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SECTION 16302

OVERHEAD ELECTRICAL WORK

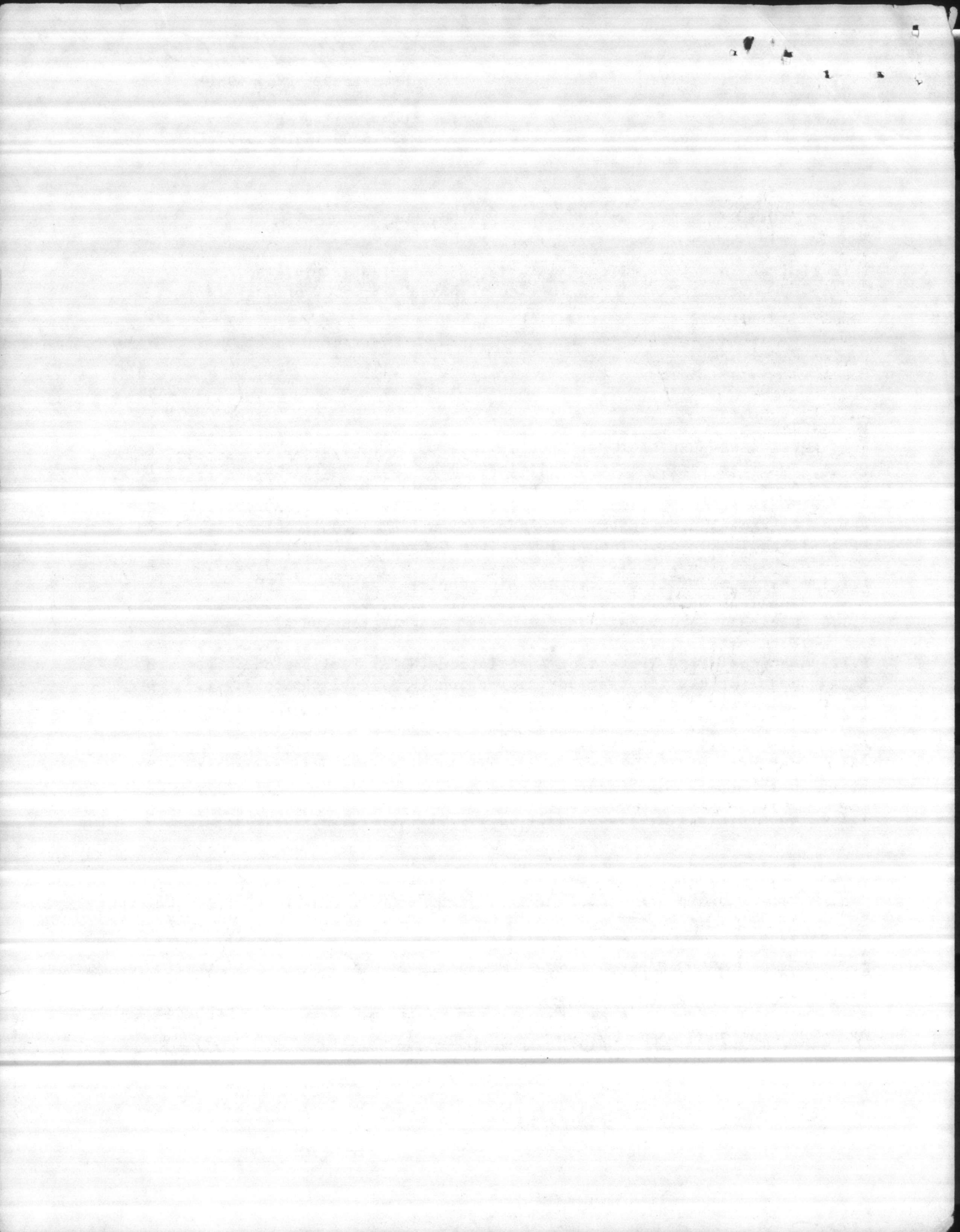
This limited guide specification is issued by Atlantic Division,
NAVFACENGCOM for regional use in lieu of NAVFAC TS-16302 of July 1979.

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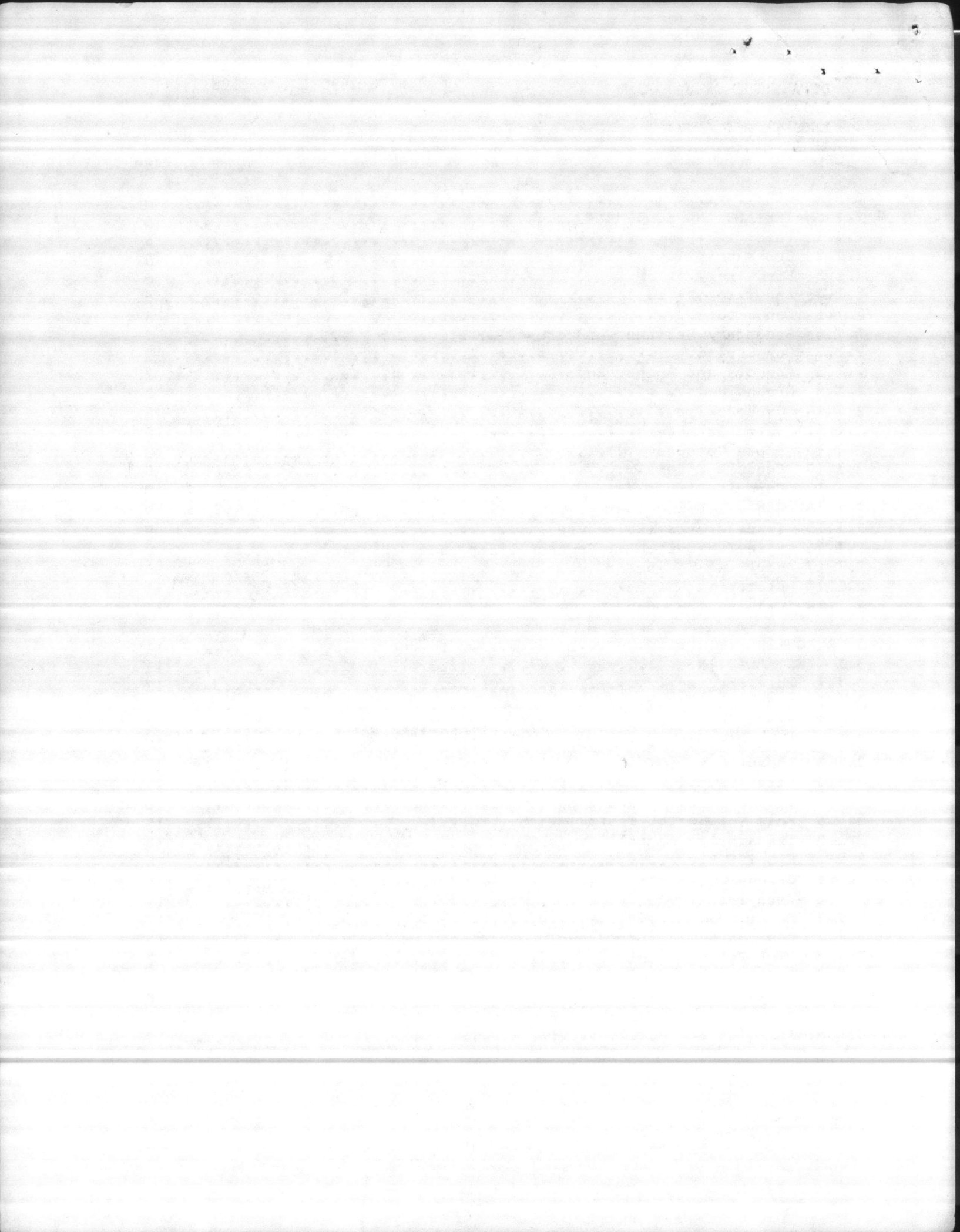
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This specification is not stocked at NPFC.



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SECTION 16302

(B)

OVERHEAD ELECTRICAL WORK

(A)

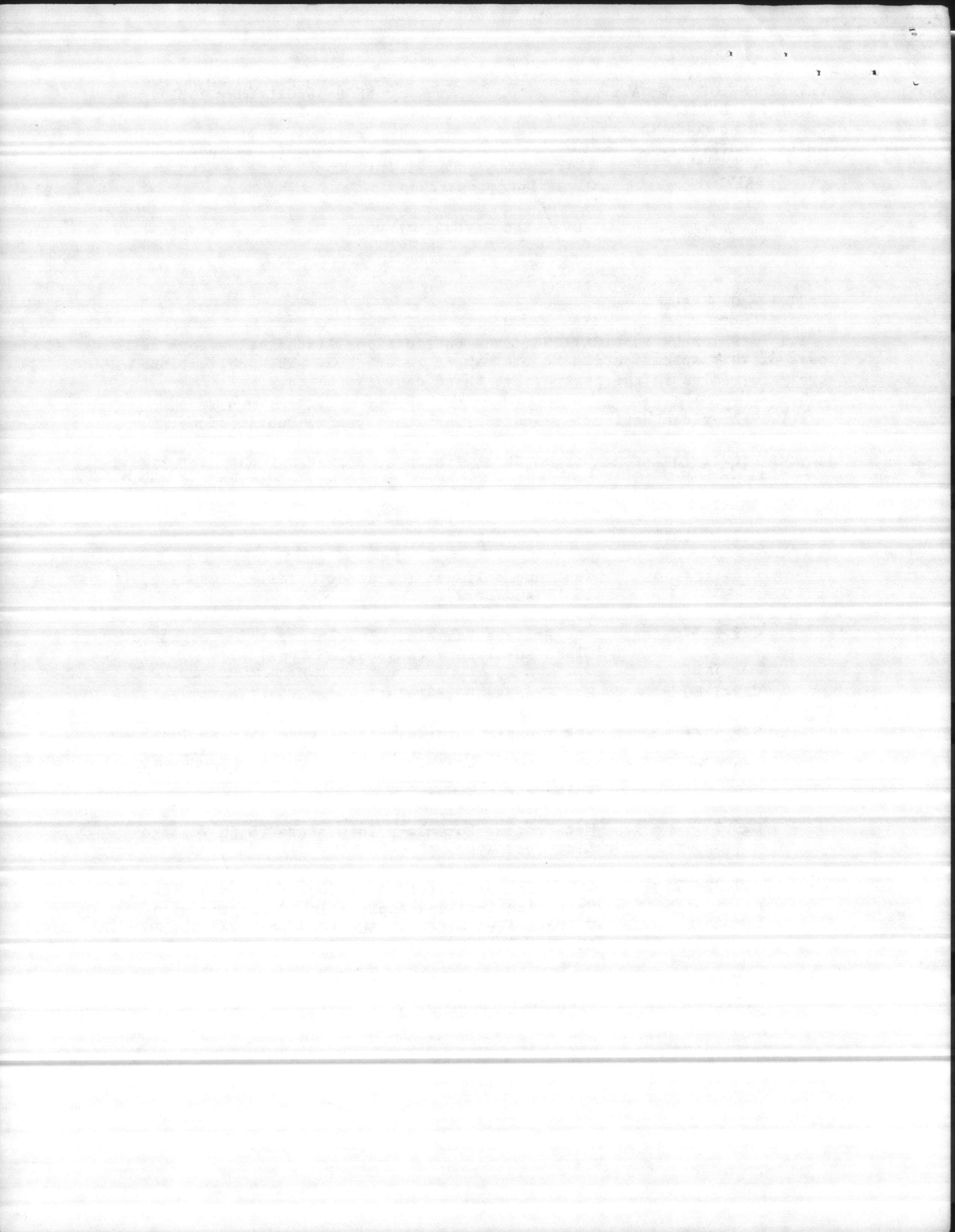
PART 1 - GENERAL

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 the basic designation only.

(C)

1.1.1 American National Standards Institute (ANSI) Publications:

B16.11-73	Forged Steel Fittings, Socket-Welded and Threaded
C2-81	National Electrical Safety Code
C12.10-1978	Watthour Meters
C12.11-1978	Instrument Transformers for Metering Purposes, 15 kV and Less
C29.2-77	Wet Process Porcelain Insulators and- Toughened Glass Insulators (Suspension Type)
C29.3-80	Wet Process Porcelain Insulators (Spool Type)
C29.4-77	Wet Process Porcelain Insulators (Strain Type)
C29.5-77	Wet Process Porcelain Insulators (Low and Medium Voltage Pin Type)
C29.7-77	Wet Process Porcelain Insulators (High Voltage Line-Post Type)
C37.32-72	Schedules of Preferred Ratings, Manufacturing Specifications and Application Guide for High Voltage Air Switches, Bus Supports, and Switch Accessories
C37.42-69 (R1974)	Distribution Enclosed, Open and Open-Link Cutouts



C37.43-69 (R1974) Distribution Fuse Cutout Links for Use in Distribution Enclosed, Open, and Open-Link Cutouts

C57.12.20-74 Overhead Type Distribution Transformers 67,000 Volts and Below: 500 KVA and Smaller, Including Supplement C57.12.20A-78

