

SECTION 16302
OVERHEAD ELECTRICAL WORK

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI):

C2-81 Natinal Electrical Safety Code
C29.3-80 Wet Process Porcelain Insulators (Spool Type)
C29.4-77 Wet Process Porcelain Insultors (Strain Type)
O5.1-79 Specifications and Dimensions for Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

A153-78 Zinc-Coating (Hot-Dip) on Iron and Steel Hardware
A475-78 Zinc-Coated Steel Wire strand

AMERICAN WOOD PRESERVERS ASSOCIATION (AWPA):

C.4-77 Standard for the Preservative Treatment of Poles by the Pressure Process

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):

70-1981 National Electrical Code

RURAL ELECTRIFICATION ADMINISTRATION (REA):

43-5 List of Material Acceptable for Use on Electric Systems
(JULY 1979) of REA Borrowers
Supplements
2 and 3

UNDERWRITERS' LABORATORIES (UL):

UL 510-76 Insulating Tape
(R JUN 80)

1.2 GENERAL REQUIREMENTS: Section 16011, Electrical General Requirements, applies to this section with additions and modifications specified herein.

1.2.1 Overhead Service: Overhead service conductors into buildings shall terminate at the service entrance fittings or weatherhead outside the building. The installation and connection of service entrance equipment to the overhead service conductor is included in Section 16402, Interior Wiring Systems. The nearby support bracket for the overhead wires shall be not less than 20 feet above the finished grade at the building.

1.2.2 Electrical Characteristics for this project shall be as indicated. Final connections to the power distribution system at the existing pole shall be made by the Contractor as directed by the Contracting Officer.

1.2.3 Connections to Existing Electrical Systems: Notify the Contracting Officer in writing at least 15 days prior to the date the connections are required; approval shall be received before any service is interrupted. Furnish all material required to make connections into the existing systems, and perform all excavating, backfilling, and other incidental labor as required.

1.2.4 Submittals: Submit following information for approval:

1.2.4.1 Catalog Information:

- a. Conductor (list each size and type)
- b. Insulator (list each size and type)

1.2.4.2 Manufacturer's Directions:

- a. Cable terminations
- b. Manufacturer's directions for use of ground megger with proposed method indicated.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT: Materials specified herein or shown on the contract drawings which are identical to materials listed in REA 43-5 shall be considered as conforming to all requirements.

2.1.1 Poles: Provide wood poles machine trimmed by turning, Douglas Fir or Southern Yellow Pine conforming to ANSI 05.1. Poles must be gained, bored and roofed before treatment. Poles shall be full length pressure treated with Chromated Copper Arsenate (CCA) or Ammoniacal Copper Arsenate (ACA) conforming to AWPA C4. Poles shall be branded by the manufacturer with his mark and date of treatment, height and class of pole, wood species, preservation code, and retention. Place the brand so that the bottom of the brand or disc is 10 feet from the pole butt for poles up to 50 feet long.

2.1.2 hardware: Pole line hardware shall be hot dip galvanized conforming to ASTM A153.

2.1.3 Insulators: Provide wet-process porcelain insulators which are radio interference freed.

- a. Spool insulators shall be class 53-2 per ANSI C29.3.
- b. Guy strain insulators shall be class 54-2 per ANSI C29.4.

2.1.4 Secondary-Service Conductors: Service conductors shall be copper, quadruplex with 600 volt cross-linked polyethylene insulation on the phase wires. The neutral shall be bare copperclad composite messenger. Minimum size shall be

No. 4 AWG stranded unless otherwise indicated.

2.1.5 Guy Strand: Provide high-strength seven-strand steel cable with Class A or B galvanizing per ASTM A475. Guy strand shall be 7/16-inch in diameter with a minimum breaking strength of 14,000 pound.

2.1.5.1 Provide 3-bolt clamp guy terminations designed for use with the particular strand and developing at least the ultimate breaking strength of the strand.

2.1.5.2 Provide round guy guards 8 feet long colored yellow. Material shall be vinyl or PVC and shall be shatter-resistant at subzero temperatures.

2.1.5.3 Provide thimble eye guy attachment using a lift plate on the down side.

2.1.6 Anchors and Anchor Rods: Provide anchors and anchor rods of hot-dipped galvanized steel. Anchor rods shall be thimble-eye, 3/4-inch diameter 7 feet long.

2.1.6.1 Screw type anchors shall be 10 inches in diameter with a minimum rating by the manufacturer of not less than 9,000 pounds in "loose-dry" soil.

