Prepared by: SXZO

25 KV UNDERARM SIDE-BREAK SWITCH 066195

Asset Type:	Electric Distribution	**Function:**	Construction, Maintenance, and Operation
Issued by:	Sam Chang (SKC5)	**Date:**	11/01/18

Rev. #22: This document replaces Document 066195, Rev. #21. For a description of the changes, see Page 21.

Purpose and Scope

This document specifies the requirements and preferred installation of manual 25 kV underarm side-break switches (U.S. Switch).

References	Location	Document
Transformer Connections for Distribution Lines	OH: Transformers	015003
Dead-End Attachments for Copper Conductors, Distribution and Telephone Lines	OH: Conductors	015218
Moldings, Conduits, and Attachments for Use on Wood Poles and Crossarms	OH: Risers/ UG-1: Terminations	021924
Pin, Post, and Dead-End Insulators for Distribution Lines	OH: Conductors	022088
Marking, Numbering, and Identification of Line Structures	OH: Marking	022168
Construction Requirements for Pole Line Guys	OH: Guys	022178
Spool and Clevis-Type Insulators–Distribution Lines	OH: Conductors	022439
Guy Hooks, Pole Plates, and Thimbles for Wood Pole Lines	ELS	023569
Insulation Districts for Overhead Lines and Stations	OH: General	026300
Installation of Cable Risers on Wood Poles	OH: Risers/UG-1 Terminations	027742
Dead-End and Angle Attachments for Aluminum Conductors - Distribution Lines	OH: Conductors	028851
Compression-Type Connectors for Overhead Distribution and Transmission	OH: Conductors	041010
Vertical and Delta Post-Type Construction 44–115 kV Pole Lines	ELS	045707
Overhead Transformer Installation	OH: Transformers	056425
Numerals for Identification on Distribution Equipment	OH: Marking	057352
Miscellaneous Hardware for Overhead Line Construction	OH: Framing	058778
Conductors for Overhead Lines	OH: Conductors	059626
Fired Wedge Connectors for Primary and Secondary Distribution Lines	OH: Conductors	066194
Standard Framing for Tangent Construction - Distribution Pole Lines	OH: Framing	066196
Equipment Clearances	OH: Clearances	066198
Corporation Padlock	TIL	068200
PG&E Overhead SCADA Installation	OH: Switches	076253

25 kV Underarm Side-Break Switch

General Information, Manual Switches

1. The U.S. Switch is required to be designed, manufactured, and tested to meet all applicable ANSI (American National Standards Institute) standards, IEEE (Institute of Electrical and Electronic Engineers) standards, and all requirements shown and described in this document. In addition, the U.S. Switch is required to be tested to meet the Cal Fire requirements and qualified as exempt electrical equipment.
2. As of November 2013, PG&E has changed the U.S. switch design to the one that utilizes sealed stainless steel maintenance−free phase and bell crank bearings. We consider the switch a marine-grade switch since it has shown better performance in corrosive environments than the previous design used in the system. This was demonstrated in a salt−fog accelerated aging test conducted by a switch manufacturer. The plan is to use this type of switch in all switch applications. However, there will still be two separate codes for different insulation districts with the AA insulation districts switches equipped with 35kV rated insulators. The current material codes will be re−used for the new type of switches. Use switch codes 341575 for all switch applications and districts, except for 21kV in AA insulation districts. For 21kV in AA insulation districts, use codes 341576. Currently, Inertia Engineering is supplying all of the manual switches required at PG&E. Both S&C and Eaton−Cooper have made requests to qualify their version of the marine−grade US switches for use at PG&E. S&C has made significant changes in their Omni−Rupter R4 switch that it is not backward compatible to the version still in use at PG&E. The switch replacement parts on the existing S&C switches listed in Table 7 on Page 7 are no longer available. The material codes for these replacement parts will need to be re−assigned to the new parts once the S&C new marine−grade switch is approved. It is quite different with the Eaton−Cooper M−Force marine−grade switch. Even though it's a new version, the switch replacement parts are backward compatible to the version still in use at PG&E with the same Eaton−Cooper Catalogue numbers. There is no need to change these material codes.
3. The switch codes shown in this document are for the U.S. Switch. These switches are shipped as tangent 3-wire, and are adaptable to all line configurations; e.g., tangent 4-wire, angle, tangent riser, dead-end riser, alley arm, etc.
4. **Caution**: The U.S. Switch is designed and manufactured to be installed in the underarm position only. **Do not** install this switch in the upright position. The bell crank operation will be reversed causing the switch to operate opposite of the normal open/close positions.
5. DE type composite insulators and extension links are not included by the manufacturer of the switch and must be ordered separately. Extension links are required for all installations where dead-ending occurs on the switch arm dead-end bracket.
6. The U.S. Switch is furnished with terminal paddles for use with fired wedge connectors. Select the appropriate fired wedge connector from Document 066194 by using 397.5 AAC (terminal paddle size) for one groove size, and the line conductor size for the other groove size. The terminal paddle has a normal ampacity rating of 900 amperes. Do **not** unbolt and reuse paddle assemblies. New assemblies **must** be used (see Table 7 on Page 7, Code 340361).
7. In order to maintain the 36-inch climbing space for below pole-top installations, the U.S. Switch is manufactured with approximately 24 inches of phase spacing. Limit span lengths to approximately 400 feet with the 24-inch phase spacing. When the switch is mounted at pole top, additional phase spacing can be achieved by moving the center dead-end bracket next to the pole mounting bracket. Moving this center dead-end bracket will allow for span lengths greater than 400 feet and will provide increased raptor protection.
8. Switches are permitted in the working space, but switches, or any part of the switch, must not be installed in the climbing space.
9. Install the switch handle (bottom when opened) at a minimum of 15 feet above the ground line.
10. Attach the operating numbers to the pole in a vertical configuration below the switch handle. If the numbers cannot be readily seen from the road, install an additional set of numbers at the 9-foot level on the traffic side of the pole.

Installation Instructions

Manual Switch

11. The U.S. Switch is unitized and fully adjusted at the factory. The following are the manufacturer's installation instructions:

    A. The U.S. Switch manufacturers apply switch contact lubrication at the factory. During installation**, do not** apply additional contact lubrication. After a few years, a switch may become stiff and difficult to operate. If that occurs, sparingly apply Mobile 28 (Code 500027) to the overhead switch contacts. Note that the switch contact lubricant "Conducto Lube" should no longer be used.

    B. All Eaton-Cooper U.S. Switches (see Note 2 on Page 2) are furnished with three galvanized steel channels for mounting larger diameter post-type insulators to the steel crossarm. **Note:** Tighten the bottom nut and lock washer to the bottom of the steel crossarm. The phase unit has a large hole for inserting a socket.

    C. Mount unitized switch to pole with 3/4-inch bolts at the desired location, using TECO shear plates as shown in "Mounting Detail" on Page 8.

    D. Attach eye bolt guides to pole as required and thread 1-inch fiberglass through guides and attach to clamp on bell crank.

    E. Use only the switch handle that comes with that switch. The manufacturers use different throws, so mixing handles will not work.

    F. Attach control rod to control handle with the control handle and adjusting clevis in position and mount handle to pole with 5/8-inch bolts. Adjust the control rod to have a slight compression load against the switch bell crank when the switch is in the fully closed position; i.e., there must be a slight bow in the fiberglass control rod when the switch is in the fully closed position. Use approximately 1-1/4 inches of compression for 30 feet of rod.

    G. Remove factory-installed contact blade shipping ties.

    H. Check interrupters individually for proper operation. Operate each interrupter by hand. A "slamming action" should occur when testing each one by moving the rod/rocker through its complete arc. A defective load interrupter will have a consistent spring tension without the "slamming action." Simply testing the switch after it has been installed will not detect this problem.

    After testing the interrupters, make sure that each interrupter is **cocked** (in the correct position for the next switch operation). If an interrupter is not properly **cocked** and **latched**, a load-break switch operation will most likely result in a flashover and a switch failure.

    I. Operate the switch several times and check for any difficulties. A compression load should be felt on the control at the end of the closing stroke. Adjustment of load can be made by adjusting clevis as needed.

    J. For Cooper Switch

    (1) Check to be sure that all phases are fully closed. Ensure that the reliabreak trip arm is passed through the catch arm in the latched position; if not, adjustment should be made at adjusting clevis. If for some reason only one or two phases are not fully closed, adjustment should be made at the interphase clamp of that unit.

    K. For S&C Switch

    (1) Check to be sure that all phases are fully closed by visually inspecting that the blades are parallel to the pole-unit bases. If for some reason only one or two phases are not fully closed, adjustment should be made at the interphase clamp of that unit. The switch is properly closed when all blades are parallel to the pole-unit base, the operating linkage is in the over-toggle position, and the yellow flag on the top of the interrupter is not visible.

    (2) When reconfiguring a factory-assembled switch to an alley arm switch, follow S&C installation Drawing Number ED-8038 which is shipped with all S&C switches.

    L. For Inertia Switch

    (1) Verify the switch operation by closing the switch with the minimum force required to fully close at the switch. If for some reason all phases do not close, loosen the phase crank clamp of the phase that is not closed, manually close the switchblade, and tighten the clamp. Note that the load interrupter flag (LIF) is no longer coming installed on new switch. If the LIF is present, it should be retrofitted with interrupter shunt, Code 343085.

