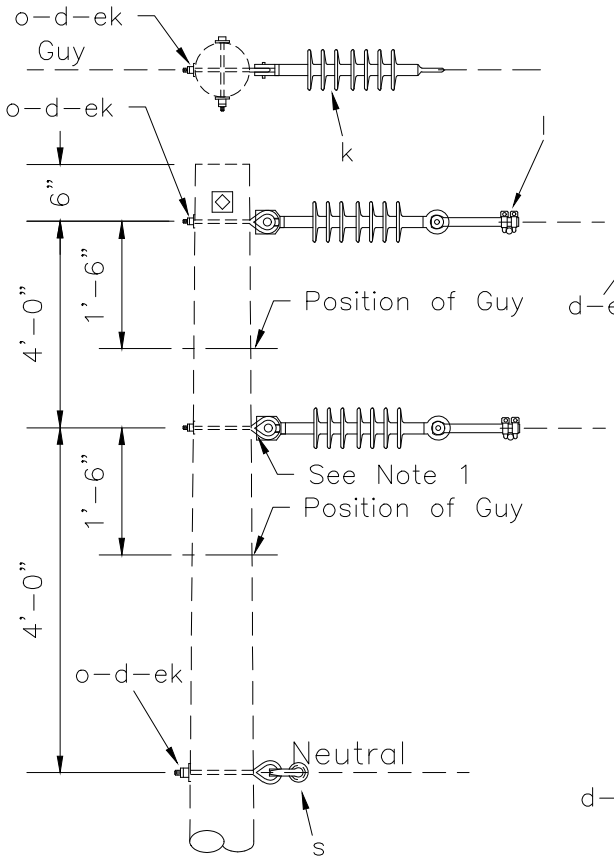
ITEM	QTY	MATERIAL
		Primary Assemblies, as req'd (See Note 2)
	2	A1.04N primary assemblies
p		Connectors, as req'd
av		Jumpers, as req'd

DESIGN PARAMETERS:

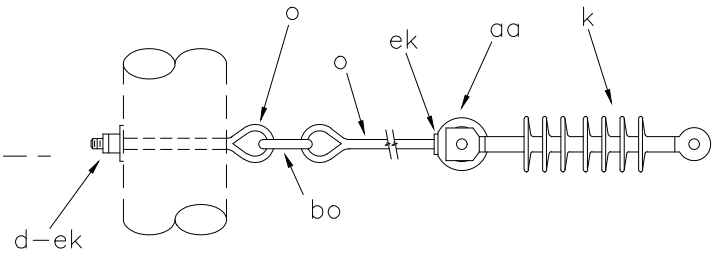
PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

DEADEND ANGLE GUIDE (15°–90°)

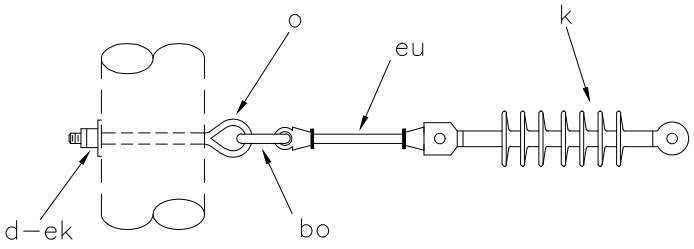
September 18	2 – PHASE PRIMARY 12.47/7.2 kV	B4.2G
FDEC		



B5.1



B5.2



B5.3

NOTES: 1. Extension link (item "eu" or "du") or eye bolt (item "o"), eye nut (item "aa") and locknut (item "ek") may be installed in lower primary position. Adjust material as required.

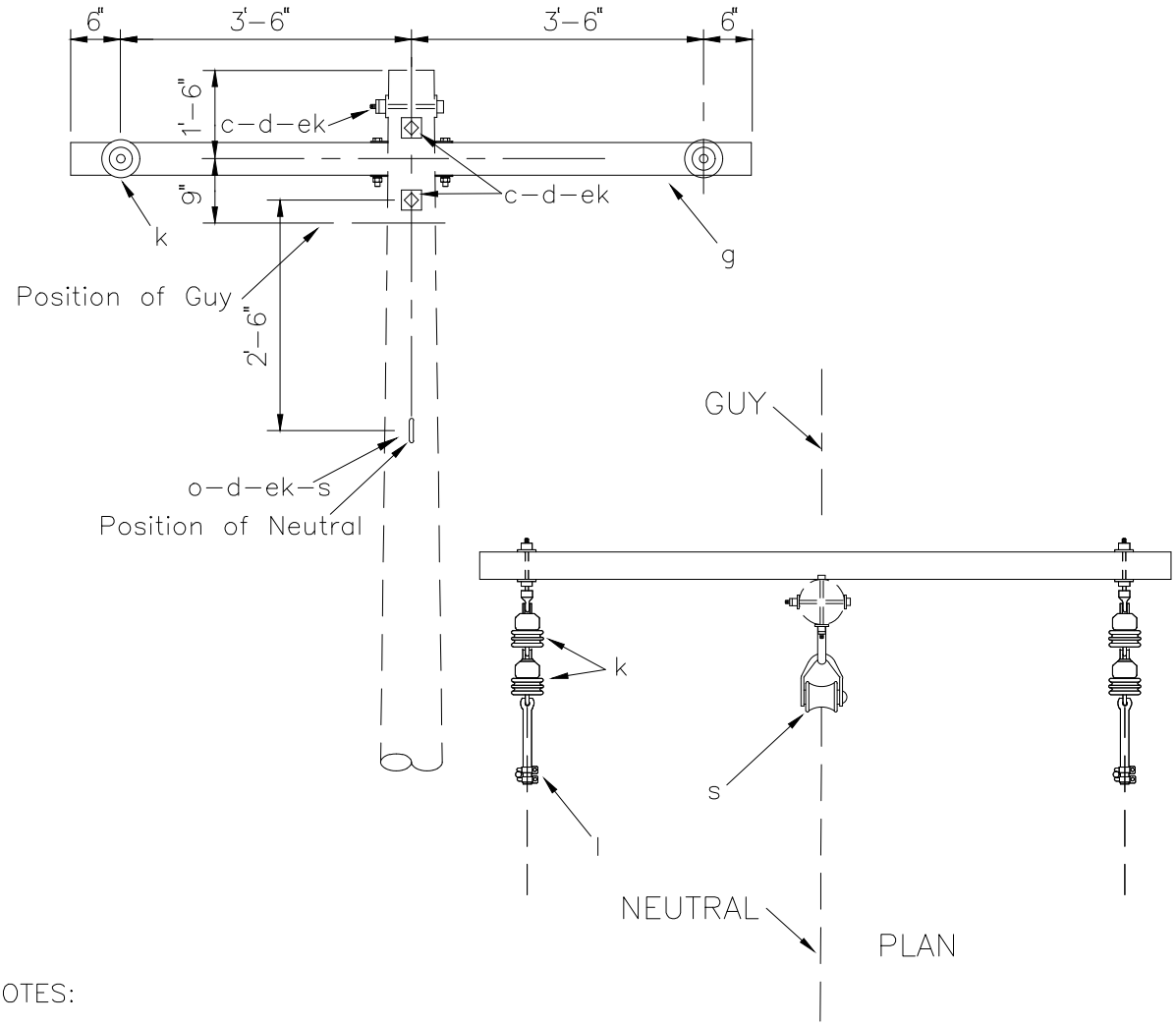
2. When connecting to existing bolt end, use eye nut "aa" and lock nut "ek" instead of eye bolt subassembly "o–d–ek".

ASSEMBLY: A5		.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
d	Washer, square, 2 1/4"	2	2	2
d	Washer, square, 3", curved	3	3	3
k	Insulator, epoxilator	2	2	2
o	Bolt, eye, 5/8"x req'd length	3	5	3
c	Bolt, machine, 5/8"x req'd length	1	1	1
p	Connectors, as req'd			
l	Primary deadend	2	2	2
s	Clevis, swinging, insulated	1	1	1
aa	Nut, eye		1	
av	Jumper's, as req'd			
bo	Shackle, anchor		2	2
ek	Locknuts	4	6	4
eu (du)	Link, extension, insulated (Link, extension) – (optional)			2 (2)

DESIGN PARAMETERS:
PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

SINGLE DEADENDS

September 18	2 – PHASE PRIMARY 12.47/7.2 kV	B5.1,B5.2,B5.3 (B5–1)
FDEC		



NOTES:

1. Other neutral assemblies may be used. See Section N. Adjust material as needed.

ITEM	QTY	MATERIAL
l	2	Clamp, dead–end
s	1	Clevis, secondary, swinging, insulated
d	2	Washer, square, 2 1/4"
d	3	Washer, square, 3", curved
k	4	Insulator, suspension, 4 1/4"
o	1	Bolt, eye, 5/8" x req'd length
ek	4	Locknuts
c	3	Bolt, machine, 5/8" x req'd length
g	1	Crossarm, fiberglass, deadend, 8'

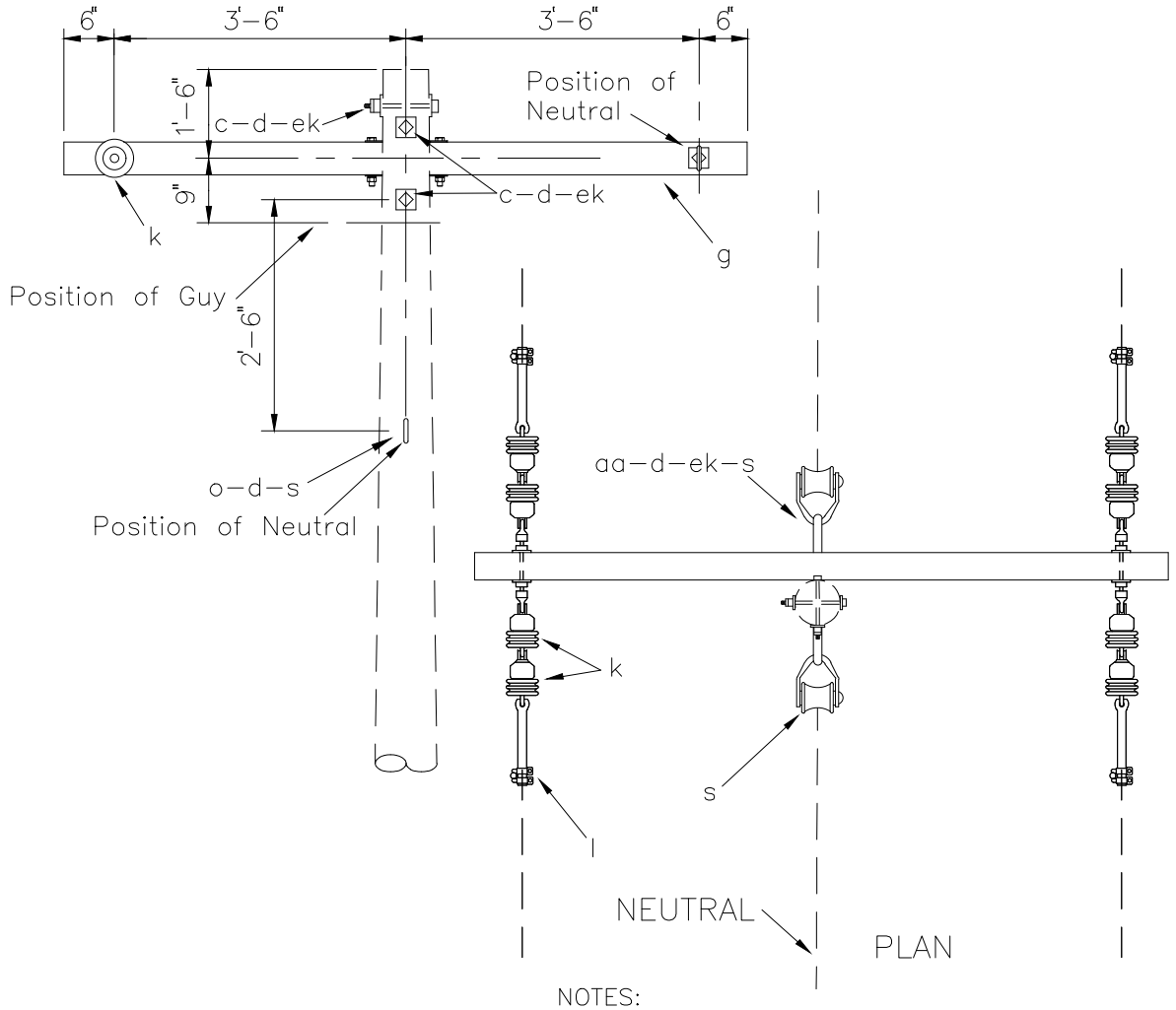
DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:

See Table A (Exhibit 2)

SINGLE DEADEND ON CROSSARMS

September 18	2 – PHASE PRIMARY 12.47/7.2 kV	B5.21 (B7)
FDEC		



NOTES:

1. Double arming bolt, item "n", and eye nut, item "aa" may be replaced with double arming eye bolt, item "dy".
2. Maximum line angle may be increased to 15° by installing anchor shackles, item "bo", to (horizontal) eyenuts and installing side guy as req'd.
3. See assembly B5.21 for alternative neutral position and materials.

ITEM	QTY	MATERIAL
l	4	Clamp, dead–end
s	2	Clevis, secondary, swinging, insulated
d	2	Washer, square, 2 1/4"
d	4	Washer, square, 3", curved
k	8	Insulator, suspension, 4 1/4"
o	1	Bolt, eye, 5/8" x req'd length
ek	4	Locknuts
c	3	Bolt, machine, 5/8" x req'd length
g	1	Crossarm, fiberglass, deadend, 8'
aa	1	Nut, eye, 5/8"

DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:

See Table A (Exhibit 2)

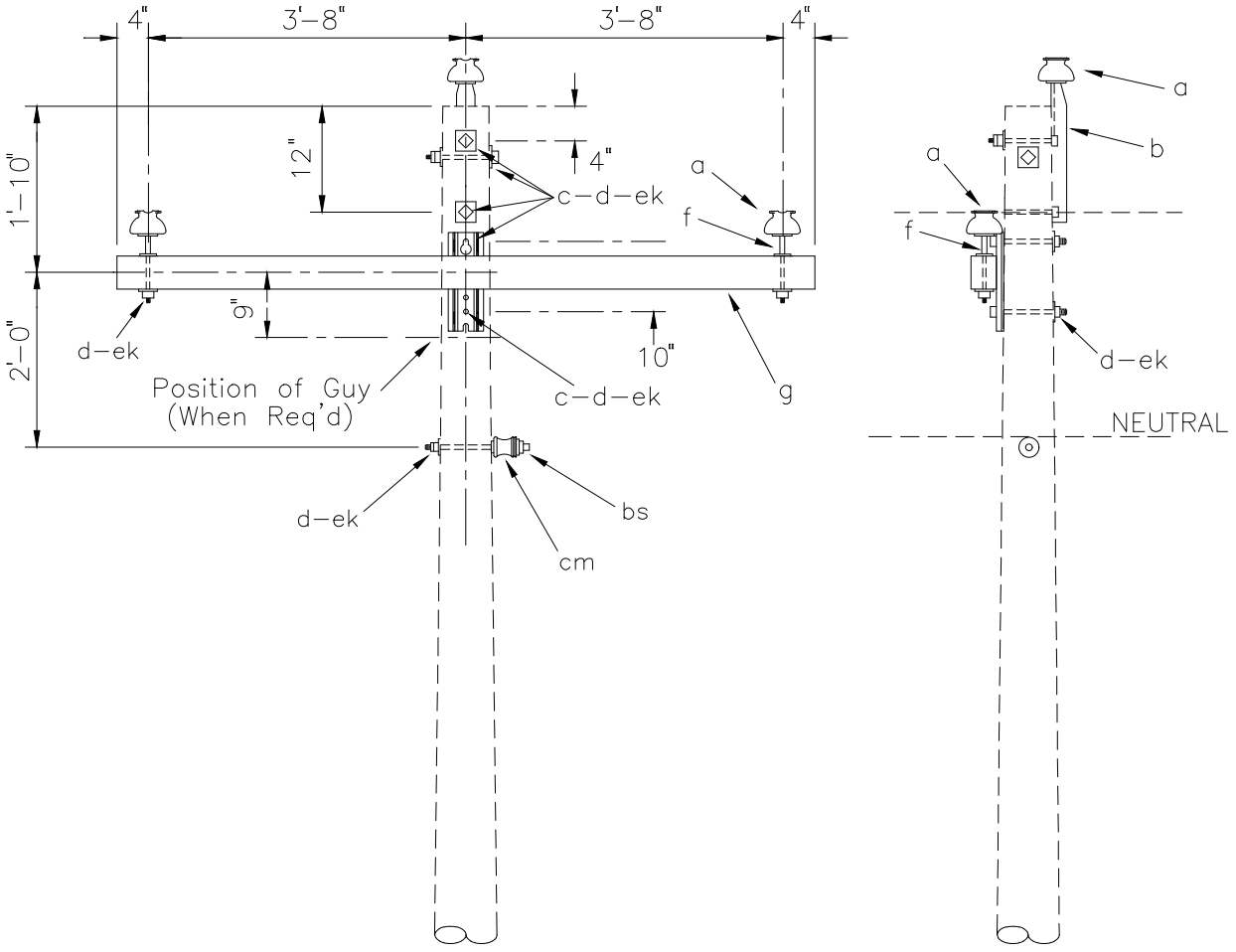
DOUBLE DEADEND ON CROSSARMS

September 18	2 – PHASE PRIMARY	
FDEC	12.47/7.2 kV	B6.21 (B8)

INDEX C

THREE-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
C1.7N		SINGLE SUPPORT – NARROW PROFILE (TANGENT)
C1.11	(C1)	SINGLE SUPPORT ON CROSSARM (TANGENT)
C1.11L	(C1-2)	SINGLE SUPPORT ON CROSSARM (TANGENT)
C1.13		SINGLE SUPPORT ON CROSSARM
C1.13L	(C1-4)	SINGLE SUPPORT ON CROSSARM (LARGE CONDUCTORS)
C2.9N		DOUBLE SUPPORT – NARROW PROFILE
C2.21L	(C1-3)	DOUBLE SUPPORT ON CROSSARMS (LARGE CONDUCTORS)
C2.52	(C2-1)	DOUBLE SUPPORT ON 10-FOOT CROSSARMS
C2.52L	(C2-2)	DOUBLE SUPPORT ON 10-FOOT CROSSARMS (LARGE CONDUCTORS)
C3.1 C3.2 C3.3	(C3)	SUSPENSION ANGLE
C4.1G	((C4-1))	DEADEND GUIDE ($90^{O} - 150^{O}$)
C4.2G		DEADEND GUIDE ($15^{O} - 90^{O}$)
C5.21	(C7)	SINGLE DEADEND ON CROSSARMS
C6.21	(C8)	DOUBLE DEADEND ON CROSSARMS



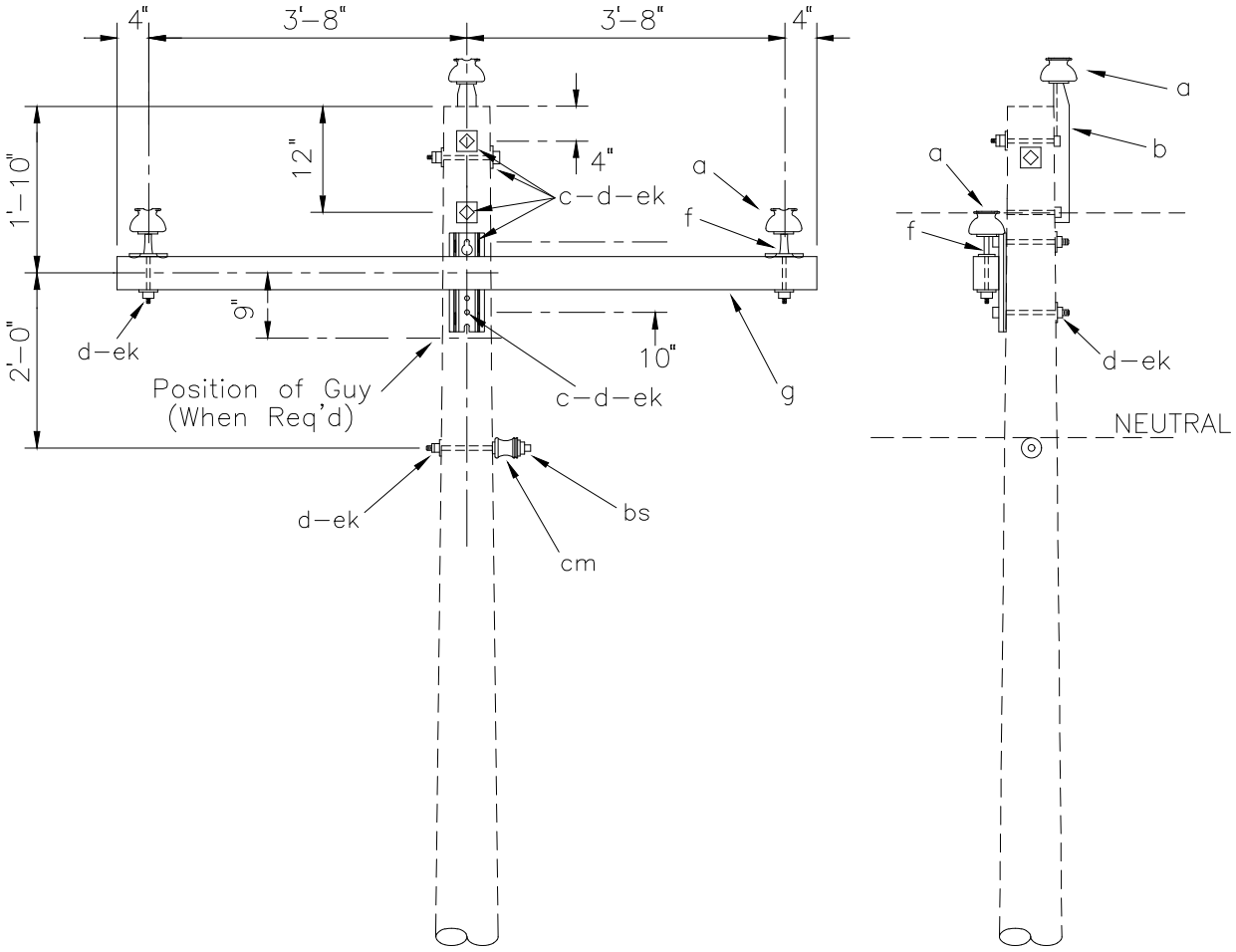
ASSEMBLY: C1.		11	
ITEM	MATERIAL	QTY	
a	Insulator, pin type (12.47/7.2 kV)	3	
b	Pin, pole top, 20"	1	
c	Bolt, machine, 5/8" x req'd length	5	
d	Washer, square, 2 1/4"	7	
d	Washer, square, 3", curved	2	
f	Pin, crossarm steel, 5/8" x 10 3/4"	2	
g	Crossarm, fiberglass, tangent, 8'	1	
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	
ek	Locknuts	8	

DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT ON CROSSARM (TANGENT)

September 18	3 – PHASE PRIMARY 12.47/7.2 kV	C1.11 (C1F)
FDEC		



ASSEMBLY: C1. | 11L |

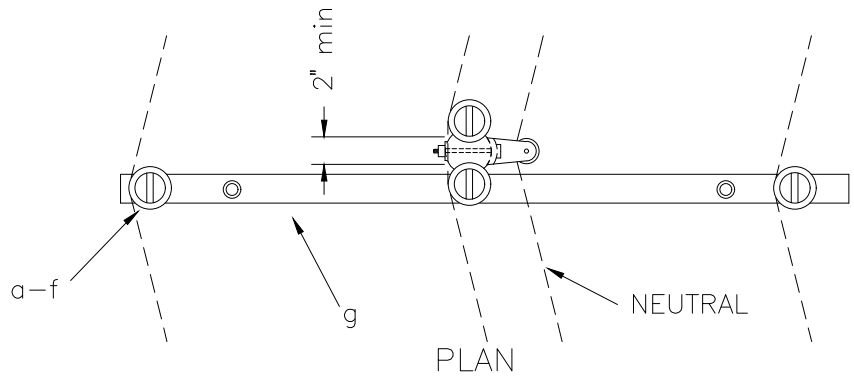
ITEM	MATERIAL	QTY	
a	Insulator, pin type (12.47/7.2 kV)	3	
b	Pin, pole top, 20"	1	
c	Bolt, machine, 5/8" x req'd length	5	
d	Washer, square, 2 1/4"	7	
d	Washer, square, 3", curved	2	
f	Pin, crossarm, clamp type	2	
g	Crossarm, fiberglass, tangent, 8'	1	
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	
ek	Locknuts	8	

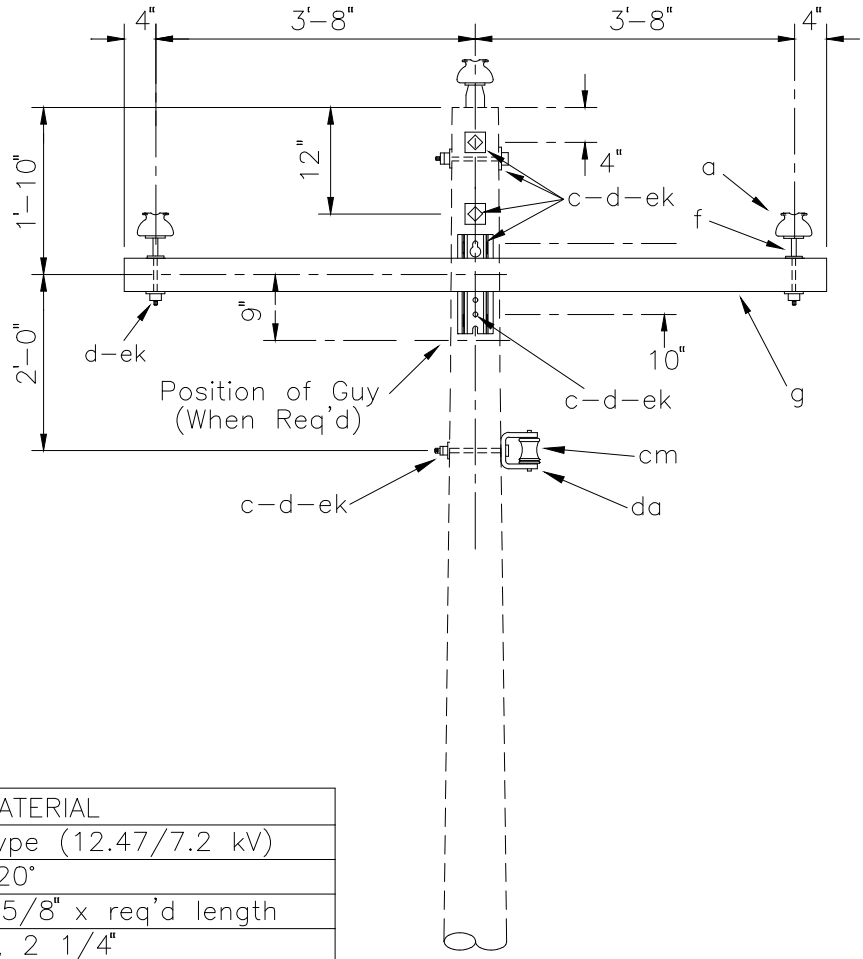
DESIGN PARAMETERS:

MAXIMUM LINE ANGLE:
2° – (Large Conductors)

SINGLE SUPPORT ON CROSSARM (TANGENT) (LARGE CONDUCTORS)

September 18	3 – PHASE PRIMARY 12.47/7.2 kV	C1.11L (C1-2)
FDEC		





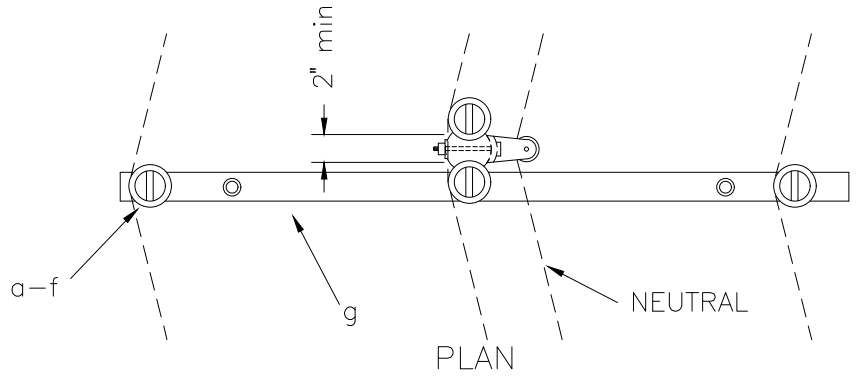
ITEM	QTY	MATERIAL
a	4	Insulator, pin type (12.47/7.2 kV)
b	2	Pin, pole top, 20°
c	6	Bolt, machine, 5/8" x req'd length
d	6	Washer, square, 2 1/4"
d	3	Washer, square, 3", curved
f	2	Pin, crossarm, steel, 5/8" x 10 3/4"
g	1	Crossarm, fiberglass, 8'
da	1	Bracket, insulated
cm	1	Insulator, spool, 3"
ek	8	Locknuts

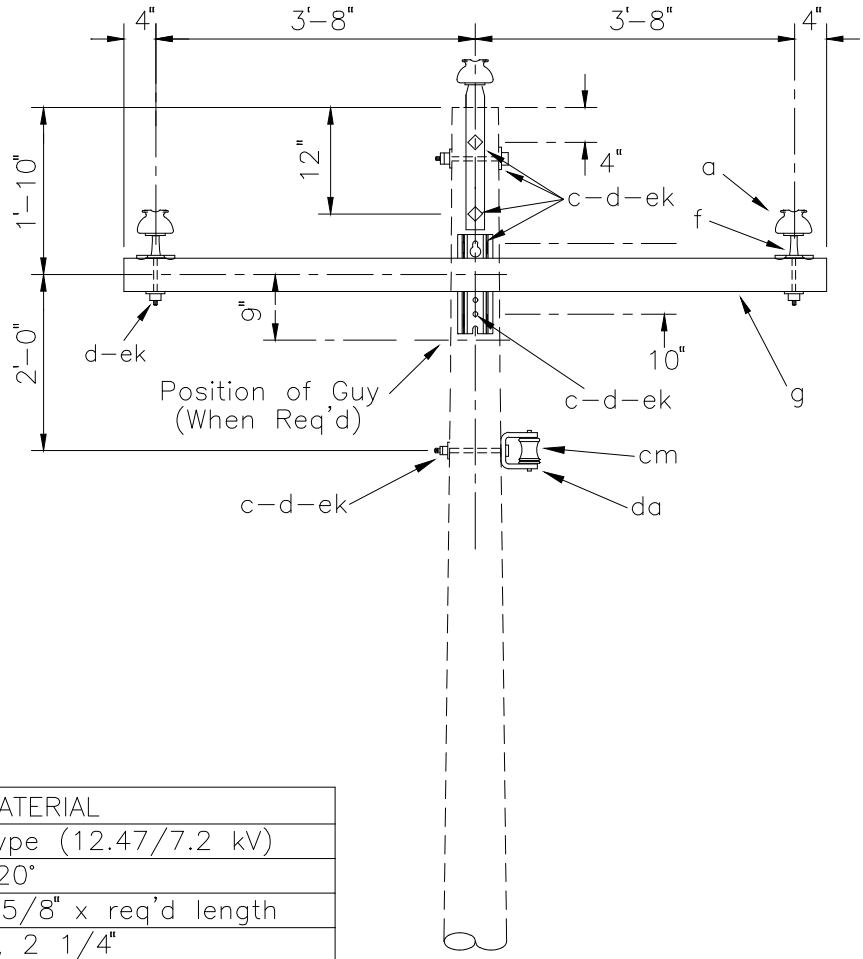
DESIGN PARAMETERS:

See TABLE I

SINGLE SUPPORT ON CROSSARM

September 18	3 – PHASE PRIMARY 12.47/7.2 kV	
FDEC		C1.13





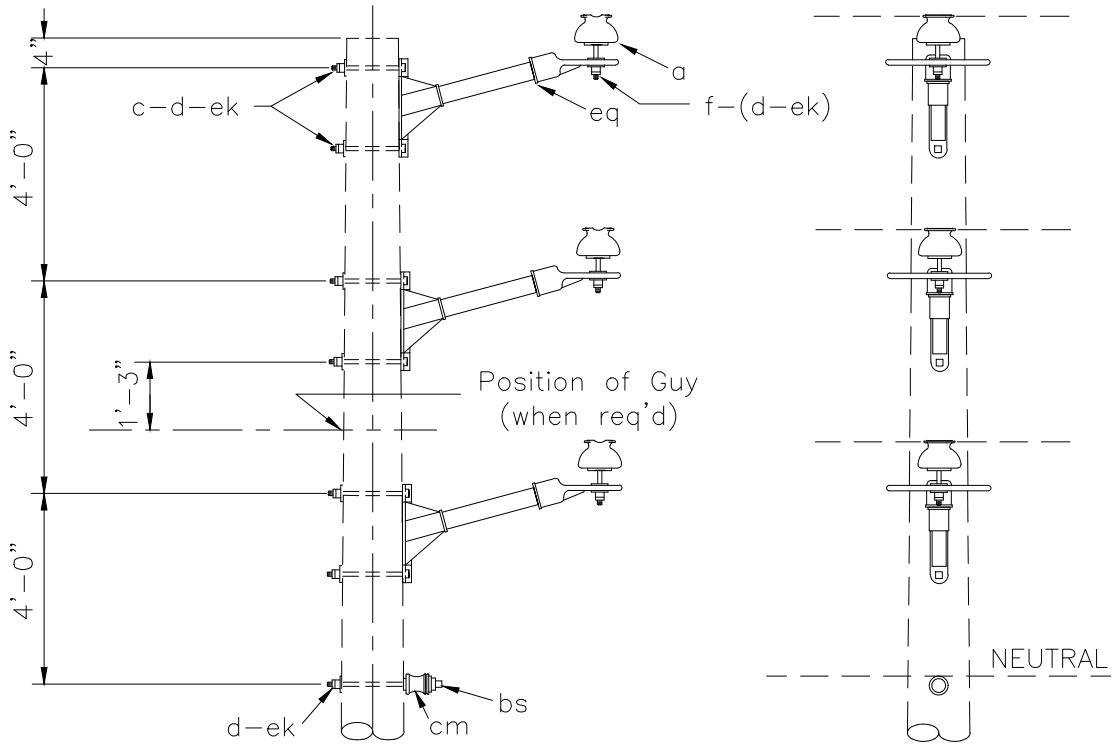
ITEM	QTY	MATERIAL
a	4	Insulator, pin type (12.47/7.2 kV)
b	2	Pin, pole top, 20°
c	6	Bolt, machine, 5/8" x req'd length
d	6	Washer, square, 2 1/4"
d	3	Washer, square, 3", curved
f	2	Pin, crossarm, clamp type
g	1	Crossarm, fiberglass, 8'
da	1	Bracket, insulated
cm	1	Insulator, spool, 3"
ek	8	Locknuts

DESIGN PARAMETERS:

See TABLE III

SINGLE SUPPORT ON CROSSARM (LARGE CONDUCTORS)

September 18 FDEC	3 – PHASE PRIMARY 12.47/7.2 kV	C1.13L (C1–4)

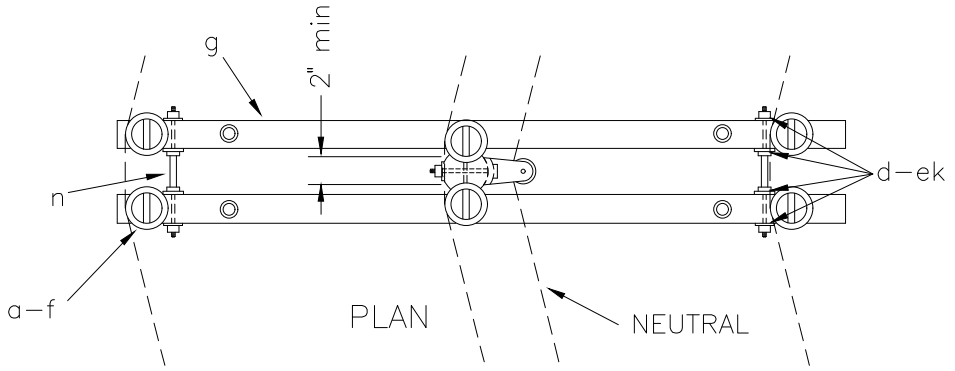


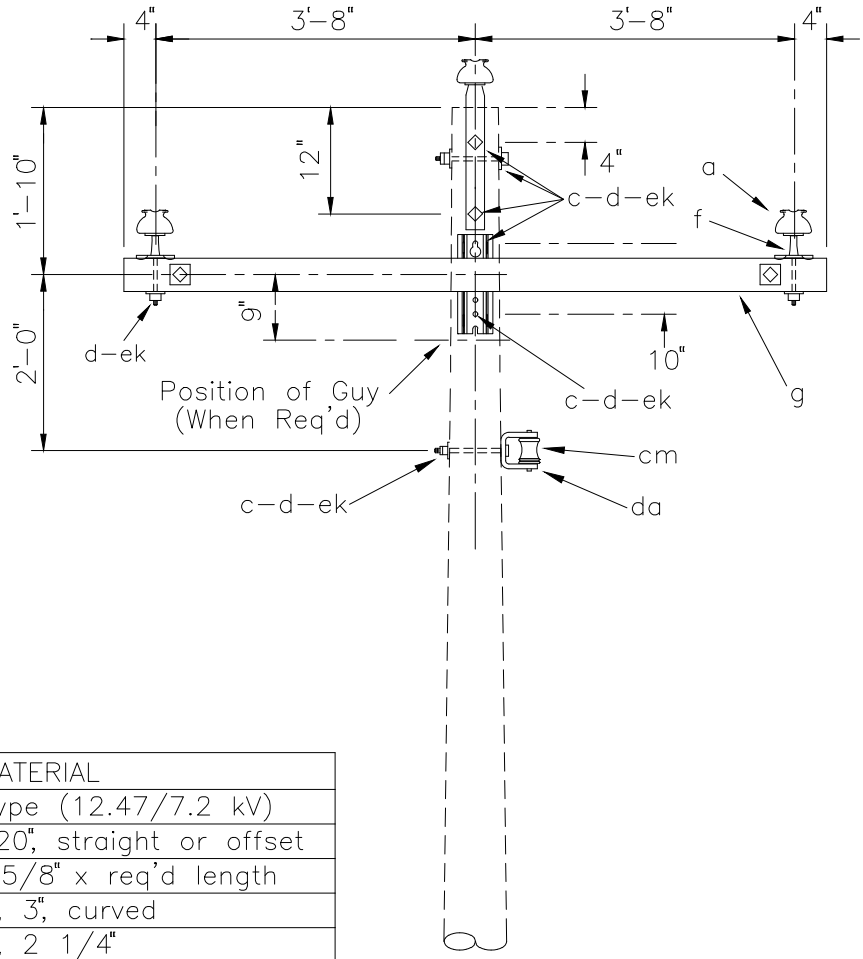
Assembly: C1.	7N	
ITEM	MATERIAL	QTY	
a	Insulator, pin type (12.47/7.2 kV)	3	
c	Bolt, machine, 5/8" x req'd length	6	
d	Washer, square 2 1/4"	7	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(3)	(If req'd)
j	Screw, lag, 1/2" x 4"		
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	
ec	Bracket, offset neutral		
ek	Locknuts	7	
eq	Bracket, insulator/equipment	3	

Design Parameters:
Maximum Line Angles
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT–NARROW PROFILE
(TANGENT)

September 18	3 – PHASE PRIMARY	C1.7N
FDEC	12.47/7.2 kV	





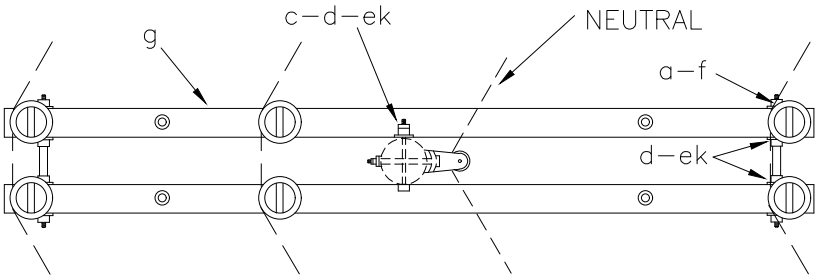
ITEM	QTY	MATERIAL
a	6	Insulator, pin type (12.47/7.2 kV)
b	2	Pin, pole top, 20", straight or offset
c	6	Bolt, machine, 5/8" x req'd length
d	1	Washer, square, 3", curved
d	14	Washer, square, 2 1/4"
f	4	Pin, crossarm, steel, clamp type
g	2	Crossarm, fiberglass, 8'
n	2	Bolt, double arming,5/8"x req'd length
da	1	Bracket, insulated
cm	1	Insulator, spool, 3"
ek	18	Locknuts

DESIGN PARAMETERS:

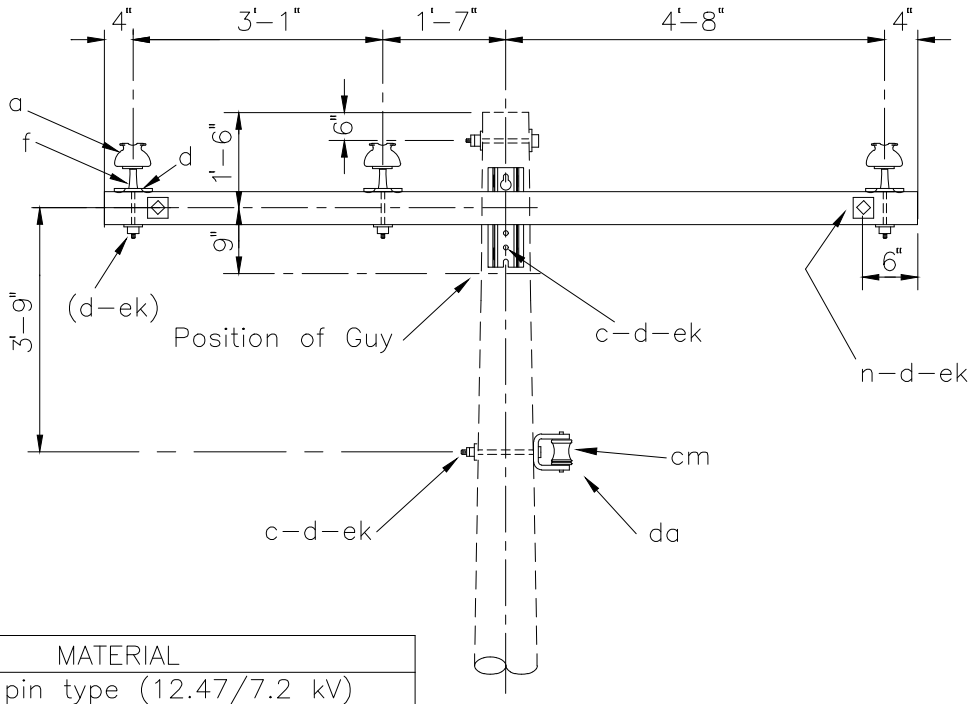
See TABLE III

DOUBLE SUPPORT ON CROSSARMS (LARGE CONDUCTORS)

September 18 FDEC	3 – PHASE PRIMARY 12.47/7.2 kV	C2.21L (C1–3)



PLAN



ITEM	QTY	MATERIAL
a	6	Insulator, pin type (12.47/7.2 kV)
c	4	Bolt, machine, 5/8" x req'd length
d	1	Washer, square, 3", curved
d	16	Washer, square, 2 1/4"
f	6	Pin, crossarm, clamp type
g	2	Crossarm, fiberglass, 10'
n	2	Bolt, double arm, 5/8" x req'd length
da	1	Bracket, insulated
cm	1	Insulator, spool, 3"
ek	18	Locknuts

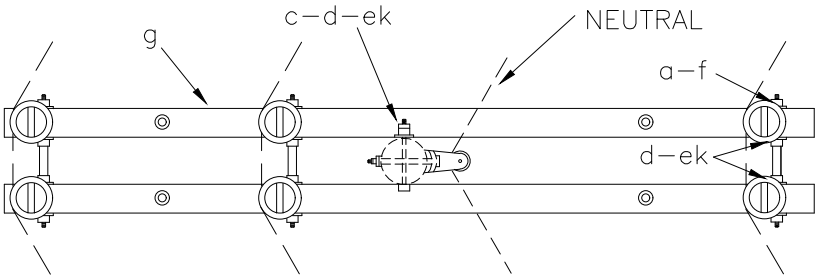
NOTE:
Neutral assembly may be installed on opposite side of pole when necessary to increase midspan conductor clearance.