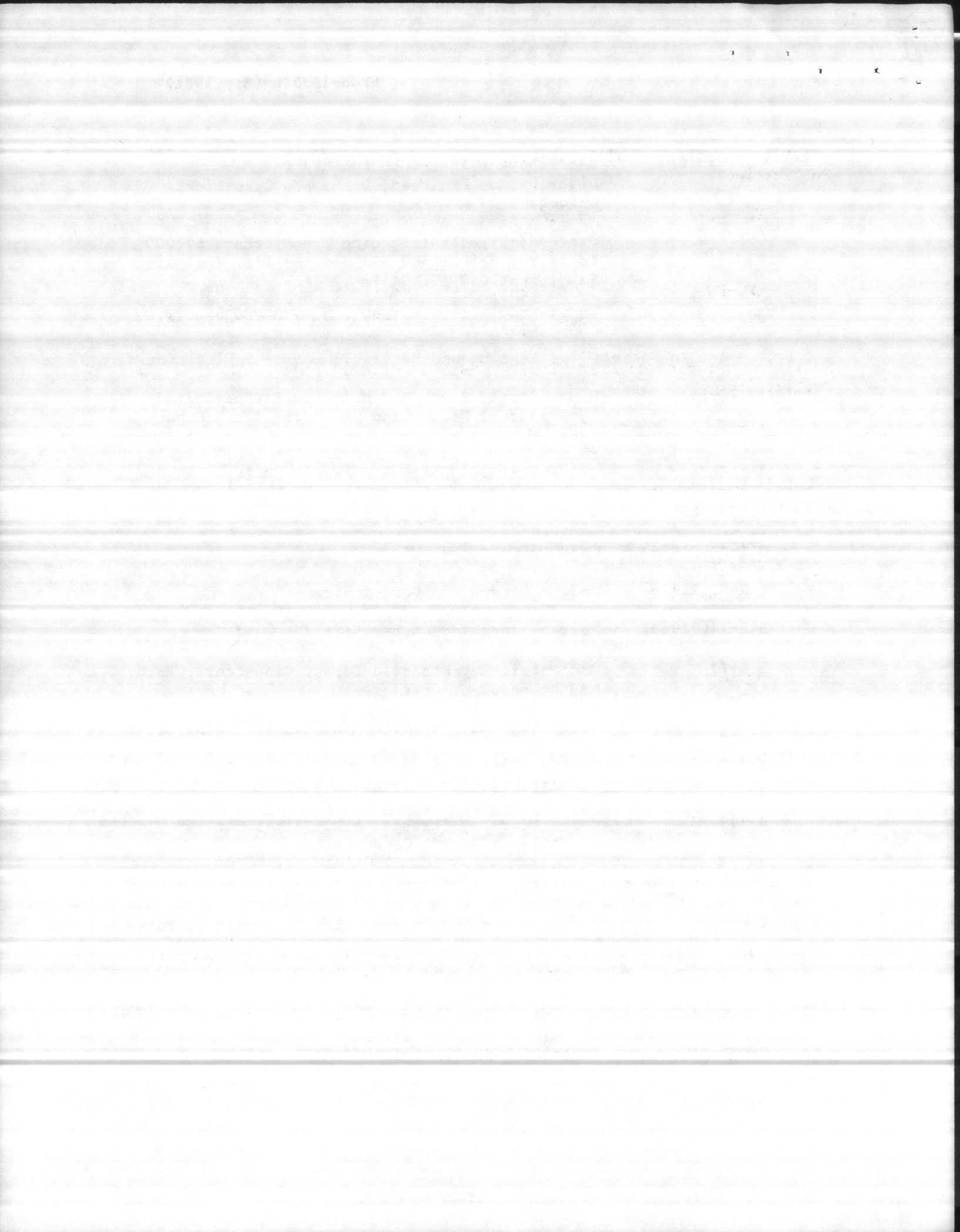
05.1-79 Specifications and Dimensions for Wood Poles

1.1.2 American Society for Testing and Materials (ASTM) Publications:

- A 120-80 Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary uses
- A 153-78 Zinc-coating (Hot-Dip) on Iron and Steel Hardware
- A 475-78 Zinc-Coated Steel Wire Strand
- B 1-70(R1976) Hard-Drawn Copper Wire
- B 2-70(R1976) Medium Hard-Drawn Copper Wire
- B 3-74(R1980) Soft or Annealed Copper Wire
- B 8-77 Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft
- B 231-78 Concentric-Lay-Stranded Aluminum 1350 Conductors
- B 397-78 Concentric-Lay-Stranded 5005-H19 Aluminum-Alloy 5005-H19 Conductors
- B 399-78 Concentric-Lay-Stranded 6201-T81 Aluminum-Alloy 6201-T81 Conductors

1.1.3 American Wood-Preservers' Association (AWPA) Publications:

- C.4-77 Standard for the Preservative Treatment of Poles by the Pressure Process
- C.25-76 Standard for the Preservative Treatment of Crossarms by the Pressure Process



1.1.4 Association of Edison Illuminating Companies (AEIC)
Publications:

- | | |
|--------|---|
| CS5-79 | Specifications for Polyethylene and Cross-Linked Polyethylene Insulated Shielded Power Cables Rated 5 through 69 kV (6th Edition) |
| CS6-79 | Specifications for Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 60 kV (3rd Edition) |

1.1.5 Institute of Electrical and Electronics Engineers (IEEE)
Publication:

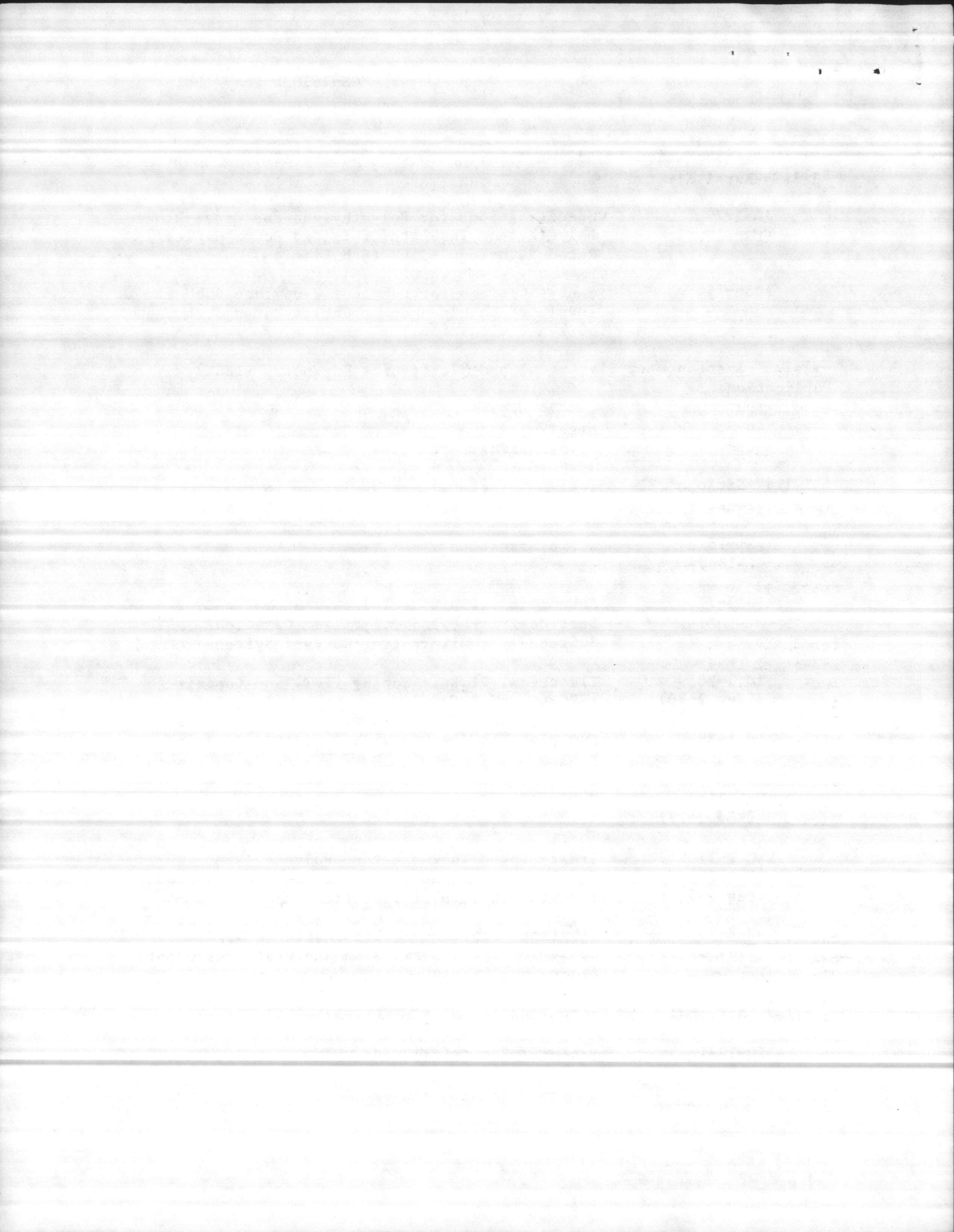
- | | |
|-------|---|
| 48-75 | High Voltage Alternating Current Cable Terminations |
|-------|---|

1.1.6 National Electrical Manufacturers' Association (NEMA)
Publications:

- | | |
|-----------------------------------|---|
| LAI-76
(R1980) | Surge Arresters |
| SG13-77 | Automatic Circuit Reclosers, Automatic-Line Sectionalizers, and Oil Filled Capacitor Switches for Alternating-Current Systems |
| TC 2-78
(Rev 2-80) | Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80) |
| TC 3-78 | PVC Fittings for Use with Rigid PVC Conduit and Tubing |
| TR1-74
(Rev 3-77) | Transformers, Regulators, and Reactors |
| WC 7-71
(R 1976)
(Rev 9-80) | Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electric Energy |
| WC 8-76
(Rev 5-80) | Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy |

1.1.7 National Fire Protection Association (NFPA) Publication:

- | | |
|---------|--------------------------|
| 70-1981 | National Electrical Code |
|---------|--------------------------|



1.1.8 Rural Electrification Administration (REA) Publications:

- | | |
|---|---|
| 44-3
(DEC 1975) | Wood Crossarms (Solid and Laminated),
Transmission Timbers and Pole Keys (DT-5B/PE-16) |
| 43-5
(JULY 1979)
Supplements
2 & 3 | List of Materials Acceptable for Use on
Electric Systems of REA Borrowers |

1.1.9 Underwriter's Laboratories (UL) Publications:

- | | |
|----------------------|-------------------------------|
| 6-76 | Rigid Metallic Conduit |
| 83-80 | Thermoplastic-Insulated Wires |
| 510-76
(R Jun 80) | Insulating Tape |

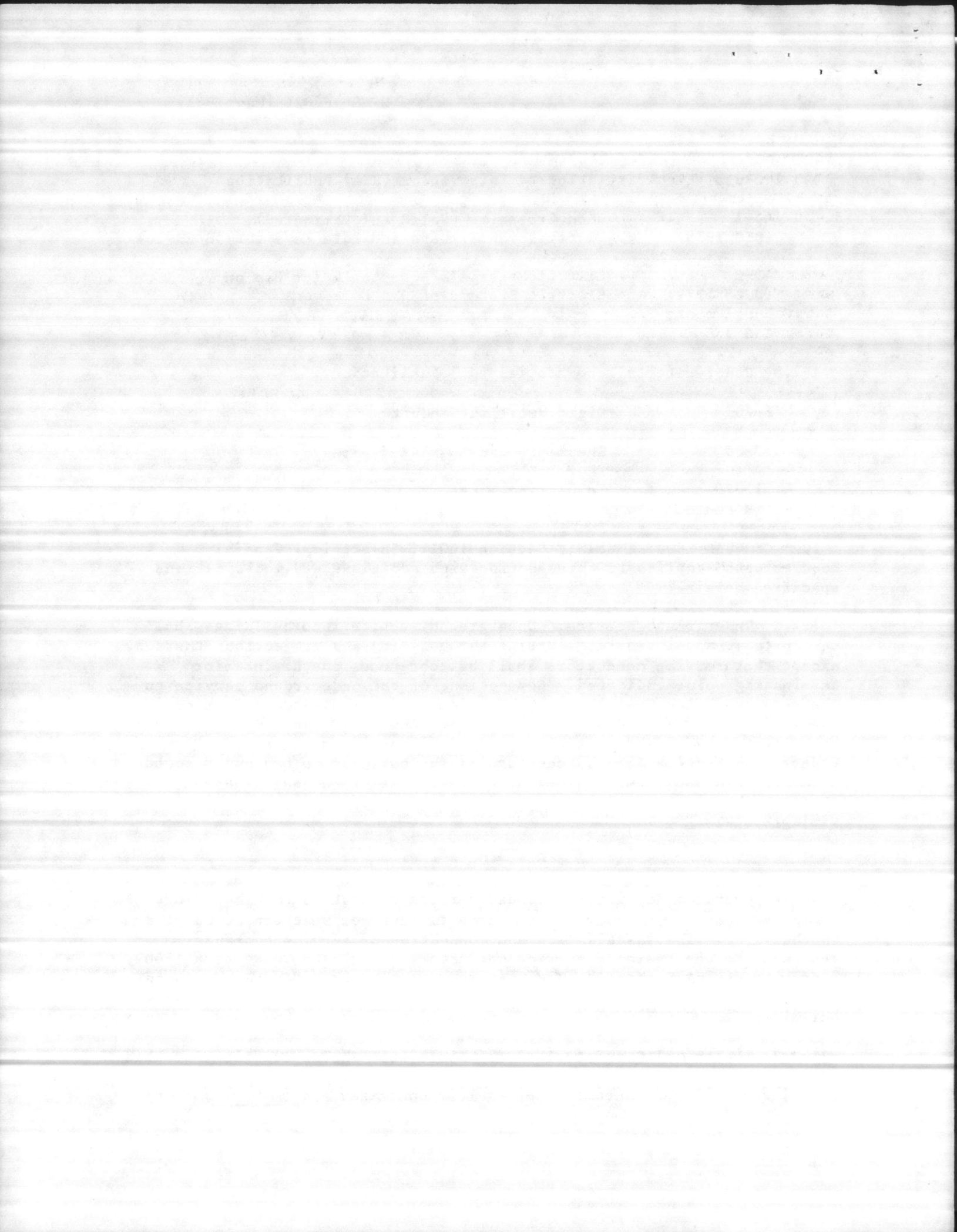
1.2 GENERAL REQUIREMENTS: Section 16011, "Electrical General Requirements" applies to this section with additions and modifications specified herein.

1.2.1 Underground Service: Underground service into buildings shall terminate at a point 5 feet outside the building and projections thereof, except that service conductors shall be continuous to the interior terminating point indicated. Connections of the underground service to the service switch, panelboard or load center is included in Section 16402, "Interior Wiring Systems." Ends of the underground conduit shall be protected by threaded metal caps until connections are made. Underground service from 5 feet outside the building to the underground terminal pole shall be provided under this section and shall have materials and installation as specified in Section 16402, "Interior Wiring Systems."

* * * OR * * *

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 [] feet above the finished grade at the building.

1.2.2 Electrical Characteristics: Electrical characteristics for this project shall be [] kV primary, [single] [three] phase, [three] [four] wire, [] hertz, [wye] [delta] connected and [] volts



secondary, [single] [three] phase, [three] [four] wire, [wye] [delta] connected. Final connections to the power distribution system at the existing [substation] [manhole] [] shall be made by the [Contractor as directed by the Contracting Officer] [Government].

