Revision 10
Sep 16, 2020

1. Scope

This specification applies to the design, material and fabrication of tapered, direct-buried and self-supporting and/or guyed Ductile Iron (DI) or steel poles.

3. Reference Standards

In the event of a conflict between this specification and referenced document the more stringent requirement will be followed.

Unless otherwise stated in this specification, metal poles shall comply with the latest revisions of the following standards:

Industry Standards

ANSI C2 National Electrical Safety Code
ANSI O5.1-2017 Standard Specifications and Dimensions (for Wood Poles)
ANSI/AWWA C110-12/A21.10 Ductile-Iron and Gray-Iron Fittings
ANSI/AWWA C151/A21.51 American National Standard for Ductile-Iron Pipe , Centrifugally Cast
ASCE/SEI 48 Design of Steel Transmission Pole Structures
ASTM A6 Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A36 Standard Specification for Structural Steel
ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143 Standard Specification for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A370 Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A384 Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A385 Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A388 Standard Practice for Ultrasonic Examination of Steel Forgings
ASTM A435 Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates
ASTM A536 Standard Specification for Ductile Iron Castings
ASTM A572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A588 Standard Specification for High-Strength Low-Alloy Structural Steel, with Atmospheric Corrosion Resistance
ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A633 Standard Specification for Normalized High-Strength Low-Alloy Structural Steel Plates
ASTM A673 Standard Specification for Sampling Procedure for Impact Testing of Structural Steel
ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A871 Standard Specification for High-Strength Low-Alloy Structural Steel Plate With Atmospheric Corrosion Resistance
ASTM D2197 Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion
ASTM D7803 Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Powder Coating
AWS D1.1 Structural Welding Code
ISO 12944 Corrosion protection of steel structures by protective paint systems
RUS Bulletin 1724E-214 Guide Specification for Standard Class Steel Transmission Poles
SSPC-PA 2 Procedure for Determining Conformance to Dry Coating Thickness Requirements

SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning
SSPC-SP 7/NACE No. 4 Brush-Off Blast Cleaning
SSPC-SP 10/NACE No.2 Near White Blast Cleaning

District Standards

T&D Guideline 4-5-40.0 Ductile Iron Transmission and Distribution Poles

4. Pole Strengths

4.1 Strength Requirement

Steel and DI poles shall meet all strength requirements of NESC-2017 Rule 261.A.1 for any combination of vertical, transverse, and longitudinal loads for NESC, Grade B construction, including any P-Delta amplification effects from the application of those loads on a vertically installed pole. ANSI O5.1-2017 tip loads shall be reduced by the wood 0.65 strength factor for Grade B construction.

4.2 Loading

Steel and DI poles shall develop a minimum ultimate moment capacity above the point-of-fixity equal to or greater than the tip load in Table 1 multiplied by the distance to the tip load. Steel or DI poles shall also develop a minimum ultimate moment capacity at 5' from the pole top as listed in Table 1. For design purposes the point-of-fixity for Steel and DI poles shall be defined as 7% of the pole length measured from the pole base.

ANSI O5.1 Wood Pole Class	RUS 1724E-214 Pole Class	Steel/Iron NESC Grade B Horizontal Tip Load 2' from Pole Top	Min. Ultimate Moment Capacity at 5' from Pole Top (ft.-kip)
N/A	S-12.0	12,000	96
N/A	S-11.0	11,000	88
N/A	S-10.0	10,000	80
N/A	S-09.0	9,000	72
N/A	S-08.0	8,000	64
H6	S-07.4	7,410	57
H5	S-06.5	6,500	50
H4	S-05.7	5,655	44
H3	S-04.9	4,875	38
H2	S-04.2	4,160	32
H1	S-03.5	3,510	27
1	S-02.9	2,925	23
2	S-02.4	2,405	19
3	S-02.0	1,950	15

4.3 Rotation and Deflection

Rotation and deflection shall be separate design considerations.

The design of all structures shall allow for one (1) degree of foundation rotation, including all "p-delta" effects from vertical load associated with such rotation.

Steel and DI poles shall deflect no more than 15% of the pole length above the point-of-fixity when subjected to the tip loads in Table 1.

4.4 Strength at Attachment Bolts

Metal poles shall support the simultaneous application of a 3,000 lb. horizontal and 5,000 lb. vertical load on a 5/8 inch through bolt reinforced with 3 inch washers (curved washers for tubular or flat for multi-sided poles) without damage to the pole or permanent deformation of the bolt hole. Steel poles shall be designed for a nominal through bolt installation torque of 50 ft-lb, but must withstand an installation torque of 100 ft-lb without damage.

4.5 Strength at Pole Steps

Metal poles shall support a sustained vertical load of 750 lb. applied 6 inches away from the pole surface on a Senior Industries SI-0040 permanent pole step or a CHANCE PS6236 removable pole step.