Note: Do not lift switch by main contact during installation.

Installation Instructions (continued)

12. Operation: The U.S. Switch should be opened or closed with one swift operation. Caution: **Do not** tease the switch while opening or closing. After closing the switch, look up to make sure all phases are fully closed. The switch blade must be parallel with the phase unit channel. The following are the instructions for making sure that each of the phase unit interrupters are latched:

    A. On the Eaton-Cooper switch (see Note 2 on Page 2), the worker must look up at the rods on the interrupter to make sure that they are latched before opening the switch.

    B. On the S&C switch (see Note 2 on Page 2), there is a yellow flag on the top of the interrupter to warn the worker if the interrupter is open or closed. The yellow flag is present when the switch is open. In other words, the worker must look up at the interrupter to verify that a yellow flag is not present and that the blade assembly is parallel to the pole-unit base when the switch is closed.

    C. On pre-2010 Inertia switches, there is a reflective yellow flag on the rotating switchblade that is visible when the switch is open or the interrupter is not latched. The worker must look up at the interrupter when closing the switch to verify that the yellow flag is not present. Properly latched interrupter flags can be seen when viewing the switch on the crossarm pole face from a distance of at least 30 feet.

    D. On post-2010 Inertia switches, the reflective yellow flags described in C have been replaced by interrupter shunts. The worker must be sure that the interrupter trip arm has passed by the catch arm before opening the switch.

Electrical and Mechanical Ratings

Table 1 Switch Ratings

Description	Rating
Maximum Voltage	25.8 kV
Continuous Current Rating	900 Amps
24-Hour Emergency	1,233 Amps
B.I.L.	150 kV
Momentary Current	40 kA – Asym
Fault Close Rating	20 kA – Asym

Table 2 Interrupter Ratings

Description	Amps
Load Dropping – Current	900
Loop – Current	900

Table 3 Approximate Component Weights (pounds)

Description	Eaton-Cooper (see Note 2 on Page 2)		S&C (see Note 2 on Page 2)		Inertia	
Manual Switch	Code 341575	Code 341576	Code 341575	Code 341576	Code 341575	Code 341576
Three-Phase Gang Switch, Total Weight	384	551	442	510	459	467
Single Switch Unit	50	101	78	100	55	58
Crossarm	173	173	173	173	173	173
Shipping Weight With Crate	654	821	760	800	725	733

Electrical and Mechanical Ratings (continued)

Table 4 Bill of Material for Installing 25 kV Underarm Side-Break Switches [1]

Item	Description	Code	Document
1	Manual U.S. Switch for All Applications and Districts, Except AA at 21 kV	341575	–
	Manual U.S. Switch for AA Insulation Districts at 21 kV	341576	–
2	DE Type Composite Insulator (as required)	–	022088
3	Extension Link, 14” (see Note 5 on Page 2)	340356 343451 [2]	–
4	TECO Shear Plate	199017	058778
5	Fired Wedge Connector	–	066194
6	High-Voltage Sign	373038	022168
7	Switch Number	–	057352
8	Dead-End Attachment (as required), Aluminum	–	028851
	Dead-End Attachment (as required), Copper	–	015218
9	Bolt, Machine, 3/4” x Length (as required)	–	058778
10	Washer, Curved, Steel, Galvanized, Square, for 3/4” Bolt	195293	
11	Bolt, Machine, 5/8” x Length (as required)	–	
12	Eyenut for 5/8” Bolt	195308	
13	Padlock	016583	068200
14	Insulator (as required)	–	022088
15	Stud or Pin (as required)	–	
16	Extension Link, 6”	180050	058778
17	Shackle, Anchor	182025	045707
18	Dead-End Bracket	340357	–
19	Eyelet, for 3/4” Bolt	195304	058778
20	Bolt, Machine, 3/4” x 8”	192339	
21	Washer, Curved, 4” x 4”, for 3/4” Bolt	195298	
22	Guy Hook, 7500#	186180	023569
23	Guy Grip 16M, Alumoweld	186172	022178
24	Guy Wire 16M, Alumoweld	101045	
25	Fiberglass Rod, 1” x 10’	343128	–
26	Washer, Lock, 3/4” Bolt	195232	–
27	Washer, Spring Clip	033501	058778
28	Insulator, Non-Ceramic, Dead-End Type, 15 kV	310054	022088
29	Guy Thimble	186213	023569
30	Nut, Square, American Standard, Regular, Galvanized, for 3/4” Bolt	195061	058778
31	Splice Coupling for Fiberglass Control Rod	343084	–

[1] See Table 7 on Page 7 for codes of replacement parts for the U.S. Switch.
[2] Use M343451 for BAC (Buy America Compliant).

Table 5 Accessory Equipment

Description	Code
Lever Extension for S&C U.S. Switches (see Note 2 on Page 2)	375049
G.O. 95 PVC Control Rod Shroud (10 foot)	341504

25 kV Underarm Side-Break Switch

Table 6 Clearances [1]

	Voltage at Switch		
	4 kV	12 kV	21 kV
Conductor at Next Unrelated Level	Vertical Clearance Required		
Communications	48 Inches	72 Inches	72 Inches
Secondary	48 Inches	48 Inches	48 Inches
4 kV and 12 kV	48 Inches	48 Inches	48 Inches
21 kV	48 Inches	48 Inches	48 Inches

[1] The minimum clearances from the bottom of the U.S. Switch (including the load-break device) to the next unrelated level of conductor below, **must** meet the dimensions listed in this table.

25 kV Underarm Side-Break Switch

Replacement Parts

Table 7 Data and Codes for 25 kV Underarm Side-Break Switch Replacement Parts

Description	Eaton-Cooper 600 A Switch	Eaton–Cooper 900 A Switch	S&C 600 A and 900 A Switch	Inertia 900 A Switch
	(see Note 2 on Page 2)			
Manual Switch	Code			
One Complete Switch Phase for the U.S. Switch, 25 kV	340364	341578	342056	342112
One Complete Switch Phase for the U.S. Switch, 35 kV	340366	341579	342058	342116
One Complete Load-Break Interrupter for the U.S. Switch (includes all hardware)	340360	341584	342059	342117
One Load-Break Interrupter Only for the U.S. Switch	340367	341587	342197	342120
One 25 kV Station Post Insulator for the U.S. Switch	340359	341732	342198	342123
One 35 kV Station Post Insulator for the U.S. Switch	340358	341590	342057	342126
One Terminal Paddle and Anti-Corrosion Pad and All Terminal Mounting Hardware for the U.S. Switch (minimum order quantities in multiples of 24)	340361	340361	340361	340361
Interrupter Shunts (set of 3)	–	–	–	343085

25 kV Underarm Side-Break Switch

Generic Switch Requirements

Notes

1. Bill of material items shown in this figure are common for the various switch configurations that follow in this document.
2. The U.S. Switch is furnished with 30 feet of fiberglass control rod and the splices for the fiberglass.
3. Install control rod guides at 5-foot (maximum) intervals. Control rod guides may be spaced 5 to 6 feet between the operating handle to the first eyenut and between the last eyenut to the bell crank connection.
4. The U.S. Switch is furnished with a steel arm and three dead-end brackets.