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)
- c. Pole top switch
- d. Reclosers
- e. Sectionalizers
- f. Cutouts
- g. Transformers
- h. Instrument transformers (metering, P.T. & C.T.)
- i. Meter test block
- j. Meter
- k. Tapes

1.2.4.2 Shop Drawings:

- a. Pole top switch
- b. Sectionalizers
- c. Transformers

1.2.4.3 Certification of Competency:

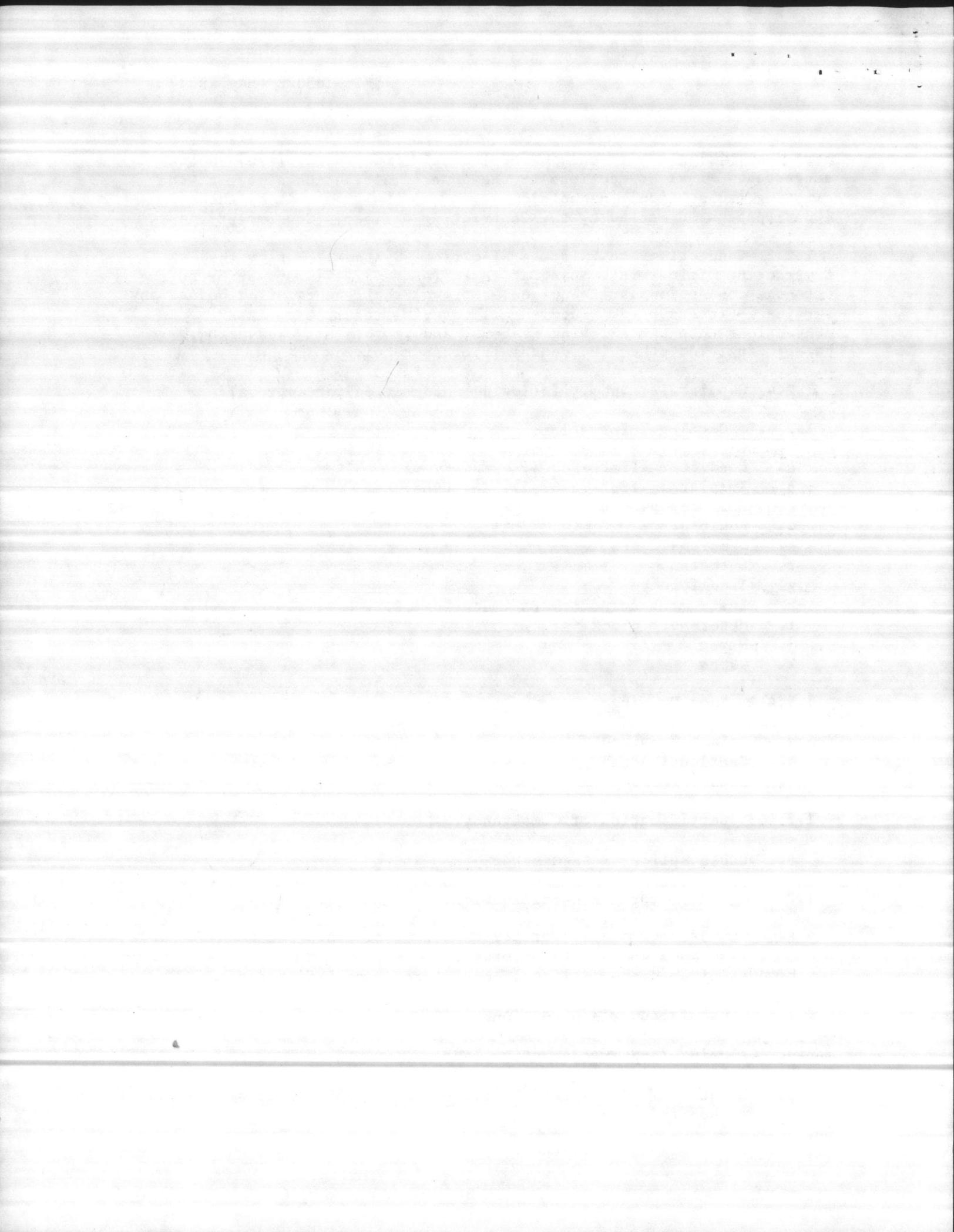
- a. Cable splicer - terminator

1.2.4.4 Manufacturer's Certification:

- a. Transformer tests: Certify that routine tests per NEMA TR1 have been made on each transformer.
- b. Aluminum/copper splices, connectors, lugs & fittings

1.2.4.5 Manufacturer's Directions:

- a. Aluminum/copper connection make-up directions
- b. Cable terminations
- c. 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 [and 14 feet from the butt for poles over 50 feet long]. (D)

2.1.2 Crossarms: Provide solid type wood crossarms conforming to REA DT-5B. Crossarms shall be pressure treated with Chromated Copper Arsenate (CCA) or Ammoniacal Copper Arsenate (ACA). Treatment shall conform to AWPA C25.

2.1.2.1 Provide crossarm braces as indicated on Overhead Sketches.

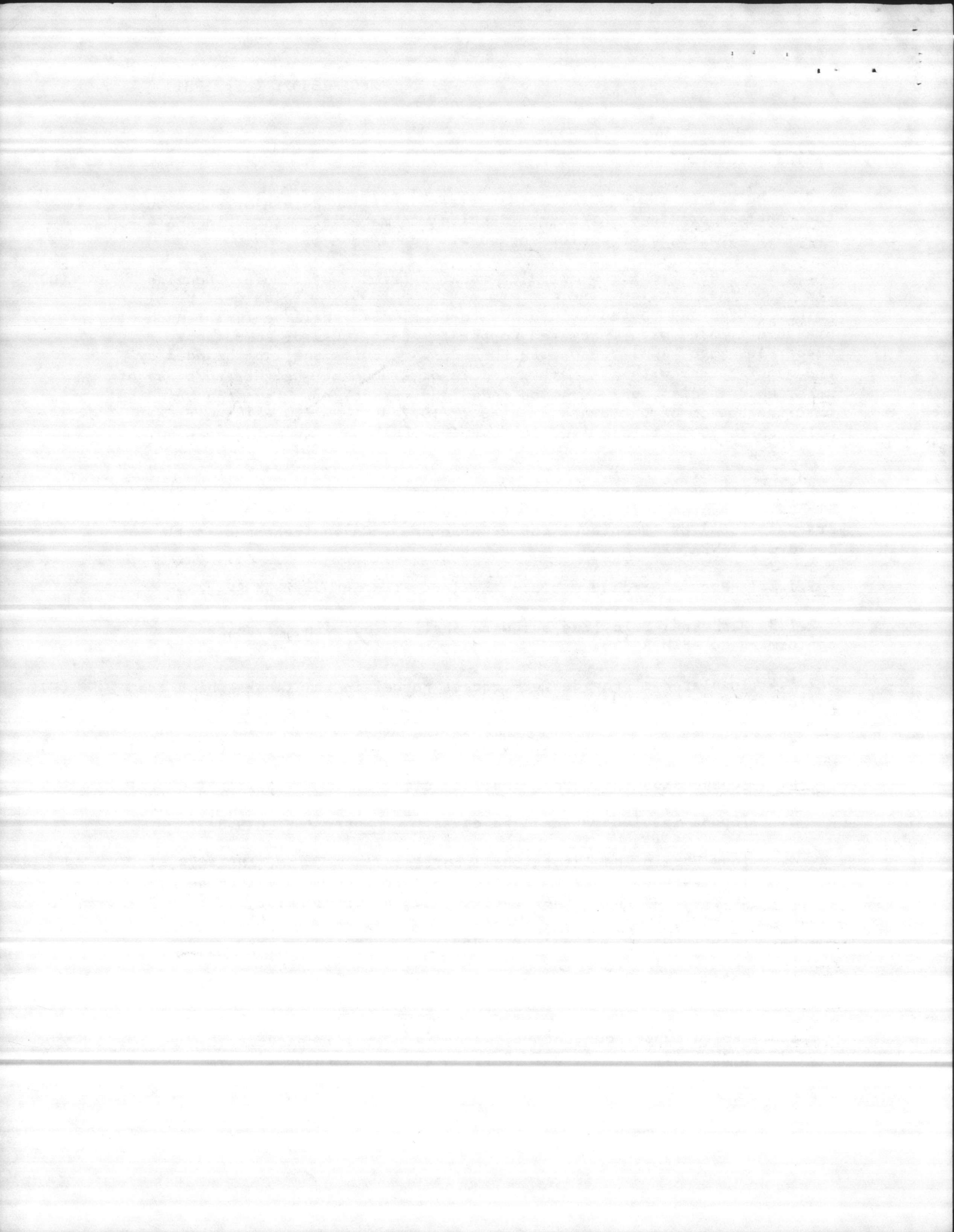
2.1.3 Hardware: Pole line hardware shall be hot dip galvanized conforming to ASTM A 153.

2.1.4 Insulators: Provide wet-process porcelain insulators which are radio interference freed. (E)

- a. [Line post type insulators shall be class _____ per ANSI C29.7]
- b. [Suspension insulators shall be class _____ per ANSI C29.2]
- c. [Spool insulators shall be class _____ per ANSI C29.3]
- d. [Guy Strain Insulators shall be class _____ per ANSI C29.4]
[except they shall be fiberglass type when used with underground terminal or when other interference problems exist]
- e. [Pin insulators shall be class _____ per ANSI C29.5]

2.1.5 Conductors: Provide overhead conductors of bare [copper] [aluminum] of the sizes and types indicated.

2.1.5.1 Solid copper conductors, hard-drawn, medium-hard-drawn, and soft drawn shall conform to ASTM B 1, B 2, and B 3 respectively. Stranded conductors shall conform to ASTM B 8.



2.1.5.2 Aluminum conductors shall conform to ASTM B 231.

2.1.5.3 Aluminum alloy conductors shall conform to ASTM B 397 or B 399.

2.1.6 Secondary-Service Conductors: [Service] [Secondary] conductors shall be [aluminum] [copper], [triplex] [quadruplex] with [300] [600] volt [cross-linked polyethylene] [neoprene] insulation on the phase wires. The neutral shall be bare [aluminum alloy] [copper] messenger. Minimum size shall be No. [4] [6] AWG stranded unless otherwise indicated.] (F)

2.1.7 Guy Strand: Provide [High-strength] [Extra-High-Strength] seven-strand steel cable with Class A or B galvanizing per ASTM A 475. [Guy strand shall be _____ inch in diameter with a minimum breaking strength of _____ pound.] [Guy strand type, and size shall be as indicated.]

2.1.7.1 Provide [automatic] [preformed] [3-bolt clamp] [indicated] guy terminations designed for use with the particular strand and developing at least the ultimate breaking strength of the strand.

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

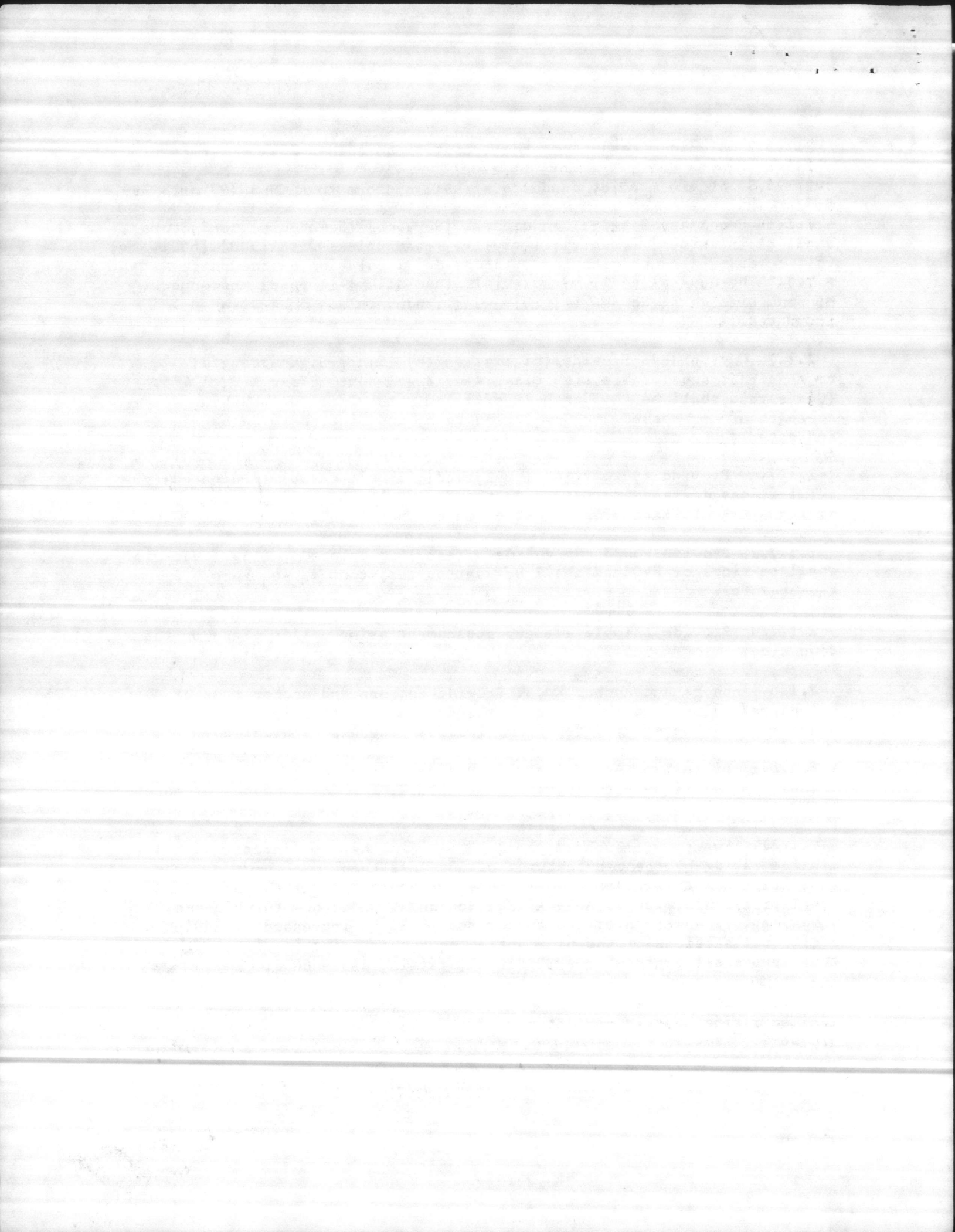
2.1.7.3 Provide thimble eye guy attachment using a lift plate on the down side.

2.1.8 Anchors and Anchor Rods: Provide anchors and anchor rods of hot-dipped galvanized steel. Anchor rods shall be thimble-eye, [3/4] [one] -inch diameter by 7 feet long [unless otherwise indicated]. (G)

2.1.8.1 Plate Type Anchors shall have an area of at least _____ square inches, and shall be rated by the manufacturer for _____ pounds or more in "loose-dry" soil.

