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Related/Referenced Documents

Include the applicable document, section, or reference "*add link here*".

Version History

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1. General

1.1 Scope

This specification covers the minimum requirements of LUMA for design, materials, fabrication, welding, galvanizing, inspection, and shipment of steel poles to be used in the construction of 115 & 230 kV transmission lines.

The requirements of this specification are to be considered additive to other requirements found in related industry standards such as ASTM, ANSI, NESC and ASCE among others.

The reference to specifications of organizations such as ASTM, ISO, EN (European Norm) together with drawings and loading diagrams shall be considered part of this specification. Referenced specifications shall be the latest edition, unless specially stated otherwise. Manufacturers must be ISO-9001 certified.

All requirements of this specification and the related industry standards shall be followed unless specific written exception has been submitted for consideration and approval by LUMA. The approval of the document for such exceptions shall be obtained prior to the start of fabrication and shall become a permanent part of the manufacturer's project files.

LUMA will provide the manufacturer with structure loads and dimension requirements. The manufacturer will reply with design calculations, pricing, fabrication, installation drawings and on acceptance of these terms, manufacturer shall provide the proposed poles, anchor bolts and associated hardware.

2. Referenced Documents (Codes, Guidelines, Regulations, and References)

- ASCE /SEI 48-19 - Design of Steel Transmission Pole Structures
- ASCE MOP 74-20 - Guidelines for Electrical Transmission Line Structural Loading, Fourth Edition
- ASTM A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
- ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- ASTM A3125 - Standard Specification for High Strength Structural Bolts, Steel, Heat Treated, 120/150 ksi Minimum Tensile Strength
- ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
- ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

- ATM A385 - Practice for Providing High Quality Zin Coating (Hot-Dip
- ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- ASTM A780 - “Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- AWS D1.1 - Structural welding code – Steel
- EN 10025 - Hot rolled products of structural steels
- EN 10149 - Hot-rolled flat products made of high yield strength for cold forming
- EN 10080 - Steel for the reinforcement of concrete
- ISO 898 - Mechanical properties of fasteners made of carbon steel and alloy steel
- EN ISO 10684 - Fasteners – Hot dip galvanized coatings
- EN ISO 15614 - Specification and qualification of welding procedures for metallic materials
- ASNT - American Society of Non-destructive Testing
- EN ISO 9606 - Qualification Testing of Welders – Fusion Welding

3. Material

3.1 General

All material supplied shall conform to ASTM Specification A-6 “General Requirements for Delivery of Rolled Steel Poles, Shapes, Sheet Piling and Bars for Structural Use” or equivalent EN standard, unless herein modified.

3.2 Poles, Arms, Attachment Plates and Brackets

The material shall conform to ASTM A-572, S460M EN 10.025-4 or S500MC EN 10149. The steel shaft shall be high strength, low alloy, structural steel, Grade 65 (min.) or equivalent EN standard.

Silicon content in high strength steel shall be controlled to produce a galvanized finish that is uniform in appearance and without dark discolorations. The steel used for the pole shaft and arms shall have a silicon content less than 0.06%.

All structural plate material, and weld consumables furnished shall be mill-certified.

The tensile strength of any steel that is welded shall be limited to the requirements of ASTM A6.

3.3 Baseplates

The base plate material shall have minimum yield strength equal to or greater than the value used in design calculations. Material shall conform to ASTM A-572 or EN10025.

The tensile strength of any steel that is welded shall be limited to the requirements of ASTM A6.

3.4 Anchor Bolts

The supplier shall furnish all the anchor bolts and nuts. Anchor bolts cages shall be delivered un-assembled.

Material shall conform to ASTM A-615 “Standard Specification for Deformed Billet Steel Bars for Concrete Reinforcement” or ASTM F1554 with a minimum yield strength of 75,000 psi or EN 10080, mill certified to meet an impact property of 15 ft-lbs @ -4°F in the longitudinal direction using the Charpy V-Notch Test.

The diameter of the bar shall be 2-1/4” (#18 J) and round enough so that a fuller thread can be cut or rolled. Each bolt shall be furnished with three (3) heavy hex nuts conforming to ASTM A563 DH or A194 2H, galvanized in accordance with ASTM A153 and tapped oversize per ASTM A563.

Anchor bolts shall have a minimum threaded length of 12 inches or equal to the sum of the base plate thickness plus the depth of two nuts (one below the plate one on top) plus one bolt diameter plus (4) inches, whichever is larger. The threading of anchor bolts shall be in accordance with ANSI-UNC-2A classification. The thread area plus 6 inches of the top of the bolts shall be partial hot deep galvanized according to ASTM A-153 or EN ISO 10684.

The supplier shall furnish steel templates, one (1) top and one (1) bottom for each pole, suitable for the installation of the anchor bolts in the foundation.

The bottom of the anchor bolts shall have a threaded length sufficient for attaching the bottom template with the corresponding nuts.

3.5 Fasteners

All connection bolts shall be galvanized hex-head conforming ASTM F3125 or A- 354 Grade BC or ISO 898. Fabricated fasteners shall conform to ASTM F 1554 Grade 105. Bolts shall hot dipped galvanized to ASTM A-153 or EN ISO 10684. Nuts shall conform to ASTM A563 Grade DH and tapped oversize in conformance with A563 or ISO 898 for galvanized finishes.

The Supplier shall furnish all the required bolts, nuts, and washers (if requested) for the installation of all parts of the steel poles, plus 5 percent extra.

4. Design Requirements

4.1 Language and Units

- All correspondence, literature, drawings, and markings shall be in the English language.
- Dimensions and tolerances shall conform to ANSI Y14.5M. Dimensions shall be in the U.S. customary units. If fabricating in SI units, both U.S. and SI units shall be shown on the drawings. Conversion dimensions shall be 1 inch = 25.4 mm. Conversion dimensions may be rounded off to the nearest 1/32 of an inch (0.794 mm), provided the rounded dimension falls within the design limits.

4.2 Design Code

The structures shall be designed in accordance with SEI/ASCE-48 latest edition, Design of Steel Transmission Pole Structures.

4.3 Analysis Method

The pole designs shall include second order (non-linear) analysis including structure loadings resulting from displacements due to deflection.

4.4 Pole Cross Section

The pole shall have a dodecagonal shape.

4.5 Helicopter Lift Requirements

Helicopter lifting provision shall be included in the design for each pole section. The overhead ground wire or similar connection points are acceptable for this purpose, given it is structurally checked.

4.6 Design Limitations

- Maximum section length limit is 50 feet.
- Minimum plate thickness for all pole components shall be 3/16 inch.
- For poles with slip joint connections, the taper shall be no less than 0.15 in/ft.
- The taper shall not exceed 0.5 in/ft, unless is has been approved by LUMA engineering in writing.
- The maximum section weight should be limited to 20,000 lbs.
- The w/t ratio shall not exceed 35 for all sections.

4.7 Deflection Requirements

Deflections shall be limited to 7 % of the above ground height under intact case (hurricane condition) without any overload factors.

Arms shall be designed so that the end of the arm is at the specified height and a positive inclination under a loading of initial conductor tension, 80°F, no wind, and no overload factors.

Arms shall not deflect vertically more than 12 inches at the end of the arm under any loading condition.

Poles shall not be cambered.

4.8 Connection Design

The connections for vangs, brackets, or stiffeners attached to the pole shaft, shall be designed to distribute the loads sufficiently to protect the wall of the pole from local buckling. Through-thickness stresses shall be limited to 36 ksi. The w/t ratio limit shall not exceed 35.

All multi-section poles shall be slip-jointed or flanged connected, with the edge of each flange permanently match-marked to indicate alignment during structure erection. Any alternate connection method shall be pre-approved by the LUMA Transmission & Substation Standards Engineering.

OPGW ring plates and DE vangs must be designed for a maximum factored tension of 15.4 kips (12.8 kips x 1.2). Conductor ring plates and DE vangs must be designed for a maximum factored tension of 26.9 kips (22.4 kips x 1.2). The plate thickness shall not exceed 7/8". For bearing capacity check of the plate, consider the pin size to be ¾".

All connections including arm connections, baseplate and anchor bolts must be designed to resist 100% moment capacity of the shaft at the location of the connection.

4.9 Design Calculations

4.9.1 Calculations Content:

Manufacturer shall submit design calculations and data with the quotation for each pole type and height. Design calculations shall contain information specified below:

- A summary page including pole top and bottom diameter, height and length, weights, file name, weight, anchor bolt circle diameter and quantity of bolts, length of bolts, base reactions.
- The controlling loads and loading case.
- General dimensions, including butt and tip diameters, wall thickness, taper, weight of the pole, and the center of gravity.
- Drawing showing structure configuration, dimensions, weights, etc. and stress diagrams or computer printout of maximum loading, indicating the loading condition that controls.
- Ultimate moment, maximum stress, and the neutral axis in each ten (10) foot section of the pole, at the attachment points, and at the ground line.
- Maximum design unit stresses in compression, tension, shear, bearing, and bending for pole, arms, base plate, flange plate, anchor bolts, and connection bolts. Indicate limiting slenderness ratio values used in design.

- Maximum ground line reactions - overturning moment, horizontal shear, and vertical loading - uplift or bearing.
- Maximum and normal deflection for each load case.
- Guy tensions with overload factors.
- Maximum stresses of all arms, braces, cross arms, and their connections.
- Wind load shall be applied in a direction that produces the worst-case loading on the structure.
- Pole shall be designed to withstand all shipping and construction loads (including lifting loads). Pole lifting requirements shall be furnished by the manufacturer and pre-approved by LUMA.

4.9.2 PLS POLE:

Manufacturer shall submit PLS-POLE model (M4) design files for each structure type and height with the quotation. PLS-POLE files shall be named as specified in the structure drawings.

