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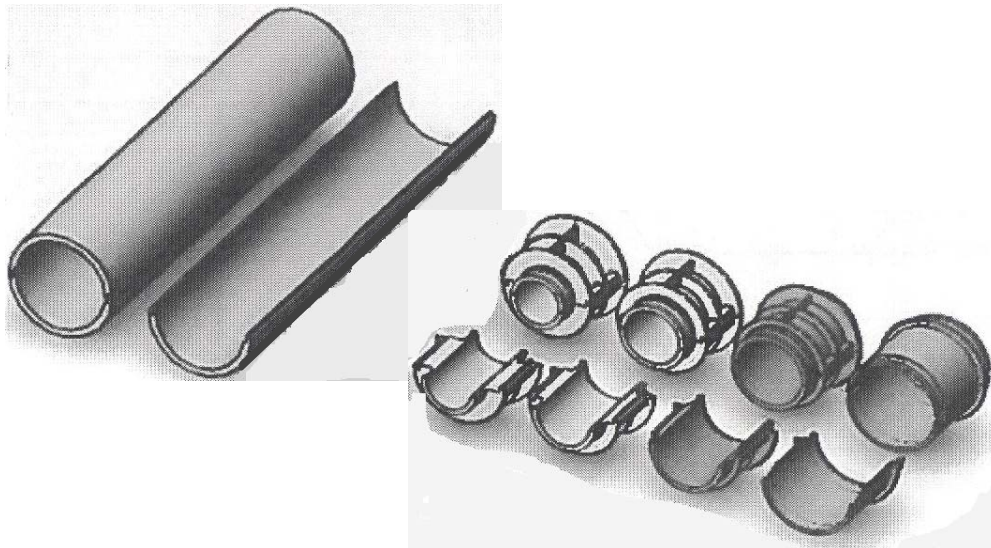
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**GENERAL**

The Broken Conduit Repair System (BCRS) will be used to repair broken PVC conduits installed on poles or in the ground. The BCRS will allow Ameren Linemen to make repairs to broken conduit without having to remove the installed cables and thereby reducing customers interruptions and the associated customers minutes out.

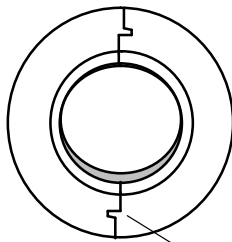
The BCRS will consist of five split couplings for the 2.0" to 4.0" conduits and a 10' length of split 5.0" schedule 80 PVC conduit. Note that the split conduit will encompass a 5.0" schedule 80 PVC conduit. The inside diameter of the split conduit is 5.563".

**COMPONENTS OF THE BCRS**

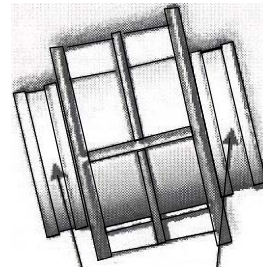


**HALF VIEW AND ASSEMBLED VIEW**

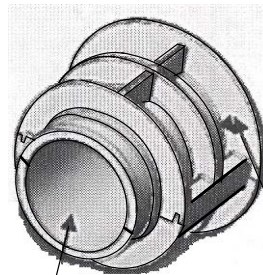
**SPLIT CONDUIT DETAILS**



INTERLOCKING DESIGN



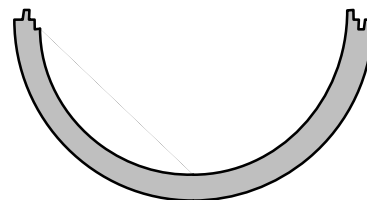
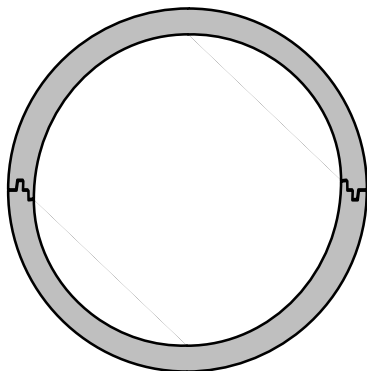
CABLE TIE AREA



SCHEDULE 80  
ID DIMENSIONS FOR  
CONDUITS 2.0" TO 4.0"

FLANGE TO SUPPORT  
5.0" SPLIT CONDUIT

**END VIEW OF SPLIT CONDUIT INTERLOCKING DESIGN**



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**MATERIALS**

<b>Dist. Std. Or Stk. No.</b>	<b>Description</b>	<b>59 14 40 40</b>
12 51 403	Conduit-Split, 10' Length, Schedule 80 PVC	
12 51 404	Conduit-Split, 2.0" to 5", PVC	
12 51 408	Conduit-Split, 2.5" to 5", PVC	
12 51 407	Conduit-Split, 3.0" to 5", PVC	
12 51 406	Conduit-Split, 4.0" to 5", PVC	
23 67 483	Strap-Kit, Standoff Bracket, 6" Conduit	
12 56 099	Cement-Solvent, PVC	
40 59 191	Tie-Wire, Black, 18" Reusable	
86 12 994	Blade-Saw, Reciprocating	

**Note:**

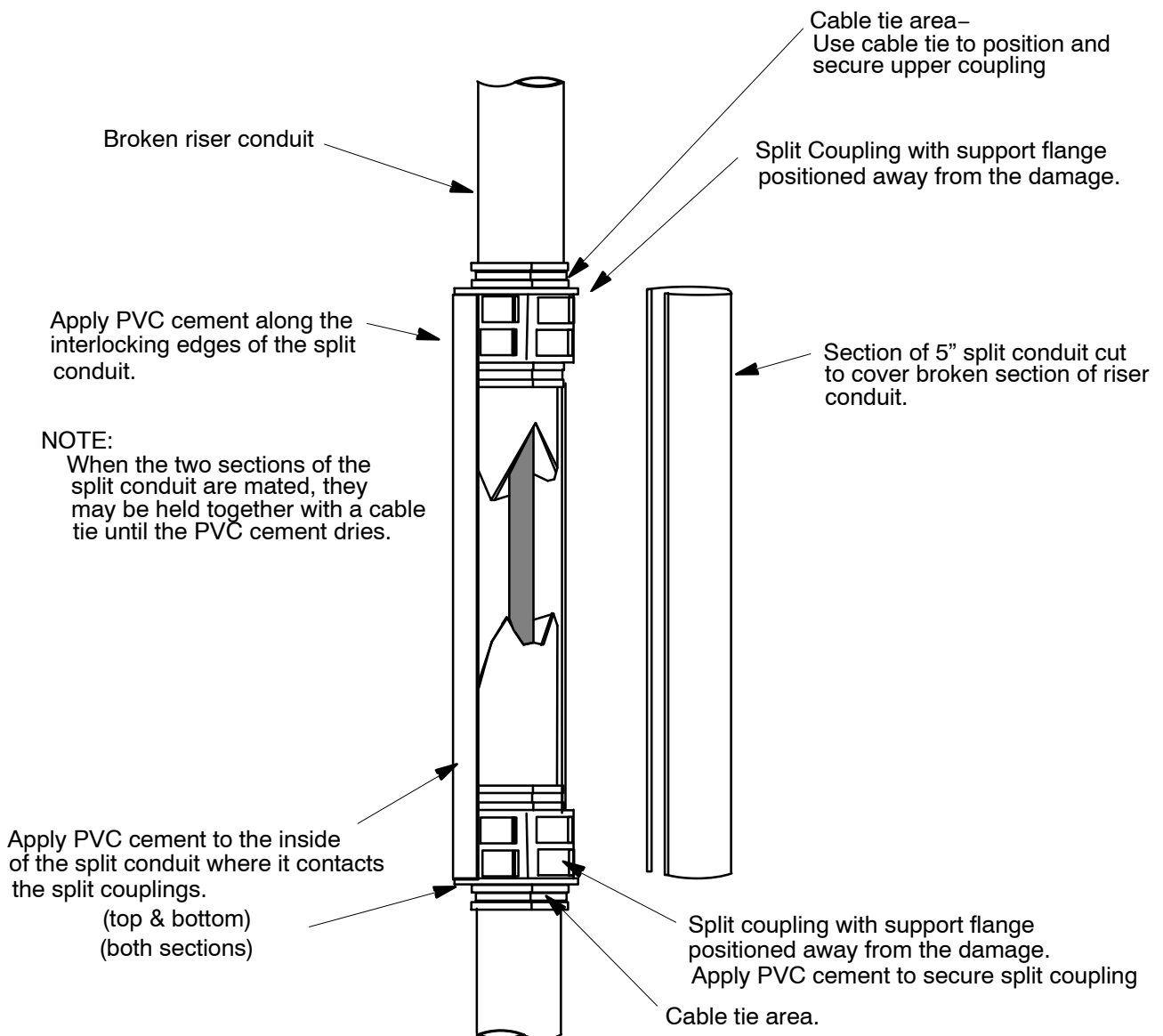
Reciprocating saw blade shown above (86 12 994) is the preferred blade for cutting split conduit. Split conduit should be assembled while cutting for best cut quality.

**REPAIR INSTRUCTIONS**

1. Determine the size of the broken conduit.
2. Remove the broken pieces of conduit.
3. Using PVC cement, attach the correctly sized split coupling to the bottom section of the broken riser conduit (below the break on the solid conduit). Position the split coupling so that the 5" split conduit support flange is away from the broken section. If necessary, a cable tie may be used to hold the split coupling in place.
4. Using a cable tie, attach a correctly sized split coupling to the top section of the broken riser conduit (above the break on the solid conduit). Position the split coupling so that the 5" split conduit support flange is away from the broken section.
5. Measure between the two split couplings to determine the length of the 5" split conduit needed to make the repair. Cut the required length of split conduit needed to make the repair.
6. Place one section of the cut split conduit on the support flange of the bottom split coupling. Slide the top split coupling down so that the section of split conduit contacts the support flange of the top split coupling. Tighten the cable tie to secure the split coupling into place.
7. Remove the section of split conduit. Apply PVC cement to the inner surface of the split conduit in the area where the conduit contacts the split coupling.
8. Re-insert the section of split conduit between the two split couplings. Apply PVC cement to the edges of the reinstalled section of split conduit. Insert the remaining section of split conduit between the top and bottom split couplings. Hold the two split conduit sections together until the PVC cement dries. The conduit sections may be held together with cable ties.

REPAIR INSTRUCTIONS

**NOTE:** Illustration shows a repair on a riser conduit. Rotate the illustration for a repair on an underground conduit.



Single weave cable grips should be laced with single strand lacing; double weave cable grips should be laced with double strand lacing. Lacing strands should be the same material as the grip. Appropriate lacing should be provided with each grip.

The split grips, used by Ameren to support cables on terminal poles, are as follows:

Stock #23-17-207 – 1.75" to 1.99" Cable Diameter, 25" Long

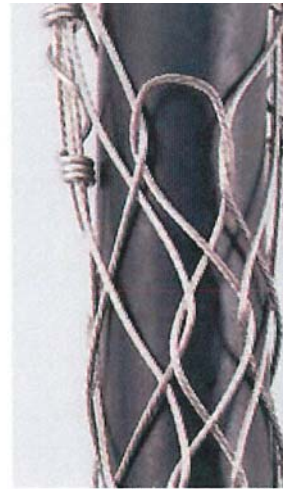
Stock #23-17-245 – 2.00" to 2.49" Cable Diameter, 27" Long

Stock #23-17-245 – 2.50" to 2.99" Cable Diameter, 29" Long

Stock #23-17-220 – 3.00" to 3.49" Cable Diameter, 34" Long

Stock #23-17-246 – 3.50" to 3.99" Cable Diameter, 36" Long

1. Start the lacing at the lead or anchoring end of the grip (where the eye is located). Thread the lacings through the first two loops of the split and pull through until the lacings are centered at this point. Lace as you would your shoe, crossing the lacings before lacing the next two loops.



2. Don't pull lacing too tight. Leave a space between adjoining loops approximately equal to the width of one diamond of the mesh grip.



3. At the very end of the mesh grip, twist the lacing ends tightly together. Wrap the ends tightly around the tail of the grip once or twice. Excess lace can be cut off.



4. Remove all slack from the mesh grip starting at the strand equalizers and working toward the tail end of the grip. Apply one or two cable ties (Stock #40-59-191) to the mesh grip approximately 1 to 2 inches from the tail end of the mesh grip. This may help keep the grip from moving or releasing. The tails of the cable ties should be cut off.
5. Attach the mesh grip eye to the anchoring hardware (generally a machine bolt, eyenut, and shackle) on the pole.





### GENERAL

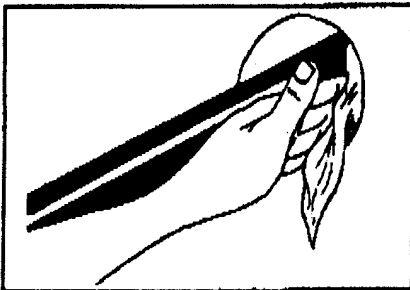
The Inflatable Duct System (DSS) may be used in conjunction with plastic, concrete, tile, fiberglass, or steel ducts to provide a weathertight duct seal. The IDSS consist of an inflatable sealed bladder, made of flexible metallic laminate material, which has pre-installed, high-temperature sealant strips on both sides. The bladder is inflated to approximately 45 psi internal pressure with an inflation tool equipped with a manometer, safety relief valve, and CO<sub>2</sub> cartridge. After the bladder is inflated, the fill tube is removed and a self-sealing gel material seals the filling hole.

The IDSS will seal ducts with or without cable(s). If three or more cables have to be sealed, sealing clips are used in combination with the inflatable bladder. To make installation easier, the metallic surfaces should be lubricated with an approved lubricant.

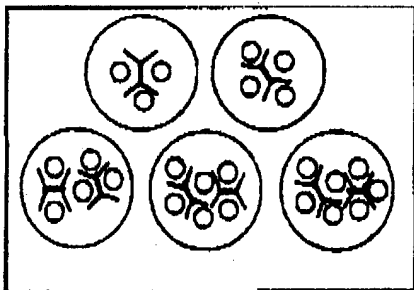
### MATERIALS

- A. CO<sub>2</sub> cartridge – Stock # 86-08-020. Noet: One cartridge will fill multiple bladders.
- B. Bladder for conduit with 3.25-4.50" I.D. – Stock # 12-51-098.
- C. Clip for use with item B – Stock # 12-51-098.
- D. Bladder for conduit with 4.75"-5.00" I.D. – Stock # 12-51-296.
- E. Clip for use with item D – Stock # 12-51-099.
- F. Bladder
- G. Clip for use with item F – Stock # 12-51-100.

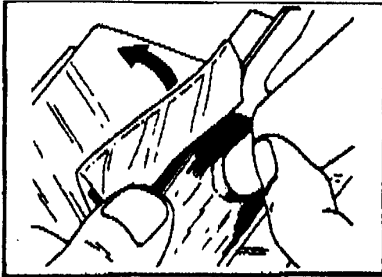
### INSTALLATION INSTRUCTIONS



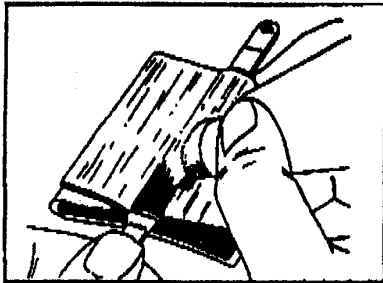
1. It is recommended to wet clean the duct and cable sheath. Remove as much dirt, crust, mud, etc. as possible. **For ducts with 3 or more cables, continue with step 2. For 0, 1, or 2 cables skip to step 9.**



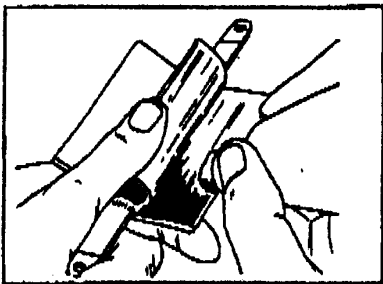
2. Examples for different multiple cable configuration. One RDSS-Clip can seal up to four cables. If more cables are to be sealed, use one extra clip per three additional cables.



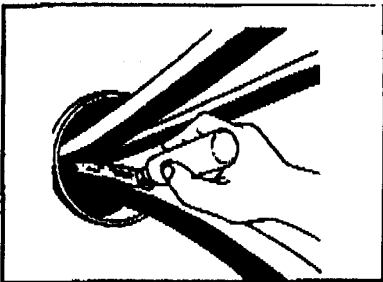
3. Open clip wings on one side. Lubricate the wings abundantly, to ensure that they don't stick together.



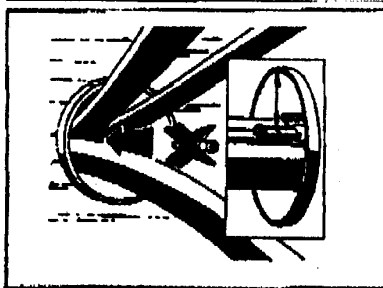
4. Remove one protection paper and lubricate abundantly the larger surface of the clip wing.



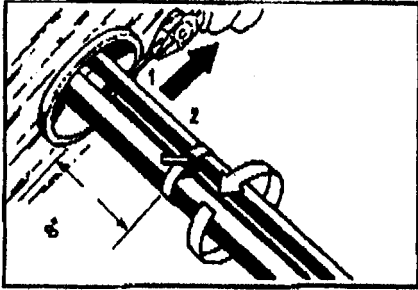
5. Repeat steps 3 & 4 for the other clip wings. Remove protection paper only after lubricating at least one wing side.



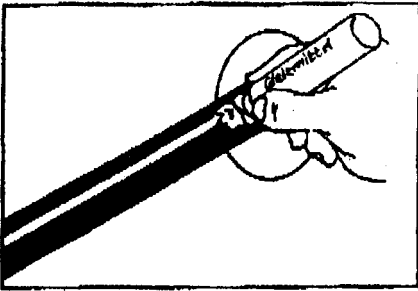
6. Abundantly lubricate the cables in the crotch area as much as possible.



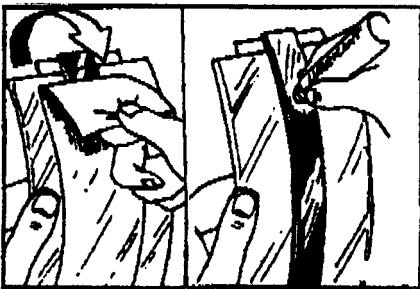
7. Insert the clip in between the cables, assuring that there is only one cable between each clip wing (see picture, step 2). Make sure that the central part of the clip is well positioned in the crotch area. The raised line on center stick should be flush with the end of the duct. Use the snort tie-wrap to hold the clip in place. Cut off the excess tie-wrap and position the locking part between the cables.



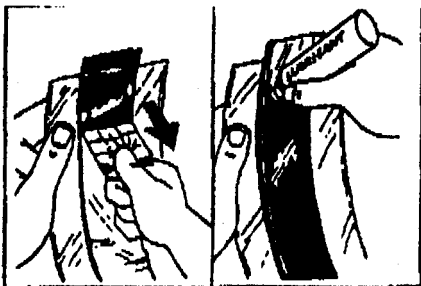
8. Install the long tie-wrap around the cable bundle at a distance of approx. 8" from the duct entrance.



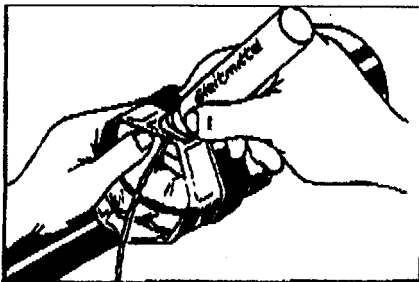
9. For ease of installation lubricate the cable.



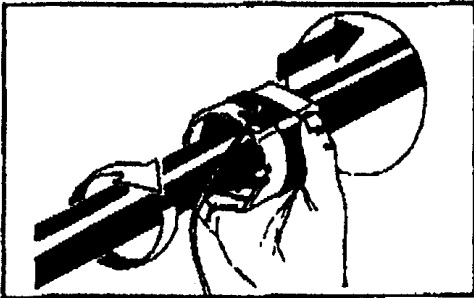
10. Remove the protective paper from the outside of the sealing strip and lubricate abundantly.



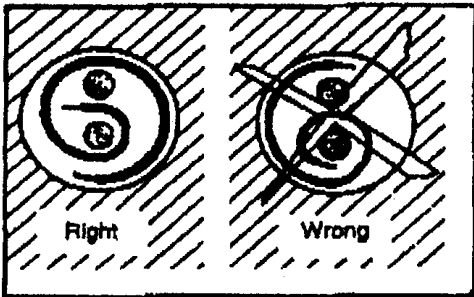
11. Continue with lubrication of the inside of the sealing strip.



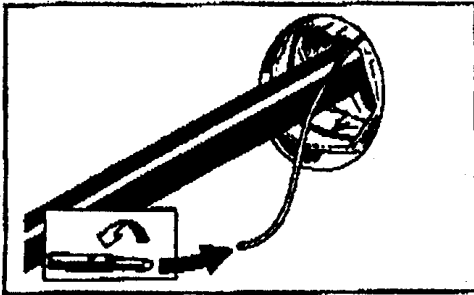
12. Lubricate the filling tube on the bladder section.



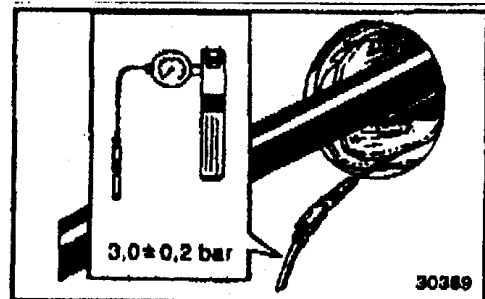
13. Wrap bladder around the cable (or cable bundle) and slide completely into the duct.



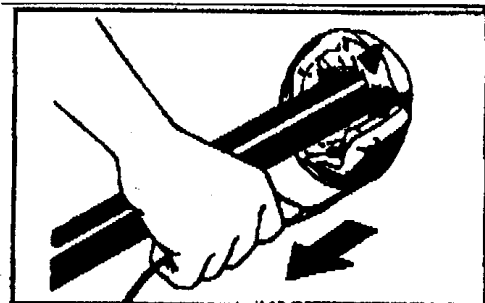
14. In case of two cables, wrap bladder around the cables as shown starting with the largest cable.



15. Connect the filling tube to the tube snap of the inflation tool. Gently insert the filling tube until it will not go any further. Tighten down the nozzle.