2.1.7 Ground Rods: Provide copperweld type copper-clad steel ground rods at least 3/4-inch in diameter and 10 feet long unless otherwise indicated. Die-stamp each near the top with the name or trademark of the manufacturer and the length of the rod in feet. The rods shall have a hard, clean, smooth, continuous, surface throughout the length of the rod.

2.1.8 Ground Wire: Provide soft-drawn copper wire ground conductors no smaller than No. 6 AWG. Ground wire protectors shall be PVC or half round wood molding.

2.1.9 Electrical Tapes: UL 510 and shall be UL listed for electrical insulation and other purposes in wire and cable splices, terminations, repairs and miscellaneous purposes.

2.1.10 Calking Compound: Compound for the sealing of conduit risers shall be of a puttylike consistency workable with the hands at temperatures as low as 35 degrees Fahrenheit, shall not slump at a temperature of 300 degrees Fahrenheit, and shall not harden materially when exposed to air. The compound shall readily calk or adhere to clean surfaces of the materials with which it is designed to be used. The compound shall have no injurious effects upon the hands of workmen or upon the materials.

PART 3 - EXECUTION

3.1 INSTALLATION: Provide overhead pole line installation conforming to the requirements of ANSI C2 (NESC) FOR Grade B construction of overhead lines in medium loading districts and NEC for overhead services. Regard NESC statements using the term "should" as mandatory unless an exception therefrom in writing is granted by the Contracting Officer. All streets, alleys, roads, and drives shall be considered "public." Pole configurations shall be as indicated and as shown on the following sketches:

<u>NUMBER</u>	<u>TITLE</u>
TS-16302L-1.1	Symbol Legend and General Notes
TS-16302L-1.2	List of Symbols
TS-16302L-1.3	Method of Showing Symbols
TS-16302L-1.3.a	Explanation of Notes Symbol
TS-16302L-1.4	Basic Vertical Spacing Requirements
TS-16302L-1.5	Pole Line Material List
TS-16302L-1.5a	Pole Line Material List
TS-16302L-35	Guy
TS-16302L-38	S3, S2, S1, SDE3, SDE2, SDE1 (0-600V)
TS-16302L-43	Ground

3.1.1 Pole Setting: Pole holes shall be at least as large at the top as at the bottom and shall be large enough to provide 4 inches clearance between the pole and the side of the hole.

3.1.1.1 Pole setting depths shall be as follows:

Length of Pole (feet):	30
Setting in Soil (feet):	5.5

3.1.1.2 "Setting in Soil" depths shall apply where pole holes are in soil, sand, or gravel or any combination of these.

3.1.1.3 Thoroughly tamp pole backfill for the full depth of the hole and mound the excess fill around the pole.

3.1.1.4 Set pole and rake against the strain, not less than 2 inches for each 10 feet of pole length above grade, nor more than 4 inches for each 10 feet of pole length after conductors are installed at the required tension.

3.1.1.5 Provide plastic pole caps with 1/4-inch sealing rings and four nailing tabs. Fill sealing are with elastigum to the level of the sealing ring, place on pole top and nail each tabl down with a 1-1/4 inch aluminum nail. No nails or holes shall be permitted on top of pole.

3.1.1.6 Storage and Handling of Poles: Poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. The handling of poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing identations more than one inch in depth shall not be used.

3.1.2 Anchors and Guys: Install guys as indicated. Place anchors in line with the strain and as nearly as possible a distance from the pole equal to the vertical distance from the pole ground line to the point of guy attachment on the pole.

3.1.2.1 Install screw anchors by torquing with boring machine. Anchor rod eye shall extend 6 to 9 inches above grade.

3.1.2.2 Complete the anchor and guy installation, dead end to dead end, and tighten the guy before wire stringing and sagging is begun on that line section. Provide strain insulators at a point on the guy strand 8 feet (minimum) from the ground and 6 feet (minimum) from the surface of the pole. Effectively ground and bond guys to the system neutral.

3.1.3 Hardware: Install hardware with washer against the wood and with nuts and lock nuts applied wrench tight.

3.1.4 Grounding: Provide grounding for pole lines conforming to ANSI C2 except that each separate ground electrode shall have a resistance to the solid earth not exceeding 10 ohms. When work in addition to that indicated or specified is indicated in order to obtain the specified ground resistance, the provisions of the contract covering "changes" shall apply.