4.6 PLS-CADD Component Library

Steel and DI pole manufacturers shall make available a current PLS-CADD component library for all pole lengths and classes offered to the District.

5. Construction

5.1 Material

Pole composition for DI should resemble the following: 93% Iron, 3.35% Carbon, 2.3% Silicon, and 0.025% Magnesium. DI Poles shall be centrifugally spun at roughly 700RPM and 2200 degrees to ensure a uniform distribution of elements and the characteristics unique to ductile iron as specified in ASTM A536. The specific material grade shall be provided to the District.

All structural steel shall meet or exceed requirements in ASTM A6, A572, A588, A633, or A871 unless approved in writing by the District.

Steel poles shall meet or exceed requirements in ASTM A572, Grade 65 for pole material unless approved in writing by the District. Material used from Coil, must be re-certified to conform to the A572 specification following decoiling per the requirements of A6 and A572.

Poles shall be mill-certified to meet an impact property of 15 ft/lbs @ -20°F in the longitudinal direction using the Charpy V-Notch test. This shall be based on an average of three tests using full size test specimens with no one test below 10 ft/lbs. If full size test specimens cannot be used, a reduction in the minimum acceptance energy values shall be in conformance to Table 9 of ASTM A370, and a CVN test temperature reduction following Table 4.15 of AWS D1.1 shall be used. For subsize specimens the dimensions and values to be used shall be in accordance with ASTM A673. Heat joint testing (Frequency "H") is acceptable. Manufacturers shall submit all applicable ANSI standards for material approval.

5.2 Pre-drilled Holes

The pole shall be provided with holes pre-drilled per Figures 2 through 6 or as specified by the District. The pole shall be designed and manufactured to withstand the weight and forces associated with attaching accessories consisting of horizontal post insulators, loaded cross-arms, miscellaneous attachment brackets, and bolting materials.

5.3 Field-drilled Holes

Manufacturer shall provide correct procedures for field drilling additional holes. Poles shall maintain strength ratings if drilled accordingly.

5.4 Dimensions

The shafts of poles shall be tapered and for a given length and class, the circumference of a metal pole at the top and the ground line shall vary no more than ± 35% from that of a Douglas Fir wood pole of the same length and class, as specified in ANSI O5.1.
All poles above 50' shall be multi-piece and no piece shall exceed 50'.
Steel poles shall have a thickness not less than 3/16".

5.5 Pole Base

The pole shall have a bearing plate permanently attached to the to the bottom of the pole prior to application of the protective and base coatings. The plug shall have an opening to prevent the pole from floating and to allow any water collecting in the pole base to drain. This hole shall not be greater than 20 percent of the base plate surface area.
The bearing plate shall be permanently marked with the pole height, pole class and actual weight.

5.6 Pole Cap

Each pole shall include a steel or DI pole cap. Cap shall fit snugly and shall be shipped securely attached to the pole by approved welding method. Metal caps shall have the same coating as the pole shaft.

5.7 Welding

Structural welding is not permitted on ductile iron poles.
Steel Pole welding shall be done in the factory and conform to the requirements of AWS D1.1
Visual weld inspection shall be performed for one hundred percent (100%) of all welds. The acceptance/rejection criteria for visual weld inspection shall be that provided in AWS D1.1 Table 6.1. In addition to visual inspection, all complete joint penetration welds shall be volumetrically inspected by either ultrasonic testing (UT) or radiographic testing (RT). The acceptance-rejection criteria for welds inspected with UT shall be the requirements shown in AWS D1.1 Table 6.2. The acceptance rejection criteria for welds tested by RT shall be as shown in AWS D1.1 Figures 6.1.

All circumferential welds including base plate, flange plate (if applicable) and arm bracket to arm shaft welds shall be complete joint penetration (CJP) welds.

All longitudinal welds in the following areas shall also be CJP welds:

1. The overlapping lengths of slip splice on the female section calculated as 1.5 times the O.D. of the female end plus 12 inches of added length to account for any slip splice under-slip tolerance.

2. Six (6) inches on either side of a circumferential weld.
3. Six (6) inches above a base plate to pole shaft weld.
4. Six (6) inches above a flange plate to pole shaft weld.
5. Six inches at the top end of the male section in a slip splice.
6. Three inches on either side of a thru vang that penetrates through the long seam.

Longitudinal welds in all other areas shall have a minimum weld penetration of 80%. The 80% penetration requirement shall be verified by ultrasonic testing (UT), on a minimum of 10% of the total length of the longitudinal weld that is 80% penetration. In addition to the weld testing during fabrication, the requirements in ASCE 48 to provide post-galvanizing UT inspection for “toe cracks” on all large CJP “T-Joints” (flange plates, base plates) shall be followed.
The Vendor shall furnish the District test results in writing for the all welds tested on all poles. The cost of the weld tests made by the Vendor shall be included in the lump sum price as stated in the proposal.