2.1.8.2 Swamp type anchors shall be _____ inches in diameter with a minimum rating by the manufacturer of not less than _____ pounds. The rods for swamp type anchors shall be extra-heavy _____ inch galvanized steel pipe conforming to ASTM A 120, Schedule 80, with a thimble-eye screw cap. The length of the anchor rod shall be increased by adding additional sections of the pipe until the anchor grips in firm earth. Couplings shall conform to ANSI B16.11, fitting class 6000.

2.1.8.3 Screw type anchors shall be _____ inches in diameter with a minimum rating by the manufacturer of not less than _____ pounds in "loose-dry" soil.



2.1.9 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.

2.1.10 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.

2.1.11 Surge Arresters: Provide valve type surge arresters conforming to NEMA LA1 arranged for crossarm mounting. Rating shall be [3 kV] [6 kV] [9 kV] [12 kV] [15 kV] [27 kV] [36 kV]. (H)

2.1.12 Fused Cutouts: Provide [heavy] [extra heavy] duty [enclosed] [drop-out] [expulsion] fused cutouts rated [100] [200] amperes at [7.8] [14.4] kV ungrounded, conforming to ANSI C37.42. Provide type [k] [t] fuses conforming to ANSI C37.43 with ampere ratings [as indicated.] [equal to 150 percent of the transformer full load rating.] Open link type fuses and fuse cutouts are not acceptable.

2.1.13 Conduit Risers: Provide rigid galvanized steel conduit conforming to UL 6 [to a point 8 feet above grade, with wood or impregnated fiber protection above that point.] [to a point 8 feet above grade with PVC conduit conforming to NEMA TC2, Type EPC-80-PVC and NFPA 70 of no less than 2-1/2-inch diameter, with fittings conforming to NEMA TC3 for the entire portion of the riser more than 8 feet above grade.] (I)

****OR****

2.1.13 Conduit Risers: Provide rigid galvanized steel conduit conforming to UL 6.

2.1.13.1 600 volt [secondary] [metering] riser conductors shall be copper, [THW] [THWN] [RHW-USE] [] conforming to UL 83.

2.1.13.2 Primary riser conductors for [34.5] [13.2] [12.47] [11.5] [4.16] kV distribution system shall be [as specified in Section 16301L, "Underground Electrical Work."] [[cross linked thermosetting polyethylene insulated cable conforming to NEMA WC7, as applicable and AEIC CS5] [or] [Ozone resistant ethylene propylene rubber insulated cable conforming to NEMA WC8, as applicable and AEIC CS6]. Cable shall be [single] [three] conductor, employing [concentric, Class B] [compact round] stranded copper conductor[s]. Cable shall have conductor and insulation shielding. Insulation shielding shall be metal wire type consisting of a concentric serving of wires according to NEMA [WC7] [WC8]. Cable shall be rated _____ kV with insulation and jacket thickness of _____ and _____ mils, respectively. Cable shall have a polyvinyl chloride jacket.] (I)

2.1.14 Cable Terminations: [Provide terminators for solid insulation nonmetallic jacketed cables of the porcelain insulator type. Terminators shall be applied to single conductor cables or to each conductor of multiple conductor cables. The terminator and all components shall be the product of one manufacturer and finished in a package or kit form compatible with the insulation and conductor material. The kit shall include complete assembly and installation instructions. Contractor shall supply one complete copy of all manufacturer's instructions and information. The terminator shall comply with all requirements of IEEE 48 Class 1 except that the requirements of design tightness test need not be met. However, the terminator shall not exude any filler compound under either test or service. The terminator shall consist of a porcelain insulator, cable connector-hoodnut assembly and aerial lug as required, metal body and support bracket, sealed cable entrance, and internal stress relief device for shielded cable, and insulating filler compound or material.] [Provide as specified in Section 16301L, "Underground Electrical Work."]

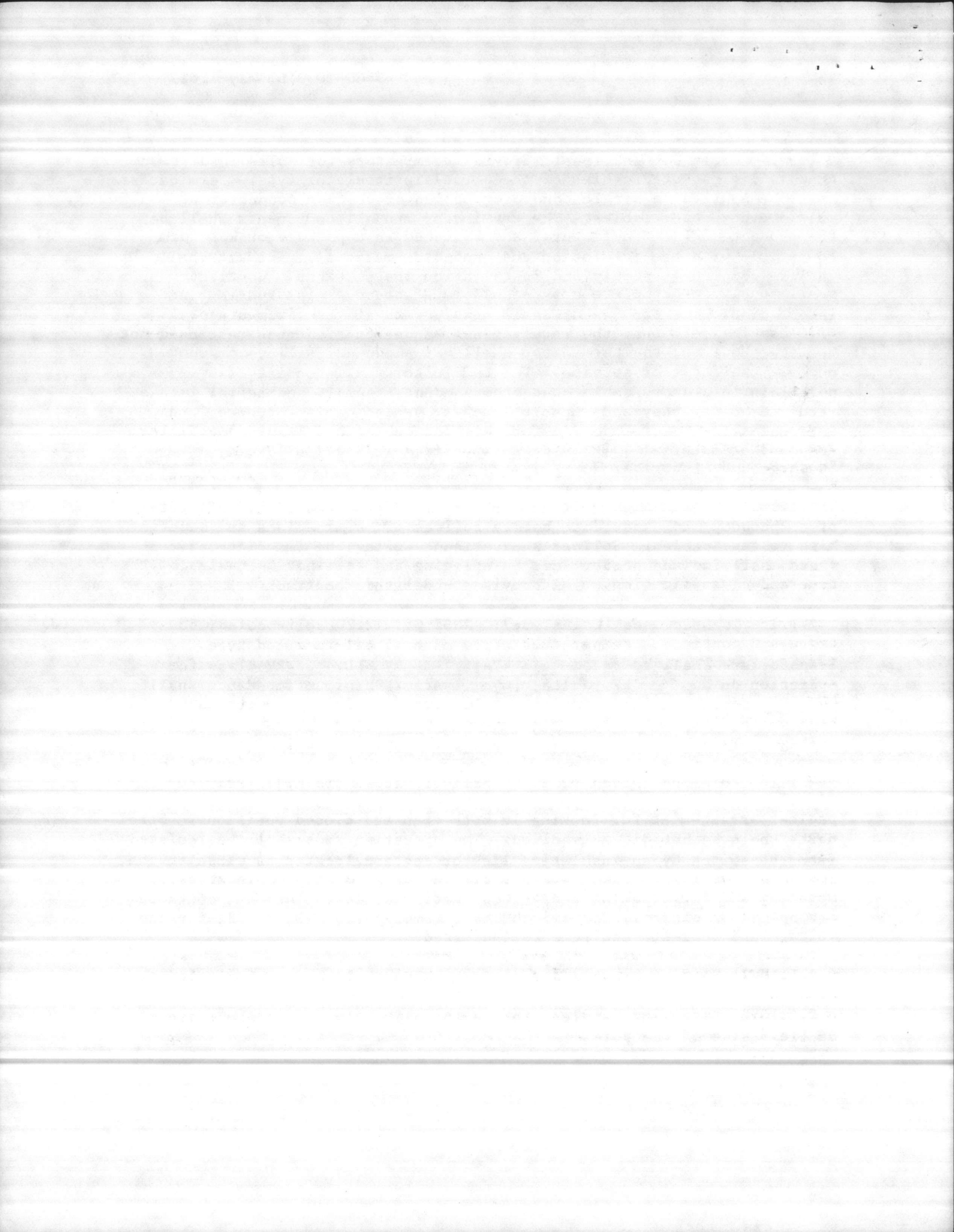
2.1.14.1 Submit high voltage cable splicer/terminator's certification of competency and experience before splices or terminations are made in high voltage cables. Splicer's experience during the immediate past 3 years shall include performance in splicing and terminating cables of the type and classification being provided under this contract.

2.1.15 Transformers (Pole-Type): ANSI C57.12.20 self-cooled, 65 degrees C continuous temperature rise, mineral oil-immersed type. Transformers shall be rated _____ kVA, _____ kV BIL, _____ kV class for operation on a _____ kV [delta] [wye] system. Minimum impedance shall be _____ percent. [Transformers shall have four 2-1/2 percent rated kVA high voltage taps, [] [two] above and [] [two] below rated primary voltage.] Tank finish coat shall be light gray, ANSI color No. 70. (J)

2.1.16 Pole Top Switch [, Sectionalizer, and Recloser]: Provide [vertical] [horizontal] -type switches, three pole gang operated, with a padlock arrangement for locking in both open and closed positions. Steel parts shall be hot dip galvanized. The operating rods shall be isolated from the switch by an insulating link or section located as close to the switch as possible. [The switch shall be designed for double crossarm mounting and for breaking a 3/4-inch coating of ice before the contacts are opened or closed.] The switch shall comply with ANSI C37.32 for the voltage and current requirements indicated.

2.1.16.1 Sectionalizer and Recloser: NEMA SG 13 and as indicated.

2.1.16.2 Operating Handle: Locate approximately 5 feet above ground on field side of the pole.



2.1.16.3 Contractor shall provide a set of erection drawings on the job site for the use of the inspector.

2.1.17 Metering Equipment: Pole mounted metering equipment shall include current transformers, potential transformers, kwh meter, [meter test switch block,] metering enclosure, wire, conduit and fittings.

2.1.17.1 Provide potential transformers rated for outdoor service fitted for crossarm mounting and secondary connection box for conduit connection. Voltage rating shall be [2.4] [4.16] [7.2] [12.0] [12.47] [_____] kV to 120 volts a.c. 60 Hz. Transformers shall conform to the requirements of ANSI C12.11, BIL [45] [60] [75] [95] kV and accuracy Class 0.3 (min.) of [75 VA.] [burden Y].

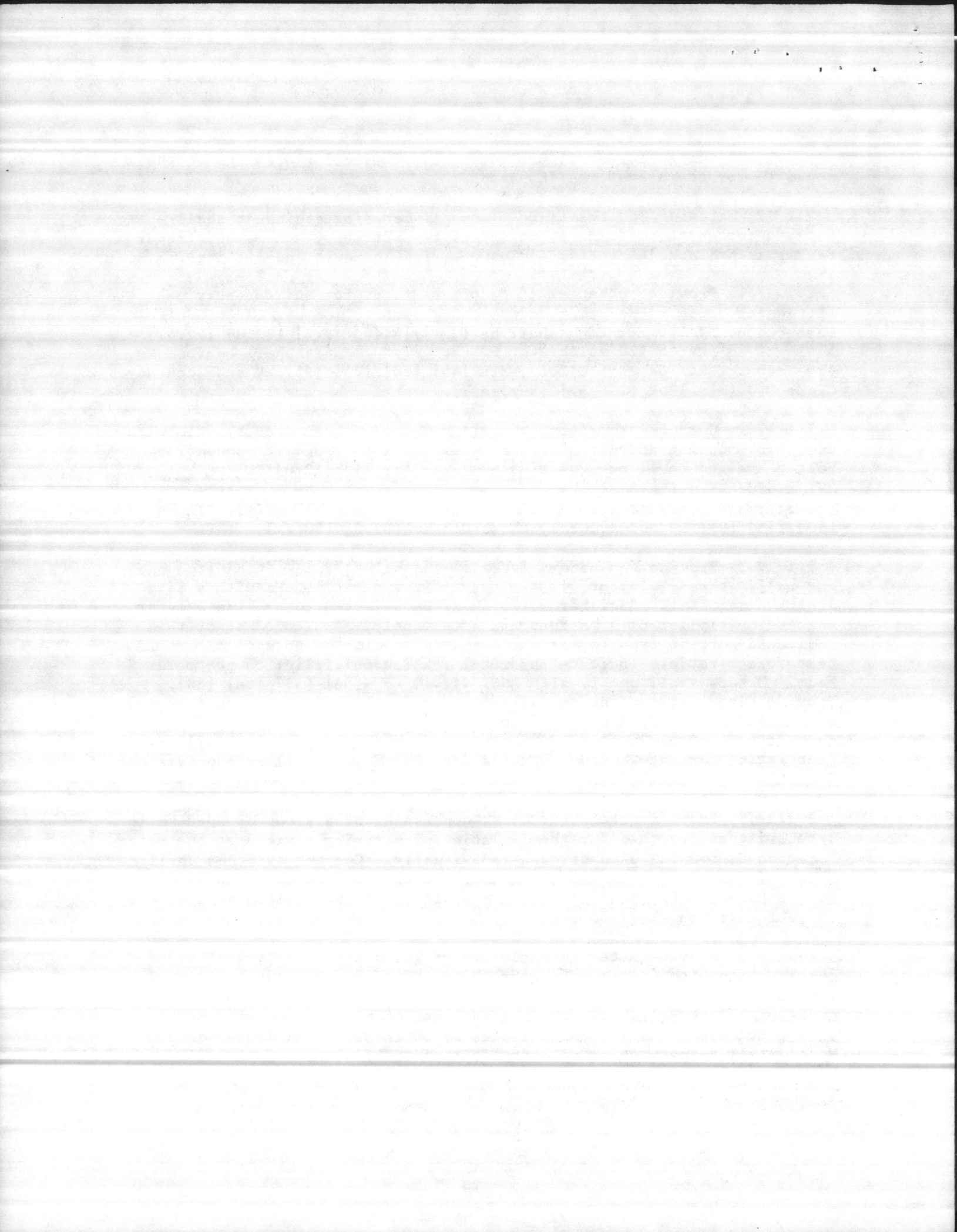
2.1.17.2 Current transformers shall be rated for outdoor service with crossarm mounting and secondary connection box for conduit connection. Voltage rating shall be [2.4] [4.16] [7.2] [12.47] [12.0] [_____] kV. Current rating shall be _____ to 5 amperes. Transformers shall conform to the requirements of ANSI C12.11, BIL [4.5] [60] [75] [95] kV and accuracy Class 0.3 at [B2.0] [50 VA].