DESIGN PARAMETERS:

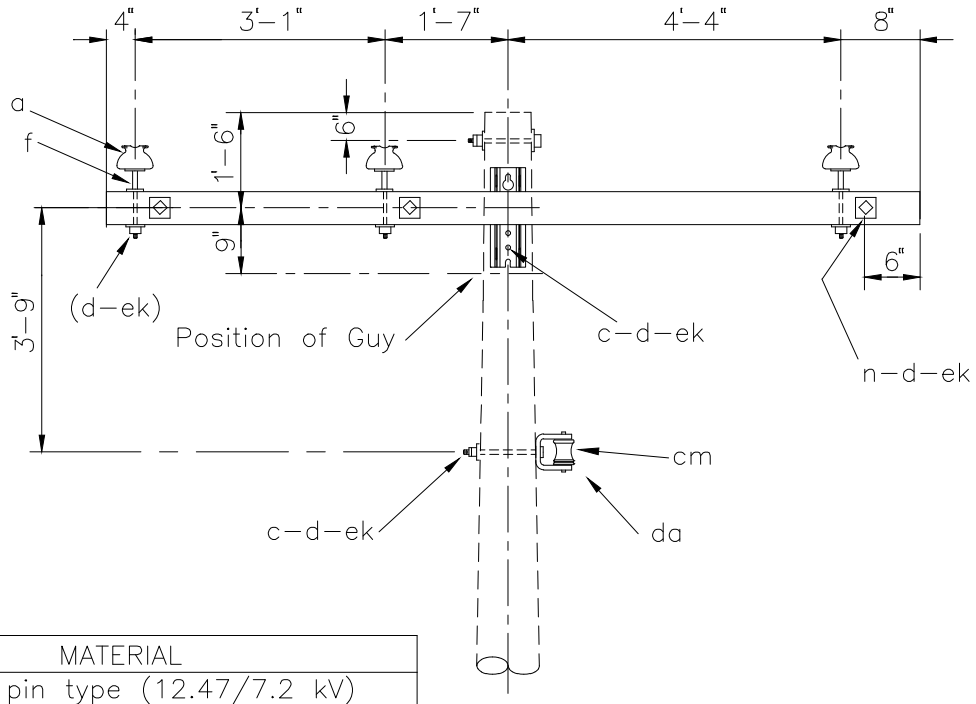
See TABLE IV

DOUBLE SUPPORT ON 10 FOOT CROSSARMS

September 18 FDEC	3 – PHASE PRIMARY 12.47/7.2 kV	C2.52 (C2–1)



PLAN



ITEM	QTY	MATERIAL
a	6	Insulator, pin type (12.47/7.2 kV)
c	4	Bolt, machine, 5/8" x req'd length
d	1	Washer, square, 3", curved
d	20	Washer, square, 2 1/4"
f	6	Pin, crossarm, steel, 5/8" X 10 3/4"
g	2	Crossarm, fiberglass, 10'
n	3	Bolt, double arm, 5/8" x req'd length
da	1	Bracket, insulated
cm	1	Insulator, spool, 3"
ek	22	Locknuts

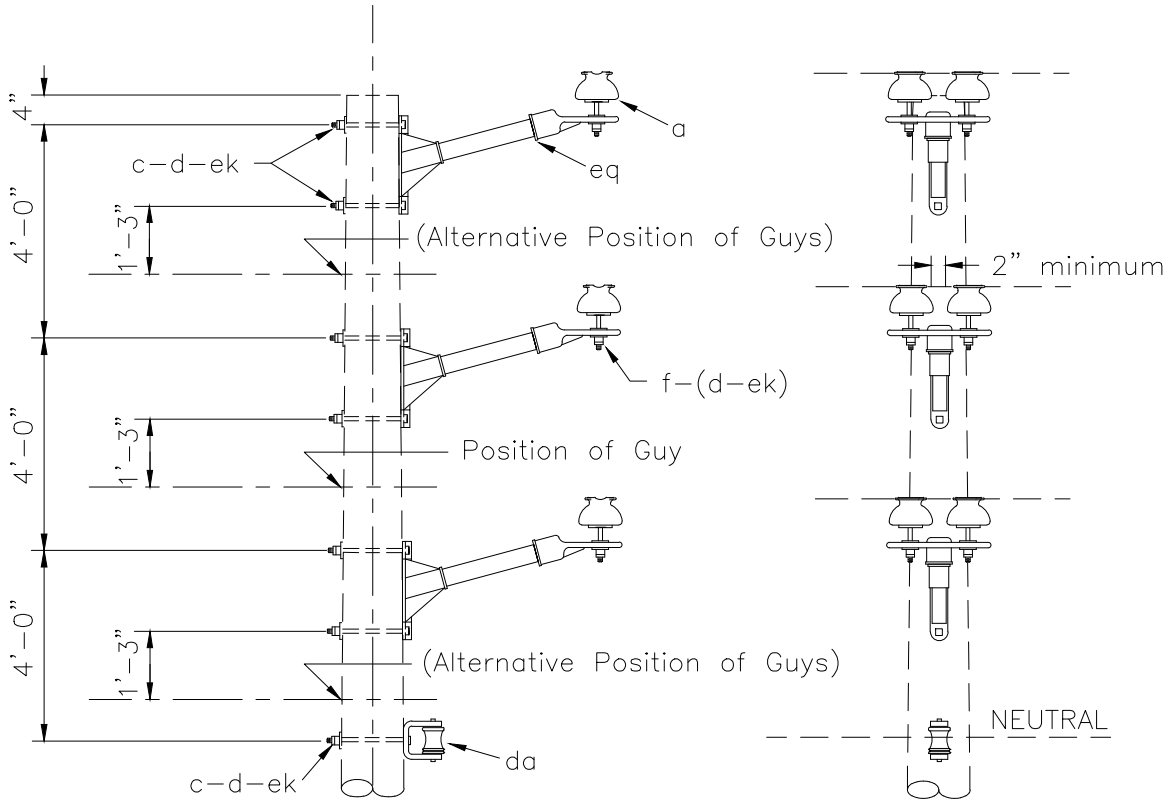
NOTE:
Neutral assembly may be installed on opposite side of pole when necessary to increase midspan conductor clearance.

DESIGN PARAMETERS:

See TABLE V

DOUBLE SUPPORT ON 10 FOOT CROSSARMS (LARGE CONDUCTORS)

September 18 FDEC	3 – PHASE PRIMARY 12.47/7.2 kV	C2.52L (C2–2)

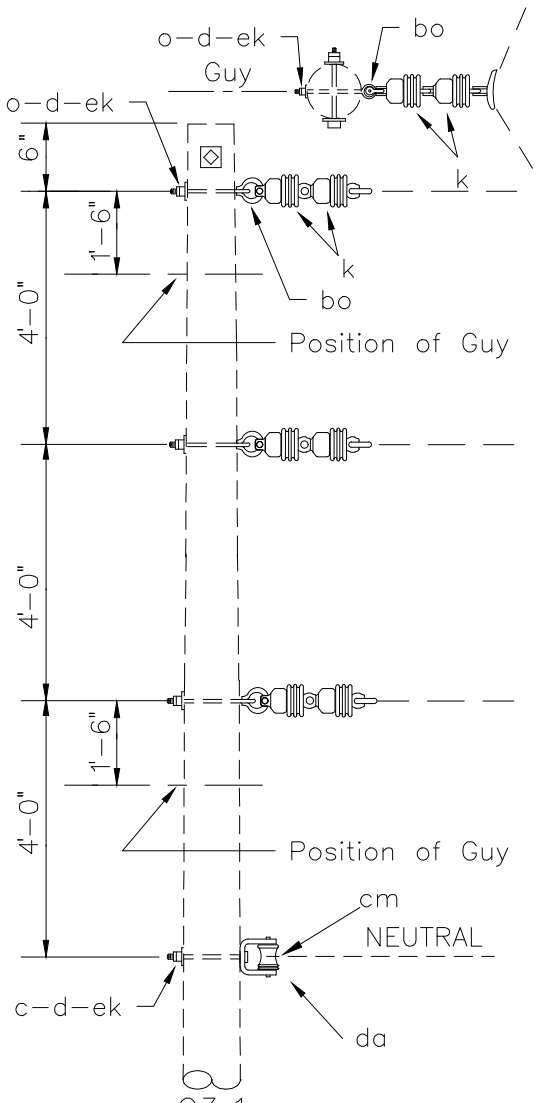


Assembly: C2.		9N
ITEM	MATERIAL	QTY
a	Insulator, pin type (12.47/7.2 kV)	6
c	Bolt, machine, 5/8" x req'd length	7
d	Washer, square 2 1/4"	7
f	Pin, crossarm, 5/8" x 6 1/2"	6
da	Bracket, insulated	1
ek	Locknuts	7
eq	Bracket, insulator/equipment	3

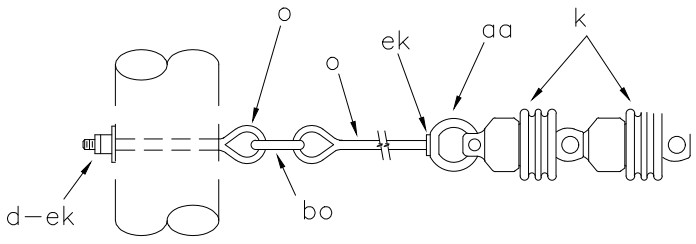
Design Parameters:
Maximum Line Angles
See TABLE IV

DOUBLE SUPPORT–NARROW PROFILE

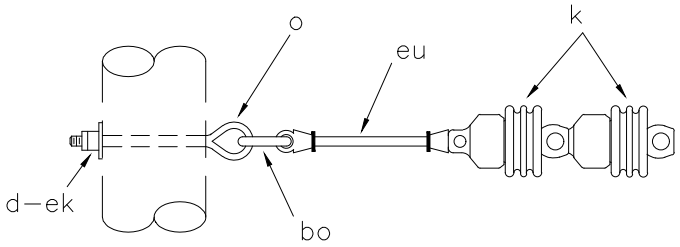
September 18	3 – PHASE PRIMARY	C2.9N
FDEC	12.47/7.2 kV	



C3.1



C3.2



C3.3

NOTE: Extension link (item "eu" or "du") or eyebolt (item "o"), eyenut (item "aa") and locknut (item "ek") may be installed in 2 lower primary positions. Adjust material as required.

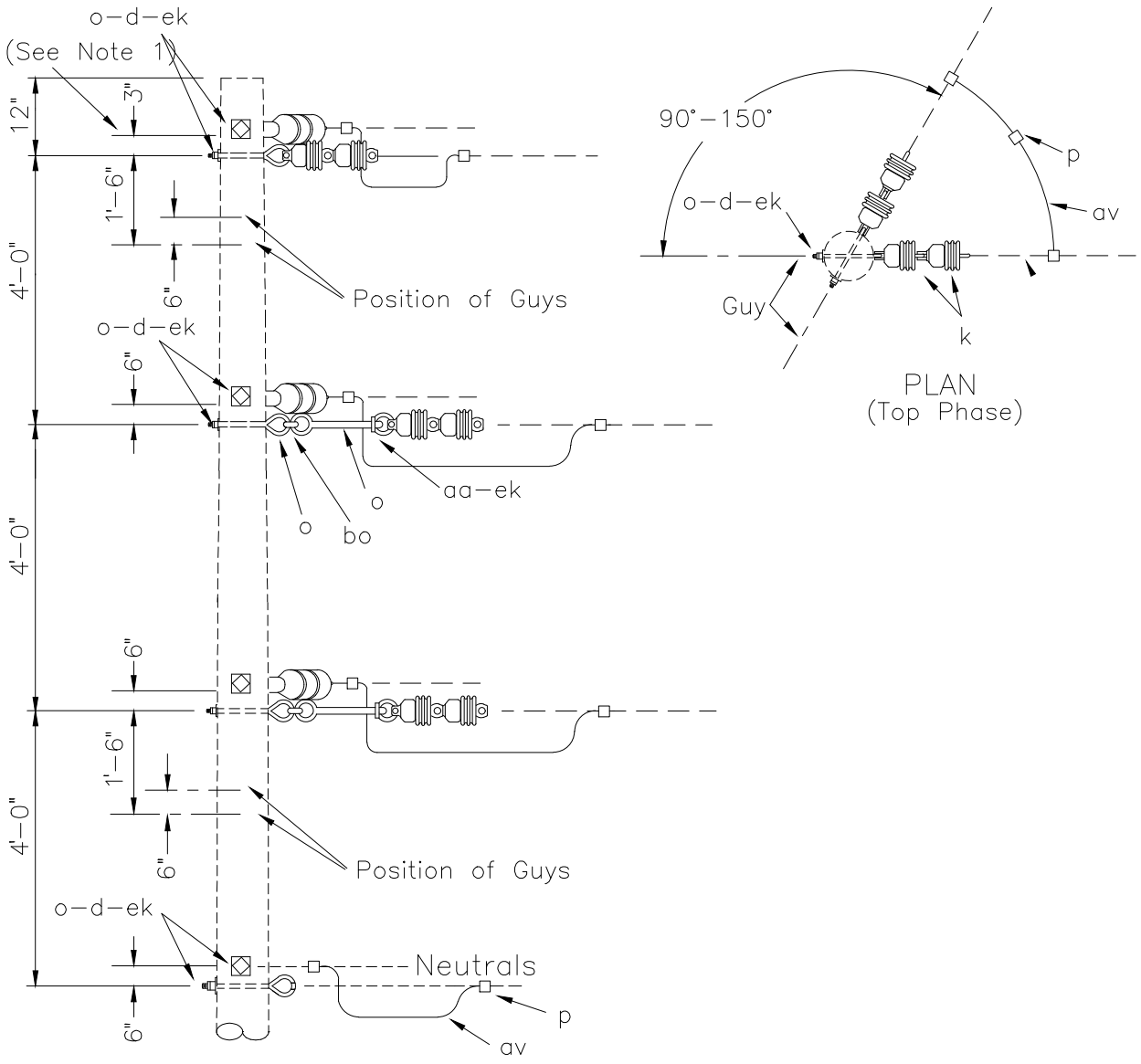
ASSEMBLY: C3		.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	2	2	2
d	Washer, square, 3", curved	4	4	4
d	Washer, square, 2 1/4"	2	2	2
k	Insulator, suspension, 4 1/4"	6	6	6
o	Bolt, eye, 5/8"x req'd length	3	6	3
aa	Nut, eye		3	
bo	Shackle, anchor	3	3	3
ek	Locknuts	5	8	5
cm	Insulator, spool, 3"	1	1	1
da	Bracket, insulated	1	1	1
eu (du)	Link, extension, insulated (Link, extension) – (optional)			3 (3)

DESIGN PARAMETERS:

PERMITTED TRANSVERSE LOAD= 5000 lbs./Conductor
20° – 60°: #1/0 ACSR & Larger
30° – 60°: Smaller Conductors

SUSPENSION ANGLE

September 18 FDEC	3 – PHASE PRIMARY 12.47/7.2 kV	C3.1,C3.2,C3.3 (C3)



NOTES:

1. Separate 6" (top position only) when angle equals 90°.
2. This drawing shows two B5.1 plus two A5.02 assemblies and their material as an example. Any combination of B5.1 – B5.9, A4.1 – A5.9 and A5.01 – A5.03 assemblies may be installed. Record assemblies separately on staking sheets. CAUTION: Use the appropriate permitted longitudinal loads.

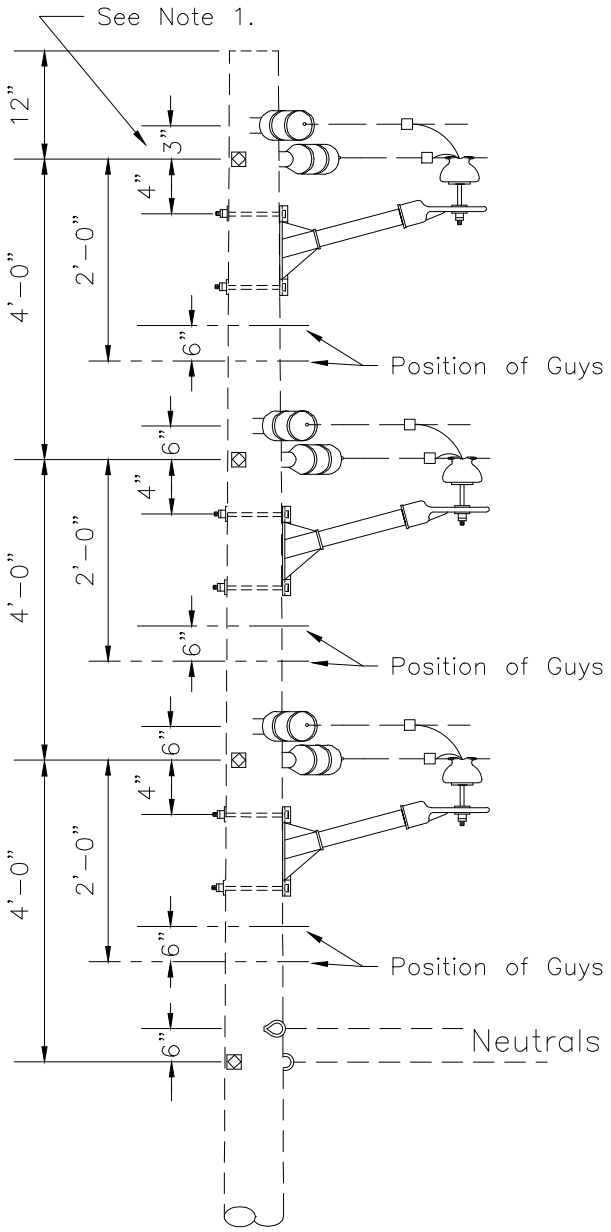
ITEM	QTY	MATERIAL
		Primary Assemblies, as req'd (See Note 2)
p		Connectors, as req'd
av		Jumpers, as req'd

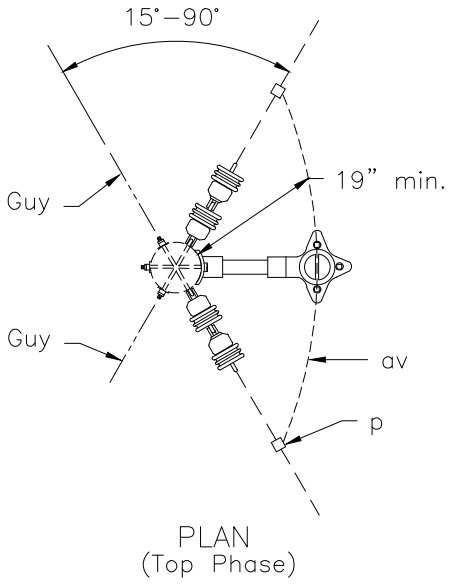
DESIGN PARAMETERS:

PERMITTED LONGITUDINAL
LOAD = 5000 lbs./Conductor

DEADEND ANGLE GUIDE (90°–150°)

September 18	3 – PHASE PRIMARY	C4.1G
FDEC	12.47/7.2 kV	(C4–1)





PLAN
(Top Phase)

NOTES:

1. Separate 6" (top position only) when angle equals 90°.
2. This drawing shows three C5.1 and three A1.04N assemblies as an example. Any combination of three A1.04N plus C5.1 – C5.9, or A5.1 – A5.9 and A5.01 – A5.03 assemblies may be installed. Record assemblies separately on staking sheets. CAUTION: Use the appropriate permitted longitudinal loads.

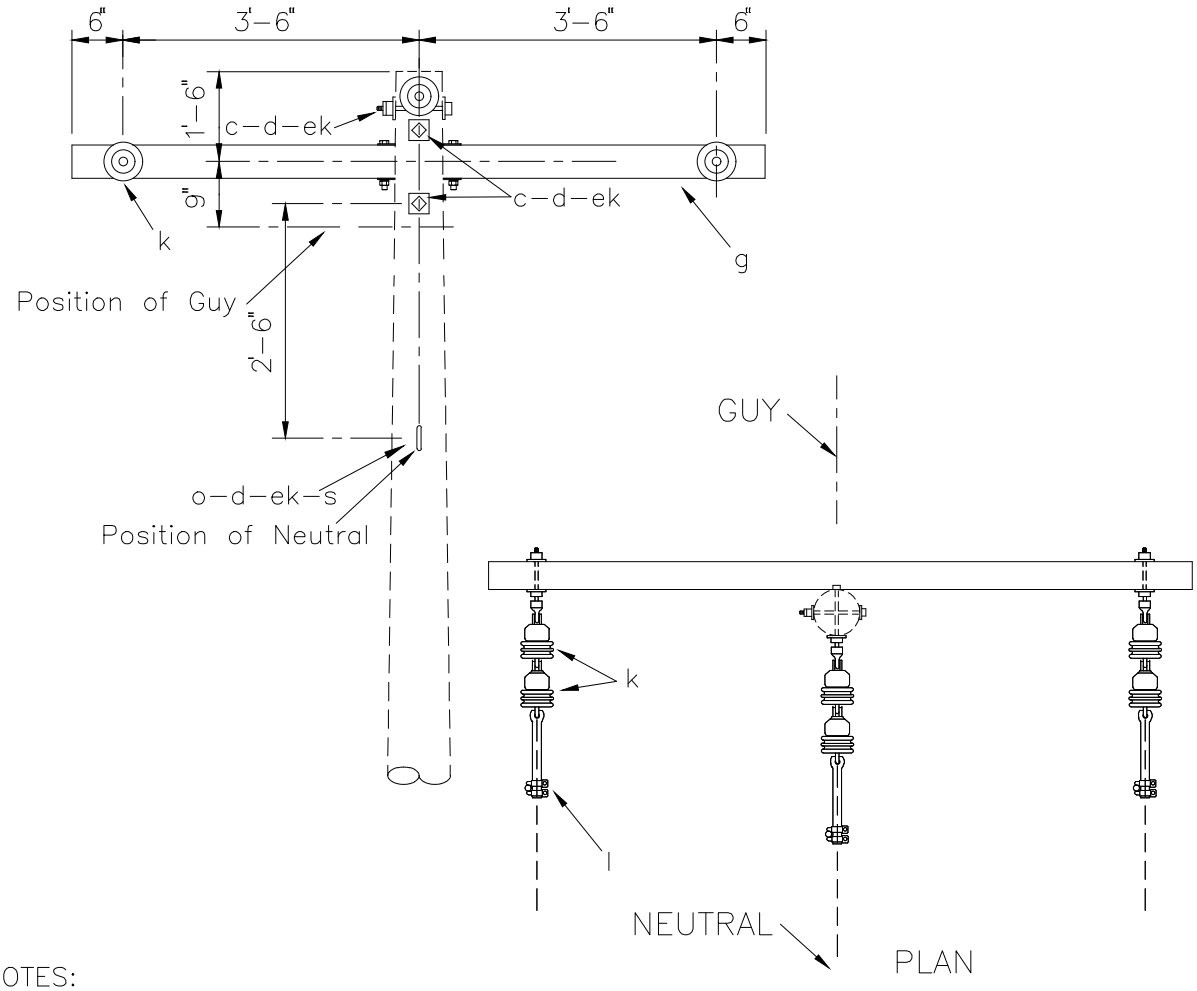
ITEM	QTY	MATERIAL
		Primary Assemblies, as req'd (See Note 2)
	3	A1.04N primary assemblies
p		Connectors, as req'd
av		Jumpers, as req'd

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

DEADEND ANGLE GUIDE (15°–90°)

September 18	3 – PHASE PRIMARY	C4.2G
FDEC	12.47/7.2 kV	



NOTES:

1. Other neutral assemblies may be used. See Section N. Adjust material as needed.
2. Use 3/4" bolts to mount crossarm

ITEM	QTY	MATERIAL
l	3	Clamp, dead–end
s	1	Clevis, secondary, swinging, insulated
d	4	Washer, square, 3", curved
d	2	Washer, square, 2 1/4"
g	1	Crossarm, fiberglass, dead–end, 8'
k	6	Insulator, suspension, 4 1/4"
c	2	Bolt, machine, 3/4" x req'd length
c	1	Bolt, machine, 5/8" x req'd length
o	2	Bolt, eye, 5/8" x req'd length
ek	5	Locknuts

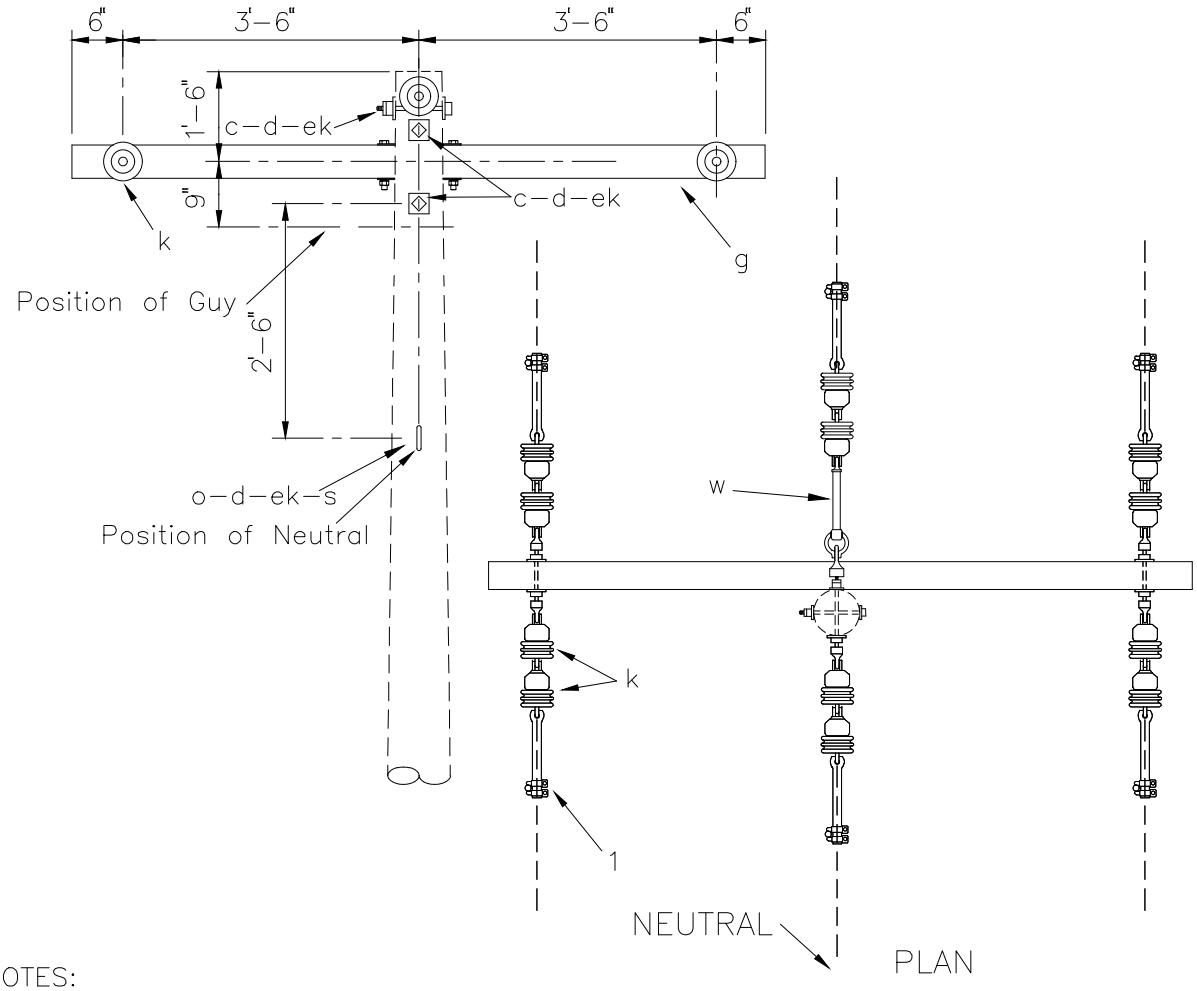
DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:

See Table A (Exhibit 2)

SINGLE DEADEND ON CROSSARMS

September 18	3 – PHASE PRIMARY 12.47/7.2 kV	C5.21 (C7)
FDEC		



NOTES:

1. Other neutral assemblies may be used. See Section N. Adjust material as needed.

ITEM	QTY	MATERIAL
w	1	Insulator, guy strain
aa	2	Nut, eye, 5/8"
l	6	Clamp, dead–end
s	2	Clevis, secondary, swinging, insulated
d	6	Washer, square, 3", curved
d	2	Washer, square, 2 1/4"
g	1	Crossarm, fiberglass, dead–end, 8'
k	12	Insulator, suspension, 4 1/4"
c	3	Bolt, machine, 5/8" x req'd length
o	2	Bolt, eye, 5/8" x req'd length
ek	5	Locknuts

DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:
See Table A (Exhibit 2)

MAXIMUM LINE ANGLE = 5°
(See Note 2)

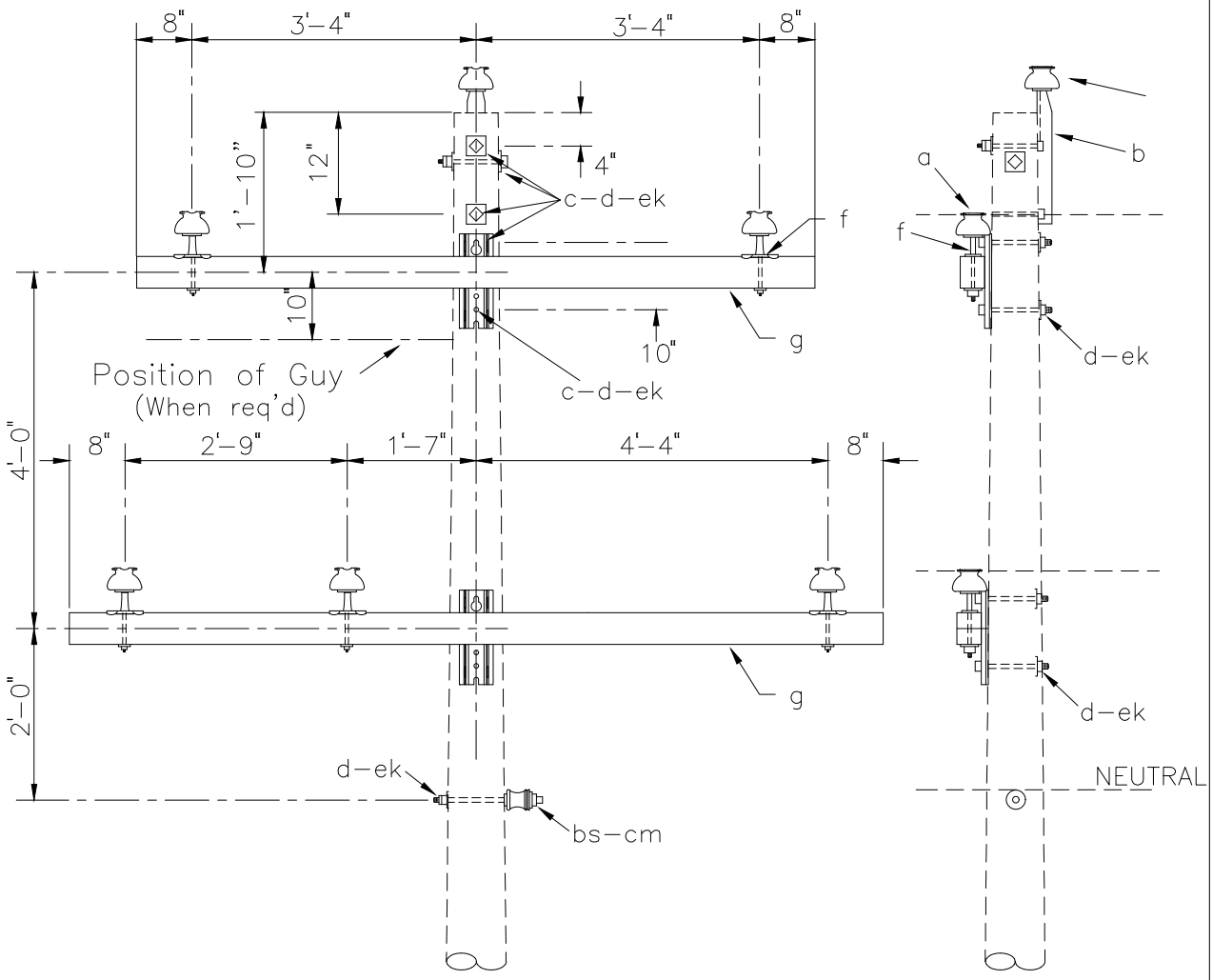
DOUBLE DEADEND ON CROSSARMS

September 18	3 – PHASE PRIMARY	C6.21 (C8)
FDEC	12.47/7.2 kV	

INDEX D

DOUBLE CIRCUIT PRIMARY POLE TOP ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
D1.81L		SINGLE SUPPORT ON CROSSARMS (TANGENT)
D2.91L		DOUBLE SUPPORT ON CROSSARMS (LARGE CONDUCTORS)
D3.1G		SUSPENSION ANGLE GUIDE
D5.91G		THREE PHASE TAP GUIDE



ASSEMBLY: D1.		81L	
ITEM	MATERIAL	QTY	
a	Insulator, pin type, (12.47/7.2 kV)	6	
b	Pin, pole top, 20"	1	
c	Bolt, machine, 3/4" x req'd length	4	
c	Bolt, machine, 5/8" x req'd length	3	
d	Washer, square, 3," curved	4	
d	Washer, square, 2 1/4"	10	
f	Pin, crossarm, steel, clamp type	5	
g	Crossarm, fiberglass, 8'	1	

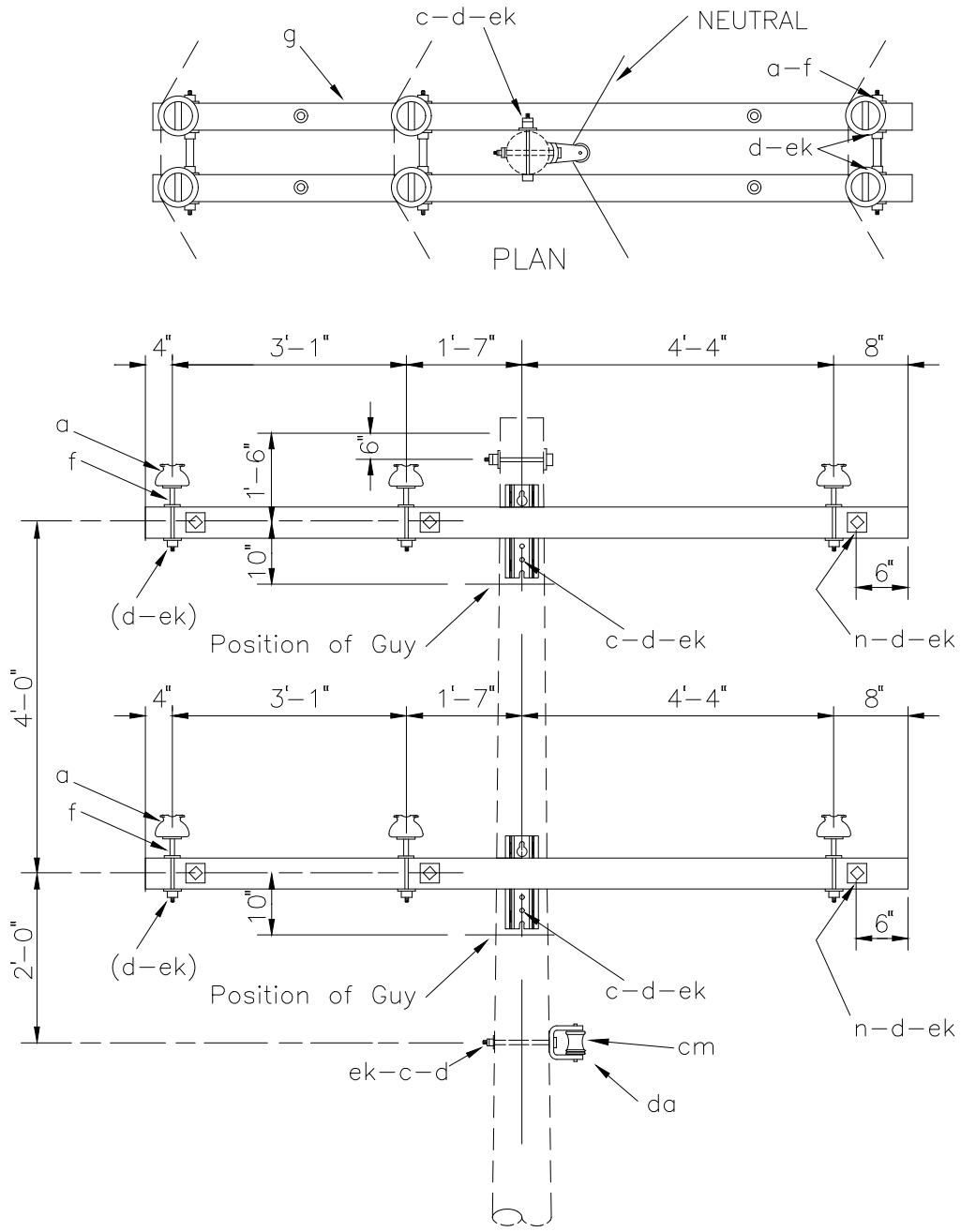
ASSEMBLY: D1.		81L	
ITEM	MATERIAL	QTY	
g	Crossarm, fiberglass, 10'	1	
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	
ek	Locknuts	13	

DESIGN PARAMETERS:

MAXIMUM LINE ANGLE = 2°

SINGLE SUPPORT ON CROSSARMS (TANGENT) (LARGE CONDUCTORS)