5.8 Protective Coatings

The protective coating shall extend through the entire length of the pole and include the pole base and pole cap prior to application of the base coating and any ground plates.

The method of SSPC surface preparation specification that precedes galvanizing shall be submitted to the District for approval. The parts to be galvanized shall be blast cleaned if necessary before pickling. The necessary precautions shall be taken to avoid embrittlement as specified by ASTM A143. Precautions shall also be taken as necessary to ensure that iron-zinc alloys do not reach the surface.

Any machining, bending or working of these parts in any manner shall be done before the parts are galvanized.

All galvanized coatings shall be of a uniform thickness per ASTM A123. No "Double-dip", "overlap" or "splice galvanizing will be allowed.

Galvanizing shall be over the entire surface area of all hardware, both internally and externally in accordance with the AGA “Quality Control Manual”.

Galvanizing repairs shall be made per ASTM A780 Annex A2 (Repair Using Paints Containing Zinc Dust) or Annex A3 (Repair Using Sprayed Zinc Metallizing). Repairs using Zinc Base Alloys or Solders shall not be allowed.

Galvanized sections shall not be water quenched after galvanizing.

All surfaces of steel poles shall be painted after galvanizing above and below the ground line coating according to ISO 12944 for high durability (>15 years) under corrosivity category: C4-IM1/IM3. The paint shall lose no more than 5% from flaking under an adhesion test per ASTM D2197 Class 4B.

Primer coat from pole base to 8' above ground line shall be a minimum dry film thickness of 5 mils. Coating from 8' above ground line to the pole top shall be a minimum of 3 mils.

Top coat shall be a uniform minimum dry film thickness of 3 mils.

Bidders shall furnish appropriate technical data on the paint. The Vendor shall furnish sufficient paint with every shipment and of the color specified but of brushing consistency, to touch-up all paint surfaces damaged by shipping and handling. Touch up paint shall have the District's purchase order number clearly and permanently identified on the container.

The manufacturer shall note on their bid if any pole will be shipped to another facility for painting after galvanization, provide distance between facilities and procedures to ensure adhesion to surface.

Weathering characteristics for DI shall exceed those of weathering/COR-TEN steel as specified in ASTM A871.

5.9 Base coating

There should be no overspray at the top of the base coating and a clean chamfered transitional termination edge should be the end result.

The base for DI poles shall have a dry film thickness of 20 mils of Permasafe ceramic epoxy or approved equivalent. The base of a DI pole shall be coated to 10% of the pole height plus an additional 5 feet as shown in Figure 1 or as specified by the District.

The base for steel poles shall have a nominal dry film thickness of 20 mils of CorroCote II Classic, Ultra or approved equivalent. Steel poles shall be coated from four feet below ground line to two feet above unless otherwise specified.

Galvanized surfaces to be top coated shall be brush blasted in accordance with SSPC-SP 7/NACE No. 4 – Brush-Off Blast Cleaning. A fine grain abrasive shall be used so that excessive zinc removal or micro-fracturing of the zinc does not occur. Steel surface temperature, humidity, and dew point shall all be measured and recorded prior to coating application. Coating shall not occur if the steel surface temperature is below 50°F and at least 5°F above the dew point.

If the base coating does not contain ultraviolet light inhibitors a UV protective top coating shall be applied over the base coating. The minimum dry film thickness for this additional UV protective coat shall be 3 mils.

5.10 Grounding

Steel/DI Poles shall be equipped with steel, iron or copper ground plates meeting the requirements of NESC 094 and shall be electrically connected to the pole power NESC 095. Manufacturer shall provide specification for grounding plate(s) and attachment details for District review and approval.
Two stainless steel 1/2"-13 rivet nuts shall be pre-installed on the pole per Figure 2 or 3 or as specified by the District.

5.11 ID Tag

Each pole shall have an approved aluminum or stainless steel ID tag securely attached as follows:

On poles less than or equal to 60 feet in length the tag shall be located exactly 12 feet from the butt of the pole, located on the "face" of the pole per Figure 1.
On poles equal to or greater than 65 feet in length the tag shall be located exactly 15 feet from the butt of the pole, oriented at the "face" of the pole per Figure 1.
Each tag shall have the following permanently embossed or stamped on it:

- Manufacturer
- Serial Number
- Part Number
- Pole Height
- Pole Class
- Nominal Weight
- Manufacturing Date
- Pole Structure Number

5.12 Pick Point and Center of Gravity

Each pole shall have a designated center of gravity permanently marked on the pole. Special handling instructions shall be securely attached to the pole in weather-proof packaging.