4.9.3 Final Design Calculations:

Final design calculations shall be submitted for approval before fabrication commences, together with the shop drawings. After approval two final original set (11" x 17") plus one electronic file with the drawings in AutoCAD shall be sent for LUMA's files. All drawings shall include a unique identifying order number. Final design calculations and input files shall be included on an electronic file for LUMA's use.

4.10 Vibration Considerations

The manufacturer shall evaluate and take the necessary measures to minimize the potential for vibrations caused by wind-induced vortex shedding of structure members. The manufacturer shall provide dampers or spoilers as required to eliminate vibrations or specific recommendation for avoidance of vibration that can lead to fatigue.

The manufacturer shall consider in their design vortex shedding failures of arms and arm connections.

4.11 Anchor Bolt Design

The length of the anchor bolts shall be the minimum length required to develop the necessary bond in concrete per the ASCE 48-19, consider a minimum compressive strength of 3500 psi at 28 days. All anchor bolts shall be the same length within each anchor bolt cage.

The bottom template (if required) for bolts shall be kept to a minimum size and used only for alignment purposes.

Anchor bolts shall be capable of resisting the design load of the structure at the yield point of the material based on the tensile stress area.

Anchor bolts shall be located equally spaced in a circle about the center of the structure, unless otherwise approved by the LUMA Transmission Lines Engineering.

No welding is permitted on anchor bolts or templates. The bottom 6 inches of anchor bolts shall not be considered in bond length developments.

Anchor bolt design shall account for an allowable total foundation rotation of 2°.

Anchor bolts cages shall be designed to withstand transportation loads without compromising the integrity of the cage. Support or stiffening rings shall be added by manufacturer discretion to prevent damage of permanent deformations.

5. Fabrication

5.1 General

Fabrication of steel poles, anchor bolts, bolts, nuts, and hardware shall conform to the applicable standards of the ASTM, AISC, AWS, NEMA and ASCE/SEI 48 (latest edition) or EN equivalent except as otherwise specified herein.

All fabrication and galvanizing facilities utilized for LUMA Transmission pole structures shall be qualified by the LUMA Transmission Standards team prior to fabricating.

LUMA or its representative shall have access to the manufacturing plant for inspection.

LUMA shall be immediately notified by the manufacturer of any changes to the notification schedule or manufacturing and galvanizing facilities.

5.2 Fabrication Drawings

After a PURCHASE ORDER has been issued and before fabricating any poles, manufacturer must furnish “For Review”, fabrication drawings of the poles containing all the information specified in this section. Poles shall not be manufactured until the fabrication drawings have been reviewed and comments submitted in writing by the LUMA Transmission & Substation Standards Engineering.

The fabrication drawings shall include the following:

- The drawings shall include dimensions for all attachments (vangs, brackets, jacking nuts, climbing details, etc.), their referenced orientation and location on the structure.
- Overhead ground wire and insulator attachments on the pole shaft or its arms shall be shown on drawings.
- All connecting parts shall be marked for identification with a welded plate and these markings shall be clearly shown on approval fabrication drawings.
- Name plate information.
- Location, type and size of welds and bolts.
- Clearly distinguish between shop and field welds and bolts.
- Clearly identify the quantity and location of long seam welds.
- Pole layout and details showing hole locations, orientation, dimensions, size, and positioning.

- Attachment and joist points
- Pole specification data including reference drawing number, working and ultimate moments, C.G., I.D. and O.D. at the top and bottom, and tip and butt thickness at top and bottom.
- Shop detail drawings applicable to design and/or detail (and to changes when fabricating to LUMA details) are to be forwarded to the LUMA transmission engineer in Adobe PDF or CAD/DXF format for approval prior to fabrication. Drawings shall include the following general assembly information:
- Weight schedule – basic structures and sections
- Bill of material
- Member mark numbers
- Member dimension
- Member quantities
- Bolt and nut size, length, and quantities
- Anchor bolt details and setting data
- Ground-line reactions
- Grounding Connections
- Loading Criteria

Upon approval by LUMA, the manufacturer shall provide final sealed drawings on LUMA's title block with drawing numbers furnished by LUMA.

5.3 Welding

5.3.1 General

All welding shall be performed by welders, welding operators, and tackers certified for the type of welding to be performed.

All welding shall be performed by certified operators using procedures in accordance with Section 5, AWS D1.1 or equivalent EN ISO 15614 and EN ISO 9606.

All welder performance certification records, weld procedures specifications, and weld procedure certifications records shall be developed and properly maintained in accordance with the applicable requirements of AWS D1.1 Structural Welding Code – Steel.

Records of welding procedure and welding operator test results shall be kept for five years by the Supplier and shall be available for review by LUMA.

Longitudinal seams in the female slip-joint area and Base plate shall be complete penetration welds.

Arm bracket joints, and post-insulator bracket joints welds shall be full penetration or equivalent ninety percent partial penetration with a fillet overlay to develop the full strength of the arm shaft. The post insulator bracket welds shall be designated to carry the specified loading requirement without any permanent damage.

Backing bars, when utilized, shall follow the requirements of AWS D1.1 and be seal-welded to the pole shaft. The butt joints of backing bars shall be 100% penetration welds and shall be made to occur in the middle of a flat rather than the bend lines of pole shaft.

Base plate, flange plate, and arm shaft to bracket joints shall be complete joint penetration welds. All flange connections shall be shop fitted and preassembled after fabrication of pole to assure proper fit and alignment.

Longitudinal welds in pole section shall meet requirements of ASCE-48-19, sections 6.3.4, 6.3.5, 6.4.1 and 7.2.3.

Each pole section shall be formed and welded with longitudinal seams. It shall not have intermediate circumferential welds. Each pole section shall be of uniform thickness.

5.3.2 Welding Inspection and Testing by manufacturer:

- The manufacturer shall indicate and adhere to the welding procedures and processes to be used in the various joints or seams on their fabrication drawings.
- The manufacturer shall indicate the inspection methods which will be used to qualify welds and will furnish certified inspection reports when requested by LUMA Transmission Engineer. Records shall be kept for five (5) years by the manufacturer.
- Ultrasonic and visual inspection shall be performed on all complete joint penetration (CJP) groove welds.
- As a minimum, ultrasonic testing shall include longitudinal straight beam for lamination or laminar tearing adjacent to CJP groove welds in accordance with AWS D1.1 UT procedure, and all steel plates over 1 ½ inches thick in accordance with ASTM A435 as applicable to the manufacturer's established procedures.
- Nondestructive testing shall be performed with established procedures and qualified personnel in accordance with AWS D1.1 and ASNT-TC-1A.
- Nondestructive testing of welds and weld repairs shall not be performed until the base metal is at ambient temperature.
- Ultrasonic testing of post-galvanized baseplate to shaft welds for the detection of toe-cracks, shall not be performed until 48 hours after galvanizing. The manufacturer shall have an established procedure that demonstrates effective examinations of this type and shall be demonstrated as requested by LUMA.
- The acceptance/rejection criteria for nondestructive testing of CJP groove welds and adjacent areas shall be in accordance with AWS D1.1.
- All welding electrodes used for weld joints and deposited weld metals shall meet, as a minimum, an impact value of 15 ft-lbs at -4° F as measured by the standard Charpy V-notch test. They shall equal or exceed the specified physical properties of the base metal being welded when tested with the applicable AWS specification for welding electrodes.
- Repair area of removed hot-dip galvanizing: When it is required to remove galvanizing to make a weld or other repair the manufacturer shall repair the galvanizing per following section of "Quality and Finish" in accordance with ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings. However, "hot stick" (zinc soldering) repairs will not be allowed for the repair of zinc coating on weld repairs.

5.3.13 Welding Inspection by LUMA:

Independent non-destructive testing may be performed by LUMA as approved by the LUMA Transmission Standard and /or LUMA Transmission Design Engineer through a 3rd party NDT testing agency (PROFESSIONAL), hired and compensated by LUMA. The Professional shall have established procedures that demonstrate effective examinations of this type and shall be demonstrated as requested by LUMA or representative. Acceptance/Rejection shall be demonstrated with a qualified procedure by the Professional and determined by LUMA.

- Straight Beam Ultrasonic Testing (UT): Professional shall perform straight beam UT through the bottom of baseplates in accordance with AWS D1.1 (latest edition) and qualified procedures. Lamination testing shall be performed prior to any other testing and the results documented. Acceptance/Rejection criteria shall be per AWS D1.1.
- Shear Wave Ultrasonic Testing (UT): Professional shall perform Code UT on complete joint penetration groove (CJP) welds in accordance with AWS D1.1 (latest edition) and qualified procedures. Professional shall perform "informational" UT on galvanized baseplate to shaft CJP welds for longitudinal cracks in accordance with a qualified procedure using a 45- degrees and 70-degrees transducer. The acceptance criteria shall be zero cracks as demonstrated and established in accordance with the Professional's qualified and approved procedures, and the results documented and reported to the Owner.
- Magnetic Particle testing (MT) or Dye Penetrant Testing (PT): When weld base metal discontinuities or defects are detected by UT on the surface, Professional shall perform MT or PT on the detected indications and remainder of the baseplate to shaft weld for longitudinal cracks. In surface preparation for the NDT performed by the Professional, the manufacturer shall completely remove any galvanizing or coatings from the baseplate to shaft CJP weld and adjacent base metal at a minimum of 1" from the edge of the weld toe areas. When the manufacturer has notified the Professional of a crack removal, Professional shall perform MT or PT during the excavation of crack repairs to validate complete removal of the crack prior to any welding on the repair area. The acceptance criteria shall be in accordance with AWS D1.1 (latest edition).
- Metal Hardness testing: Professional shall perform hardness tests on the baseplate to shaft CJP weld and the heat effected zones (HAZ) of the CJP weld on the baseplate and shaft sides. Acceptance/rejection criteria shall be per AWS D1.1 as a minimum. Metal hardness not to exceed 200 in Brinell scale.
- Repair area of removed hot-dip galvanizing: After the removal of galvanizing and crack repair by welding, the manufacturer shall repair the galvanizing in accordance with ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

5.4 Pole Shafts

Cross section shape shall be the same over the entire pole shaft unless prior approval is obtained from the LUMA Transmission & Substation Standards Engineering. Taper shall be in the range of 0.125 to 0.5 inches per linear feet. Any changes to shaft diameter shall be approved by the LUMA Transmission & Substation Standards Engineering.