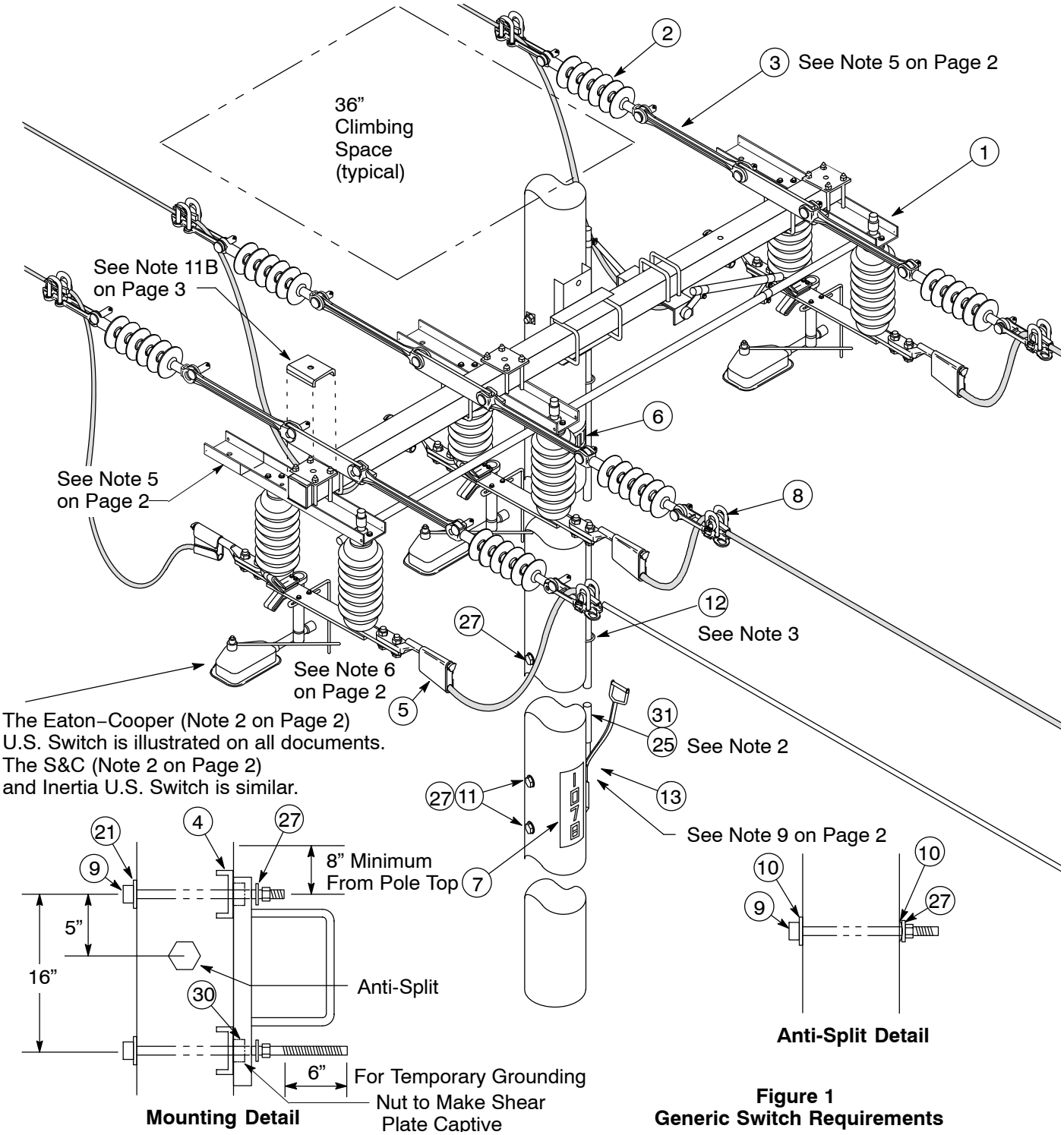


Figure 1
Generic Switch Requirements

25 kV Underarm Side-Break Switch

3-Wire, Tangent Construction - Alternate

Notes

1. See Page 8 for common bill of material requirements.
2. The dimensions shown in the figure below are as received from the manufacturer. The S&C (see Note 2 on Page 2) and Inertia dimensions are the same as the Eaton−Cooper dimensions (see Note 2 on Page 2), except for those shown with an asterisk (*).
3. Use the Inertia dimensions. That way, if the Inertia switch is used as a replacement, there will not be a clearance problem.
4. Where the switch is a SCADA switch, two links are required on all three line current sensor insulator sides.

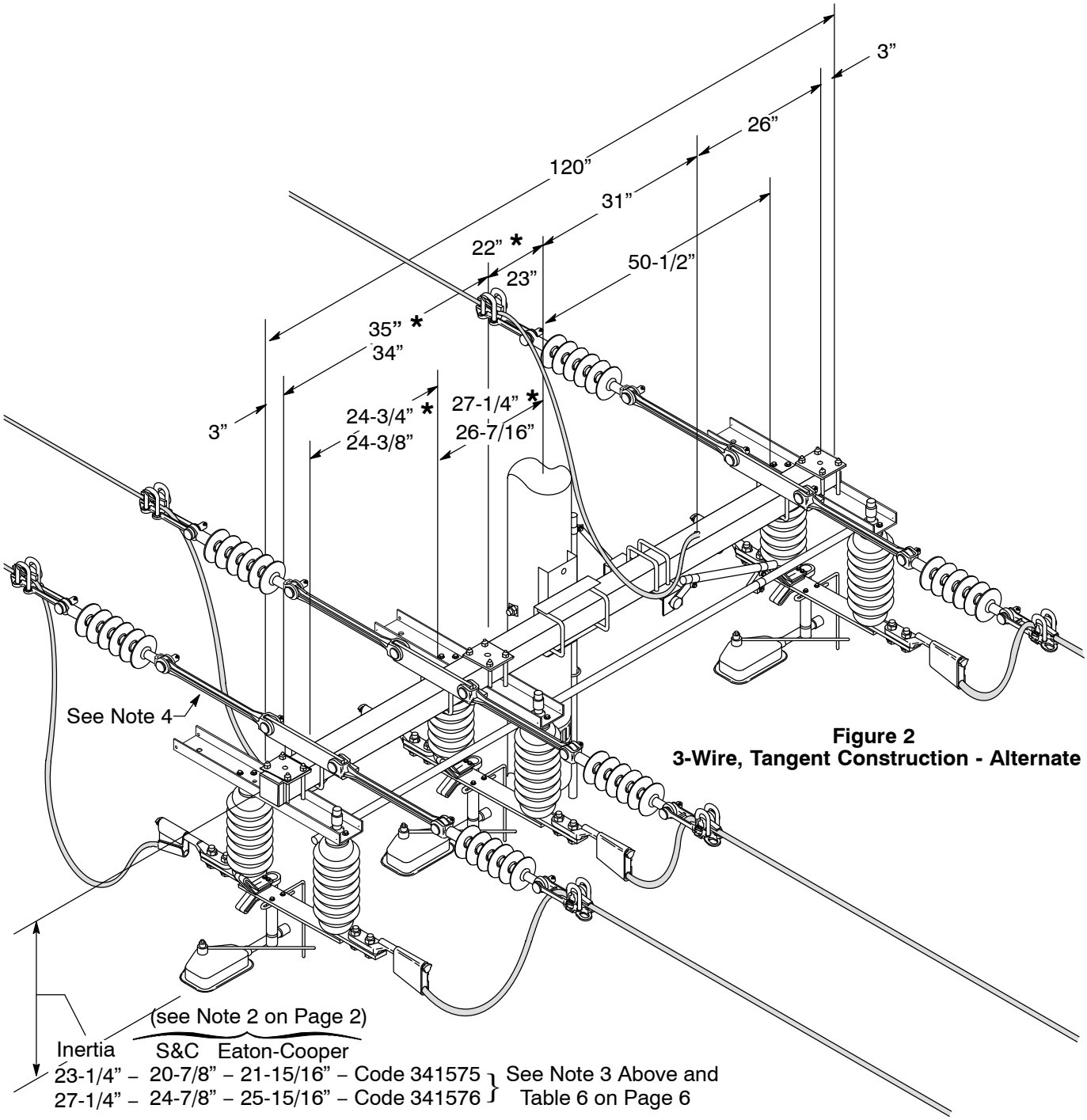


Figure 2
3-Wire, Tangent Construction - Alternate

* = Inertia and S&C dimensions.

3-Wire, Tangent Construction – Preferred (see Note 3)

Notes

1. See Page 8 for common bill of material requirements.
2. For angle construction, the maximum angle is limited by the post insulator strength. For the maximum allowable angle, see Document 066196, table titled “Angle and Span Limitation for Fiberglass Bracket Construction.”
3. This preferred construction **must not** be used in the following three conditions:
   A. Where raptor protection is a concern. Use the “Alternate Tangent Construction” type of design shown on Page 9.
   B. Where the switch is a SCADA switch and the arm is grounded. Use the “Alternate Tangent Construction” type of design shown on Page 9.
   C. Where the angle is greater than that as determined in Note 2 above. Use the “Angle Construction” type of design shown on Page 11.