5.13 Pole Weights

Weights shall be submitted to the District for approval.

MID	Height (ft)	Pole Class	Max. Weight (lb)
5001540	35	2	1150
5001542	40	2	1400
5000170	45	2	1650
5000171	50	1	2150
5000177	50	H2	2950
5000172	55	1	2600
5000179	55	H2	3500
5002920	55	H7	4900
5000176	60	1	2950
5000908	60	H2	3850
5001420	60	H4	4700
5001430	60	H6	5250
5000909	65	H2	4450
5001421	65	H4	5300
5001431	65	H6	6000
5000920	70	H2	4950
5001422	70	H4	5900
5001432	70	H6	6750
5000921	75	H2	4900
5001423	75	H4	5850
5001433	75	H6	6700
5000922	80	H2	5800
5001424	80	H4	6850
5001434	80	H6	8500
5000894	85	H2	6550
5001425	85	H4	7850

MID	Height (ft)	Pole Class	Max. Weight (lb)
5001435	85	H6	9000
5000895	90	H2	6450
5001426	90	H4	7750
5000896	95	H2	6950
5001427	95	H4	8900

6. Drilling

The District's engineer will determine the drilling pattern for all metal poles. The standard base for all poles is shown in Figure 1, the pole holes for typical distribution poles are shown in Figures 2 and 3, the standard for most transmission poles is shown in Figures 4 and 5 and the option of pole steps is shown in Figure 6.
All holes shall be parallel with or perpendicular to each other as specified. All holes shall be clean, smooth and shall be sealed with securely attached plug. The plugs shall be black or of a color matching the pole.