3.1.4.1 Make ground rod connections by thermit weld for all ground wire or wire to rod connections.

3.1.4.2 Make thermit welds strictly in accordance with the manufacturer's written recommendations. Welds which have puffed up or which show convex surfaces indicating improper cleaning, are not acceptable. No mechanical connectors are required at thermit weldments.

3.1.4.3 Ground noncurrent carrying metal parts of equipment or enclosures and cable messengers.

3.1.4.4 Protect grounding conductors which are run on the surface of wood poles by wood molding or plastic molding of equal mechanical strength within 8 feet of finished grade.

3.1.5 Conductors shall be handled with all care necessary to prevent nicking, kinking, gouging, flattening, or otherwise deforming or weakening the conductor or impairing its conductivity. Remove all damaged sections of conductor and splice the conductor.

3.1.5.1 Conductor splices, as installed, shall exceed the ultimate rated strength of the conductor and shall be of the type recommended by the conductor manufacturer. No splice shall be permitted within 10 feet of any support.

3.1.5.2 String new conductors to "INITIAL" sag table values recommended by the manufacturer for the conductor type and size of conductor and ruling span indicated. Conductor sags shall adhere as closely as possible to the values given in the chart but may be adjusted where required by proximity of other existing circuits to provide ample clearance between conductors. Changes in the values of sag shall be subject to the approval of the Contracting Officer.

3.2 FIELD TESTS: As an exception to requirements that may be stated elsewhere in the contract, the Contracting Officer shall be given 15 working days notice prior to each.

3.2.1 Ground Rod Tests: Do not connect the ground rods until they have been tested for ground resistance value. Make ground resistance measurements in normally dry weather, not less than 48 hours after rainfall. Ground resistance shall also be measured from each piece of equipment to the ground electrode. Use a portable ground testing megger to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the electrode under test. Follow the directions provided by the equipment manufacturer for proper use of the equipment. Provide one copy of the directions for the use of the observing inspectors.

END OF SECTION

SYMBOL LEGEND

A	-----	ANGLE
AB	-----	ANGLE BRACE
D	-----	DOUBLE
DE	-----	DEADEND
F	-----	FLAT (HORIZONTAL)
FB	-----	FLAT BRACE
LP	-----	LINE POST
N	-----	NEUTRAL
R	-----	RIDGE OR POLE TOP PIN
S	-----	SECONDARY, OPEN WIRE
St	-----	SECONDARY, TRIPLEX
SQ	-----	SECONDARY, QUADRUPLIX
T	-----	TRANSFORMER
TERM	-----	TERMINAL
UG	-----	UNDERGROUND
V	-----	VERTICAL
X	-----	CROSSARM, 8'
X10	-----	CROSSARM, 10'

GENERAL NOTES:

1. Symbols comprising the overhead sketches are not intended to be "all inclusive" for use on every distribution pole line configuration. Only sketches which reflect typical arrangements are included. For other desired arrangements, sketches should be modified or separate details drawn to reflect the specific conditions.
2. Each sketch contains material items which comprise a part of each individual symbol referenced by that sketch. These items are indicated by circled numerals which are identified by Sketches TS-16302L-1.5 and TS-16302L-1.5a.
3. Spacing requirements related to individual components of a symbol are indicated on the appropriate sketch. Vertical spacing requirements between circuits and/or systems are indicated on Sketch TS-16302L-1.4. All other separations between circuits, equipment, etc., shall conform to the National Electrical Safety Code- ANSI C2.

SKETCH TS-16302L- 1.1

Symbol Legend & General Notes

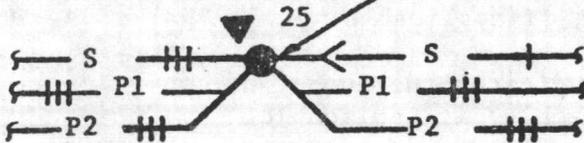
LIST OF SYMBOLS

<u>SKETCH NUMBER</u>		<u>CATEGORY</u>	
TS 16302L-2	THRU	TS 16302L-11	CROSSARM SYMBOLS
TS 16302L-12	THRU	TS 16302L-15	HORIZONTAL (TANGENT OR ANGLE) CONSTRUCTION SYMBOLS
TS 16302L-16	THRU	TS 16302L-20	HORIZONTAL DEADEND CONSTRUCTION SYMBOLS
TS 16302L-21	THRU	TS 16302L-25	VERTICAL CONSTRUCTION SYMBOLS
TS 16302L-26	THRU	TS 16302L-27	ARMLESS CONSTRUCTION SYMBOLS
TS 16302L-28	THRU	TS 16302L-31	TRANSFORMER SYMBOLS
TS 16302L-32	THRU	TS 16302L-34	UNDERGROUND TERMINAL SYMBOLS
TS 16302L-35	THRU	TS 16302L-36	GUY SYMBOLS
TS 16302L-37			CONDUIT RISER SYMBOL
TS 16302L-38	THRU	TS 16302L-42	SECONDARY SYMBOLS
TS 16302L-43			GROUND SYMBOL