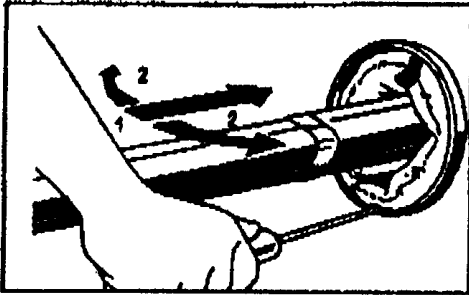


16. Inflate bladder up to the pressure of 3.0 bar (43.5 psi) and keep the pressure there for 30 seconds, after which the tool must be shut off.  
**Note:** Refer to the operation manual for the specific inflation tooling being used.

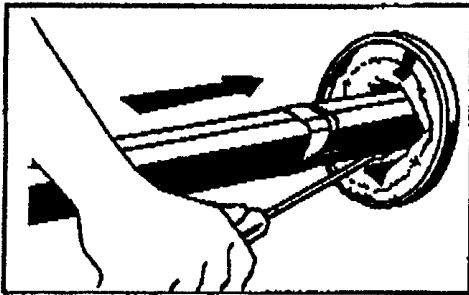


17. BEFORE removing the installation tool connection from the filling tube, pull out of the filling tube in one gentle move in the direction of the cable installation is complete

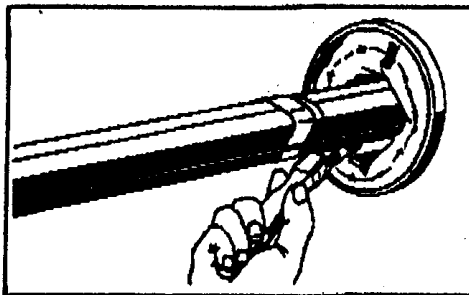
REMOVAL INSTRUCTIONS



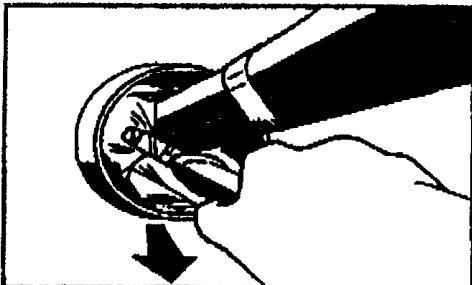
1. Deflate the bladder by piercing with a screw driver. Release the bladder from the duct wall by using a blunt tool.



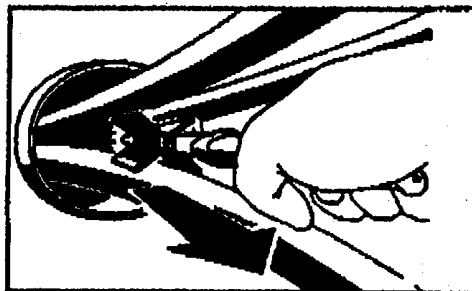
2. Release bladder from the cable or cable bundle.



3. Apply lubricant on the released areas.



4. Pull the bladder out of the duct with a pair of pliers.



5. If applicable: Remove tie wraps from the cable bundle. Spread cables. Remove clip core and sealant as much as possible with a pair of pliers.

**UNDERGROUND LINES INSTRUCTION**  
**Non-Lead Direct Buried Cable**  
**Burial Information**

**59 40 00 10**

Sheet 1 of 1

1. General

This instruction covers both normal installations and allowable deviations in burial depth of non-lead direct buried cables. New three phase primary cables shall be installed in conduit.

2. Non-Fused Primary Cable (Generally all 750 kcmil cable)

No new or replacement 750 kcmil cable direct buried installations shall be made.

For existing installations, the normal burial depth should be 48" in trenchable earth.

Existing installations in rock should be at a depth of no less than 24" and the cable should be installed in conduit and covered with 2 or more inches of protective concrete.

3. Fused Primary (Generally #2 or 4/0 cable)

In trenchable earth the normal burial depth shall be 36". The minimum depth shall be 30".

This may be reduced to 12" if the cable(s) are in conduit and covered with 2 or more inches of protective concrete.

4. Secondary

In trenchable earth the normal burial depth shall be 36". The minimum depth shall be 24".

This may be reduced to 12" if the cable(s) are in conduit.

5. Services

In trenchable earth the normal and minimum burial depth shall be 24".

This may be reduced to 12" if the cable(s) are in conduit.

6. Street Light Cable

In trenchable earth the normal depth shall be 24" and minimum burial depth shall be 18" where conflicts with other underground facilities exist.

In rock the depth may be reduced to 12" if the cable(s) are in conduit.

7. Special Cases

If depths other than those specified above are desired on specific jobs, the Standards Department shall be consulted.

8. Definitions

A. **Trenchable Earth** – Earth that can be excavated by use of a trenching machine.

B. **Rock** – Rock or Earth and rock that cannot be excavated by use of a trenching machine at the rate of 1.5 feet/minute.

C. **Burial Depth** – The amount of cover over the top of a cable or conduit.

D. **Suitable Backfill** – Dirt free of rock or debris; sand; or 1/4" limestone screening.

9. Other Conditions

A. Primary and secondary cables shall be installed random lay.

B. The first 6" of backfill over all cables not in conduit shall be of suitable backfill material.

C. The base of the trench on which the cable will lie shall be free of rock and/or debris. If rock and/or debris is present, backfill material can be put in the trench to form a 4" base for the cable to lie on or conduit may be used.

D. When the material excavated from a trench is not itself suitable backfill, a field decision by the Company Construction Supervisor or his representative will be made to either obtain suitable backfill, use conduit, or use cable-in-duct.

E. When cables or conduits are installed in areas that are congested (such as where we cross other underground facilities) and additional digging by others is highly likely to occur, "Caution Buried Cable" tape (stock number 49-16-061) may be used to mark the cable route. The caution tape should be installed 12"-18" below ground level and 12" directly above the buried cable or conduit.

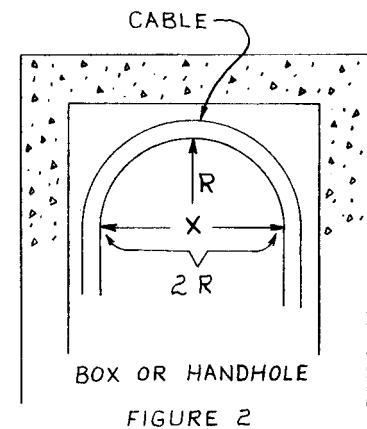
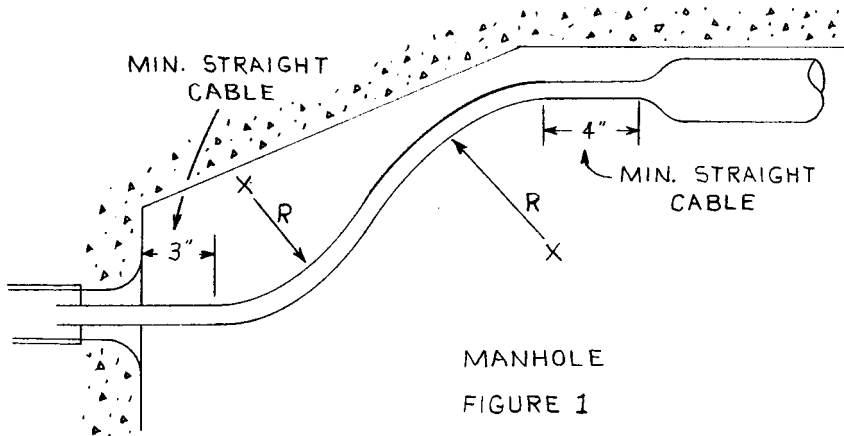
### General

This standard covers minimum bending radii for training underground cables.

### Bending Radii

The radii quoted in this instruction are minimum standards and should be exceeded where possible. Normal bending radii are ordinarily 12 times the cable diameter for non-armored paper lead cable. Minimum bending radii for solid dielectric cables vary widely. Secondary solid dielectric cable through 350 kcmil may be trained to a radius of 4 times the cable diameter. A no. 2 solid dielectric primary cable is properly trained at 5 times the cable diameter. A 750 kcmil as. 15kV cable is properly trained at 6 times and a 1500 kcmil cable at 8 times the cable diameter.

The information on this standard shall be used in obtaining minimum dimensions for construction of new underground facilities. Figures 1 and 2 below indicate normal measurements of typical bending radii for cables not direct buried.



ALL DIMENSIONS ARE IN INCHES.

<u>Size – Paper Lead Cable</u>	<u>Minimum Bending Radii</u>	<u>Normal Bending Radii</u>	<u>Cable O.D.*</u>
800–3C, 35kV	36	42	3.6
500–350–3C, 35kV	32	36	3.25
800–3C, 15kV	30	34	2.9
500–350–3C, 15kV	20	24	2.5
4/0–1/0–3C, 15kV	16	20	1.95
800–500–3C, 5kV	25	30	2.5
350–4/0–3C, 5kV	15	19	1.87
750–500–1C, 35kV	20	24	1.9
350–4/0 1C, 35kV	16	20	1.6
750–500–1C, 15kV	13	17	1.55
4/0–2–1C, 15kV	9	12	1.06

<u>Size – Solid Dielectric Cable</u>			
3–750R, 5kV	6.5	8	1.59
3–350 through 1/0R, 5kV	5	7	1.21
3–500 RL, 15kV	12	14	1.78
3–1500 AL., LCX, 15kV	24	28	2.35
3–4/0 through 1/0 AL. CNX or P, 15kV	8	10	0.98
3–2 through 1/0 CNR & P, 5kV	4	6	0.841
6 through 4 CNR & P, 5kV	4	6	0.73
3–350, FSR, P,RW 15kV	9.0	11	1.13
3–750, FSR,P,RW 15kV	11.0	14	1.43

<u>Size – 600V Solid Dielectric</u>			
4 through 2 R	1.5	3	0.476
10 through 6 R	1.0	2	
1/0 through 4/0 R	3.25	5	0.79
250 through 500 R	4.5	7	1.15
750 R	5.5	9	1.37



<u>Size – URD Cables</u>	<u>Minimum Bend- ing Radius</u>	<u>Normal Bending Radius</u>	<u>Cable O.D.*</u>	<u>Stock No.</u>
2-350 x 3/0 AL, X, 600V	3.5	5.0	0.869	18-07-201
2-350 x 3/0 AL, X, 600V C/D	20.0	24.0	–	18-07-248
2-3/0 x 1/0 AL, X, 600V	2.5	4.0	0.626	18-07-202
3-1/0 AL, X, 600V	2.0	3.0	0.529	18-07-203
3-750 x 1-350 AL, X, 600V	6.0	10.0	1.218	18-07-217
2 AL, CNRP, 15 kV	7.0	9.0	0.912	18-07-238
3-2 AL, CNRP, 15 kV	7.0	9.0	0.912	18-07-237
3-4/0 AL, CNRP, 15 kV	8.0	10.0	1.051	18-07-240
1-500 AL, CNRP, 15 kV	12.0	15.0	1.53	18-07-261
3-750 AL, CNR P, 15 kV	12.0	15.0	1.57	18-07-243
3-750, LCX, 15 kV	32.0	36.0	1.77	18-07-244
1-4/0 AL, LCR, 35 kV	32.0	36.0	1.74	18-07-219
1-750 AL, LCX, LCR, 35 kV	36.0	45.0	2.25	18-07-214
3-350 CU, LCR 35 kV	24.0	30.0	1.84	18-07-250
3-750 CU, FSR 35 kV	15.0	19.0	1.87	18-07-249
1-500 AL, CNRP, 69 kV	33.0	41.0	2.713	18-07-283
1-750 AL, CNRP, 69 kV	35.0	44.0	2.908	18-07-292
<u>CIC Primary</u>				
1-#2 CNRP 15kV in Conduit		18.0	–	18-07-242
1-#4/0 CNR P 15 kV in Conduit		24.0	–	18-07-241

1C	One Conductor	LC	Longitudinally Corrugated
3C	Three Conductor	CNP	Concentric Neutral Poly
X	Cross-Linked Poly	CNX	Concentric Neut. X-Linked Poly
R	Rubber	CNR	Concentric Neutral Rubber
RW	Reduced Wall (Insulation)	P	Protected (Jacketed)
L	Lead Sheath	FSR	Flat Strap, Rubber

\*The outside diameter given for multiple conductor cable is the diameter of the largest conductor.

15 kV Cable Ratings in Amps										
One Circuit Only – Not for Multi-Circuit Installations										
Stock Number	Size AWG or kcmil	Insulation	Direct Burial				Buried Conduit*			
			Summer		Winter		Summer		Winter	
			Normal / Emergency		Normal / Emergency		Normal / Emergency		Normal / Emergency	
			Single Phase	Three Phase	Single Phase	Three Phase	Single Phase	Three Phase	Single Phase	Three Phase
1807238	1-2AL	XLP or EPR	226/260	165/190	249/286	182/209	176/202	150/173	194/222	165/190
1807260	1-1/0AL	XLP or EPR	297/342	214/246	327/376	235/271	232/267	182/209	255/294	200/230
1807240	3-4/0AL	XLP or EPR		316/363		348/400		293/337		322/371
1807261	1-500AL	XLP or EPR		513/590		564/649		402/462		442/508
1807237	3-2AL	XLP or EPR		165/190		182/209		150/173		165/190
1807239	1-4/0AL	XLP or EPR	447/514		492/566		349/401		384/441	
1807243	3-750AL	XLP or EPR		628/722		691/794		493/567		542/624
1807245	3-350	XLP or EPR		533/613		586/674		416/478		458/526
1807244	3-750	XLP or EPR		745/857		820/943		582/669		640/736

\*This rating applies only when cables are enclosed completely in conduit from the terminal pole to the first termination. Use the direct burial rating for cable installed in a conduit only for the pole riser section.

600 Volt Cross-Linked Polyethylene Insulated Cable Ratings in Amps			
Stock Number	Cable Size	Direct Burial	Buried Conduit
1807252	#6 Al. Duplex	90	65
1807266	1/0-2-1/0 Al.	220	198
1807202	3/0-1/0-3/0 Al.	286	255
1807201	350-4/0-350 Al.	432	381

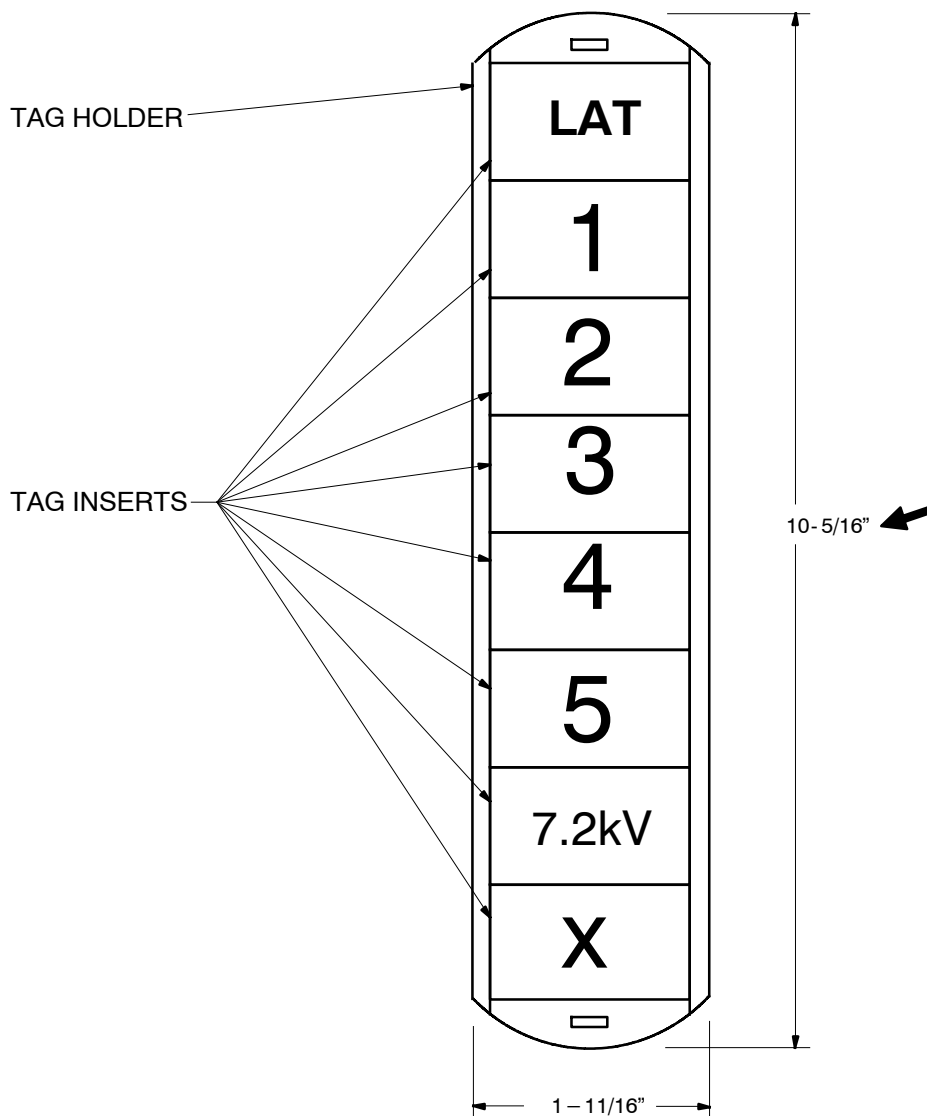
Quadruplexed 600 Volt Cross-Linked Polyethylene Cable Ratings in Amps (Three-Phase Service)		
Number of Conduits	Stk. # 18 07 288 3-350 x 1-4/0 Al	Stk. # 18 07 217 3-750 x 1 - 350 Al
1	335	509
3	278	421
6	228	346
9	208	316

1.0 General

This standard covers the basic information and materials required to produce cable tags for cables energized at 2.4 kV, 4 kV, 7.2 kV, 12 kV, or 34 kV. The cable tags will be produced by construction district personnel after obtaining the proper circuit designation and abbreviation from the appropriate authority. See DCS 59 40 00 41 for lead tag information and applications.

2.0 Cable Tag Construction

The cable tags will consist of a holder and various inserts. The holder will accommodate a maximum of ten inserts. A sample tag is shown.



**SAMPLE CABLE TAG**

### 3.0 Tag Use

These tags may be used as direct replacements for lead tags (Stk.# 16 – 01 – 099) and formica tags. However, it is not advisable to use these tags in locations where they may be damaged for long term submersion, petroleum products, etc.

### 4.0 Tag Attachment Methods

#### 4.1 Copper Wire or Nylon Cable Tie

Whenever a tag is attached directly to a cable; a piece of concentric neutral, #14 binding wire (Stk #18 – 52 – 018), or appropriately sized nylon cable tie may be used.

Whenever a tag is attached to a conduit strap; a piece of concentric neutral, #14 binding wire (Stk # 18– 52 – 018), or nylon cable tie may be used. Only black nylon cable ties shall be for outdoor applications.

#### 4.2 Galvanized Nails – Stk.# 21 – 57 – 047

Whenever a tag is attached directly to a pole; two galvanized nails shall be used for the attachment.

### 5.0 Typical Tag Locations

Generally only one tag will be installed on a cable.

#### 5.1 Cables In Manholes

Tags shall be attached within two feet of the west or north side of the cable joint nearest the manhole entrance.

Tags shall face toward the manhole entrance.

Tags attached to cables in racks shall be staggered.

See Distribution Standard 59 50 00 41 for lead tags.

#### 5.2 Cables In Network Vaults

Tags shall be attached within two feet of the duct entrance and face toward the vault entrance.

See Distribution Standard 59 50 00 41 for lead tags.

#### 5.3 Cables On Terminal Poles

Tags may be attached directly to the pole where there is only one lateral. If the terminal pole has more than one lateral, the tags shall be attached to the appropriate cables.

Tags attached to the cables shall be positioned immediately below the terminators.

Tags attached to the poles shall be positioned approximately 8' – 10' above grade or immediately above the guard.

Tags may be attached to a conduit strap if one lateral is on stand– off brackets. The tags shall be positioned approximately 8' – 10' above grade.

### 6.0 Special Requirements

#### 6.1 Cables Cut Dead

Cables cut dead are to be identified by a hole punched in the cable tag circuit voltage. Do not remove the cable tag and do not punch out any other information on the tag.

#### 6.2 Customer Owned Cables

Tags shall be attached to all customer owned cables. If the customer's cables are on terminal poles or attached to overhead facilities a yellow "Customer Owned" tag (Stk # 16 – 01 – 159) shall be attached (with binding wire or a black nylon) near the ends of each cable.

If the customer's cable enters a padmount transformer, switchgear, or pedestal the cables shall be marked with the tag described above or a wire tie (Stk # 40 – 59 – 268) that is imprinted with "Customer Owned Cable".

Each customer owned cable shall be tagged.

Customer owned cables, that are inside meter enclosures, shall be marked with the wire tie described above.

See distribution standard 59 52 00 41 for additional information about customer owned cables and parallel cables.