Shaft sections shall be pre-fitted for a telescoping type of assembly unless otherwise specified. The upper section at a joint shall telescope over the lower section by not less than 1-1/2 times the outer section diameter including the manufacturing tolerances. Structure sections shall be numbered to relate to the structure identification in the Bid Sheet and, at joints, both sections shall be clearly marked so that the related faces can be correctly matched in the field assembly.

Eight (8) 1 inch diameter heavy hex-nuts per splice joint shall be welded (over holes on galvanized structures only) to accommodate a hydraulic jacking device for field assembly. Each section shall have two (2) pairs of nuts, each pair located diametrically opposite walls of the pole shaft. The nuts shall be spaced 30 inches from center to center, parallel to the long axis of the pole and located as to be clear of the section overlap and not less than 24 inches apart when the joint is fully telescoped. All nuts must be oriented so that two (2) flats are perpendicular to the long axis of the pole.

Each pole shaft section shall have lifting attachments and/or holes with the capacity to lift each pole section into a plumb position. This may be accomplished by either designating elements of the pole shaft as acceptable lifting points or by installing specific capable attachments and designating them on the drawings. Round lifting hole centerlines shall have a maximum edge distance of 6-inches from the top of the pole section and a minimum diameter of 2-inches. Where vertical slotted lifting holes are provided in pole walls, the clear distance from the top of the pole section to these holes may not exceed 4-inches. Unless otherwise required by the drawings, poles shall not be sealed. All poles shall have a vented pole top. The pole shall have a bolted metal top cap. The bolt diameter shall not be less than 1/2" and the cap will not exceed the pole top diameter by more than 1 inch.

Base-plated poles shall have a free-draining base connection detail. Embedded poles shall incorporate a bearing plate with a center opening adequate for internal coating and drainage. The bearing plate shall have a hole at the center of plate not larger than 30% of the total base diameter.

The poles shall have a fastening system between all pole sections to ensure sections will not come loose when lifted by the helicopter.

5.5 Direct Embedded Structures

Direct embedded structures shall be designed so that the embedded section will be as indicated on the drawings.

Each pole shaft shall have provisions for bolted ground clamp, consisting of a plate capable of receiving a NEMA 2-hole pad or a ground lug attachment, located 18-inches above the ground line. The specific attachment number will be included on the structure drawing.

Pole shafts shall include a steel bearing plate under the shaft walls having a minimum thickness of at least 3/16 inch.

The poles shall have a corrosion-resistant coating covering from 6 ft below to 6 ft above ground line. This coat shall be a suitable below grade protection of galvanized surfaces and shall be

applied as per the manufacturer instructions after galvanizing. The application thickness shall conform to the coating manufacturer instructions. Approved below-grade coatings are Corrocote Classic, Chemthane 2260, Rocathaan Hotspray or equivalent Polyurea approved by LUMA.

Embedded Structures shall have a ground sleeve of 3/16 in, 5.5 ft above ground level and 5.5 ft below ground level. Ground sleeve should not be considered for the final capacity of the structure.

5.6 Baseplate Anchored Structures

The structures shall be supplied with base plates made of fabricated steel designed to match the strength of the structural member to which it is attached.

Baseplates shall include a matching reference mark to aid in field determination of the proper orientation of the base section of the pole onto the anchor bolts according to the "V"notch in the pole templates.

Anchor bolt holes in the baseplates shall be of a diameter within the range of 3/8-inch to ½-inch larger than the anchor bolts with which they are used and shall be equally spaced.

Each pole shaft shall have provisions for a bolted ground clamp consisting of a plate capable of receiving a NEMA 2-hole pad or a ground lug attachment located 18-inches above the base plate. The specific attachment will be included on the structure drawing. See details per pole.

Welded spliced sections to fabricate a baseplate is not acceptable.

Use of a backing or strapping bar on the exterior side of the shaft to base plate weld joint shall not be permitted.

Anchor Bolts shall comply with ASTM F1554.

5.7 Anchor Bolt Cages

Anchor bolts shall be capable of resisting the design load of the structure at the yield point of the material based on the tensile stress area.

Anchor bolts shall be located equally spaced in a circle about the center of the structure, unless otherwise approved by the LUMA Transmission & Substation Standards Engineering.

Anchor bolt cages shall have at least four (8) anchor bolts that shall be assembled in the field with a bottom ring and a top template to provide for placement in the foundation as a unit.

Anchor bolt templates shall include a reference marking (such as a notch or a weld) identifying the interior bisector angle on angle structures and the transverse axis on tangent structures. The reference marks on the template and the baseplate will be used along with field reference stakes marking the transverse axis of the structure to assure proper orientation of the anchor bolt cage and the structure. The template shall be of sufficient strength to support the weight of the anchor bolt cage during construction of the foundation.

Welding of anchor bolts shall not be permitted unless otherwise approved by the LUMA Transmission & Substation Standards Engineering, and therefore shall be welded in accordance with AWS D1.4 (latest edition) “Structural Welding Code – Steel Reinforcing Bars”.

5.8 Climbing and Working Provisions

Pole vendor shall provide fall protection anchorage in accordance with OSHA requirements.

All 115 & 230 kV transmission line pole shafts shall include provisions for use of removable step bolts.

Each step bolt (which is not a fall protection anchorage) shall be capable of withstanding a minimum of 450 pounds ultimate load, applied to the outer edge of the step bolt, without causing failure to the bolt or to the point of attachment.

Step bolts shall be supplied starting at 15ft above the ground level. Such bolts shall be the removable type ¾" -10 UNC 2A x 8" LG Type, hot dipped galvanized with 2-inch thread length and the unthreaded section shall have an abrasive surface. The supplier can propose an equivalent step bolt. The detail of the proposed step shall be submitted to LUMA for approval.

Step bolts shall be spaced 18 inches center to center, staggered appropriate for climbing the pole easily. Additional step bolts shall be installed 4' -0" below each arm and ground wire attachment to facilitate work on these areas. Pole steps orientation and vertical specified spacing shall be shown on drawings.

5.9 Quality and Finish

Quality control and manufacturing tolerances shall be such that there will be no problems encountered during field assembly of the finished product.

The Supplier shall provide upon request, procedures detailing the galvanizing process.

For galvanized finish, steel shall be hot dip galvanized after fabrication is completed per the requirements of ASTM 123. Any exceptions to this process.

5.10 Modifications

Structures are to be fabricated in accordance with detailed drawings furnished by the manufacturer for approval of LUMA Transmission & Substation Standards Engineering. Any modifications must be approved by LUMA Transmission & Substation Standards Engineering in writing.

For fabrication only orders (engineering completed previously or by others), minor deviations in member layout to accommodate variations in shop practices will be permitted provided that these deviations do not materially alter the configuration of the structures and do not reduce the strength of the structures. When such deviations in member layout are made, drawings showing

these deviations shall be submitted to LUMA Transmission Engineer for approval and the originals of such drawings shall become the property of LUMA upon completion of the order.

6. Identification

6.1 Pole Bottom Section

Each pole shall include (welded) one steel plate at 5 feet from the ground elevation or from the pole base plate with the following information clearly stated:

- Manufacturer:
- Manufacture Date:
- Owner: LUMA
- Purchase Order No.:
- Moment at Base (Ft-k):
- Shear at Base (Kips):
- Axial Loat at Base (Kips);
- Weight (lbs.):
- Pole Length/Height (ft):
- Pole Name

6.2 All Pole Sections

Each section shall be identified:

- T=Top, M= Middle, B=Bottom
- Pole Name –Example – T-230kV- DE-DC-VERT-ARM DE-2
- Purchase Order Number

6.3 Arms

Each arm shall be identified and Purchase Order Number:

- C=Conductor, O= OHGW
- Pole Name –Example – C - 230kV- DE-DC-VERT-ARM
- Purchase Order Number

7. Galvanizing

The Supplier shall provide upon request procedures detailing the galvanizing process.

All steel work, including bolts, shall be hot-dipped galvanized in accordance with ASTM Specifications A-123, A-153 or EN ISO 10684.

Fabrication should be complete prior to galvanizing.

All holes must be punched or drilled before galvanizing and the holes must be sealed with a removable plastic cap, to seal the pole to prevent water.

The coating quality shall be determined as described in the ASTM A123 Standard.

The Supplier shall provide upon request a detailed inspection procedure and evidence that ultrasonic test is performed on base and flange plate welds after galvanizing.

The steel shall be suitable for hot dip galvanizing.

Hot dipped galvanizing process is required that every section of the pole shall be covered in single submersion end to end in a single bath.

8. Quality Control

8.1 General

The Supplier shall be ISO 9001 and ISO 14001 certified.

The manufacturer shall have an established quality management system with a quality program that will ensure conformance to the project requirements and this specification. All project related documentation that is required by the quality control program and project requirements shall be available to LUMA or its representative upon request and kept in record retention by the manufacturer for a minimum period of five (5) years.

8.2 Certified Mill Test Reports

Mill test reports certificates shall be furnished for steel plates used for the fabrication of pole shaft, base plate and all accessories where loads are applied. Certificate of conformity shall be furnished for bolts.