SKETCH TS-16302L-1.2

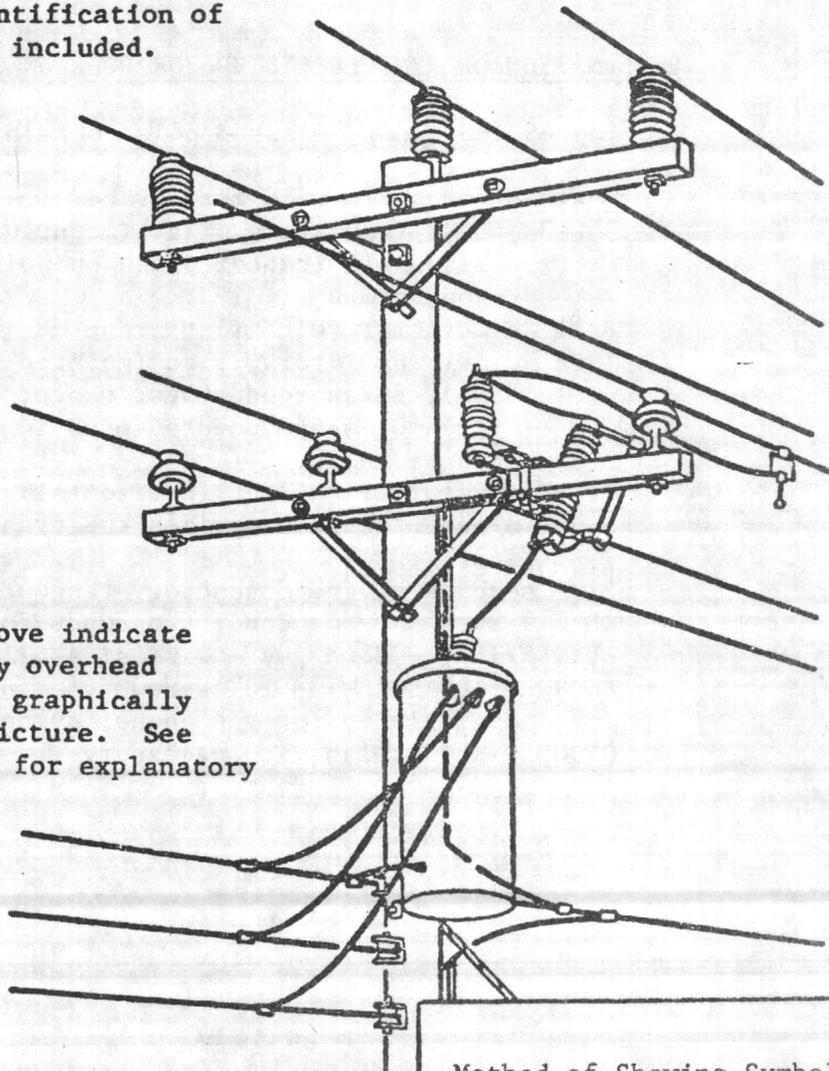
List of Symbols

Pole # _____ (45'-3)
 X-FB, 35FR3
 X-FB, 15F3
 TF (25KVA, 7.6KV - 120/240V)
 S1, SDE2
 GUY (5/16")
 ANCHOR (10" Screw)
 GROUND



DESIGN NOTE:

Method of showing information on plan view is optional and shall be coordinated with legend on individual design basis. However, characteristics & identification of all circuits shall be included.



NOTE:

The symbols listed above indicate material (described by overhead sketches) which is graphically illustrated by this picture. See Sketch TS-16302L-1.3a for explanatory notes.