### 7.0 Tag Holder and Inserts

Cable tags will be produced using the following stock items. The tags are shown are black on yellow measuring 7/8" H x 1 1/2 W"

<u>Stock Number</u>	<u>Description</u>	<u>Stock Number</u>	<u>Description</u>
16 – 06 – 277	Holder, Tag, Black Poly	16 – 01 – 209	Tag, Cable "F"
16 – 01 – 318	Tag, Cable, "LAT"	16 – 01 – 210	Tag, Cable "G"
16 – 01 – 329	Tag, Cable, Dash ( – )	16 – 01 – 211	Tag, Cable "H"
16 – 01 – 330	Tag, Cable, "FDR"	16 – 01 – 303	Tag, Cable "I"
16 – 01 – 331	Tag, Cable, "DIP"	16 – 01 – 304	Tag, Cable "J"
16 – 01 – 319	Tag, Cable "12 kV"	16 – 01 – 305	Tag, Cable "K"
16 – 01 – 320	Tag, Cable "7.2 kV"	16 – 01 – 306	Tag, Cable "L"
16 – 01 – 321	Tag, Cable "2.4 kV"	16 – 01 – 307	Tag, Cable "M"
16 – 01 – 326	Tag, Cable "4 kV"	16 – 01 – 308	Tag, Cable "N"
16 – 01 – 327	Tag, Cable "34 kV"	16 – 01 – 309	Tag, Cable "O"
*16 – 01 – 195	Tag, Cable "0"	16 – 01 – 212	Tag, Cable "P"
16 – 01 – 196	Tag, Cable "1"	16 – 01 – 310	Tag, Cable "Q"
16 – 01 – 197	Tag, Cable "2"	16 – 01 – 311	Tag, Cable "R"
16 – 01 – 198	Tag, Cable "3"	16 – 01 – 213	Tag, Cable "S"
16 – 01 – 199	Tag, Cable "4"	16 – 01 – 214	Tag, Cable "T"
16 – 01 – 200	Tag, Cable "5"	16 – 01 – 312	Tag, Cable "U"
16 – 01 – 201	Tag, Cable "6" or "9"	16 – 01 – 313	Tag, Cable "V"
16 – 01 – 202	Tag, Cable "7"	16 – 01 – 314	Tag, Cable "W"
16 – 01 – 203	Tag, Cable "8"	16 – 01 – 215	Tag, Cable "X"
16 – 01 – 204	Tag, Cable "A"	16 – 01 – 216	Tag, Cable "Y"
16 – 01 – 205	Tag, Cable "B"	16 – 01 – 217	Tag, Cable "Z"
16 – 01 – 206	Tag, Cable "C"	16 – 01 – 221	Tag, Cable "CIPS"
16 – 01 – 207	Tag, Cable "D"	16 – 01 – 050	Tag, Cable "Light"
16 – 01 – 208	Tag, Cable "E"	16 – 01 – 224	Tag, Cable "Pedestal"
16 – 01 – 218	Tag, Cable "A – Phase"	16 – 01 – 322	Tag, Cable "Riser"
16 – 01 – 219	Tag, Cable "B – Phase"	16 – 01 – 225	Tag, Cable "Service"
16 – 01 – 220	Tag, Cable "C – Phase"	16 – 01 – 223	Tag, Cable "Streetlight"
		16 – 01 – 323	Tag, Cable "Switch"
		16 – 01 – 324	Tag, Cable "Trans."
		16 – 01 – 222	Tag, Cable "To"

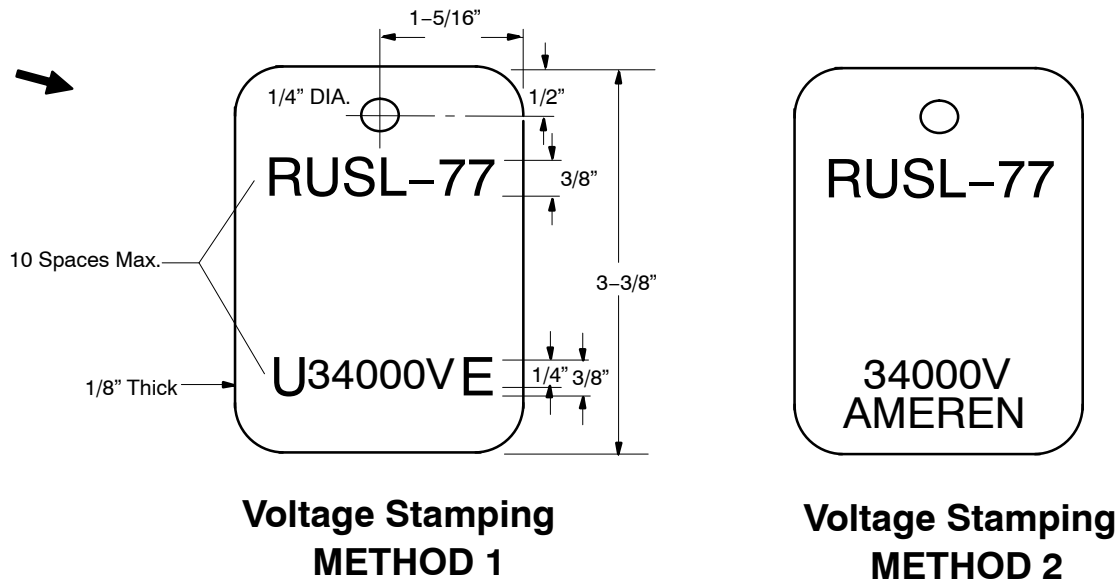
\* THE ZERO TAG IS ACTUALLY A PHASE SYMBOL THAT HAS BEEN ROTATED 90° TO APPEAR AS A ZERO WITH A LINE THROUGH IT. THIS IS TO HELP DISTINGUISH BETWEEN "ZERO" AND THE LETTER "O"

### 1.0 General

This standard covers a method that may be used for tagging cables.

### 2.0 Tags

Lead cable tags are generally stamped in the field and are routinely used for marking cables in manholes. The blank lead tag is Stock #16-01-099. The voltage shall be as shown, not abbreviated. See DCS 59 40 00 40 for tags that may be used on terminal poles.



### 3.0 Method of Attachment

Tags are to be attached to cables with a No. 14 tinned copper binding wire, Stock #18-52-018.

The procedure of attachment outlined below shall be followed

- \* Securely fasten tag to one end of wire.
- \* Bring the free end of wire under cable and serve it on the tag end.
- \* Bend served wire down on cable in such a manner that the tag can easily be seen.

### 4.0 Tag Placement

Only one tag per cable shall be installed in a given manhole. After repairs are completed, tags are to be returned to their original location.

Cable tags shall be located as outlined below.

#### 4.1 Tagging Cables in Manholes

Tags shall be attached within two feet of the west or north side of the cable joint nearest the manhole entrance.

The attached tag shall face toward the manhole entrance.

Tags attached to cables in racks shall be staggered.

4.2 Tagging in Network Vaults

Tags shall be attached within two feet of the duct entrance and face toward the vault entrance.

4.3 Tagging on Terminal Poles

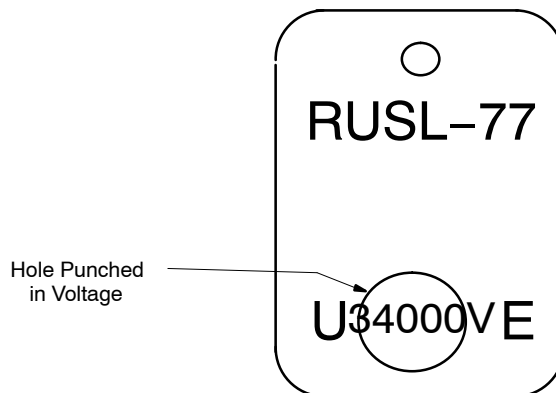
See DCS 59 40 00 40 for tags used on terminal poles.

4.4 Tagging Customer Owned Cables

Tags shall be placed on all customer owned cables. If the customer's cables are on terminal poles or attached to overhead facilities, a yellow "Customer Owned" tag (Stock #16-01-159) should be attached (with binding wire) near the end of each cable. If the Customer Owned cables enter a padmount transformer, switchgear, or pedestal, etc. they should be marked with either the tag described above, or a wire tie (Stock #40-59-268) imprinted with "Customer Owned Cable". Each cable should be tagged. Customer owned cables inside meter enclosures should be marked with wire ties, Stock #40-59-268. See DCS 59 52 00 41 for additional information about customer owned cables and parallel cables.

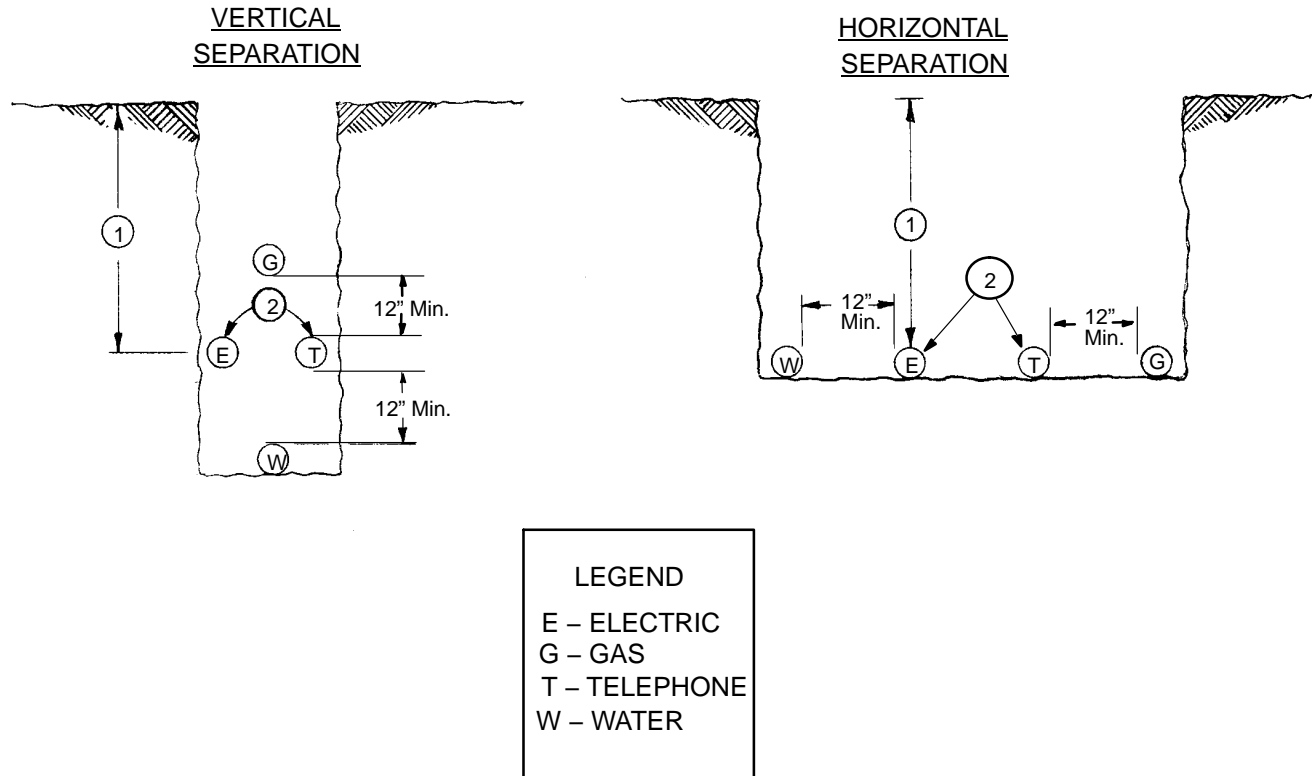
5.0 Tagging Cables Cut Dead

Cables cut dead are to be identified by a 3/4" hole punched in the cable tag circuit voltage as shown below. Do not punch out circuit name, cable number, or circuit number.



**Method to Identify Dead Cables**

1. Joint Trench Separation Requirements (NESC, 2017 Edition, Rules 320B and 353)  
These minimum separations apply to direct buried cables and cables installed in conduit.



#### NOTES:

1. Burial depth per DCS. 59 40 00 10.
2. This dimension may be reduced to 6 inches minimum in Missouri providing all parties are in agreement to this reduction. (NESC, 2017 Edition, Rule 320B2 Exception)

2. Swimming Pool Separation Requirements (NESC, 2017 Edition, Rule 351 C1 and C2)

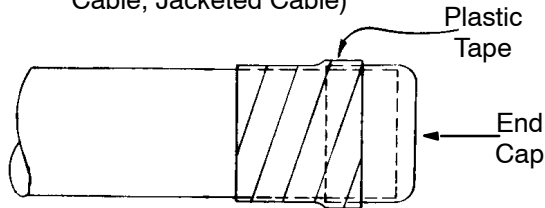
- A. Direct buried supply cables should not be installed within 5 feet of a swimming pool or its auxiliary equipment. If 5 feet is not attainable, see B. below.
- B. Supply cables installed in conduit have no clearance requirement. Burying under a swimming pool, even in conduit, should be avoided.



## ALL CABLES MUST BE SEALED.

### Sealing With End Caps

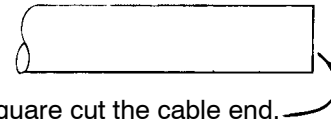
(Service, Non-Jacketed Cable, Jacketed Cable)



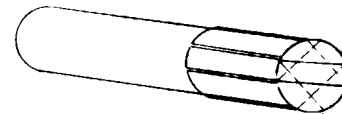
1. Choose the proper end cap for the cable being sealed.
2. Square cut the cable end.
3. Insert the cable into the end cap.
4. Secure the end cap with plastic tape (Stk. #25-53-055). Note: The heat shrinkable end cap requires no taping. Just shrink cap using an appropriate torch.

### Sealing Without End Caps

(To be used when end caps are not available)



1. Square cut the cable end.



2. Apply longitudinal strips of plastic tape. (Stk. #25 53 055)



3. Apply circumferential wraps of plastic tape over the longitudinally applied tape.

CABLE END CAPS			600 VOLT CABLE SIZE	5 KV NON- SHIELDED CABLE	15 KV JACKETED CABLE	34 KV EPR JACKETED
STOCK NO.	COLOR	I.D. (INCHES)				
40 59 144	RED	.437	1/0			
40 59 145	YELLOW	.562	3/0 4/0			
40 59 146	ORANGE	.813	350	1/0		
40 59 171	MAROON	1.00			#2 AL.	
40 59 166	BLACK	1.125	500 NW 750	350	350 Reduced Dia.	
40 59 194	BROWN	1.37	750 NW		4/0	
40 59 172	BLUE	1.50		750	350	1/0
40 59 193	BLACK	1.625			500	
40 59 173	GREEN	1.75			750	350
12 05 041	BLACK – HEATSHRINKABLE	4.5"			1000	750

# UNDERGROUND LINES INSTRUCTION

## Designation of Underground Cables

59 40 00 70

Sheet 1 of 4

### A. General

This instruction lists the standard formats to be used in designating various types of cable assemblies on all Company documents and records

Standard abbreviations:

Description	Abbreviation	Description	Abbreviation
Conductor Size	kcmil (Formerly MCM)	Varnish Cambric	VC
		Rubber	R
Conductor Size	AWG (American Wire Gauge)	Polyethylene	P
		Cross-Linked Poly	X
Paper-Insulated-lead Covered	PILC	Series Light	SL
Concentric Neutral	CN	Multiple Light	ML
Bare Neutral	BN	Lead	L
Network Type Cable	NW	Kilovolts	kV
Aluminum	AL	Tape Shield	TS
Longitudinally - Corrugated	LC	Protected (Jacketed)	P
Aerial	A	Conductive Jacket	PC
Flat Strap	FS	Duct	D
Reduced Insulation Wall	RW	Cable in Conduit	C/D

General Rules:

- When copper conductors are used in a cable assembly, the conductor material is not specified in the cable description. If the conductor material is aluminum, AL is used.
- When the cable is of the paper-insulated lead-covered type, the insulating material and the lead sheath are not specified.
- When the letter "P" is used following PILC cable descriptions, it indicates a protective covering has been installed over the metal cable sheath. When the letter "P" follows a comma, as CNX, P, the "P" stands for a jacket over the shield or concentric.
- AWG conductor sizes below 1/0 should use the numeral sign (#) preceding the AWG wire size (Example #2).

### B. Paper-Insulated Lead-Covered Cable (PILC)

All PILC cable designations follow one of the forms listed below. The conductor size is specified in kcmil or AWG, followed by the number of conductors under a common covering. The letter P is added if the sheath is jacketed and then the voltage is stated in kV.

Cable Description	Handwritten	Typed
800-3C, 35kV, PILC	800- <sup>3</sup> 35 kV	800-3C, 35kV
4/0-3C, 15kV, PILC Jacketed	4/0- <sup>3</sup> P, 15 kV	4/0-3C, P, 15kV
750-1C, 35kV, PILC	750- <sup>1</sup> 35kV	750-1C, 35kV
Three 750-1C Jacketed Cables installed in the same duct	3-750 P, 35kV	3-750 P, 35kV

### C. Lead-Covered Cables with Insulation Other Than Paper

These cables normally consist of one or three conductors under a lead sheath. The insulation is usually rubber (abbreviated "R") or Varnish cambric (abbreviated "VC"). The lead sheath is identified by the letter "L". These letters are added to the form specified in Section "B" in the position shown in the samples below.

Cable Description	Handwritten	Typed
Rubber-insulated lead-covered 500kcmil 15kV-3 cables triplexed (18-08-207). No longer stocked	3-500 RL, 15 kV	3-500 RL, 15kV
Varnish Cambric insulated lead-covered, 500 kcmil, 1C, 1000 Volt (18-08-019). No longer stocked	500- <sup>1</sup> VCL, 1kV	500-1C, VCL, 1kV
Rubber Lead - 300 kcmil, 3C, 600 V (18-08-014). No longer stocked	300- <sup>3</sup> RL	300-3C, RL

### D. Multi-Conductor Assemblies of Single Conductor Cables (Other than Concentric Neutral Type)

This cable is identified by stating the number and size of all conductors. When the neutral is the same size as the phase conductor, it is included with the phase conductors. If the neutral is bare, the abbreviation "BN" is added to the description following the conductor size. If the neutral is smaller than the phase conductors, it is specified following the phase conductor by adding the multiplication symbol "x" and the size. If more than one conductor is used for the neutral, the number of conductors must be specified.

Example: 3-500 kcmil phase conductors with a 4/0 bare neutral - 3-500 x 4/0 BN  
 3-750 kcmil phase conductors with 3-#2 covered neutrals - 3-750 x 3-#2

To complete the description, the conductor metal must be shown if it is other than copper. Also, the insulation material and the rated voltage must be shown. If the rated voltage is 1000 volts or higher, the voltage is specified in kV (Example: 5kV). If the cable is rated at 600 volts, the voltage should not be shown. Any other cable assemblies designed for underground use, but not rated 600 volts should carry the rated voltage in volts (Example: 300V).

Several complete examples are given below.

<u>Cable Description</u>	<u>Written or Typed</u>
Pole Riser - Rubber Insulated 5kV consisting of 3-750 kcmil phase conductors and 3-#2 or 1-4/0 neutral conductors (18 07 031).	3-750 x 3-#2, R, 5kV 3-750 x 1-4/0, R, 5kV
URD Secondary - Cross-linked polyethylene insulated consisting of 2-350 kcmil aluminum phase conductors and a 3/0 AWG aluminum insulated cable triplexed together. Rated voltage 600 volts (18 07 201).	2-350 x 3/0 AL, X
URD Service - Cross-linked polyethylene insulated consisting of 2-3/0 AWG phase conductors and 1-1/0 AWG neutral conductor twisted together. All conductors are aluminum. Rated voltage is 600 volts. 18 07 202, or 2-350 kcmil with a 3/0 neutral in duct (18 07 248).	2-3/0 x 1/0 AL, X 2-350 x 3/0 AL, X, C/D

### E. Network Type Cable - Rubber

Network cable (abbreviated NW) is a special construction of the cable specified in Section D. It consists of copper conductors covered with rubber insulation and a tough neoprene rubber jacket. It is rated 600 volts. This cable is identified by placing the abbreviation "NW" as a suffix to the description stated in Section D, Paragraph 1.

### Cable Description

Network – 500 kcmil, 3C x 4/0 AWG

Bare Neutral – 600 V. (18 07 010)

Network – #2 AWG, 3C, 600 Volt

Bare Neutral (18 07 026)

### Written or Typed

3–500 x 4/0 BN, NW

3–#2 BN, NW

### F. Network Type Cable – Cross-Linked Poly

Another class of cables is crosslinked network. This cable has a copper conductor, is cross-link poly insulated, and is basically used as a duct cable was therefore designated as a network style cable with the NW description, rated 600 volts. See Ameren Material Spec. 2.2.206.

The usual description for item C which has a bare neutral would be: 3–2/0 NW, X, BN. Item D would be 3–1/0 NW, X because all three conductors are insulated.

Stock No.	Stock Description	Assembly of Insulated	Conductors Bare (AWG)	Record Description
18 07 011	NW, 1–750 kcmil	1–750 kcmil	–	1–750 NW, X
18 07 027	NW, 3–4/0 AWG (BN)	2–4/0 AWG	1–4/0	3–4/0 NW, X, BN
18 07 246	NW, 3–2/0 AWG (BN)	3–2/0 AWG	1–2/0	3–2/0 NW, X, BN
18 07 043	NW, 3–1/0 AWG	3–1/0 AWG	–	3–1/0 NW, X
18 07 026	NW, 3–#2 AWG (BN)	2–#2 AWG	1–#2	3–#2 NW, X, BN
18 07 001	NW, 4–#2 AWG (BN)	3–#2 AWG	1–#2	4–#2 NW, X, BN

### G. Primary–Extruded Insulation Concentric, Tape, Longitudinal Corrugated, or Flat Strap Shield

To identify this type of cable, the number of insulated conductors making up the cable the size of the conductor, the conductor metal, the abbreviation "CN" indicating concentric neutral followed by the abbreviation for the style of insulation and construction. A comma and the rated voltage follow.

There are several types of extruded "High Voltage" cable insulations on the Ameren System. All types of rubber cable insulations use "R" to designate the rubber regardless of the style of rubber cable. X is used to designate cross-linked poly while P was used when Ameren purchased high molecular weight polyethylene which was not cross linked. While manufacturers used HMWP, Ameren used "P" (Poly) for the insulation description. For concentric neutral cables designated CN the X, P, or R should follow the CN immediately CNX, CNP, CNR. All cable currently purchased for URD primary will also have a P in the abbreviated description to indicate jacketed. Hence "CNR,P" is the modern URD cable now being used. It is important to cable operations that all cable be accurately posted with its proper abbreviated description and date of installation, month and year.

Cable Description	Posting
1–#2 AL, Rub, 15kV, Concentric Neutral, Jacketed	1–#2 AL, CNR, P (F) M/Yr.
3–#2 AL Rub, 15kV, Concentric, Triplexed, Jacketed	3–#2 AL, CNR, P (F) M/Yr.
3–750 AL, Rub, 15kV, Concentric, Triplexed, Jacketed	3–750 AL, CNR, P (F) M/Yr.
3–750 Rubber, 15kV, Longitudinal Corrugated Shield	3–750, LCR, P(F) M/Yr.
*3–350, Rub, 15kV, Flat Strap, Tripl., Jkt, Reduced Insul.	3–350, FSR, P, RW(F) M/Yr.
*3–750, Rub, 15kV, Flat Strap, Tripl., Jkt, Reduced Insul.	3–750, FSR, P, RW(F) M/Yr.
1–#2 AL, Rub, 15kV, Conc. Neutral, Jacketed in Conduit	1–#2 AL, CNR, P, C/D (F) M/Yr.

1-1000 Rubber, 15kV, Tape Shielded, Jacketed	1-1000, TSR, P(F) M/Yr.
3-350 Rubber, 35kV, Longitudinal Corrugated Shield	3-350, LCR, P (H) M/Yr.
3-750 Rubber, 35kV Flat Strap Shielded Jacketed	3-750, FSR, P (H) M/Yr.

\* Used by Heavy Underground Only.

H. Identification of Rated Voltage on Plat Book Records

In identifying rated voltage of cables on the plat book records, the following letters are used and the voltage used in the description above is eliminated.

A – 600 Volts or Less

D – 8.0 kV

G – 27 kV

B – 500 Volts d.c.

E – 6.6 kV

H – 35 kV

C – 5 kV

F – 15kV

J – 69 kV

In actual practice, the letters B, D, E, and G are no longer used.

When a cable is rated at a higher voltage than its operating voltage, it should carry the symbol corresponding to its rated voltage on all plat book records. The circuit name will show the operating voltage of the cable.

SCOPE: This standard provides for the joining, sealing placing and repair of plastic conduit.