All project material test reports and documentation (inspection and test records) shall be kept for a period of five years and be available on request by LUMA for all material.

8.3 Control Plan

Nature	DESIGNATION	CONTROL	
		TYPE	FREQUENCY
Welds	All welds	Visual	100%
	Longitudinal welds at 100% penetration	Ultrasonic test	20%
	Circumferential welds at 100% penetration of pole shaft on base plate.	Ultrasonic test	20%

Dimensions	Pole sections and accessories	Dimensional	10%
Identification	Presence, position and orientation of markings on all pole elements and fittings.	Visual	Random Sampling
Galvanization	Thickness.	Magnetic gauge	10%
Packing	Quantitative control of packing and telescoping (if any) of shafts and their accessories.	Visual / Counting	100%

Table 1. Quality Control Plan

8.4 Inspection

The pole supplier shall allow LUMA or its representatives to verify that the finished products and materials supplied correspond to the requirements of these specifications.

LUMA shall have the option of performing partial or complete Supply Conformance Assessment (SCA) inspections as deems necessary. All sections of the manufacturer's plant concerned with the work shall be always open to LUMA or its representative while the work is being performed to allow the LUMA to make on-site inspections. The manufacturer shall advise the LUMA or its representative one week prior to the beginning of fabrication of the LUMA's order. The manufacturer shall include an estimated completion date, including final surface preparation. The intent of this notification is to allow LUMA to exercise the option of factory inspection any time during fabrication. SCA inspector is to be allowed to inspect finish product and project documentation for acceptance of structures by LUMA.

The manufacturer shall formally notify LUMA two (2) weeks prior to the initial start of the project fabrication as contractually ordered with the location(s) of the manufacturing and galvanizing (if applicable) facilities.

8.5 Documentation

The manufacturer shall be responsible for retaining all LUMA documents such as design calculations and fabrication drawings for at least 5 years.

The manufacturer shall be responsible for the accuracy of all drawings and shall also be responsible for notifying the LUMA Transmission & Substation Standards Engineering of any revisions made after furnishing the original drawings. Any errors in the detail drawings shall be corrected by the manufacturer at the manufacturer's expense.

The manufacturer, by accepting a PURCHASE ORDER from LUMA, acknowledges that LUMA has the right to use the final shop fabrication detail drawings in any manner beneficial to LUMA, including use by other manufacturers in the fabrication of like structures for LUMA.

All calculations and drawings shall be provided in paper and electronic form. Drawings shall be provided in AutoCAD format. Calculations may be in Adobe PDF format.

Final shop fabrication detail drawings shall be submitted in Adobe PDF format with or prior to the delivery of the structures. These drawings shall show all details necessary to fabricate the structures.

Review of drawings by the LUMA shall not serve as a complete check but will indicate only that the structure appears to be in general conformance with the contract documents. Review of the drawings by the LUMA does not relieve the manufacturer from the responsibility for the correctness of the details on the drawings.

9. Packing and Shipping

Each part, assembly or sub-assembly shall be packed in such a manner as to minimize structural damage or damage to the galvanizing. Any damaged part shipped will be replaced by the manufacturer.

Anchor bolts and templates may be shipped in advance and have nuts on the bolts to ensure proper fit and anchor bolt thread protection.

Shipments shall be accompanied by a packing list of all parts which will be identifiable by structure name and type.

Material should be delivered in open platforms, which are free of foreign material that could cause damage. Air circulation should be provided between the floor of the platform and the bundle. Proper bulk heading and suitable vertical and horizontal spacers should be used to prevent damage and facilitate unloading.

Pole delivery will not be accepted without LUMA's Transmission & Substations Standards Engineering approval.

Pole bolts will be delivered using UV resistance recipients or wooden cases adequately identified with its order number and pole belonging. Cardboard boxes and unidentified cases will not be accepted.

Bid price shall include costs for transportation, delivery, and trailers standby time of 10 working days at LUMA's Warehouse 05 in Palo Seco, Toa Baja or project site. LUMA will be responsible of unloading the poles. Supplier shall notify LUMA at least 2 weeks prior to delivery of poles and hardware and shall submit a delivery schedule including dates and details of shipments.

10. Compliance

Should any piece or equipment fail to meet the requirements of these specifications within the warranty period, it shall be optional for the LUMA Transmission & Substation Standards Engineering to accept or reject the pole or its appurtenances and direct the manufacturer to proceed at once with making alterations or furnish such new pole or parts as may be necessary to make it meet the warranty and requirements. All expense of furnishing any replacement pole or parts shall be borne by the manufacturer.

11. 115 & 230 KV Structures

11.1 General

This section covers the future standard 115kV and 230kV structures. For additional information regarding framing types and configurations, please refer to the drawings references in section 11.2 and 11.3 tables.

11.2 Double Circuit Structures

Structure Type		Drawing Reference	PLS POLE Reference (.pol)
DC Side to Side	DE-DC-VERT-ARM	4752.332 Appendix J	DC-ARMS-DE-1
			DC-ARMS-DE-2
			DC-ARMS-DE-3
			DC-ARMS-DE-4
	DE-DC-VERT-SHORTARM	4752.332 Appendix M	DC-SHORTARMS-DE-1
			DC-SHORTARMS-DE-2
			DC-SHORTARMS-DE-3
			DC-SHORTARMS-DE-4
	SU-DC-VERT-BP	4752.332 Appendix K	SU-DC-VERT-BP-03_0-800ft_DPier
			SU-DC-VERT-BP-03_1500ft_DPier
	SU-DC-VERT-ARM_V-03	4752.332 Appendix N	SU-DC-VERT-V-03-1500ft_Dpier
			SU-DC-VERT-V-03-800ft_Dpier
DC Vertically stacked	DE-DC-2VERT	4752.332 Appendix B	DC-VSTK-DE-1
			DC-VSTK-DE-2
			DC-VSTK-DE-3
			DC-VSTK-DE-4
	SU-DC-2VERT-BP	4752.332 Appendix C	SU-DC-STACKED VERT-BP-03_0-800ft_DPier
			SU-DC-STACKED VERT-BP-03_1500ft_DPier

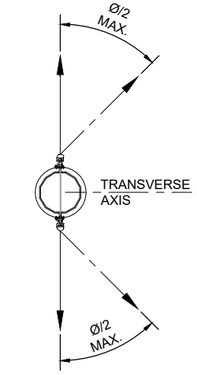
11.3 Single Circuit Structures

Structure Type		Drawing Reference	PLS POLE Reference (.pol)
3-Pole	HSU-SC-3P-HORIZ	4752.332 Appendix L	SU_3 POLE-POST-03_0-800ft
	HDE-SC-3P-HORIZ	4752.332 Appendix A	3P-DE-1
			3P-DE-2
			3P-DE-3
SC Monopole Configurations	DE-SC-VERT-ARM	4752.332 Appendix D	SC-ARMS-DE-1
			SC-ARMS-DE-2
			SC-ARMS-DE-3
			SC-ARMS-DE-4
	DE-SC-VERT	4752.332 Appendix I	SC-VERT-DE-1
			SC-VERT-DE-2
			SC-VERT-DE-3
			SC-VERT-DE-4
	SU-SC-DELTA-ARM_V-03	4752.332 Appendix E	SU-SC-DELTA-V-03-1500ft_Dpier
			SU-SC-DELTA-V-03-800ft_Dpier
	SU-SC-DELTA-BP	4752.332 Appendix O	SU-SC-DELTA-BP-03_0-800ft_DPier
			SU-SC-DELTA-BP-03_1500ft_DPier
	SU-SC-VERT-BP	4752.332 Appendix F	SU-SC-VERT-BP-03_0-800ft_DPier
			SU-SC-VERT-BP-03_1500ft_DPier
	SU-SC-VERT-ARM_V-03	4752.332 Appendix G	SU-SC-VERT-V-03-1500ft_Dpier
			SU-SC-VERT-V-03-800ft_Dpier

11.4 Design Loads

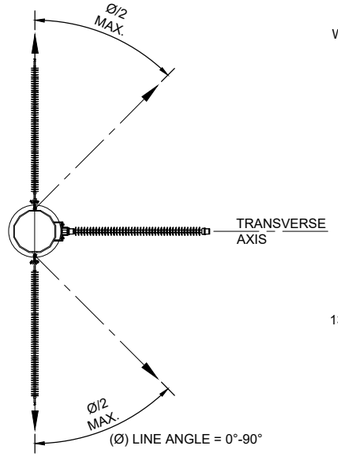
For reference to the design loads for each structure refer to the Appendix H.

12. Appendix



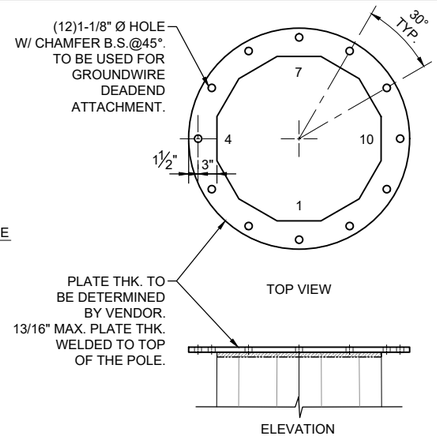
(Ø) LINE ANGLE = 0°-90°

VIEW A-A (OHGW/OPGW)
N.T.S.