Method of Showing Symbols

SKETCH TS-16302L- 1.3

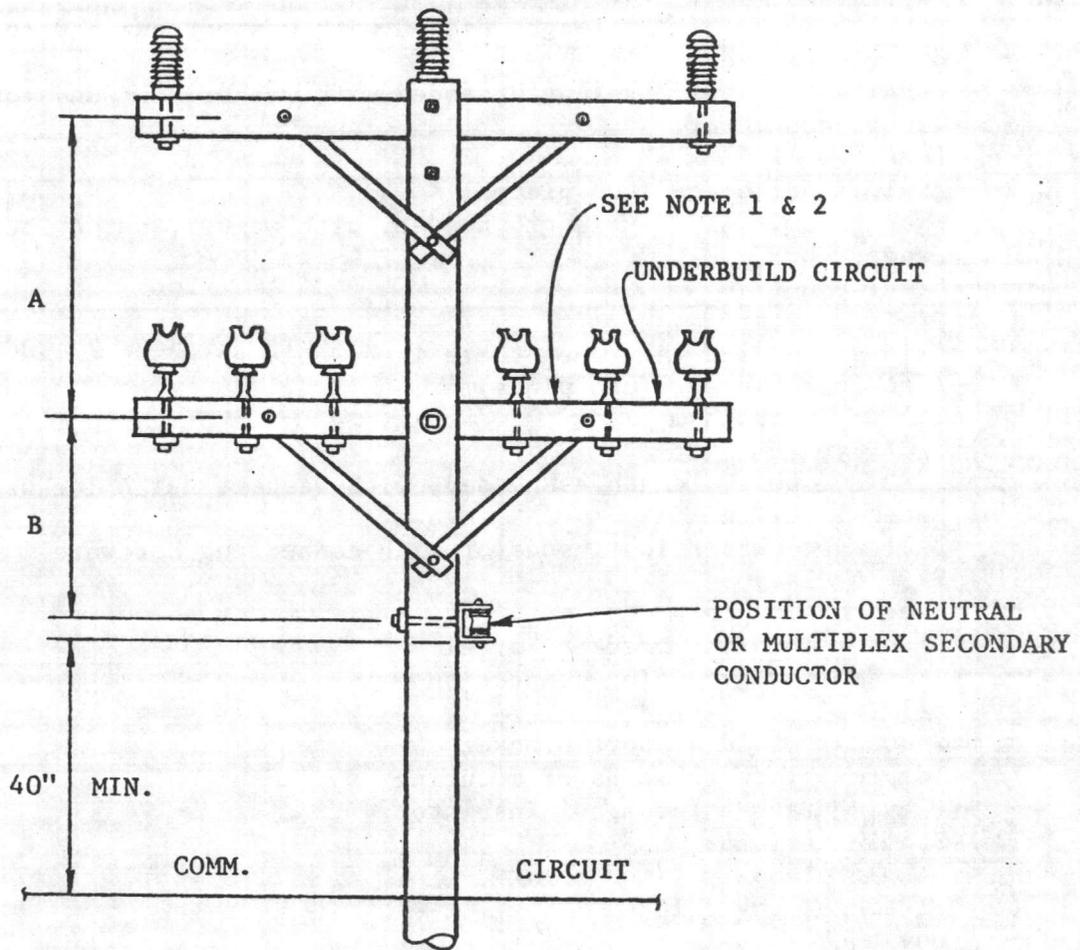
EXPLANATORY NOTES - METHOD OF SHOWING SYMBOLS

1. Symbols are shown in the basic order as they appear on the pole, by starting at the top and working down.
2. Numerals preceding the symbol indicate the minimum required voltage rating of the assembly, if applicable.
3. Numeral following the symbol indicates the number of conductor associated with the assembly, if applicable.
4. Numeral in parenthesis following the symbol denotes the number of assemblies required, if more than one.
5. Data in parenthesis following the symbol provides information relative to the symbol.

EXPLANATION OF SYMBOLS LISTED FOR POLE ON SKETCH TS-16302L-1.3

Provide 45 foot long, class 3 pole containing:

- X-FB- 8' crossarm with flat brace
 35FR3 - 35KV insulators, flat (mounted horizontal on crossarm),
 ridge pin (center phase on pole top pin), three
 conductors
- X-FB- 8' crossarm with flat brace
 15F3 - 15KV insulators, flat (mounted horizontal on cross-
 arm), three conductors. Note: this symbol calls for
 three crossarm mounted pins in lieu of ridge pin on
 center phase.
- TF - transformer on flat (horizontal) construction. Data
 in parenthesis describes the transformer characteris-
 tics.
- S1 - secondary, one conductor, tangent construction
- SDE2 - secondary deadend, two conductors, open wire
- GUY (5/16") - down guy - wire size 5/16"
- ANCHOR (10" SCREW) - 10" screw type anchor. Note: No plate
 is included for the anchor symbol
- GROUND - no explanation necessary



NOTES:

1. For new construction or operating voltages greater than 5KV, limit the number of conductors on crossarm to a maximum of three.
2. Use 10' crossarms for all underbuild circuits with operating voltages greater than 15KV.
3. For horizontal spacing requirements for conductors on same support, refer to the National Electrical Safety Code, ANSI C 2.