September 18	DOUBLE CIRCUIT PRIMARY 12.47/7.2 kV	D1.81L
FDEC		



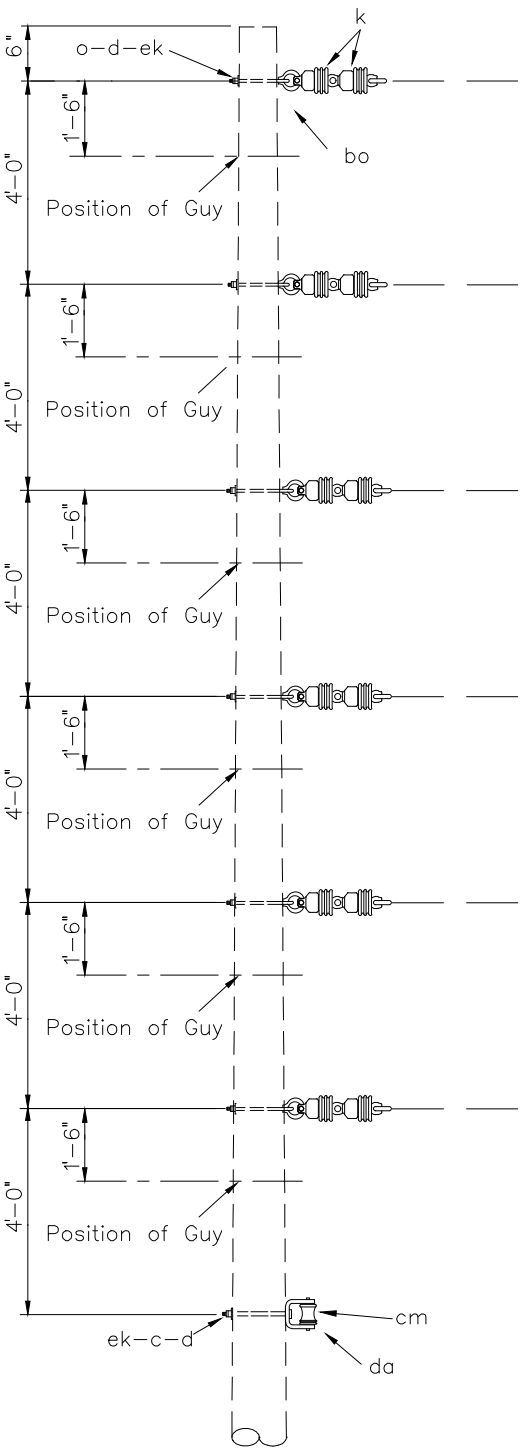
ITEM	QTY	MATERIAL
a	12	Insulator, pin type (12.47/7.2 kV)
c	4	Bolt, machine, 3/4" x req'd length
c	2	Bolt, machine, 5/8" x req'd length
d	1	Washer, square, 3", curved
d	42	Washer, square, 2 1/4"
f	12	Pin, crossarm, steel, clamp type
g	4	Crossarm, fiberglass, 10'

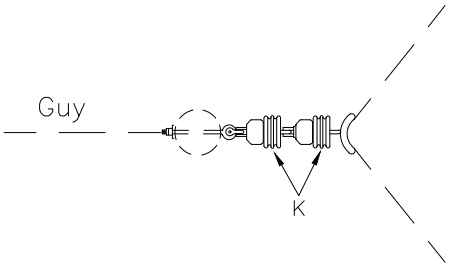
ITEM	QTY	MATERIAL
n	6	Bolt,double arming,5/8x req'd length
cm	1	Insulator, spool, 3"
da	1	Bracket, insulated
ek	42	Locknuts

DESIGN PARAMETERS:
See Table V

DOUBLE SUPPORT ON CROSSARMS (LARGE CONDUCTORS)

September 18	DOUBLE CIRCUIT PRIMARY	
FDEC	12.47/7.2 kV	D2.91L





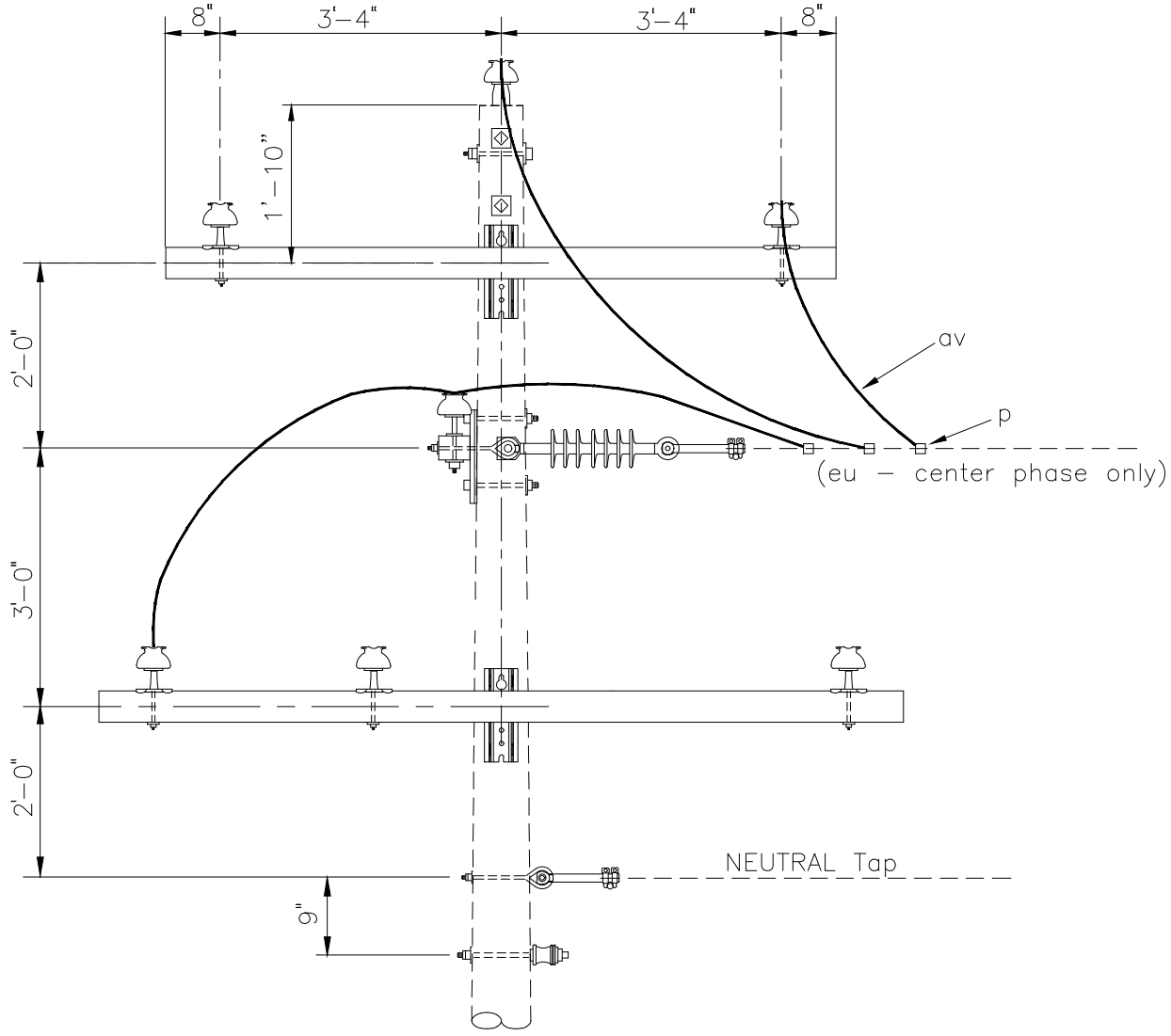
ITEM	QTY	MATERIAL
	2	"C3.1" through "C3.9" Primary Assemblies (Delete material for one neutral subassembly: "o–d–ek")

DESIGN PARAMETERS:

See "C3.1 through "C3.9"

SUSPENSION ANGLE GUIDE

September 18	DOUBLE CIRCUIT PRIMARY	
FDEC	12.47/7.2 kV	D3.1G



ITEM	QTY	MATERIAL
p		Connectors, as required
av		Jumpers, as required
eu		Link, extension, insulated, 12" min.

DESIGN PARAMETERS:

THREE PHASE TAP GUIDE

September 18 FDEC	DOUBLE CIRCUIT PRIMARY 12.47/7.2 kV	D5.91G

INDEX E

GUYING ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
E1.1	(E1-2)	SINGLE DOWN GUY (THROUGH BOLT TYPE)
E1.1L	(E1-3)	SINGLE DOWN GUY - HEAVY DUTY (THROUGH BOLT TYPE)
E1.4	(E2-2)	SINGLE OVERHEAD GUY - (THROUGH BOLT TYPE)
E1.4L	(E2-3)	SINGLE OVERHEAD GUY - HEAVY DUTY (THROUGH BOLT TYPE)
E1.5		GUY STRAIN INSULATOR
E2.1G		DOUBLE DOWN GUY GUIDE - (THROUGH BOLT TYPE)
E3.1LG		THREE DOWN GUY GUIDE - HEAVY DUTY (THROUGH BOLT TYPE)

CONSTRUCTION SPECIFICATIONS FOR GUYS

The design engineer shall determine the number and type of guys needed to be installed.

Guys shall be attached to the pole as shown in the construction drawings and shall be installed before conductors are strung. Deadend structure guys shall be installed, as nearly as practicable, in line with the pull of conductors. Guys that bisect line angles (bisector guys) at line angle structures shall be installed as nearly as practicable to the true bisector of the line angle.

The distance from the pole to the anchor rod (the guy lead) is recommended to be the same distance as from the ground to the guy attachment on the pole. This 1:1 guy slope is especially recommended on deadend structures.

Written permission from RUS is required prior to the installation of sidewalk guys and push poles. RUS will consider the use of sidewalk guys and push poles on a case-by-case basis.

The NESC requires that the grade of construction of guys be the same or higher as the grade of construction of: (1) the pole or structure to which they are attached, or (2) the highest grade required for any conductors supported by the pole or structure.

The permitted loads shown in the design parameters for guying assemblies have already been calculated by RUS by multiplying a strength factor of 0.85 to the RUS designated loading (or strength) of the guying assemblies. The strength factor of 0.85 was used by RUS as an additional safety factor and is based on the spirit of the rules of NESC Section 261 and NESC Table 261-1A.

The permitted loads shown on the guy assembly drawings shall be reduced by 25 percent for NESC Grade B construction.

The permitted loads on guy wires shall be determined by multiplying the rated breaking strength of the guy wire by the strength factor of 0.90 given in NESC Table261-1A.

Guy strength that must be provided is determined by totaling all loads expected to be exerting tension on the guy assembly and guy wire(s) and multiplying this total load by the appropriate overload factors according to NESC Rule 253 and as shown in NESC Table 253-1.

CONSTRUCTION SPECIFICATIONS FOR GUYS *(cont.)*

If the separation on the pole between any guy attachment bolt or hardware and any phase conductor attachment bolt is less than 15 inches, then a guy strain insulator assembly (E5.1) shall be installed at the top of the guy and the guy wire shall be effectively grounded below the insulator by bonding the guy wire to the system neutral and the pole ground if present. Alternatively, an insulated extension link (item "eu") shall be installed in the primary conductor tap, deadend, or suspension angle subassembly where it attaches to the pole.

The purpose of this specification is to maintain minimum basic insulation impulse levels (BIL) and to increase clearances for line workers.

Down guy and overhead guy wires shall be effectively grounded in accordance with Rule 215C2 of the NESC and in accordance with the RUS assembly drawings. Effectively grounded guy wires provide a direct path to ground and thus decrease the chances of electric shock, serious injury and even death to a person standing on the ground and making contact with a guy wire that has accidentally become energized by means of contact with a primary, secondary, service or neutral conductor. Furthermore, effectively grounded guy wires bonded to anchor rods decrease the overall system impedance to ground and improve the chances of primary overcurrent protection devices to operate as designed.

Down guy and overhead guy wires may be insulated in portions of a borrower's service area if all 5 of the following conditions are met:

(1) The borrower: (1) has records documenting that anchors or anchor rods have failed due to corrosion after less than 20 years of service, or (2) has performed and documented a study that has determined that insulating down guy wires is an adequate and economical method to mitigate predicted premature corrosion of anchors and anchor rods in the service area covered by the study. Such studies or records shall be made available for RUS review upon request;

(2) Insulated down guys and their component parts shall be in compliance with all of the applicable rules of the NESC;

(3) Only fiberglass guy strain insulators (item "w") shall be used to insulate guy wires and the insulators shall be installed at the top of the guy wire as depicted in assembly drawing E1.5;

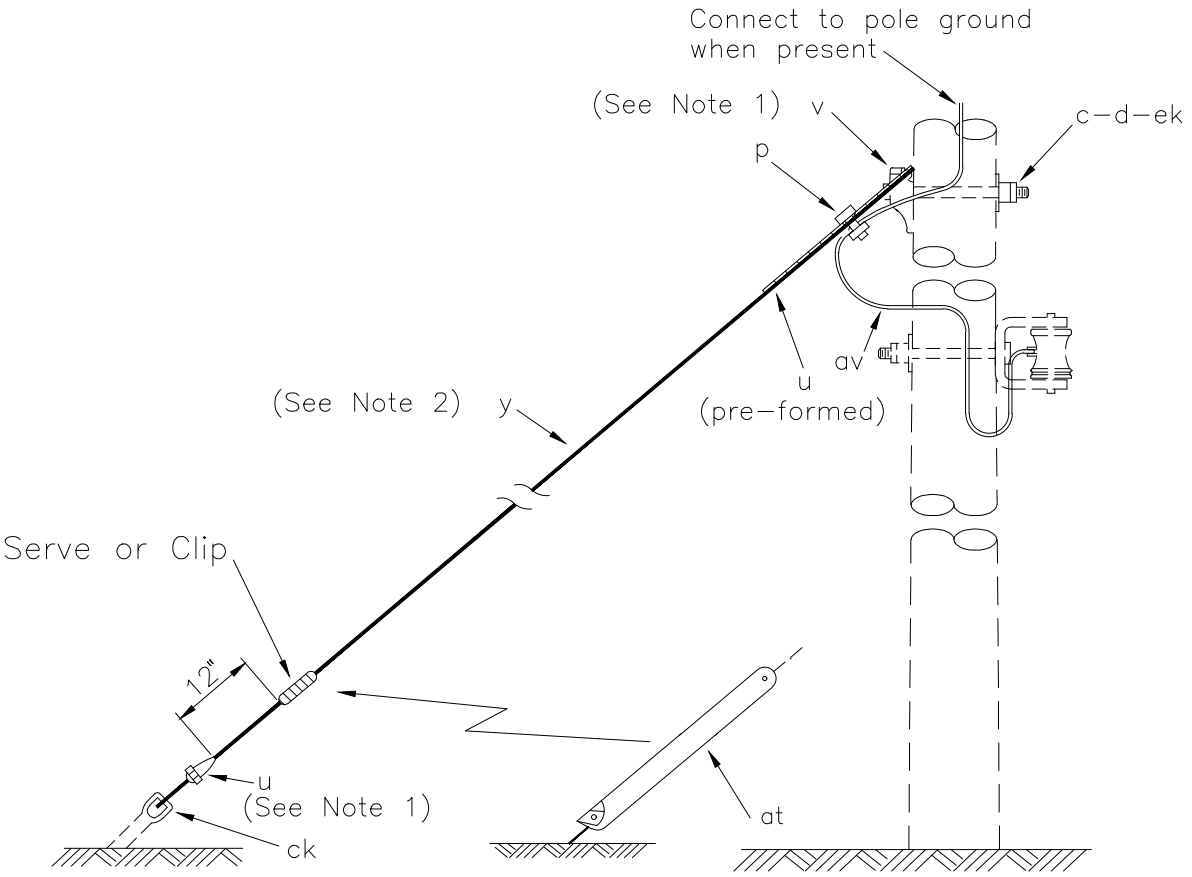
(4) RUS required bonding clamps are securely installed between the anchor rod and the guy wire attached to the anchor rod; and

(5) The borrower has a special regimented maintenance program in place that periodically (as experience indicates) checks the insulation integrity of installed guy insulators.

CONSTRUCTION SPECIFICATIONS FOR GUYS *(cont.)*

Down guys installed on tangent, double deadend assemblies (e.g., A6.1) shall have a minimum clearance to the neutral conductor of 6 inches and shall have a guy strain insulator(s) installed at the top of the guy that extends from the pole attachment to at least 12 inches past the neutral conductor.[1] Alternatively, two down guys without guy strain insulators may be installed, one on each side of the neutral, such that clearance between each down guy wire and the neutral conductor is a minimum of 12 inches. For either of the above designs, the down guy wire shall be effectively bonded to ground in accordance with RUS specifications and the rules of the NESC.

[1] For example, the 6-inch clearance can be met for a down guy with a 30-foot guy lead that is attached to the pole 30 feet above the ground and 2.5 feet above the neutral by installing (offsetting) the guy anchor 6 feet perpendicular to the line of the neutral conductor.



NOTES:

1. Other accepted and equivalent guy deadend (item "u") and attachment (item "v") material may be substituted for the ones shown.

ITEM	QTY	MATERIAL
c	1	Bolt, machine, 5/8" x req'd length
d	1	Washer, 3" square, curved
p		Connectors, guy bond and as req'd
u	1	Deadend for guy strand (See Note 1)
u	1	Deadend for guy strand pre–formed
v	1	Guy attachment (See Note 1)
y		Guy wire, as req'd (See Note 3)
at	1	Guy marker
av		Jumpers, as req'd
ck	1	Clamp, anchor bonding
ek	1	Locknuts

DESIGN PARAMETERS:

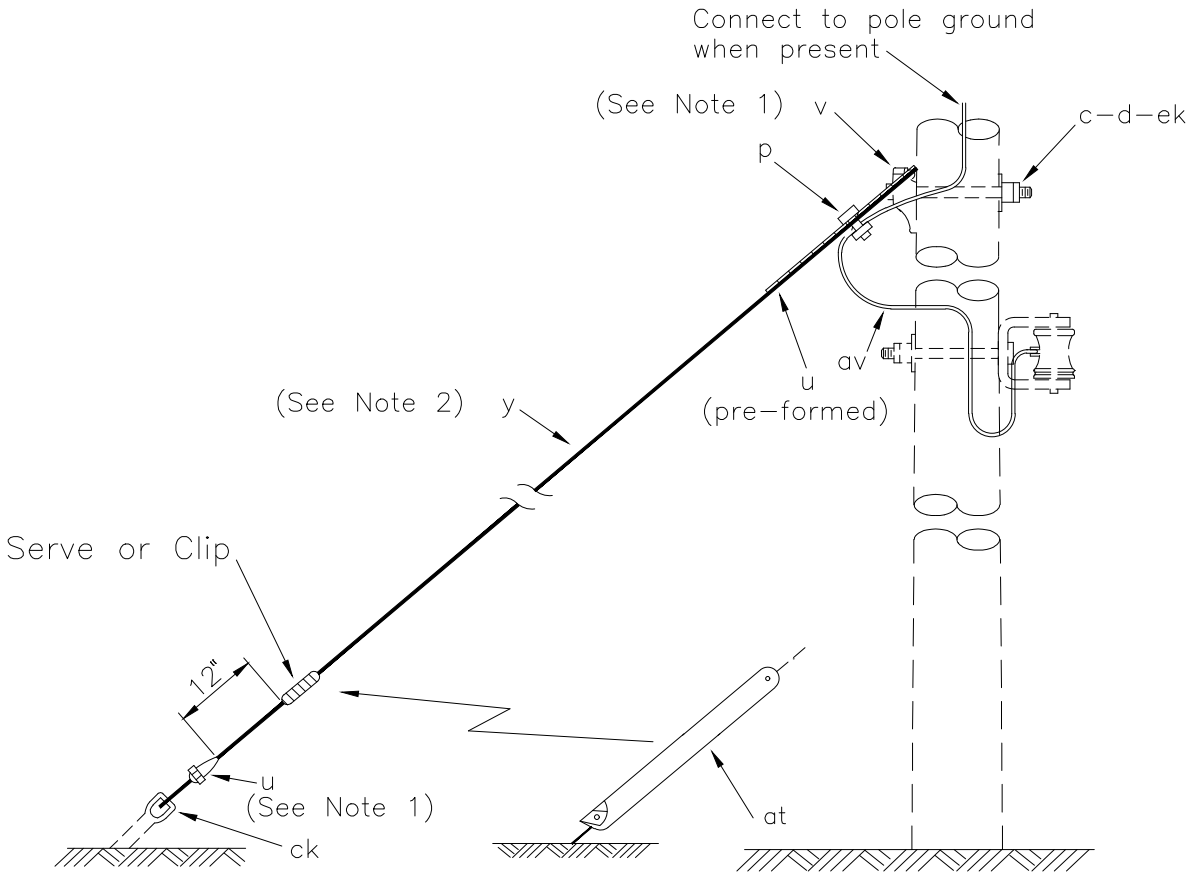
PERMITTED LOAD IS LESSER OF:
6,600 lbs (in any direction)
or 90% of RATED BREAKING
STRENGTH OF GUY WIRE

SINGLE DOWN GUY (THROUGH BOLT TYPE)

September 18

FDEC

E1.1
(E1–2)



NOTES:

1. Other accepted and equivalent guy deadend (item "u") and attachment (item "v") material may be substituted for the ones shown.

ITEM	QTY	MATERIAL
c	1	Bolt, machine, 3/4" x req'd length
d	1	Washer, square, 4", curved
p		Connectors, guy bond and as req'd
u	1	Deadend for guy strand, heavy duty
u	1	Deadend for guy strand pre–formed
v	1	Guy attachment, guy hook type
y		Guy wire, as req'd (See Note 4)
at	1	Guy marker
av		Jumpers, as req'd
ck	1	Clamp, anchor bonding
ek	1	Locknuts

DESIGN PARAMETERS:

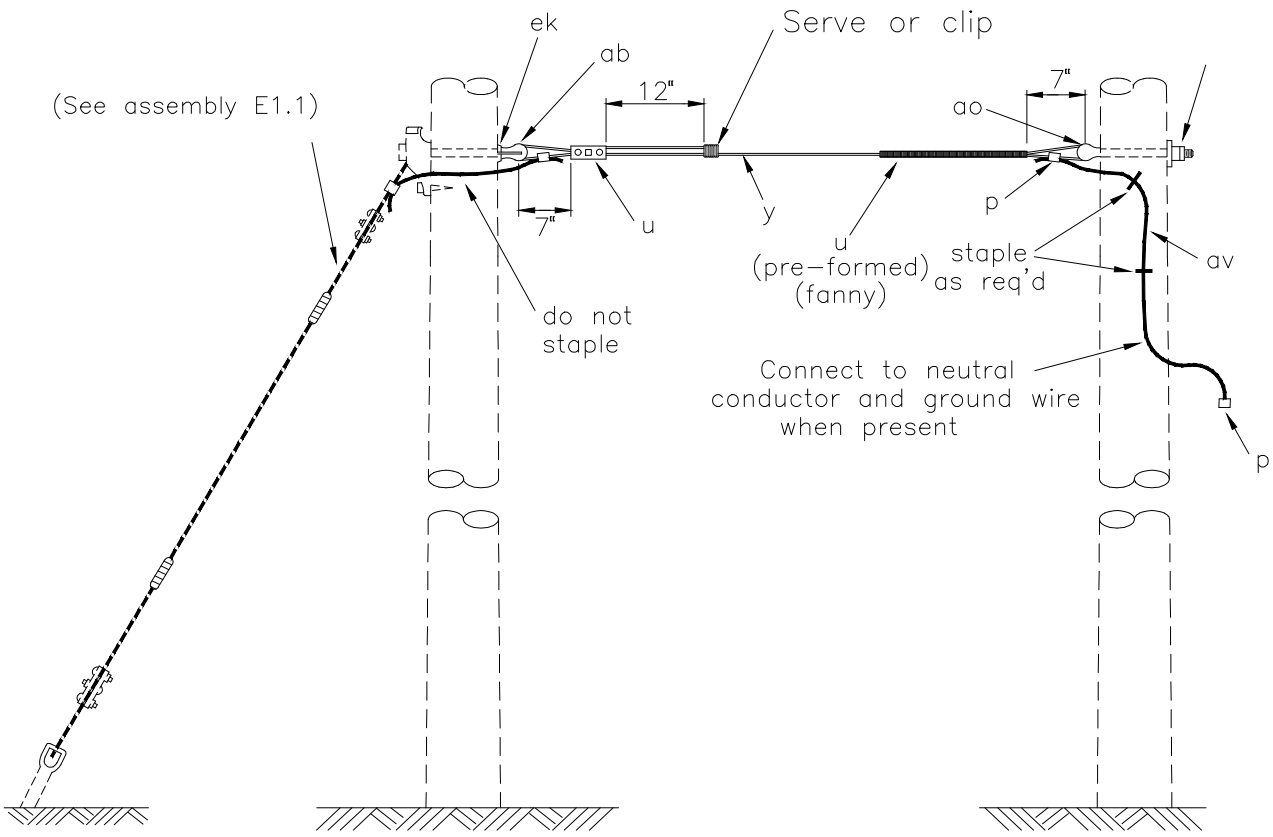
PERMITTED LOAD IS LEAST OF:
8,500 lbs (in any direction)
or 90% of RATED BREAKING STRENGTH OF GUY WIRE

SINGLE DOWN GUY – HEAVY DUTY (THROUGH BOLT TYPE)

September 18

FDEC

E1.1L
(E1–3)



NOTES:

1. Other accepted and equivalent, guy deadends (item "u"), may be substituted for the 3-bolt clamps shown.
2. Specify guy wire size, type and required length.
3. Wrapped type overhead guys may be used. (See drawing E1.2 as guide)

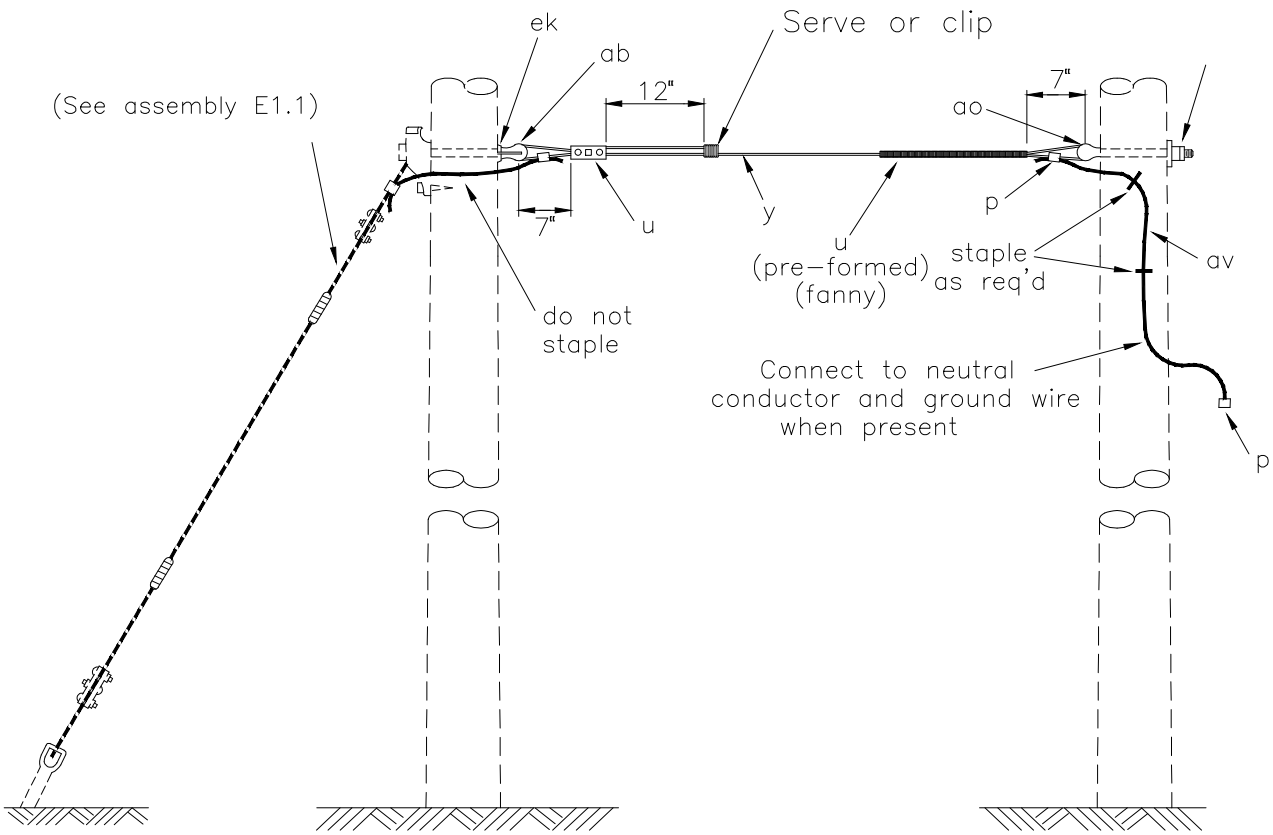
ITEM	QTY	MATERIAL
d	1	Washer, 3" square, curved
p		Connectors, guy bond and as req'd
u	1	Deadend for guy strand
u	1	Deadend for guy strand, pre-formed
y		Guy wire, as req'd (See Note 2)
ab	1	Nut, thimble eye type, 5/8"
ao	1	Bolt, thimble eye, 5/8"x req'd length
av		Jumpers, as req'd
ek	2	Locknuts

DESIGN PARAMETERS:

PERMITTED LOAD IS LESSER OF:
6,600 lbs. (HORIZONTAL)
or 90 % of RATED BREAKING STRENGTH OF GUY WIRE

SINGLE OVERHEAD GUY (THROUGH BOLT TYPE)

September 18		E1.4
FDEC		(E2-2)



NOTES:

1. Other accepted and equivalent, guy deadends (item "u"), may be substituted for the 3–bolt clamps shown.
2. Specify guy wire size, type and required length.
3. Wrapped type overhead guys may be used. (See drawing E1.2 as guide)
4. Assembly requires 3/4" bolt on down guy assembly attachment.

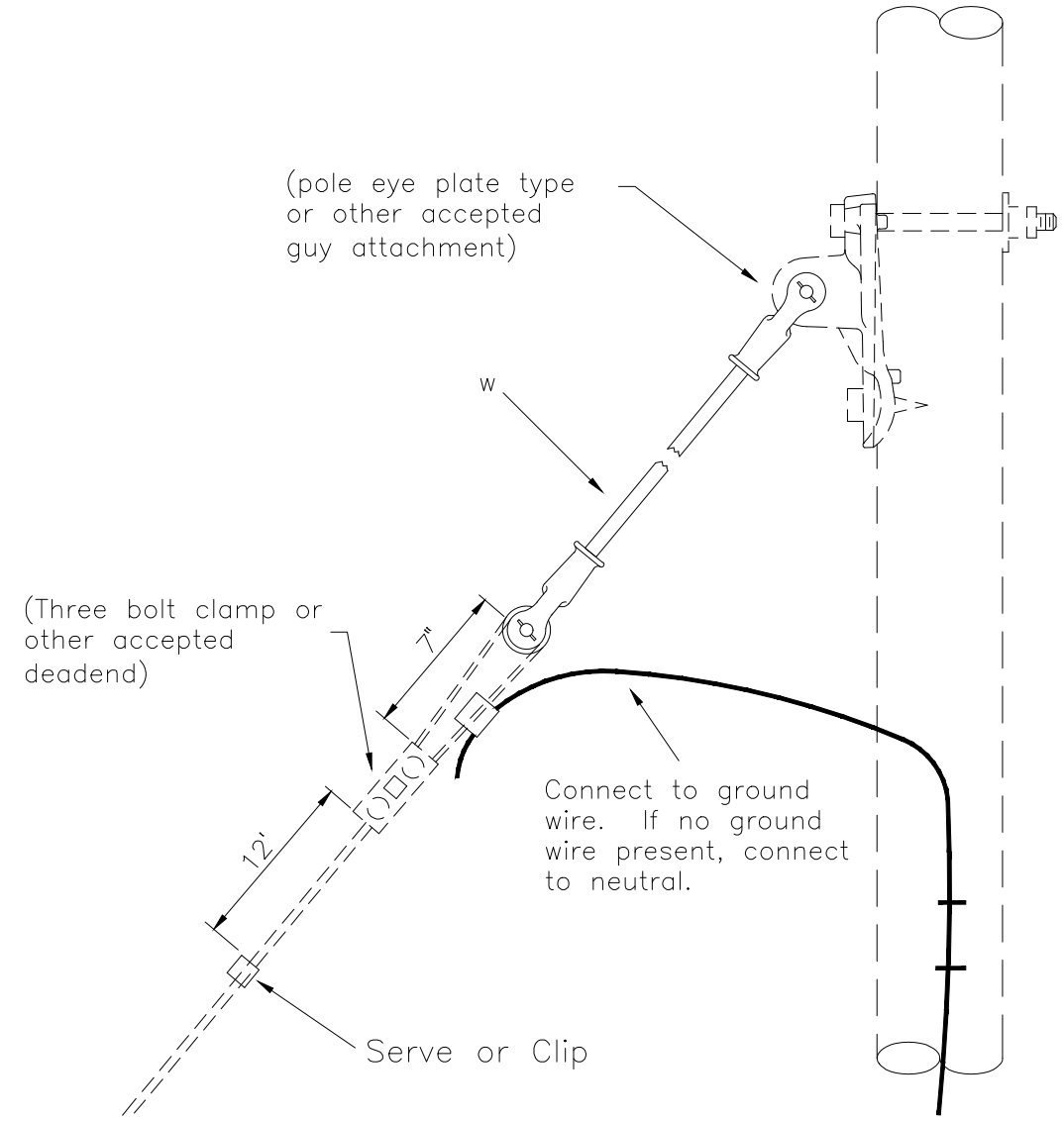
ITEM	QTY	MATERIAL
d	1	Washer, 4" square, curved
p		Connectors, guy bond and as req'd
u	1	Deadend for guy strand, heavy duty
u	1	Deadend for guy strand, pre–formed
y		Guy wire, as req'd (See Note 2)
ab	1	Nut, thimble eye type, 3/4"
ao	1	Bolt, thimble eye, 3/4"x req'd length
av		Jumpers, as req'd
ek	2	Locknuts

DESIGN PARAMETERS:

PERMITTED LOAD IS LESSER OF:
8,500 lbs. (HORIZONTAL)
or 90 % of RATED BREAKING STRENGTH OF GUY WIRE

SINGLE OVERHEAD GUY – HEAVY DUTY (THROUGH BOLT TYPE)

September 18		E1.4L (E2–3)
FDEC		



NOTE: Ground wire jumper may be attached to down guy wire below guy deadend connector.

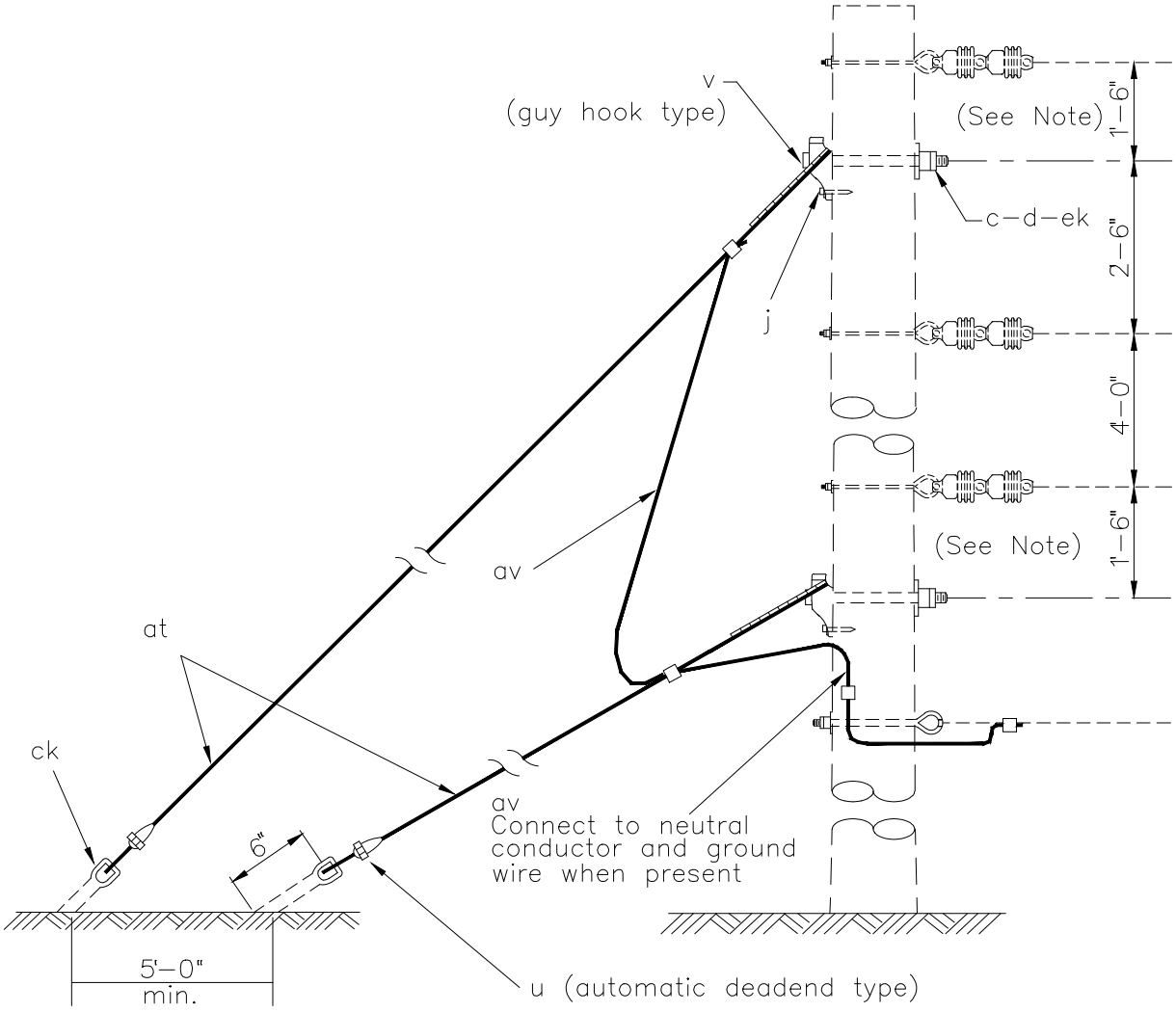
ITEM	MATERIAL
W	Insulator, guy strain

DESIGN PARAMETERS:

PERMITTED LOAD = 8,500 lbs.

GUY STRAIN INSULATOR

September 18		E1.5
FDEC		



NOTES:
Position guys as shown on applicable pole top assembly unit if different than shown here. If distance between primary assembly and down guy is less than 12", install (minimum 12") guy strain insulator,(item "w"), or insulated extension link, (item "eu"), (mininum 12"), in primary assembly.