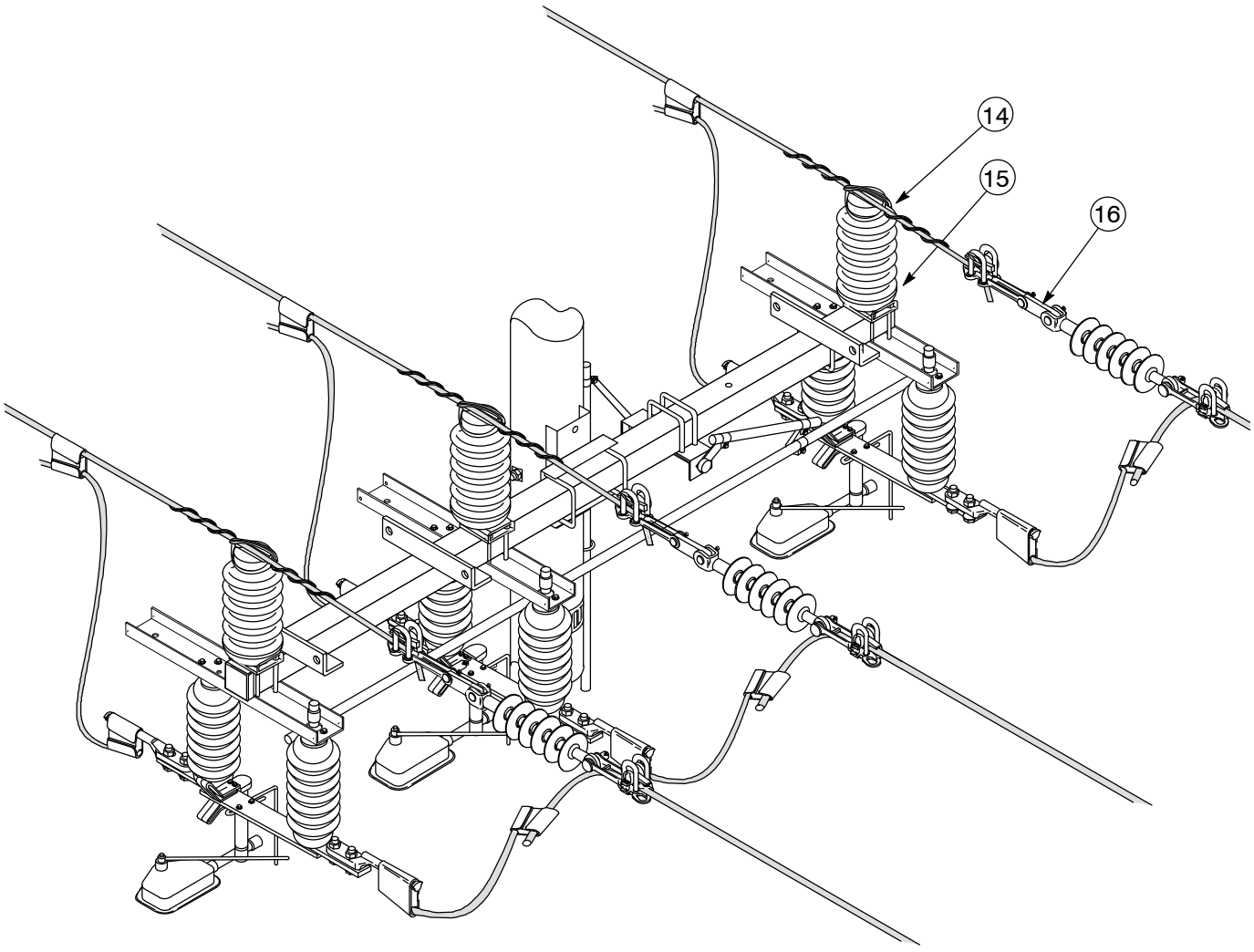


Figure 3
3-Wire, Tangent Construction – Preferred

3-Wire, Angle Construction

Notes

1. The U.S. Switch can be installed in any angle installation, up to 35°. The angle can be on either side of the switch or split.
2. See Page 8 for common bill of material requirements.
3. Where the switch is a SCADA switch, two links are required on all three line current sensor insulator sides.

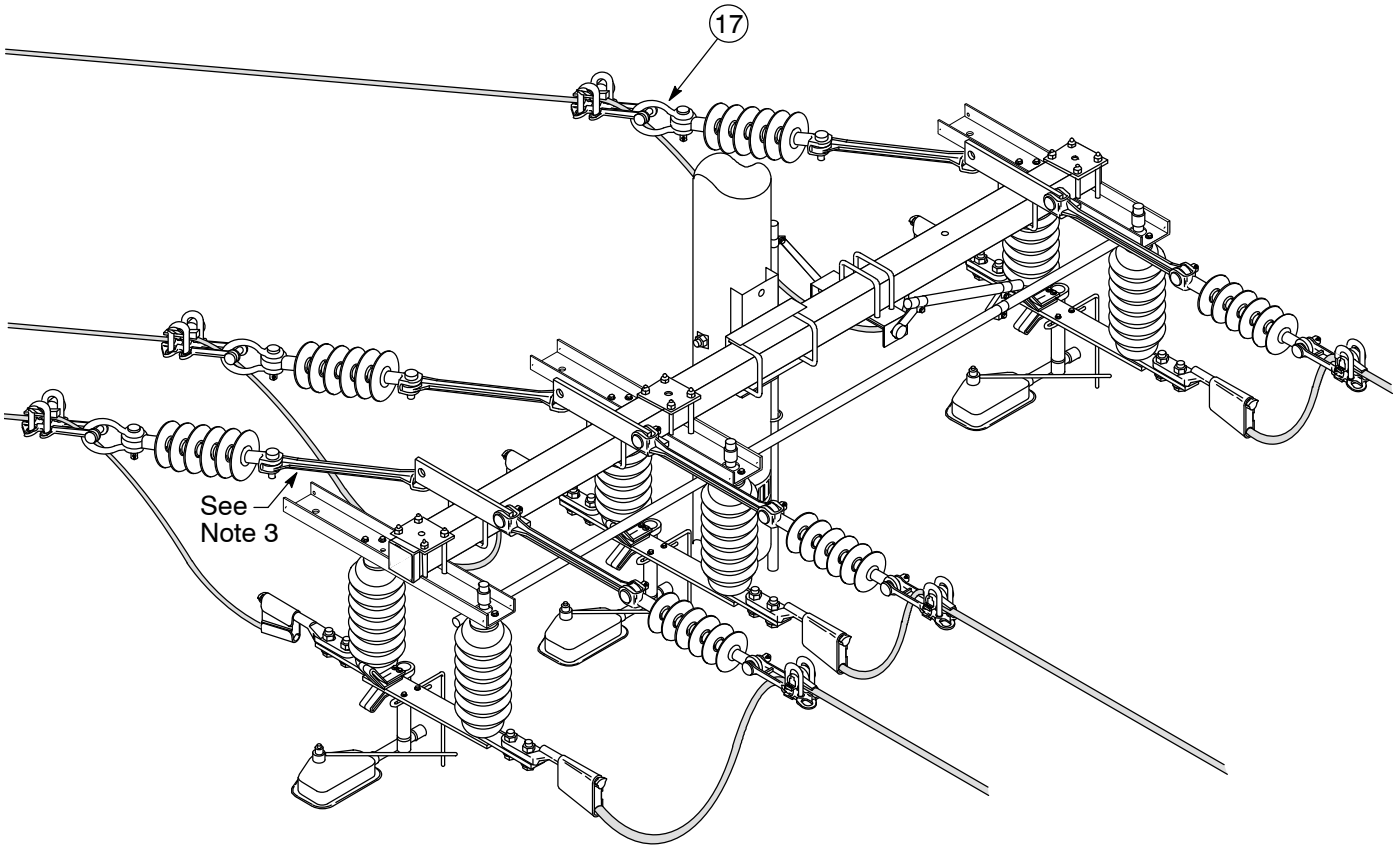


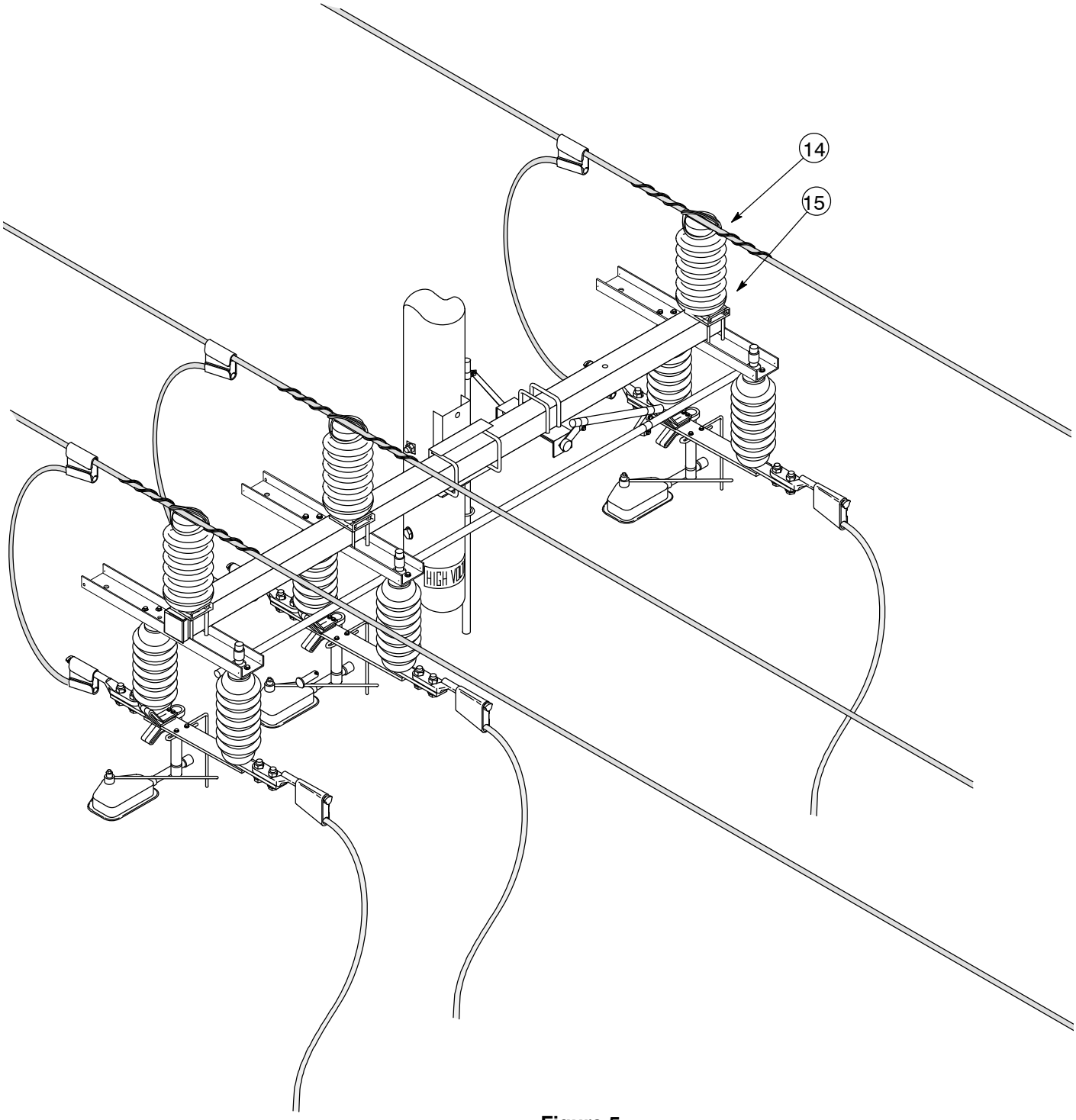
Figure 4
3-Wire, Angle Construction

25 kV Underarm Side-Break Switch

3-Wire, Tangent Riser Construction

Notes

1. For details on the riser installation, see the “Risers” section of the *Electric Overhead Construction Manual*.
2. See Page 8 for common bill of material requirements.
3. Where the switch is a SCADA switch and the arm is grounded, use Part 3 insulators and cover all three phases with insulator/line covers.