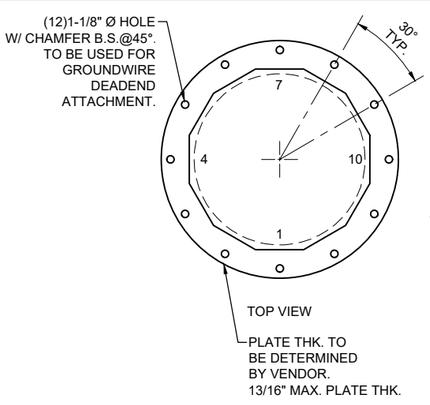


(Ø) LINE ANGLE = 0°-90°

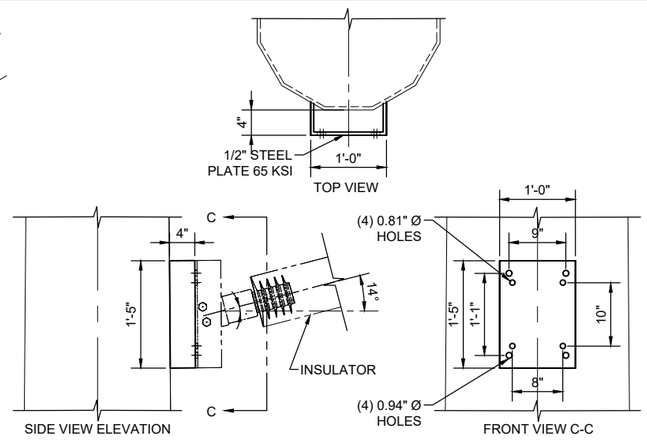
VIEW B-B (CONDUCTORS)
N.T.S.



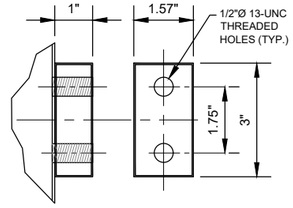
DETAIL A - OPGW/OHGW RING PLATE
N.T.S.



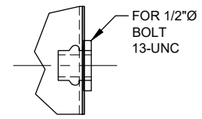
DETAIL B - COND. RING PLATE
N.T.S



DETAIL C - JUMPER POST INSULATOR BRACKET
N.T.S



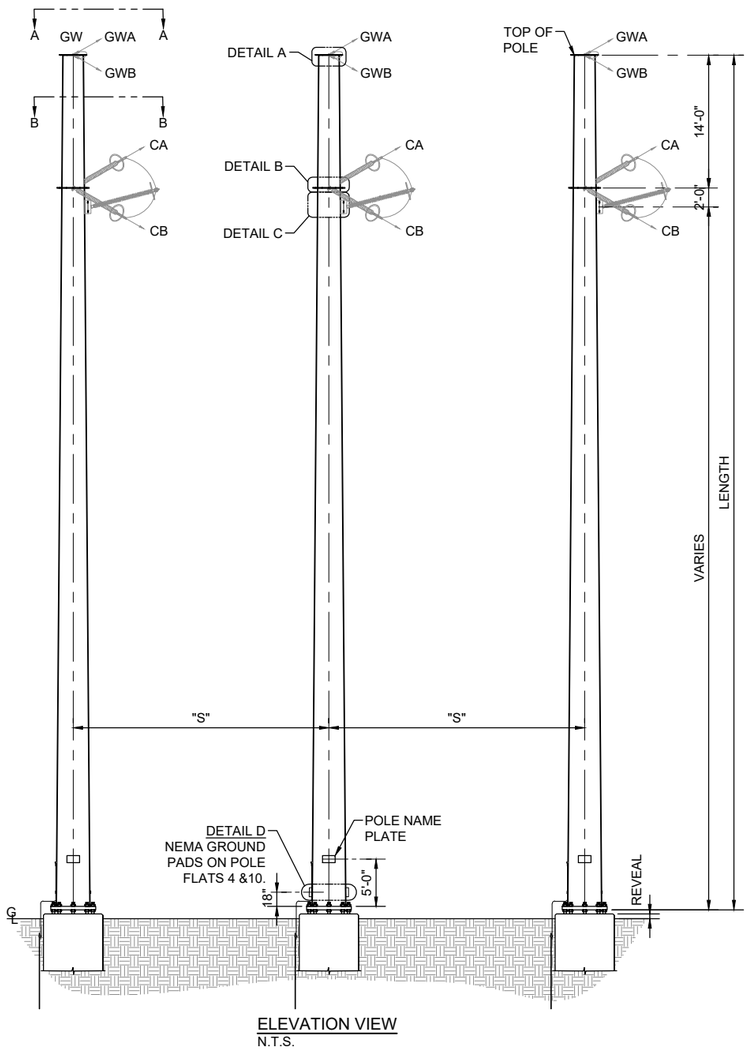
DETAIL D - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S



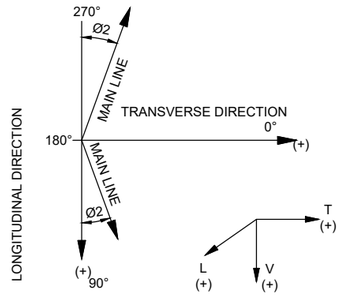
DETAIL E - RIVNUT 1/2"
N.T.S

PLS-POLE FILE	*DESIGN TYPE	*DESIGN TENSION	*MAX. LINE ANGLE (Ø)	"S" (FT)	*SPAN (FT)	**LOADING TABLE
3P-DE-2	TERMINAL DE	15K	60	TBD	1,500	DE-2
***3P-DE-3	TERMINAL DE	15K	90	TBD	1,500	DE-3
	TERMINAL DE	22.4K	60	TBD	1,500	
3P-DE-4	TERMINAL DE	22.4K	90	TBD	1,500	DE-4

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.
***SHALL BE DESIGNED FOR BOTH CONDITIONS, AS LISTED IN THE TABLE.

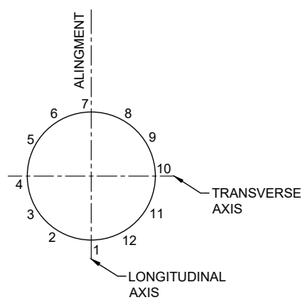


ELEVATION VIEW
N.T.S.



LOAD DIRECTION

LOAD AXIS



POLE FLAT ORIENTATION

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. ALL 3 POLES SHOULD BE DESIGNED AND MANUFACTURED IDENTICALLY, INCLUDING ATTACHMENT HARDWARE.
3. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
4. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
5. POLE CAMBERING IS NOT ALLOWED.
6. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
7. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
8. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL E), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0"
9. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
10. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
11. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
12. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
13. AE TO VERIFY ADEQUATE SHIELDING OF PHASES. MIDDLE POLE SHALL CARRY A SHIELD WIRE IF SHIELDING IS NOT ADEQUATE FOR LARGER SPACING BETWEEN POLE. SPACING "S" TO BE DETERMINED BY THE AE FIRM ACCORDING TO THE FIELD CONDITIONS AND CLEARANCES REQUIRED FOR THE STRUCTURE.
14. ALL CONNECTIONS (ARM CONNECTIONS, FLANGES, BASE PLATES, ANCHOR BOLTS, ETC.) MUST BE DESIGNED TO WITHSTAND A MOMENT EQUIVALENT TO 100% MOMENT CAPACITY OF THE SHAFT.
15. POLE SHALL HAVE A BRACKET ON THE POLE AS SHOWN IN DETAIL D. AE TO VERIFY IF JUMPER POST IS NECESSARY FOR THE SITE SPECIFIC LINE ANGLE CONDITIONS.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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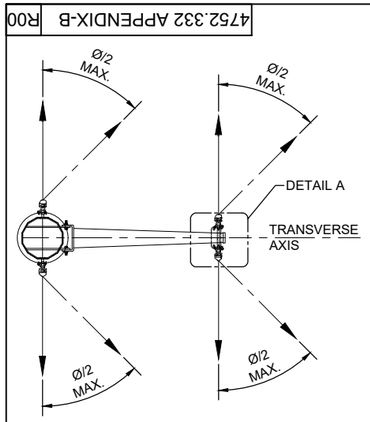
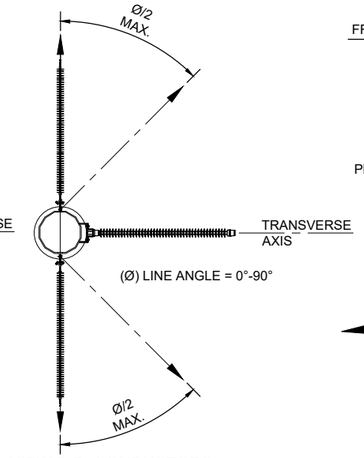
LUMA

TRANSMISSION LINES ENGINEERING
115kV & 230kV STEEL POLE, DEADEND
SINGLE CIRCUIT, 3-POLE
WITH LINE POST INSULATORS
HDE-SC-3P-HORIZ-010

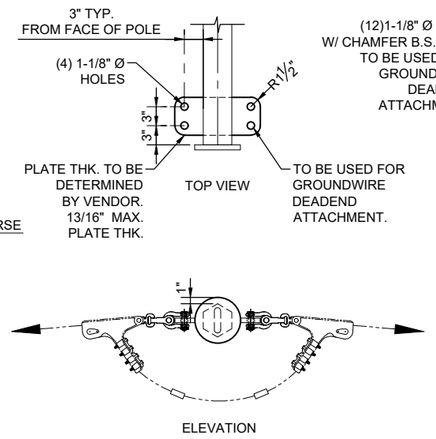
PREPARED: VALENTIN VAZQUEZ	LICENSE 2766	DATE 08/17/2023	PROJECT NO. 14F0030410000	TEMPLATE N/A	SCALE AS SHOWN
REVIEWED: JUAN MIRANDA	LICENSE 26800	DATE 10/27/2023	DRAWING: 4752.332 APPENDIX-A		R00
APPROVED: OSCAR VENEGAS	LICENSE 23125	DATE 10/27/2023	SHEET 1 OF 1		



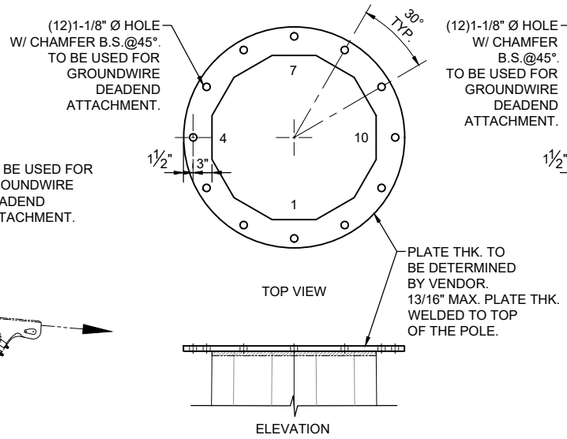
VIEW A-A (OHGW/OPGW)
N.T.S.