2.1.17.3 Provide kWh meter, [socket] ["A base"] type, [two] [two and one half] [three] element, 120 volts, 2-1/2 amperes, 60 Hz with a five dial kWh register. Register ratio shall be selected to provide a meter reading multiplier of even hundreds after applying the product of the indicated current transformer ratio and the indicated potential transformer ratio. Indicate the meter reading multiplier on the meter face. Meters shall comply with ANSI C12.10 for [5A] [5S] [6A] [6S]. Provide block interval demand element type for [15] [30] minute interval with [dial and sweep hand pointer operated by a pusher] [provide cumulative register]. Provide matching meter socket with [manual] [automatic] current short-circuiting device. Meter shall have provisions for future pulse initiation. (K)

2.1.17.4 Provide meter test block consisting of a group of open knife type switches designed for the isolation of metering devices at the meter location by opening each circuit individually. Current switches shall short circuit the current supply before opening the meter circuit. Switch handles of potential switches shall be black. Switch handles of current switches shall be red. (L)

2.1.17.5 Provide metering enclosure of galvanized steel, weatherproof construction with pole mounting bracket, and 3/4-inch exterior plywood, full size backboard and hinged door arranged for padlocking in closed position. Internal space shall be adequate to house the equipment and wiring but not smaller than 20 inches by 30 inches by 11 inches deep. Metal shall be painted manufacturer's standard finish.

Form 5S, 5A ^{socket} - 2 STATOR, 3-WIRE, 3φ (DELTA)
 Form 6A, 6S ^{Bottom connecting} - 2 STATOR, 4-WIRE, 3φ (WYE)



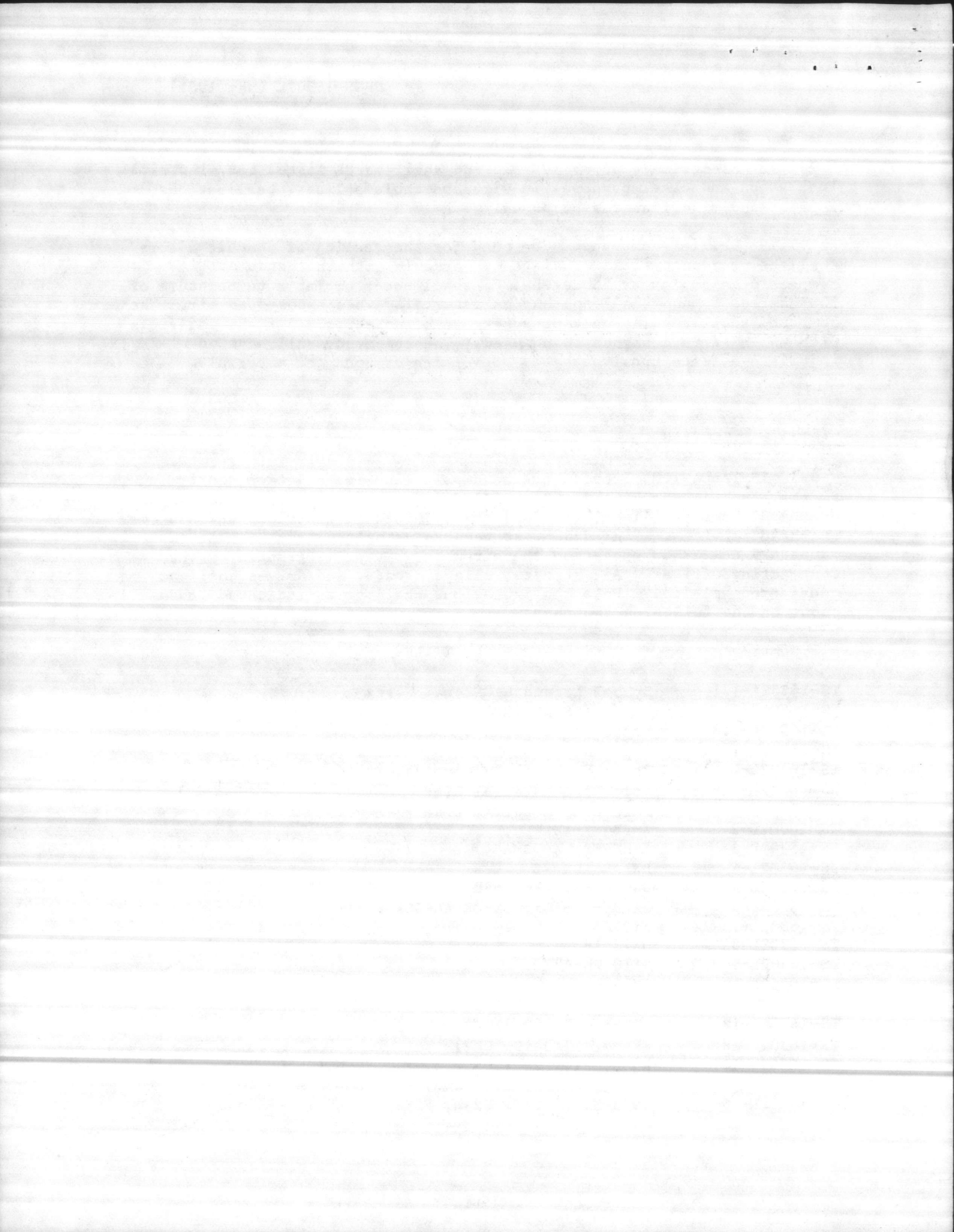
2.1.18. Electrical Tapes: UL 510 and shall be UL listed for electrical insulation and other purposes in wire and cable splices, terminations, repairs and miscellaneous purposes.

2.1.19 Calking Compound: Compound for the sealing of conduit risers shall be of a putty like consistency workable with the hands at temperatures as low as 35 degrees F, shall not slump at a temperature of 300 degrees F, 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] [C] construction of overhead lines in [light] [medium] [heavy] 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:

NUMBER	TITLE
TS-16302L-1.1	Symbol Legend & General Notes
TS-16302L-1.2	List of Symbols
TS-16302L-1.3	Method of Showing Symbols
TS-16302L-1.3a	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-2	X-FB, X-AB
TS-16302L-3	X-DE-FB, X-DE-AB
TS-16302L-4	DX-AB, DX-FB
TS-16302L-5	DX-DE-FB, DX-DE-AB
TS-16302L-6	DX-DE-FB-BOX, DX-DE-AB-BOX
TS-16302L-7	X10-AB
TS-16302L-8	DX10-AB
TS-16302L-9	DX10-DE-AB
TS-16302L-10	DX10-DE-AB-BOX
TS-16302L-11	LPDE
TS-16302L-12	FR3-N, FR3 (0-50KV)
TS-16302L-13	FRA-N, FRA3 (0-50KV)
TS-16302L-14	R3-N, F1, F2, F2-N, F3, F4, F4-N (0-50KV)
TS-16302L-15	FA3-N, FA1, FA2, FA2-N, FA3, FA4, FA4-N (0-50KV)
TS-16302L-16	FDE3-N, FDE2, FQE2-N, FDE3 (0-50KV)



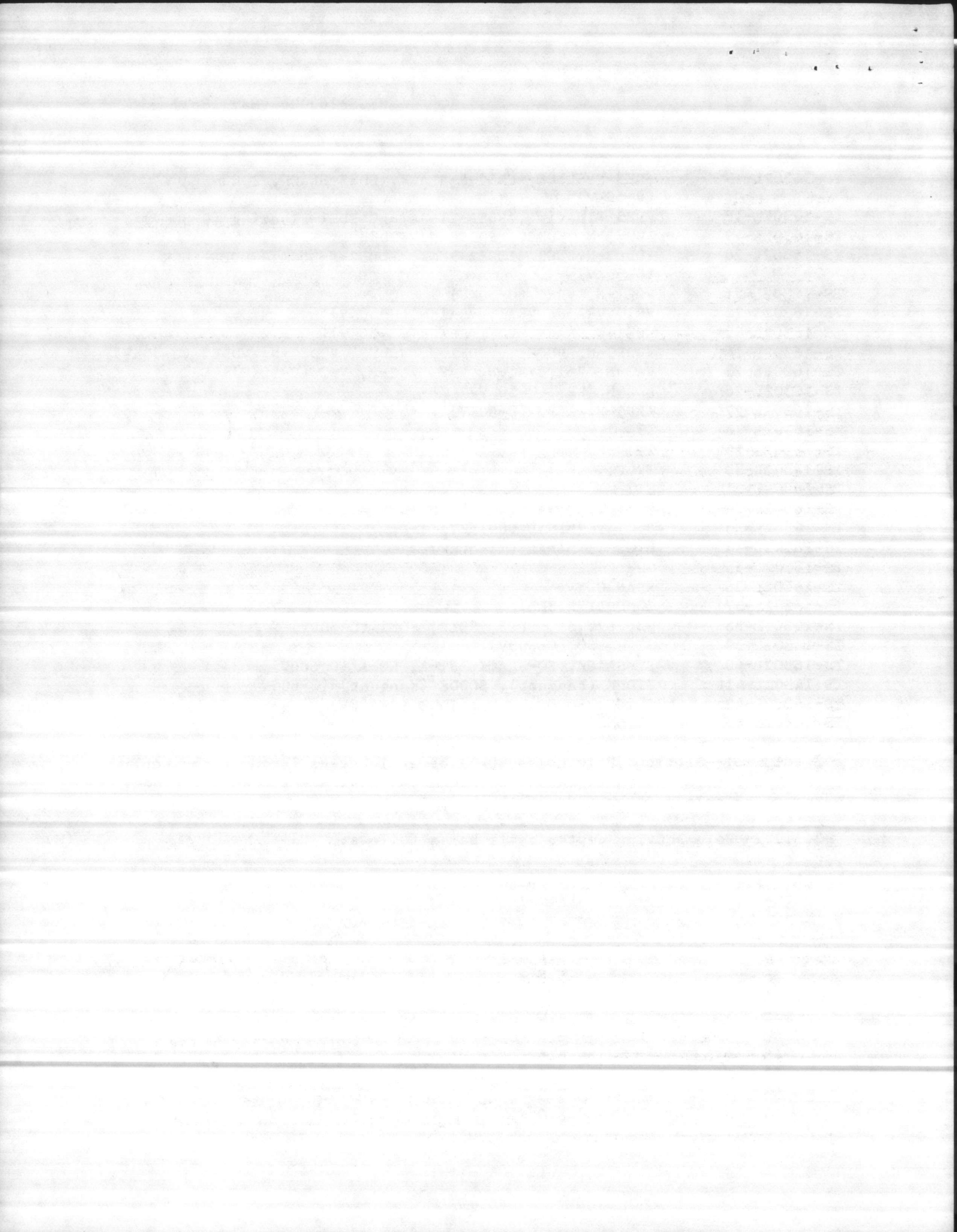
TS-16302L-17	FDE3-N-SLACK, FDE2-N-SLACK, FDE2-SLACK, FDE3-SLACK (0-50KV)
TS-16302L-18	FDE3-Floating, FDE2-Floating, FDE1-Floating (0-50KV)
TS-16302L-19	FDDE3-N, FDDE2, FDDE2-N, FDDE3
TS-16302L-20	FDDE3-N-BUCK, FDDE2-BUCK, FDDE2-N-BUCK, FDDE3-BUCK (0-50KV)
TS-16302L-21	VDE1-N, VDE1 (0-50KV)
TS-16302L-22	VR1, VR1-N, VRA1, VRA1-N (0-50KV)
TS-16302L-23	VDE1-N-SLACK, VDE1-SLACK (0-50KV)
TS-16302L-24	VDDE3-N, VDDE1, VDDE1-N, VDDE2, VDDE2-N, VDDE3 (0-50KV)
TS-16302L-25	VA3-N, VA1, VA1-N, VA2, VA2-N, VA3 (0-50KV)
TS-16302L-26	LP3-N, LP3 (0-50KV)
TS-16302L-27	ALP3-N, ALP3 (0-50KV)
TS-16302L-28	TF
TS-16302L-29	TV
TS-16302L-30	TVLP
TS-16302L-31	TTT
TS-16302L-32	U.G. TERMINAL (SINGLE PHASE)
TS-16302L-33	U.G. TERMINAL (0-15KV)
TS-16302L-34	U.G. TERMINAL (15-50KV)
TS-16302L-35	GUY
TS-16302L-36	SPAN GUY
TS-16302L-37	CONDUIT RISER
TS-16302L-38	S3, S2, S1, SDE3, SDE2, SDE1 (0-600V)
TS-16302L-39	ST or SQ (0-600V)
TS-16302L-40	ST-SLACK, SQ-SLACK, ST-A, SQ-A (0-600V)
TS-16302L-41	STDDE (tangent), SQDDE (tangent) (0-600V)
TS-16302L-42	STDDE, SQDDE, STDE, SQDE (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:

(M)

Length of Pole (feet)	Setting in Soil (feet)
-----	-----
20	5.0
25	5.5
30	5.5
35	6.0
40	6.0
45	6.5
50	7.0
55	7.5
60	8.0



3.1.1.2 "Setting in Soil" depths shall apply where pole holes are in soil, sand, or gravel or any combination of these. [At corners, dead ends and other points of extra strain, poles 40 feet or more long shall be set 6 inches deeper.]