See Note 1

Figure 5
3-Wire, Tangent Riser Construction

3-Wire, Dead-End Riser Construction

Notes

1. Regarding dead-end riser installations, the preferred construction is to install the U.S. Switch in a normal tangent configuration one span before the riser. This is to eliminate pole “clutter” on the riser pole. If field conditions do not allow for a switch to be installed one span before the riser, the U.S. Switch may be installed as a riser switch.
2. For details on the riser installation, see the “Risers” section of the *Electric Overhead Construction Manual*.
3. The U.S. Switch is capable of handling 3,500 pounds per conductor of three-wire dead-end tension.
4. See Page 8 for common bill of material requirements.
5. See the “Guys” section of the *Electric Overhead Construction Manual* for down guy requirements.
6. Where the switch is a SCADA switch and the arm is grounded, use Part 3 insulators and cover all three phases with insulator/line covers.

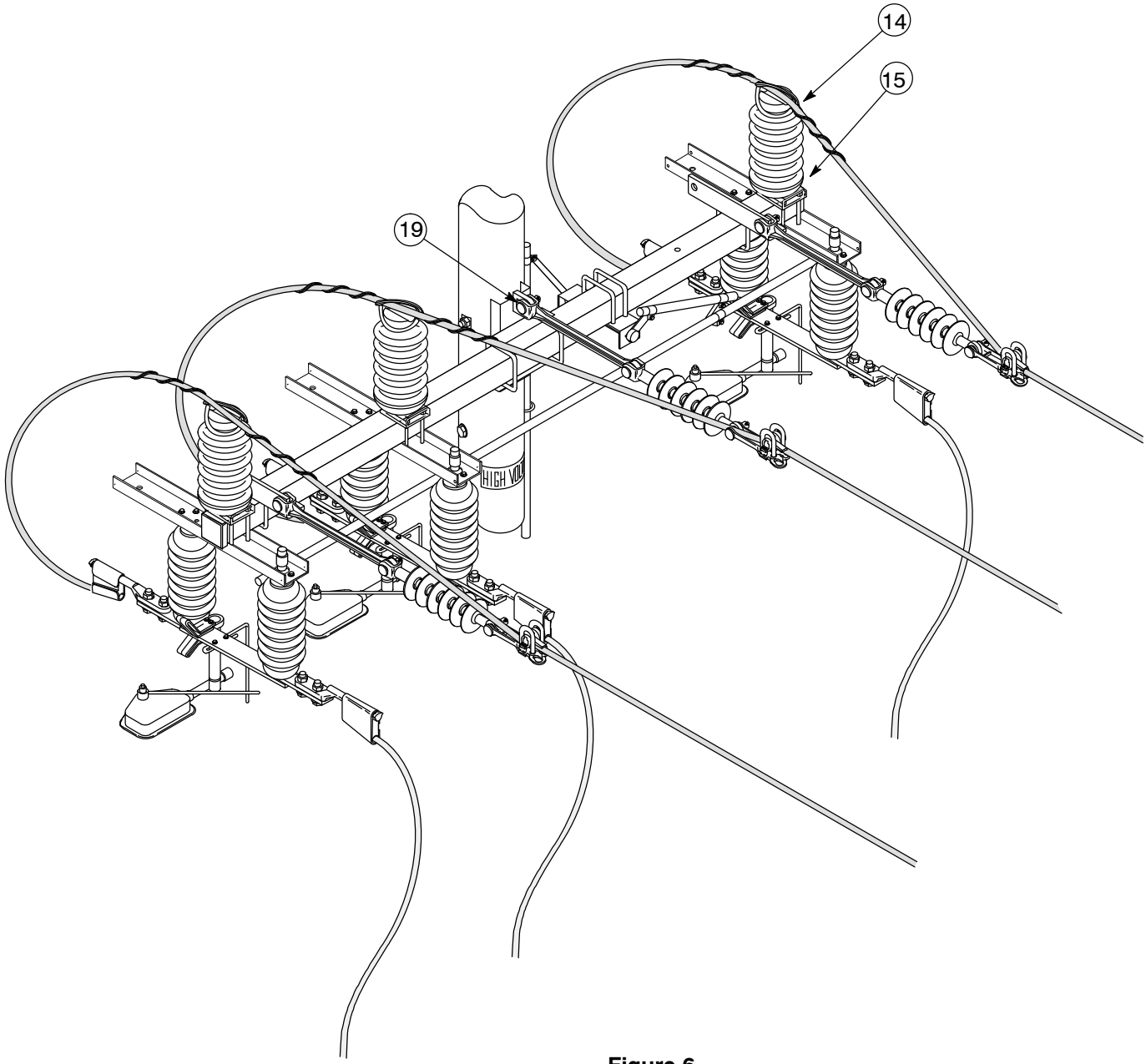


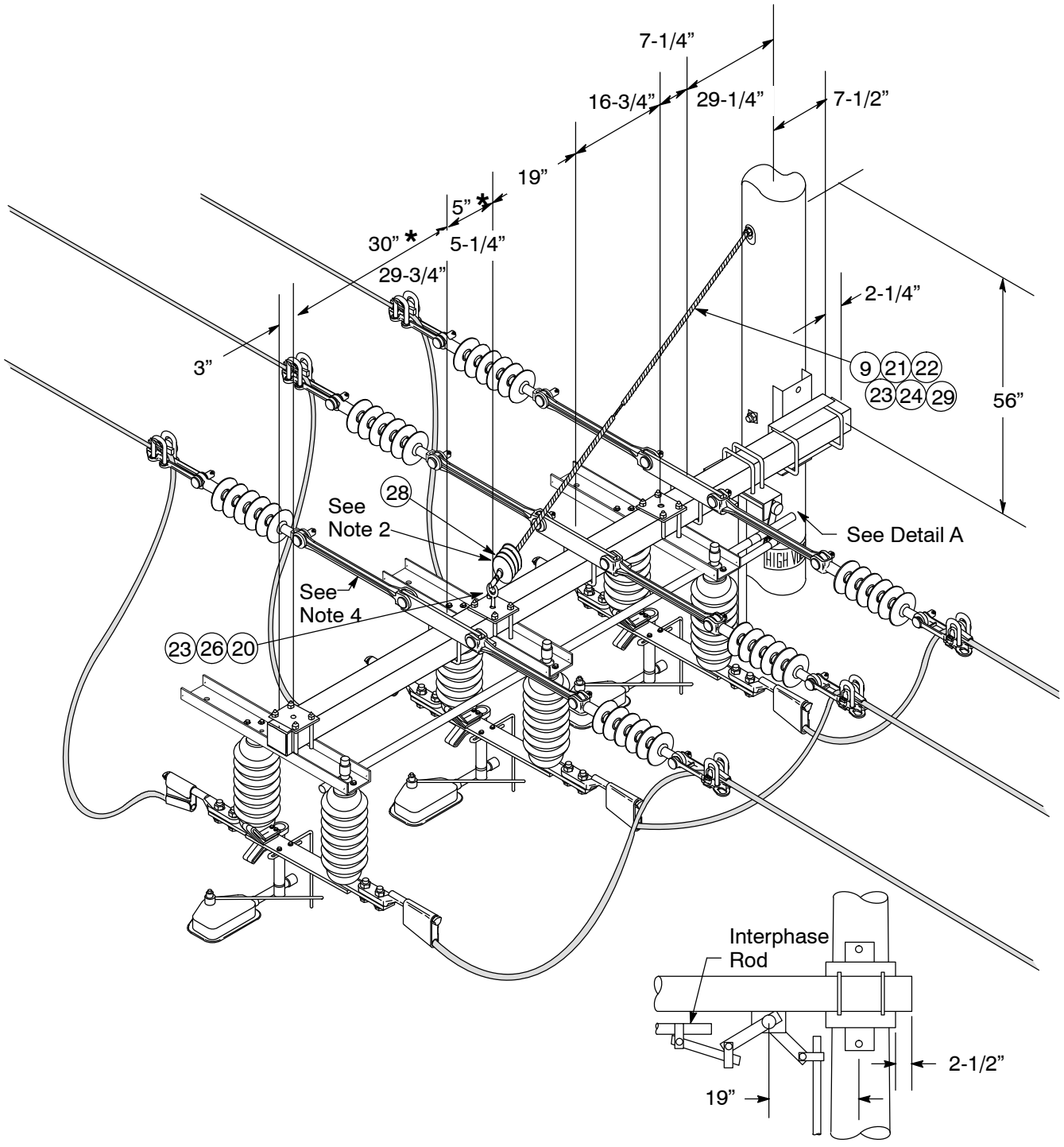
Figure 6
3-Wire, Dead-End Riser Construction

25 kV Underarm Side-Break Switch

3-Wire, Alley Arm Construction

Notes

1. See Page 8 for common bill of material requirements.
2. The insulator is only needed for below pole-top installations. A guy thimble is required for all installations.
3. The S&C (see Note 2 on Page 2) and Inertia dimensions are the same as the Eaton−Cooper dimensions (see Note 2 on Page 2), except for those shown with an asterisk (*).
4. Where the switch is a SCADA switch, two links are required on all three line current sensor insulator sides.