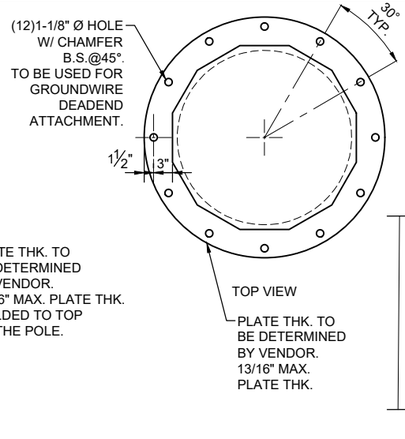
VIEW B-B (CONDUCTORS)
N.T.S.



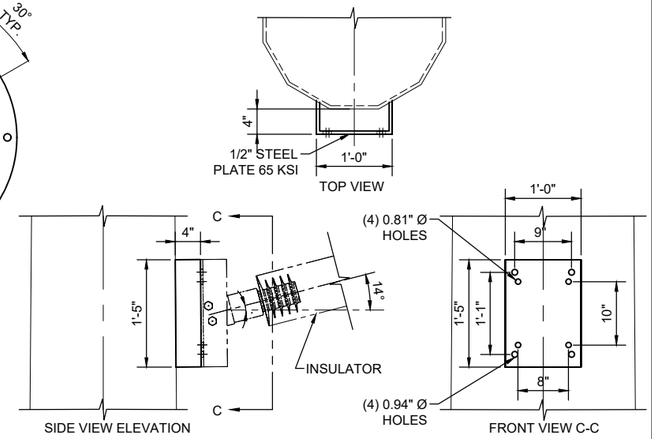
DETAIL A - OPGW ARM END PLATE
N.T.S.



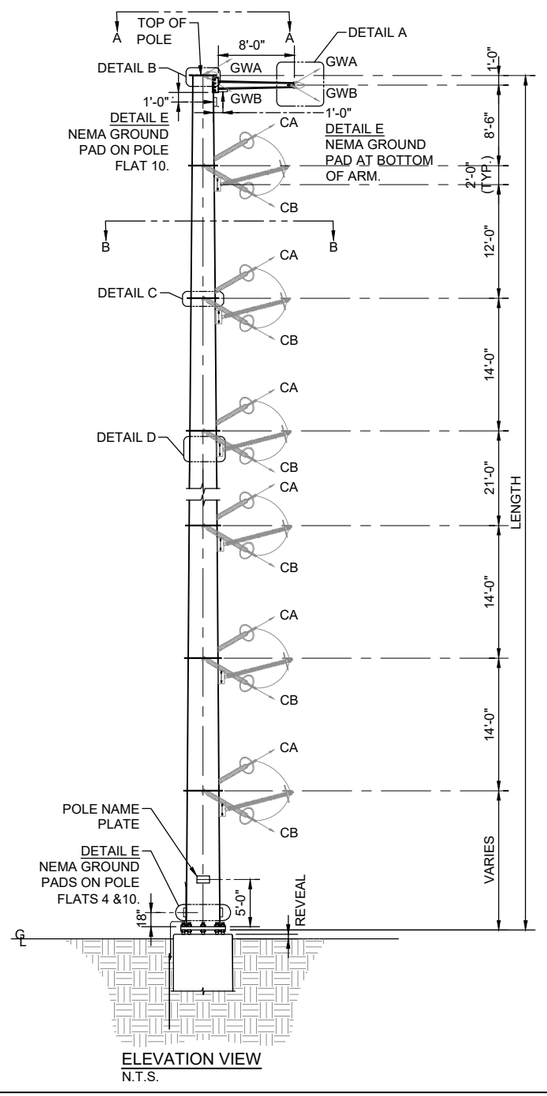
DETAIL B - OPGW/OHGW RING PLATE
N.T.S.



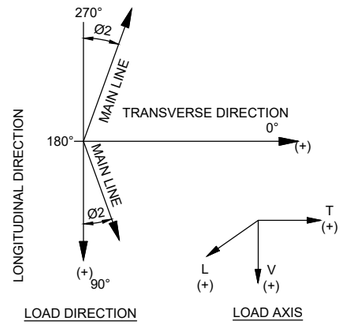
DETAIL C - COND. RING PLATE
N.T.S



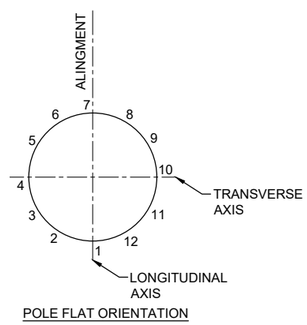
DETAIL D - JUMPER POST INSULATOR BRACKET
N.T.S



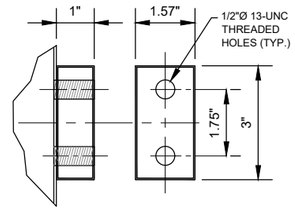
ELEVATION VIEW
N.T.S.



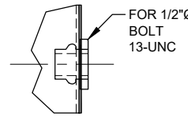
LOAD DIRECTION LOAD AXIS



POLE FLAT ORIENTATION



DETAIL E - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S



DETAIL F - RIVNUT 1/2"
N.T.S

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
3. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
4. POLE CAMBERING IS NOT ALLOWED.
5. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
6. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
7. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL F), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0"
8. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
9. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
10. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
11. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
12. ALL CONNECTIONS (ARM CONNECTIONS, FLANGES, BASEPLATES, ANCHOR BOLTS, ETC.) MUST BE DESIGNED TO WITHSTAND A MOMENT EQUIVALENT TO 100% MOMENT CAPACITY OF THE SHAFT.
13. ARM RISE MAY BE ADJUSTED TO FIT ARM CONNECTION ON THE POLE. ATTACHMENT ELEVATION SHALL REMAIN AS SHOWN IN THE ELEVATION VIEW.
14. POLE SHALL HAVE A BRACKET ON THE POLE AS SHOWN IN DETAIL D. AE TO VERIFY IF JUMPER POST IS NECESSARY FOR THE SITE SPECIFIC LINE ANGLE CONDITIONS.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

PLS-POLE FILE	*DESIGN TYPE	*DESIGN TENSION	*MAX. LINE ANGLE (Ø)	*SPAN (FT)	**LOADING TABLE
DC-VSTK-DE-1	STRAIN DE	15K	30	1,500	DE-1
***DC-VSTK-DE-2	TERMINAL DE	15K	60	1,500	DE-2
	STRAIN DE	22.4K	30	1,500	
***DC-VSTK-DE-3	TERMINAL DE	15K	90	1,500	DE-3
	TERMINAL DE	22.4K	60	1,500	
DC-VSTK-DE-4	TERMINAL DE	22.4K	90	1,500	DE-4

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.
***SHALL BE DESIGNED FOR BOTH CONDITIONS, AS LISTED IN THE TABLE.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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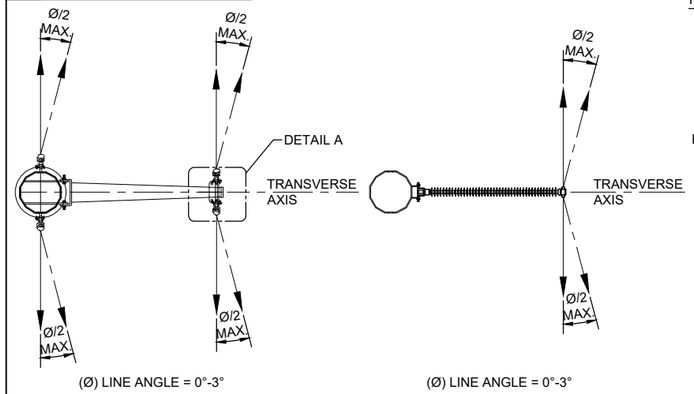
LUMA

TRANSMISSION LINES ENGINEERING
115kV & 230kV STEEL POLE, DEADEND
DOUBLE CIRCUIT, VERTICAL
WITH LINE POST INSULATORS
DE-DC-2VERT

PREPARED:	LICENSE:	DATE:	PROJECT NO.:	TEMPLATE:	SCALE:
VALENTIN VAZQUEZ	2766	08/21/2023	14F0003410000	N/A	AS SHOWN
REVIEWED:	LICENSE:	DATE:	DRAWING:		
JUAN MIRANDA	26800	10/27/2023	4752.332 APPENDIX-B		R00
APPROVED:	LICENSE:	DATE:	SHEET 1 OF 1		
OSCAR VENEGAS	23125	10/27/2023			

4752.332 APPENDIX-C R00

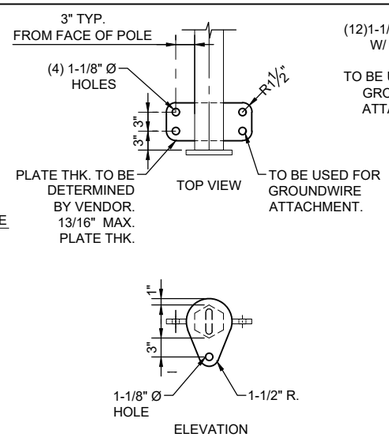


(Ø) LINE ANGLE = 0°-3°

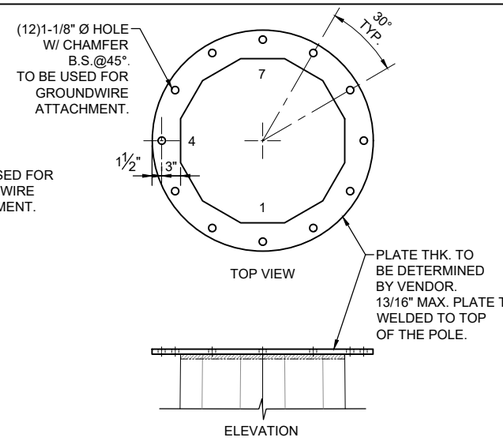
VIEW A-A (OHGW/OPGW)
N.T.S.