### MATERIALS

The conduits and fittings used shall be in accordance with Ameren Specifications and the conduit standards referenced therein. The male ends of all conduit shall be beveled on the inside 1/2" wide from edge. Pieces that are field cut shall be cut straight and beveled on the inside edge. This will provide a smooth internal transition between pieces avoiding damage to the cable.

### INSTALLATION

1. Preparation of the materials shall include –
  - a. Cleaning surfaces to be joined
  - b. Eliminating cracked or defective parts or conduit
  - c. Make sure male ends of conduit have an inside beveled edge
  - d. Close tolerance shall be adhered to in the cutting and fitting
  - e. Fresh good solvent or cement shall be used
2. Continuity of size shall be maintained between manholes etc., where conduits end. Necessary changes in size due to adaptation to existing system shall use approved fittings and methods.
3. Proper support and transportation must be used to insure good materials. Do not drop conduit in cold weather.

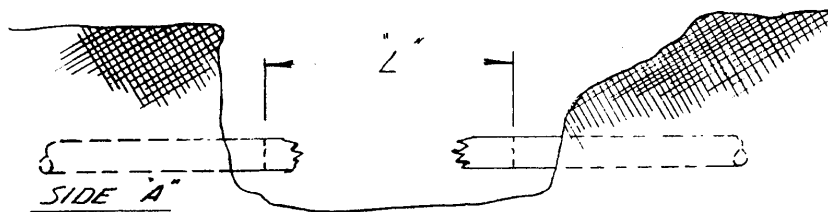
### JOINTING

1. Cement the cleaned surfaces using a liberal amount of cement. Coat the entire length of the socket.
2. Work fast. If delays occur re-cement before joining.
3. Slip the conduit into the socket with a firm twist until bottoming is felt. Hold the joint motionless for 15 seconds longer when the weather is very cold. Do not drive or twist a completed joint.
4. Full curing takes one hour. Avoid transportation or unnecessary movement. Use care when adding additional sections. Stake bends to keep the stress off the joints.
5. All plastic conduit and fittings to be joined shall be exposed to the same temperature conditions for an hour prior to joining.
6. Precautions shall be taken to allow extra length where the conduit is at higher temperatures than the earth or the reverse, extra room, if the conduit is colder than the earth.
7. Backfilling shall be from the center of the ditch toward the ends or from one tie in point to the other.
8. Use only approved fittings and couplings. End bell or duct terminators shall be used at the terminations.
9. Free ends of conduit must be sealed when any work delay occurs. All completed ducts shall be wired and sealed.

Stock Numbers  
Schedule 40 Couplings

Size	Standard	Repair Sleeve*
1"	12-51-237	--
1-1/4"	12-51-280	--
1-1/2"	12-51-278	--
2"	12-51-181	12-51-287
2-1/2"	12-51-265	12-51-288
3"	12-51-158	12-51-289
4"	12-51-157	12-51-290
5"	12-51-156	12-51-291

\*No center stop.



"L"	
MIN. LENGTH OF REPAIR CONDUIT	
DIA.	LENGTH
2"	15"
3"	20"
4"	25"
5"	30"

### SIDE "A"

EXPOSE CONDUIT AND CLEAR DEBRIS SQUARE CUT EDGES.  
MEASURE & CUT REPAIR PIECE 1/2" SHORTER THAN "L".  
CLEAN ALL EDGES TO BE FITTED.  
CEMENT & INSTALL COUPLING ON REPAIR LENGTH  
APPLY CEMENT TO SIDE "A".

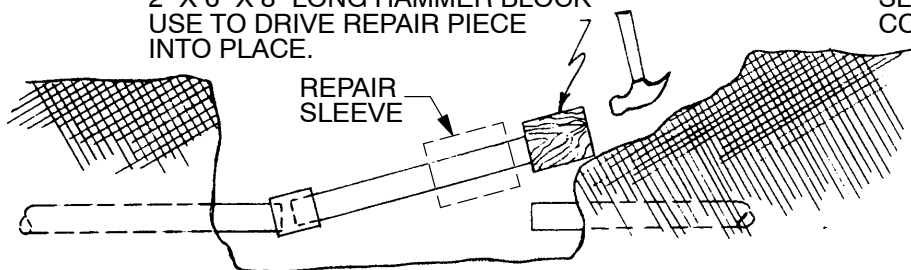
### OPTION 1

2" X 6" X 8" LONG HAMMER BLOCK  
USE TO DRIVE REPAIR PIECE  
INTO PLACE.

OR

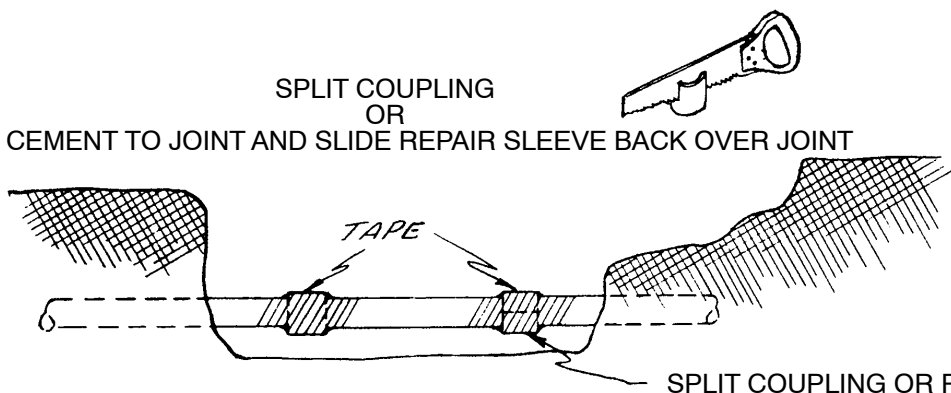
### OPTION 2

SLIDE REPAIR SLEEVE ON  
CONDUIT PAST JOINT.

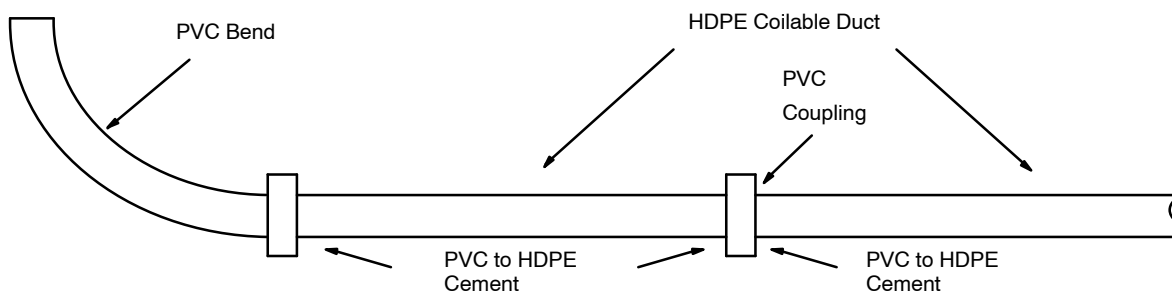


SPLIT COUPLING  
OR

APPLY CEMENT TO JOINT AND SLIDE REPAIR SLEEVE BACK OVER JOINT



CEMENT COUPLING TO CONDUIT.  
TAPE COMPLETELY SEALED WITH 1-1/2" WIDE PLASTIC TAPE.  
ALLOW CEMENT TO SET - CAREFULLY BACKFILL.



**Epoxy Cement Application Instructions**

The stocked epoxy cement will effectively bond HDPE coilable duct to PVC bends and couplings if the following instructions are properly observed:

1. Cut the HDPE coilable duct to the desired length at a 90 degree angle. A straight cut will maximize adhesion.
2. For coilable duct over 3 inches, taper the end at a 45 degree angle using a knife.
3. Clean the coilable duct and the coupling or bend thoroughly to remove dirt and grime.
4. Using the abrasive cloth provided with the bonding kit, sand the outside of the coilable duct from the end to ½ inch beyond the depth of insertion into the coupling or bend. Using the same cloth, thoroughly sand the inside of the coupling or bell end of the bend. Be sure that all of the polish is removed.
5. Clean the adhesion surfaces again to remove loose material or water.
6. To avoid waste of the epoxy cement clean as many coilable duct ends, couplings, and bends as possible before opening the adhesive cartridge.
7. Place the epoxy cement cartridge into the dispensing tool and snap it into place.
8. Twist the cap off of the epoxy cement cartridge.
9. Place the mixing nozzle onto the cartridge and lock into place by twisting clockwise. Depress the handle on the dispensing tool until the epoxy cement comes out of the nozzle tip. Pump one or two more times to assure that the mixture is even (no streaking). Discard this excess cement.
10. Place the epoxy cement in a ⅛ to ¼ inch bead using a zigzag pattern the depth of the connector insert. The pattern should be about ½ inch in width and extend to the outer edge of the coilable duct. The end of the nozzle may be trimmed off up to the last notch to place a larger bead for larger diameter duct.
11. Twist the coupling immediately onto the coilable duct. It is important to twist the coupling to make sure that the epoxy cement is well mixed and spread evenly on the inside of the connection.
12. Smooth any excess epoxy cement. Use gloves to smooth out the cement.
13. Allow sufficient time for the epoxy cement to set:

<b>Temp</b>	<b>Working Time</b>	<b>Set Time Before Movement</b>
35 Deg. F	40 Minutes	7 Hours
52 Deg. F	20 Minutes	3 ½ Hours
60 Deg. F	10 Minutes	1 ½ Hours
70 Deg. F	6 Minutes	60 Minutes
88Deg. F	4 Minutes	40 Minutes

14. To store cartridge for later reuse, remove the mixing nozzle and replace the cap on the cartridge. Discard used mixing nozzles.



- 
15. The working temperature for the epoxy cement is 35 Deg. F to 95 Deg. F.
  16. The following epoxy cement components are stocked by Ameren:
    - a. Starter Kit (Dispensing tool, 2 cartridges, and 10 nozzles) stk. #12-06-126
    - b. Case of 12 cartridges and 24 mixing nozzles stk #12-06-127
    - c. Mixing Nozzles (each) stk. #12-06-128

Guide for the use of insulating compounds (I semi fluid, II fluid, III resin based).

STOCK DESCRIPTION:

**I. Compound – Insulating – – –**

A. –Asphaltic – Semi-Fluid, Low Loss Stk. No. 31 53 074 (new) T&D Spec. 2.2.88

TEMP.

Min. Pour 280 Flash Pt. 430.

Max. Pour 400°F

FOR USE IN

1. All PILC potheads rated through 35kV

B. Petroleum Base – Petrolatum Stock No. 31 51 062

TEMP.

Min. Pour 250°F Flash Pt. 400°F

Max. Pour 350°F

FOR USE IN

1. All PILC joints rated through 35kV where factory paper insulation is used.

Exception: a. 35kV crotch joints Use Stk. No. 31 51 020

2. All paper lead transition splices where hand applied tapes are of the varnish cloth type (varnished polyester)

**II. Compound Insulating-Fluids**

A. – 219 – Oil Fluid – A. Stk. No. 31 51 003 (042) T&D Spec. 2.2.135 (55 Gallon Drum) ◀—

TEMP.

Pour 70/105°F Flash Pt. 445°F

1. All cable terminal chambers on the network system.

2. All hot test caps through 35kV. (31 51 003)

B. Polybutene – Fluid B

Compound Insulating, for poly and rubber joints and transition splices, where lead sleeves are used.

U.E. Stock No. 31 51 049 (Usually G&W Novoid 224)

**III. Resin Base – Oil Insoluble Stk. No. 31 53 028**

1. For use in special applications where migration could be a problem.

TEMP.

Minimum Pour 300°F Flash Point 450°F

Maximum Pour 375°F

**IV. Gel – Cold Mix – Stk. No. 31 51 099 ◀—**

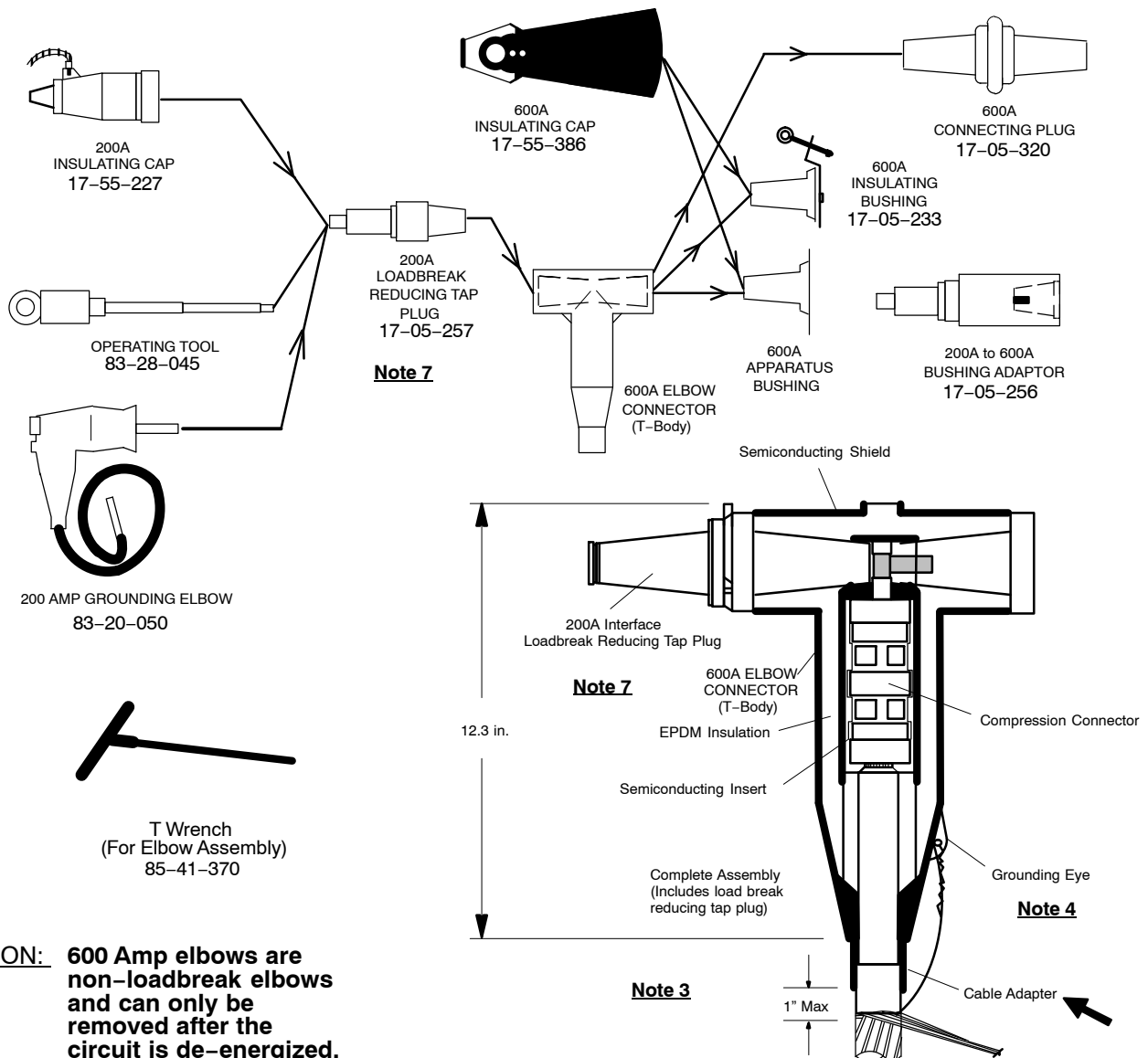
1. For use in PILC Joints and Potheads.

# UNDERGROUND LINES INSTRUCTION

## 15kV, 600A T-Body Termination and Accessories

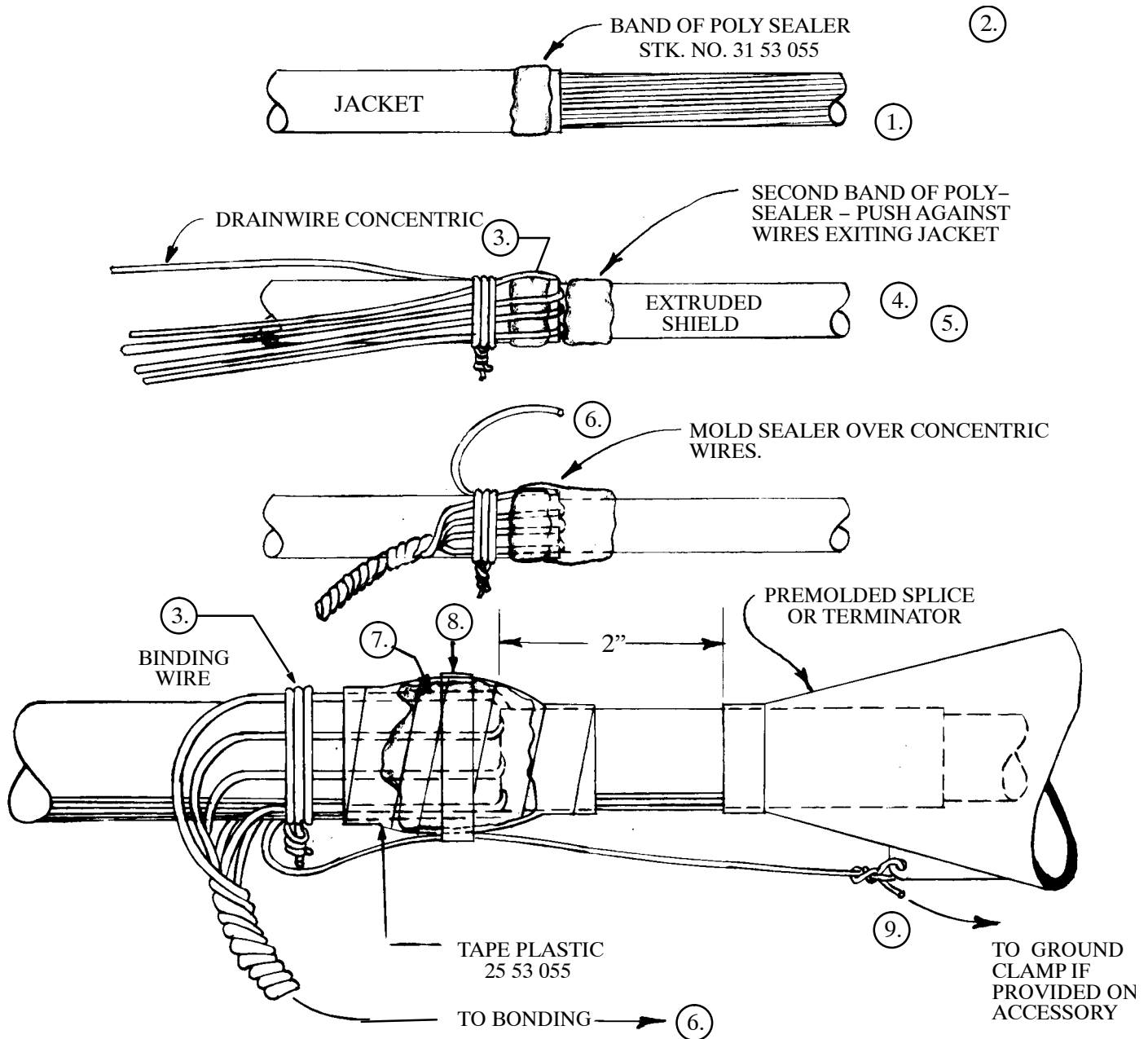
59 40 60 01

Sheet 1 of 1



### Notes

- Tools and hands shall be clean at all times to eliminate foreign particles in the elbow.
- In cold weather, keep the elbow in your truck cab until you are ready to install it.
- Install elbow per manufacturer's instructions and Dist. Std. 42 34 64 \*\*.
- Connect one concentric neutral strand in the grounding eye and twist tight. Reform the strands as nearly as possible to their original position and bind at this point with a scrap piece of concentric neutral strand. Twist the strands to form a single conductor for ground connection.
- The apparatus bushing must be clean and silicone grease applied before the elbow is connected.
- Remove all marking tape.
- Replacement needed only if existing loadbreak reducing tap plug is damaged. Note: A Cooper (RTE) Loadbreak Reducing Tap Plug (LB RTP) will only fit a Cooper (RTE) elbow and an Elastimold LB RTP will only fit an Elastimold elbow.



1. Remove jacket sufficiently long to allow concentric length for neutral connections.
2. Place a band of sealer putty just 1/2" to 3/4" wide sufficient to bury concentrics into.
3. Bend concentrics back and bury them in the putty -- Bind concentrics into place with wire as shown.
4. Place a band of poly putty in front of the jacket on the extruded shield so that it seals against the concentric wires where they exit from under the jacket.
5. Mold against the jacket & over the concentric wires.
6. Leave one wire out of bunch – Twist the balance to form one stranded conductor to take to the neutral bond or connection.
7. Tape two layers of plastic tape stretched tightly over the molded putty seal.
8. Add a third layer of tape using less tension.
9. Take the bond wire to grounding eyelet of accessory, connect as shown.

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## SCOPE

This instruction covers the handling and use of Varnished polyester (glass) insulating tapes used in the hand insulating of paper lead cable.

## STORAGE OF MATERIALS

The tapes shall be stored in closed polyethylene bags or sealed cans. Unstored bags left in the air shall not be used. Materials left unused in trucks or other equipment stored in poly bags shall not be used if the storage period exceeds 3 months.

## Peeling

The mastic used to secure the end of the roll shall be cut off.

## Heating

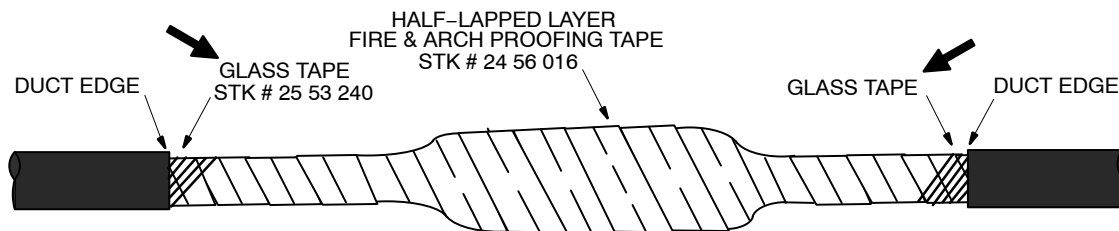
The peeled tapes shall be placed in the aluminum taping pot with sufficient 219 oil to cover the tapes. The pot and oil shall be heated to 150°F prior to taping. (Compound insulating 219 – Stock No. 31 51 003 in gallon cans.)

## Taping

1. Start the tape application in the lowest spot usually next to the connector.
2. Fill in lower spot first, fill in level pulling the tapes tight to obtain a void free fill.
3. Care shall be taken that no sharp step is created that causes voids.
4. Pour or wipe oil over each half lapped layer as the tape is applied.
5. Each new pot of tapes shall be heated. No tapes shall be applied cold.

TEST each leg for firmness before going on or applying the shield.