3.1.1.3 On sloping ground, always measure the depth of the hole from the low side of the hole.

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

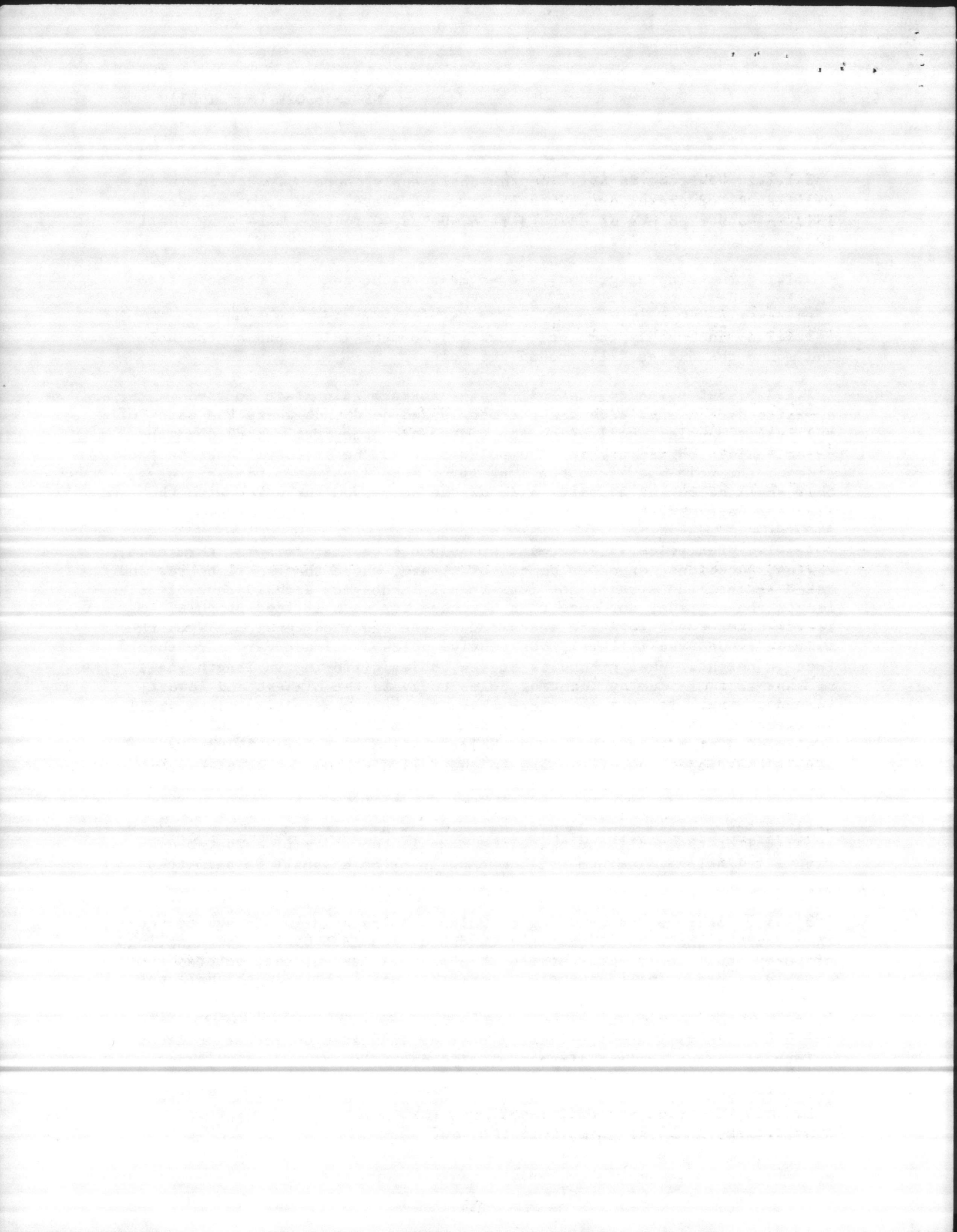
3.1.1.5 Set poles so that alternate crossarm gains face in the opposite directions, except at terminals and dead ends where the gains of the last two poles shall be on the side facing the terminal or dead end. On unusually long spans, set the poles so that the crossarm comes on the side of the pole away from the long span. Where pole top pins are used, they shall be on the opposite side of the pole from the gain, with the flat side against the pole.

3.1.1.6 Set poles in alignment and plumb except at corners, terminals, angles, junctions, or other points of strain, where they shall be set and raked 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. When the average ground run is level, consecutive poles shall not vary more than 5 feet in height. When ground is uneven, poles differing in length shall be kept to a minimum by locating poles to avoid the highest and lowest ground points. If it becomes necessary to shorten a pole, a piece shall be sawed off the top and the shortened end of the pole given an application of hot preservative. Holes shall be dug large enough to permit the proper use of tampers to the full depth of the hole.

3.1.1.7 Provide plastic pole caps with 1/4-inch sealing rings and four nailing tabs. Fill sealing area with [elastigum] [] to the level of the sealing ring, place on pole top and nail each tab down with a 1-1/4-inch aluminum nail. No nails or holes shall be permitted on top of pole. (N)

3.1.1.8 Storage and Handling of Poles: Poles held in storage for more than 2 weeks shall be stored in accordance with ANSI 05.1. The handling of poles shall be in accordance with ANSI 05.1, except that pointed tools capable of producing indentations more than one inch in depth shall not be used.

3.1.2 Anchors and Guys: Install guys as indicated on corner poles at points of change in line direction, at ends of lines, and on adjacent brace poles at railroad and main highway crossings. 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 Set anchors in place with the anchor rod aligned with, and pointing directly at, the guy attachment on the pole with the anchor rod projecting 6 to 9 inches out of the ground to prevent burial of the rod eye.

** OR **

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

** OR **

3.1.2.1 Install swamp anchors by torquing with boring machine or wrenches, adding sections of pipe as required until the anchor helix is fully engaged in firm soil.

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.] (O)

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 directed in order to obtain the specified ground resistance the provisions of the contract covering "changes" shall apply. (P)

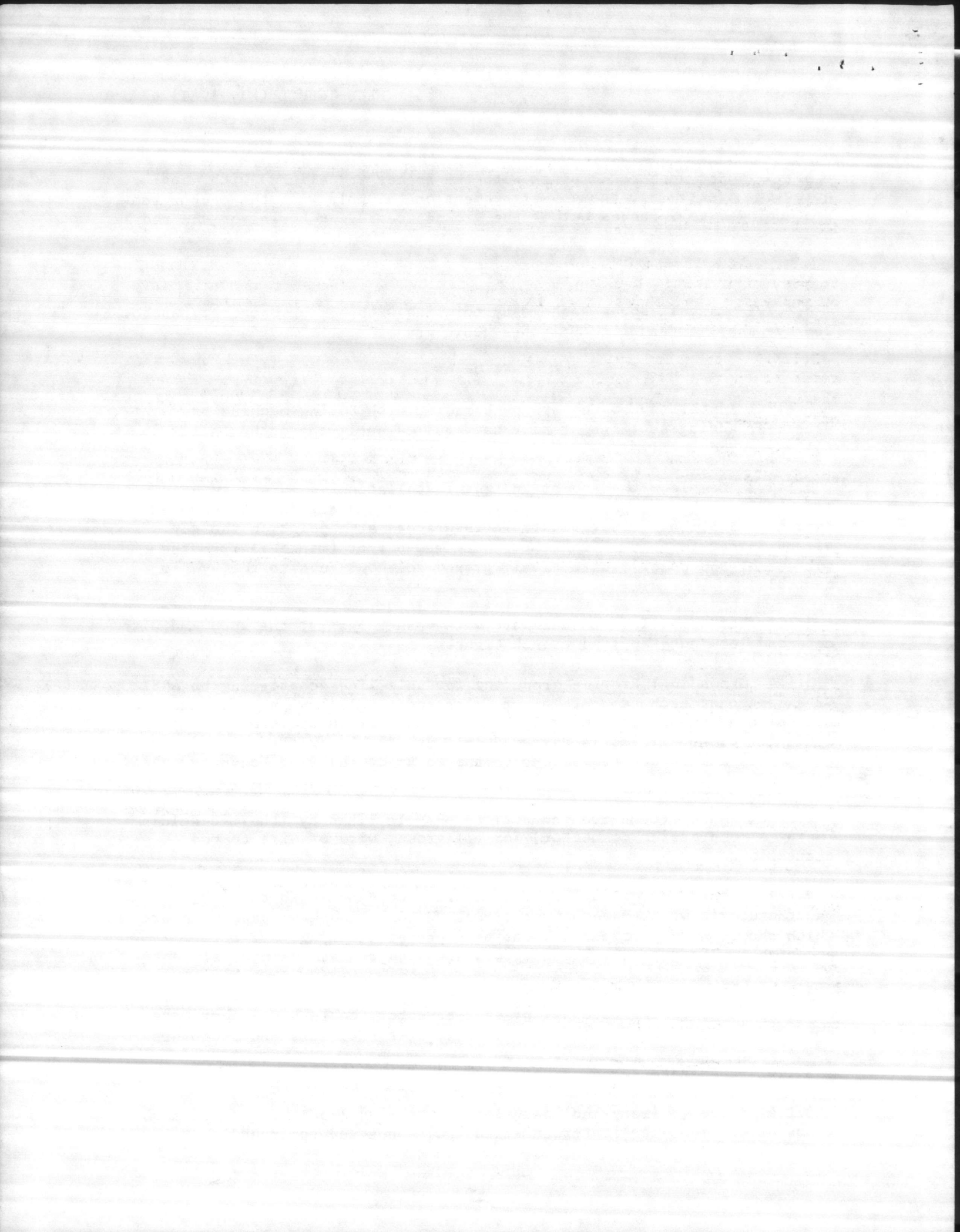
3.1.4.1 Make ground rod connections on pole lines by [thermit weld] [using a compression connector] for all ground wire or wire to rod connections.

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, grounding terminal of each arrester, cable messengers, and operating mechanism of pole-top switches, sectionalizers and reclosers.

3.1.4.4 Separate surge arrester grounds from other grounds.

3.1.4.5 The [primary and] secondary neutral[s] [and the tank of each transformer] shall be [interconnected and] connected to ground. (Q)



3.1.4.6 Protect grounding conductors which are run on the surface of wood poles by wood molding [or plastic molding of equal mechanical strength] [extending from the ground line throughout communication and transformer spaces] [within 8 feet of finished grade].

3.1.5 Conductors: 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 Ties on pin insulators shall be tight against the conductor and insulator and ends shall be turned down flat against the conductor so that no wire ends project.

3.1.5.3 Existing conductors to be reinstalled or resagged shall be strung to "FINAL" sag table values for the particular conductor type and size involved. (R)

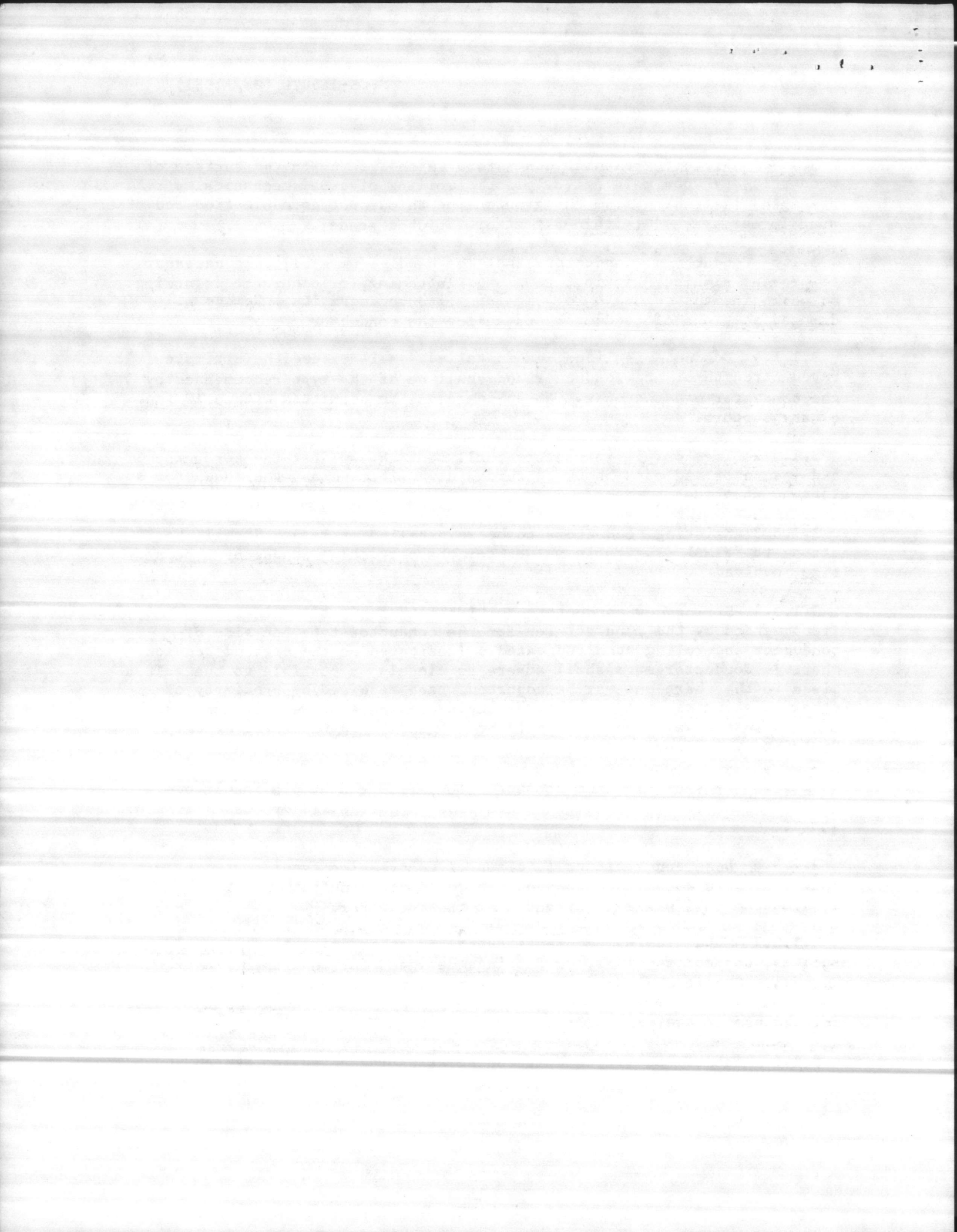
3.1.5.4 String new conductors to "INITIAL" sag table values [recommended by the manufacturer for the conductor type and size of conductor and ruling span indicated.] [indicated on the sag and tension chart.] Conductor sags shall adhere as closely as possible to the values given in the chart but may be 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. (R)

3.1.5.5 Protect Aluminum conductors by armor rod at pin insulators and by flat aluminum wire at attachments made of galvanized or coated iron or steel.

3.1.5.6 Dead end fittings [, clamp or compression type] shall conform to the written recommendations of the conductor manufacturer and shall develop the full ultimate strength of the conductor.

3.1.5.7 Make aluminum connections to any other material using only splices, connectors, lugs, or fittings designed for that specific purpose. Submit the manufacturer's directions for applying these fittings for reference and one additional copy maintained at the job site for the use of the inspector.

3.1.6 Risers: Secure conduits on poles as indicated [on Sketch. TS-16302L-37]. Ground metallic conduits.



3.1.7 Pole Mounted Metering Equipment:

3.1.7.1 Install primary metering transformers [as indicated] [according to the manufacturer's drawings]. Make connections to the metering circuits within each transformer conduit connection box.

3.1.7.2 Metering enclosure shall house the kWh meter and the meter test block. Secure the enclosure to the pole at a height of 6 feet above grade to the center of the enclosure. Ground the enclosure.

a. Connect the meter as indicated.

b. Connect the meter test block between the meter and the metering transformers to isolate the meter for removal, test or adjustment.

c. Phase sequence and color code of potential and current leads shall be identical. Mark wires which are connected to transformer terminals identified with polarity marks (dots) by a yellow plastic tape around the wire at each end.