The following single down guy assemblies may be used, (multiply material quantities by 2):

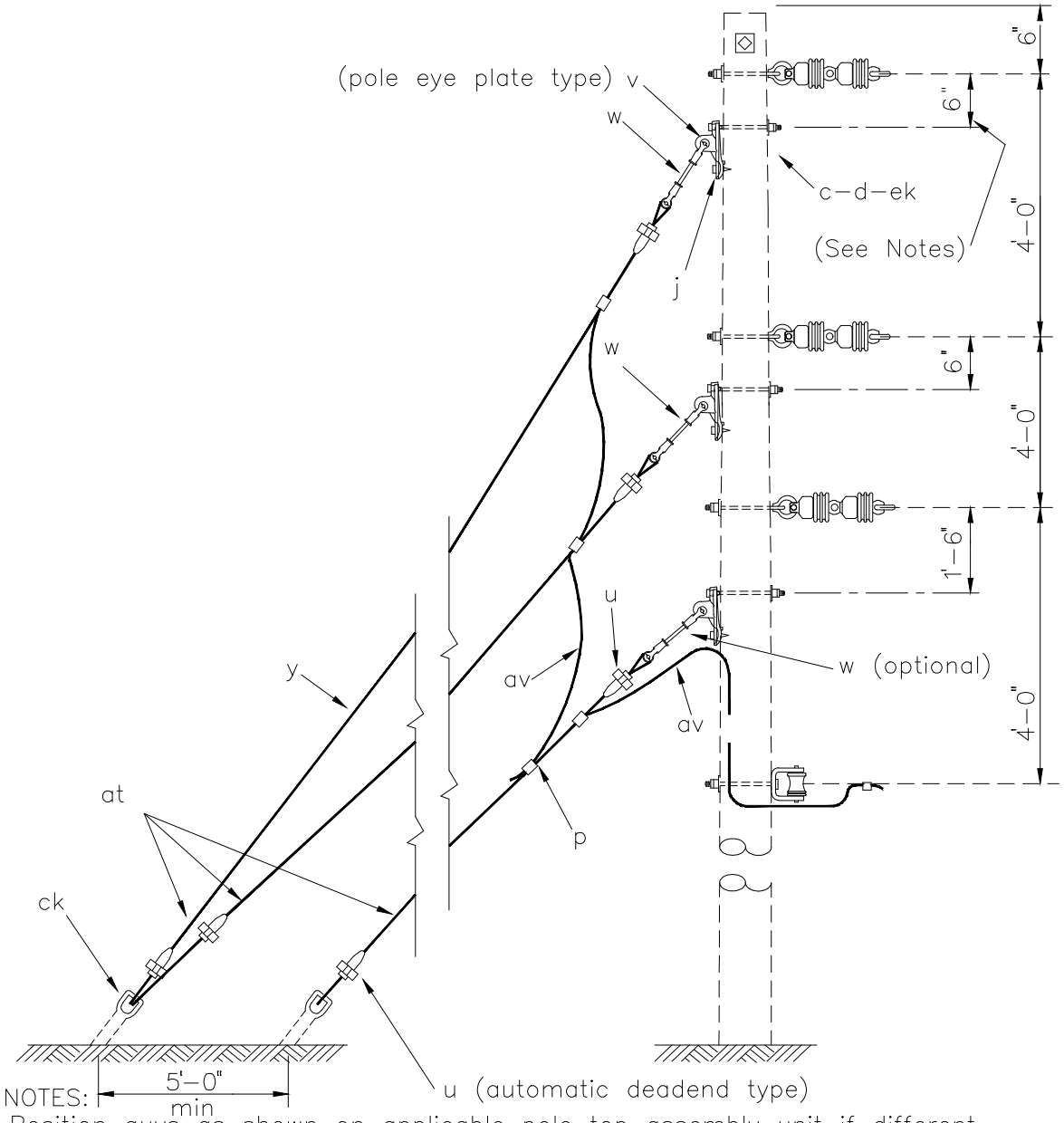
E1.1: Through Bolt Type (shown above)
E1.1L: Through Bolt Type, Heavy Duty
E1.2: Wrapped Type
E1.3L: Pole Band Type

DESIGN PARAMETERS:

(See Single Down Guy drawings)

DOUBLE DOWN GUY GUIDE (THROUGH BOLT TYPE)

September 18		
FDEC		E2.1G



NOTES:

Position guys as shown on applicable pole top assembly unit if different than shown here. If distance between primary assembly and down guy is less than 12", install (minimum 12") guy strain insulator, (item "w"), or insulated extension link, (item "eu"), (mininum 12"), in primary assembly.

The following single down guy assemblies may be used,
(multiply material quantities by 3):

E1.1: Through Bolt Type
E1.1L: Through Bolt Type, Heavy Duty (shown above)
E1.2: Wrapped Type
E1.3L: Pole Band Type

DESIGN PARAMETERS:

(See Single Down Guy drawings)

THREE DOWN GUY GUIDE – HEAVY DUTY (THROUGH BOLT TYPE)

September 18		E3.1LG
FDEC		

ANCHOR ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
F1.8	(F1-2)	EXPANDING TYPE ANCHORS
F1.12	(F1-4)	
F2.8	(F1-2S)	SCREW ANCHORS (POWER INSTALLED)
F2.12	(F1-4S)	
F4.2	(F4.1S)	SERVICE ANCHORS

CONSTRUCTION SPECIFICATIONS FOR ANCHORING

As much as practicable, anchors and rods shall be installed in line with, and in the opposite direction of, the resultant strain of the conductors. Anchor assemblies shall be installed so that approximately 6 inches of the rod remains out of the ground. In cultivated fields or other locations as deemed necessary, the projection of the anchor rod above earth may be increased to a maximum of 12 inches to prevent burial of the rod eye.

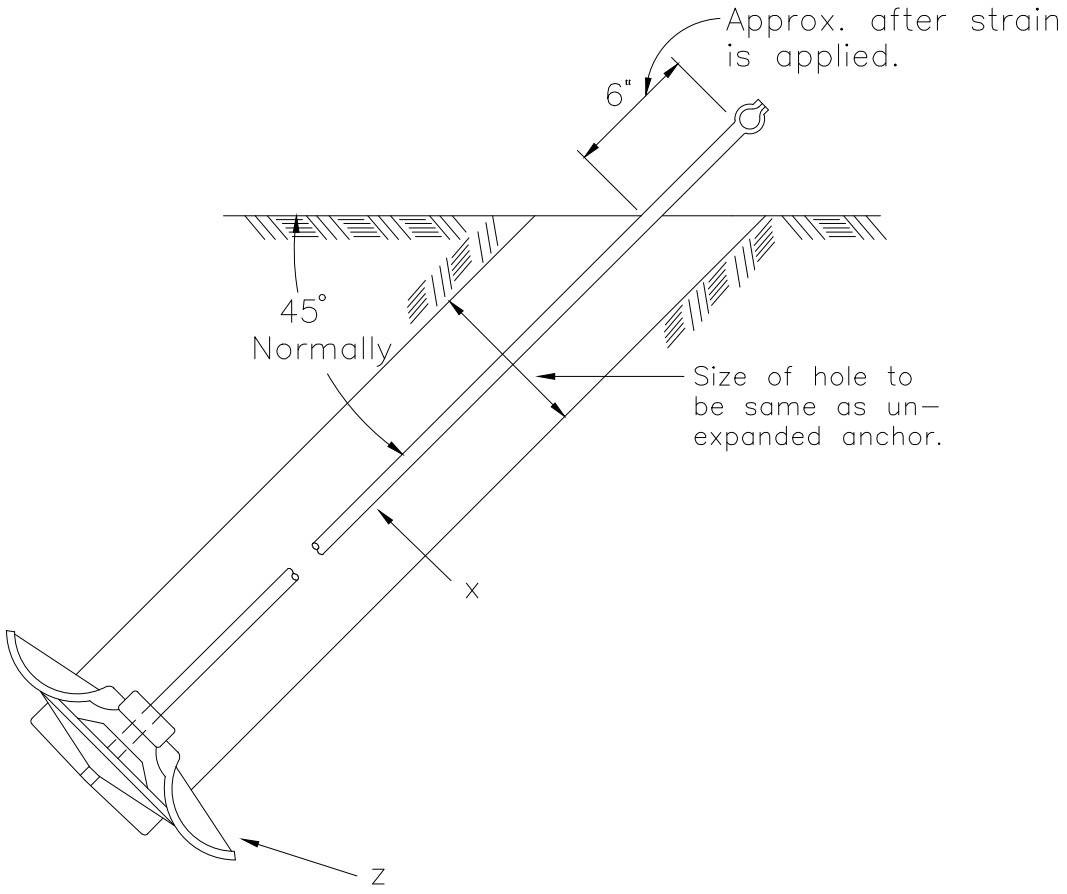
The backfill of all anchor holes must be thoroughly tamped the full depth. After a cone anchor has been set in place, the hole shall be backfilled with coarse crushed rock for 2 feet above the anchor and tamped during the filling. The remainder of the hole shall be backfilled and tamped with dirt.

The designated holding powers shown on the anchor assembly drawings are based on the maximum holding power of average, Class 5 soil. When the anchor is installed in poorer soils, the holding power of the anchor shall be derated. A suggested guide is to derate by 25 percent in Class 6 soil and by 50 percent in Class 7 soil. For Class 8 soil it is usually necessary to use swamp anchors or power driven screw anchors which can penetrate the poor soil into firmer soil. See the “Soil Classifications” table on the following page for soil classes.

Log type anchors are acceptable for use on distribution systems. Refer to the appropriate drawings in RUS Bulletin 1728F-811,“Electric Transmission Specifications and Drawings, 115 kV through 230 kV” for assembly units and construction details.

SOIL CLASSIFICATIONS

Class	Engineering Description
0	Sound hard rock, unweatherd
1	Very dense and/or cemented sands; coarse gravel and cobbles
2	Dense fine sand; very hard silts and clays (may be preloaded)
3	Dense clayed sand and gravel; very stiff to hard silts and clays
4	Medium dense sandy gravel; very stiff to hard silts and clays
5	Medium dense coarse sand and sandy gravels; stiff to very stiff silts and clays
6	Loose to medium dense fine to coarse sand; firm to stiff clays and silts
7	Loose fine sand; alluvium; loess; soft-firm clays; varved clays; fill
8	Peat; organic silts; inundated silts; fly ash



NOTE: Designated maximum holding power rating assumes proper installation in class 5 soil.

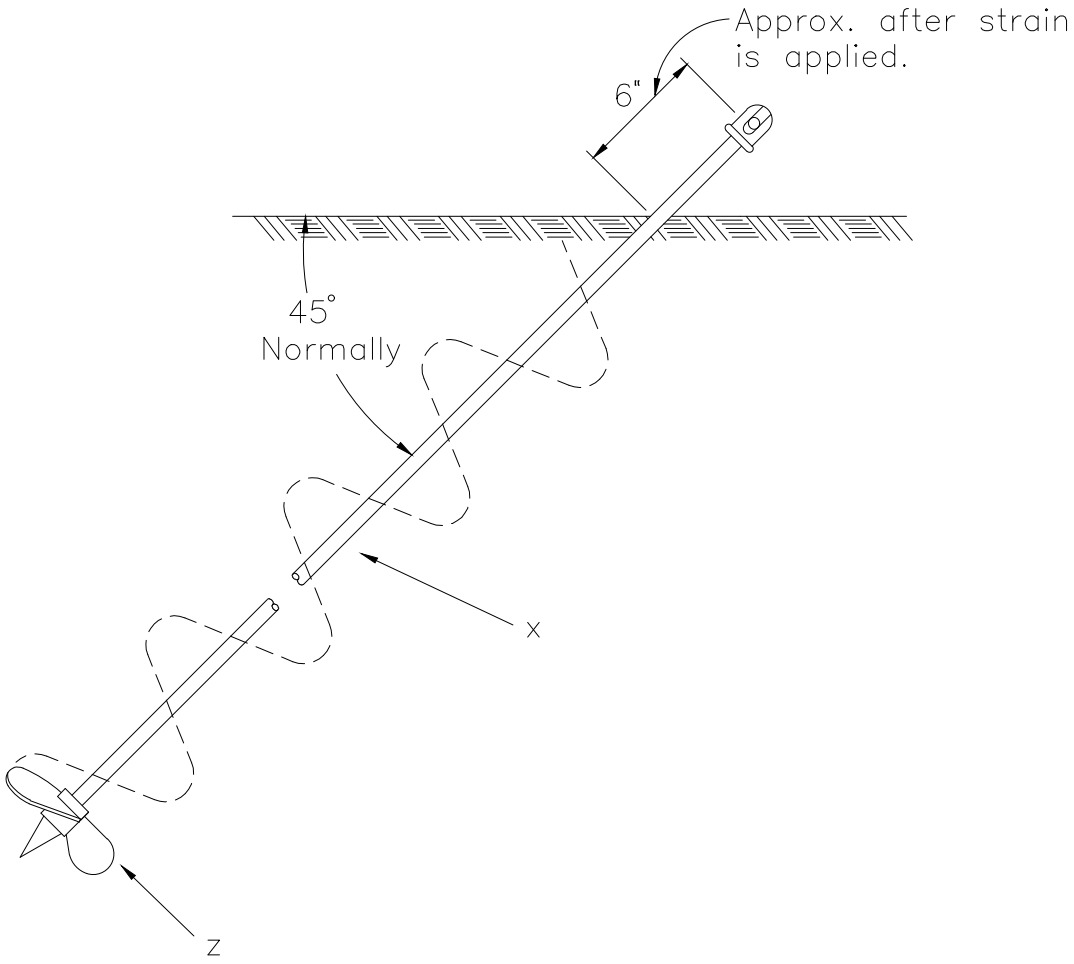
	ASSEMBLY: F1	.8	.12
	Minimum Area (sq. in.)	100	135
ITEM	MATERIAL	QTY	QTY
x	Rod, anchor, thimble eye, 5/8" x 7'0"	1	
x	Rod, anchor, twin eye, 3/4" X 8'0"		1
z	Anchor, expanding type	1	1

DESIGN PARAMETERS:
DESIGNATED MAXIMUM HOLDING POWER (lbs.)

F1.8: 8,000
F1.12: 12,000

EXPANDING TYPE ANCHORS

September 18		F1.8, F1.12
FDEC		



NOTE: Designated maximum holding power rating assumes proper installation in class 5 soil.

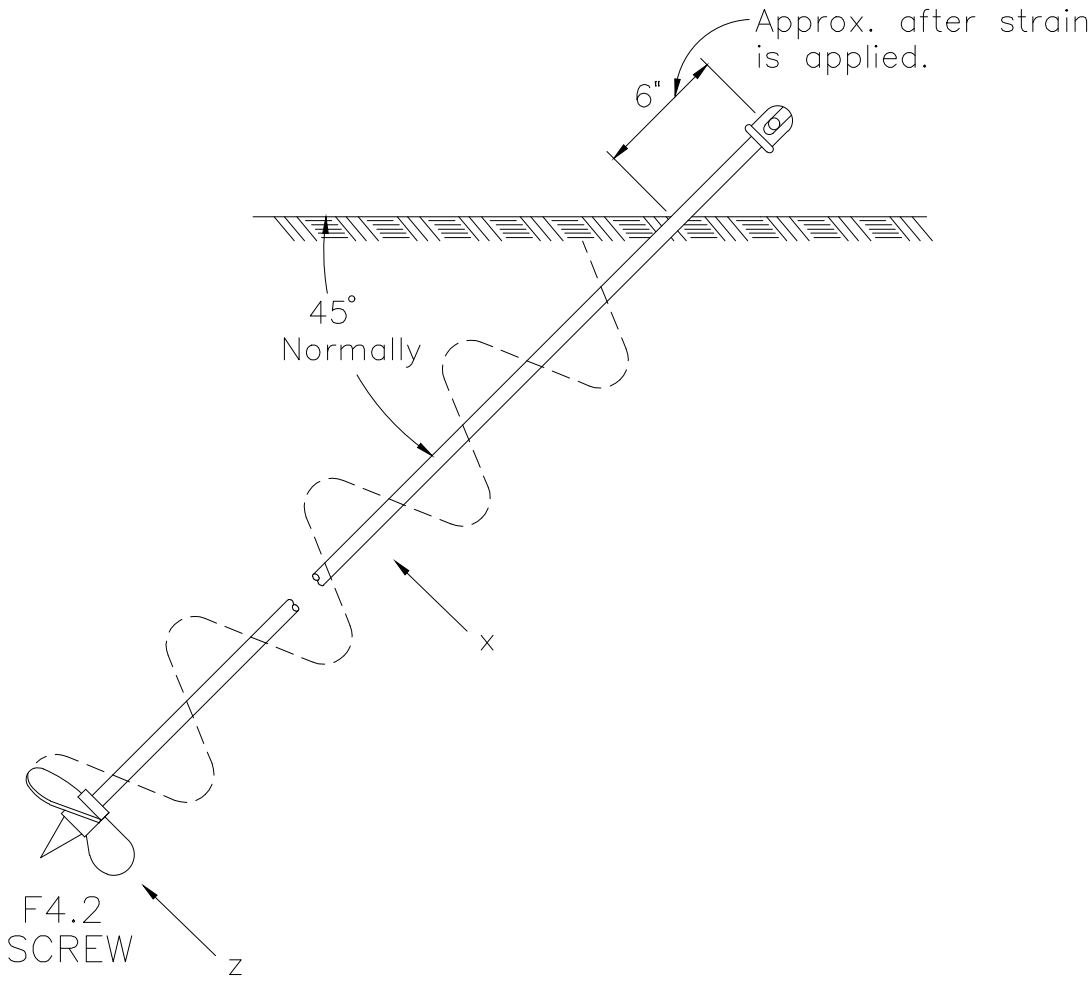
	ASSEMBLY: F2	.8	.12
	Minimum Area (sq. in.)	100	135
ITEM	MATERIAL	QTY	QTY
x	Rod, anchor, thimble eye, 5/8" x 7'0"	1	
x	Rod, anchor, twin eye, 3/4 X 8'0		1
z	Anchor, screw type, power installed	1	1

DESIGN PARAMETERS:
DESIGNATED MAXIMUM
HOLDING POWER (lbs.)

F2.8: 8,000
F2.12: 12,000

SCREW ANCHORS, (POWER INSTALLED)

September 18		F2.8, F2.12
FDEC		



NOTE:
Designated maximum holding power rating assumes proper installation in dense, sandy soil.

ASSEMBLY: F4.2

ITEM	MATERIAL	QTY
x	Rod, anchor, thimble eye type	1
z	Anchor, service, screw type	1

DESIGN PARAMETERS:

DESIGNATED MAXIMUM HOLDING POWER (lbs.)

F4.2: 2,500

SERVICE ANCHORS

September 18

FDEC

F4.2

INDEX G

TRANSFORMER ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
G1.1G	(M27-1A)	TRANSFORMER INSTALLATION GUIDE SINGLE -PHASE, POLE-TYPE TRANSFORMER
G1.2G		POLE TYPE TRANSFORMER LOCATION GUIDE
G1.2	(G105-) (G136-)	SINGLE-PHASE, CSP TRANSFORMER (TANGENT POLE)
G1.3	(G106-)	SINGLE-PHASE, CSP TRANSFORMER (DEADEND POLE)
G1.4 G1.5		SINGLE-PHASE, CONVENTIONAL TRANSFORMER (TANGENT POLE)
G1.6		SINGLE-PHASE, CONVENTIONAL TRANSFORMER (DEADEND POLE)
G1.7	(G9-) (G39-)	SINGLE-PHASE, CONVENTIONAL TRANSFORMER (TANGENT POLE)
G1.8	(G10-)	SINGLE-PHASE, CONVENTIONAL TRANSFORMER (DEADEND POLE)
G2.1	(G210-)	TWO-PHASE TRANSFORMER BANK OPEN-WYE PRIMARY OPEN-DELTA, 4 WIRE SECONDARY
G2.1G		TRANSFORMER / METER CONNECTION GUIDE THREE-PHASE, OPEN-WYE - OPEN DELTA FOR 120/240 VOLT POWER LOADS
G3.1	(G310-)	THREE-PHASE TRANSFORMER BANK UNGROUNDED-WYE PRIMARY CENTER-TAP GROUNDED DELTA, 4 WIRE SECONDARY
G3.1G		TRANSFORMER / METER CONNECTION GUIDE UNGROUNDED WYE - CENTER TAP GROUNDED DELTA FOR 120/240 VOLT POWER LOADS

TRANSFORMER ASSEMBLY UNITS

DRAWING NUMBERS		DRAWING TITLE (DESCRIPTION)
1728F-804 (New)	**Bulletin 50-3** (Old)	
G3.2	(G311-)	THREE-PHASE TRANSFORMER BANK UNGROUNDED WYE - PRIMARY CORNER GROUNDED DELTA, 3 WIRE SECONDARY
G3.2G		TRANSFORMER / METER CONNECTION GUIDE UNGROUNDED WYE - CORNER GROUNDED DELTA FOR 240 OR 480 VOLT POWER LOADS
G3.3	(G312-)	THREE-PHASE TRANSFORMER BANK GROUNDED-WYE PRIMARY GROUNDED WYE, 4 WIRE SECONDARY
G3.3G		TRANSFORMER / METER CONNECTION GUIDE GROUNDED WYE - GROUNDED WYE FOR 120/208 VOLT POWER LOADS

CONSTRUCTION SPECIFICATIONS FOR TRANSFORMERS

It may be necessary, and it is permissible, to lower the neutral attachment on standard single-phase conventional type transformer assemblies an additional distance not exceeding 2 feet to provide adequate clearances for cutouts.

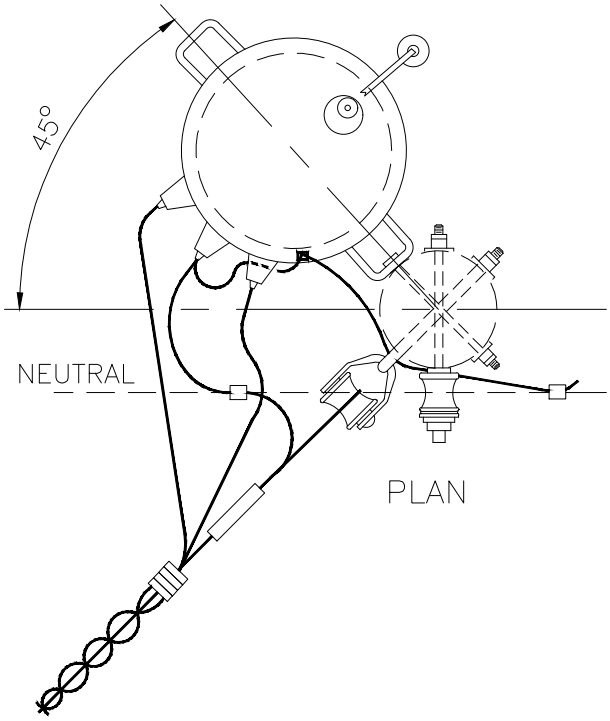
Where applicable, the external gap on surge arresters shall be set according to the manufacturer's recommended spacing.

The construction drawings for three-phase transformer banks (e.g., "G3.1") show cutouts (items "af") and arresters (items "ae) mounted adjacent to one another on the crossarm. However, a cutout and arrester, as shown, may be replaced with a combination cutout/arrester (item "ax"). This change will require a change in the assembly's material shown on the construction drawings. Moreover, the arresters may be mounted directly on the transformer tank. (The cutouts remain on the arm.) Any of the above mounting arrangements for three-phase transformer banks are acceptable; the choice is left to the design engineer.

The construction drawings for single-phase conventional transformer assemblies show surge arresters mounted directly on the transformer tank which maximizes transformer surge protection. Except for single-phase conventional transformers with open link fused cutouts (assemblies "G1.7" and "G1.8"), the arrester may be mounted on a crossarm, on a bracket (item "fn") adjacent to the cutout, or a combination cutout/arrester (item "ax") may be used. The choice of using any of these acceptable mounting arrangements is left to the design engineer.

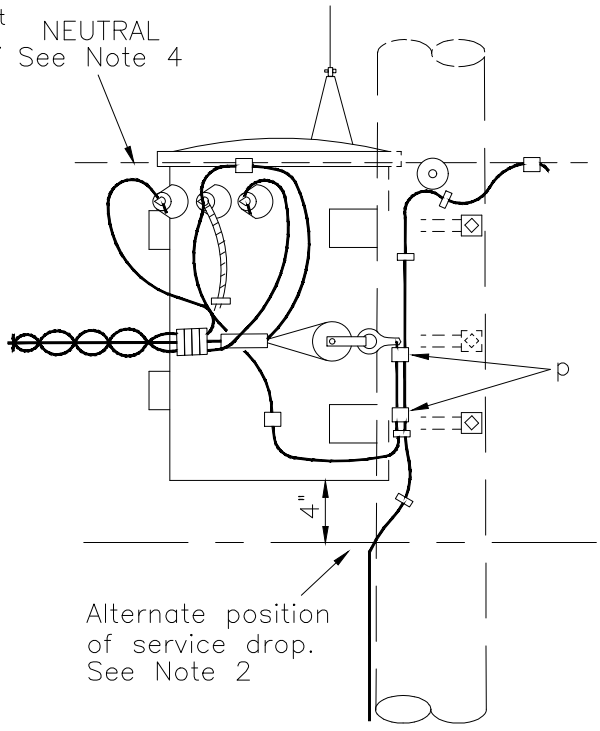
Tank-mounted arresters provide maximum surge protection to transformers because of the arresters' minimum lead lengths. However, when arresters are mounted directly on transformer tanks, the fused cutouts have less surge protection and are subject to more frequent operations. Nuisance operations on fused cutouts with minimal surge protection can be lessened with the use of dual-element fuses.

The wiring schematics on the three-phase transformer/meter connection guide drawings (e.g., "G3.1G") are based on single-phase transformers with additive polarity. ANSI Standard C57-12.20 specifies that all single-phase transformers larger than 200 kVA have subtractive polarity. If the transformer/meter connection guides are used for single-phase transformers larger than 200 kVA, the schematic diagrams will need to be modified accordingly.



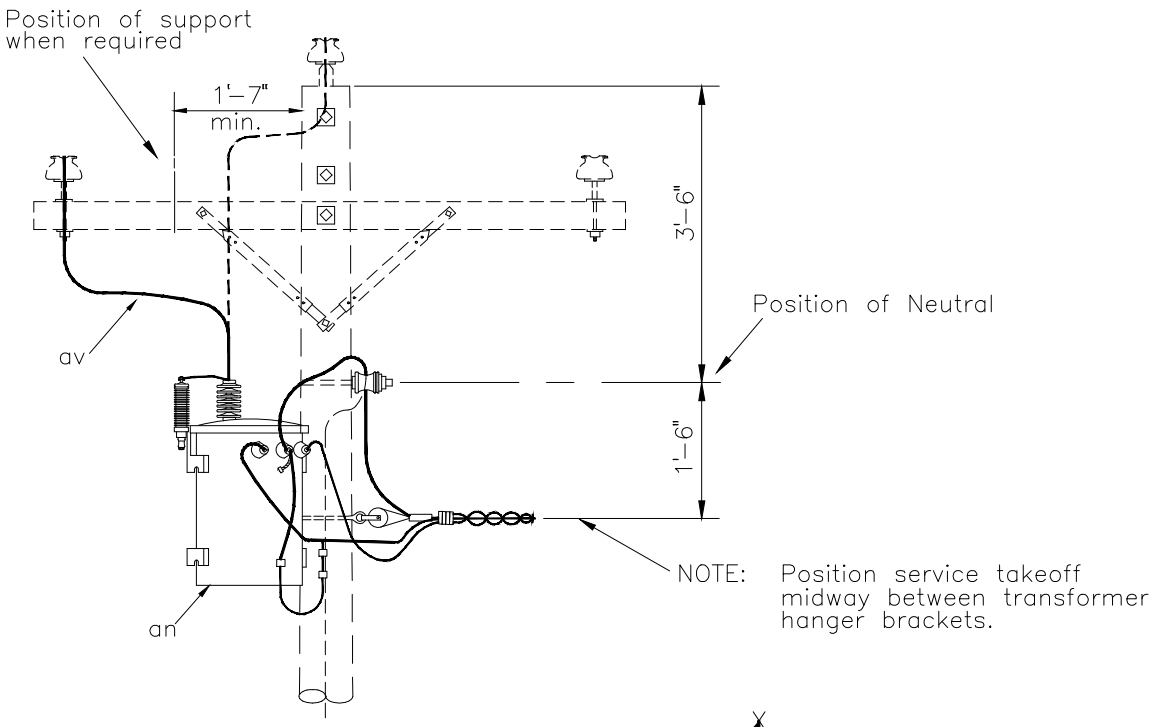
NOTES:

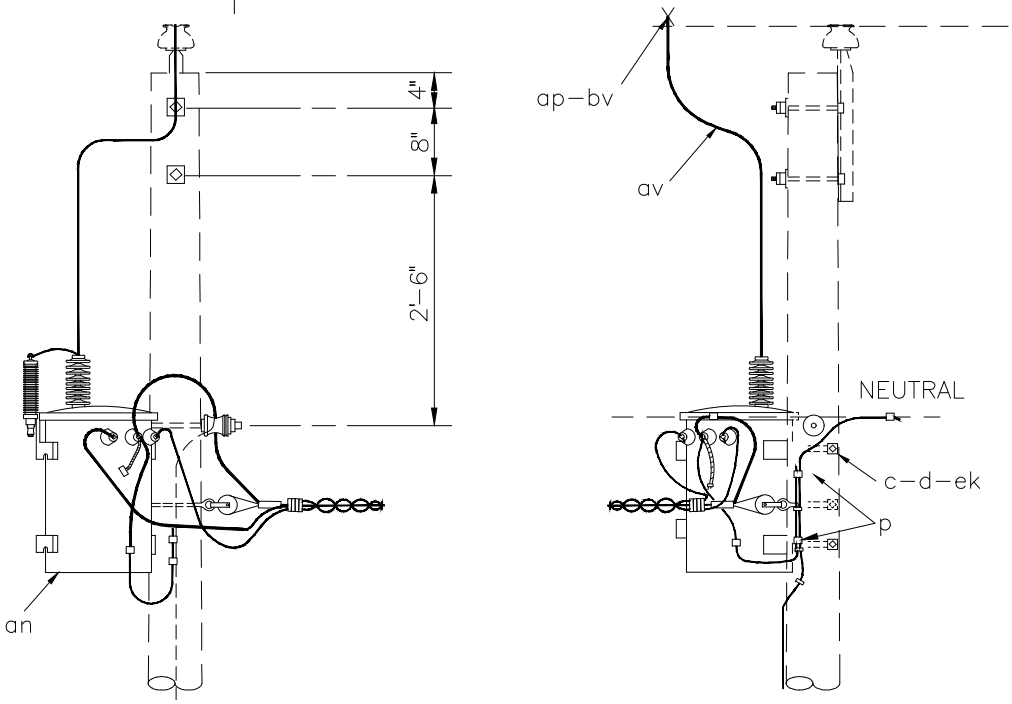
1. Install transformer on tangent poles on a quadrant on the opposite side of pole from primary neutral.
2. When it is necessary to install transformer in the same quadrant as a service drop, attach the service drops 4 inches below the transformer.
3. Install transformer so that primary neutral is at same height as bottom of transformer lid on tangent poles, or 3 inches above transformer lid on deadend poles.
4. Use compression type connectors (item "p").
5. Standard aluminum alloy or standard soft–drawn copper is recommended for the grounding loop conductor.
6. Transformer secondary bushings are not to be used for bi–metal connections.
7. Cover secondary terminals with moisture seal and/or dress conductor ends downward to prevent entry of moisture. (Mininum bending radius is six times the overall cable diameter).



TRANSFORMER INSTALLATION GUIDE
SINGLE–PHASE, POLE–TYPE TRANSFORMER

September 18 FDEC		G1.1G (M27–1A)





ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
p		Connectors,compression type,as req'd
an	1	Transformer, 12.47 kV, self-protected

ITEM	QTY	MATERIAL
ap	1	Clamp, hot line
av		Jumpers, stranded, as req'd
bv	1	Rod, armor (as req'd)
ek	2	Locknuts

DESIGN PARAMETERS:

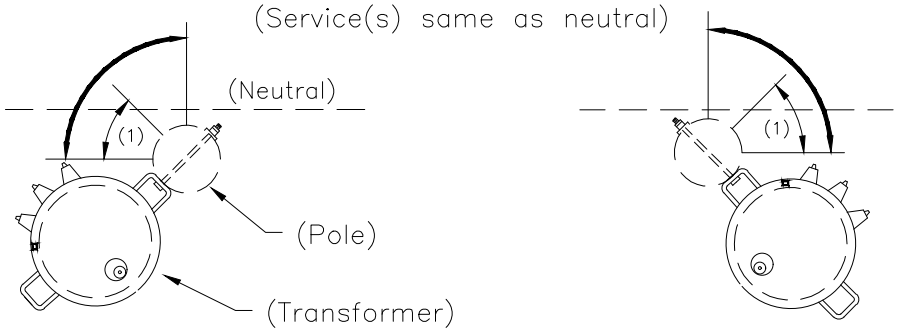
See Guide Drawing "G1.1G"

SINGLE-PHASE, CSP TRANSFORMER (TANGENT POLE)

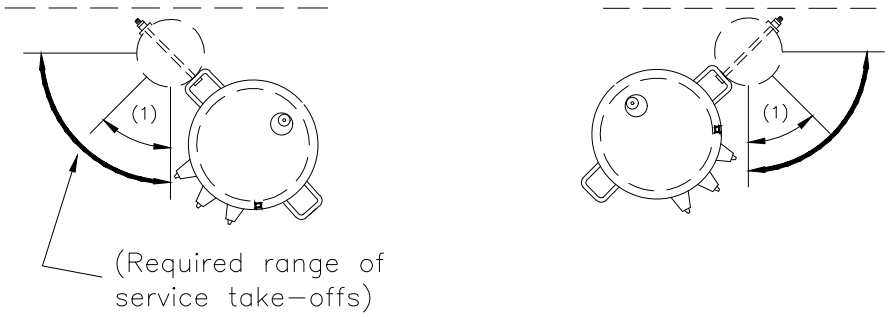
September 18		G1.2
FDEC	12.47/7.2 kV	(G105-),(G136-)

TANGENT POLES

(Service(s) same as neutral)

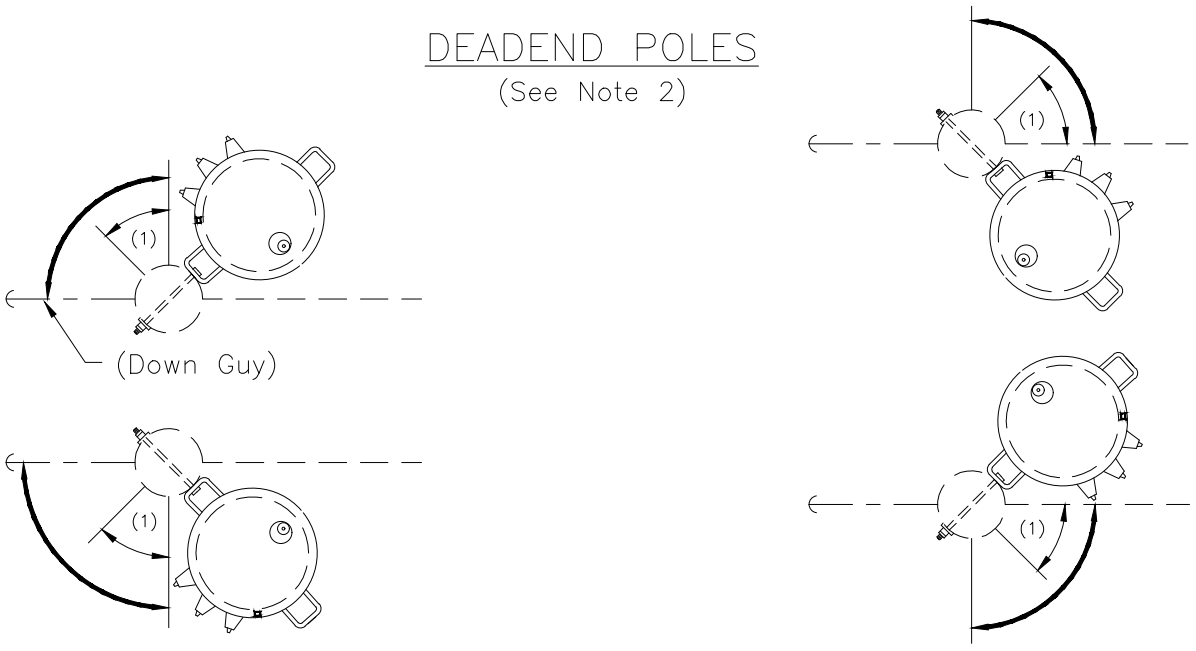


(Service(s) opposite side of neutral)



DEADEND POLES

(See Note 2)

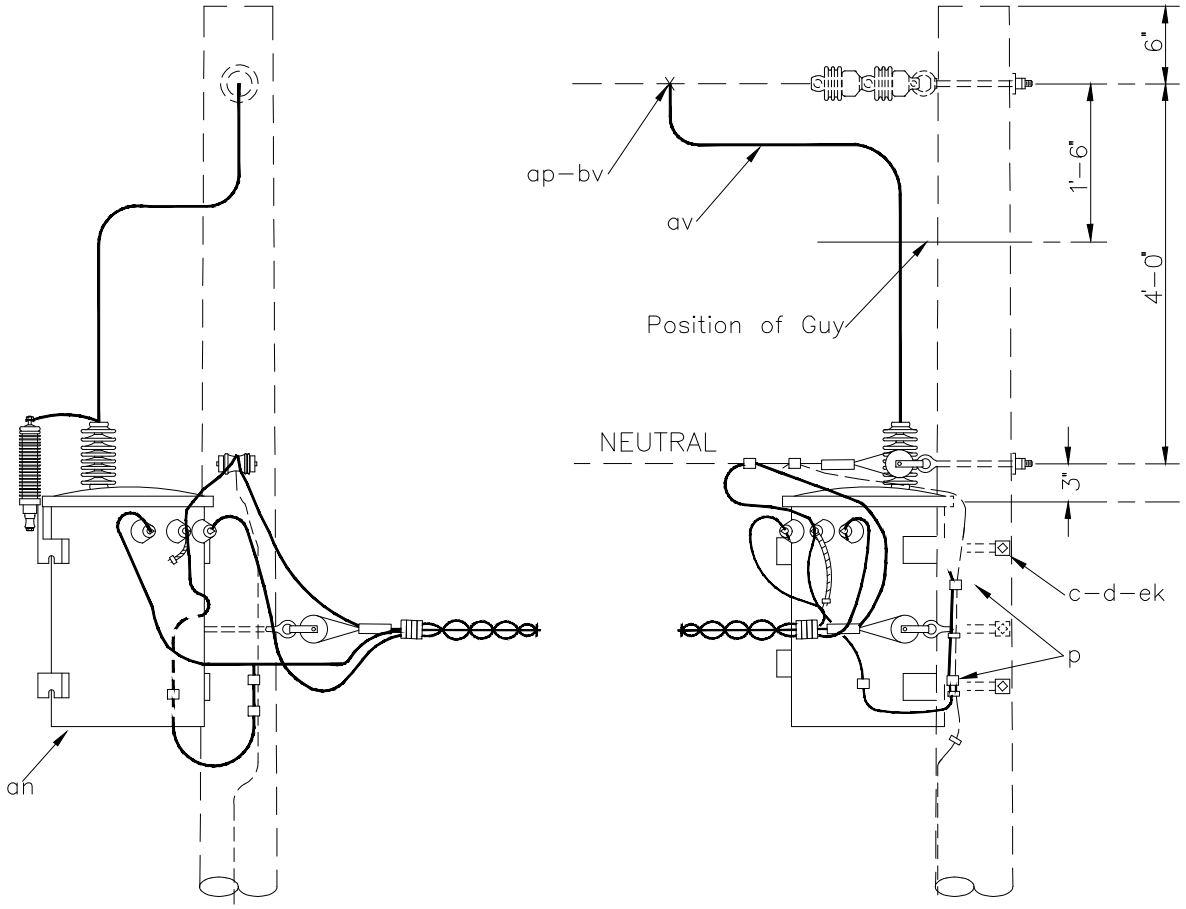


NOTES:

1. Lower service(s) to 4 inches below transformer if necessary for adequate clearances.
2. Lower transformer so that neutral is 3 inches above transformer lid.

POLE TYPE TRANSFORMER LOCATION GUIDE

September 18		G1.2G
FDEC		



NOTE: Install transformer so that primary neutral is 3 inches above bottom of transformer lid on both single–phase and three–phase primary assemblies. See drawing "C5.21" for three–phase deadend.

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
p		Connectors,compression type as req'd
an	1	Transformer, 12.47 kV, self protected

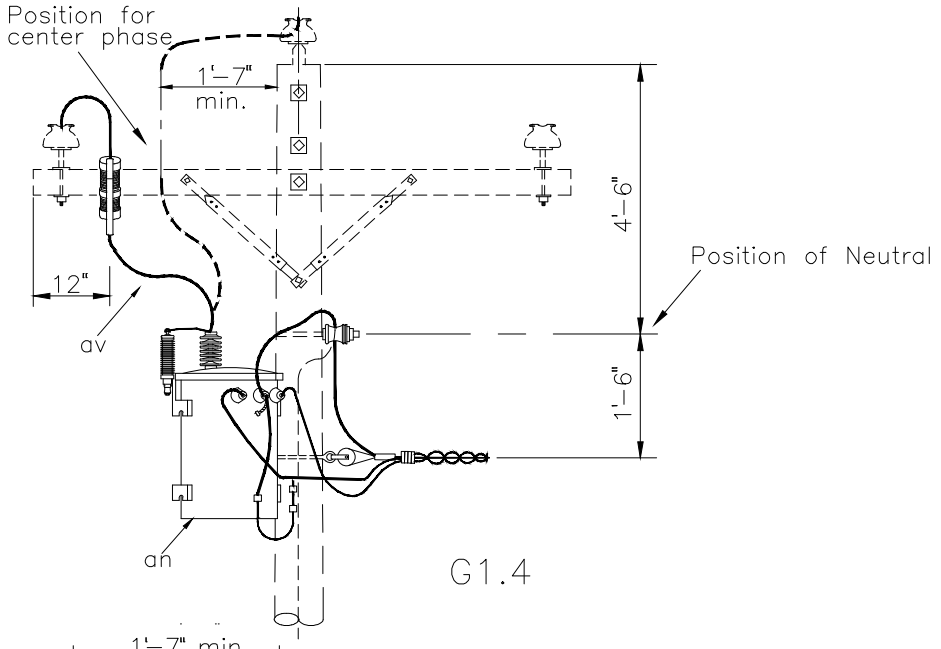
ITEM	QTY	MATERIAL
ap	1	Clamp, hot line
av		Jumpers, stranded, as req'd
bv	1	Rod, armor (as req'd)
ek	2	Locknuts

DESIGN PARAMETERS:

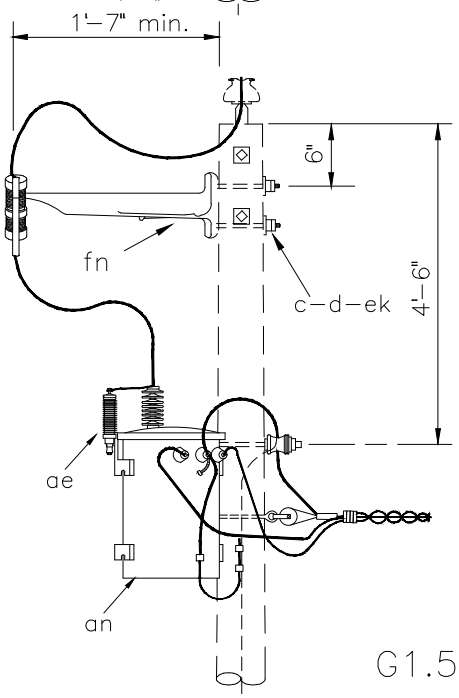
See Guide Drawing "G1.1G"

SINGLE–PHASE, CSP TRANSFORMER (DEADEND POLE)

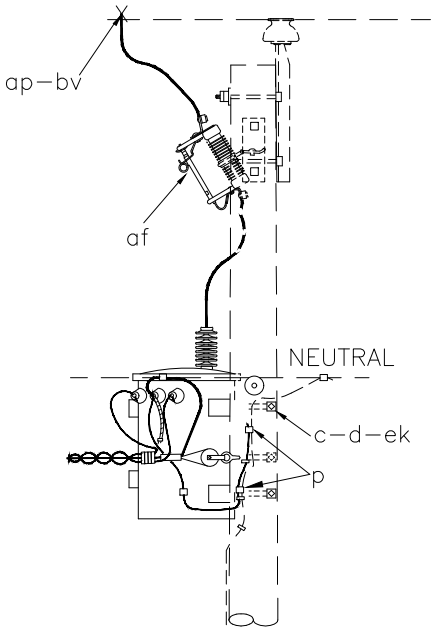
September 18		G1.3
FDEC	12.47/7.2 kV	(G106–)



G1.4



G1.5



NOTE: Rotate cutout so the blade faces climbing face of pole.