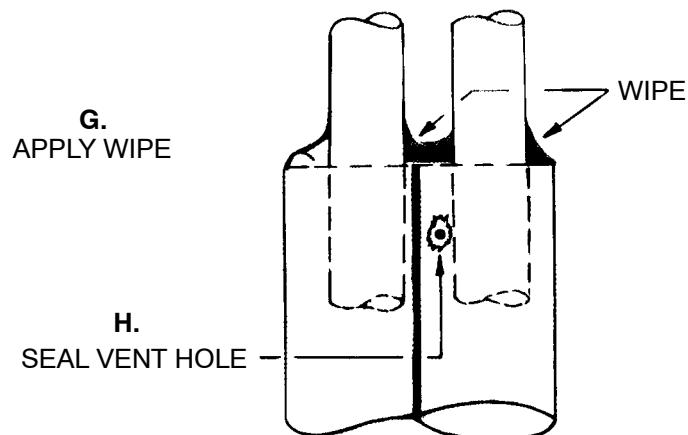
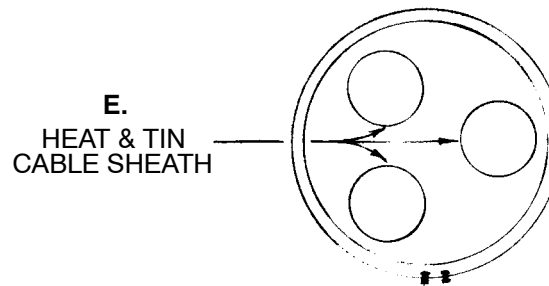
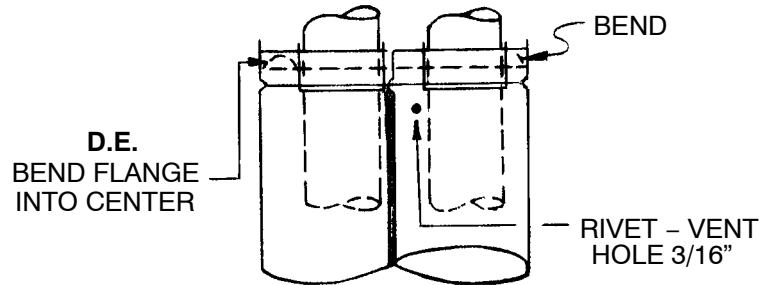
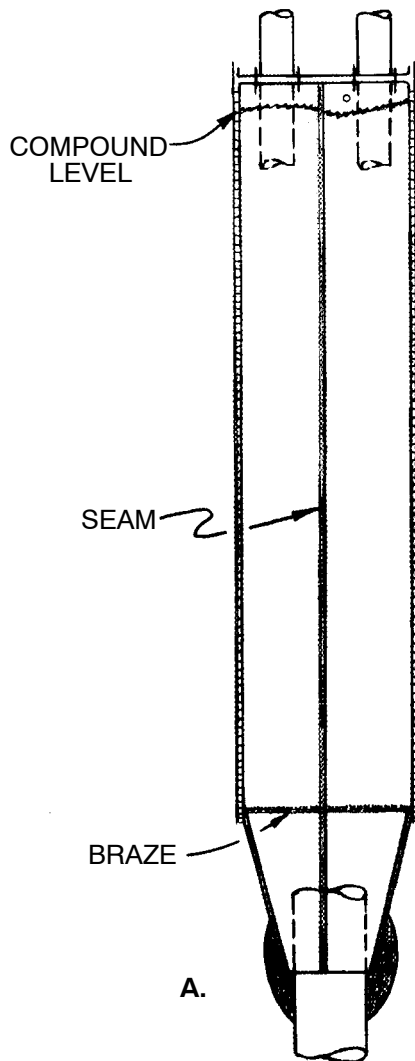
1. All cables in manholes and vaults, when personnel may be present, and the cables are operating at 2400 volts and above should be protected from fire and arcing. Note: Do not cover bond wires or bare neutral wires.
2. Apply fire and arc proofing tape to the cable with one half-lapped layer. The tape may be applied with either side toward the cable. The tape may be pulled tight to obtain a snug, wrinkle-free wrap which conforms to the cable (and splice). Overlap the last six (6) inches of protected cable when starting a new roll of tape.
3. Since fire and arc proofing tape may not be adhesive coated, it must be held in place after wrapping with glass tape. Secure the ends with several wraps of glass tape. (See Figure 1)
4. Fire and arc proofing tape shall be applied from duct edge to duct edge.
5. Triplexed cables shall be treated as a single cable except at locations where it is un-layed for splicing and then protect each leg and splice individually.



**CABLE & SPLICE COVERED**  
**FIGURE 1**

## SEALING TRIFURCATING SLEEVES

- A. The sleeve should be placed with the seam away from the pole or support structure.
- B. Apply the bottom wipe tinning the copper sleeve and sealing the cable to lead sheath.
- C. Fill the joint with compound leaving 1-3/4 to 2 inches of depth unfilled so that the compound does not run out of the brass riveted venting hole.
- D. Place the trifurcating end cover into the copper sleeve dished up until it sits tightly onto the rolled indent.



- E. Peen the "1" inch of copper sleeve above the indent so that it leans into the trifurcating end plate. See figure.
- F. Heat and tin the sheath of the single conductor cable where they will contact the wipe before placing the mass of lead which makes up the wipe.
- G. Apply the wiping solder while in the plastic state wiping and securing a tinned connection between the solder, sheath, and copper sleeve.
- H. As the last step, solder seal the brass rivet hole to the copper sleeve.

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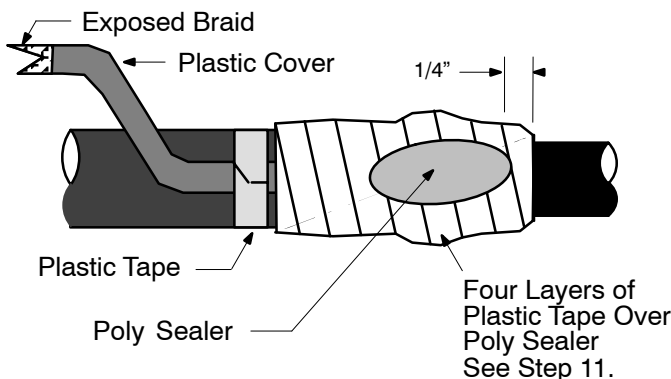
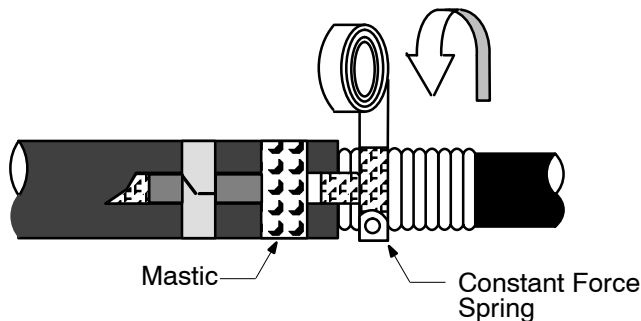
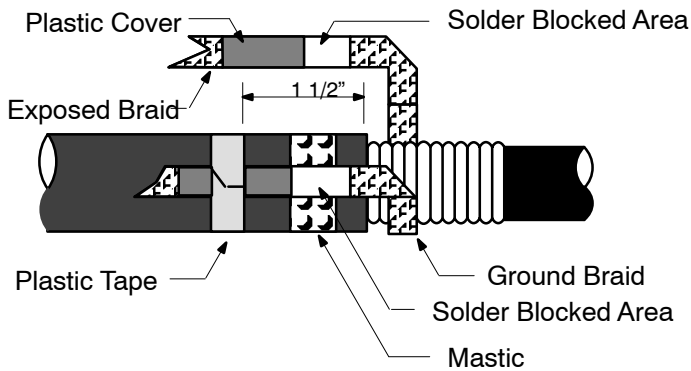
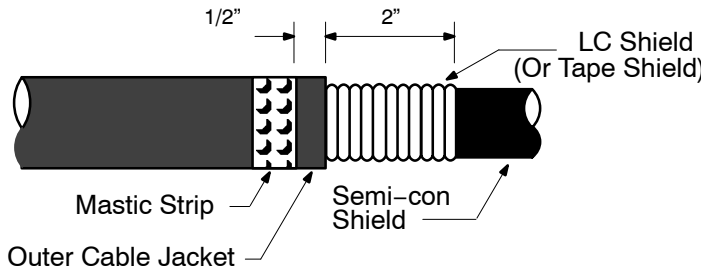
**CONNECTOR TINNING**

1. The conductors shall have been previously prepared by proper cutting with a hacksaw and stripped to the dimensions indicated per standard.
2. The insulation shall be protected by wrapping with several layers of glass tape 25 53 057 at the shoulder to prevent scorching during tinning.
3. The conductors must be well coated with paste flux, 22 02 255.
4. The connectors must be squeezed onto the conductors tightly but allowing the proper 1/8 inch slot opening to allow for proper tinning of the conductors.
5. The solder shall be tinning hot, 370°C (a cardboard or heavy paper quickly dipped into the solder shall turn brown but not burst into flames).
6. Starting at one end pour hot solder into the slot until the solder has heated the copper to the extent that molten solder runs through the connector. Then move the pouring back and forth along the slot.
7. Continue to pour solder into the slot using the cooling solder in the catch box. Pour and force mushy solder into slot until a solidly filled connector is obtained.
8. Use the gloved finger or wiping cloth to smooth the soft solder across and around the connectors.
9. After cooling, file and sand the connector to obtain a smooth finish removing any burrs or lead piles created during the tinning.
10. Remove the glass tape and dress up the shoulders of the insulation. Remove any burns or damaged insulation, and assure that no lead burrs remain.



#### CONSTANT FORCE SPRING CONNECTION WITH BRAID

NOTE: The constant force spring connector can be used on either LC shielded or tape shielded cables.



1. Strip jacket and semi-con shield to dimensions required.
  2. Select one of three mastic strips from the grounding kit ( Stk. #17-54-306). Remove liners and wrap mastic around the cable jacket, 1/2" from the cut edge. Discard any excess mastic from this piece.
  3. Position twin pre-formed ground braid with one tail along the cable jacket. The mastic must be within the solder blocked area.
  4. Secure the braid to the cable jacket with plastic tape, 1-1/2" from the cut edge of the jacket.
  5. Wrap the braid around the metallic shield and secure it in place with the constant force spring.
  6. Wrap the spring in the same direction as the braid and cinch (tighten) the final lap.
  7. Position the tail of the preformed ground braid along the cable jacket. The mastic must be within the solder blocked area.
  8. Secure the braid to the cable jacket with plastic tape, 1-1/2" from the cut edge of the jacket.
  9. Apply a second mastic strip layer over the braid tail. The second mastic strip should be positioned so that it overlays the previously installed mastic strip. Press the two mastic strips together to form a water tight seal.
  10. To seal the connection, apply poly sealer (Stk. #31-53-055) over the metallic shield, the constant force spring, and the mastic strips. Start sealing approximately 1/4" beyond the end of the metallic shield.
  11. Tape over the poly sealer with two layers of plastic tape (Stk. #25-53-055) stretched very tightly. Add two more layers of plastic tape, half lapped, to complete the water seal.
  12. Attach the two exposed braid tails to a #2 Cu. bond wire (Stk. #18-54-027) with a two bolt connector (Stk. #17-54-145). If an accessory drain wire is needed, include a #14 Cu. binding wire (Stk. #18-52-018) in the two bolt connection.
- \* Seal the two bolt connector using poly sealer and plastic tape.

**I. General**

The following instructions apply to all 35 kV joints shown in the 41 40 \*\* \*\* sections of the Dist. Const. Standards.

**II. Precautions**

1. Great care must be exercised to prevent moisture, dirt, or metal particles from getting into the insulation or the cable compound during construction of the cable joint.
2. During warm weather or in warm manholes the splicer shall keep his hands clean and free of perspiration by wiping them with rags and solvent degreaser while doing any work on the insulation.
3. All materials in direct contact with the insulation such as spacer blocks and wood chisels shall be boiled in oil until free of moisture and kept in oil until used.
4. All boiling out operations to be made with GE 219 taping oil (31-51-003) heated to 135° – 140° C during summer and 140° – 145° C in winter.
5. During the process of making the joint, the cable must not be bent or the conductors spread to such a degree that the insulation is damaged.

**III. Preparation of the Manhole**

1. A guard shall be placed around the manhole opening when necessary to prevent street dirt from blowing into the manhole.
2. Wipe all moisture and loose dirt from the roof, side wall, the cable to be worked on and other cables adjacent to the point where the joint is to be made.
3. In damp or wet manholes place a rubber blanket above the working area so that moisture cannot drop into the joint.

**IV. Training**

1. Train the cables into approximately their final position and support them on wood blocks and/or rollers on the iron pin cable supports.
2. Cables shall be trained so that a 6 inch section of straight cable extends from the duct mouth before beginning a bend.

**V. Determining the Center of the Joint**

1. Select a point, along the overlapping cable ends, for the center of the joint, so that there will be at least 21 inches of straight cable on each side of this center.
2. Wrap a marker tape around the cables just back of the center and cut the cables at right angles to their axes at this point.

**VI. Removing the Lead Sheath and Belt or Binder Tape****1. General**

- a) Mark the lead sheath at the point where it is to be removed.
- b) At this point cut a groove around the cables halfway through the lead with the chipping knife.
- c) Clean with a wire brush or sand cloth and inspect the lead sheath for a distance of 4 inches back from the groove.

- d) Make a longitudinal cut in the section of lead between the groove and the end of the cable.
- e) Remove the lead sheath by tearing it off at the groove around the cable. This will leave a partial belling of the lead sheath.

**2. Belted Cable**

- a) Complete the belling of the lead sheath with a fibre belling tool, using care to avoid damaging the insulation.
- b) Tie a string around the belt insulation at a point 1 inch from the lead sheath.
- b) Remove the belt insulation by tearing against the binder string.
- c) Wrap 4 layers of V.P. tape over belt and tie off tightly.

**3. Shielded Cable**

- a) Unwind any binder tape and cut off as close as possible to the lead sheath.
- b) Bind the cable next to lead sheath with 4 layers of 1 inch V.P. tape.

**VII. Preparing the Outer Sleeves****1. General**

- a) Copper Sleeve  
Carefully clean the sleeve.
- b) Lead Sleeve  
Carefully clean the sleeve, wire brush and inspect the outside of the sleeve for a distance of 4 inches from each end.

**2. For Oil-Filled Joints**

- a) Insert brass bushings (for fitting) and solder them in place being careful not to get solder on the inside of the bushing (19-11-094).
- b) Remove any solder from the inside of the sleeve.
- c) Slip the lead sleeve back over the cleaned cable.

**3. For Compound-Filled Joints**

- a) Same as for VII-2 except at one end of the sleeve the bushing is to be soldered in place after filling the joint. This half is to be on the cable at the lower or filling end.

**VIII. Preparing the Conductor Ends and Shaping Conductors**

- 1. Remove the fillers to within 1/2 inch from the belt on belted cable or the lead on shielded cable.
- 2. On shielded cables, unwind the copper shielding tape on the conductors, overlap and tack solder. 4 inches from the sheath. Place spacer blocks.
- 3. Wrap plastic sheeting tightly around the three conductors from the lead to the spacer blocks.
- 4. Shape the conductors straight and parallel to the cable.

**IX. Stepping Conductor Insulation**

- 1. Tie a string around the conductor insulation at the furthest step.
-

2. Remove ten layers of paper, tearing each layer against the string leaving a rough tapered surface.
3. In succession at each step tie a string and remove ten layers. At the last step remove half of the layers, and with the last string tied remove the remaining layers.
4. Wrap the insulation with plastic sheeting before working on the other conductors.

**X. Installing Copper Connectors**

1. Spread the connectors uniformly, sufficient to allow them to be slipped over the conductors.
2. Apply soldering paste to the conductors and slip all the connectors on the cable by grasping the cable with both hands, one just back of either crotch and push the two cable ends out toward the wall of the manhole until the ends of the connectors just pass the other conductor ends. Adjust each conductor to fit into the copper sleeve. Pull the cables back in the same manner.
3. Press the copper connectors together shaping them to conform to the conductor leaving no open space between the conductor and the inside of the connectors. Tap down any sharp edges with a ballpeen hammer.

**XI. Soldering Copper Connectors**

1. Carefully protect the end of the insulation and part of the exposed copper with several layers of glass tape, leaving 1/8" exposed copper next to sleeve.
2. Apply more soldering paste and then pour hot 50–50% solder into the slot in the connector until the conductors are properly tinned.
3. Allow the solder to cool until a surplus of solder can be built up over the ends and along the slot in the connector, making as smooth a wipe as possible.
4. With a sharp knife cut off any rough spots and projections of solder and sand connector.
5. If the solder is not smooth or other imperfections are noted, resolder and repeat the operation.
6. Remove the glass tape.

**XII. Preparation of V.P. Tape**

1. Open the can of V.P. tape and pour out oil into stewing pan.
2. Heat oil to 135° C.
3. Remove a 2 foot sample of tape and test for moisture by placing it in the hot oil. If the tape bubbles the entire can of tape shall be tagged and returned to the Stores Department as wet tape.
4. Pour hot oil back into can over V.P. tape.

**XIII. Applying the Tape**

1. General
  - a) Remove the spacer blocks and remove plastic only from conductor to be worked on, also cut the strings holding the stepped paper insulation. On Anaconda's cable remove the semi-conducting (carbon black) tape to a point 4 inches from the lead sheath.
  - b) Boil out the conductor to be worked on, when conditions are very wet and legs may get wet.

- c) Pour cold #219 taping oil from a new can over the conductor.
- d) Remove the V.P. tape from the can and remove the strings or stickers. Place sufficient rolls of tape into stew pan filled with oil.
- e) With the V.P. tape folded lengthwise fill the gap between the connector and the first step, gradually building up evenly over the connector.
- f) Tape back and forth between steps until even with the conductor insulation.
- g) Continue taping between the limits of 4 inches from the lead sheath. Each successive layer to be stopped about 1/2 inch from the underlying layer thereby forming a long taper. The center portion of the taping should be built up to the required circumference.
- h) The V.P. tape should be drawn tight after each turn or tightened after not more than 4 turns by gripping the last turn and twisting it with the lay.
- i) Use the warm taping oil freely on every layer.

#### 2. For Joining Shielded Cables

- a) At one end solder the shielding braid to the copper shielding tape.
- b) Butt wrap the shielding braid, covering the insulation across the entire joint and solder to the copper shielding tape on the opposite end of the joint.
- c) Solder the shielding braid across the entire joint with a soldering iron, touching the copper tape and braid lightly to prevent injury to the insulation or the expelling of any compound from under the tape.

#### 3. For Joining Shielded and Belted Cable

- a) Build up the insulation at the crotch of the shielded cable after the conductors have been taped as in XIII-1. The taping must be in a cone shape starting in the crotch at the edge of the tack soldered factory shield and extending for 4 inches.
- b) Wrap the shielding braid around the built-up cone, stopping at the highest point.
- c) Solder the braid to prevent it from unraveling, tack soldering to the factory shield.

#### 4. For Joining Three Conductor Shielding Cables

##### With Three Single Conductor Cables

- a) Apply the copper shielding braid over the entire length of each conductor and solder in place as in XIII 2C, and solder to the copper band on the single conductor side.
- b) Solder the copper band to the single conductor lead sheath.

#### XIV. Wrapping the Binder Belt

1. Wrap V.P. tape over all three conductors, covering the center of the joint with three layers of tape.
2. Boil out the complete joint with taping oil heated to 120°C.

#### XV. Wiping Outer Sleeve

1. Slip the sleeves in place and wipe the two halves together.
2. Center the sleeve.
3. Insert the lead wedges around the cable at each end of the sleeve and tap them in place.

4. Place markers around the cable sheath at each end at a distance of 1 1/2 inches from the sleeve.
5. Remove the fittings or plugs from the sleeve to permit the escape of air during the wiping operation.
6. Wipe the sleeve to the cable sheath. Do not use stearine to cool wipes.

**XVI. Filling of the Joint****1. Type of Filling Compound**

- a) For completely shielded joints, connecting shielded to shielded cable, fill joint with (Molex) oil insoluble compound 31 53 028 (or Petrolatum 31 51 062).
- b) For all joints connecting to submarine cables, fill with GE 5314 oil 31 51 020.
- c) For belted cables where no reservoirs are available and on new cable where temporary joints are to be made, fill with GE 219 compound, 31 51 003 (or Petrolatum 31 51 062).

**2. Heating of Compound**

- a) Heat four gallons of oil, petrolatum, or compound to a minimum temperature of 145°C in winter and 135°C in summer.

**3. Oil (or Petrolatum) Filled Joints**

- a) Place a funnel in the hole at the low end of the joint. Pour the oil through the joint until bubbles have ceased flowing out at the high end.
- b) Insert the alemite fitting at one end and a plug at the other end.
- c) For reservoir connection remove alemite and insert Lunkenheimer "L" and connect flushed tubing.

**4. Compound Filled Joints**

- a) Place a funnel in the hole at the low end of the joint. Fill the joint with compound.
- b) Fill the joint with the approved filling compound. Fill with hot compound and seal, do not allow to cool and top off.
- c) Replace the bushing and plug and solder the entire assembly in place.

For Tape Shielded, Rubber Insulated Cables

Dist. Stds. 41 44 30 01, 41 44 20 \*\*, 41 43 20 01

**A. Jacket Removal**

Remove the jacket by scoring with a sharp knife. This jacket is only 50 mils thick – 0.05 inches. A deep circumferential cut could go thru the jacket and then thru the copper shield tape, which is only .005 inches thick. A slanted blade cut or a perpendicular score will both do a good job for the long score, but the circumferential score is more tricky.

**B. Removal of the Copper Shield Tape**

Two wraps of 3/4 inch plastic tape (25 53 055) shall be used to mark the cut off dimension for the copper shield tape. The tape should be positioned on the keeper side of the cut off dimension so that it can be left in place to hold the shield tapes. Using the triangular file (85 19 036) to score the shield tape insures that no deep cut will be made into or thru the extruded shield. A file score mark on the extruded shield does not injure the cable. Removal of the copper tape by scoring leaves no sharp burrs or disfigured shield points to worry about. Since the tape is only 5 mils thick, not much of a file score is necessary. A deeper score will be needed where the shield tapes overlap, or the knife blade can be used as a ruler edge to tear the tape against at the overlay points. The plastic guide tape is left in place to secure the shield tape.

**C. Semi-Con Shield Removal**

Removal of the semi-con shield should be done with the bana-peeler-scoring tool (85-32-090). Using the bana-peeler to score the semi-con is the most controllable method to accomplish this task.