(Ø) LINE ANGLE = 0°-3°

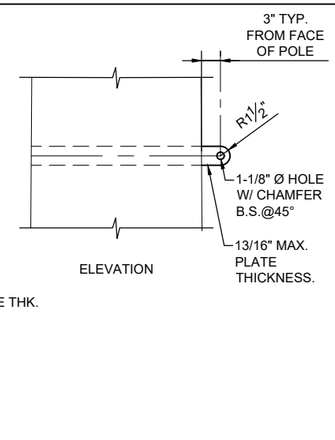
VIEW B-B (CONDUCTORS)
N.T.S.



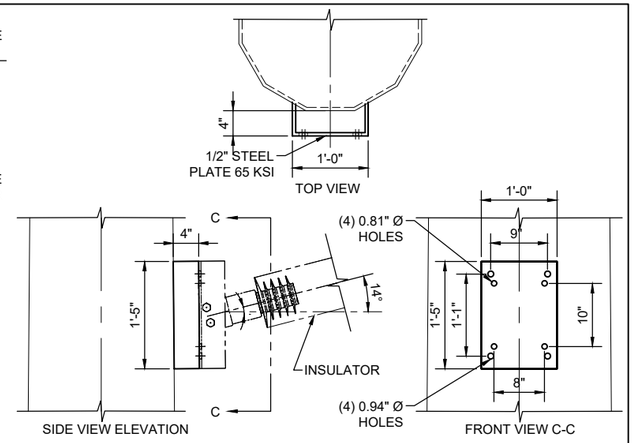
DETAIL A - OPGW / OHGW HORIZONTAL VANG FOR DEADEND ATTACHMENT AND ARM END PLATE FOR SUSPENSION ATTACHMENT
N.T.S.



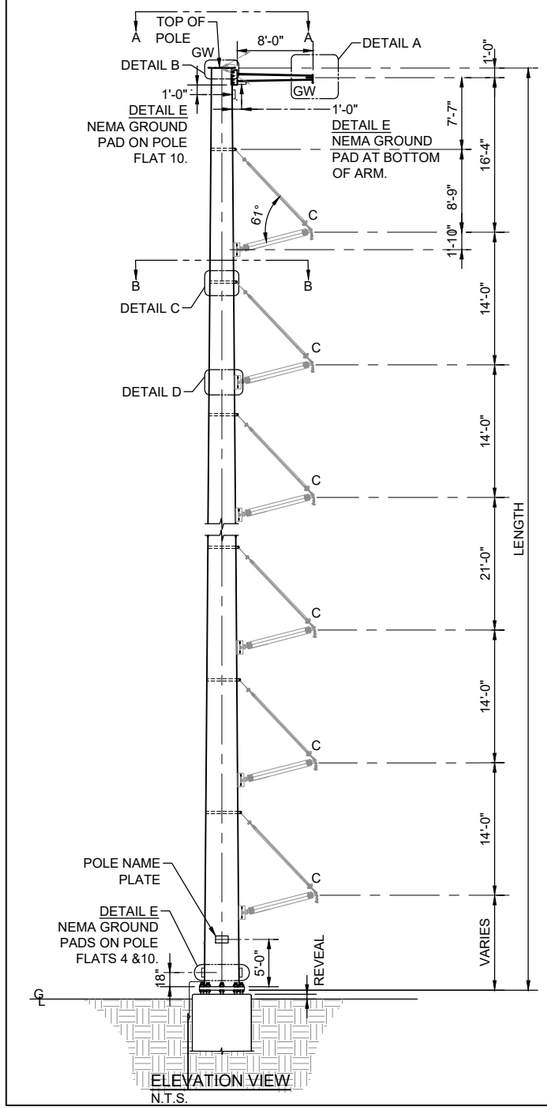
DETAIL B - OPGW/OHGW RING PLATE
N.T.S.

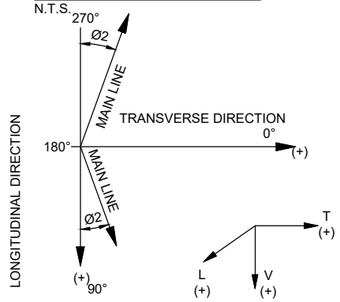


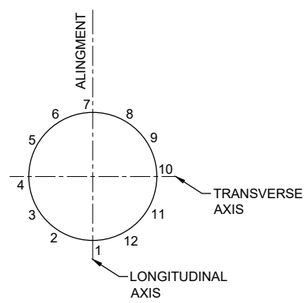
DETAIL C - VANG FOR BRACE ATTACHMENT
N.T.S

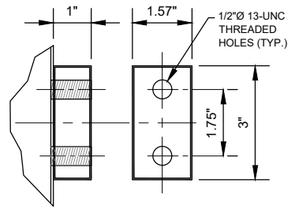


DETAIL D - BRACED POST INSULATOR BRACKET
N.T.S

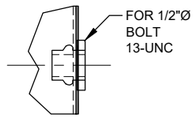








DETAIL E - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S



DETAIL F - RIVNUT 1/2"
N.T.S

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
3. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
4. POLE CAMBERING IS NOT ALLOWED.
5. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
6. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
7. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL F), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0"
8. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
9. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
10. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
11. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
12. LOAD CASE (BROKEN WIRE) TO BE APPLIED ON ONE BROKEN WIRE POSITION AT A TIME, WHILE OTHER WIRES ARE SUBJECTED TO HURRICANE INTACT LOADING. POLE NEEDS TO BE DESIGNED FOR THE WORST COMBINATION.
13. ARM RISE MAY BE ADJUSTED TO FIT ARM CONNECTION ON THE POLE. ATTACHMENT ELEVATION SHALL REMAIN AS SHOWN IN THE ELEVATION VIEW.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS
4752.330 - BRACED POST INSULATORS

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

PLS-POLE FILE	*DESIGN TYPE	*SPAN (FT)	*MAX. LINE ANGLE (Ø)	**LOADING TABLE
SU-DC-STACKED VERT-BP-03_0-800ft_Dpier	TANGENT SUSP.	0-800	3	SUSP-800
SU-DC-STACKED VERT-BP-03_1500ft_Dpier	TANGENT SUSP.	0-1500	3	SUSP-1500

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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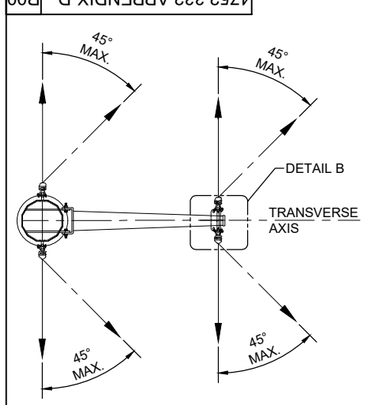
LUMA

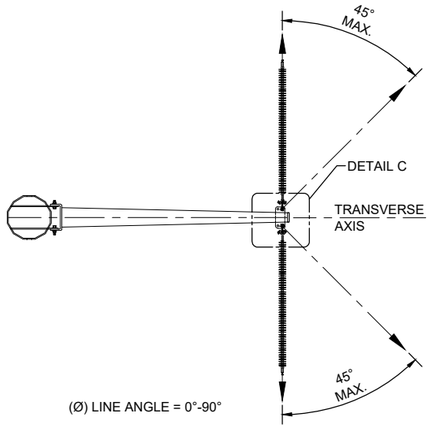
TRANSMISSION LINES ENGINEERING
115kV & 230kV STEEL POLE, TANGENT
DOUBLE CIRCUIT, VERTICAL
WITH BRACED POST INSULATORS
SU-DC-2VERT-BP

PREPARED:	LICENSE:	DATE	PROJECT NO.	TEMPLATE	SCALE
VALENTIN VAZQUEZ	2766	08/22/2023	14F003410000	N/A	AS SHOWN
REVIEWED:	LICENSE	DATE	DRAWING:		
JUAN MIRANDA	26800	10/27/2023	4752.332 APPENDIX-C		R00
APPROVED:	LICENSE:	DATE:	SHEET 1 OF 1		
OSCAR VENEGAS	23125	10/27/2023			

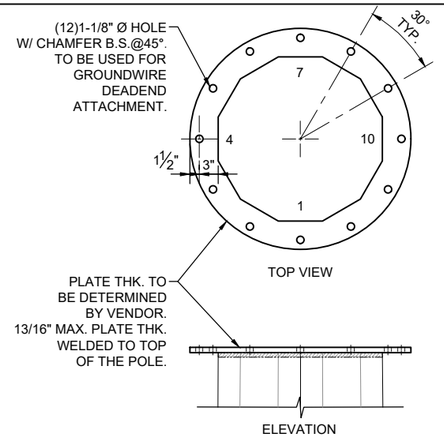
4752.332 APPENDIX-D R00



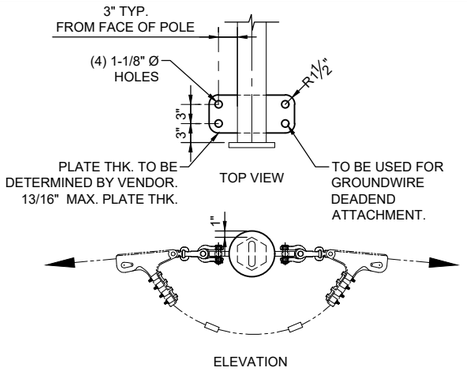
VIEW A-A (OHGW/OPGW)
N.T.S.