* = Inertia and S&C dimensions.

Figure 7
3-Wire, Alley Arm Construction

Detail A

4-Wire, Tangent Construction - Alternate

Note

1. See Page 8 for common bill of material requirements.
2. Where the switch is a SCADA switch, two links are required on all three line current sensor insulator sides.

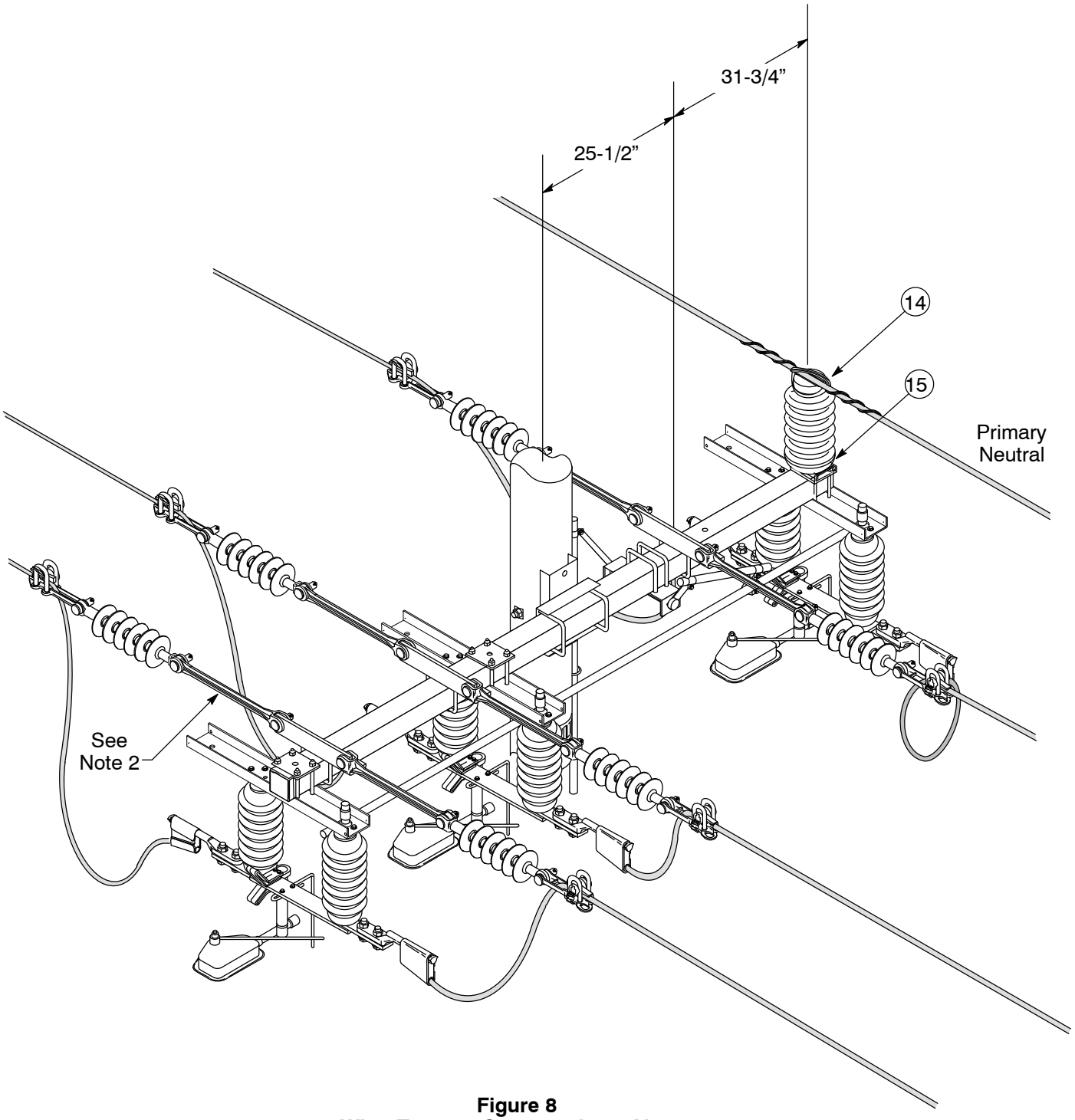


Figure 8
4-Wire, Tangent Construction - Alternate

4-Wire, Tangent Construction – Preferred (see Note 3)

Notes

1. See Page 8 for common bill of material requirements.
2. For angle construction, the maximum angle is limited by the post insulator strength. For the maximum allowable angle, see Document 066196, table titled “Angle and Span Limitation for Fiberglass Bracket Construction.”
3. This preferred construction **must not** be used in the following three conditions:
   A. Where raptor protection is a concern. Use the “Alternate Tangent Construction” type of design shown on Page 15.
   B. Where the switch is a SCADA switch and the arm is grounded. Use the “Alternate Tangent Construction” type of design shown on Page 15.
   C. Where the angle is greater than that as determined in Note 2 above. Use the “Angle Construction” type of design shown on Page 17.

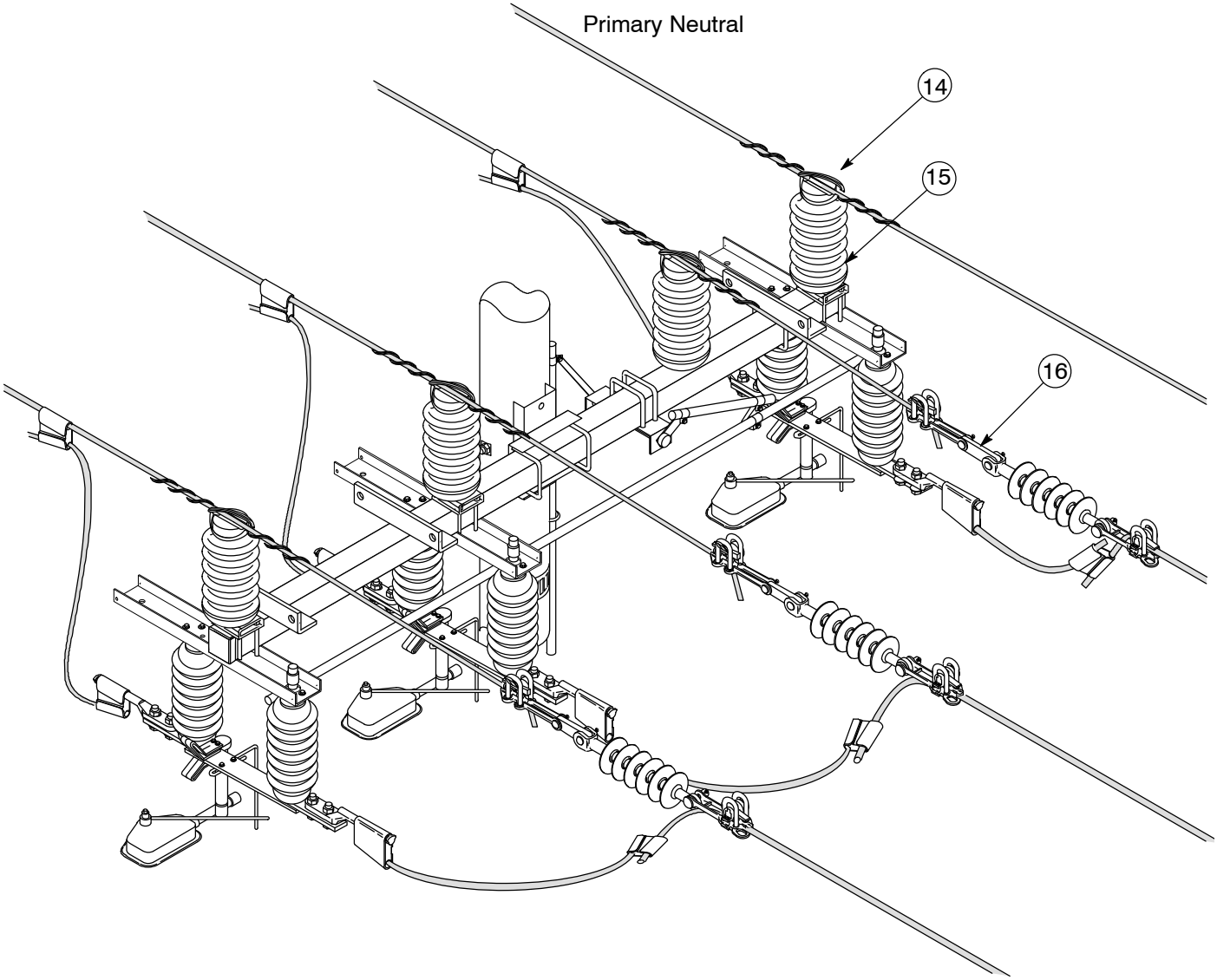


Figure 9
4-Wire, Tangent Construction – Preferred

4-Wire, Angle Construction

Notes

1. The U.S. Switch can be installed in any angle installation, up to 35°.
2. See Page 8 for common bill of material requirements.
3. For below pole-top installations, the angle must be on the arm side in order to maintain climbing space. For pole-top installations, the angle can be on either side of the switch or split.
4. Where the switch is a SCADA switch, two links are required on all three line current sensor insulator sides.