**D. Repairs**

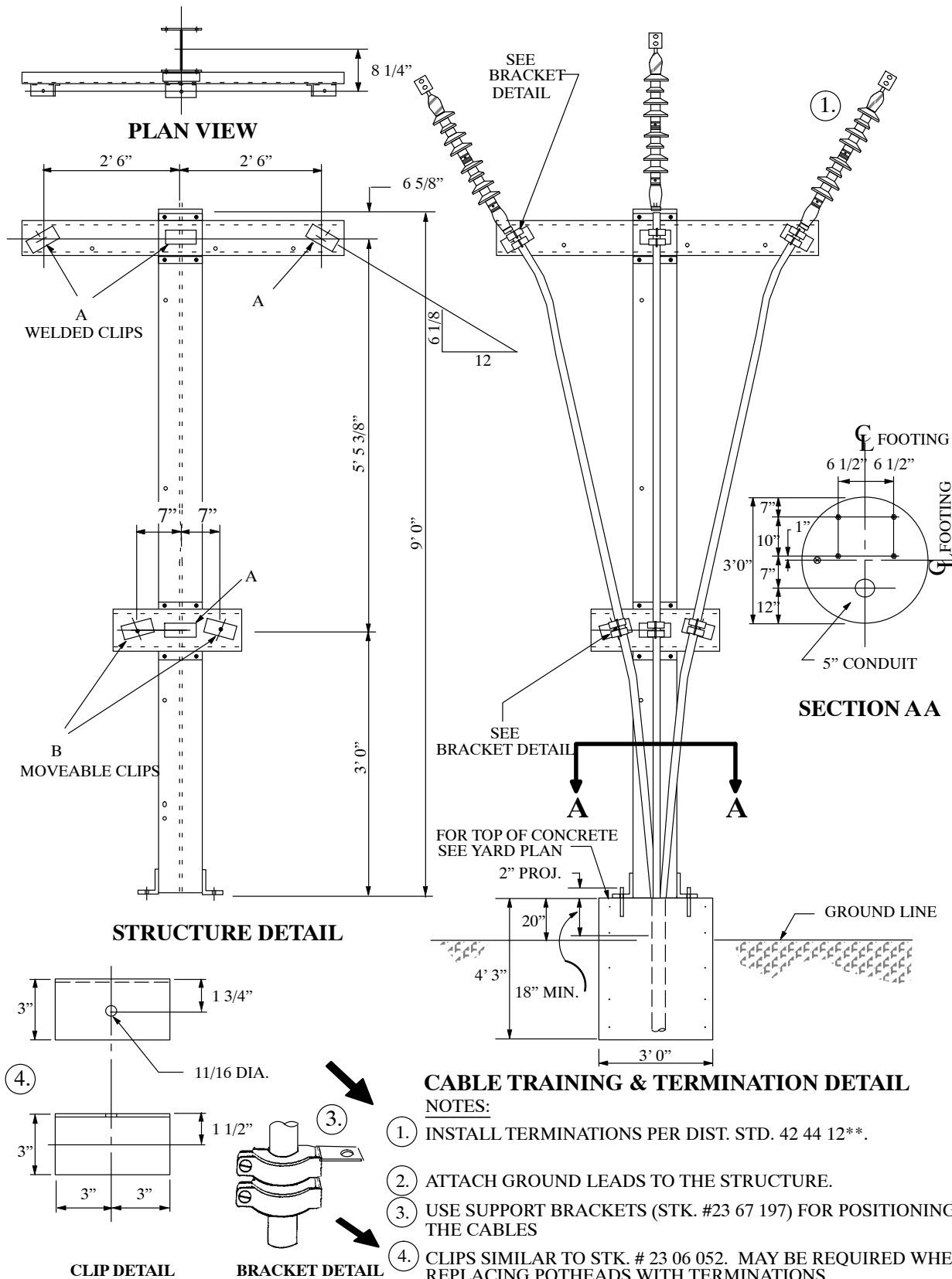
Any score which digs into the insulation must be sanded out using sanding cloth (22-05-213). A score in the insulation resulting from the circumferential scoring should be filled with silicone grease since it would be nearly impossible to sand out next to the semi-con shield.

**E. Insulation Removal**

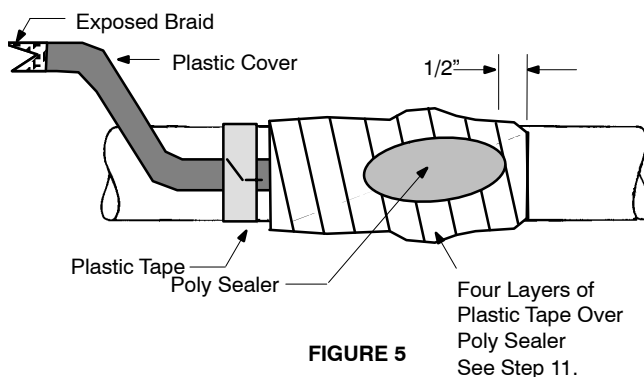
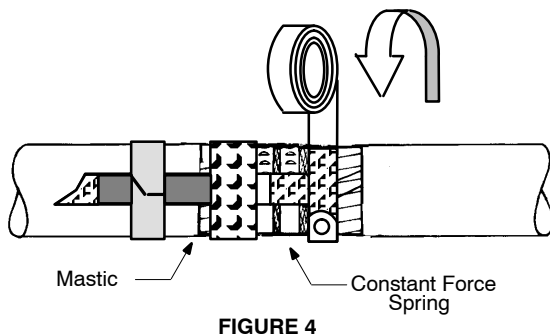
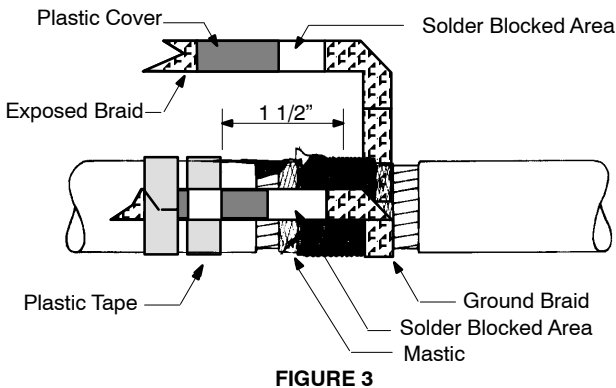
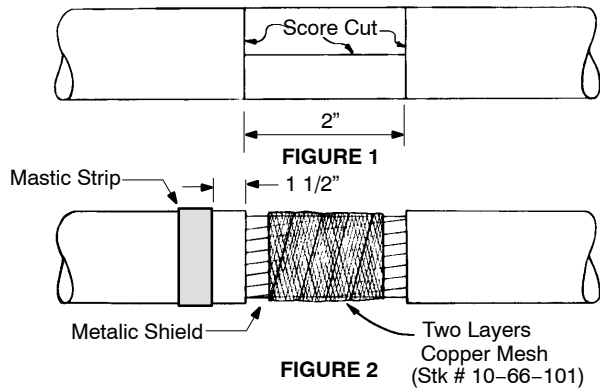
Insulation stripping for the lug is left to the splicers discretion and preference. An insulation stripping tool is available from stock. Ripley Co. Utility Tool WS-50 (83-36-031).

**F. Pencilling Insulation**

Use the WS-8 Pencilling Tool for 35kV, 750 kcmil insulation when splicing (85-29-250).







1. Score jacket carefully as shown. Do not cut through concentrics which are #18 AWG wires. Remove the jacket by prying and lifting along score. Cut.
2. Wrap two layers of half lapped copper mesh (Stk. # 10-66-101) over concentric wires as shown.
3. Select one of three mastic strips from the grounding kit ( Stk. #17-54-306). Remove liners and wrap mastic around the cable 1/2" from the cut edge. Discard any excess mastic from this piece.
4. Position twin pre-formed ground braid with one tail along the cable. The mastic must be within the solder blocked area.
5. Secure the braid to the cable with plastic tape, 1-1/2" from the cut edge of the copper mesh.
6. Wrap the braid around the copper mesh and secure it in place with the constant force spring.
7. Wrap the spring in the same direction as the braid and cinch (tighten) the final lap.
8. Position the tail of the preformed ground braid along the cable. The mastic must be within the solder blocked area.
9. Secure the braid to the cable with plastic tape, 1-1/2" from the cut edge.
10. Apply a second mastic strip layer over the braid tail. The second mastic strip should be positioned so that it overlays the previously installed mastic strip. Press the two mastic strips together to form a water tight seal.
11. Seal the connection by applying poly sealer (Stk. #31-53-055). Start sealing approximately 1/2" beyond the cut edge and extend the seal to the plastic tape.
12. Tape over the poly sealer with two layers of plastic tape (Stk. #25-53-055) stretched very tightly. Add two more layers of plastic tape, half lapped, to complete the water seal.
13. Attach the two exposed braid tails to a #2 Cu. bond wire (Stk. #18-54-027) with a two bolt connector (Stk. #17-54-145).
14. Seal the two bolt connector using poly sealer and plastic tape.

This instruction provides a method for labeling cables, transformers or switch locations supplied by primary cable loops associated with underground distribution. This labeling is used to identify a particular switch, cable, padmount junction or padmount transformer for operating purposes.

The labeling method described here is used primarily in the former UE service areas. Labeling methods, different from those described here, are used by the other legacy companies. This instruction should not be interpreted as a requirement for the other legacy companies to change their current labeling methods.

1. The engineer responsible for the job's one line drawing shall show on the one line (or plat if there is no one line) the lateral name, and at each transformer or switching location, a location (or pad) number and an X and Y terminal of the primary cables.

Lateral naming shall be in accordance with the Operating Procedures followed by the reporting center located by district or division.

In the St. Louis area, the transformer or switch location (pad) number assignment will also be obtained from the Distribution Operating Department where these numbers are assigned and recorded. In other divisions or districts it will probably be convenient to use the transformer number for a location number. (All numbers must be different.)

Where cables loop up into a transformer or switch, the ends shall be marked with X and Y tags. One end of each cable shall be tagged with an X and the other end tagged with a Y in such a manner that when tracing along the path of the cable in one direction, the near ends of each cable segment will be tagged X and far ends Y. Each transformer or switch location will have a Y end of one cable segment and an X end of the next segment.

The X and Y designation will have nothing to do with the normal direction of supply or the normally open switch. They are to designate which of the two switches or connections at a location are being referenced. The X and Y are not to be considered part of the lateral/loop name.

The lateral should be marked according DCS 59 40 00 40.

Pad mounted switching and/or fusing compartments, usually associated with three phase supply, shall also be numbered for identification purposes. Cables in the switching and/or fusing compartments are to be tagged similar to terminal poles.

2. Construction Personnel will label each cable end and transformer location in accordance with the one line drawing or construction plat. The foreman or crew leader, after checking that the marking is in accord with the one line, will sign it and return it to the office for posting in the usual manner.

Pad mounted transformers will be numbered as shown on the one line by applying pressure sensitive numbers. These numbers shall be located on the outside of the transformers facing in the direction of most likely access so that they can be seen from the street or from as far away as possible by the troublemen. A duplicate set of numbers shall be located on the inside of the door in such a position that they can be readily seen by anyone operating the high voltage switch or disconnect.

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Vault mounted transformers shall have the assigned numbers stamped in brass or copper identification plates. The plates shall be affixed to the vault grates.

The cable ends will be marked X or Y as shown by the one line by applying a "tag – blue formica triangle – letter Y" (Stock No. 16-51-080) or "tag – orange formica square – letter X" (Stock No. 16-51-079), tied with a small copper wire to the cable at the end of the concentric neutral strands or just below the termination. To avoid confusion the cables should enter on the side of the pad from which they come and should not cross each other under the pad.

When a pad mounted transformer is replaced, the number should be removed from the old transformer and the same number used for the new transformer using new pressure sensitive high visability numbers. In the case of a vault mounted transformer, the plate shall remain attached to the grate.

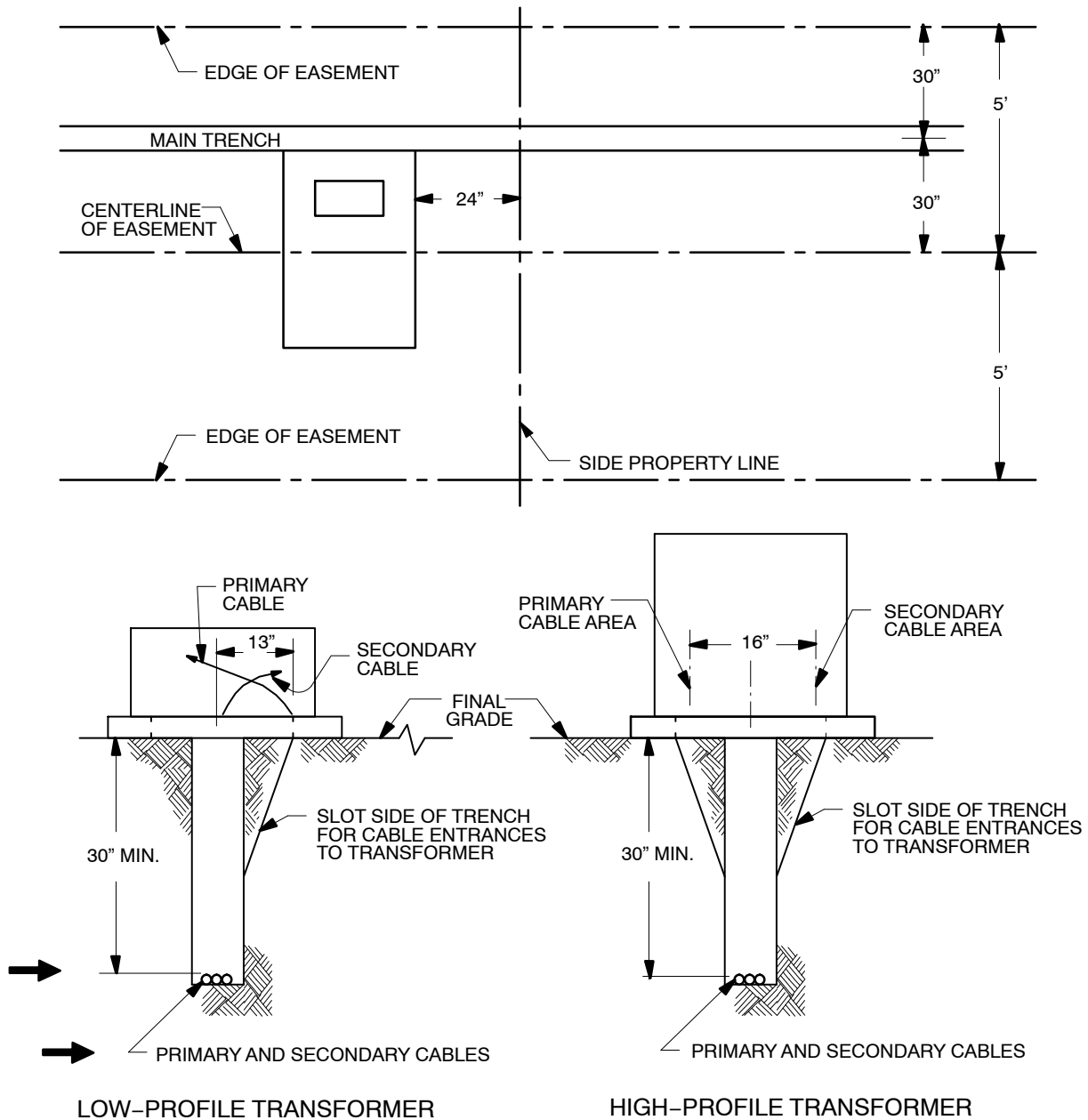
**3.** Construction personnel shall number each pad mounted switching or fusing compartment by applying pressure sensitive high visability numbers. These numbers shall be located on the outside of the compartment facing in the direction of most likely access.

The cable ends shall be marked with a phase identification in each pad mounted switchgear, three phase transformer, and terminal pole with more than one phase. This will be done by applying a "tag – round formica, green A" (Stock No. 16-01-122), "tag – round formica, black B" (Stock No. 16-01-123), or "tag – round formica, red C" (Stock No. 16-01-124) tied with a small copper wire to the cable just below the cable termination.

All other information, such as circuit names, shall be stenciled on the inside of the compartments.



## ILLINOIS ONLY



### NOTES

- Bottom of trench shall be free from rocks or debris. Backfill shall be dirt, free from stones, broken glass, cans, or other debris that might damage the cables. The backfill must be tamped at transformer and pedestal locations.

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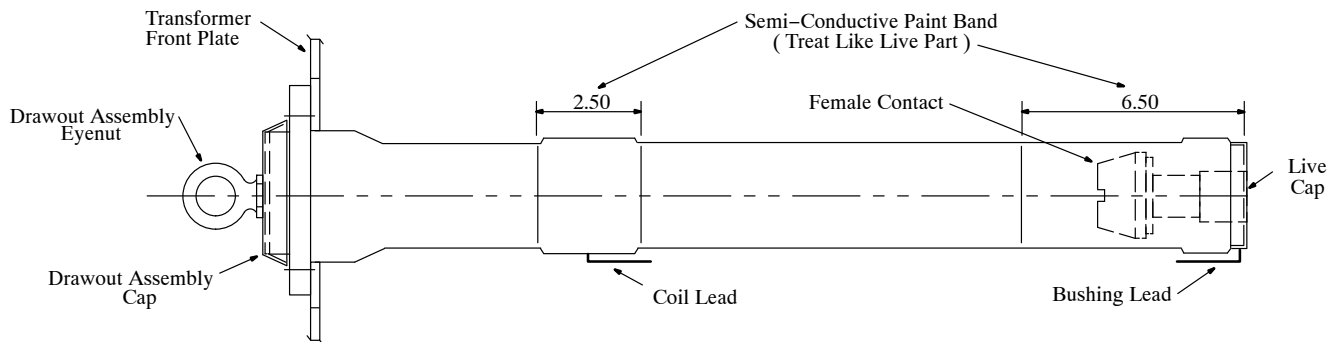
GENERAL

Many three-phase pad mounted transformers installed in legacy CIPS Districts are equipped with dry-well current-limiting fuses. Three-phase Commercial Subsurface Transformers (CST) installed in some legacy IP Districts are also equipped with dry-well current-limiting fuses.

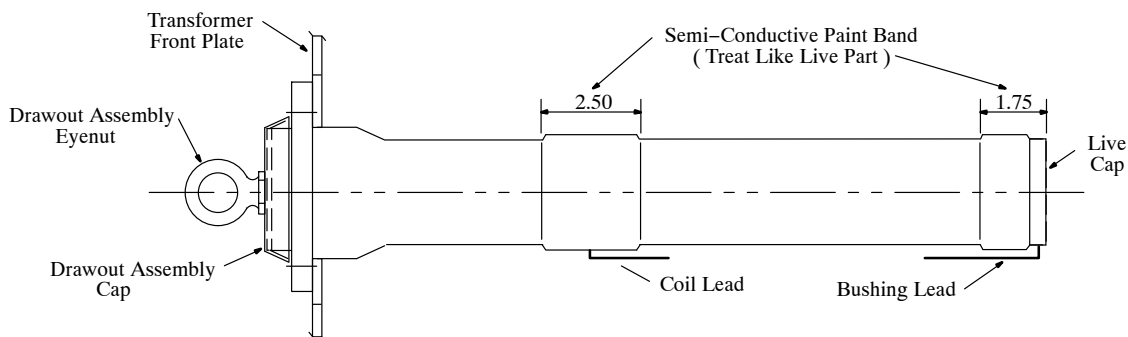
The instructions provided in this DCS are for de-energizing and re-energizing dry-well fused pad mounted transformers. The replacement fuse parts shown in the drawings are also for dry-well fuses in pad mounted transformers.

CST transformers are equipped with three-phase loadbreak switches that interlock with the fuse holders to prevent the removal or insertion of the current-limiting fuses unless the switch is in the open position. The replacement fuse parts for CST transformers are similar but different in that they are modified for submersible environments to prevent water ingress into the transformer. If such replacement parts are needed, contact Distribution Standards.

The current-limiting fuses listed at the end of this DCS can be used in either type of transformer.



**Loadbreak Dry Well Fuseholder Housing**



**Non-Loadbreak Dry Well Fuseholder Housing**

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TO DE-ENERGIZE

**CAUTION: Only Loadbreak Fuseholders And Loadbreak Fuse Assemblies Can Be Operated While Energized.**

1. Attach live-line tool to the drawout assembly eyenut.
2. Rapidly withdraw the drawout assembly from the fuseholder housing.
3. Removal of the drawout assemblies will de-energize the transformer. However, the primary elbows are still energized and the remaining transformers are energized ( if in a loop ).

NOTE 1: Three-phase transformers, 500 kVA and below, are equipped with three loadbreak fuseholders and assemblies. Three-phase transformers, 750 kVA and above, are equipped with three loadbreak fuseholders and assemblies in parallel with three non-loadbreak fuseholders and assemblies.

NOTE 2: When loadbreak fuseholders are connected in parallel with non-loadbreak fuseholders, the transformers will be designed so that the non-loadbreak fuseholders cannot be accessed without first removing the drawout assemblies from the loadbreak fuseholders. The design will also prevent the drawout assemblies from non-loadbreak fuseholders from being inserted after the drawout assemblies for the loadbreak fuseholders have been inserted.

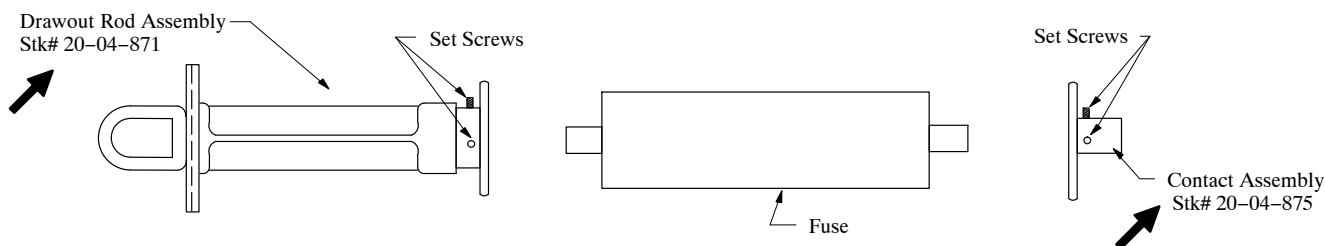
TO RE-ENERGIZE

1. Attach live-line tool to the drawout assembly eyenut.
2. Insert the drawout assembly into the fuseholder housing. The end of the drawout rod should be positioned just inside the fuseholder housing.
3. Rapidly push the drawout assembly into the fuseholder housing until the drawout assembly cap seats under the spring clips.

FUSE REPLACEMENT

Three different fuse assembly styles are in use. The styles are loadbreak, non-loadbreak and parallel loadbreak. Fuses listed can be used with all the fuse assembly styles.