$\emptyset - \emptyset$ VOLTAGE	0 - 15KV	15 - 50KV
SPACING A	40"	48" *
SPACING B	40"	40"

* Provide 60" clearance when operating voltage of underbuild circuit is greater than 15KV

SKETCH TS-16302L-1.4

Basic Vertical Spacing Requirements

POLE LINE MATERIAL LIST

TS-16302L (SEPTEMBER 1980)

- ① Flat steel brace (two pieces)
- ② Machine bolt, 3/8" x length needed with washer, nut and lockwasher
- ③ 8' wood crossarm
- ④ Machine bolt, 5/8" x length needed with washer, nut and lockwasher
- ⑤ Timber connector
- ⑥ Lagscrew, 1/2" x 4"
- ⑦ Angle steel brace (two pieces)
- ⑧ Machine bolt, 1/2" x length needed, with washer, nut & lockwasher
- ⑨ Deadend box
- ⑩ Steel pin
- ⑪ Pin insulator
- ⑫ Grid gain, used only when there is no pole gain
- ⑬ Angle steel brace (one piece)
- ⑭ 10' wood crossarm
- ⑮ 5/8" eye nut
- ⑯ 5/8" eye bolt, length as needed, with washer, nut & lockwasher
- ⑰ Extension link
- ⑱ Bell type suspension insulator with connecting hardware
- ⑲ Strain clamp
- ⑳ Steel angle pin
- ㉑ Cluster mounting bracket, steel
- ㉒ Transformer grounding connection
- ㉓ Stirrup
- ㉔ Secondary lead support bracket
- ㉕ Adapter plate for cluster mounting
- ㉖ Clevis bracket for spool insulator
- ㉗ Spool insulator
- ㉘ U bolt clamp
- ㉙ Preformed guy grip
- ㉚ Guy hook
- ㉛ Guy strain insulator
- ㉜ Guy wire, size as specified
- ㉝ #4 WP Cu. soft drawn ground wire
- ㉞ Ground clamp
- ㉟ Conduit coupling
- ㊱ Conduit bend
- ㊲ Insulated bushing
- ㊳ Perforated strapping, 1 1/2" wide
- ㊴ Hot line clamp
- ㊵ Fused cutout, as specified
- ㊶ Surge arrester, as specified
- ㊷ Pole top pin
- ㊸ Crossarm angle pin
- ㊹ Angle pole top pin
- ㊺ Wire, #4 WP Cu., (unless otherwise specified) soft drawn
- ㊻ Tri-mount bracket
- ㊼ Terminator, porcelain housed
- ㊽ Mounting bracket
- ㊾ Cable grip hanger
- ㊿ Hose clamp