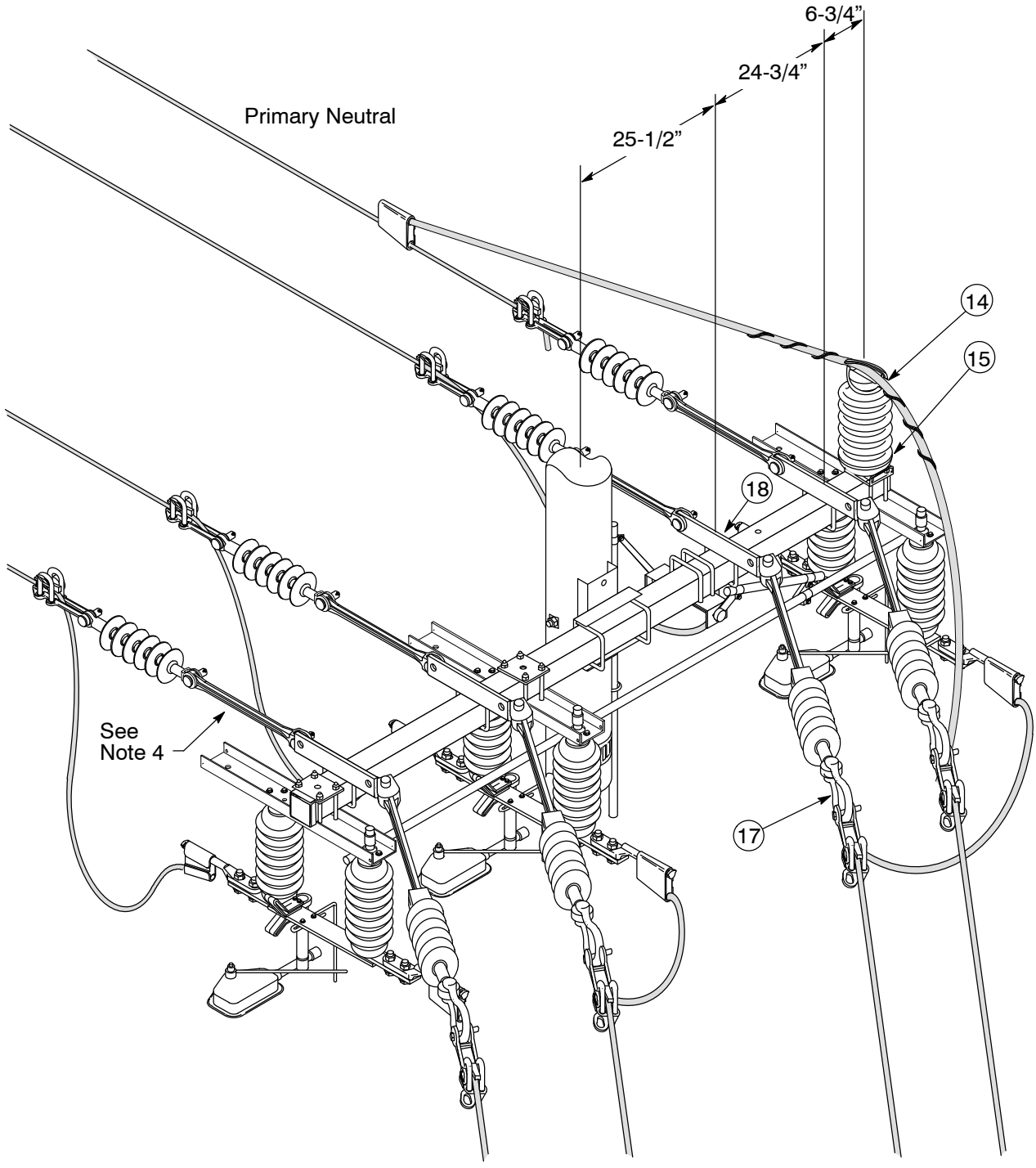


Figure 10
4-Wire, Angle Construction

25 kV Underarm Side-Break Switch

4-Wire, Tangent Riser Construction

Notes

1. For details on the riser installation, see the “Risers” section of the *Electric Overhead Construction Manual*.
2. See Page 8 for common bill of material requirements.
3. Where the switch is a SCADA switch and the arm is grounded, use Part 3 insulators and cover all three phases with insulator/line covers.

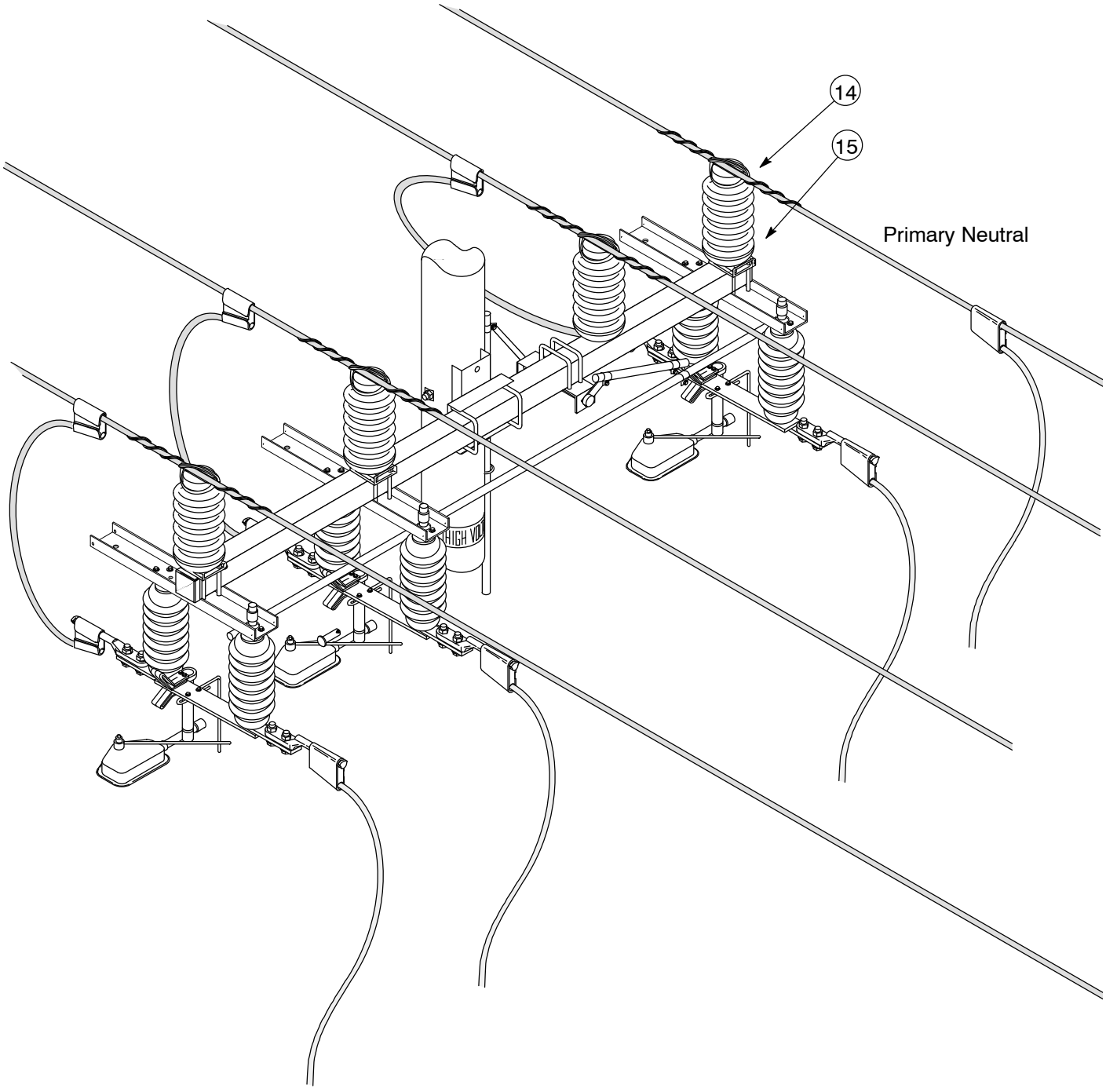


Figure 11
4-Wire, Tangent Riser Construction

4-Wire, Dead-End Riser Construction

Notes

1. Regarding dead-end riser installations, the preferred construction is to install the U.S. Switch in a normal tangent configuration one span before the riser. This is to eliminate pole “clutter” on the riser pole. If field conditions do not allow for a switch to be installed one span before the riser, the U.S. Switch may be installed as a riser switch.
2. For details on the riser installation, see the “Risers” section of the *Electric Overhead Construction Manual*.
3. The U.S. Switch is capable of handling 3,000 pounds per conductor of four-wire dead-end tension.
4. See Page 8 for common bill of material requirements.
5. See the “Guys” section of the *Electric Overhead Construction Manual* for down guy requirements.
6. Where the switch is a SCADA switch and the arm is grounded, use Part 3 insulators and cover all three phases with insulator/line covers.