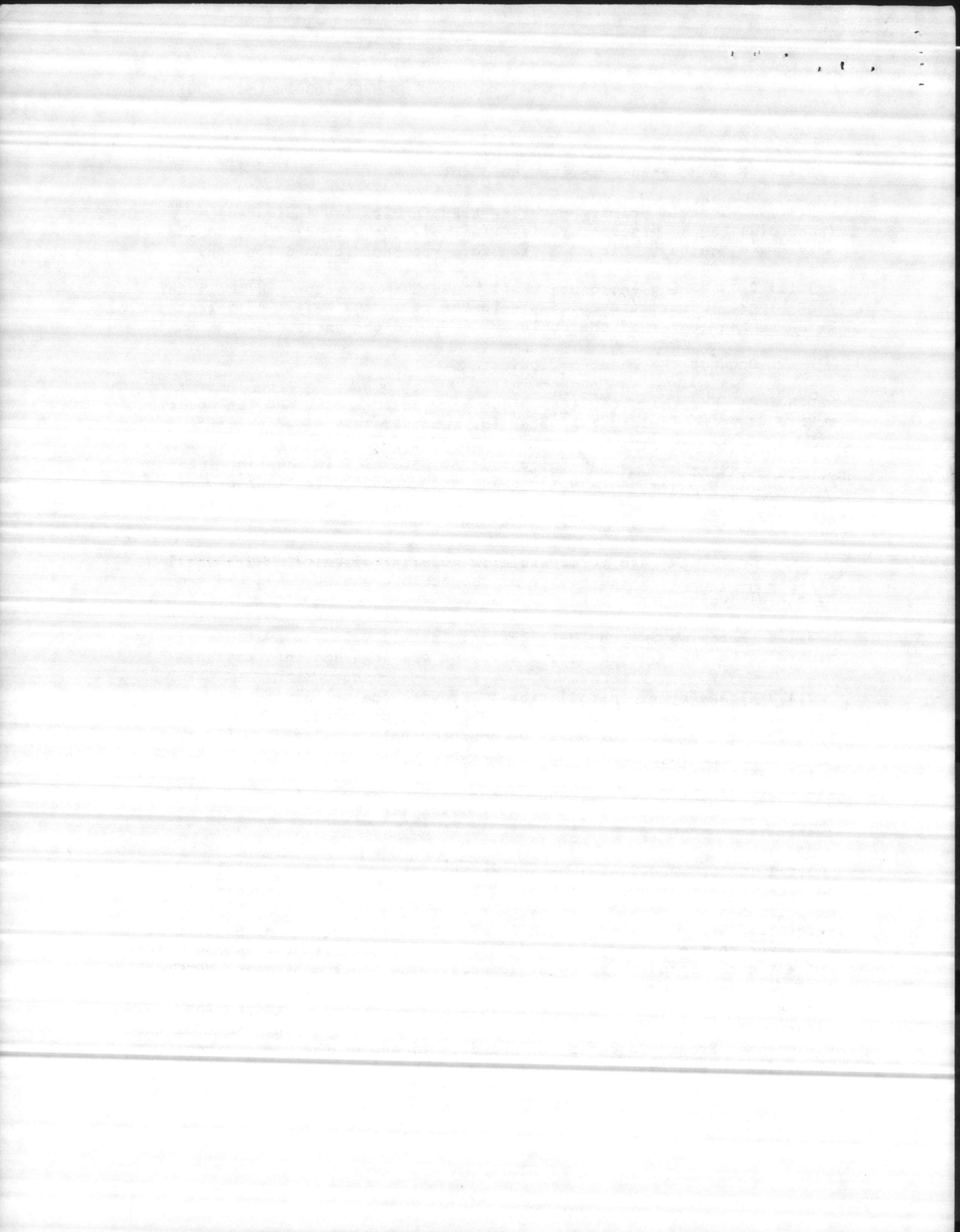
d. No splices are permissible in metering circuits. Wire shall be trained at the sides and bottom of the enclosure back board and secured by plastic wraps.

3.1.8 Pole Top Switch Installation: Install pole top switch strictly according to the manufacturer's erection drawings and information.

3.1.9 Transformer Installations: Provide one primary fuse cutout and one surge arrester for each ungrounded phase conductor. The transformer's kVA rating shall be conspicuously displayed on its tank.

3.2 FIELD TESTS: As an exception to requirements that may be stated elsewhere in the contract, the Contracting Officer shall be given [5] [] working days notice prior to [each] [] test[s].

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.



3.1.7 Pole Mounted Metering Equipment:

3.1.7.1 Install primary metering transformers [as indicated] [according to the manufacturer's drawings]. Make connections to the metering circuits within each transformer conduit connection box.

3.1.7.2 Metering enclosure shall house the kWh meter and the meter test block. Secure the enclosure to the pole at a height of 6 feet above grade to the center of the enclosure. Ground the enclosure.

a. Connect the meter as indicated.

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3.1.7.2 Metering enclosure shall house the kWh meter and the meter test block. Secure the enclosure to the pole at a height of 6 feet above grade to the center of the enclosure. Ground the enclosure.

- a. Connect the meter as indicated.
- b. Connect the meter test block between the meter and the metering transformers to isolate the meter for removal, test or adjustment.
- c. Phase sequence and color code of potential and current leads shall be identical. Mark wires which are connected to transformer terminals identified with polarity marks (dots) by a yellow plastic tape around the wire at each end.
- d. No splices are permissible in metering circuits. Wire shall be trained at the sides and bottom of the enclosure back board and secured by plastic wraps.

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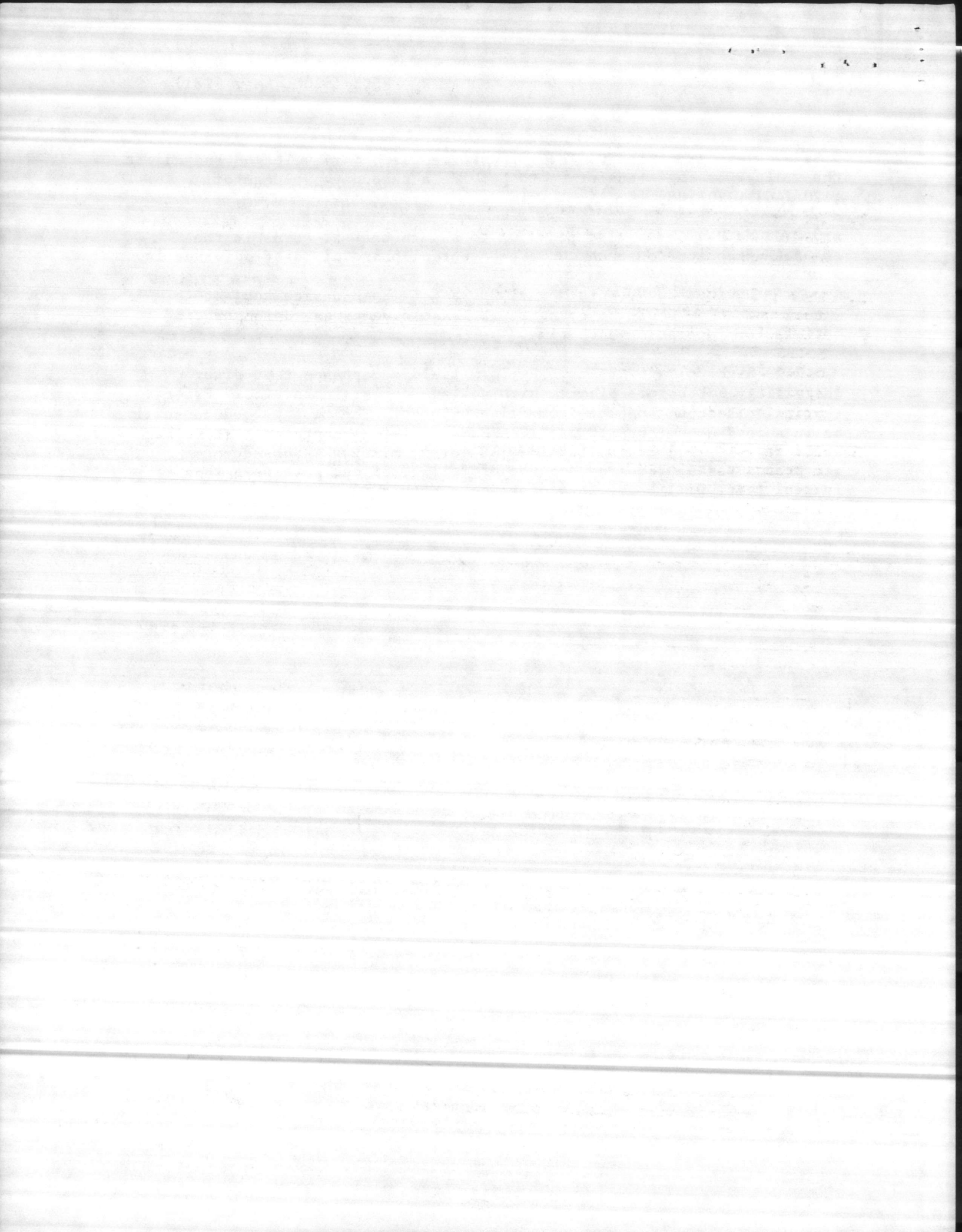
3.2.2 Test Transformer: Test transformer secondary voltages and adjust the voltage at the transformer to provide a secondary voltage of [120/240] [120/208] [_____].

3.2.3 Meter: Check disc rotation to assure that it turns in the correct direction for each current-potential phase circuit individually.

3.2.4 Devices Subject to Manual Operation: Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

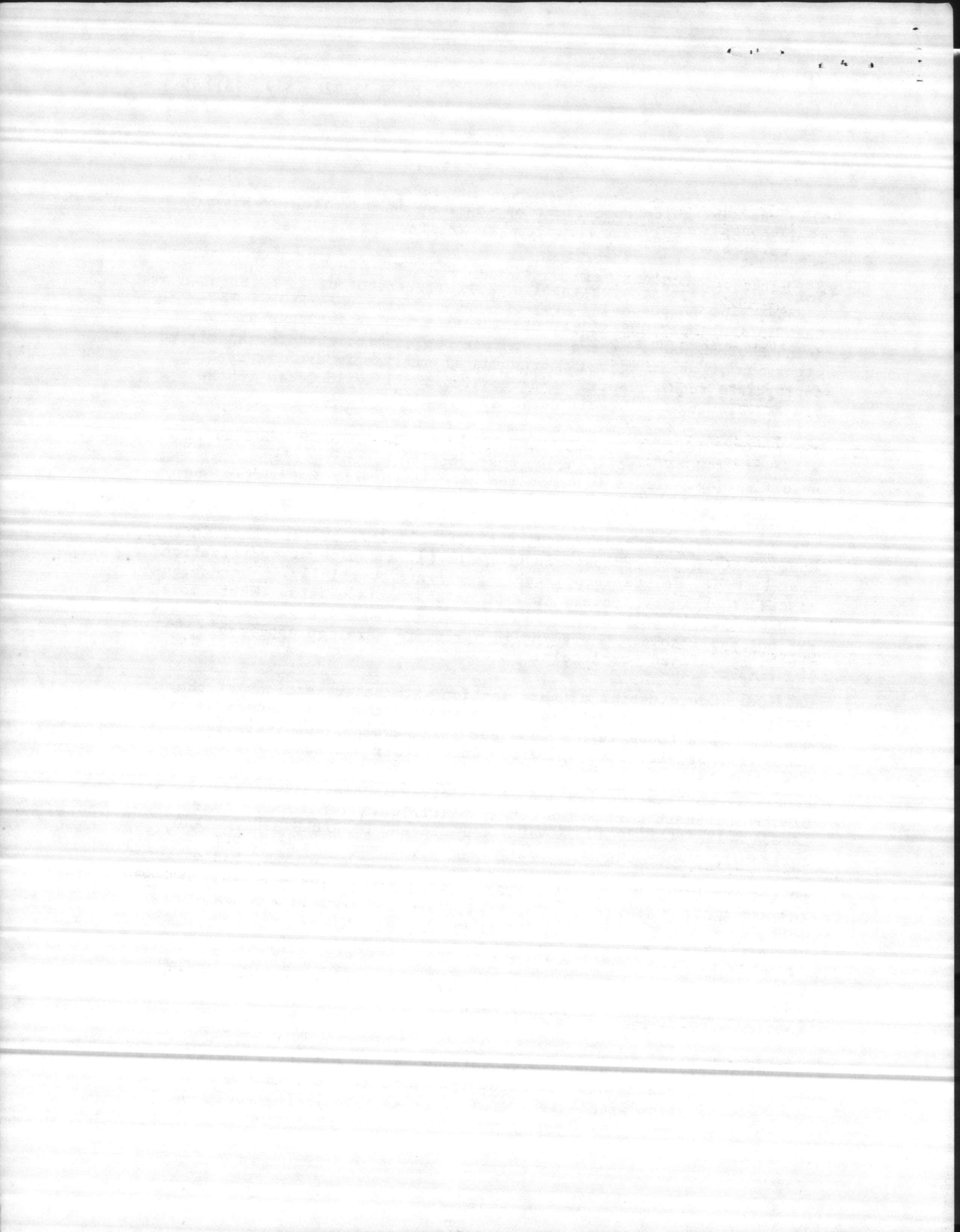
3.2.5 High Voltage Cables: Perform field acceptance test after installing, but before placing high voltage cables in service. Prior to testing, disconnect cables from all equipment. The test procedure shall be in accordance with AEIC and ICEA/NEMA. Field acceptance test voltage shall be [_____] kV [DC for 15] [AC for 5] minutes. Subsequent acceptance tests, required because of failure of cable to pass the initial test, will be performed at Contractor's expense.