SKETCH TS-16302L-1.5

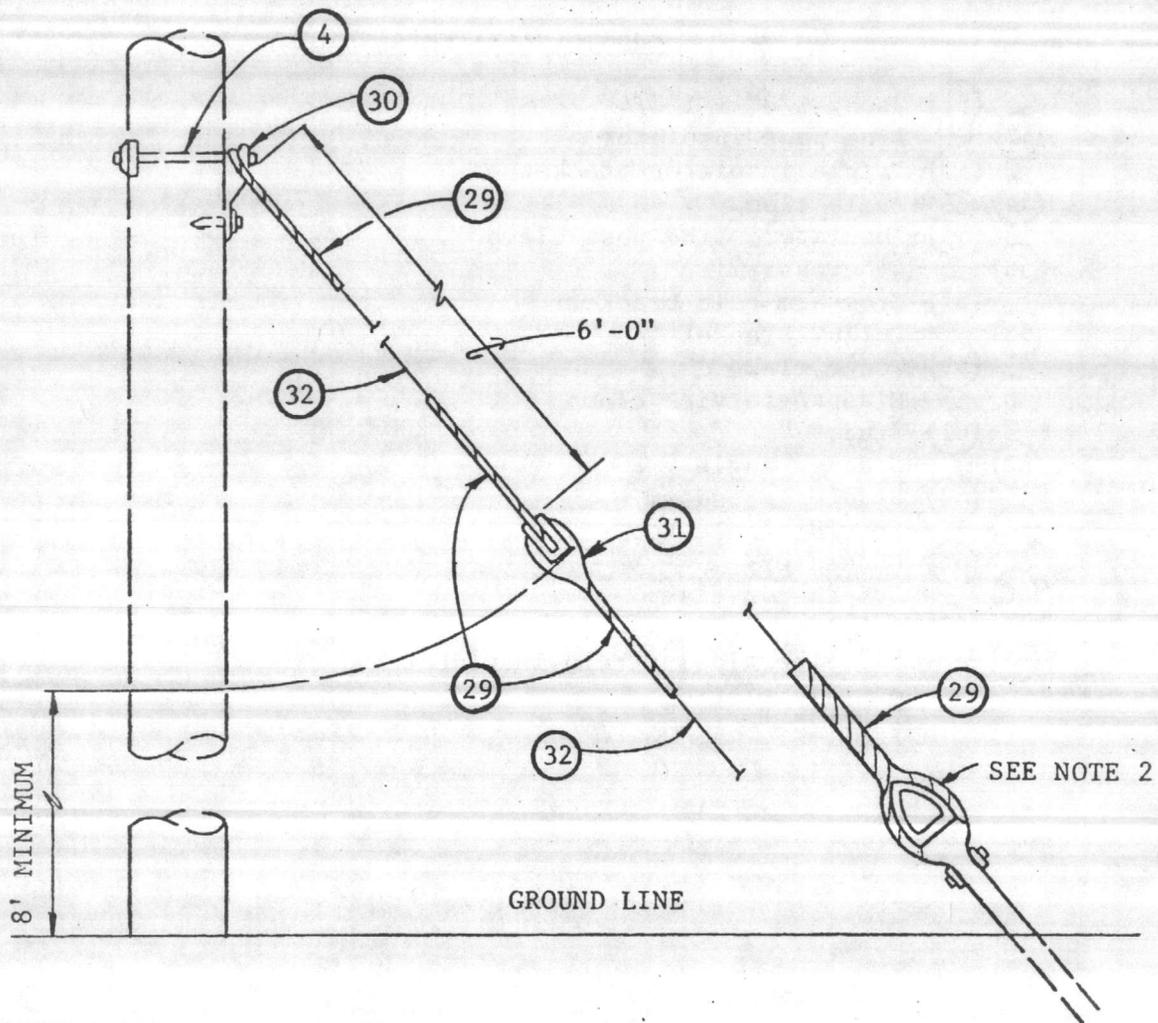
Pole Line Material List

POLE LINE MATERIAL LIST

- 51—Stud, 3/4" x 1 3/4"
- 52—Line post insulator
- 53—Triple insulator bracket
- 54—Angle clamp
- 55—Insulator, line post clamp
- 56—4' crossarm
- 57—Crossarm gain bracket
- 58—Pulley bracket
- 59—Wedge clamp
- 60—Midspan service clamp
- 61—Stud, 7"
- 62—Saddle, angle
- 63—Saddle, crossarm
- 64—Fitting, pole top
- 65—Connector
- 66—Suspension clamp
- 67—Tie, service cable
- 68—54" Fiberglass strain insulator