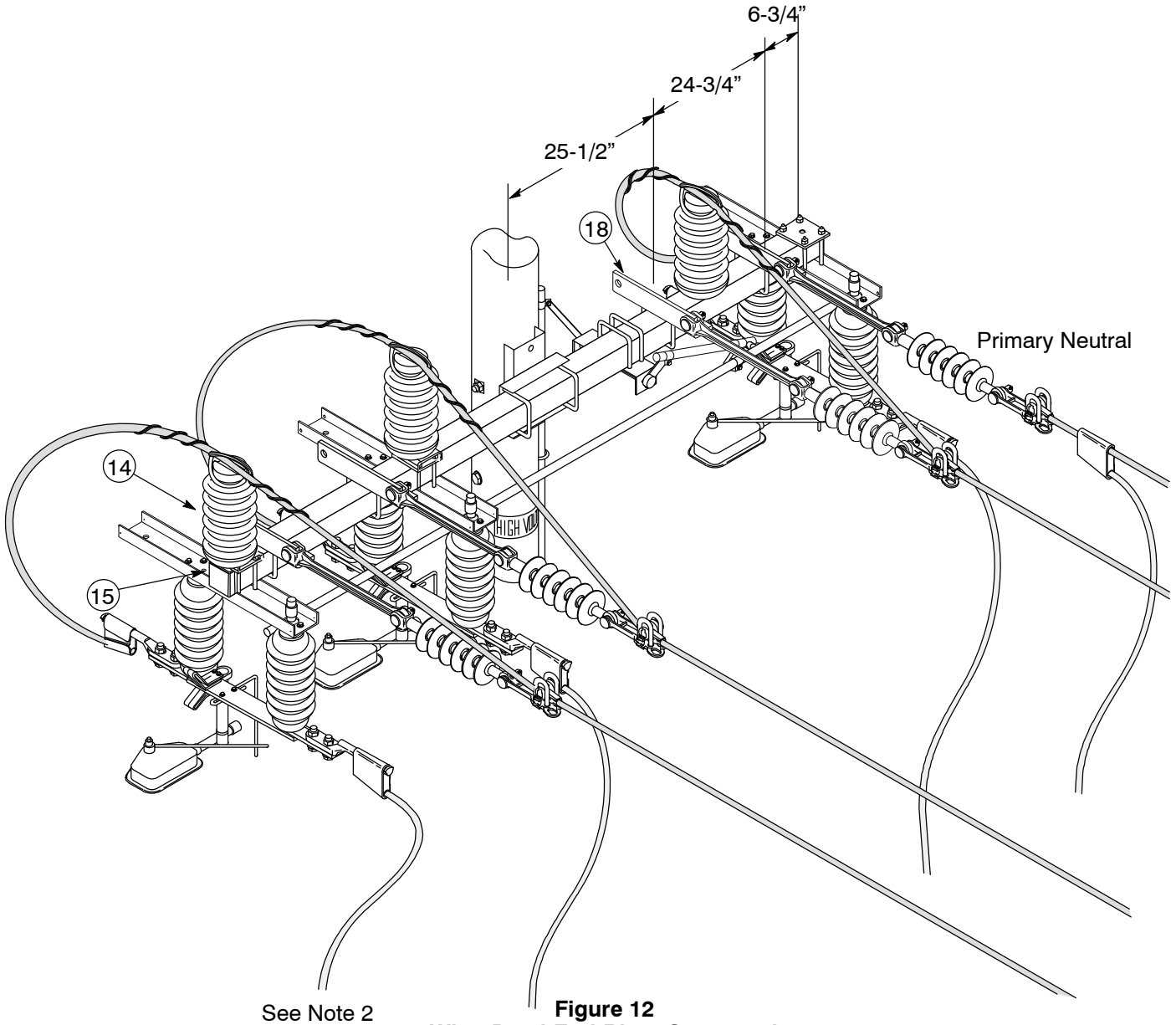


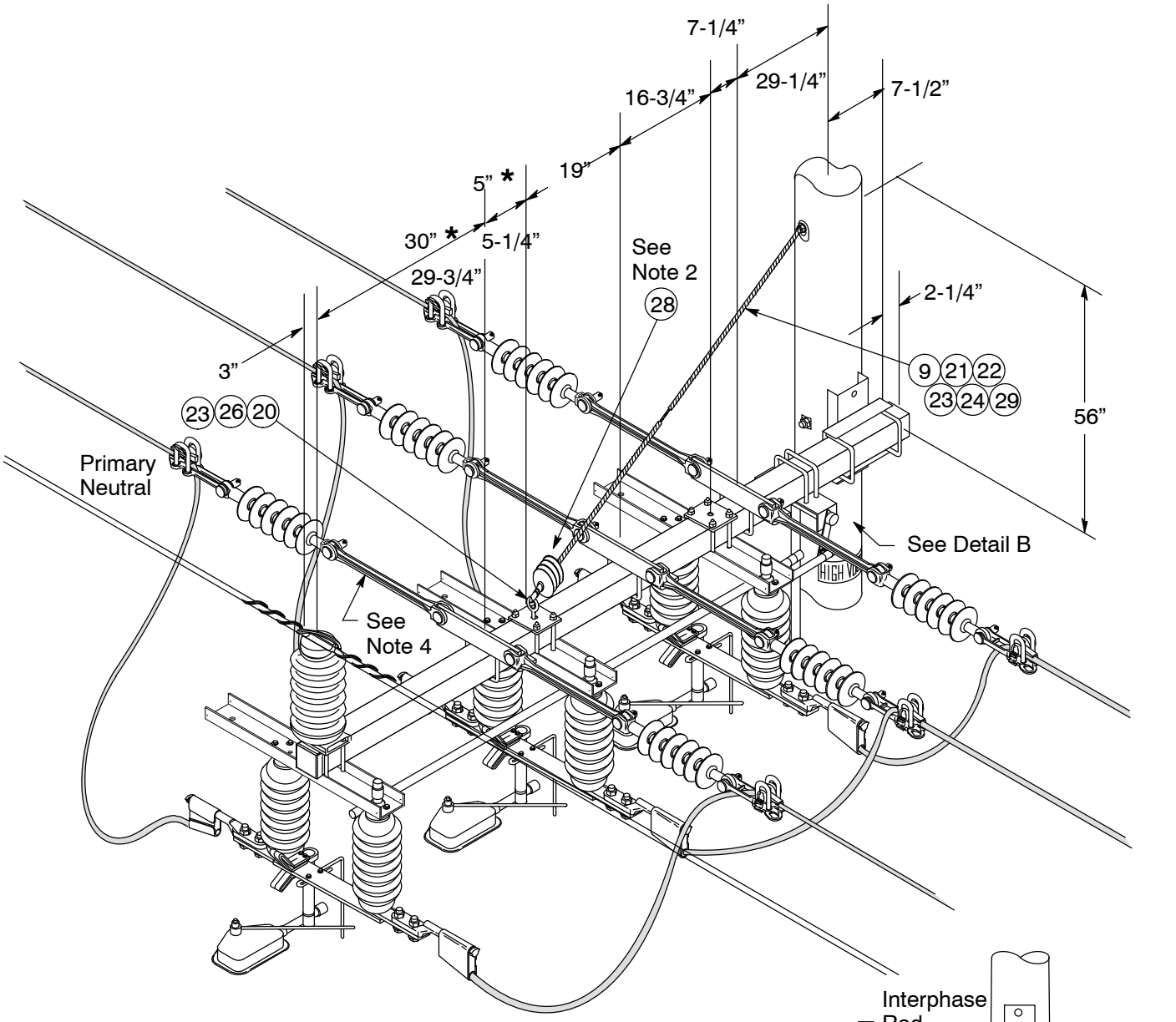
Figure 12
4-Wire, Dead-End Riser Construction

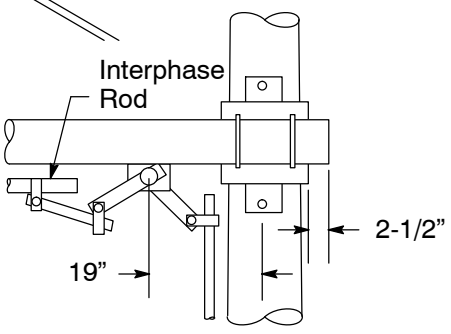
25 kV Underarm Side-Break Switch

4-Wire, Alley Arm Construction

Notes

1. See Page 8 for common bill of material requirements.
2. The insulator is only needed for below pole-top installations. A guy thimble is required for all installations.
3. The S&C (see Note 2 on Page 2) and Inertia dimensions are the same as the Eaton-Cooper dimensions (see Note 2 on Page 2), except for those shown with an asterisk (*).
4. Where the switch is a SCADA switch, two links are required on all three line current sensor insulator sides.





Detail B

* = Inertia and S&C dimensions.

Figure 13
4-Wire, Alley Arm Construction

Revision Notes

Revision 22 has the following changes:

1. Replaced any reference to EDS 054422 with EDS 076253.
2. Remove information on automated switches, see TD-076253B-001.
3. Revised Note 2 on Page 2.
4. Revised Note 9 on Page 2.
5. Revised Note 10 on Page 2.
6. Revised Note 11.B on Page 3.
7. Revised Note 12.A and 12.B on Page 4.
8. Revised Table 3 on Page 4.
9. Revised Table 5 on Page 5.
10. Revised Table 7 on Page 7.
11. Edited Figure 1 on Page 8.
12. Edited Figure 2 and Note 2 on Page 9.
13. Edited Note 3 and Figure 7 on Page 14.
14. Edited Note 3 and Figure 13 on Page 20.