**1) Non-Loadbreak Fuse Assembly**



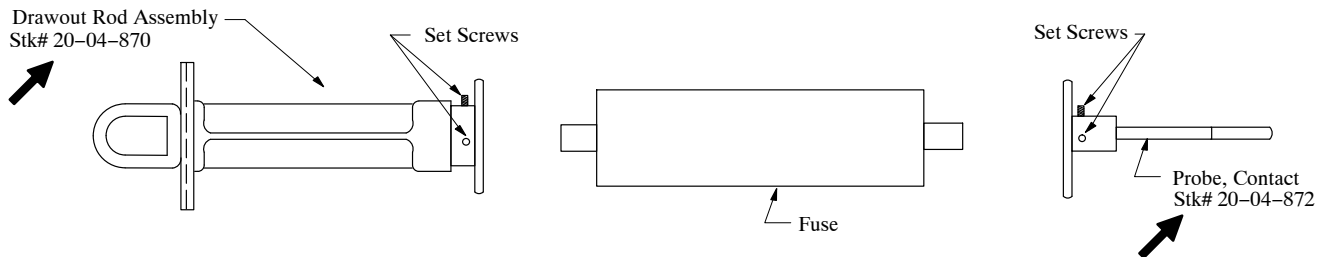
- \* Disassemble by loosening the set screws.
- \* Replace the blown fuse with a new fuse of the same rating.
- \* Reassemble with the parts oriented as shown above.
- \* Securely tighten the set screws.

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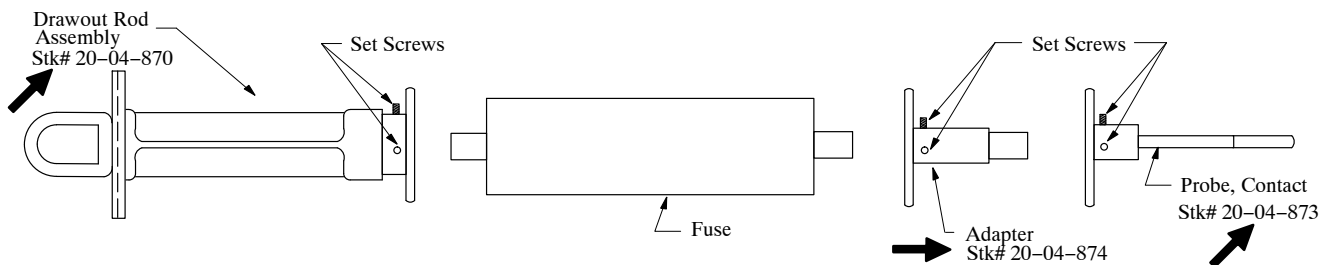
**AMEREN ILLINOIS ONLY**

## 2) Loadbreak Fuse Assembly



- \* Disassemble by loosening the set screws.
- \* Replace the blown fuse with a new fuse of the same rating.
- \* Reassemble with the parts oriented as shown above.

## 3) Parallel Loadbreak Fuse Assembly



- \* Securely tighten the set screws.
- \* Disassemble by loosening the set screws in the drawout rod assembly and the adapter.
- \* Replace the blown fuse with a new fuse of the same rating.
- \* Reassemble with the parts oriented as shown above.
- \* Securely tighten all set screws.



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**FUSE TABLE**

TRANSFORMER SIZE	4160 VOLTS		12470 VOLTS		
	FUSE RATING	AMEREN STOCK NO (4.3 kV) (Note 1)	FUSE RATING	AMEREN STOCK NO. (8.3 kV) (Note 2)	AMEREN STOCK NO (15.5 kV) (Note 3)
75 kVA	18C AMP.	20 04 370	8C AMP.	20 04 382	
150 kVA	35C AMP.	20 04 372	12C AMP.	20 04 384	20 04 646
225 kVA	50C AMP.	20 04 374	18C AMP.	20 04 386	20 04 647
300 kVA	75C AMP.	20 04 376	25C AMP.	20 04 388	20 04 648
500 kVA	100C AMP.	20 04 378	40C AMP.	20 04 391	20 04 663
750 kVA	*2-75C AMP.	20 04 376	*2-25C AMP.	20 04 388	20 04 648
1000 kVA	*2-100C AMP.	20 04 378	*2-40C AMP.	20 04 391	20 04 663

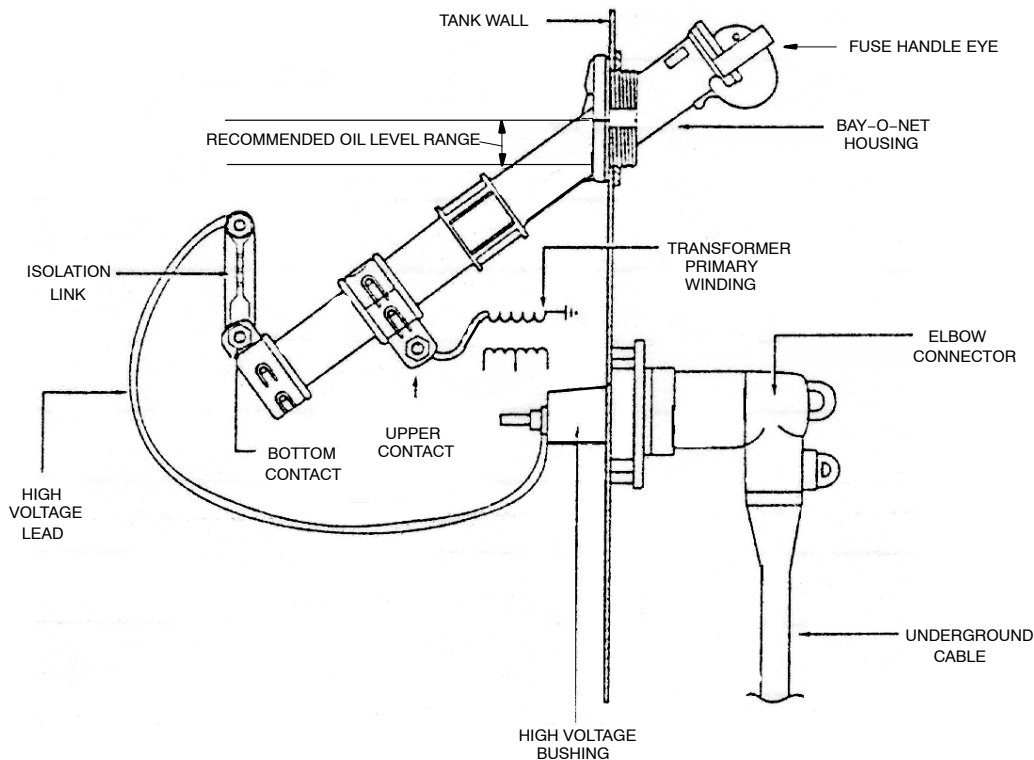
**\* TWO FUSES IN PARALLEL**

- 4.3 kV rated fuses are clip style fuses, 10 inches long from tip-to-tip, and fit in code 4 fuse mountings or canisters. These fuses are not to be used on systems above 4.16 kV.
- 8.3 kV rated fuses are clip style fuses, 10 inches long from tip-to-tip, and fit in code 4 fuse mountings or canisters. These fuses are used in 2.47 kV transformers and switchgear with dry-well fusing (see note 3 for exceptions). These fuses are also to be used in dual rated (4.16 X 12.47 kV) dry-well fused transformers when operated at 12.47 kV. Note: Although not used by Ameren, 8.3 kV rated fuses larger than 40C Amps require code 5 fuse mountings or canisters.
- Some 12.47 kV dry-well fused transformers purchased by legacy company Illinois Power were purchased with 15.5 kV dry-wells. The 15.5 kV rated fuses are required for these transformers. They are clip style fuses, 14.4 inches long from tip-to-tip, and fit in code 5 fuse mountings or canisters.
- Fault current interrupting capability of these fuses is 50,000 Amps symmetrical.

GENERAL

Bay-O-Net fuses can be used to turn transformers off or on with primary load current 150 Amps or less up to 15kV and 50 Amps or less up to 35kV. This DCS provides instructions on the de-energizing and re-energizing of padmount transformers equipped with Bay-O-Net fuses. Fuse link replacement instructions are also provided.

**NOTE:** Bay-O-Net fuses **MUST** be latched at all times when the transformer is unattended.



LINE ILLUSTRATION OF BAY-O-NET ASSEMBLY WITH INTERNAL ISOLATION LINK

BEFORE OPERATING THE BAY-O-NET FUSE

1. Carefully assess the condition of the transformer. Check for any audible sounds of arcing occurring inside the tank. Check for bulging of the tank or any signs of oil leakage or spillage. Check the tank in the proximity of the pressure relief device for any signs of oil leakage, spillage, or for black carbon smudges. If any of these conditions are present, do not attempt to switch the transformer on or off with the Bay-O-Net fuse.
2. Inspect the area around the unit to make sure the ground is level and the footing is sound.

TO DE-ENERGIZE

1. Release transformer tank pressure.
  - a. Pull pressure relief valve open for 30 seconds or until pressurized air can no longer be heard evacuating audibly through the valve.
  - b. Close pressure relief valve and wait 30 seconds.
  - c. Pull pressure relief valve open again and keep it open until audible pressure (air flow) stops and hold it open for an additional 5 seconds.

**NOTE:** If the transformer does not have a pressure relief valve, loosen the 1/2" oil fill plug to relieve any built-up tank pressure.

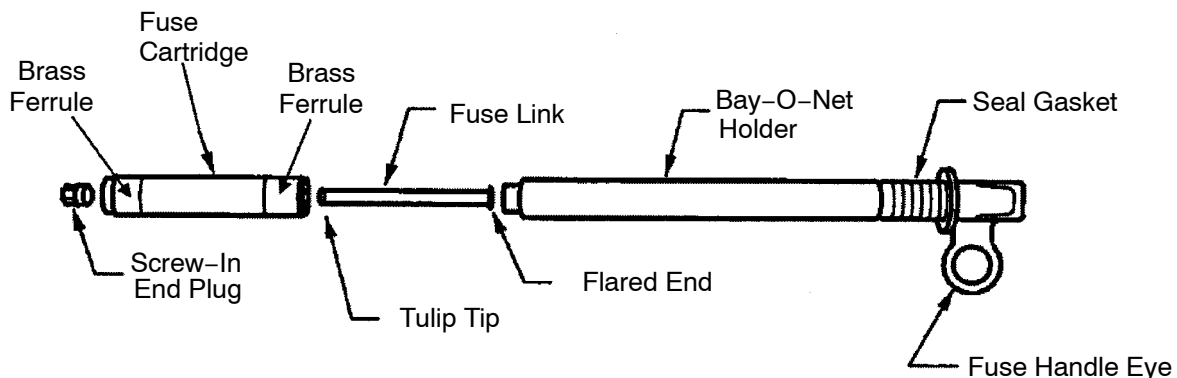
2. Standing to one side of the transformer, attach live-line tool to fuse handle eye and lift the handle to unlock the Bay-O-Net.
3. Push down and rotate the handle 90° to release additional pressure and to break the adhesion between the seal gasket and the Bay-O-Net housing.
4. Pull the Bay-O-Net fuse holder out rapidly in one motion 6 to 8 inches to interrupt the transformer load. Wait several seconds for oil to drain into tank.  
**NOTE:** If any arcing is noticed or rumbling is heard, the fuse should be immediately slammed back into the transformer and latched. De-energize the transformer at a remote location before proceeding with fuse removal.
5. Remove fuse holder from the Bay-O-Net housing. If a drip is present, rest the Bay-O-Net holder on the drip guard for 30 seconds to 1 minute to minimize the potential of oil spillage onto the rubber terminations. Remove the Bay-O-Net and wipe off remaining oil.
6. The transformer is now de-energized. However, the primary elbows are still energized and the remaining transformers (if in a loop) are energized.

**NOTE:** On 3 phase transformers, there will be three Bay-O-Nets and the same procedure must be followed for each one.

#### TO RE-ENERGIZE

1. Check the oil level in the transformer. It should be approximately at the base of the protruding plastic threads of the Bay-O-Net housing at 25°C (77°F) with the transformer on a level surface.
2. Pull pressure relief valve, keeping it held open until audible pressure evacuation stops and then hold open for another 5 seconds.
3. Attach the live-line tool to the fuse handle eye of the Bay-O-Net.
4. Place the Bay-O-Net into the housing until it is about 5 inches from the closed position.  
**NOTE:** This will prevent any damage to the contacts due to arcing.
5. Turn away from the transformer and slam the Bay-O-Net home.
6. When the Bay-O-Net is inserted as far as possible, push down and rotate the locking handle hooking it over the shoulder of the housing. When the handle is in the locked position, check to make sure the cover washer is seated against the shoulder of the housing.
7. The transformer is now energized.  
**NOTE:** If the fuse blows upon re-energizing the transformer, find and correct the cause of the failure before attempting to re-energize the transformer again.

#### FUSE LINK REPLACEMENT INSTRUCTIONS



1. Unscrew and remove the fuse cartridge from the fuse holder.
2. Remove the plug from the end of the fuse cartridge.

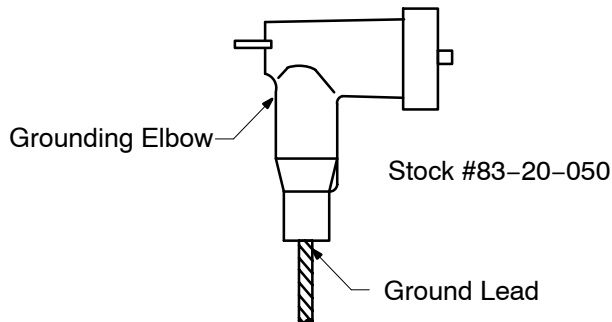
3. Straighten the spread leaves of the tulip tip and push the fuse link out of the fuse cartridge.
4. Inspect the cartridge bore to make sure it is clean, then replace the fuse link with a new fuse link of the same size and rating. The new fuse link may be inserted from either end of the fuse cartridge (at times, a slight resistance may occur).
5. Be sure the contact flare end is secured in place between the fuse cartridge and the Bay-O-Net. Tighten the fuse cartridge against the Bay-O-Net. Do not overtighten. Hand tight is sufficient.
6. Spread the tulip tip of the fuse link and place the end plug on the end of the fuse cartridge. Tighten the end plug. Do not use wrench on brass ferrules of the cartridge. A wrench can be used on the end plug.
7. Remove the end plug and ensure the leaves of the tulip tip have spread uniformly. Failure to do so can cause malfunction.
8. Replace the end plug.

FUSE LINKS FOR THREE-PHASE PADMOUNT TRANSFORMERS (ALL FUSE LINKS ARE LOAD CURRENT AND TEMPERATURE SENSING)				
	Ameren Stock Nos.	Transformer KVA	Fuse Part Numbers	
			4160 Volts	12470 Volts & 13200 Volts
1	20-53-109	75	358C10 (25A)	
	20-53-110	150	358C12 (50A)	
	20-53-121	300	358C14 (65A)	
	20-53-119	75		358C05 (8A)
	20-53-108	150		358C08 (15A)
	20-53-109	300		358C10 (25A)
	20-53-110	500		358C12 (50A)
	20-53-121	750		358C14 (65A)
	20-53-121	1000		358C14 (65A)
	20-53-238	1500		38361C04CB (100A)
	20-53-239	2500		38361C05CB (125A)

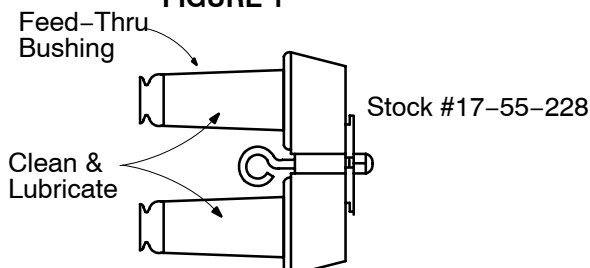
FUSE LINKS FOR SINGLE-PHASE PADMOUNT TRANSFORMERS (ALL FUSE LINKS ARE LOAD CURRENT AND TEMPERATURE SENSING)				
	Ameren Stock Nos.	Transformer KVA	Fuse Part Numbers	
			2400 Volts	7200 Volts, 7620 Volts & 7970 Volts
1	20-53-109	25	358C10 (25A)	
	20-53-110	50	358C12 (50A)	
	20-53-121	75	358C14 (65A)	
	20-53-121	100	358C14 (65A)	
	20-53-120	167	358C18C (140A)	
	20-53-119	25		358C05 (8A)
	20-53-108	50		358C08 (15A)
	20-53-109	75		358C10 (25A)
	20-53-109	100		358C10 (25A)
	20-53-110	167		358C12 (50A)
	20-53-121	250		358C14 (65A)

**NOTES:**

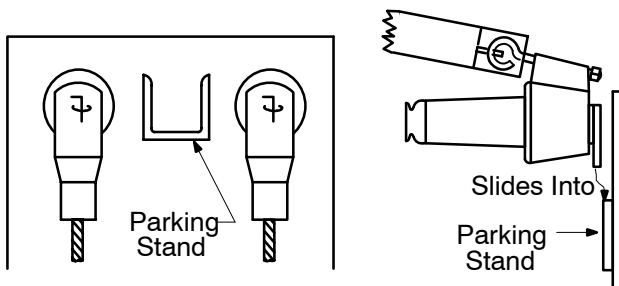
1. This fuse comes pre-assembled as a unit with the fuse, the cartridge, and the end-plug. Replace the entire fuse and cartridge when the fuse operates.



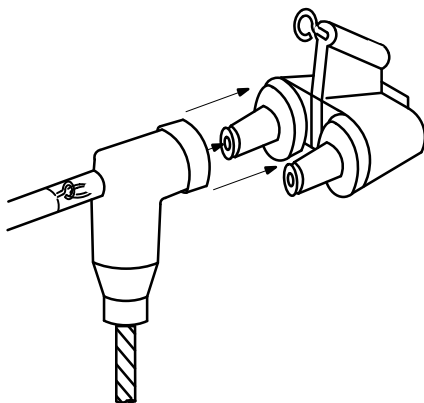
**FIGURE 1**



**FIGURE 2**

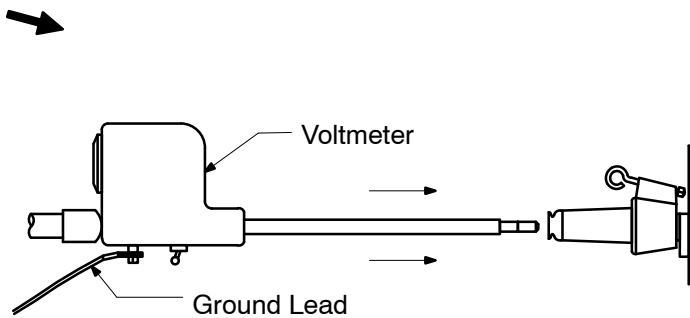


**FIGURE 3**



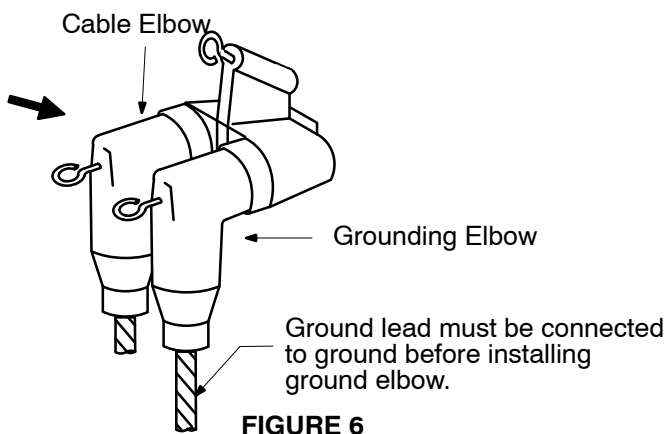
**FIGURE 4**

1. Connect lead on Grounding Elbow to Ground. **IMPORTANT: DO NOT INSERT GROUNDING ELBOW INTO FEED-THRU BUSHING UNTIL CIRCUIT HAS BEEN TESTED "DEAD".** Grounding elbow shown in Figure 1.
2. Remove protective covers from the feed-thru bushing. Clean and lubricate the surfaces of the feed-thru bushing with silicone grease. **ALWAYS REPLACE PROTECTIVE COVERS WHEN THE FEED-THRU BUSHING IS NOT IN USE.** Connect one #14 ground wire to grounding point of feed-thru bushing. Connect to ground, leaving enough slack to operate with a shotgun tool. Feed-thru bushing shown in Figure 2.
3. Attach the feed-thru bushing eye and crossbar firmly to shotgun tool. Slide the feed-thru bushing onto parking stand. Tighten down eye by rotating shotgun tool clockwise until snug. **DO NOT OVERTIGHTEN.** See Figure 3. **NOTE: #14 ground wire not shown.**
4. Remove the elbow from the equipment bushing following applicable loadbreak operating instructions. Insert the elbow into the nearest feed-thru plug and push until it is firmly in place and the internal locking ring is seated. See Figure 4.



**FIGURE 5**

5. Attach voltmeter firmly to universal hot stick. Insert meter rod in second plug of feed-thru bushing. Check for voltage. **CAUTION:** Do not leave the meter attached to an energized line any longer than 1 minute. If attached longer, the instrument may overheat. See Figure 5. **NOTE:** Elbow not shown on the feed-thru bushing.



**FIGURE 6**

6. After circuit has been tested "Dead", remove test rod and using shotgun tool immediately insert the grounding elbow into the feed-thru bushing. See Figure 6.