*** END OF SECTION ***



GENERAL NOTES

1. This regional guide specification shall be used in lieu of NAVFAC TS-16302 of July 1979. Requirements for Underground Electrical Work are covered in TS-16301L.
2. This guide specification shall not be referenced but is to be used as a manuscript in preparing project specifications. APPROPRIATE CHANGES AND ADDITIONS AS MAY BE NECESSARY AND AS REQUIRED BY THE NOTES MUST BE MADE. Where the phrase "unless indicated or specified otherwise", "as indicated", or words of similar import are used, appropriate requirements, as necessary, shall be included in the project drawings or specifications.
3. The capital letters in the right hand margins indicate that there is a technical note pertaining to that portion of the guide specification. It is intended that the letters in the margins be deleted before typing the project specification.
4. Where numbers, symbols, words, phrases, clauses, or sentences in this specification are enclosed in brackets [], a choice or modification must be made; delete inapplicable portion(s) carefully. Where blank spaces occur in sentences, insert the appropriate data. Where more than one paragraph has the same number, delete those paragraphs that are not applicable. Where entire paragraphs are not applicable, they should be deleted completely.
5. CAUTION: Coordination of this section with other sections of the specification and with the drawings is mandatory. If materials or equipment are to be furnished under this section, but installed, connected, or placed in operation under other sections of the specification and/or the drawings, then state that fact clearly and concisely in this section and in all other sections involved. EACH DISCIPLINE SHALL REVIEW THE ENTIRE SPECIFICATION TO INSURE THAT LANGUAGE IS INCLUDED TO PROVIDE COMPLETE AND OPERABLE SYSTEMS AND EQUIPMENT.
6. DO NOT INCLUDE TABLE OF CONTENTS, GENERAL NOTES, AND TECHNICAL NOTES IN THIS SECTION IN FINAL MANUSCRIPT.
7. The following information should be shown on the drawings:
 - a. Conductor sizes, types, and materials.
 - b. Guy strand type and size.
 - c. Primary fused cutout; give voltage rating and state fusing (ampere rating and "k" quick or "t" tardy required for coordination with existing upstream sectionalizing equipment.



- d. Pole top switch. State voltage and current ratings required. Use only standard pole top switch ratings as used in ANSI C37.32 and not the nominal line voltage or current.
 - e. Meter connections (can be determined from NEMA EI 20 or similar source)
 - f. Pole height and class.
 - g. Anchor type, description, and dimensions suitable for the ultimate load and the specific soil at location
 - h. Indicate ruling span (average span length plus 2/3 of the difference between the longest and the average spans)
 - i. Sag table(s) for the specific conductor, the ruling span(s) and the loading zone
 - j. The mechanical strength of poles, crossarms, insulators, pins, guys and anchors must be engineered for each job and the dimensions, materials, and other descriptions covered by drawings. Strength requirements of ANSI C2 are MINIMUM.
7. Suggestions for improvement of this specification will be welcomed and should be forwarded using DD Form 1426 or any other format to:

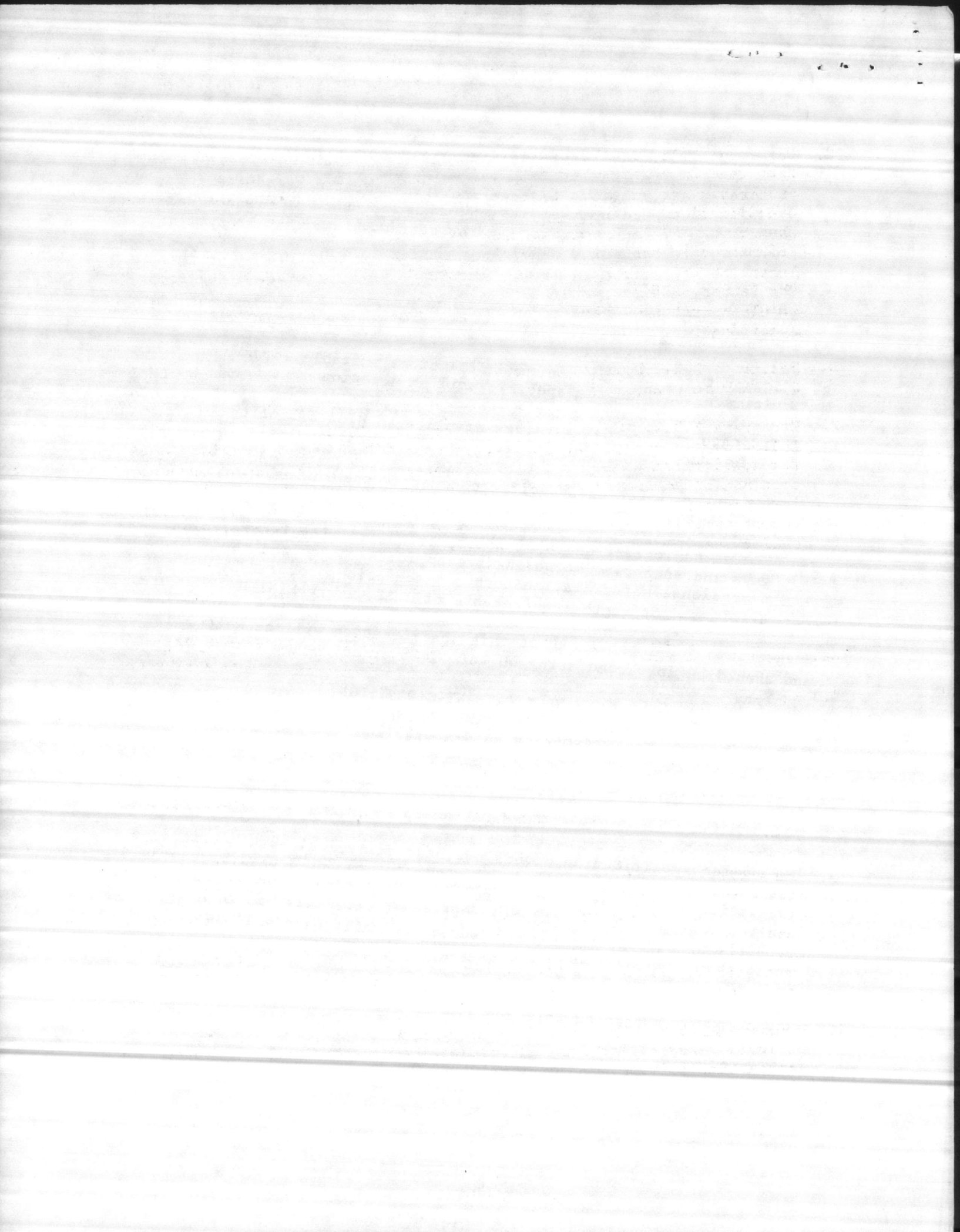
COMMANDER, ATLANTIC DIVISION,
NAVAL FACILITIES ENGINEERING COMMAND (406)
NORFOLK, VIRGINIA 23511

TECHNICAL NOTES

- A. This guide specification covers overhead electrical work but it does not cover all possible methods or requirements for providing overhead facilities. This guide/type specification presents the usual methods and the most used alternatives. Different materials and methods, properly specified, indicated, and economically used will be acceptable when approved by cognizant authority.
- B. Specification, section, and page numbers shall be centered at the bottom of each page of this section.

EXAMPLE:

05-81-0000
16302-1



- C. Paragraph 1.1: The listed designations for publications are those that were in effect when this guide specification was being prepared. Designations that are known to be out of date when project specifications are prepared should be changed to those current at that time, and the nomenclature, type, grades, classes, etc., referenced in the guide should be checked for conformance to the latest revision or amendment. To minimize the possibility of error, the letter suffixes, amendments, and dates indicating specific issues should be retained here and omitted elsewhere in the project specification.
- D. Paragraph 2.1.1 Poles: Other wood species which are covered by ANSI 05.1 may be used, provided they are available at the project location.
- E. Paragraph 2.1.4: Stipulate insulator class required for each. The following table suggests insulator types for specific ANSI Standards for application under normal conditions. Environments with unusual contaminant conditions would require special treatment. Spool insulators for use with upset bolts, brackets or devices to support the neutral-messenger of triplex or quadruplex, secondary or service cables should conform to ANSI C29.3 Class 53-2.

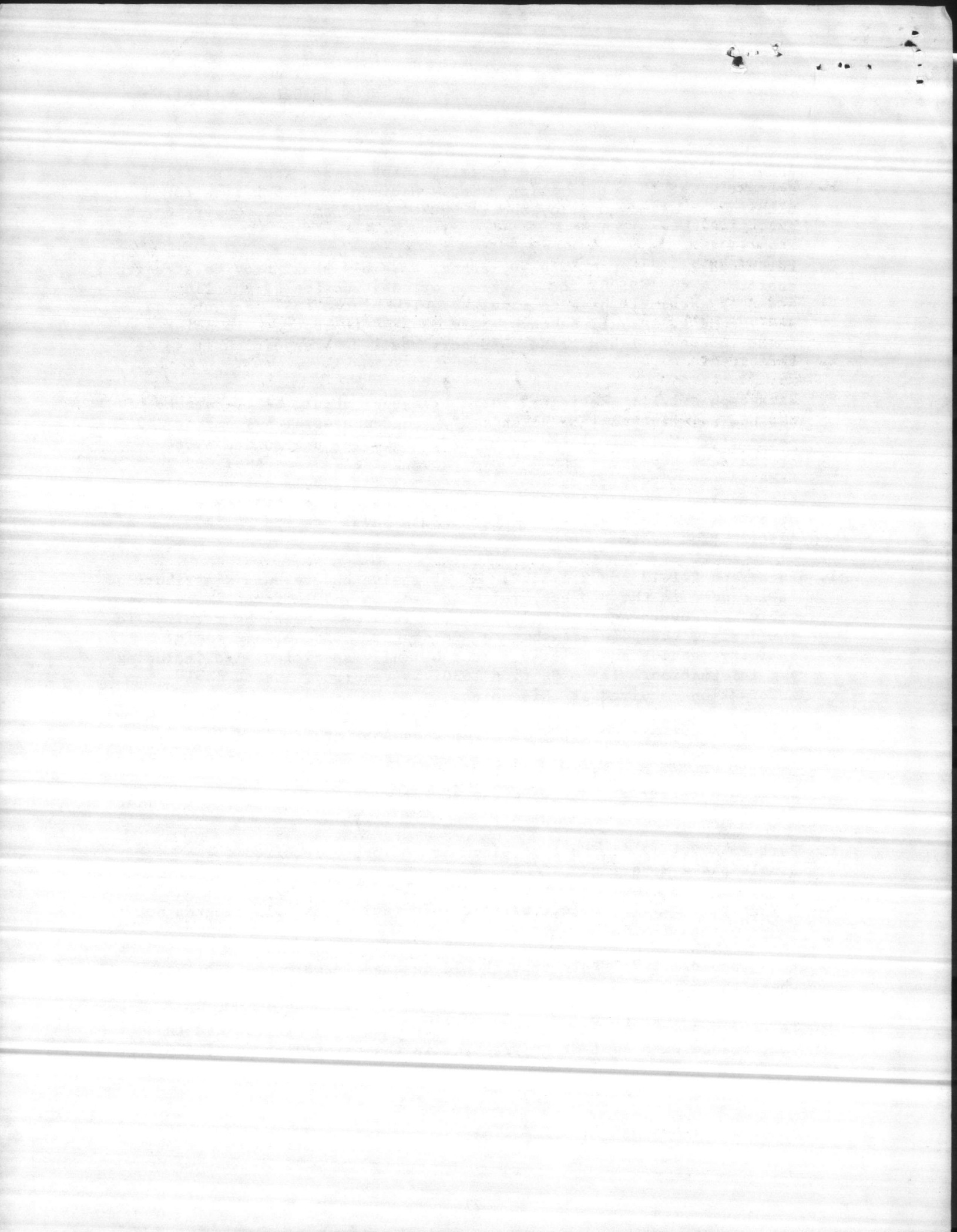
Voltage kV	ANSI C29.5 PIN	ANSI C29.7 POST ("L" or "S")	ANSI C29.2 SUSPENSION	ANSI C29.4 GUY STRAIN
5.0 or less	55-3	-	52-1	54-4
15	55-5	57-1	2/52-1 or 2/52-9	54-4
34.5	-	57-4	3/52-4	54-4

When specifying or indicating post insulators, add the appropriate "L" or "S" designation indicating "L" long studs or "S" short.
 Example: "57-1L" would indicate an insulator for wood crossarms and "57-1S" would indicate an insulator for use on steel members. When the engineer determines that station policy differs from these requirements, insulators which match the policy in effect at the station shall be specified by ANSI reference and class. Insulator flashover values shall be determined from table 30, ANSI C2. In areas with severe lighting problems, transmission line corners and dead ends should be provided with special pressure-treated wood-guy insulators having arcing horns for lighting discharge.

- F. Paragraph 2.1.6: The term "secondary conductors", for our general purpose, means either bare or insulated conductors to be operated the utilization voltage. Service conductors are insulated conductors

extending from a pole to the metering point or service entrance connection at the utilization point. Minimum conductor size for aluminum or aluminum alloy should be No. 4 AWG and for copper, No. 6 AWG.

- G. Paragraph 2.1.8: Complete guy-anchor assembly shall provide strength conforming to ANSI C2 for the grade of construction of the line. In areas of extremely high chemical activity of the soil, anchor rods and ground rods shall be completely encased in concrete to point 4 inches above finished grade. Anchors shall be a special unit to be indicated.
- H. Paragraph 2.1.11: Rating of surge arresters should be 80 percent of the nominal line-to-line voltage of grounded neutral systems or 100 percent of the nominal line-to-line voltage for ungrounded systems, or the next standard rating above those values. (See ANSI C62.2 or NEMA L41 for standard ratings.) External air gap is not normally acceptable. For certain cases, intermediate- or station-type arresters may be required on the Norfolk Naval Station 34.5kV distribution system.
- I. Paragraph 2.1.13 and 2.1.13.2: If extensive underground distribution is included in the project, refer to section 16301L for primary riser cable. If overhead high voltage cable (and messenger) is required in the design, the pole attachments, messenger, high voltage cable, splicing methods and materials must be fully specified also including sag information. If no Section 16301 is required, insert cable information required at this point.
- J. Paragraph 2.1.15: Specify if other than ANSI standard accessories are required.
- K. Paragraph 2.1.17.3: Single-phase socket connected meter should be form 2S.
- L. Paragraph 2.1.17.4: No test block or enclosure required for single-phase metering.
- M. Paragraph 3.1.1.1: Delete setting information for pole lengths not required.
- N. Paragraph 3.1.1.7: Pole caps should be used in warm humid areas where the need for them has been established.
- O. Paragraph 3.1.2.2: Guy strand shall be insulated or grounded in conformance with ANSI C2 or practice in the particular station.



- P. Paragraph 3.1.4: The maximum value for grounds with an ungrounded system is 25 ohms. Multiple-ground systems depend on the multiplicity of grounds to reduce the system ground ohmage resistance. As a consequence no individual ground ohmage values are prescribed. However, the system ground value must not exceed 25 ohms.
- Q. Paragraph 3.1.4.5: Transformer tank and neutral grounding shall conform with ANSI C2 or practice at the particular station.
- R. Paragraphs 3.1.5.3 and 3.1.5.4: Sag tables are usually available from conductor manufacturers. For projects which entail considerable length of overhead line, sag tables for the particular line as staked and designed should be indicated.

*** E N D ***