Pole Line Material List

SKETCH TS-16302L-1.5a

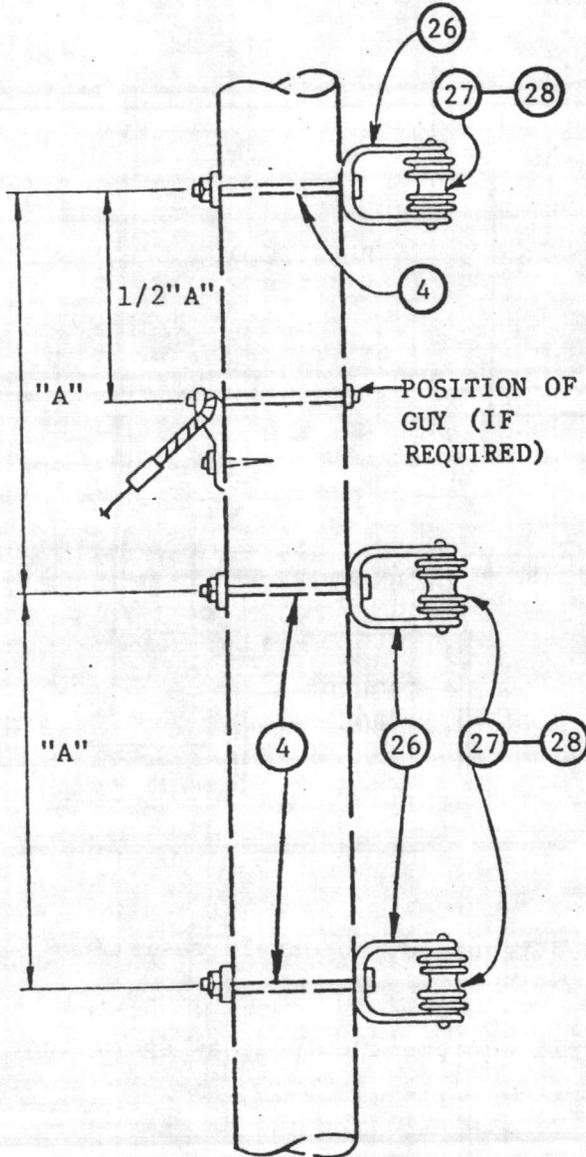


NOTES:

1. On circuit operating voltages greater than 15KV, substitute (68) for (31).
2. Coordinate installation with anchor as specified.

SKETCH TS-16302L- 35

GUY



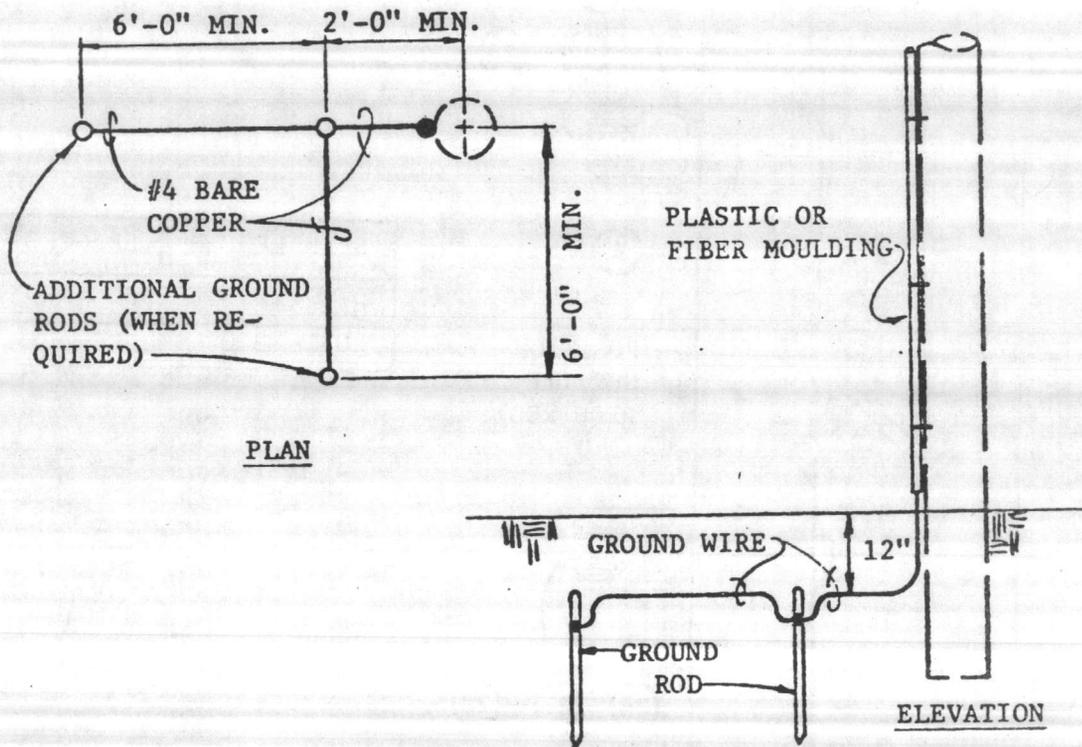
SPAN LENGTH	SPACING "A"
0 - 200'	10"
201 - 300'	14"

NOTES:

1. Drawing represents S3 or SDE3. Omit insulator assemblies as required to coincide with number of conductors.
2. Omit item (28) for S3, S2, and S1.

S3, S2, S1, SDE3, SDE2, SDE1
(0-600V)

SKETCH TS-16302L-38



NOTES:

1. Use additional ground rods, when required, to obtain resistance value, as specified.
2. Make grounding connections to all equipment on pole as specified.

SKETCH TS-16302L- 43

GROUND