Figure 1
Pole Base, Ground Plate and ID Tag

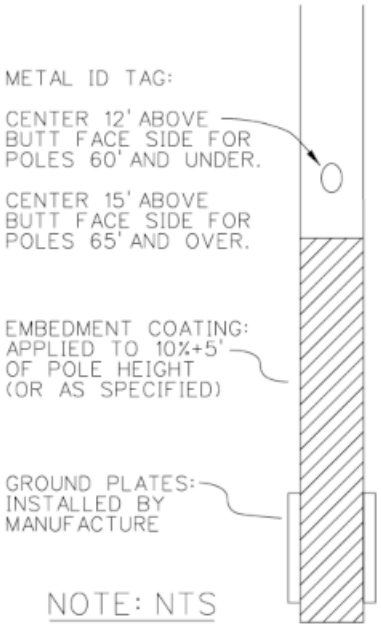


Figure 2
Drilling Pattern for 35 ft - 40 ft Poles

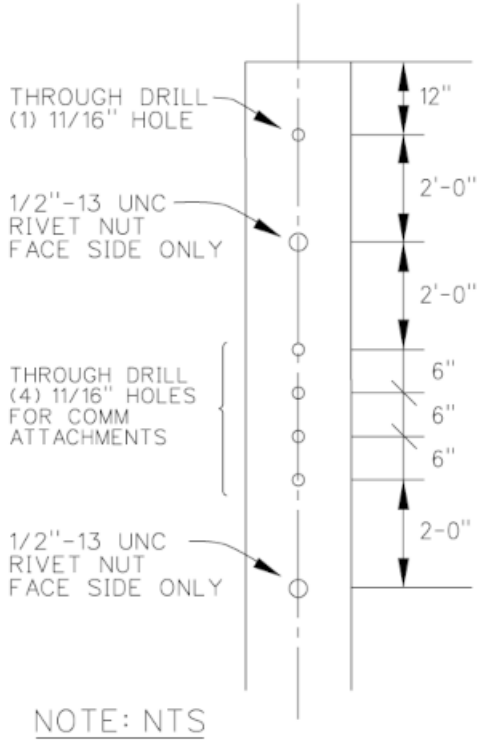
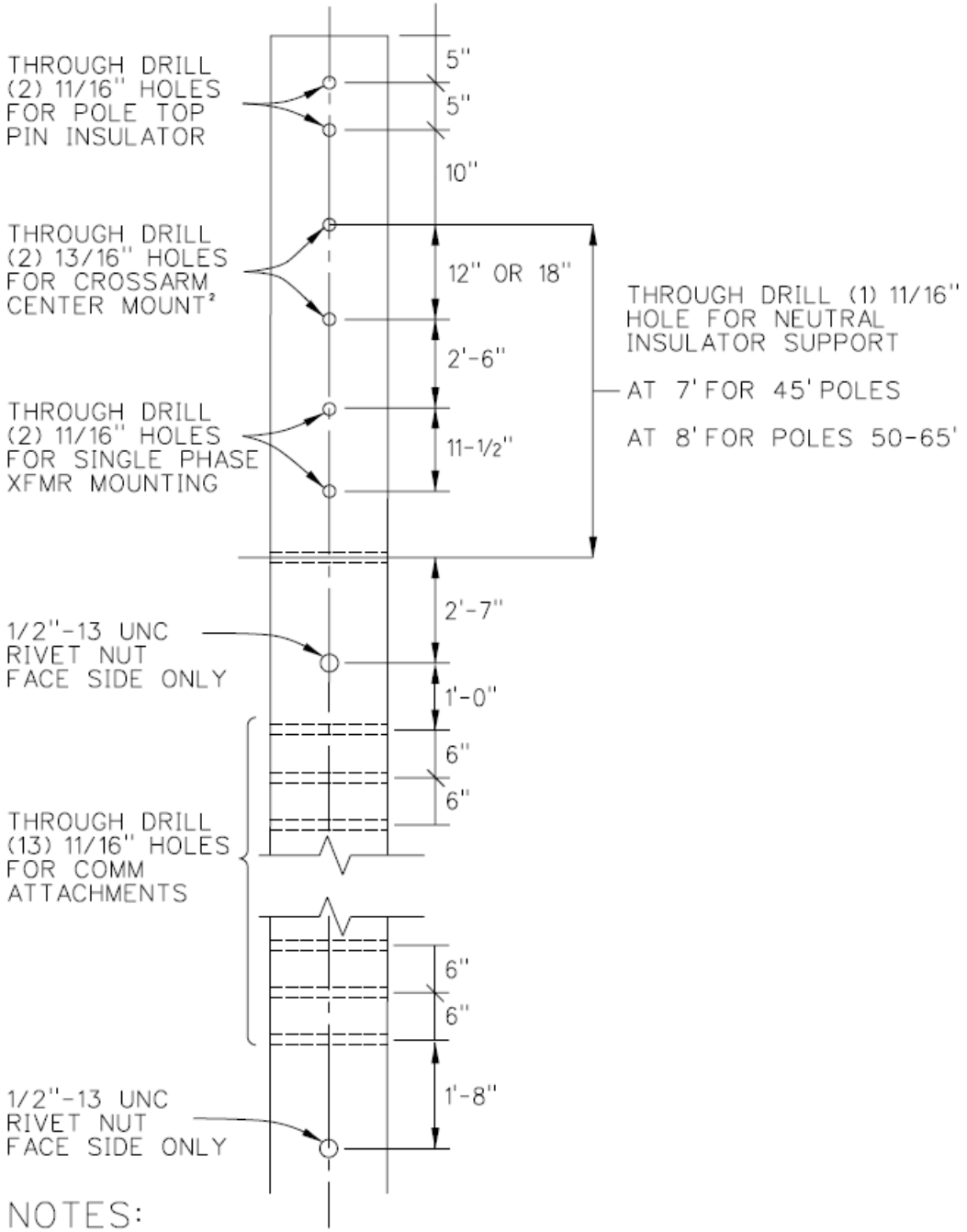


Figure 3
Drilling Pattern for 45 ft - 65 ft Poles



NOTES:

1. NOT TO SCALE
2. THROUGH HOLES FOR CROSSARM VARY BASED ON LENGTH AND TYPE. SEE MAT. STD. 872657.1 FOR TANGENT CROSSARMS AND MAT. STD. 872607.1 FOR DEADEND CROSSARMS.