ASSEMBLY: G1		.4	.5
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	2	4
d	Washer, square, 2 1/4"	2	4
p	Connectors, as req'd		
ae	Arrester, surge (9 kV)	1	1
af	Cutout, dist., open (15 kV)	1	1
an	Transformer, 12.47 kV, conventional	1	1

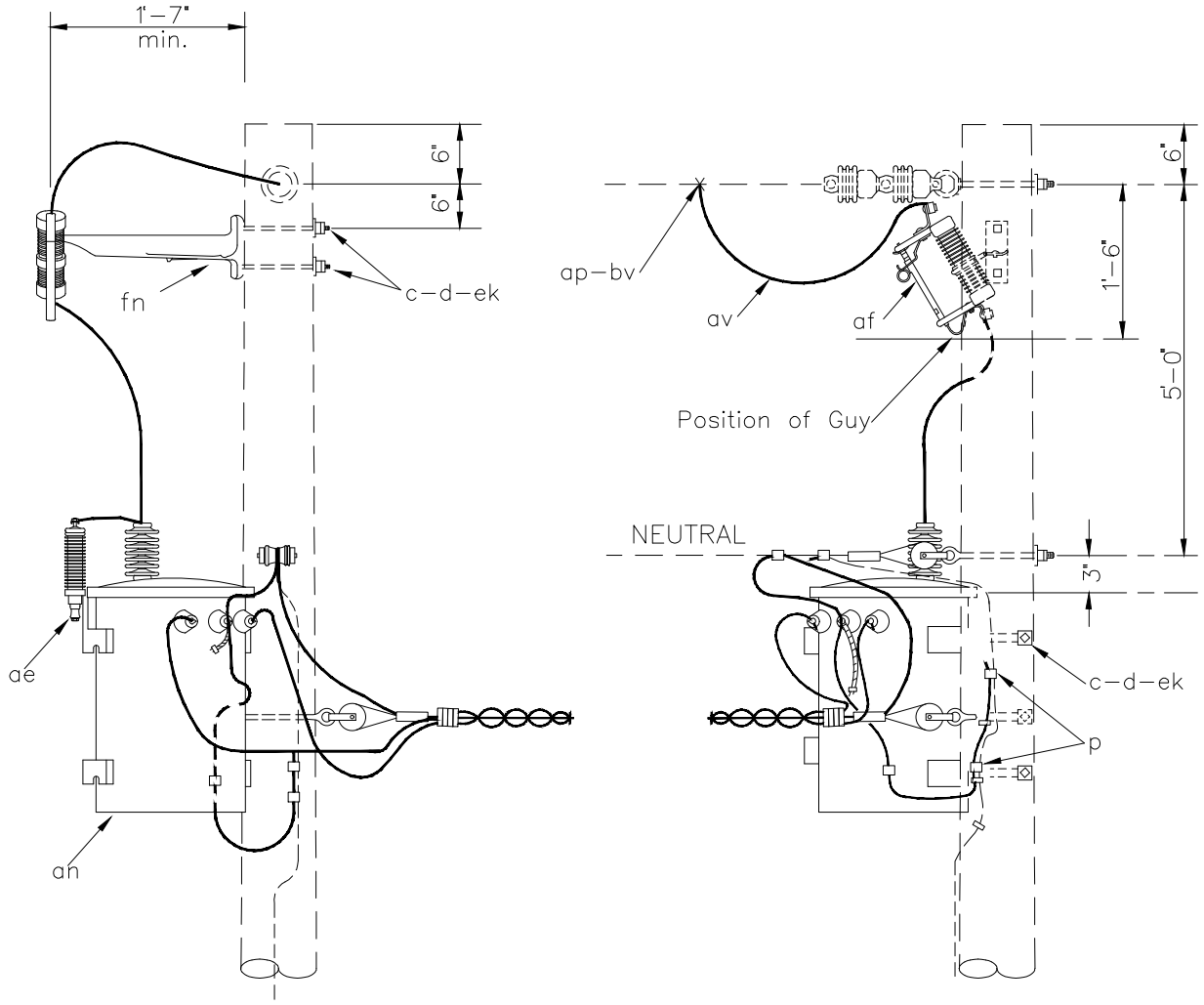
ASSEMBLY: G1		.4	.5
ITEM	MATERIAL	QTY	QTY
ap	Clamp, hot line	1	1
av	Jumpers, stranded, as req'd		
bv	Rod, armor, as req'd		
ek	Locknuts,	2	4
fn	Bracket, extension		1

DESIGN PARAMETERS:

See Guide Drawing "G1.1G"

SINGLE–PHASE, CONVENTIONAL TRANSFORMER (TANGENT POLE)

September 18		
FDEC	12.47/7.2 kV	G1.4 G1.5



NOTE: Rotate cutout so that the blade faces climbing face of pole.

ITEM	QTY	MATERIAL
c	4	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 2 1/4"
p		Connectors, as req'd
ae	1	Arrester, surge (9 kV)
af	1	Cutout, dist. open (15 kV)
an	1	Transformer, 12.47 kV, conventional

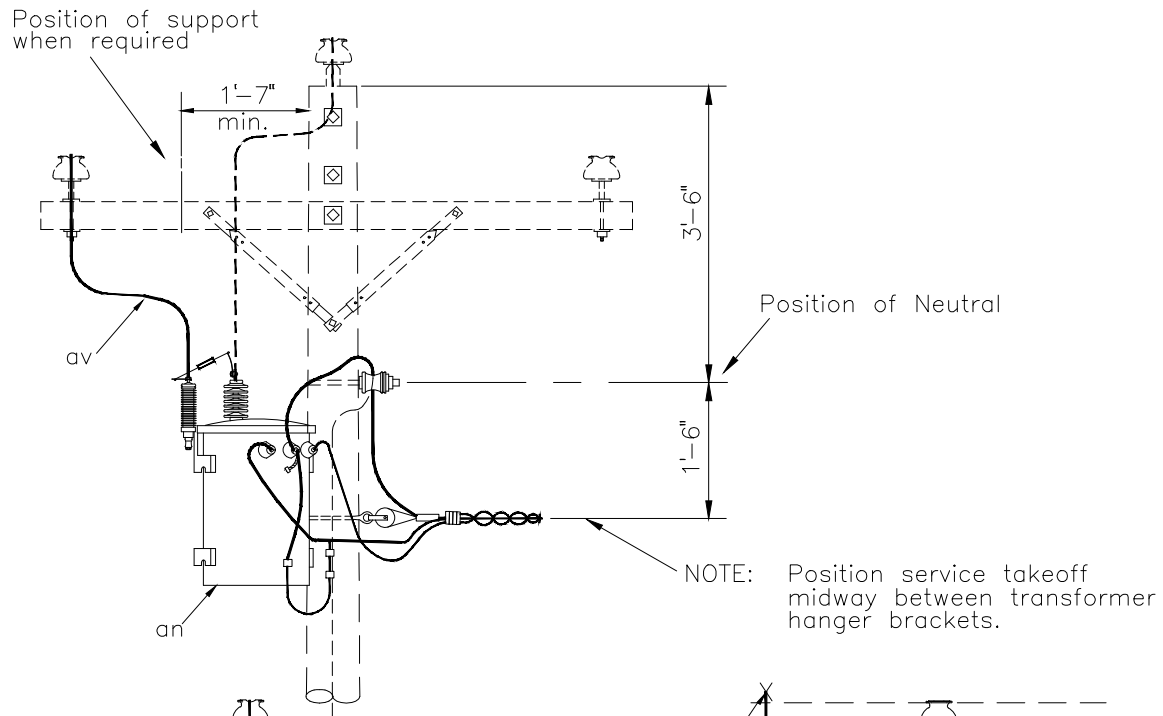
ITEM	QTY	MATERIAL
ap	1	Clamp, hot line
av		Jumpers, stranded, as req'd
bv	1	Rod, armor as req'd
ek	4	Locknuts
fn	1	Bracket, extension

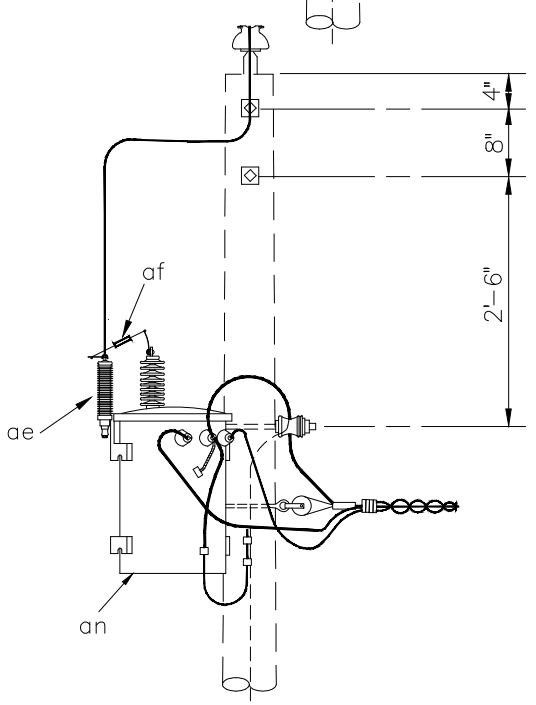
DESIGN PARAMETERS:

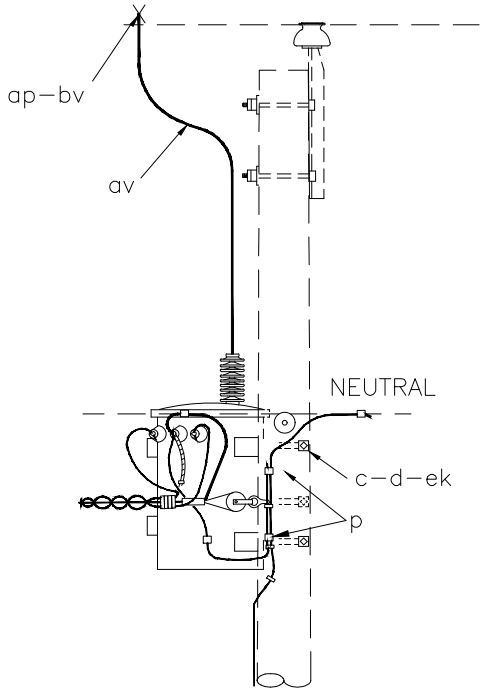
See Guide Drawing "G1.1G"

SINGLE–PHASE, CONVENTIONAL TRANSFORMER (DEADEND POLE)

September 18		
FDEC	12.47/7.2 kV	G1.6







ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
p		Connectors,compression type,as req'd
an	1	Transformer, 12.47 kV, conventional
ae	1	Arrester, surge (9 kV)

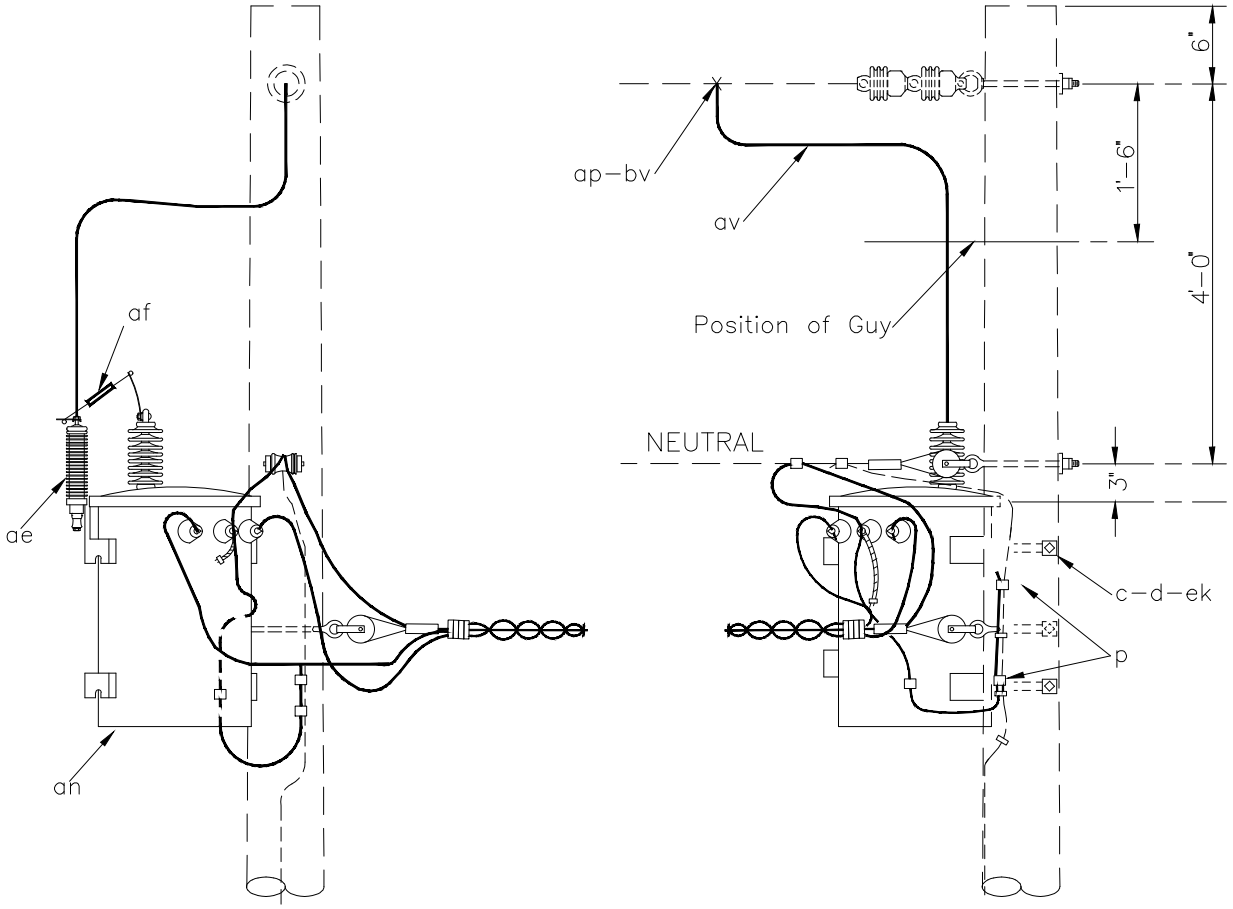
ITEM	QTY	MATERIAL
af	1	Cutout, fuse, open link
ap	1	Clamp, hot line
av		Jumpers, stranded, as req'd
bv	1	Rod, armor (as req'd)
ek	2	Locknuts

DESIGN PARAMETERS:

See Guide Drawing "G1.1G"

SINGLE-PHASE, CONVENTIONAL TRANSFORMER (TANGENT POLE)

September 18 FDEC	12.47/7.2 kV	G1.7 (G9-),(G39-)



NOTE: Install transformer so that primary neutral is 3 inches above bottom of transformer lid on both single–phase and three–phase primary assemblies. See drawing "C5.21" for three–phase deadend.

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
p		Connectors,compression type as req'd
an	1	Transformer, 12.47 kV, conventional
ae	1	Arrester, surge (9 kV)

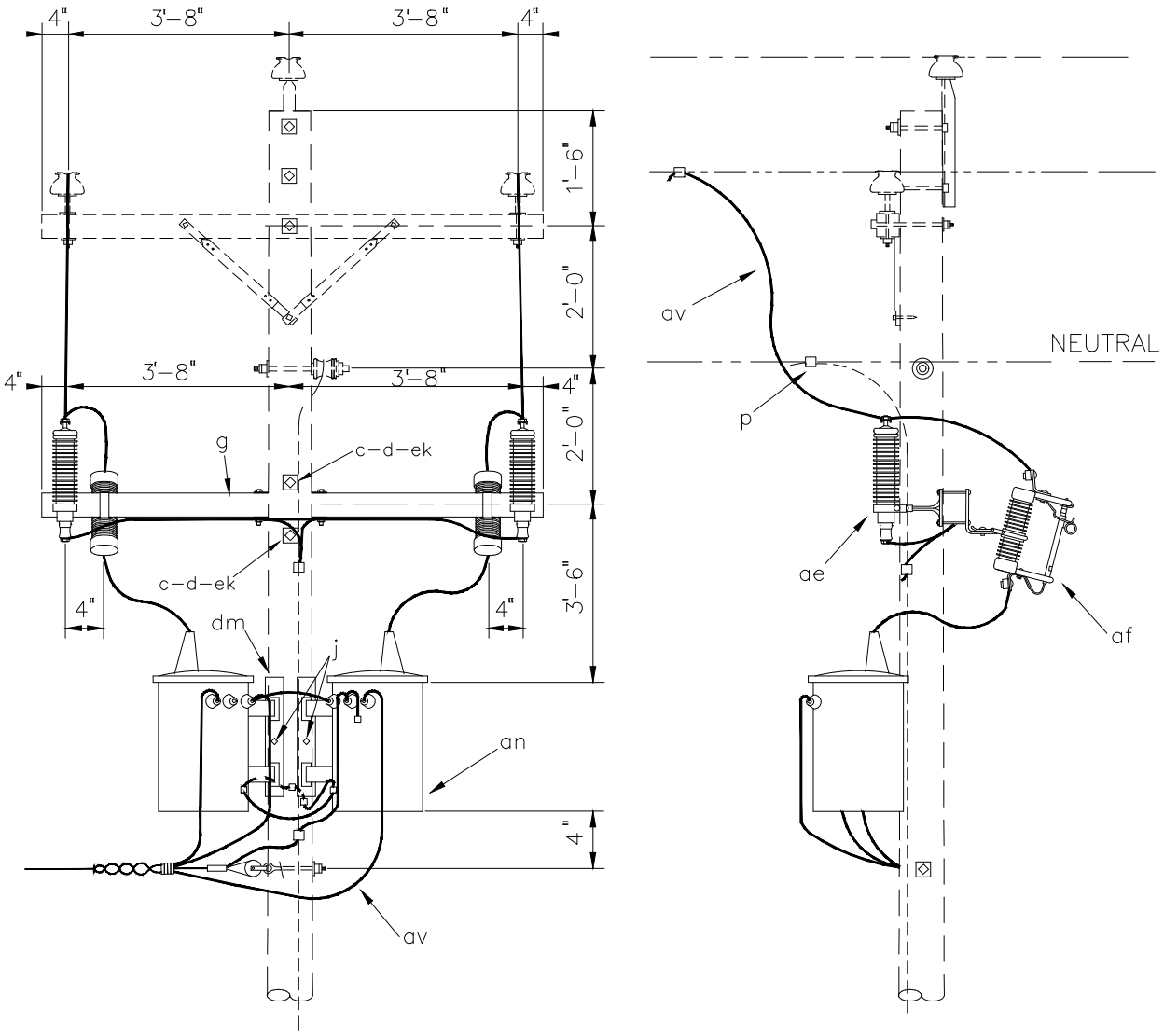
ITEM	QTY	MATERIAL
af	1	Cutout, fuse, open link
ap	1	Clamp, hot line
av		Jumpers, stranded, as req'd
bv	1	Rod, armor (as req'd)
ek	2	Locknuts

DESIGN PARAMETERS:

See Guide Drawing "G1.1G"

SINGLE–PHASE, CONVENTIONAL TRANSFORMER (DEADEND POLE)

September 18		G1.8
FDEC	12.47/7.2 kV	(G10–)



ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
g	1	Crossarm, fiberglass, 8'
p		Connectors, as req'd
p		Connectors, compression, as req'd
ae	2	Arrester, surge, (9 kV)
af	2	Cutout, dist. open (15 kV)

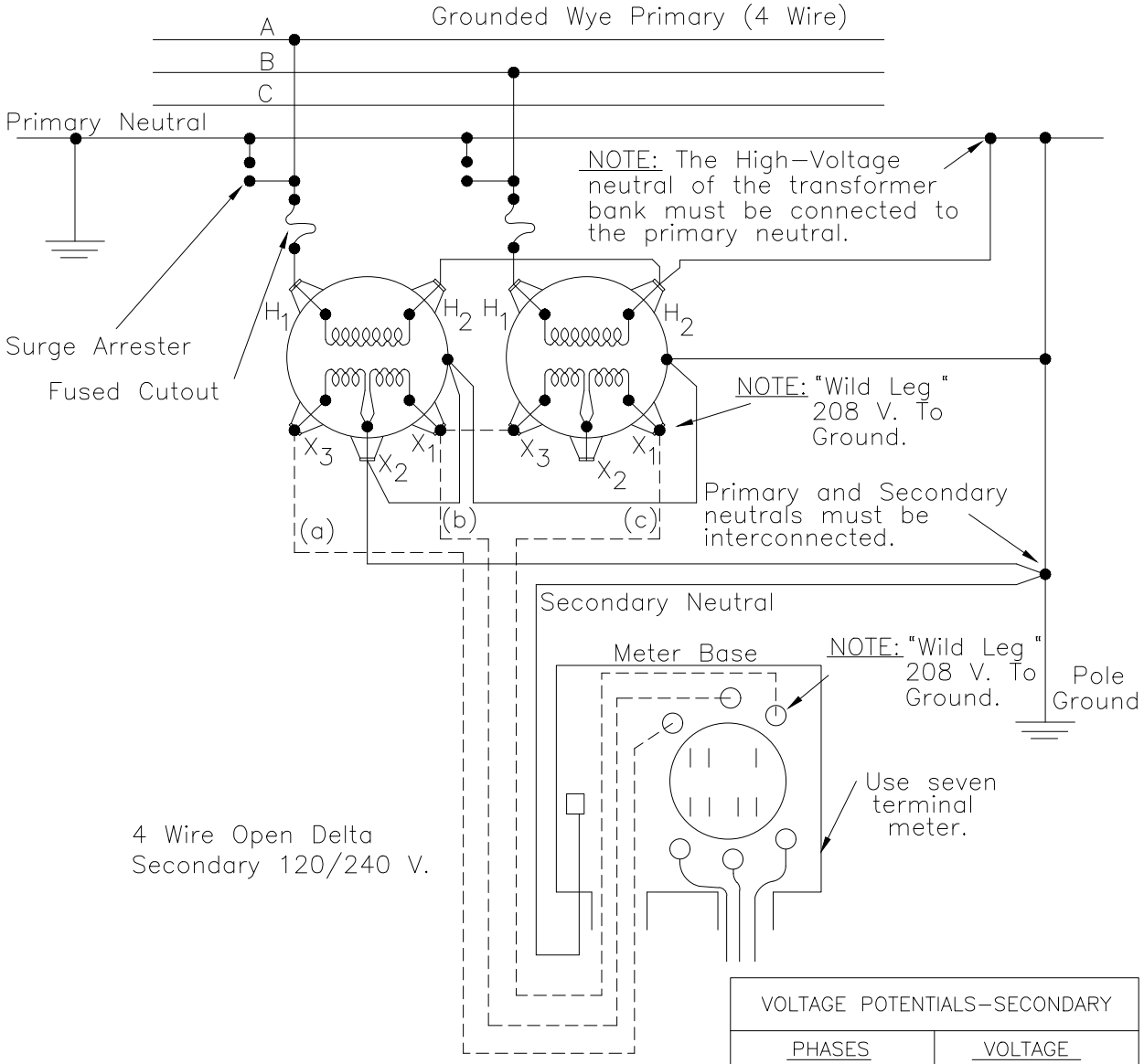
ITEM	QTY	MATERIAL
an	2	Transformer, 12.47 kV, conv.
av		Jumpers, bare, stranded, as req'd
av		Jumpers, service, as req'd
dm	1	Bracket, transformer, cluster with
		adapter plates as req'd
ek	4	Locknuts
j		Screw, lag, 1/2 x 4, as req'd

DESIGN PARAMETERS:

See Guide Drawing "G2.1G"

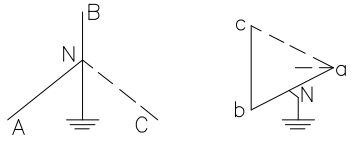
TWO–PHASE TRANSFORMER BANK
OPEN–WYE PRIMARY
OPEN–DELTA, 4 WIRE SECONDARY

September 18		G2.1 (G210–)
FDEC	12.47/7.2 kV	



VOLTAGE POTENTIALS—SECONDARY	
PHASES	VOLTAGE
a—b	240 VOLTS
b—c	240 VOLTS
a—c	240 VOLTS
a—N	120 VOLTS
b—N	120 VOLTS
c—N	208 VOLTS

210° ANGULAR DISPLACEMENT



(Additive Polarity—See TRANSFORMER SPECIFICATIONS)

APPLICATION: Used to supply large single-phase, 120/240 volt loads with small amount of three phase loads. Also used when only two phases of primary are available or during emergencies when one unit of a four-wire, wye-delta bank is disabled.

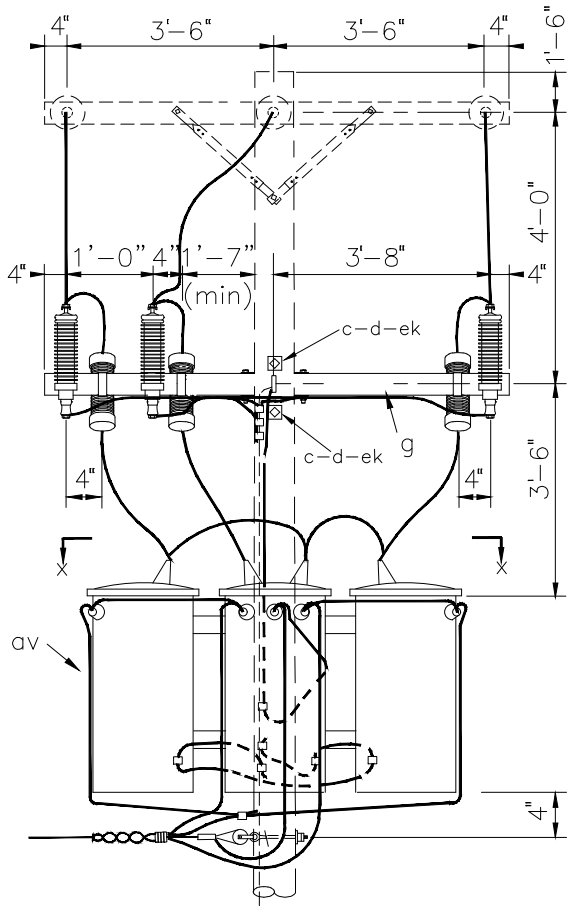
See drawing "G2.1" or "VG2.1" for construction details. One-bushing or two-bushing transformers may be used. Usually transformers of different KVA sizes are used.

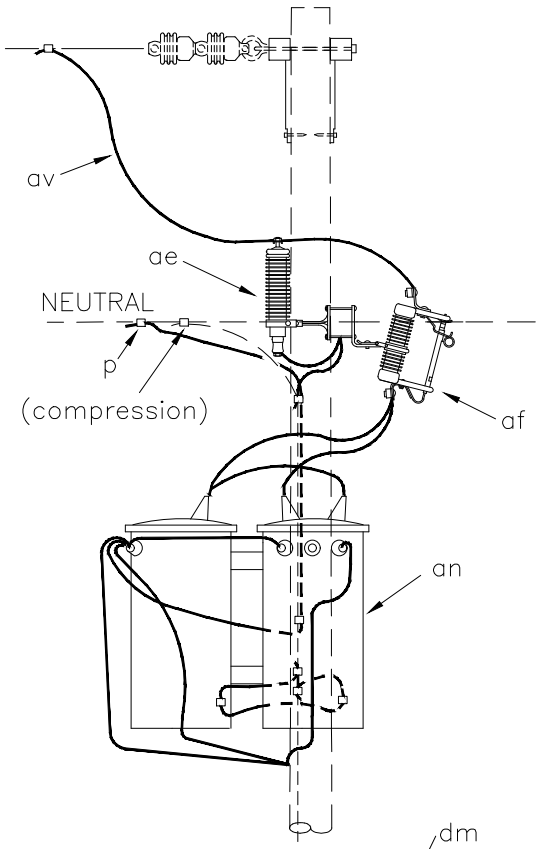
BANK RATING: This bank has only 86.6% of the rating of the two units making up the three-phase bank and only 57.7% of the three-phase rating of a closed delta-delta bank of three transformers. Thus, it is relatively inefficient where three-phase loads predominate.

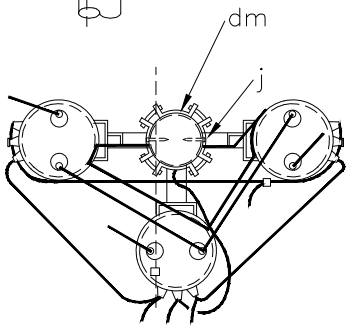
TRANSFORMER/METER CONNECTION GUIDE

THREE-PHASE, OPEN-WYE – OPEN DELTA
FOR 120/240 VOLT POWER LOADS

September 18		
FDEC		G2.1G







SECTION X–X

NOTES:
1. See Drawing "Q3.1" for additional connection and metering details.
2. All transformer tanks must be grounded.

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
g	1	Crossarm, fiberglass, 8'
j		Screw, lag, 1/2 x 4, as req'd
p		Connectors, as req'd
p		Connectors, compression, as req'd
ae	3	Arrester, surge, (9 kV)

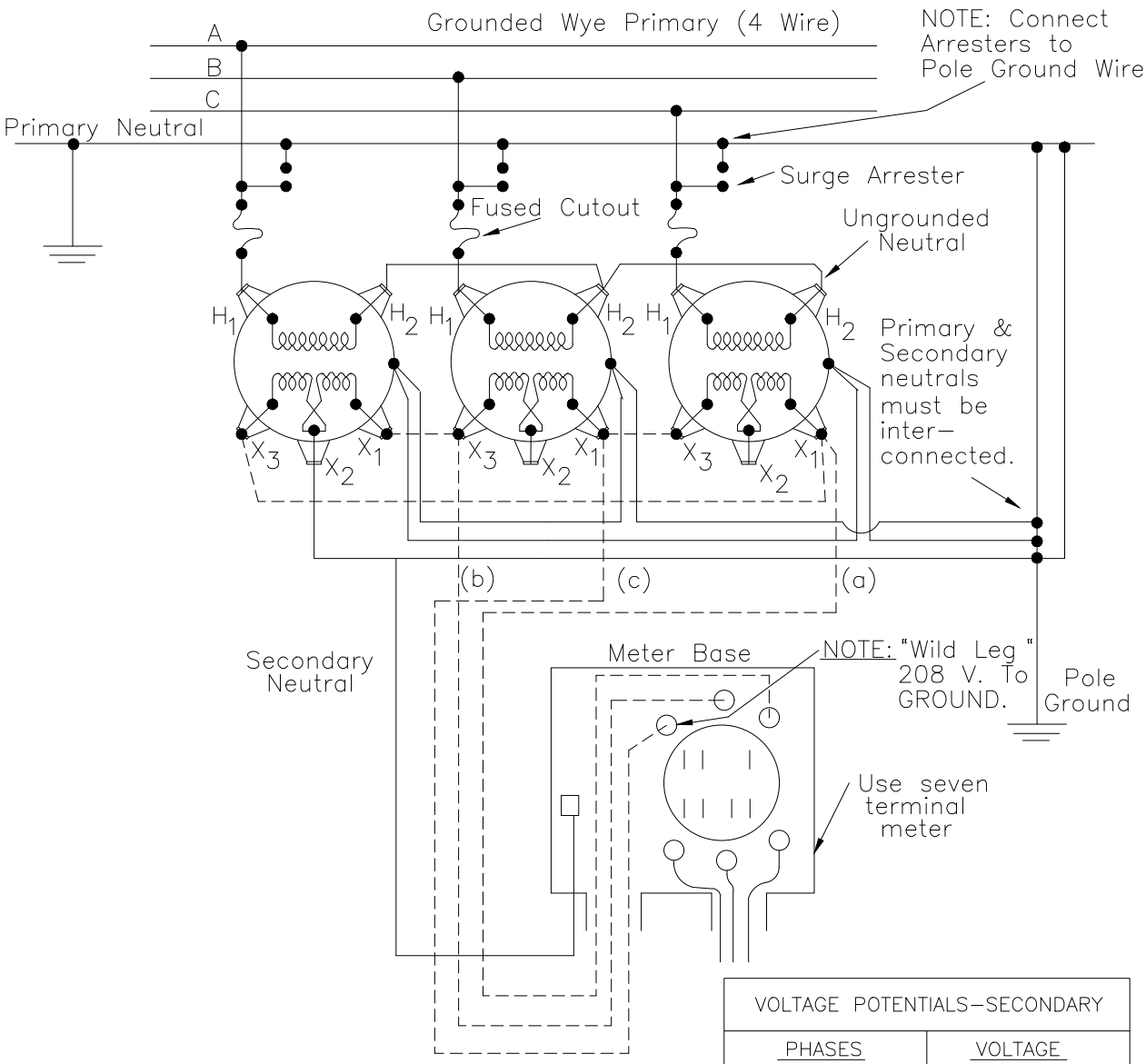
ITEM	QTY	MATERIAL
af	3	Cutout, dist. open (15 kV)
an	3	Transformer, 12.47 kV, conventional
av		Jumpers, bare, stranded
av		Jumpers, service, as req'd
dm	1	Bracket, transformer, cluster with
		adapter plates as req'd
ek	6	Locknuts

DESIGN PARAMETERS:

See Guide Drawing "G3.1G"

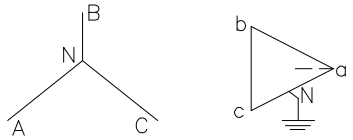
THREE–PHASE TRANSFORMER BANK
UNGROUNDED–WYE PRIMARY
CENTER–TAP GROUNDED DELTA, 4 WIRE SECONDARY

September 18 FDEC	3 – PHASE PRIMARY 12.47/7.2 kV	G3.1 (G310–)



VOLTAGE POTENTIALS—SECONDARY	
PHASES	VOLTAGE
a—b	240 VOLTS
b—c	240 VOLTS
a—c	240 VOLTS
a—N	120 VOLTS
b—N	120 VOLTS
c—N	208 VOLTS

210° ANGULAR DISPLACEMENT



(Additive Polarity—See TRANSFORMER SPECIFICATIONS)

APPLICATION: Used to supply three—phase, 240 volt loads with small amounts of 120/240 volt single—phase loads.

See drawing "G3.1" or "VG3.1" for construction details.

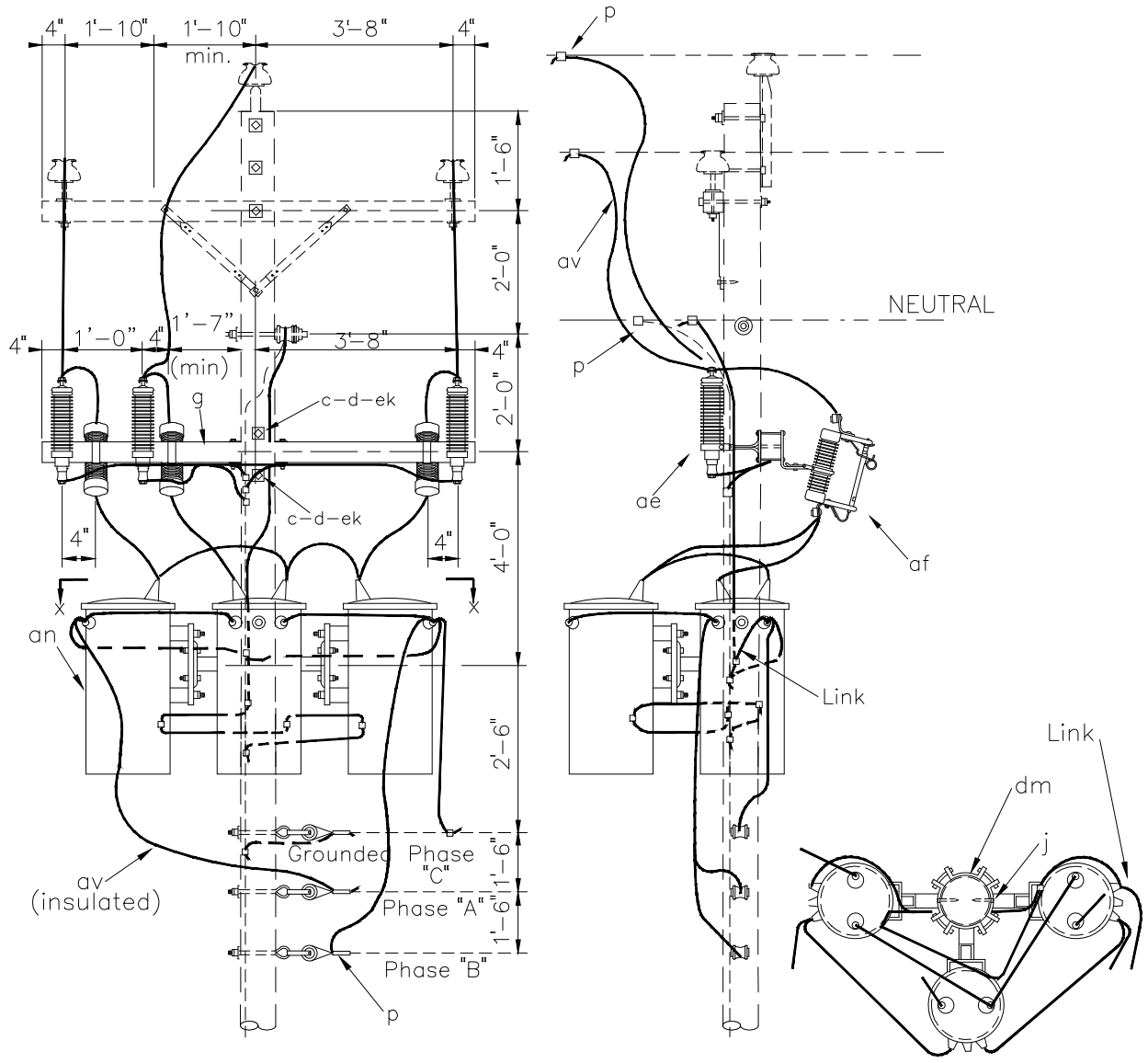
CAUTION: Only ground one secondary neutral bushing of the three transformers.
Connecting the high—voltage neutral to the system neutral may cause the transformer bank to burn out.
Largest transformer capacity should not be more than 2 times the smallest transformer kVA.

BANK RATING: The center tapped transformer carries 2/3 of the 120/240 volt single—phase load; each of the three units carry 1/3 of the 240 volt three—phase load.

TRANSFORMER/METER CONNECTION GUIDE

UNGROUNDED WYE — CENTER TAP GROUNDED DELTA FOR 120/240 VOLT POWER LOADS

September 18	3 — PHASE PRIMARY	
FDEC		G3.1G



SECTION X–X

NOTES:

1. See Drawing "Q3.2" for additional connection and metering details.
2. This transformer connection not recommended for new services.