**UNDERGROUND LINES INSTRUCTION**  
Identification of Secondary and Service Cables  
Underground Residential Subdivision

59 52 00 41

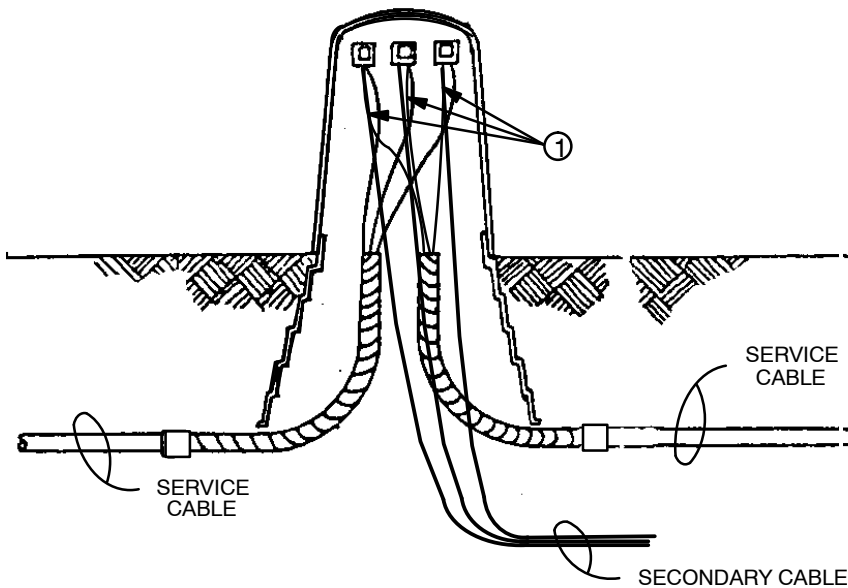
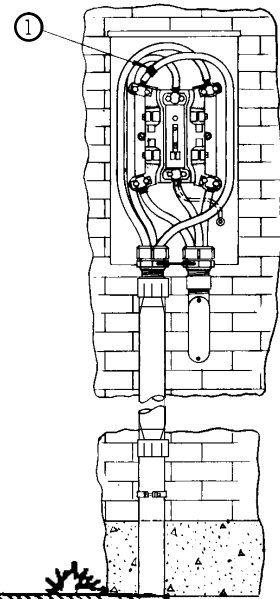
Sheet 1 of 2



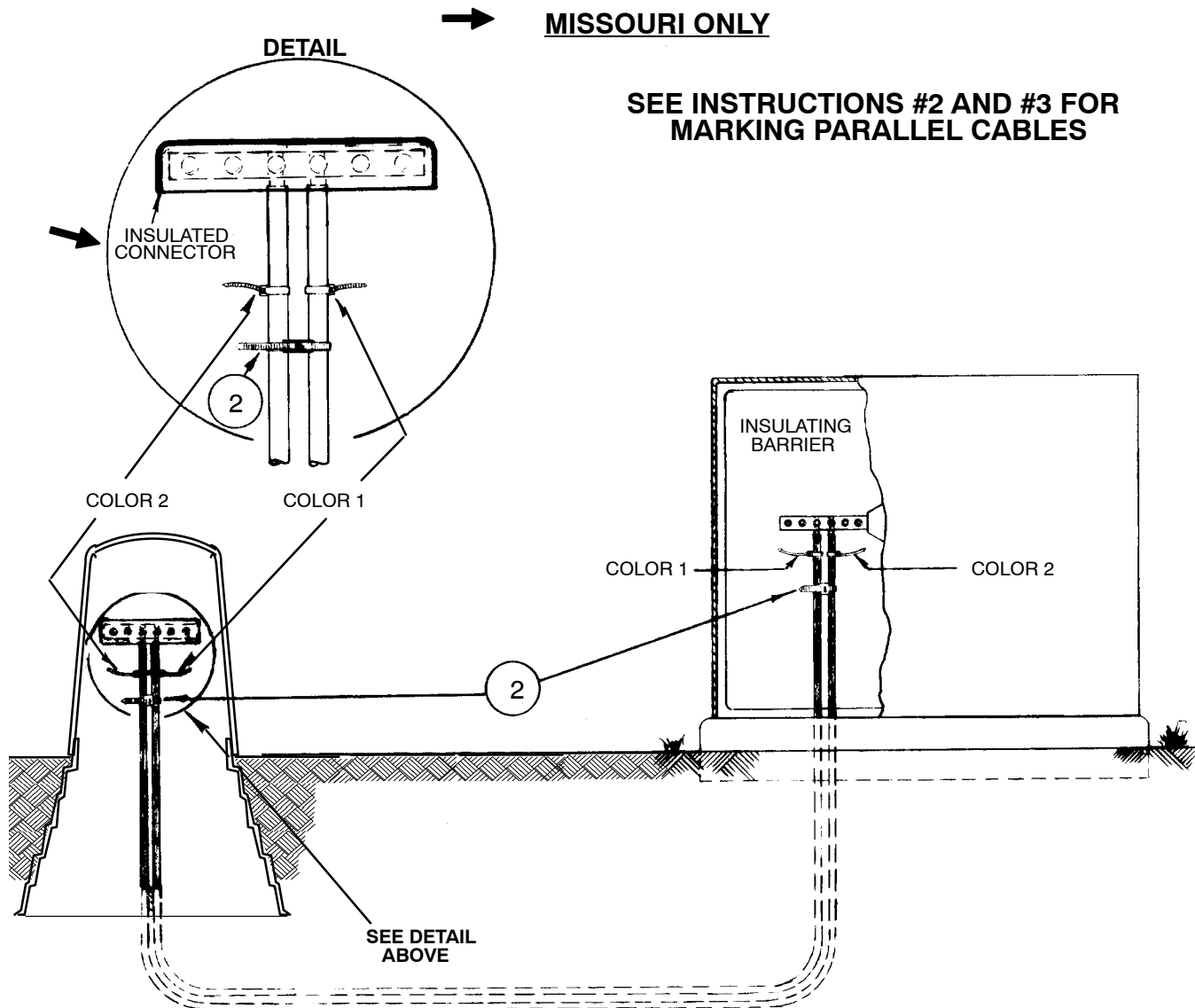
**MISSOURI ONLY**

When more than one service cable emanates from pedestals, handholes or transformers, it is desirable to identify the cables with respect to specific customers. Various wire ties are stocked for this purpose. See the instructions below for various marking requirements.

SEE INSTRUCTION # 4 FOR MARKING  
"CUSTOMER OWNED CABLES."



		Std. / Stk. No.	Description
1	A	40 59 135	Tie-Wire, Identification, Red Color
	B	40 59 138	Tie-Wire, Identification, Green Color
	C	40 59 139	Tie-Wire, Identification, Blue Color
	D	40 59 137	Tie-Wire, Identification, Yellow Color
	E	40 59 136	Tie-Wire, Identification, Orange Color
	F	49 59 140	Tie-Wire, Identification, Purple Color
	G	40 59 162	Tie-Wire, Identification, Brown Color
	H	40 59 163	Tie-Wire, Identification, Gray Color
2	I	40 59 191	Tie-Wire, Identification for Parallel Cables
2	J	16 01 184	Tag - Parallel Cable
4	K	40 59 268	Tie - Wire, Identification, "Customer Owned Cable"
4	L	16 01 159	Tag - Customer Owned



**INSTRUCTIONS:**

1. With reference to the sketch, one identification tie of a particular color is installed on a conductor within the meter socket. At the supply end of the service cable, identification ties of the same color are installed on each of the three conductors. Thus, by using the different colored ties, as many as eight sets of service cables can be identified. Four ties of the same color required per service cable.
2. After identifying each cable with a different color tie, parallel cables are marked as a pair by using Stock # 40-59-191 around both cables. A tag (Stk # 16-01-184) engraved "Parallel Cable" may also be attached to the parallel cables. Parallel cables shall be marked on the plats.
3. Parallel cables fed from the overhead shall be tagged at the top of the conduit on the pole with a tag (Stock #16-01-184 ) engraved "Parallel Cable". These cables shall be marked on the plats.
4. If the cable is owned by the customer, attach a "Customer Owned Cable" wire tie (Stock #40-59-268) to each cable. These wire ties should be attached to each cable end and are in addition to any other ties required to identify the cables. A "Customer Owned" tag may also be used (Stk. # 16 01 159). Customer owned cable should be marked on the plats.



1. GENERAL

This instruction covers the special procedures required for making bolted aluminum connections, both aluminum-to-aluminum and aluminum-to-copper.

2. CONTACT SURFACE PREPARATION

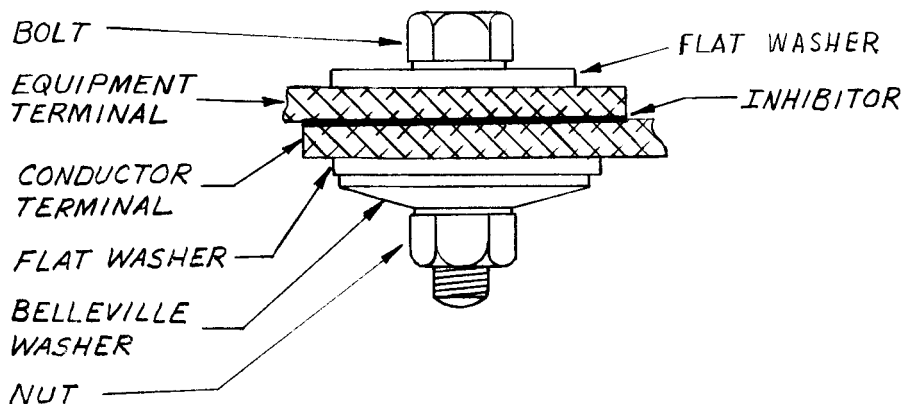
All aluminum contact surfaces that are not either silver plated or tin plated must be properly cleaned prior to making the electrical connection. Clean the contact surfaces with a wire brush to remove the oxide coating. Immediately coat the brushed contact surface with a liberal amount of corrosion inhibitor (Stock #31-59-058).

3. FLAT-TO-FLAT CONNECTIONS

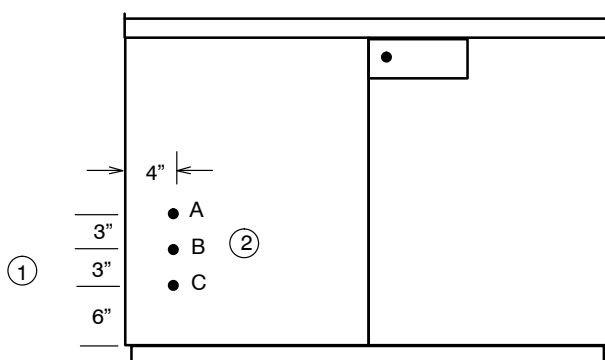
The electric current will flow between the two mated surfaces at the points or areas of least resistance. Therefore, the distribution of forces at the contact surfaces must be given careful consideration.

To avoid concentrated paths of current flow and hot spots within the connection the clamping forces must be properly distributed. A flat washer of the same alloy as the bolt should be placed between the bolt head and one side of the connection. A steel Belleville washer with a matching steel flat washer should be placed on the opposite side of the connection under the nut. The Belleville washer must be installed with the convex side up (toward the nut).

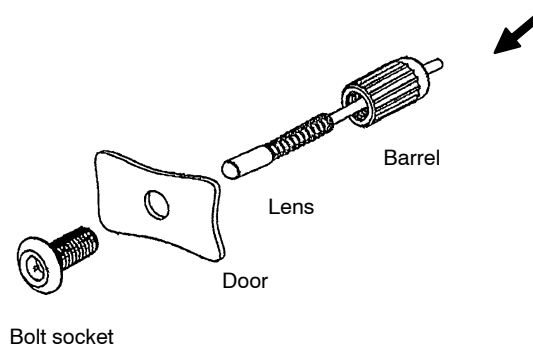
Tighten the nut until a sudden increase in torque is felt. The Belleville washer is now flattened. Do not over tighten. And it is not necessary to "back off" the nut. The bolted assembly should be as shown in the figure below.



1. Drill three 5/16" holes in the lower (hinged) corner of the outgoing switch compartment door. The holes should be positioned as shown in Figure 1. Note: Changes have been made to the material specification for padmount switchgear to call for predrilled and plugged holes in each switch compartment door.
2. Directly beside each hole apply a high intensity reflective 1-3/4" x 2-7/8" letter for phase identification. The top hole will be marked with "A" (Stk. #1604317), the middle hole with "B" (Stk. #1604318), and the bottom hole with "C" (Stk. #1604319).
3. Install a faulted circuit indicator (Stk. #6055001) onto each outgoing cable/lug. Note: Faulted circuit indicator Stk. #6055024 may be used if the cable/lug OD is larger than 1.57".
4. Snap the fiber optic cable plastic end fitting into the cup around the LED on the faulted circuit indicator. The fiber optic cable (Stk. #1866658) is 6 foot long. Care must be taken not to kink the fiber optic cable. The fiber optic cables must be routed and secured to prevent damage associated with the operation of the door and other routine work.
5. Remove the bolt socket from the fiber optic cable barrel. The bolt socket will then be inserted through the 5/16" hole. See Figure 2.
6. Place the fiber optic cable lens into the bolt socket and securely screw the barrel onto the bolt socket. **BE SURE THAT THE FIBER OPTIC CABLES ARE POSITIONED BY THE CORRECT PHASE DESIGNATION.**



**Figure 1**



**Figure 2**

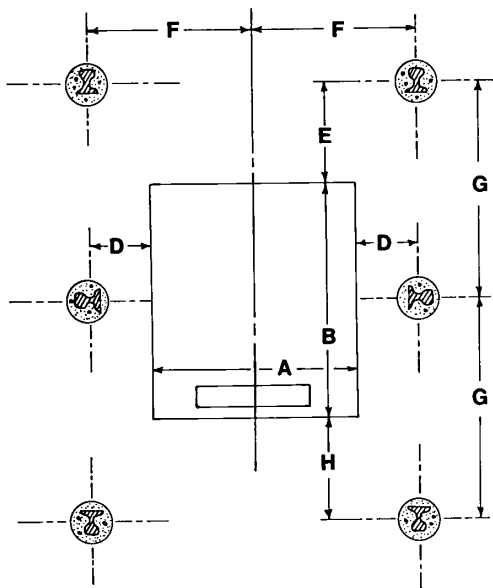


FIGURE 1

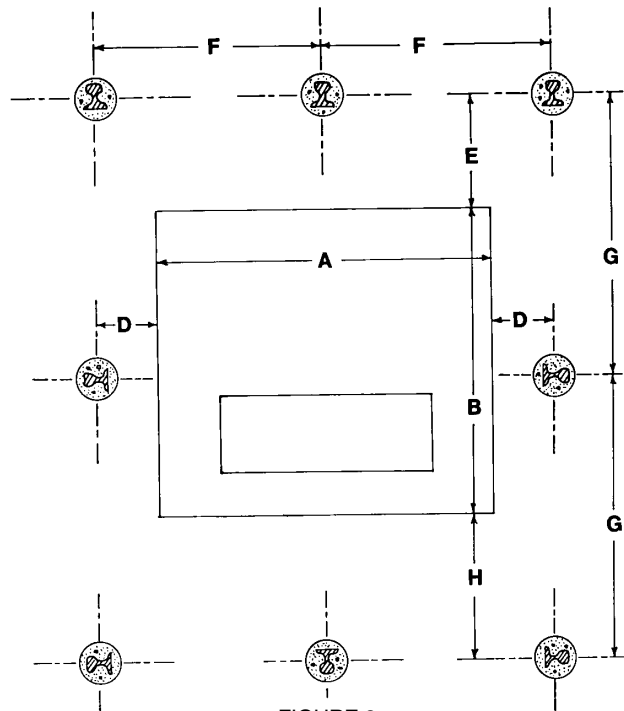


FIGURE 2

	PADMOUNT TRANSFORMERS	COMPOSITE PAD STOCK NO.	A	B	C	D	E	F	G	H
Figure 1	0-167 kVA, 1Ø, Lightweight Pad	12 06 164	42"	47"	4"	12"	15"	33"	40"	18"
Figure 1	0-167 kVA, 1Ø, Heavy Pad	12 06 198	42"	47"	4"	12"	15"	33"	40"	18"
Figure 2	75-750 kVA, 3Ø, Radial Feed	12 06 123	72"	65"	4"	32"	27"	68"	64"	36"
Figure 2	1000-2500 kVA, 3Ø, Radial Feed	12 06 124	84"	72"	5"	32"	38"	74"	73"	36"
Figure 2	75-1000 kVA, 3Ø, Loop Feed	12 06 124	84"	72"	5"	32"	38"	74"	73"	36"

COMPOSITE SWGR PAD STOCK NO.	FIGURE 3						
	A	B	C*	D	E	F	G
12 06 109	69"	63"	36"	24"	36"	58.5"	67.5"
12 06 165	76"	74"	36"	24"	36"	62"	73"
12 06 165(Auto)**	76"	74"	36"	49"	36"	62"	73"

\*C = HEIGHT OR THICKNESS OF PAD

(Auto)\*\* = AUTOMATED SWITCHGEARS REQUIRE LARGER SIDE CLEARANCE (D)  
 TO OPEN THE DOORS ON CONTROL BOXES AND METER OPERATORS.

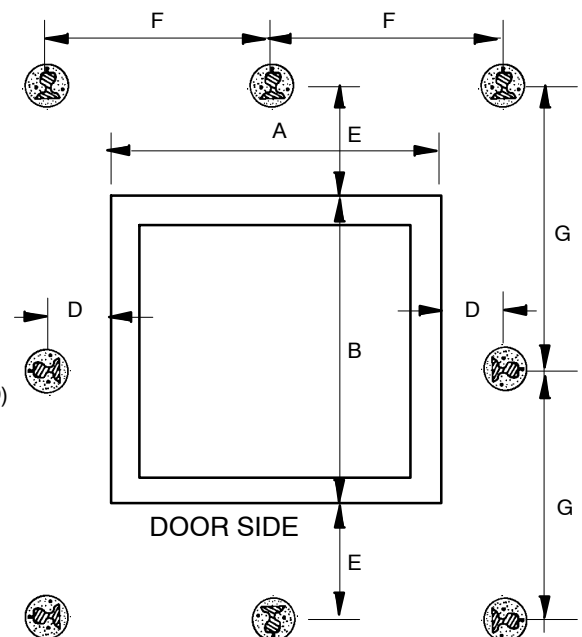
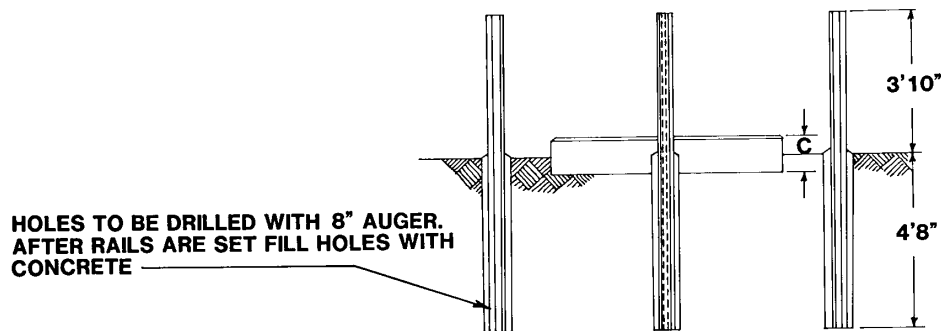


FIGURE 3



1. Barrier iron to be railroad rails, 8'6" long, 50–100 lbs. per yard. An acceptable alternate is 4" iron pipe, 8'6" long, concrete filled or see Dist. Std. 34 22 01 00 for a power installed bumper post.
2. Barriers on sides not accessible to vehicles may be omitted.
3. All materials and labor for protective barrier rail installation shall be provided by customer.
4. Customer is encouraged to paint barrier rails with yellow street marking lacquer.

NOTE: If circumstances are such that Ameren Crews are to install barriers, the following material is carried as stock items in AmerenUE storerooms only:

Stk No.	Description
68 05 024	Rail – Barrier, 8'6" (Ea)
11 04 105	Concrete – Premix (Sk)
30 57 025	Lacquer – Yellow (Gal)

CAUTION: Installation of barrier rails must be coordinated with electric conduit installation to avoid mutual interference.

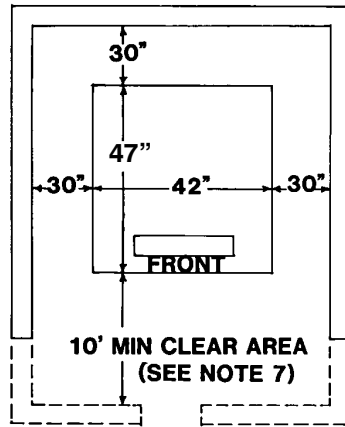
# UNDERGROUND LINES INSTRUCTION

## Customer Installed Pad Installations Required

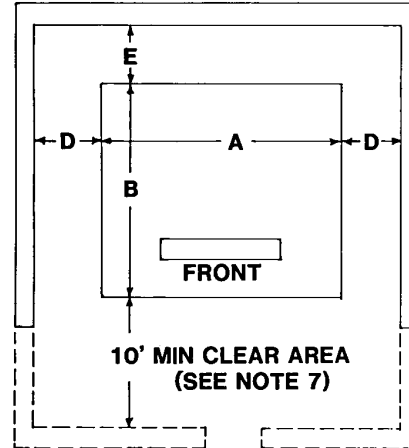
### Clearances For Padmounted Transformers and Switchgear

59 81 51 11

Sheet 1 of 1



1 Ø INSTALLATIONS  
25-167 KVA TRANSFORMERS



3 Ø INSTALLATIONS

Dimensions for 1Ø pads pertain to all Ameren Companies.

For 3Ø installations, dimensions A and B pertain to dimensions of AmerenUE equipment pads. Pad specifications for Ameren Illinois companies vary.

The critical dimensions for all padmounted equipment are the distances from the left, right, rear, and front of pads, not the equipment installed on the pad. These dimensions shall be maintained in all installations.

Verify pad dimensions with your local contacts.

3Ø INSTALLATIONS	A	B	D	E
75 Thru 300 kVA Radial Feed Transformers	72"	65"	30"	35"
500 & 750 kVA Radial Feed Transformers	72"	65"	45"	43"
75 Thru 1000 kVA Loop Feed Transformers	84"	72"	45"	44"
1000 Thru 2500 kVA Radial Feed Transformers	84"	72"	45"	56"
Switchgear (Live Front)	69"	63"	49"	120"
Switchgear (Dead Front)	76"	74"	49"	120"

#### NOTES:

- If pad mount is enclosed on all 4 sides, 10' minimum clearance from the front of transformer to inside of wall must be maintained for hot stick operations.
- If a 4 sided enclosure is used, an opening or doorway shall be provided. If a lock is required provisions shall be made to provide Ameren personnel access.
- Customer to provide drainage away from enclosed areas to prevent oil and/or water from standing.
- If a 4 sided enclosure is used, a minimum of 10 square feet of venting space in the form of 50% effective louvers or 5 square feet of opening shall be provided located along the bottom of each wall. If a 3 sided wall is used, wall venting space is desirable, but not required.
- Location must be accessible for installing or replacing transformer with crane.
- Developer to provide plastic conduit of size specified by Ameren to a point designated by Ameren outside the wall 36" to 42" below final grade.
- The 10' distance between the front of the pad and the wall may be reduced to 48" if an opening or gate is provided. The opening or gate should be centered on the front of the pad and should provide for a minimum opening of 3-1/2' for 1Ø and 9-1/2' for the 3Ø installation. A 10' clear area in front of the pad must still be available with the opening or when the gate is open for hot stick operations.
- To provide for transformer replacement, enclosed area is to be free of overhangs or overhead obstructions. Wall height not to exceed 8' unless the above mentioned gate or opening is provided or an easily removable wall is used.
- Should upgrading be required, the dimensions as shown provide adequate ventilation and space for 1 size larger transformer.
- Walls shown in drawing, but clearances are required for any obstruction, i.e. switchgear, dumpsters, etc.