Figure 4
Drilling Pattern for Phase-Opposite-Phase Transmission Poles

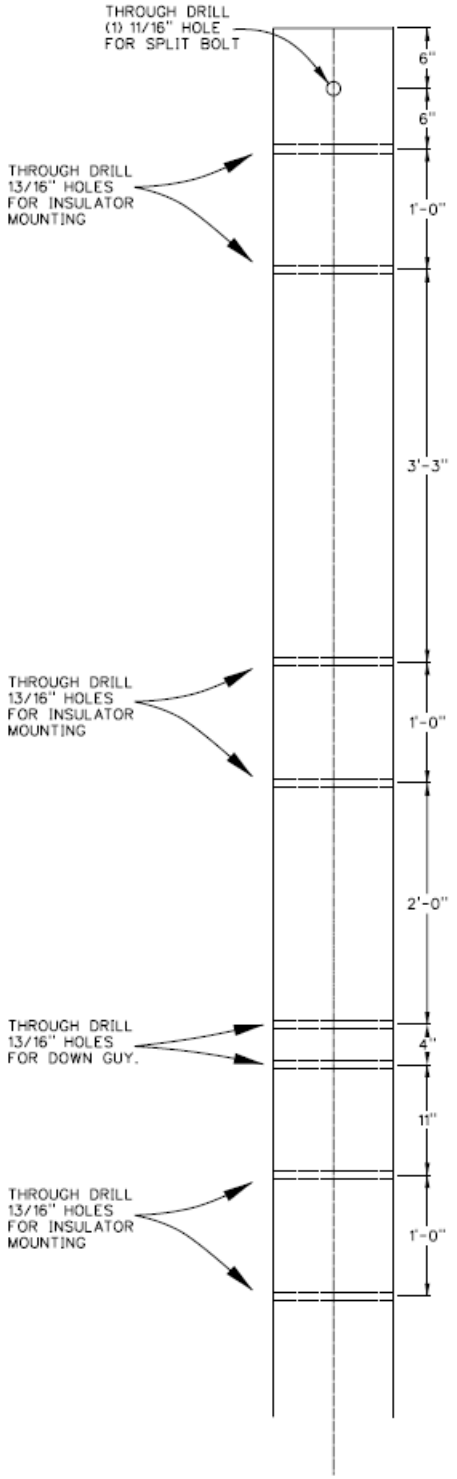


Figure 5
Drilling Pattern for Phase-Over-Phase Transmission Poles

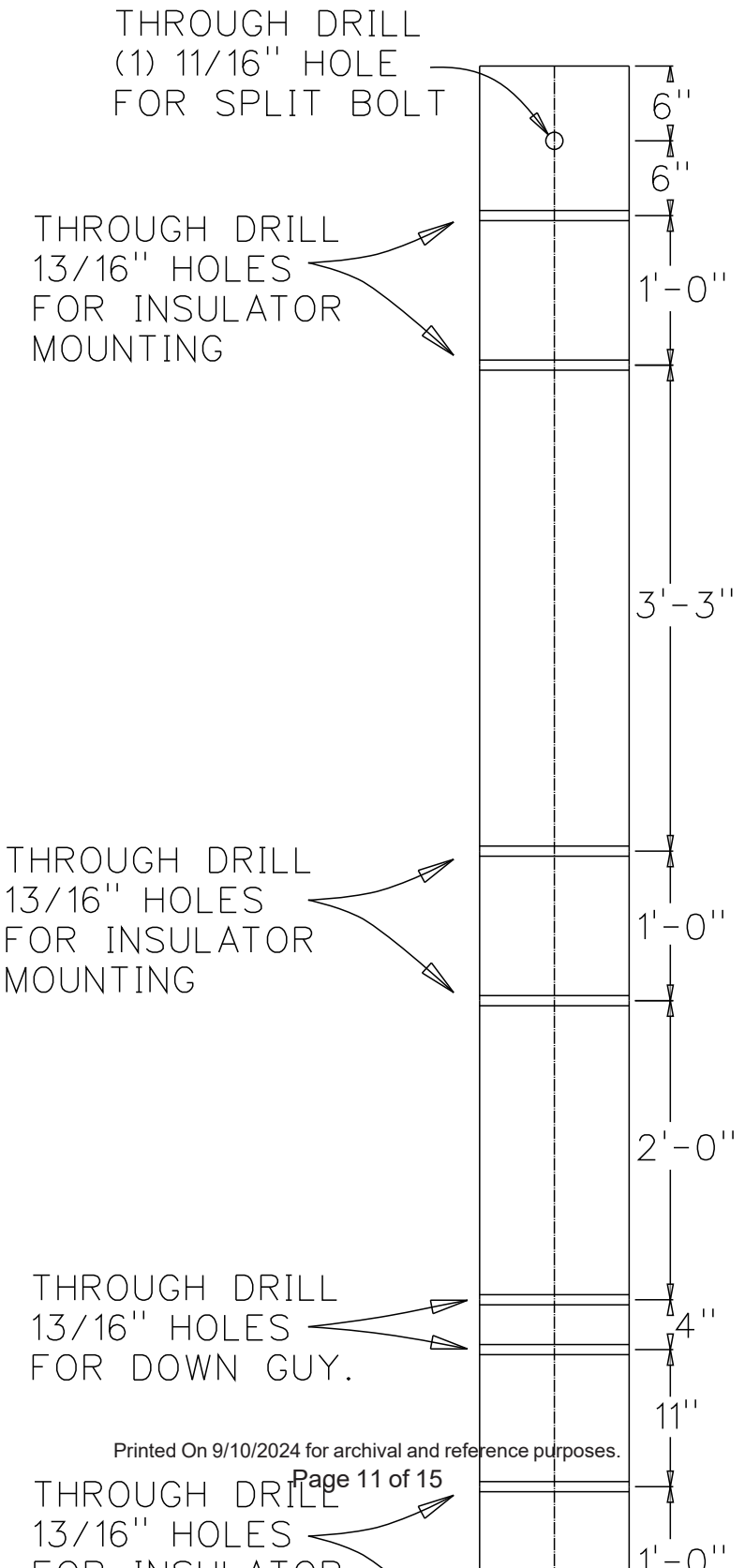
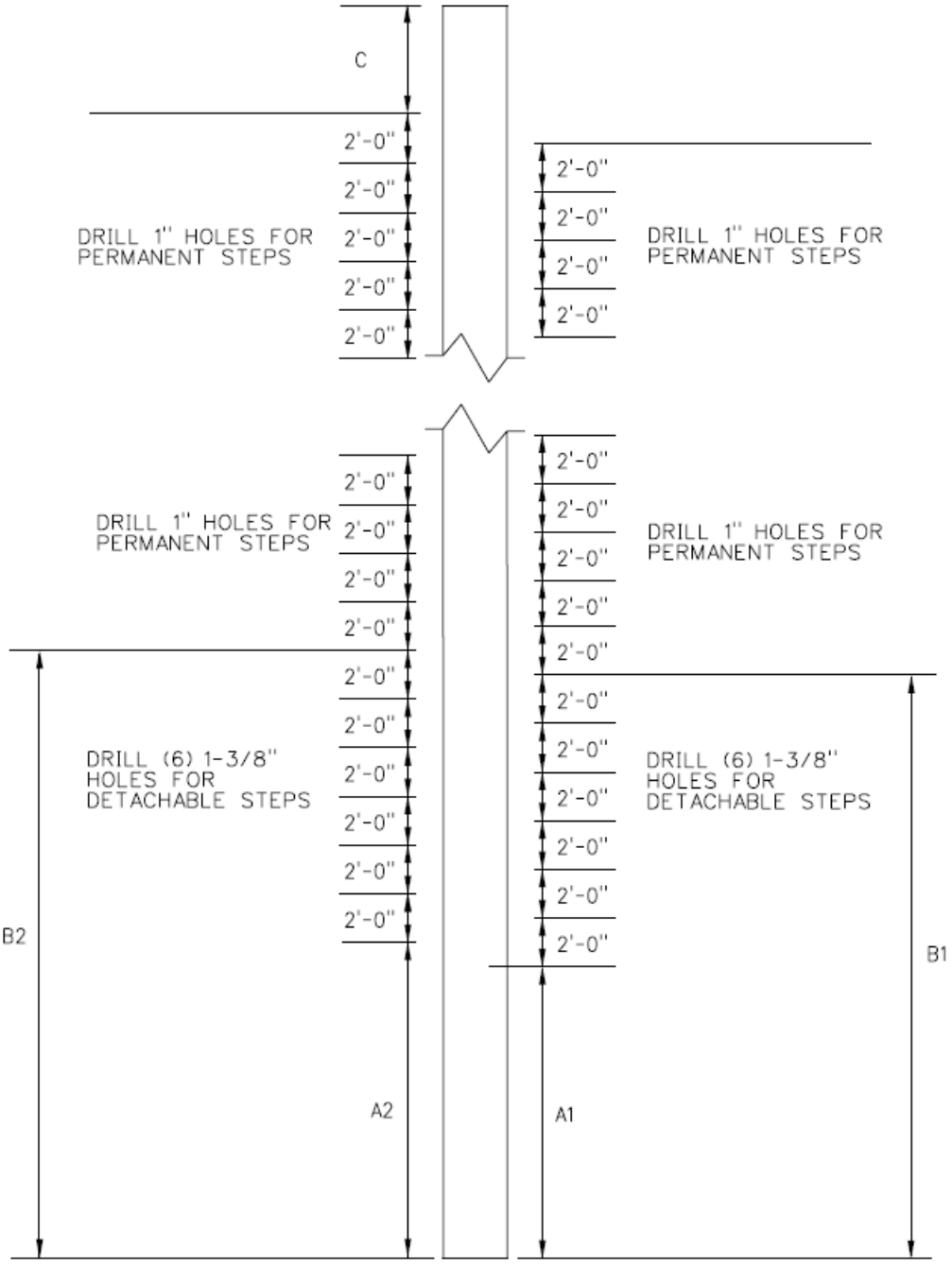


Figure 6
Drilling Pattern for Pole Step Holes (When Specified)
45 ft - 95 ft Poles



NOTES:
1. SEE TABLE 3 FOR VARIABLE POLE DRILLING DIMENSIONS AND NUMBER OF POLE STEP HOLES PER SIDE OF POLE.
2. PERMANENT STEPS ARE IN ADDITION TO HOLES DRILLED TO SATISFY FRAMING REQUIREMENTS.