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8 x req'd length
d	2	Washer, square, 2 1/4"
g	1	Crossarm, fiberglass, 8'
j		Screw, lag, 1/2" x 4", as req'd
n	1	Bolt, dble arm, 5/8" x req'd length
p		Connectors, as req'd
p		Connectors, compression, as req'd
ae	3	Arrester, surge, (9 kV)

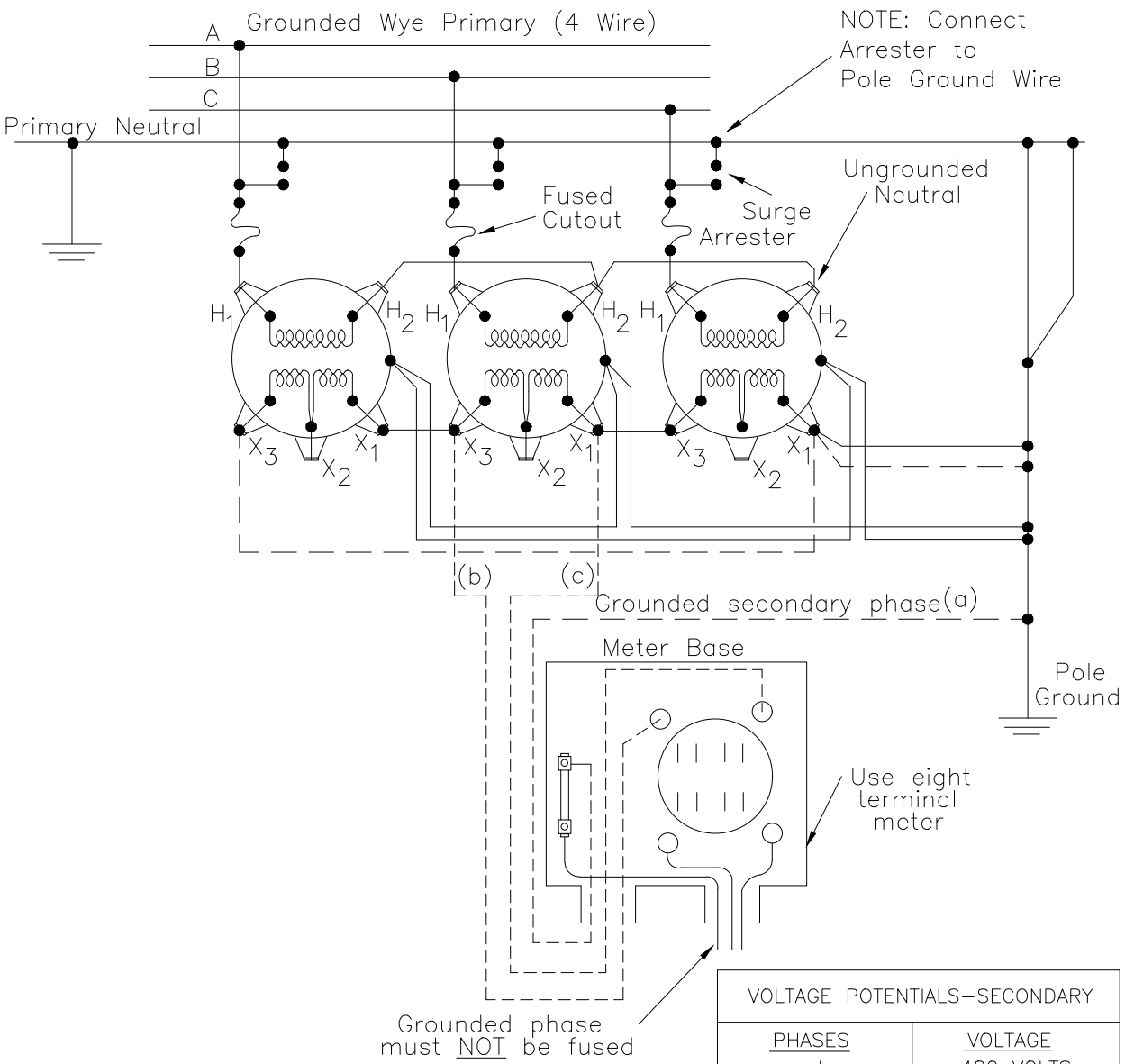
ITEM	QTY	MATERIAL
af	3	Cutout, dist. open (15 kV)
an	3	Transformer, 12.47 kV, conventional
av		Jumpers, bare, stranded
av		Jumpers, service, as req'd
dm	1	Bracket, transformer, cluster with
		adapter plates as req'd
ek	6	Locknuts

DESIGN PARAMETERS:

See Guide Drawing "G3.2G"

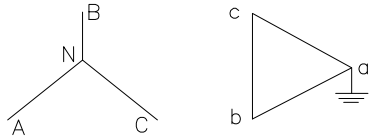
THREE–PHASE TRANSFORMER BANK
UNGROUNDED–WYE PRIMARY
CORNER GROUNDED DELTA, 3 WIRE SECONDARY

September 18	3 – PHASE PRIMARY	G3.2
FDEC	12.47/7.2 kV	(G311–)



VOLTAGE POTENTIALS—SECONDARY	
PHASES	VOLTAGE
a—b	480 VOLTS
b—c	480 VOLTS
a—c	480 VOLTS
a—GRD	0 VOLTS
b—GRD	480 VOLTS
c—GRD	480 VOLTS

210° ANGULAR DISPLACEMENT



(Additive Polarity—
See TRANSFORMER SPECIFICATIONS)

APPLICATION: Used to supply three—phase (only), 240 or 480 volt power loads.

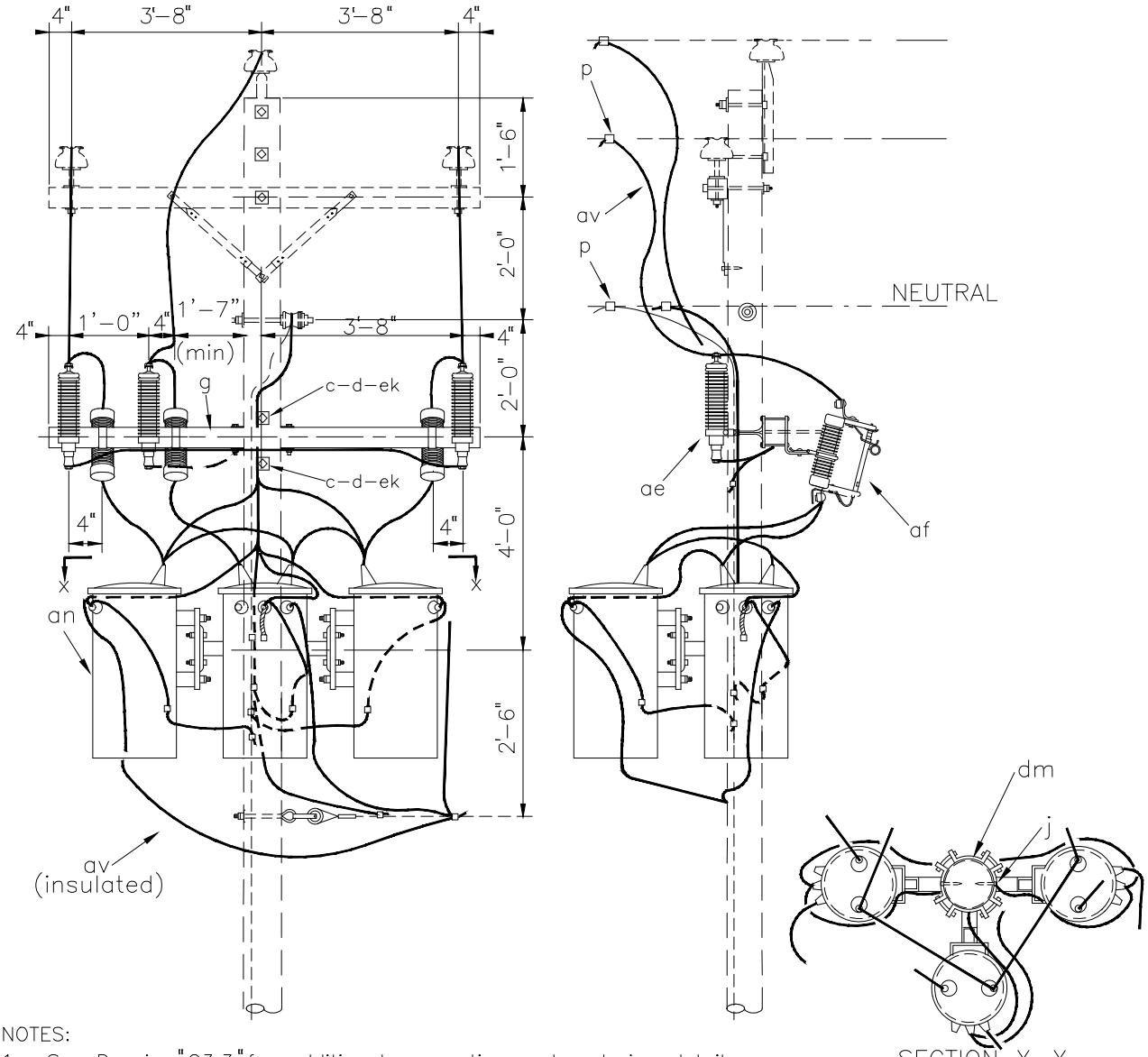
See drawing "G3.2" or "VG3.2" for construction details.

BANK RATING: The maximum safe kVA rating of the bank is three times the kVA rating of the smallest transformer.

NOTES:
One—half of the above voltages apply when a 240 volt bank is used.
All tanks to be grounded.
Disconnect all secondary neutrals from tank and do not ground.
Do not ground bank on primary side. (If grounded, the bank would be a grounding bank for the entire circuit.)
The grounding secondary wire is a current carrying phase wire operating at ground potential and must be identified throughout the circuit run. It is not a neutral.

TRANSFORMER/METER CONNECTION GUIDE
UNGROUNDED WYE — CORNER GROUNDED DELTA
FOR 240 or 480 VOLT POWER LOADS

September 18	3 — PHASE PRIMARY	
FDEC		G3.2G



SECTION X–X

NOTES:

1. See Drawing "Q3.3" for additional connection and metering details.

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8 x req'd length
d	2	Washer, square, 2 1/4"
g	1	Crossarm, fiberglass, 8'
j		Screw, lag, 1/2" x 4", as req'd
n	1	Bolt, dble arm, 5/8" x req'd length
p		Connectors, as req'd
p		Connectors, compression, as req'd
ae	3	Arrester, surge, (9 kV)

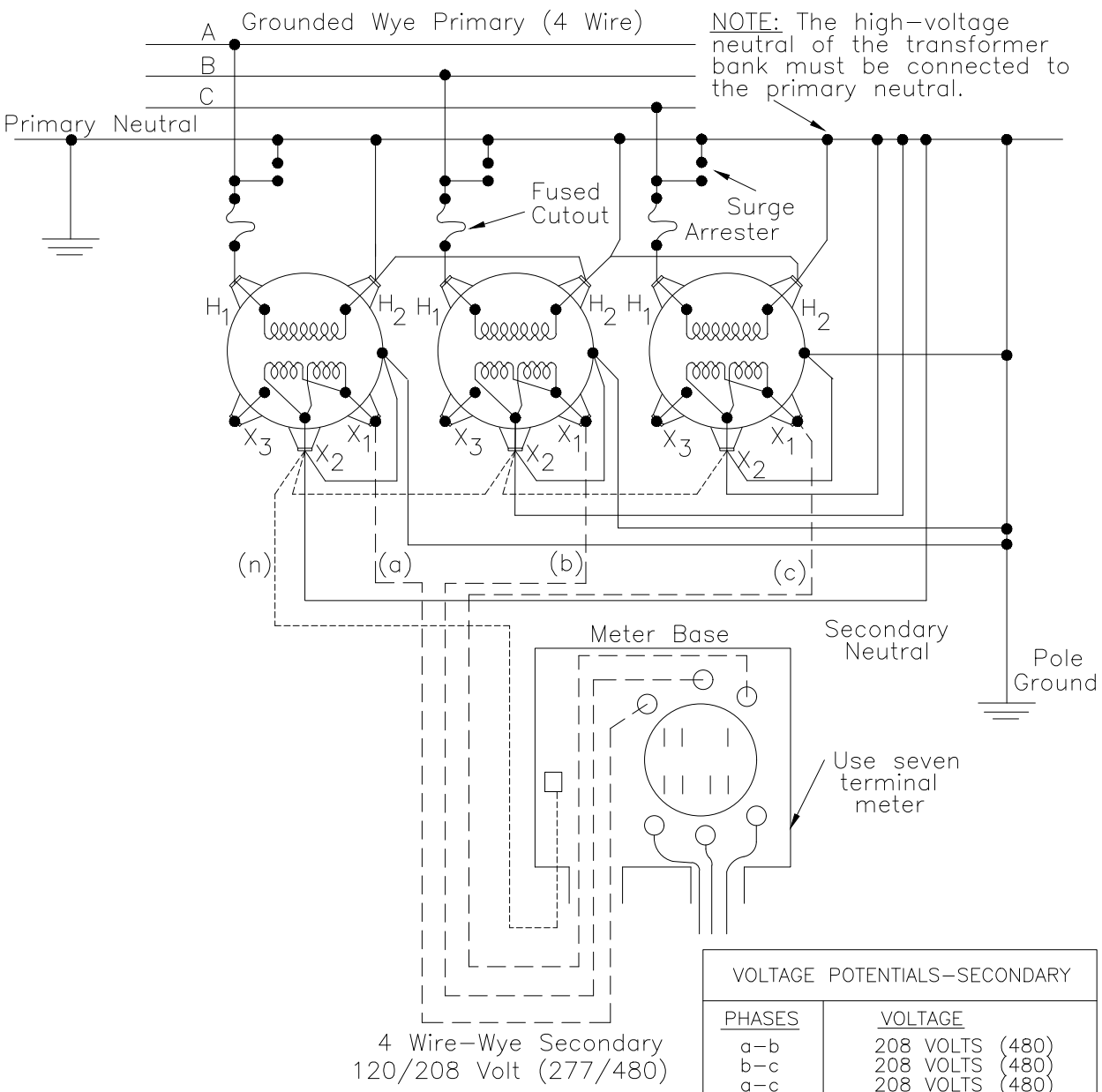
ITEM	QTY	MATERIAL
af	3	Cutout, dist. open (15 kV)
an	3	Transformer, 12.47 kV, conventional
av		Jumpers, bare, stranded
av		Jumpers, service, as req'd
dm	1	Bracket, transformer, cluster with
		adapter plates as req'd
ek	6	Locknuts

DESIGN PARAMETERS:

See Guide Drawing "G3.3G"

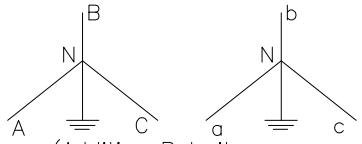
THREE–PHASE TRANSFORMER BANK
GROUNDED–WYE PRIMARY
GROUNDED WYE, 4 WIRE SECONDARY

September 18	3 – PHASE PRIMARY	G3.3
FDEC	12.47/7.2 kV	(G312–)



VOLTAGE POTENTIALS-SECONDARY	
PHASES	VOLTAGE
a-b	208 VOLTS (480)
b-c	208 VOLTS (480)
a-c	208 VOLTS (480)
a-N	120 VOLTS (277)
b-N	120 VOLTS (277)
c-N	120 VOLTS (277)

0° ANGULAR DISPLACEMENT



(Additive Polarity-
See TRANSFORMER SPECIFICATIONS)

APPLICATION: Used to supply 120/208 volt single-phase and 208 volt, three-phase power loads.

See drawing "G3.3" or "VG3.3" for construction details. Reconnect secondary windings of transformers as shown. Matched (impedance and kVA) transformers are usually used.

BANK RATING: Each unit will supply 1/3 of the three-phase load and all of the single-phase load connected to it.

CAUTION: The primary and secondary neutrals must be firmly tied together and grounded or else excessive secondary voltages may develop.

TRANSFORMER/METER CONNECTION GUIDE
GROUNDED WYE - GROUNDED WYE
FOR 120/208 VOLT POWER LOADS

September 18	3 - PHASE PRIMARY	
FDEC		G3.3G

GROUNDING ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
H1.1	(M2-11)	GROUNDING ASSEMBLY - GROUND ROD TYPE
H4.1	(M2-15A)	GROUNDING ASSEMBLY - PLATFORM TYPE (FOR SECTIONALIZING AIRBREAK SWITCH)

CONSTRUCTION SPECIFICATIONS FOR GROUNDING

Ground rods (item “ai”) shall be driven to their full length in undisturbed earth, a minimum of 2 feet from the face of the pole. The tops of the ground rods shall be at least 12 inches below the surface of the earth. The ground wire (item “av”) shall be attached to the rod with a ground rod clamp (item “aj”) and shall be secured to the pole with staples. The staples on the ground wire shall be spaced 2 feet part, except for the first 8 feet above the ground and the top 8 feet of the ground wire where they shall be spaced 6 inches apart.

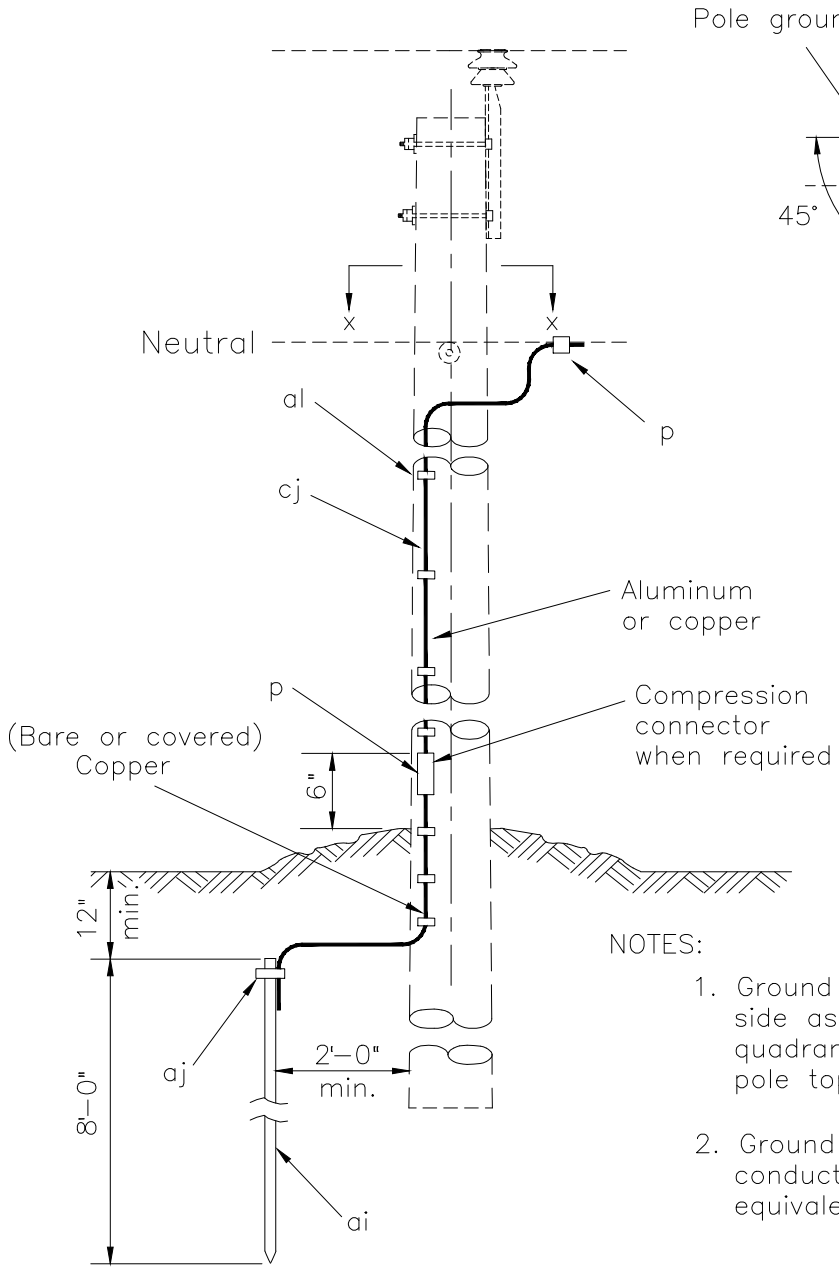
The connection between the ground rod and the system neutral should be made by one continuous piece of conductor (the pole ground wire), and shall be installed in the shortest and most direct path according to the construction drawings. Splices, if required, shall be made using a compression type connector and shall be installed a minimum of 6 inches above the ground line. The pole ground wire shall be connected to the system neutral using a compression type connector.

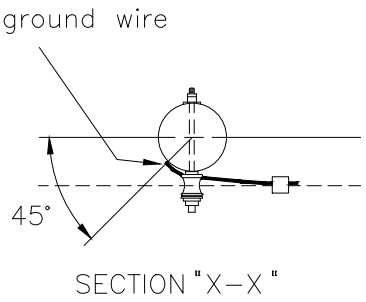
All equipment shall have at least 2 connections from the frame, case, or tank to the multi-grounded system neutral conductor as shown on the construction drawings. The pole ground wire may be used for one or both of these connections.

All neutral conductors on the pole shall be bonded directly to each other, and connected to the pole ground wire if present. All equipment ground wires, neutral conductors, downguys, messenger wires, and surge-protection ground wires shall be interconnected and attached to a common (pole) ground wire in accordance with the requirements of the National Electrical Safety Code (NESC).

Borrowers shall install effectively grounded driven ground rods (assembly H1.1) or trench type grounding assemblies (assembly H2.1) a maximum of 1,320 feet (433 meters) apart along overhead distribution lines. Customer-owned or other installed electric service grounds shall not be counted in the above minimum grounding assembly requirement.

Whereas under certain circumstances, plate type and wrap-around type grounding improvement assemblies (assemblies H5.1 and H5.2, respectively) may meet the grounding electrode requirements of Rule 094B4 of the NESC, RUS does not allow these types of grounding assemblies to be used to meet the NESC requirement of 4 grounds per mile because the effectiveness of these types of grounds in “disturbed” earth is often questionable. However, RUS encourages the installation of these grounding improvement assemblies to augment and improve the overall grounding of the distribution system that in turn generally improves the performance of line protection devices and improves safety.





NOTES:

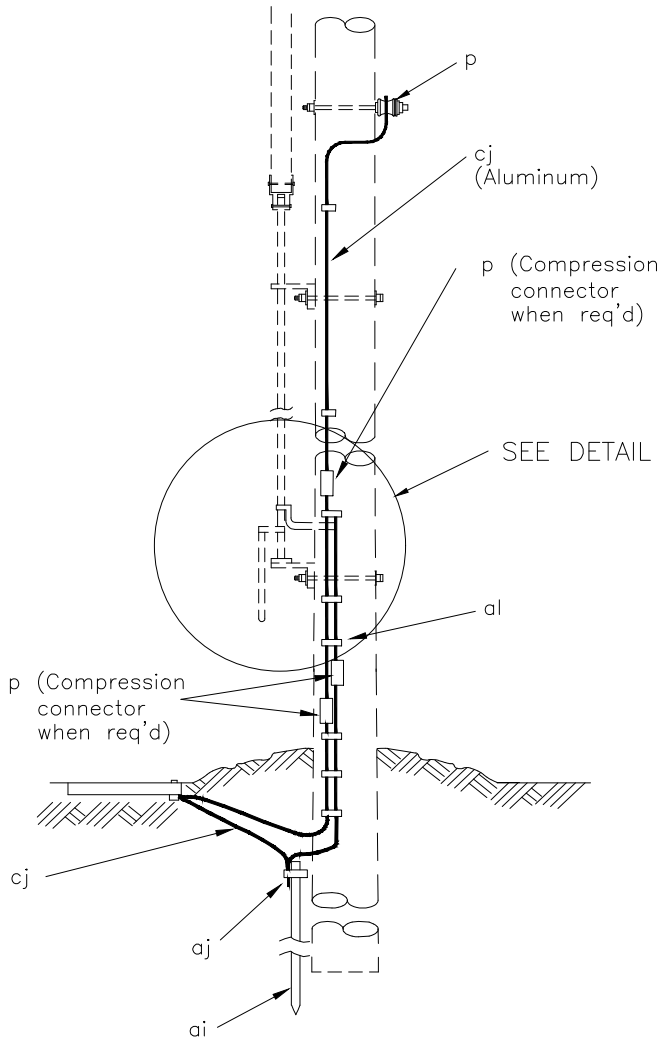
1. Ground wire to be located on same side as neutral conductor and in quadrant opposite climbing space or pole top pin.

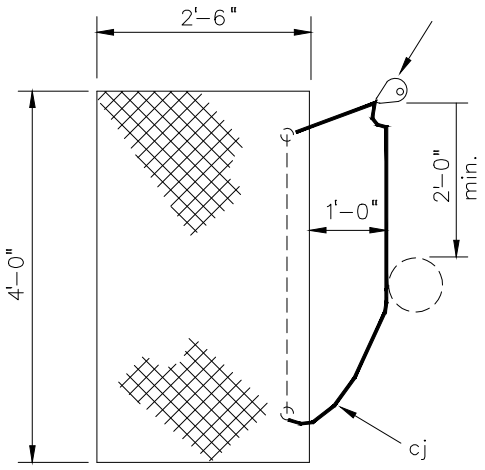
2. Ground wire ("cj") to have minimum conductivity of No. 6 Copper or equivalent.

ITEM	QTY	MATERIAL
p		Connector, compression, as req'd
ai	1	Rod, ground, 5/8" min. diameter
aj	1	Clamp, ground rod, cadweld
al		Staple, ground wire, as req'd
cj		Wire, pole ground, as req'd

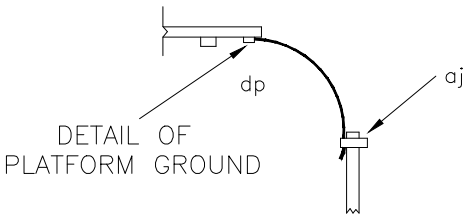
GROUNDING ASSEMBLY – GROUND ROD TYPE

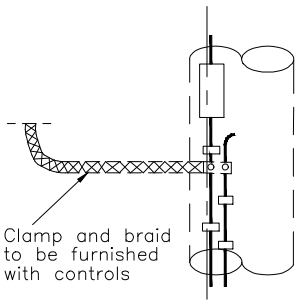
September 18 FDEC		H1.1 (M2-11)





DETAIL OF PLATFORM





DETAIL

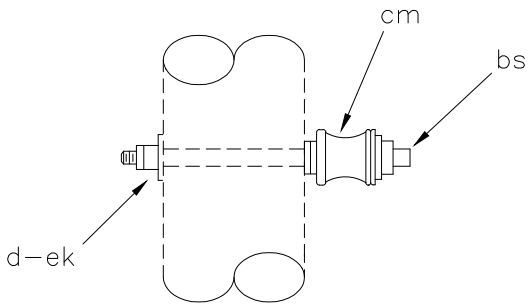
ITEM	QTY	MATERIAL
p		Connector, compression, as req'd
ai	1	Rod, ground, 5/8 min. dia., (galv.)
aj	1	Clamp, ground rod, cadweld
al		Staple, ground wire, (galv.), as req'd
cj		Wire pole ground, as req'd Soft annealed iron, 5/16" with class C galvanizing
dp	2	Clamp, ground wire, cadweld
	1	Platform, grounding plate, galv. iron

GROUNDING ASSEMBLY – PLATFORM TYPE (FOR SECTIONALIZING AIRBREAK SWITCH)

September 18 FDEC		H4.1 (M2–15A)

SECONDARY ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
J1.1	(J8)	SECONDARY ASSEMBLIES - (SMALL ANGLE)
J2.1	(J10)	SECONDARY ASSEMBLIES - (LARGE ANGLE)
J3.1	(J6), (J11)	SECONDARY ASSEMBLIES - (DEADEND, MISC.)



J1.1

		J1.1	
ITEM	MATERIAL	QTY	
d	Washer, 2 1/4" square	1	
bs	Bolt, single upset	1	
cm	Insulator, spool	1	
ek	Locknuts	1	

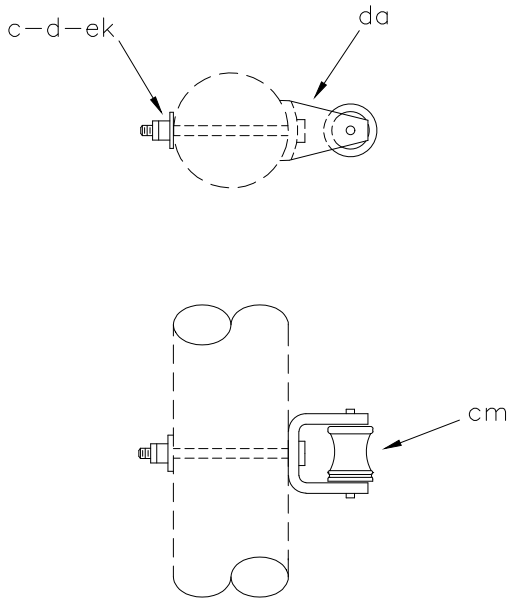
DESIGN PARAMETERS:
MAXIMUM LINE ANGLES

5° – Small Conductors
2° – Larger than #1/0

SECONDARY ASSEMBLIES
(SMALL ANGLE)

September 18
FDEC

J1.1
(J8)



J2.1

		J2.1	
ITEM	MATERIAL	QTY	
c	Bolt, machine, 5/8" X req'd length	1	
d	Washer, 2 1/4" square	1	
cm	Insulator, spool, 3"	1	
da	Bracket, insulated	1	
ek	Locknuts	1	

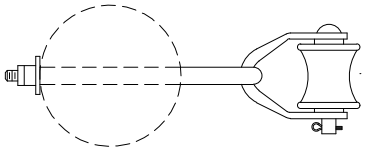
DESIGN PARAMETERS:
MAXIMUM LINE ANGLES

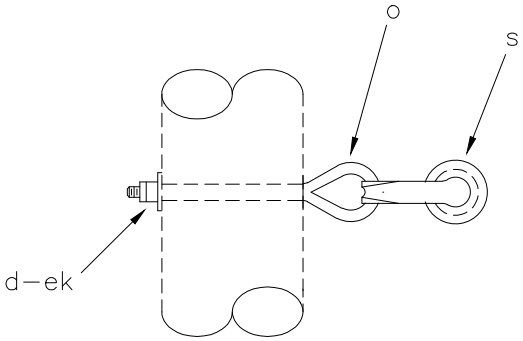
J2.1: 60°
J2.2: 60°

SECONDARY ASSEMBLIES
(LARGE ANGLE)

September 18
FDEC

J2.1
(J10)





J3.1

		J3.1	
ITEM	MATERIAL	QTY	
d	Washer, 2 1/4" square	1	
o	Bolt, eye, 5/8" x req'd length	1	
s	Clevis, secondary, swinging, insulated	1	
ek	Locknuts	1	

DESIGN PARAMETERS: (J3.1)

PERMITTED LONGITUDINAL LOADING:
1,500 lbs. (ANSI Class 53–2 Insulator)
2,250 lbs. (ANSI Class 53–4 Insulator)

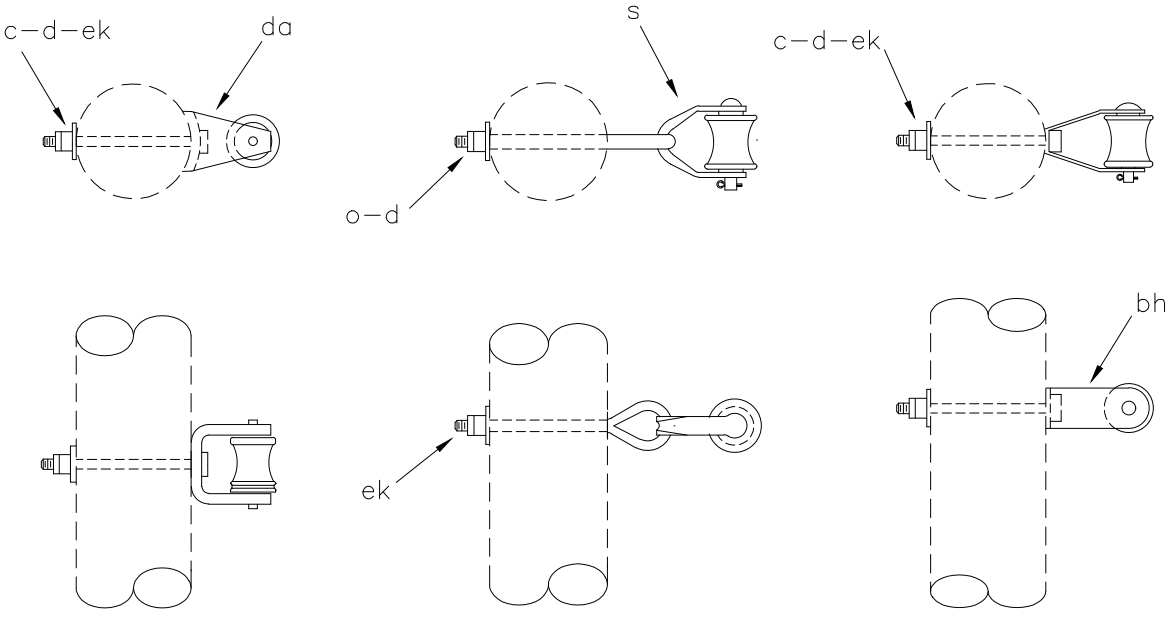
SECONDARY ASSEMBLIES
(DEADEND, MISC.)

September 18		J3.1
FDEC		(J6)

INDEX K

SERVICE ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
K1.1	(K14C)	SECRVICE ASSEMBLIES - (POLE MOUNTED)
K1.2	(K11C)	
K1.3	(K14), (K14L)	
K1.4	(K11), (K11L)	SECRVICE ASSEMBLIES - (POLE MOUNTED)
K1.5	(K15C)	
K2.1	(K10), (K10L)	SERVICE ASSEMBLIES
K2.2	(K10C)	
K2.3	(K10C)	
K3.1	(K17), (K17L)	SERVICE ASSEMBLIES - (MAST TYPE)
K3.2	(K16C)	
K4.2G	(M24-10)	MAST TYPE SERVICE ASSEMBLY GUIDE



K1.1 K1.2 K1.3

ASSEMBLY: K1		.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
c	Bolt, machine, 5/8" X req'd length	1		1
d	Washer, 2 1/4" square	1	1	1
o	Bolt, eye, 5/8" X req'd length		1	
s	Clevis, secondary, swinging, insulated		1	
bh	Clevis, service, deadend, insulated			1
ek	Locknuts	1	1	1
da	Bracket, insulated	1		

DESIGN PARAMETERS:

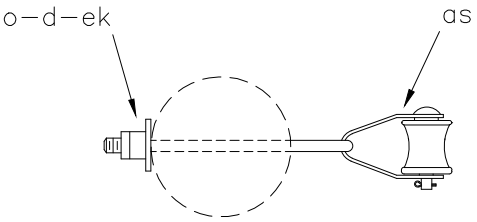
PERMITTED LONGITUDINAL LOADING:
1,500 lbs. (ANSI Class 53–2 Insulator)
2,250 lbs. (ANSI Class 53–4 Insulator)

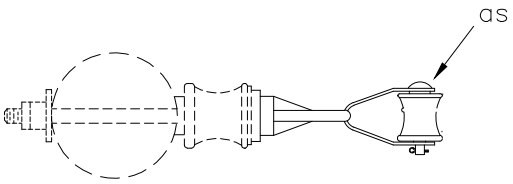
SERVICE ASSEMBLIES (POLE MOUNTED)

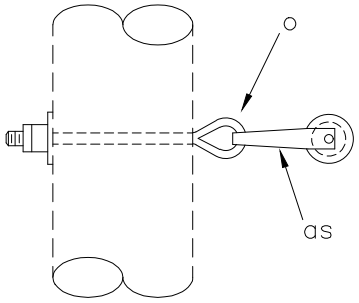
September 18

FDEC

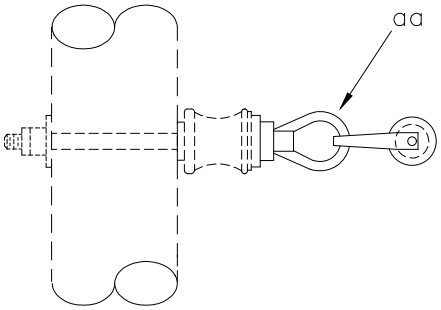
K1.1,K1.2,K1.3







K1.4



K1.5

ASSEMBLY: K1		.4	.5
ITEM	MATERIAL	QTY	QTY
d	Washer, 2 1/4" square	1	
o	Bolt, eye, 5/8" X req'd length	1	
aa	Nut, eye		1
as	Clevis, service, swinging, insulated	1	1
ek	Locknuts	1	

DESIGN PARAMETERS:

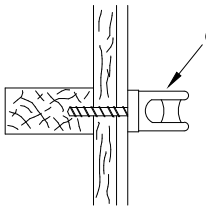
PERMITTED LONGITUDINAL LOAD:
1,500 lbs. (ANSI Class 53–2 Insulator)
2,250 lbs. (ANSI Class 53–4 Insulator)

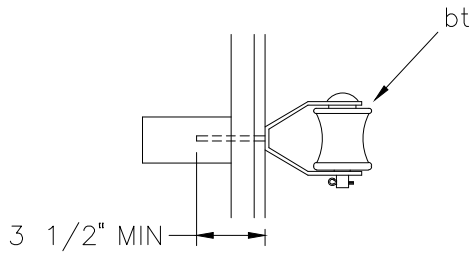
SERVICE ASSEMBLIES (POLE MOUNTED)

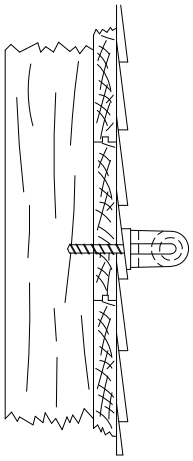
September 18

FDEC

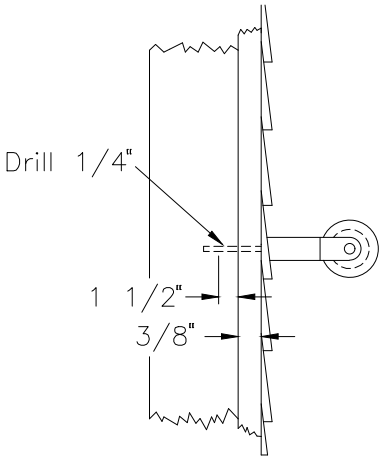
K1.4,K1.5
(K11,K11L),(K15C)



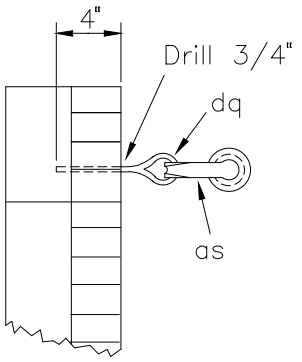




K2.1



K2.2



BRICK OR MASONRY

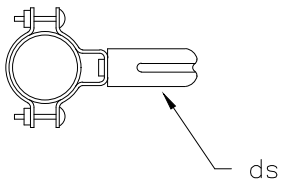
K2.3

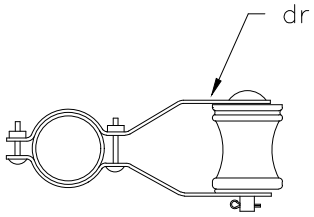
NOTE: Assembly K2.1 not suitable for large conductors or cable services.

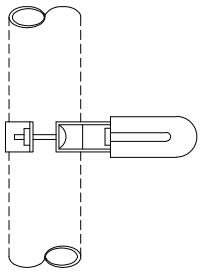
ASSEMBLY: K2		.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
ar	Wireholder	1		
as	Clevis, secondary, swinging, insulated			1
bt	Wireholder, clevis type insulated, #24 Woodscrew		1	
dq	Eye, screw, elliptical, 1/2" X 6"			1
	3/4" x 3 1/2" expansion shield			1

SERVICE ASSEMBLIES

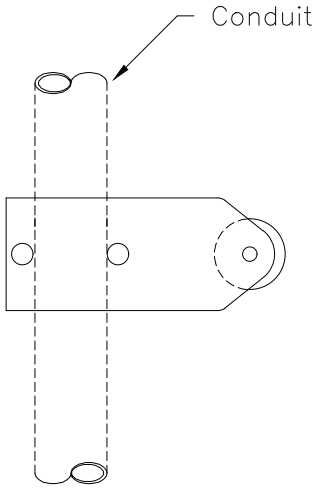
September 18		K2.1,K2.2,K2.3
FDEC		(K10,K10L),(K10C)







K3.1



K3.2

NOTE: Assembly K3.1 not suitable for loarge conductors or cable services.