Pole Length (ft)	Bottom of Pole to Ground line (ft)	A1 Distance from Bottom of Pole to First Detachable Step Hole A1 (ft)	B1 Distance from Bottom of Pole to First Per-manent Step Hole B1 (ft)	A2 Distance from Bottom of Pole to First Detachable Step Hole A2 (ft)	B2 Distance from Bottom of Pole to First Per-manent Step Hole B2 (ft)	No. of 1-3/8" Holes for Detachable Steps on Each Side of Pole	No. of 1" Holes for Permanent Steps on Each Side of Pole	Distance of Highest Step Hole from Top of Pole (ft)
35	5.5	7.5	19.5	8.5	20.5	6	6	3.5
40	6.5	8.5	20.5	9.5	21.5	6	8	4.0
45	6.5	8.5	20.5	9.5	21.5	6	11	3.5
50	7.0	9.0	21.0	10.0	22.0	6	13	4.0
55	7.5	9.5	21.5	10.5	22.5	6	15	4.5
60	8.0	10.0	22.0	11.0	23.0	6	17	5.0
65	8.5	10.5	22.5	11.5	23.5	6	20	3.5
70	9.0	11.0	23.0	12.0	24.0	6	22	4.0
75	9.5	11.5	23.5	12.5	24.5	6	24	4.5
80	10.0	12.0	24.0	13.0	25.0	6	26	5.0
85	10.5	12.5	24.5	13.5	25.5	6	29	3.5
90	11.0	13.0	25.0	14.0	26.0	6	31	4.0
95	11.5	13.5	25.5	14.5	26.5	6	33	4.5

Drilling Details for Pole Step Holes (When Specified)
35' - 90' Poles
Table 3

7. Testing

The chemical compositions and appropriate mechanical properties of structural steel used shall be verified either by providing the District with the manufacturer's certificates of compliance or with laboratory testing results prior to shipping.

The vendor shall bear all costs of chemical analysis, physical tests and furnishing of all certified reports required hereunder.

Materials and workmanship shall at all times be open to inspection by the District and acceptance or rejection by the District may occur either at the Vendor's plant or at the point of delivery. Any omission or failure on the part of the District to disapprove or reject any workmanship or materials at the time of inspection shall not be construed as an acceptance of any defective workmanship or materials.

All nondestructive testing shall be performed by an ASNT Level II Inspector in the specific method that he/she is performing inspections. The inspector shall meet all of the requirements recommended in ASNT SNT-TC-1A.

The District or the District's contracted 3rd party representative shall have free entry, at all times while work is in progress, to all parts of the Vendor's plant involved in the fabrication of the structures furnished pursuant to these specifications. Such accessibility for quality inspections shall also apply to any sub-contractors used by the Vendor.

The Vendor shall afford the District or the District's representatives reasonable facilities, without charge, to allow them to verify that the finished products and materials being furnished are in accordance with the requirements of these specifications.

8. Packaging And Delivery

Poles shall be shipped on an open flatbed trailer in a bundle that may be handled and easily unloaded by forklift without damage to the poles. The butts and tops of each row shall be alternated. Pole bundles shall be secured by cushioned 2 inch x 4 inch minimum support braces and banding straps. Positions of the bracing and banding shall be approximately 36 inches to 48 inches from each end, and then evenly divided along the length with no more than 15 feet between support braces. These cushioned braces shall be located in between each layer of poles at each bracing/banding strap location to prevent poles from rubbing together during shipment.

Poles damaged in shipment, not drilled correctly, or otherwise not meeting this specification will be rejected and the cost of returning the poles to the vendor shall be at the vendor's expense. Alternatively at the option of the District poles may be repaired on site. Repair of damaged hot dip galvanized surfaces shall be in accordance with ASTM A780.

Each multi-piece pole shall include assembly instructions. Instructions shall be secured to the pole base in weatherproof packaging. For multi-piece poles, the minimum overlap shall be permanently marked on the male section. Poles shall include provisions for jacking & bolting the pole sections.

Unless otherwise directed all poles and any associated hardware shall be delivered in one shipment to:

1802 75th Street SW
Everett, WA 98203

9. Bidders' Data

Each bidder shall submit the following: Detailed installation instructions, an outline drawing of each pole type including all dimensions, weights, center of gravity and pick points.

A description of any proposed changes, additions, deviations or exceptions to the Standard shall be submitted along with reasons for the departure.

10. Evaluation of Bids

The following factors will be considered in the analysis and evaluation of bids and subsequent bid award:

- Adherence to Standard
- Quality of product
- Past performance of Product and Bidder
- Proposed delivery
- Per unit bid price

11. Guarantee

The failure of any pole due to defective design, material and/or workmanship within 12 months after being set or 18 months after delivery, whichever comes first, shall be repaired or replaced without cost to the District. Any defect in design, material and/or construction discovered within this period shall be corrected at the manufacturer's expense, either by repair or by replacement.