ASSEMBLY: K3		.1	.2
ITEM	MATERIAL	QTY	QTY
dr	Clevis, conduit, insulated		1
ds	Wireholder, conduit	1	

DESIGN PARAMETERS:

PERMITTED LOADING (lbs)

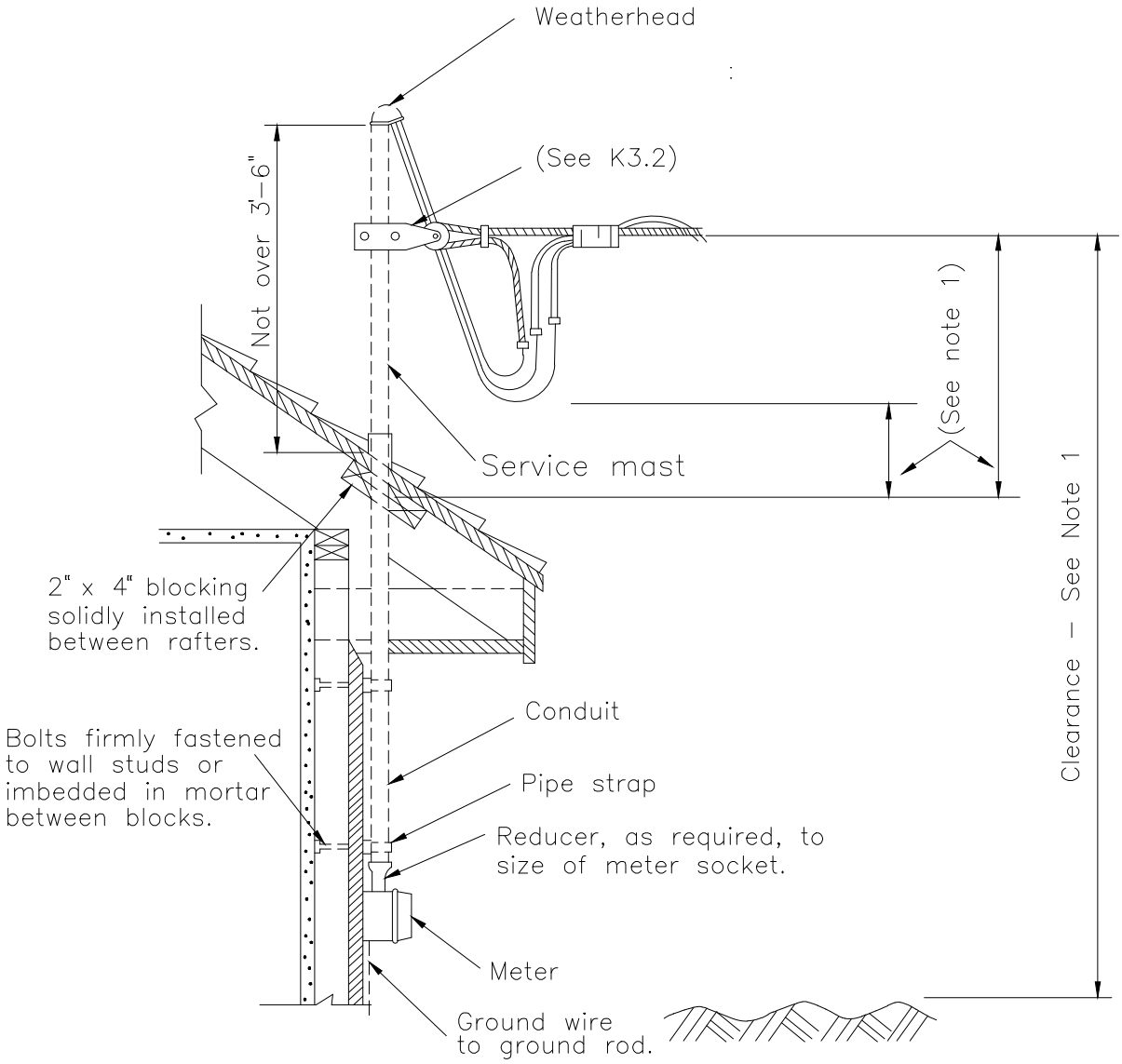
	Deadend	Cantilever
K3.1	1500	800
K3.2	1500	400

SERVICE ASSEMBLIES
(MAST TYPE)

September 18

FDEC

K3.1,K3.2
(K17,K17L),(K16C)



NOTES:

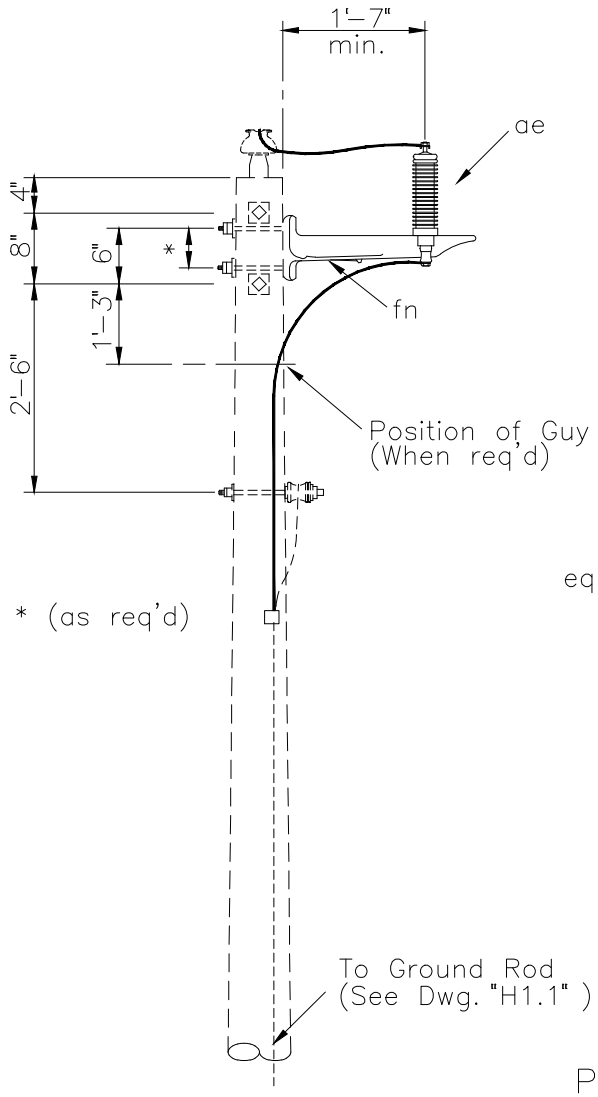
1. All clearances to be in conformance to the most stringent requirements of the NESC, NEC or other codes of governmental or regulating authorities as applicable.

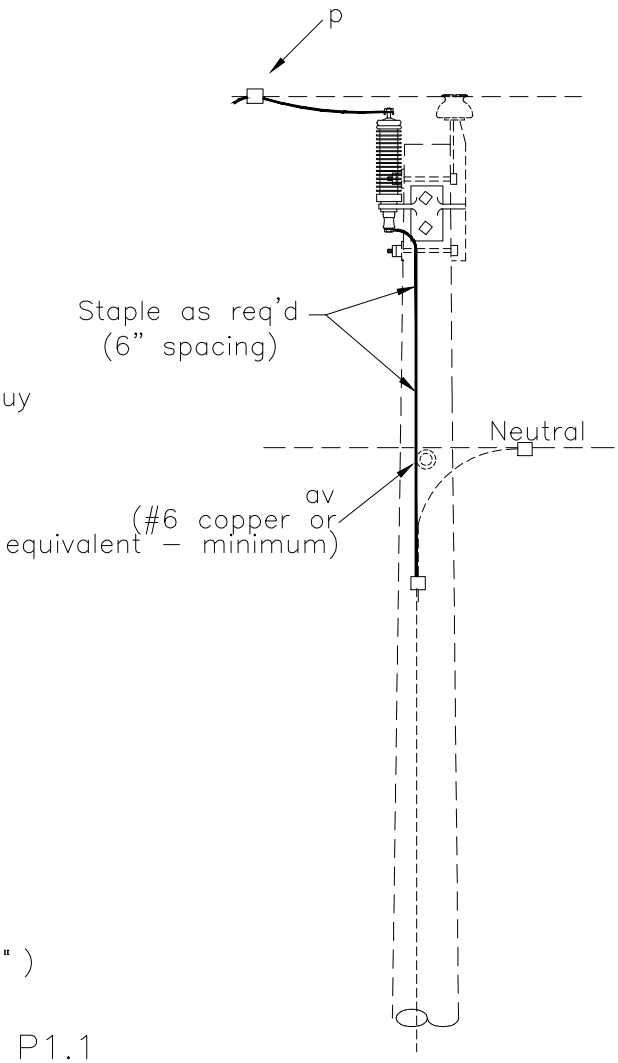
2. If length of conduit exceeds 10 feet, coupling is permitted on end adjacent to meter.

	MAST TYPE SERVICE ASSEMBLY GUIDE	
	September 18 FDEC	K4.2G (M24–10)

PROTECTION ASSEMBLY UNITS

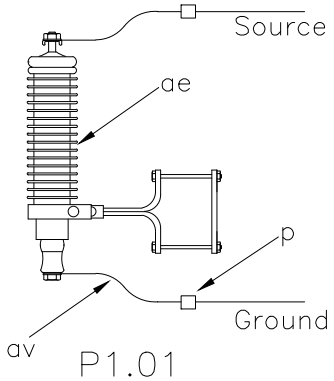
DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
P1.01	(M5-6)	SURGE ARRESTERS - SINGLE PHASE
P1.1		
P1.1NG		SURGE ARRESTER GUIDE - NARROW PROFILE
P1.3		SURGE ARRESTERS - 3 SINGLE PHASE





P1.1

NOTE: Use "P1.01" on existing arm, a minimum of 19" from face of pole.

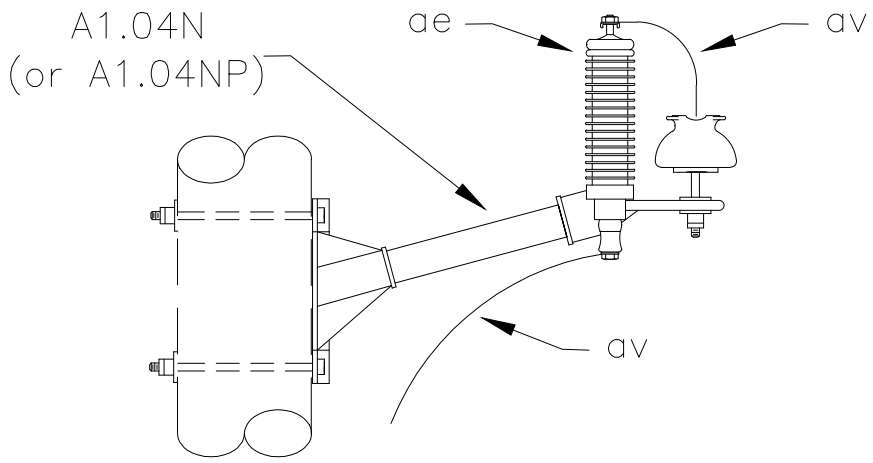


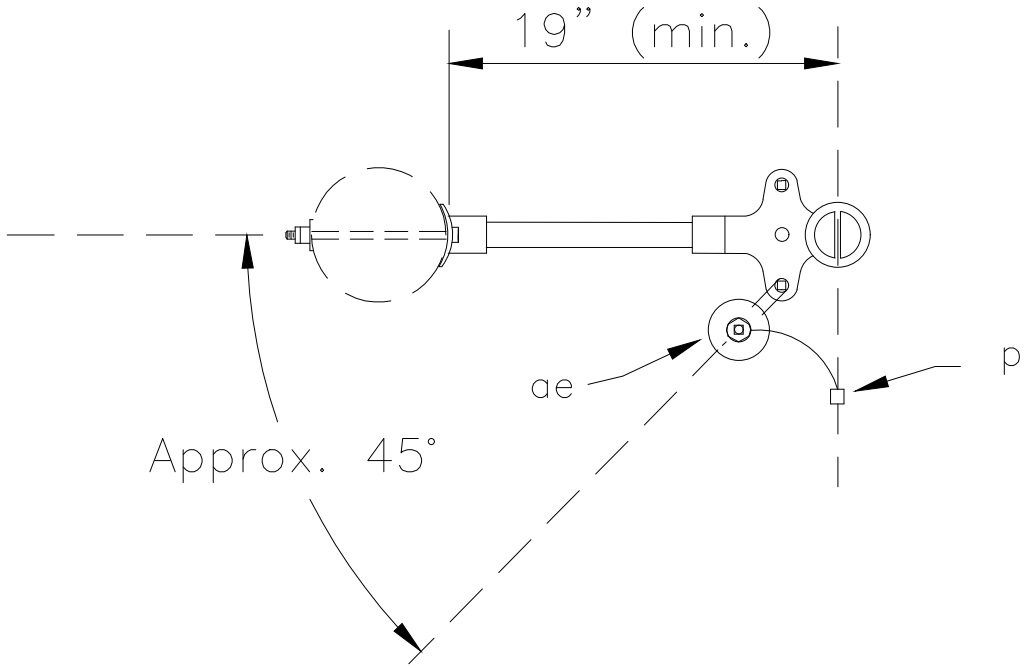
P1.01

ASSEMBLY: P1		.01	.1
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8 x req'd length		2
d	Washer, square, 2 1/4		2
p	Connectors, as req'd		
ae	Arrester, surge, (9 kV)	1	1
av	Jumpers, as req'd		
fn	Bracket, cutout extension		1
ek	Locknuts		2

SURGE ARRESTERS – SINGLE PHASE

September 18	1 – PHASE PRIMARY	P1.01, (M5–6)
FDEC	12.47/7.2 kV	P1.1





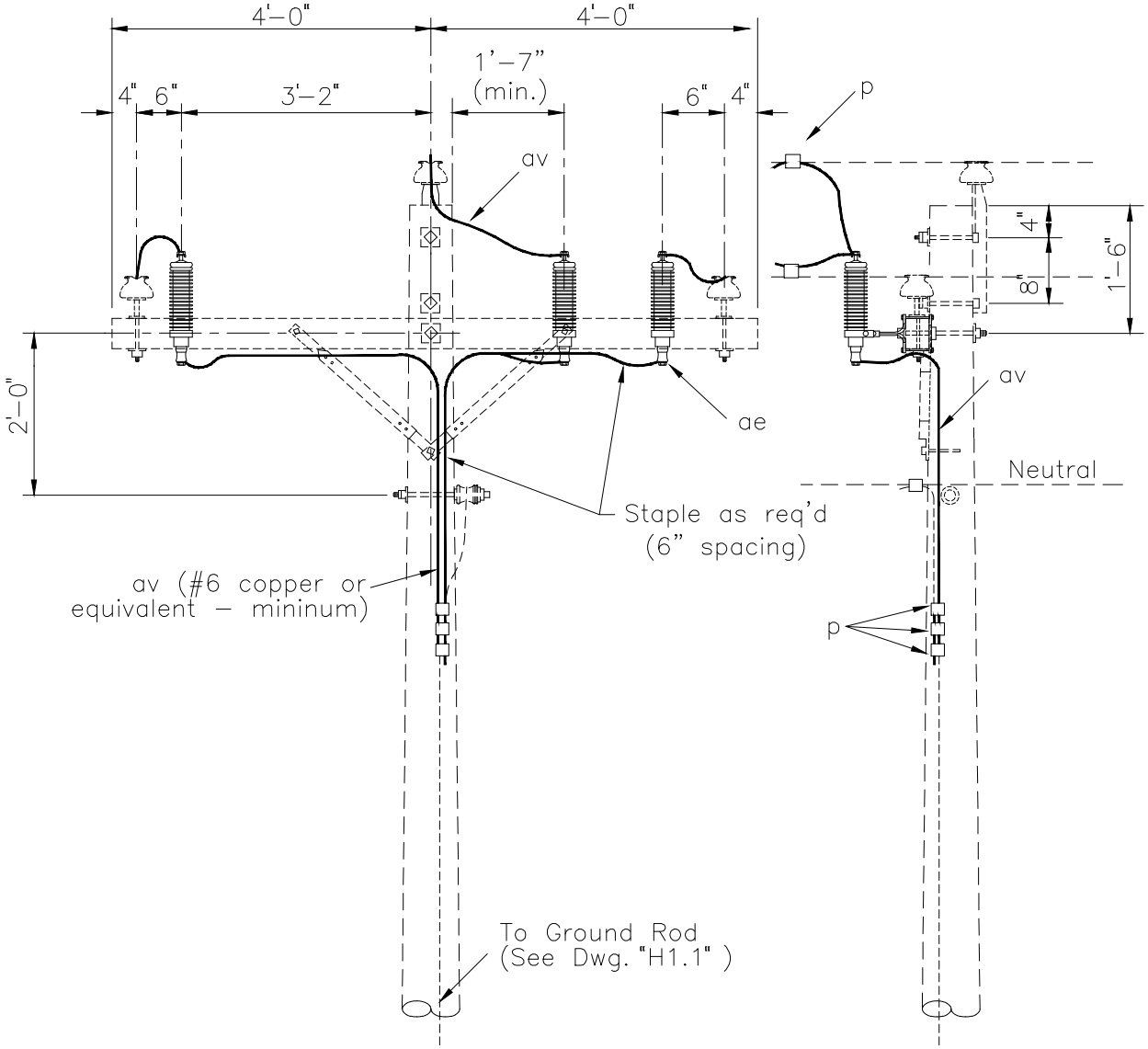
ITEM	MATERIAL
	Assembly A1.04N or A1.04NP
ae	Arrester, surge (9kV)
av	Jumpers, as req'd
p	Connectors, as req'd

NOTE: May be used on an apparatus mounting bracket (item "fm") of any 1, 2 or 3–phase narrow profile assembly. Specify quantity of surge arresters (item "ae").

Design Parameters:

SURGE ARRESTER GUIDE–NARROW PROFILE

September 18	1 – PHASE PRIMARY	P1.1NG
FDEC	12.47/7.2 kV	



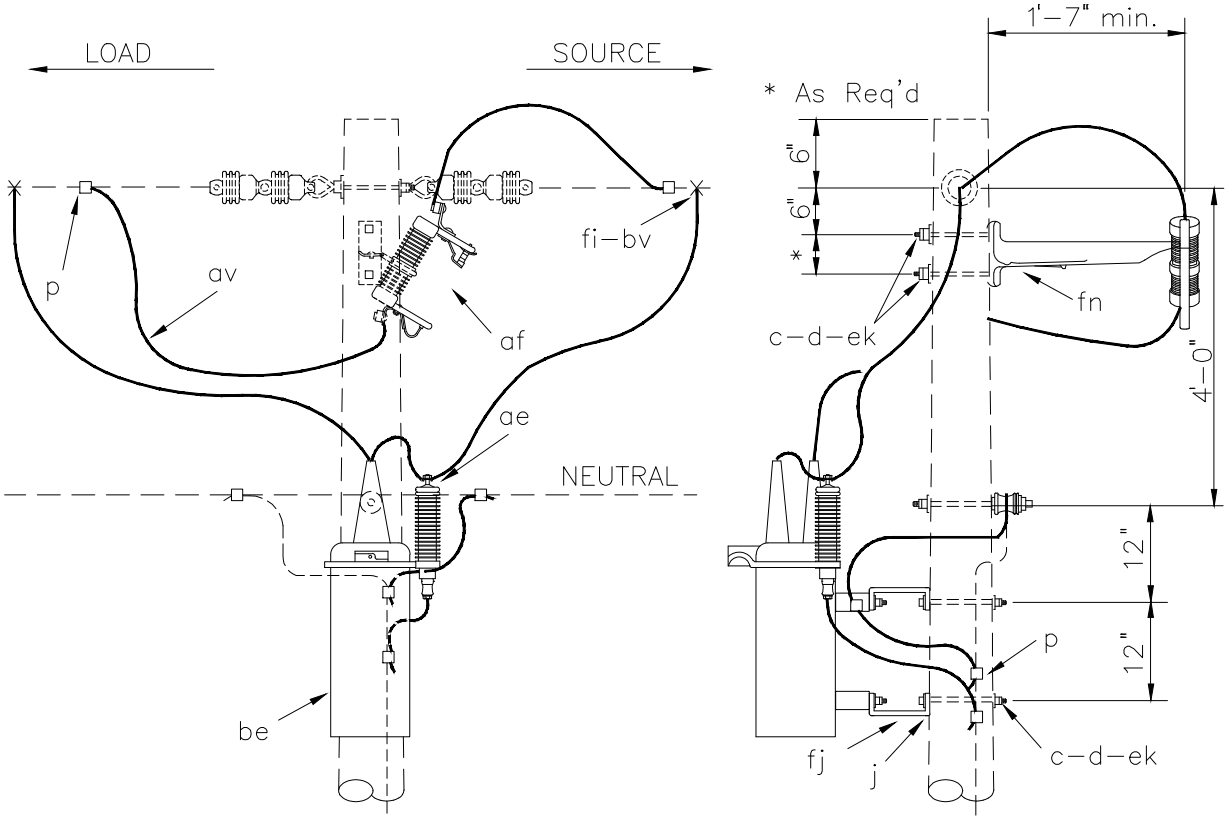
ITEM	QTY	MATERIAL
p		Connectors, as req'd
ae	3	Arrester, surge, (9 kV)
av		Jumpers, as req'd

SURGE ARRESTERS – 3 SINGLE PHASE

September 18	3 – PHASE PRIMARY 12.47/7.2 kV	
FDEC		P1.3

OIL CIRCUIT RECLOSER ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	DRAWING NUMBERS Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
R1.2	(M3-23A)	OIL CIRCUIT RECLOSER - (WITH BYPASS CUTOUT)
R2.2	(M3-24A)	(THREE) OIL CIRCUIT RECLOSERS
R3.2	(M3-25A)	(WITH BYPASS SWITCHES)
R3.3	(M3-30)	THREE-PHASE OIL CIRCUIT RECLOSER WITH BY-PASS SWITCHES



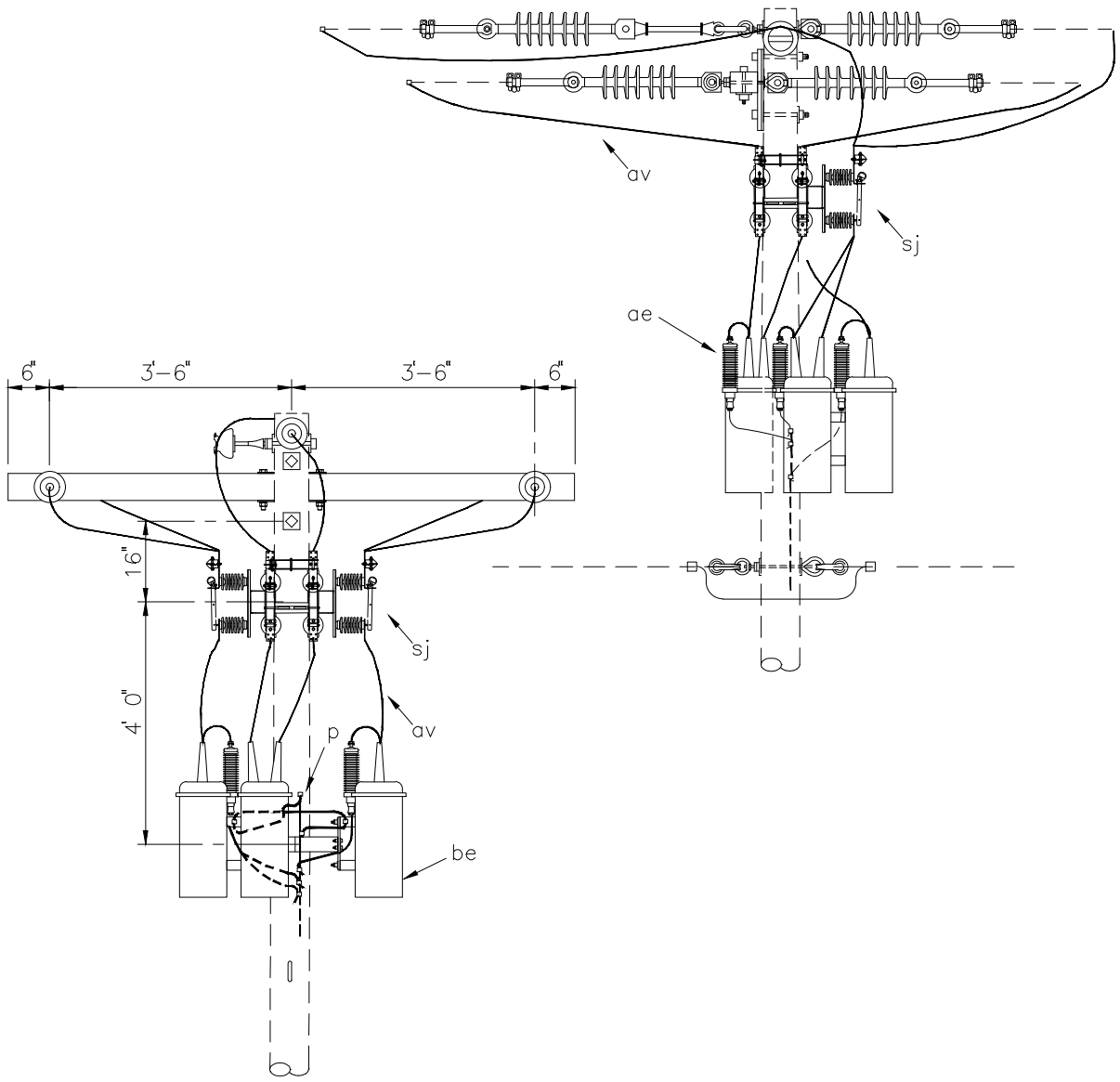
NOTE: The recloser terminal bushing connected to the coil should be connected to the source.

ITEM	QTY	MATERIAL
c	4	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 2 1/4"
p		Connector, as required
ae	1	Arrester, surge (9 kV)
af	1	Cutout, distribution, open (15 kV)
av		Jumpers, stranded, as required

ITEM	QTY	MATERIAL
be	1	Recloser, oil circuit (12.47 kV)
bv		Rod, armor, as req'd
ek	4	Locknuts
fi	2	Connector, hot line
fj	2	Brackets, extension, 9" long
fn	1	Bracket, extension

OIL CIRCUIT RECLOSER (WITH BYPASS CUTOUT)

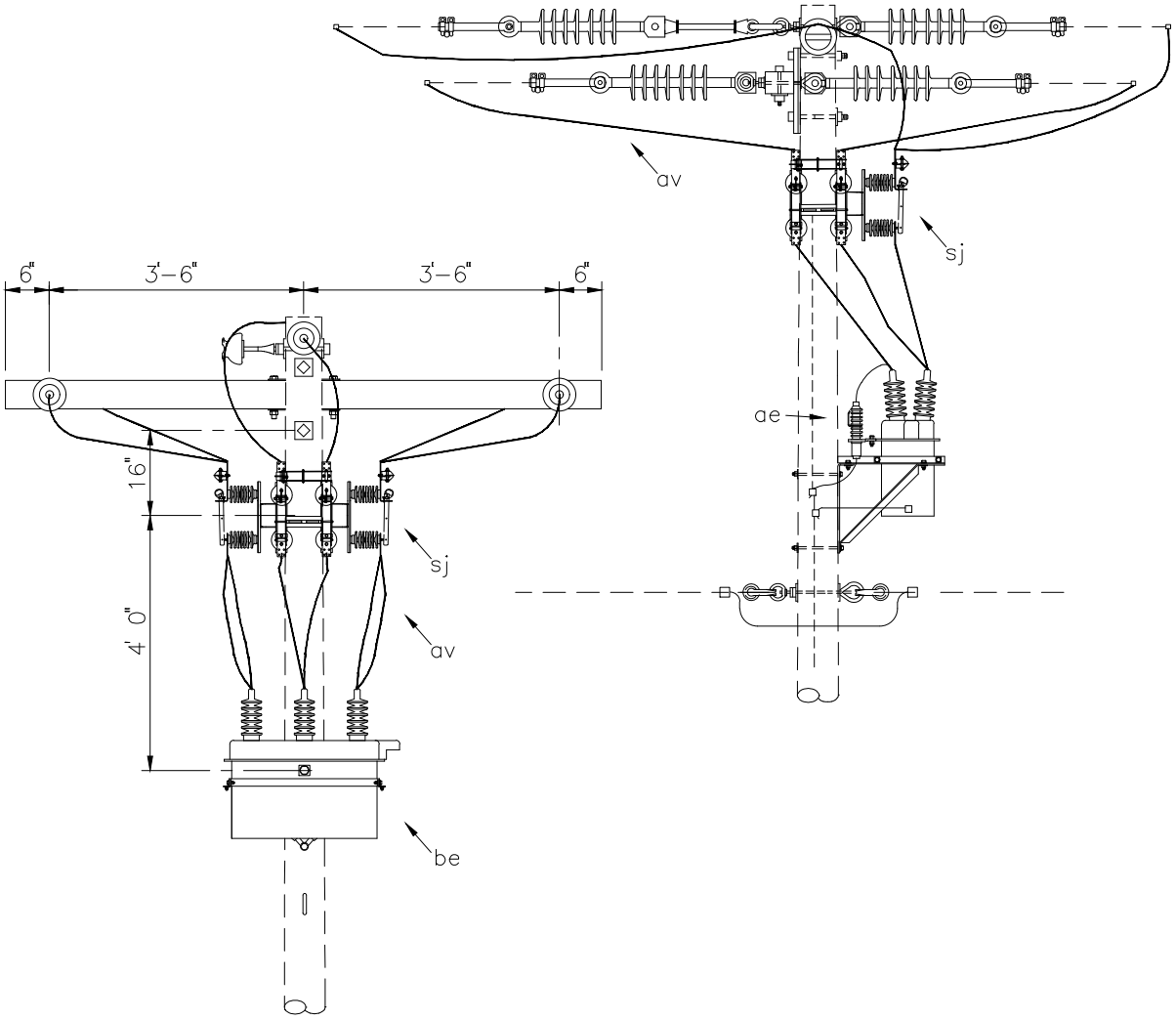
APRIL 2005	1 – PHASE PRIMARY	R1.2
RUS	12.47/7.2 kV	(M3–23A)



ITEM	QTY	MATERIAL
c	4	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 2 1/4"
p		Connectors, as required
ae	3	Arresters, surge, (9 kV)
av		Jumpers, riser wire, as req'd
be	3	Recloser, oil circuit
dm	2	Bracket, cluster mount
ek	4	Locknuts
sj	3	Switch, OCR, bypass

(THREE) OIL CIRCUIT RECLOSERS (WITH BYPASS SWITCHES)

September 18	3 – PHASE PRIMARY	R2.2
FDEC	12.47/7.2 kV	R3.2



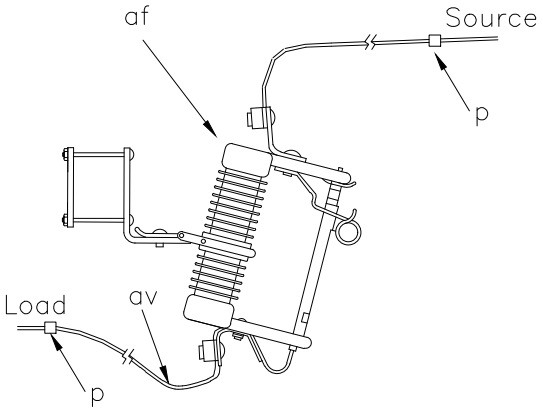
ITEM	NO.	MATERIAL
a	1	Insulator, pin type
c	4	Bolt, machine, 5/8"x req'd length
d	4	Washer, square, 2–1/4"
f	1	Adapter, pin type
p		Connectors, compression, as req'd
ae	3	Arresters, surge
av		Jumpers, riser wire, as req'd
be	3	Recloser, oil circuit – 3 Phase
dm	1	Bracket, cluster mount
ek	4	Locknuts
sj	3	Switch, OCR, bypass
*	1	Mounting bracket for 3–Phase recloser

THREE–PHASE OIL CIRCUIT RECLOSER WITH BY–PASS SWITCHES

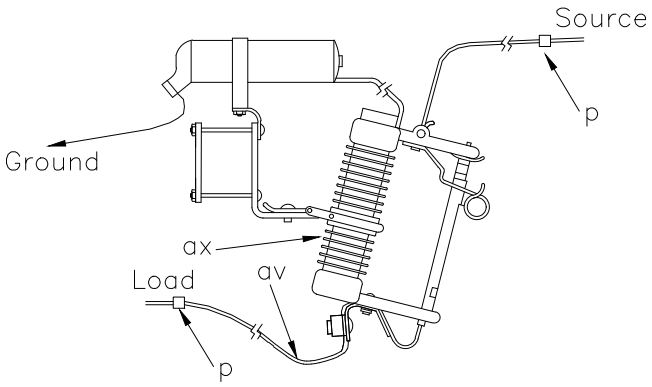
September 18	3 – PHASE PRIMARY 12.47/7.2 kV	
FDEC		R3.3

SECTIONALIZING ASSEMBLY UNITS

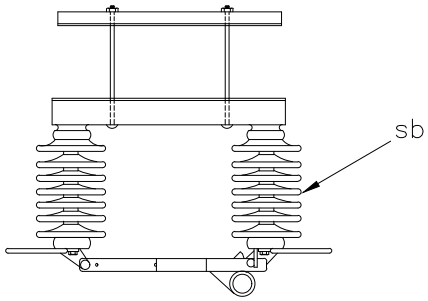
DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
S1.01 S2.01	(M5-9)	MISCELLANEOUS CUTOUTS AND DISCONNECT SWITCH
S1.03		TRIP SAVER CUTOUTS - (THREE SINGLE-PHASE)
S2.21 S2.31	(M3-2A) (M3-3A)	DISCONNECT SWITCHES - (TWO OR THREE SINGLE-PHASE)
S3.1	(M3-41)	SECTIONALIZER



S1.01



S1.02



S2.01

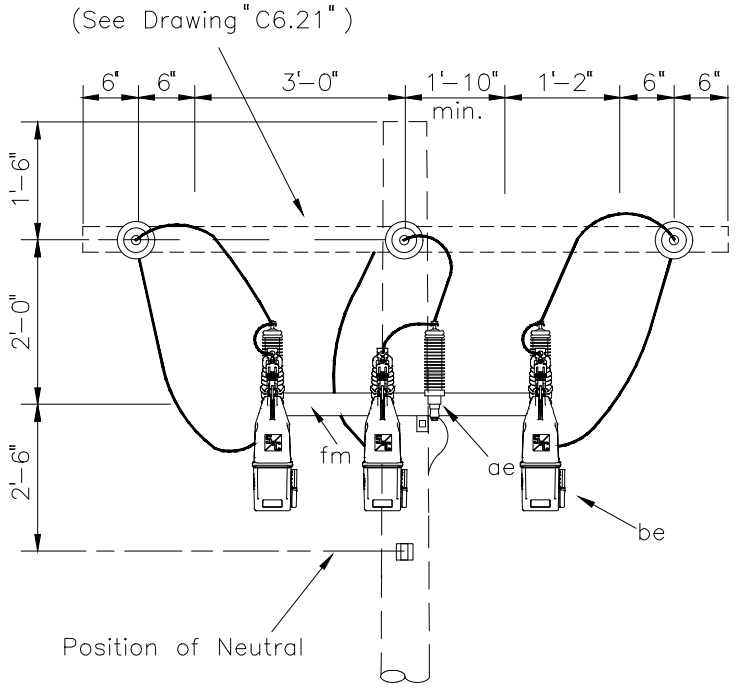
NOTES: Specify cutouts to be furnished with fuse tube or switch blade.

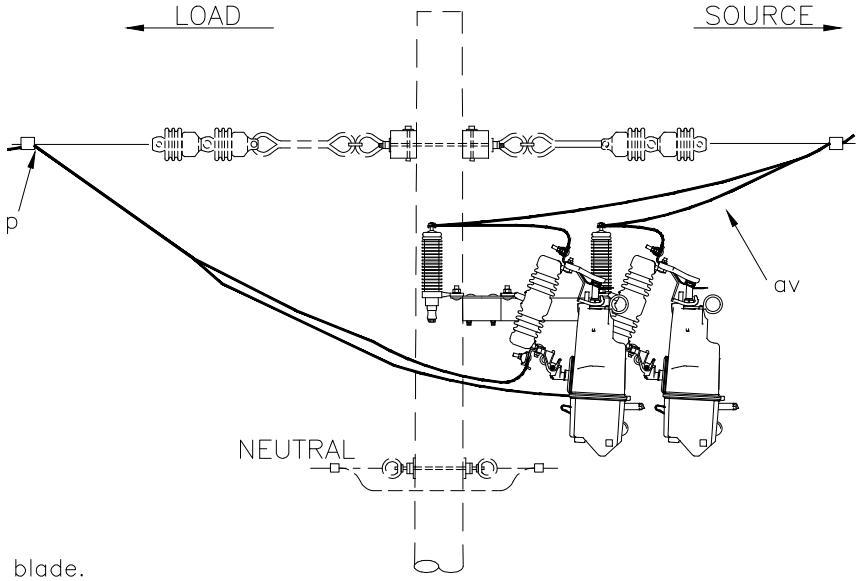
"S2.01" may be used with assembly "C6.21" (mount braces above crossarm). See "S2.32".

ASSEMBLY: S		1.01	2.01
ITEM	MATERIAL	QTY	QTY
p	Connector, as req'd		
af	Cutout, dist., open (15 kV)	1	
av	Jumpers, as req'd		
sb	Switch, disconnect (15 kV)		1

MISCELLANEOUS CUTOUTS AND DISCONNECT SWITCH

September 18		S1.01
FDEC	12.47/7.2 kV	S2.01



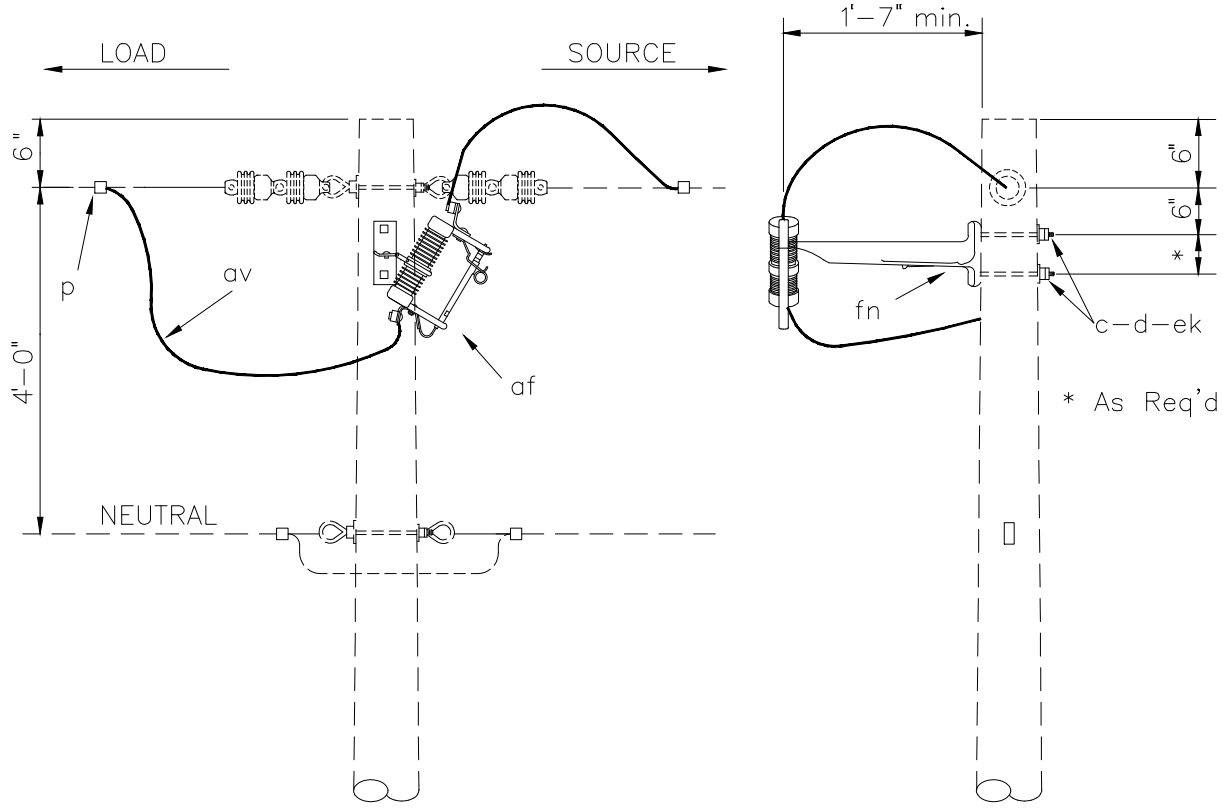


NOTES:
1. Specify fuse size or solid blade.
2. Mount cutouts so that blades face climbing face of pole.

ITEM	QTY	MATERIAL
p	6	Connector, compression type
af	3	Cutout, distribution open (15 kV)
av		Jumpers, as req'd
be	3	Recloser, s&c TripSaver II
		cutout mounted
ae	3	Arrester, surge (9 kV)

CUTOUTS
(THREE SINGLE-PHASE)

September 18		
FDEC	12.47/7.2 kV	S1.03

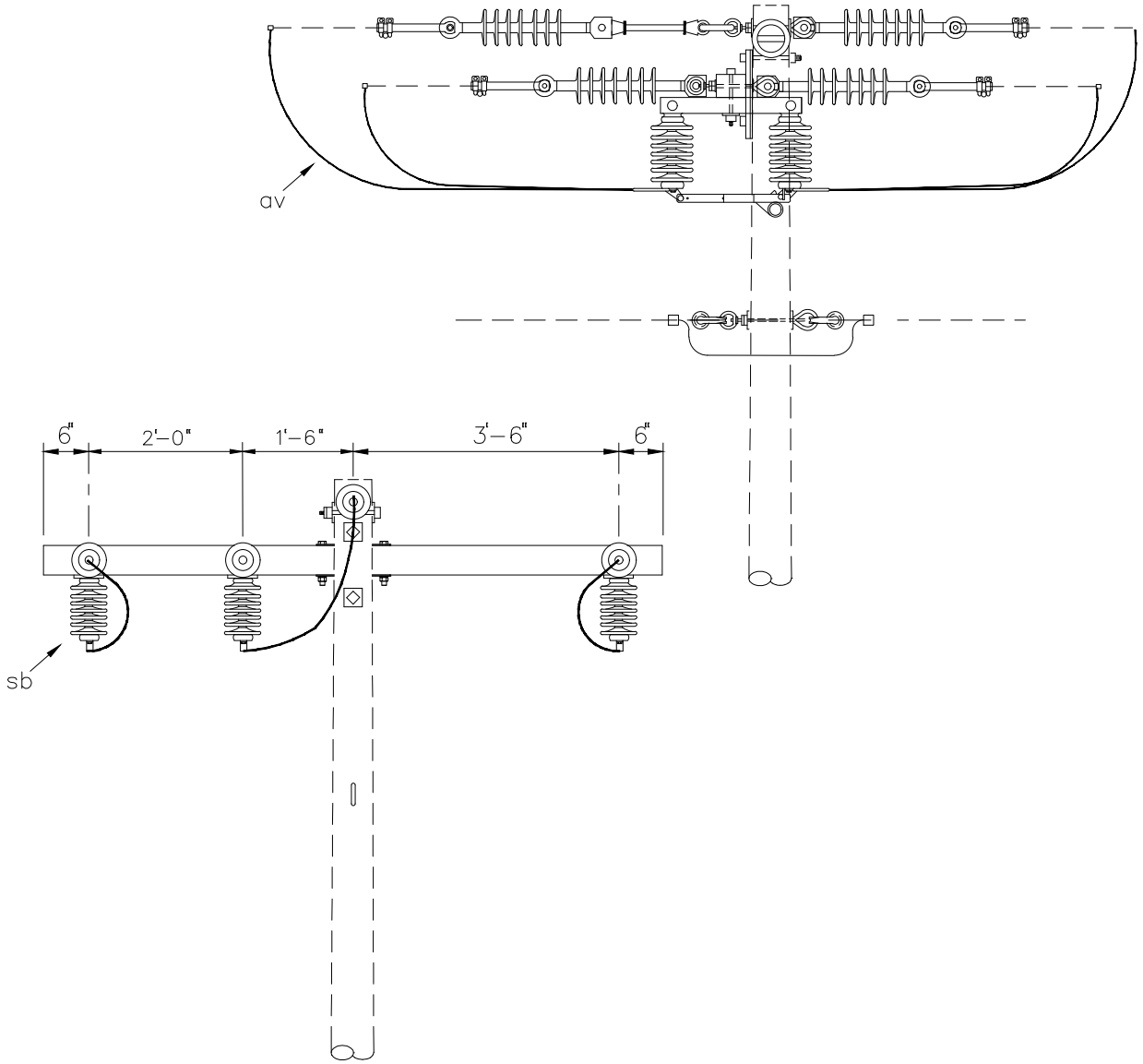


NOTE: Specify fuse size or solid blade

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
p	2	Connector, compression type
af	1	Cutout, distribution, open (15 kV)
av		Jumpers, as required
ek	2	Locknuts
fn	1	Bracket, extension

CUTOUT – SINGLE PHASE

September 18 FDEC	12.47/7.2 kV	S1.1 (M3–4)

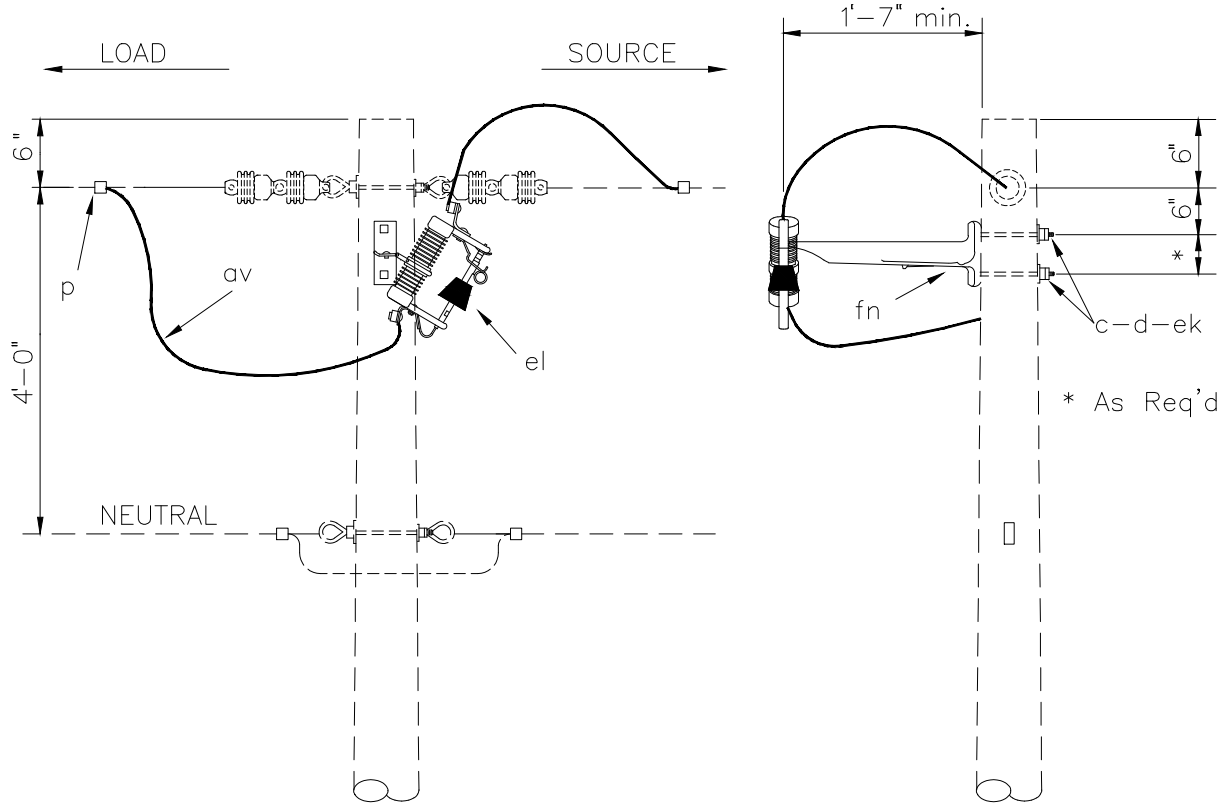


NOTE: For 2-phase installations, omit switch and related items on center phase and designate as "S2.21."

ITEM	QTY	MATERIAL
p		Connectors, compression as required
sb	3	Switch, disconnect, 15 kV,
av		Jumpers, as required(#2 copper min.)

DISCONNECT SWITCHES (TWO or THREE SINGLE-PHASE)

September 18		S2.21,S2.31
FDEC	12.47/7.2 kV	(M3-2A),(M3-3A)



NOTE: Specify fuse size or solid blade

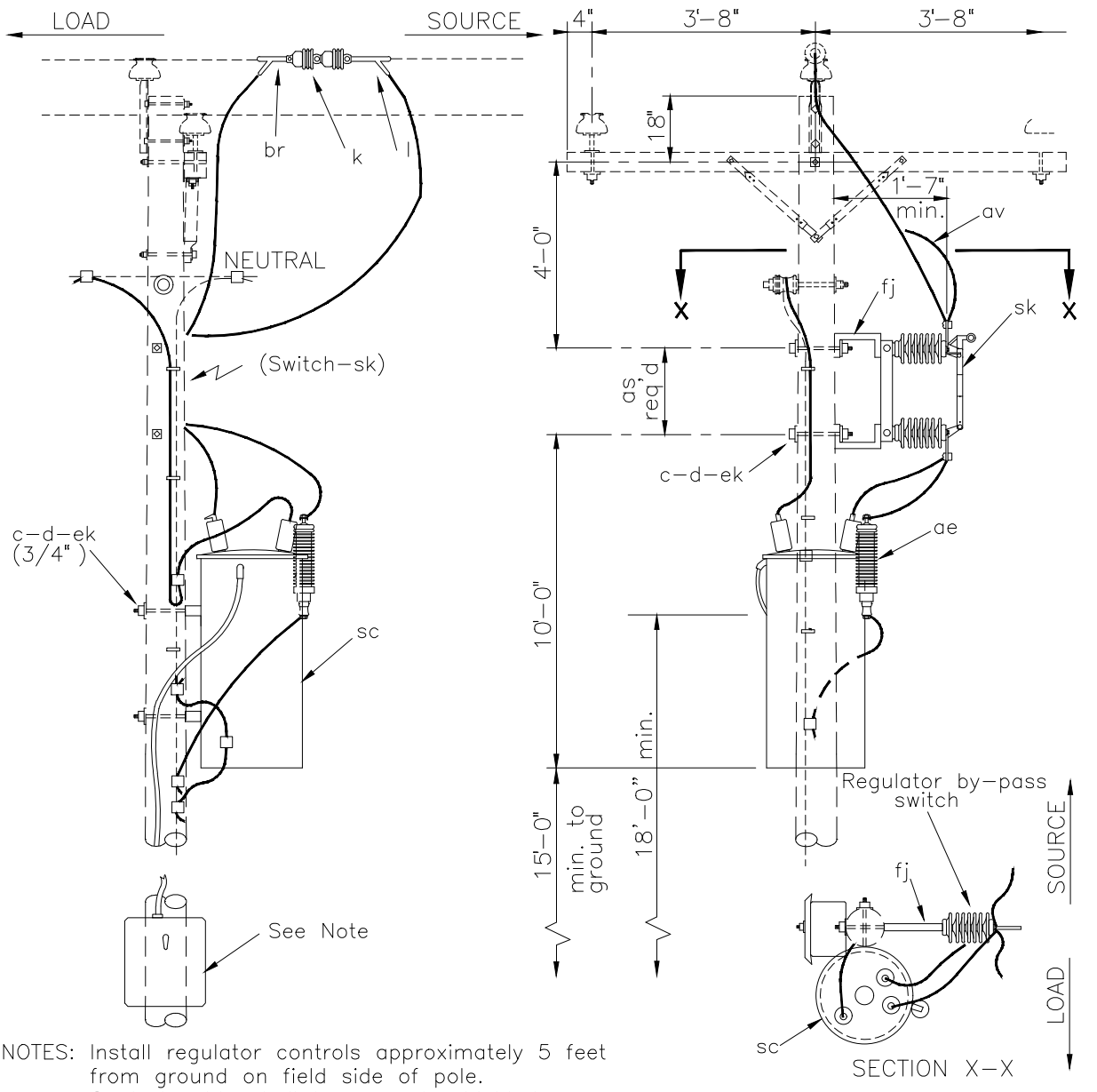
ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
p	2	Connector, compression type
el	1	Sectionalizer
av		Jumpers, as required
ek	2	Locknuts
fn	1	Bracket, extension

SECTIONALIZER

September 18 FDEC	1 – PHASE PRIMARY 12.47/7.2 kV	S3.1

VOLTAGE ALTERATION EQUIPMENT ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
Y1.1	(M7-11)	VOLTAGE REGULATOR, POLE MOUNTED (ONE SINGLE-PHASE)
Y3.2	(M9-12)	THREE-PHASE CAPACITOR BANK
Y3.3	(M9-13)	
Y3.4		SWITCHED CAPACITOR BANK - THREE-PHASE



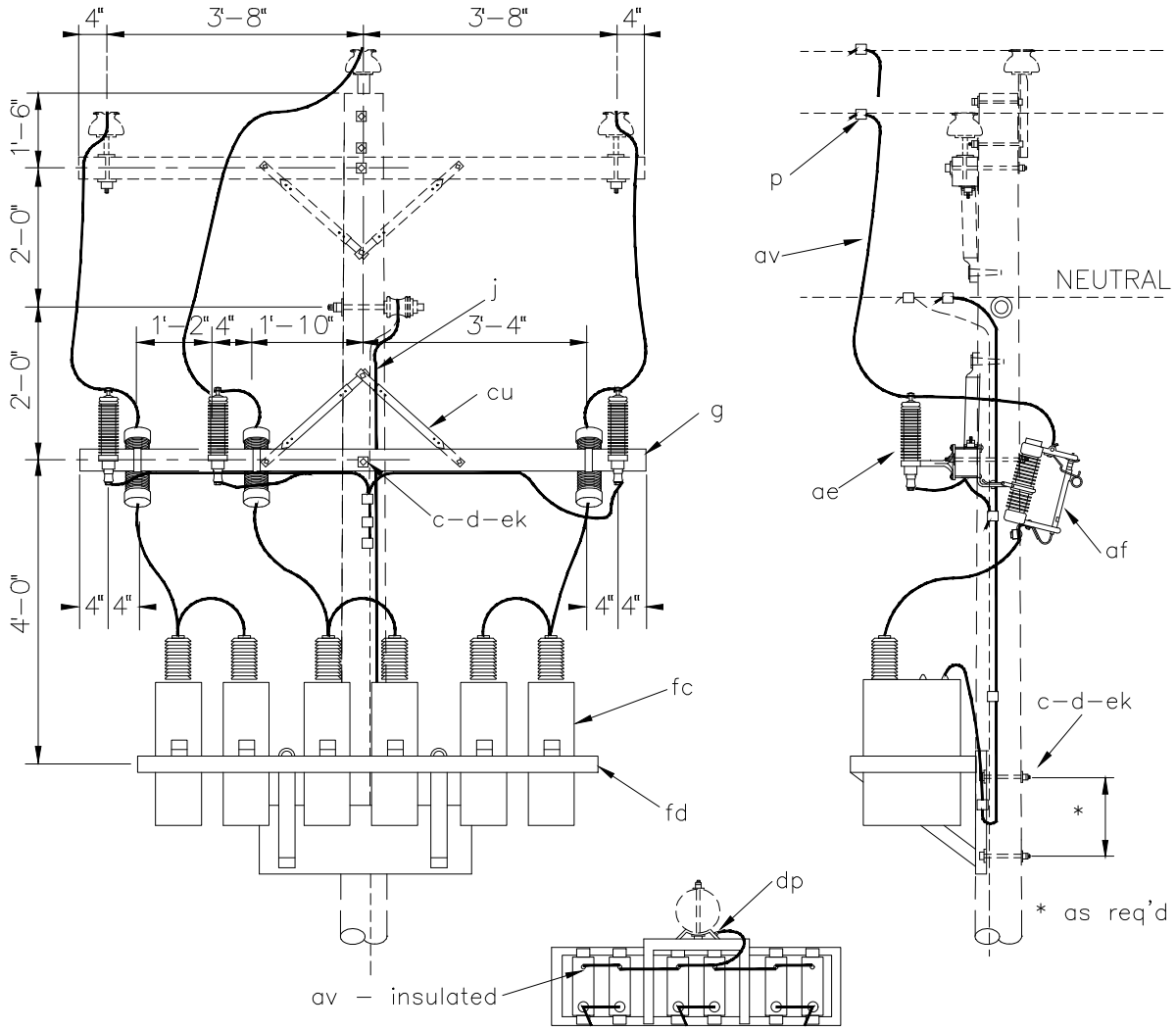
NOTES: Install regulator controls approximately 5 feet from ground on field side of pole.
Control cable shall be properly shielded or installed in suitable conduit.

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
c	2	Bolt, machine, 3/4" x req'd length
d	2	Washer, square, 2 1/4"
d	2	Washer, square, 3," curved
k	2	Insulator, suspension, 4 1/4
l	2	Clamp, deadend
p		Connectors, compression, as req'd
ae	1	Arrester, surge (9 kV)

ITEM	QTY	MATERIAL
av		Jumpers, bare, stranded, as req'd
br	1	Chain link
bu		Connector, grounding
fj	2	Bracket, extension, 9"
sc	1	Regulator, voltage, step–type
		12.47/7.2 kV
sk	1	Switch, regulator by–pass
ek	4	Locknuts

VOLTAGE REGULATOR, POLE MOUNTED (ONE SINGLE–PHASE)

September 18		Y1.1
FDEC	12.47/7.2 kV	(M7–11)



WIRING DIAGRAM

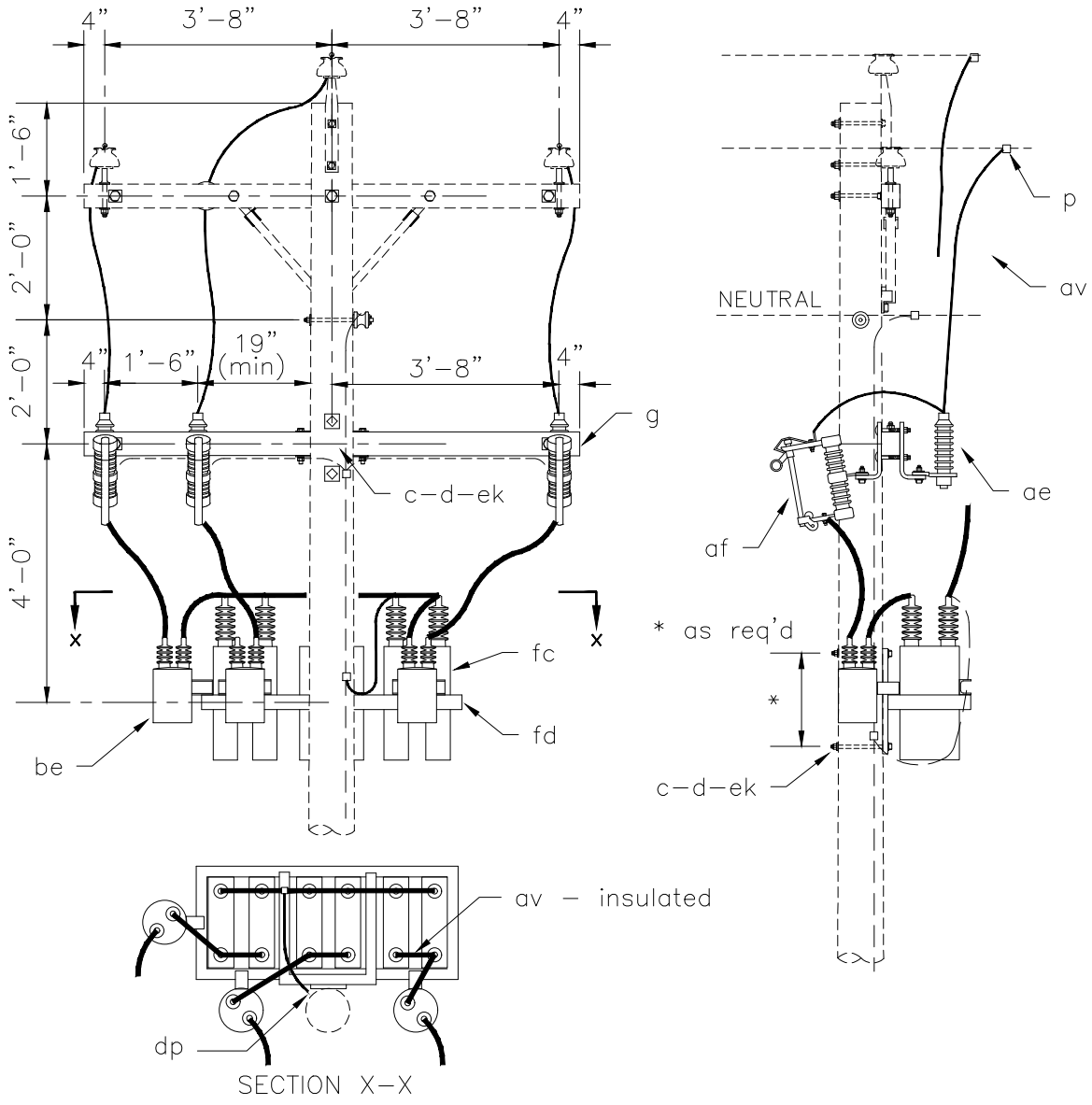
NOTE:
1. Specify insulating caps for primary terminal bushings.
2. For two–phase assemblies, omit capacitors and other material on center phase; designate assembly as "Y3.2."

ITEM	QTY	MATERIAL
c	3	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 2 1/4"
g	1	Crossarm, 3 5/8" X 4 5/8" X 8–0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
p		Connectors, as req'd
p		Connectors, compression, as req'd
ae	3	Arrester, surge (9 kV)
af	3	Cutout, dist., loadbreak, (15 kV)

ITEM	QTY	MATERIAL
av		Jumpers, bare, stranded, as req'd
av		Jumpers, insulated, as req'd
cu	2	Brace, 28"
dp	1	Clamp, ground wire
ek	5	Locknuts
fc		Capacitor, shunt, 12.47/7.2 kV
		(specify number and kVAR)
fd	1	Hanger, capacitor

THREE PHASE CAPACITOR BANK

September 18 FDEC	3 - PHASE PRIMARY 12.47/7.2 kV	Y3.2,Y3.3 (M9–12),(M9–13)



NOTE:

1. Specify insulating caps for primary terminal bushings.

ITEM	QTY	MATERIAL
c	4	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 2 1/4"
g	1	Crossarm, fiberglass, 8'
p		Connectors, as req'd
p		Connectors, compression,as req'd
ae	3	Arrester, surge (9 kV)
af	3	Cutout, dist., loadbreak, (15 kV)
av		Jumpers, riser wire, as req'd
dp	1	Clamp, ground wire

ITEM	QTY	MATERIAL
ek	4	Locknuts
fc		Capacitor, shunt, 12.47/7.2 kV
		(specify number and kVAR)
fd	1	Hanger, capacitor
be	3	Switch, oil, with controls
	1	Control, capacitor

THREE–PHASE SWITCHED CAPACITOR BANK

September 18 FDEC	3 – PHASE PRIMARY 12.47/7.2 kV	Y3.4

Calculation of Maximum Line Angles

The following formula and the data tabulated below were used to calculate the maximum line angles on pin and spool insulator assemblies:

$$Sin(\theta/2) = \frac{P - (Fw \times Sw \times Ww)}{2 \times Ft \times T} \qquad \theta = 2 \times Arc\sin\left[\frac{P - (Fw \times Sw \times Ww)}{2 \times Ft \times T}\right]$$

Where:

θ = Maximum Line Angle (calculated): [Degrees]
P = Designated Maximum Transverse Load (allowed on pin or insulator): [lbs]
Fw = Wind Overload Factor for Transverse Loads
Ft = Wire Tension Overload Factor for Transverse Loads
Sw = Wind Span (equals ½ sum of adjacent spans): [ft]
Ww = Wind Load on Conductor: [lbs/ft] *(See Table Below)*
T = Design Tension of Conductor: [lbs] *(See Table Below)*

From NESC Table 253-1 for Grade C Construction:

Fw = 1.75 for non-crossing spans (Footnote 4 to Table 253-1)
= 2.20 for crossing spans
Ft = 1.30

CONDUCTOR SIZE & TYPE	Strength	Maximum Tension	Design Tension *(T)(lbs)*
4 ACSR (7/1)	2360	60%	1416
2 ACSR (6/1)	2850	60%	1710
2 ACSR (7/1)	3640	60%	2184
1/0 ACSR (6/1)	4380	60%	2628
123.3 AAC (7)	4460	60%	2676
2/0 ACSR (6/1)	5310	50%	2655
3/0 ACSR (6/1)	6620	50%	3310
4/0 ACSR (6/1)	8350	40%	3340
246.9 AAC (7)	8560	40%	3424
336.4 ACSR (18/1)	8680	40%	3472
336.4 ACSR (26/7)	14100	35%	4935

	WIND LOAD (*Ww*) *(lbs/ft)* by NESC Loading District		
	LIGHT	MEDIUM	HEAVY
4 ACSR (7/1)	0.1928	0.2523	0.4190
2 ACSR (6/1)	0.2370	0.2720	0.4387
2 ACSR (7/1)	0.2438	0.2750	0.4417
1/0 ACSR (6/1)	0.2985	0.2993	0.4660
123.3 AAC (7)	0.2985	0.2993	0.4660
2/0 ACSR (6/1)	0.3353	0.3157	0.4823
3/0 ACSR (6/1)	0.3765	0.3340	0.5007
4/0 ACSR (6/1)	0.4223	0.3543	0.5210
246.9 AAC (7)	0.4223	0.3543	0.5210
336.4 ACSR (18/1)	0.5130	0.3947	0.5613
336.4 ACSR (26/7)	0.5408	0.4070	0.5737

TABLE I

MAXIMUM LINE ANGLES (Degrees)
PIN and POST TYPE INSULATOR ASSEMBLIES

NESC Grade C Construction ***(Re-calculate for NESC Grade B)***

Designated Maximum Transverse Load = 500 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE	**LIGHT LOADING DISTRICT**					
4 ACSR (7/1)	14	13	13	12	12	11
2 ACSR (6/1)	11	11	10	10	9	9
2 ACSR (7/1)	9	8	8	8	7	7
1/0 ACSR (6/1)	7	7	6	6	5	5
123.3 AAAC (7)	7	7	6	6	5	5
2/0 ACSR (6/1)	7	6	6	5	5	4
3/0 ACSR (6/1)	5	5	4	4	4	3
4/0 ACSR (6/1)	5	5	4	4	3	3
246.9 AAAC (7)	5	5	4	4	3	3
336.4 ACSR (18/1)	5	4	3	3	2	2
336.4 ACSR (26/7)	3	3	2	2	2	1
	MEDIUM LOADING DISTRICT					
4 ACSR (7/1)	14	13	12	11	11	10
2 ACSR (6/1)	11	10	10	9	9	8
2 ACSR (7/1)	9	8	8	7	7	6
1/0 ACSR (6/1)	7	7	6	6	5	5
123.3 AAAC (7)	7	7	6	6	5	5
2/0 ACSR (6/1)	7	6	6	6	5	5
3/0 ACSR (6/1)	5	5	5	4	4	4
4/0 ACSR (6/1)	5	5	5	4	4	3
246.9 AAAC (7)	5	5	4	4	4	3
336.4 ACSR (18/1)	5	5	4	4	3	3
336.4 ACSR (26/7)	4	3	3	3	2	2
	HEAVY LOADING DISTRICT					
4 ACSR (7/1)	12	11	10	9	8	6
2 ACSR (6/1)	10	9	8	7	6	5
2 ACSR (7/1)	8	7	6	5	5	4
1/0 ACSR (6/1)	6	6	5	4	4	3
123.3 AAAC (7)	6	6	5	4	4	3
2/0 ACSR (6/1)	6	6	5	4	3	3
3/0 ACSR (6/1)	5	4	4	3	3	2
4/0 ACSR (6/1)	5	4	4	3	2	2
246.9 AAAC (7)	5	4	4	3	2	2
336.4 ACSR (18/1)	4	4	3	3	2	1
336.4 ACSR (26/7)	3	3	2	2	1	1

TABLE II

MAXIMUM LINE ANGLES (Degrees)
PIN and POST TYPE INSULATOR ASSEMBLIES

NESC Grade C Construction (Re-calculate for NESC Grade B)

Designated Maximum Transverse Load = 750 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE	**LIGHT LOADING DISTRICT**					
4 ACSR (7/1)	22	21	21	20	20	19
2 ACSR (6/1)	18	17	17	16	16	15
2 ACSR (7/1)	14	13	13	13	12	12
1/0 ACSR (6/1)	11	11	10	10	10	9
123.3 AAAC (7)	11	11	10	10	9	9
2/0 ACSR (6/1)	11	11	10	10	9	9
3/0 ACSR (6/1)	9	8	8	7	7	6
4/0 ACSR (6/1)	8	8	7	7	6	6
246.9 AAAC (7)	8	8	7	7	6	6
336.4 ACSR (18/1)	8	7	7	6	6	5
336.4 ACSR (26/7)	5	5	5	4	4	3
	MEDIUM LOADING DISTRICT					
4 ACSR (7/1)	21	21	20	19	19	18
2 ACSR (6/1)	18	17	16	16	15	14
2 ACSR (7/1)	14	13	13	12	12	11
1/0 ACSR (6/1)	11	11	10	10	10	9
123.3 AAAC (7)	11	11	10	10	9	9
2/0 ACSR (6/1)	11	11	10	10	9	9
3/0 ACSR (6/1)	9	8	8	8	7	7
4/0 ACSR (6/1)	9	8	8	7	7	7
246.9 AAAC (7)	8	8	8	7	7	6
336.4 ACSR (18/1)	8	8	7	7	6	6
336.4 ACSR (26/7)	6	5	5	5	4	4
	HEAVY LOADING DISTRICT					
4 ACSR (7/1)	20	19	18	17	15	14
2 ACSR (6/1)	16	15	14	13	12	11
2 ACSR (7/1)	13	12	11	10	10	9
1/0 ACSR (6/1)	11	10	9	8	8	7
123.3 AAAC (7)	10	10	9	8	8	7
2/0 ACSR (6/1)	10	10	9	8	8	7
3/0 ACSR (6/1)	8	8	7	6	6	5
4/0 ACSR (6/1)	8	7	7	6	6	5
246.9 AAAC (7)	8	7	7	6	6	5
336.4 ACSR (18/1)	8	7	6	6	5	5
336.4 ACSR (26/7)	5	5	4	4	4	3

TABLE III

MAXIMUM LINE ANGLES (Degrees)
PIN and POST TYPE INSULATOR ASSEMBLIES

NESC Grade C Construction ***(Re-calculate for NESC Grade B)***

Designated Maximum Transverse Load = 1,000 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE	**LIGHT LOADING DISTRICT**					
4 ACSR (7/1)	30	29	29	28	28	27
2 ACSR (6/1)	24	24	23	23	22	22
2 ACSR (7/1)	19	19	18	18	17	17
1/0 ACSR (6/1)	16	15	15	14	14	13
123.3 AAAC (7)	15	15	14	14	13	13
2/0 ACSR (6/1)	15	15	14	14	13	13
3/0 ACSR (6/1)	12	12	11	11	10	10
4/0 ACSR (6/1)	12	11	11	10	10	9
246.9 AAAC (7)	11	11	11	10	10	9
336.4 ACSR (18/1)	11	10	10	9	9	8
336.4 ACSR (26/7)	8	7	7	6	6	6
	MEDIUM LOADING DISTRICT					
4 ACSR (7/1)	29	29	28	27	27	26
2 ACSR (6/1)	24	23	23	22	22	21
2 ACSR (7/1)	19	18	18	17	17	16
1/0 ACSR (6/1)	16	15	15	14	14	13
123.3 AAAC (7)	15	15	14	14	13	13
2/0 ACSR (6/1)	15	15	14	14	13	13
3/0 ACSR (6/1)	12	12	11	11	11	10
4/0 ACSR (6/1)	12	12	11	11	10	10
246.9 AAAC (7)	12	11	11	10	10	10
336.4 ACSR (18/1)	11	11	11	10	10	9
336.4 ACSR (26/7)	8	8	7	7	7	6
	HEAVY LOADING DISTRICT					
4 ACSR (7/1)	28	27	26	24	23	22
2 ACSR (6/1)	23	22	21	20	19	18
2 ACSR (7/1)	18	17	16	16	15	14
1/0 ACSR (6/1)	15	14	13	13	12	11
123.3 AAAC (7)	14	14	13	12	12	11
2/0 ACSR (6/1)	15	14	13	12	12	11
3/0 ACSR (6/1)	12	11	10	10	9	9
4/0 ACSR (6/1)	11	11	10	10	9	8
246.9 AAAC (7)	11	11	10	9	9	8
336.4 ACSR (18/1)	11	10	10	9	8	8
336.4 ACSR (26/7)	8	7	7	6	6	5

TABLE IV

MAXIMUM LINE ANGLES (Degrees)
PIN and POST TYPE INSULATOR ASSEMBLIES

NESC Grade C Construction ***(Re-calculate for NESC Grade B)***

Designated Maximum Transverse Load = 1,500 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE	**LIGHT LOADING DISTRICT**					
4 ACSR (7/1)	46	46	45	45	44	44
2 ACSR (6/1)	38	37	37	36	35	35
2 ACSR (7/1)	29	29	28	28	28	27
1/0 ACSR (6/1)	24	24	23	23	22	22
123.3 AAAC (7)	24	23	23	22	22	21
2/0 ACSR (6/1)	24	23	23	22	22	21
3/0 ACSR (6/1)	19	18	18	17	17	17
4/0 ACSR (6/1)	18	18	17	17	16	16
246.9 AAAC (7)	18	17	17	17	16	16
336.4 ACSR (18/1)	17	17	16	16	15	15
336.4 ACSR (26/7)	12	12	11	11	10	10
	MEDIUM LOADING DISTRICT					
4 ACSR (7/1)	46	45	44	44	43	42
2 ACSR (6/1)	37	37	36	36	35	34
2 ACSR (7/1)	29	29	28	28	27	27
1/0 ACSR (6/1)	24	24	23	23	22	22
123.3 AAAC (7)	24	23	23	22	22	21
2/0 ACSR (6/1)	24	23	23	22	22	21
3/0 ACSR (6/1)	19	18	18	18	17	17
4/0 ACSR (6/1)	19	18	18	17	17	17
246.9 AAAC (7)	18	18	17	17	17	16
336.4 ACSR (18/1)	18	17	17	16	16	16
336.4 ACSR (26/7)	12	12	12	12	11	11
	HEAVY LOADING DISTRICT					
4 ACSR (7/1)	44	43	42	41	39	38
2 ACSR (6/1)	36	35	34	33	32	31
2 ACSR (7/1)	28	27	27	26	25	24
1/0 ACSR (6/1)	23	23	22	21	20	20
123.3 AAAC (7)	23	22	21	21	20	19
2/0 ACSR (6/1)	23	22	22	21	20	19
3/0 ACSR (6/1)	18	18	17	17	16	15
4/0 ACSR (6/1)	18	17	17	16	16	15
246.9 AAAC (7)	18	17	16	16	15	15
336.4 ACSR (18/1)	17	17	16	15	15	14
336.4 ACSR (26/7)	12	12	11	11	10	10

TABLE V

MAXIMUM LINE ANGLES (Degrees)
PIN and POST TYPE INSULATOR ASSEMBLIES

NESC Grade C Construction ***(Re-calculate for NESC Grade B)***

Designated Maximum Transverse Load = 2,000 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE	**LIGHT LOADING DISTRICT**					
4 ACSR (7/1)	60	60	60	60	60	60
2 ACSR (6/1)	52	51	50	50	49	49
2 ACSR (7/1)	40	39	39	38	38	38
1/0 ACSR (6/1)	33	32	32	31	31	30
123.3 AAAC (7)	32	32	31	31	30	30
2/0 ACSR (6/1)	32	32	31	31	30	30
3/0 ACSR (6/1)	26	25	25	24	24	23
4/0 ACSR (6/1)	25	25	24	24	23	23
246.9 AAAC (7)	25	24	24	23	23	22
336.4 ACSR (18/1)	24	23	23	22	22	21
336.4 ACSR (26/7)	17	16	16	15	15	15
	MEDIUM LOADING DISTRICT					
4 ACSR (7/1)	60	60	60	60	60	59
2 ACSR (6/1)	51	51	50	49	49	48
2 ACSR (7/1)	40	39	39	38	38	37
1/0 ACSR (6/1)	33	32	32	31	31	30
123.3 AAAC (7)	32	32	31	31	30	30
2/0 ACSR (6/1)	32	32	31	31	30	30
3/0 ACSR (6/1)	26	25	25	24	24	24
4/0 ACSR (6/1)	25	25	25	24	24	23
246.9 AAAC (7)	25	24	24	24	23	23
336.4 ACSR (18/1)	24	24	23	23	22	22
336.4 ACSR (26/7)	17	17	16	16	16	15
	HEAVY LOADING DISTRICT					
4 ACSR (7/1)	60	60	59	58	57	55
2 ACSR (6/1)	50	49	48	47	46	45
2 ACSR (7/1)	39	38	37	36	35	35
1/0 ACSR (6/1)	32	31	30	30	29	28
123.3 AAAC (7)	31	31	30	29	29	28
2/0 ACSR (6/1)	31	31	30	29	29	28
3/0 ACSR (6/1)	25	24	24	23	23	22
4/0 ACSR (6/1)	25	24	24	23	22	22
246.9 AAAC (7)	24	24	23	22	22	21
336.4 ACSR (18/1)	24	23	22	22	21	21
336.4 ACSR (26/7)	17	16	16	15	15	14

TABLE VI

MAXIMUM LINE ANGLES (Degrees) ON SPOOL INSULATOR ASSEMBLIES

NESC Grade C Construction ***(Re-calculate for NESC Grade B)***
(ANSI Clss 53-2 Spool Insulator)

Designated Maximum Transverse Load = 1,500 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE	**LIGHT LOADING DISTRICT**					
4 ACSR (7/1)	46	46	45	45	44	44
2 ACSR (6/1)	38	37	37	36	35	35
2 ACSR (7/1)	29	29	28	28	28	27
1/0 ACSR (6/1)	24	24	23	23	22	22
123.3 AAAC (7)	24	23	23	22	22	21
2/0 ACSR (6/1)	24	23	23	22	22	21
3/0 ACSR (6/1)	19	18	18	17	17	17
4/0 ACSR (6/1)	18	18	17	17	16	16
246.9 AAAC (7)	18	17	17	17	16	16
336.4 ACSR (18/1)	17	17	16	16	15	15
336.4 ACSR (26/7)	12	12	11	11	10	10
	MEDIUM LOADING DISTRICT					
4 ACSR (7/1)	46	45	44	44	43	42
2 ACSR (6/1)	37	37	36	36	35	34
2 ACSR (7/1)	29	29	28	28	27	27
1/0 ACSR (6/1)	24	24	23	23	22	22
123.3 AAAC (7)	24	23	23	22	22	21
2/0 ACSR (6/1)	24	23	23	22	22	21
3/0 ACSR (6/1)	19	18	18	18	17	17
4/0 ACSR (6/1)	19	18	18	17	17	17
246.9 AAAC (7)	18	18	17	17	17	16
336.4 ACSR (18/1)	18	17	17	16	16	16
336.4 ACSR (26/7)	12	12	12	12	11	11
	HEAVY LOADING DISTRICT					
4 ACSR (7/1)	44	43	42	41	39	38
2 ACSR (6/1)	36	35	34	33	32	31
2 ACSR (7/1)	28	27	27	26	25	24
1/0 ACSR (6/1)	23	23	22	21	20	20
123.3 AAAC (7)	23	22	21	21	20	19
2/0 ACSR (6/1)	23	22	22	21	20	19
3/0 ACSR (6/1)	18	18	17	17	16	15
4/0 ACSR (6/1)	18	17	17	16	16	15
246.9 AAAC (7)	18	17	16	16	15	15
336.4 ACSR (18/1)	17	17	16	15	15	14
336.4 ACSR (26/7)	12	12	11	11	10	10

TABLE VII

MAXIMUM LINE ANGLES (Degrees) ON SPOOL INSULATOR ASSEMBLIES

NESC Grade C Construction ***(Re-calculate for NESC Grade B)***
(ANSI Clss 53-4 Spool Insulator)

Designated Maximum Transverse Load = 2,250 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE	**LIGHT LOADING DISTRICT**					
4 ACSR (7/1)	60	60	60	60	60	60
2 ACSR (6/1)	59	58	58	57	57	56
2 ACSR (7/1)	45	45	44	44	43	43
1/0 ACSR (6/1)	37	37	36	36	35	35
123.3 AAAC (7)	36	36	35	35	35	34
2/0 ACSR (6/1)	37	36	35	35	34	34
3/0 ACSR (6/1)	29	28	28	28	27	27
4/0 ACSR (6/1)	29	28	28	27	27	26
246.9 AAAC (7)	28	27	27	26	26	25
336.4 ACSR (18/1)	27	27	26	25	25	24
336.4 ACSR (26/7)	19	18	18	18	17	17
	MEDIUM LOADING DISTRICT					
4 ACSR (7/1)	60	60	60	60	60	60
2 ACSR (6/1)	59	58	57	57	56	55
2 ACSR (7/1)	45	45	44	44	43	42
1/0 ACSR (6/1)	37	37	36	36	35	35
123.3 AAAC (7)	36	36	35	35	35	34
2/0 ACSR (6/1)	37	36	36	35	35	34
3/0 ACSR (6/1)	29	29	28	28	27	27
4/0 ACSR (6/1)	29	28	28	27	27	27
246.9 AAAC (7)	28	28	27	27	26	26
336.4 ACSR (18/1)	28	27	27	26	26	25
336.4 ACSR (26/7)	19	19	19	18	18	18
	HEAVY LOADING DISTRICT					
4 ACSR (7/1)	60	60	60	60	60	60
2 ACSR (6/1)	57	56	55	54	53	52
2 ACSR (7/1)	44	43	42	42	41	40
1/0 ACSR (6/1)	36	36	35	34	33	33
123.3 AAAC (7)	36	35	34	34	33	32
2/0 ACSR (6/1)	36	35	34	34	33	32
3/0 ACSR (6/1)	29	28	27	27	26	26
4/0 ACSR (6/1)	28	28	27	26	26	25
246.9 AAAC (7)	27	27	26	26	25	24
336.4 ACSR (18/1)	27	26	26	25	24	24
336.4 ACSR (26/7)	19	18	18	17	17	17