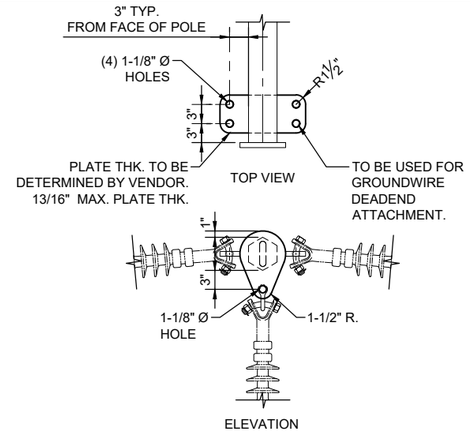
VIEW B-B (CONDUCTORS)
N.T.S.



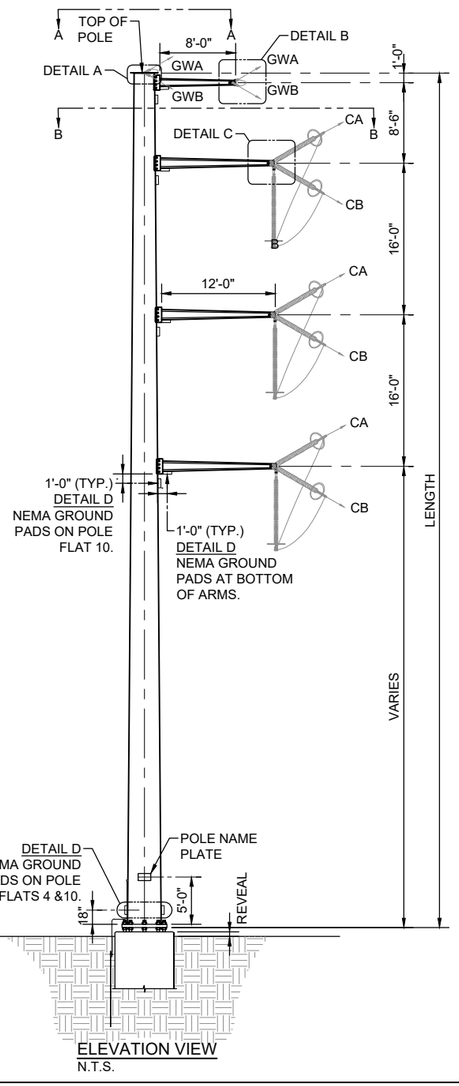
DETAIL A - OPGW/OHGW RING PLATE
N.T.S.



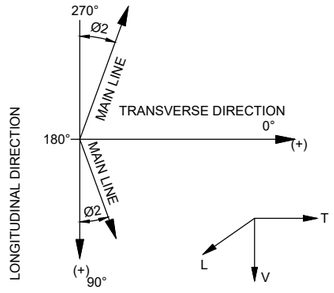
DETAIL B - OPGW ARM END PLATE
N.T.S.



DETAIL C - COND. ARM END PLATE
N.T.S.

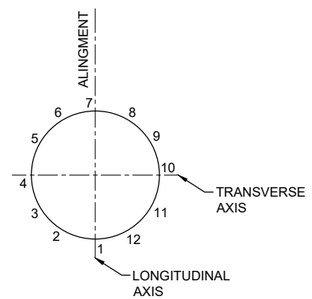


ELEVATION VIEW
N.T.S.

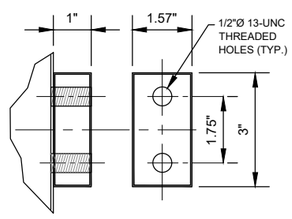


LOAD DIRECTION

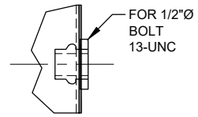
LOAD AXIS



POLE FLAT ORIENTATION



DETAIL D - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S



DETAIL E - RIVNUT 1/2"
N.T.S

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
3. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
4. POLE CAMBERING IS NOT ALLOWED.
5. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
6. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
7. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL E), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0"
8. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
9. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
10. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
11. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
12. ALL CONNECTIONS (ARM CONNECTIONS, FLANGES, BASEPLATES, ANCHOR BOLTS, ETC.) MUST BE DESIGNED TO WITHSTAND A MOMENT EQUIVALENT TO 100% MOMENT CAPACITY OF THE SHAFT.
13. ARM RISE MAY BE ADJUSTED TO FIT ARM CONNECTION ON THE POLE. ATTACHMENT ELEVATION SHALL REMAIN AS SHOWN IN THE ELEVATION VIEW.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

PLS-POLE FILE	STEEL POLE PROPERTY	*DESIGN TYPE	*DESIGN TENSION	*MAX. LINE ANGLE (Ø)	*SPAN (FT)	**LOADING TABLE
SC-ARMS-DE-1	SC-VERT-DE-1	STRAIN DE	15K	30	1,500	DE-1
***SC-ARMS-DE-2	SC-VERT-DE-2	TERMINAL DE	15K	60	1,500	DE-2
		STRAIN DE	22.4K	30	1,500	
***SC-ARMS-DE-3	SC-VERT-DE-3	TERMINAL DE	15K	90	1,500	DE-3
		TERMINAL DE	22.4K	60	1,500	
SC-ARMS-DE-4	SC-VERT-DE-4	TERMINAL DE	22.4K	90	1,500	DE-4

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.
***SHALL BE DESIGNED FOR BOTH CONDITIONS, AS LISTED IN THE TABLE.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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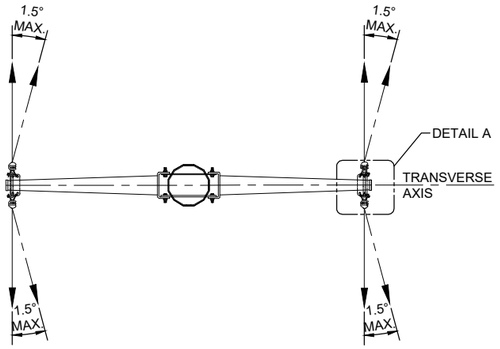
LUMA

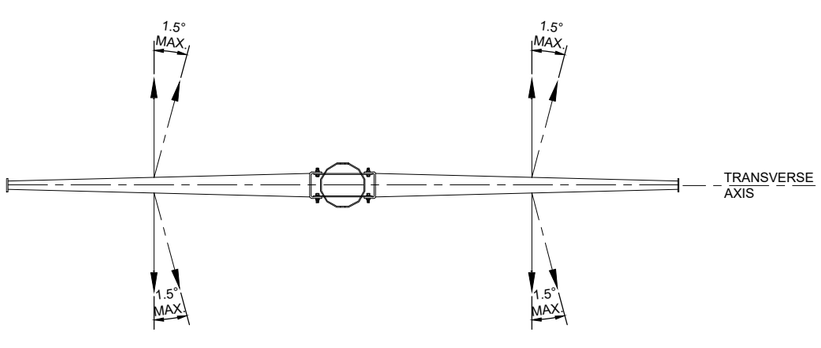
TRANSMISSION LINES ENGINEERING
230kV STEEL POLE, DEADEND
SINGLE CIRCUIT, VERTICAL
WITH ARMS
DE-SC-VERT-ARM

PREPARED: VALENTIN VAZQUEZ	LICENSE: 2766	DATE: 08/22/2023	PROJECT NO.: 14F003410000	TEMPLATE: N/A	SCALE: AS SHOWN
REVIEWED: JUAN MIRANDA	LICENSE: 26800	DATE: 10/27/2023	DRAWING: 4752.332 APPENDIX-D		R00
APPROVED: OSCAR VENEGAS	LICENSE: 23125	DATE: 10/27/2023	SHEET 1 OF 1		



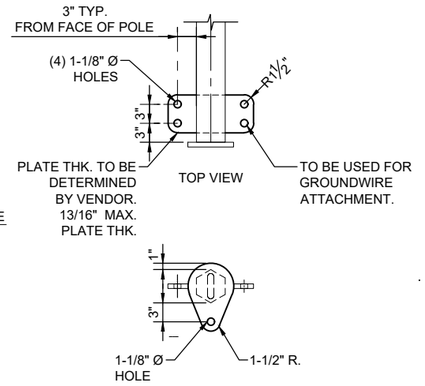
LINE ANGLE = 0°-3°

VIEW A-A (OHGW/OPGW)
N.T.S.

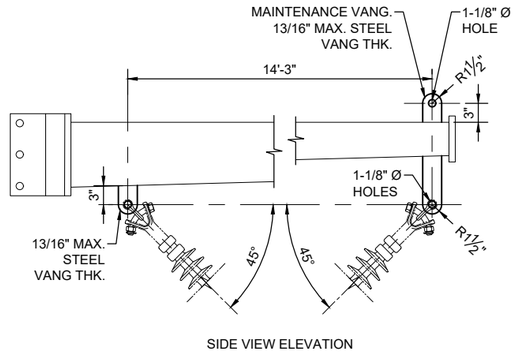


LINE ANGLE = 0°-3°

VIEW B-B (CONDUCTORS)
N.T.S.

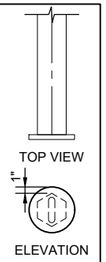


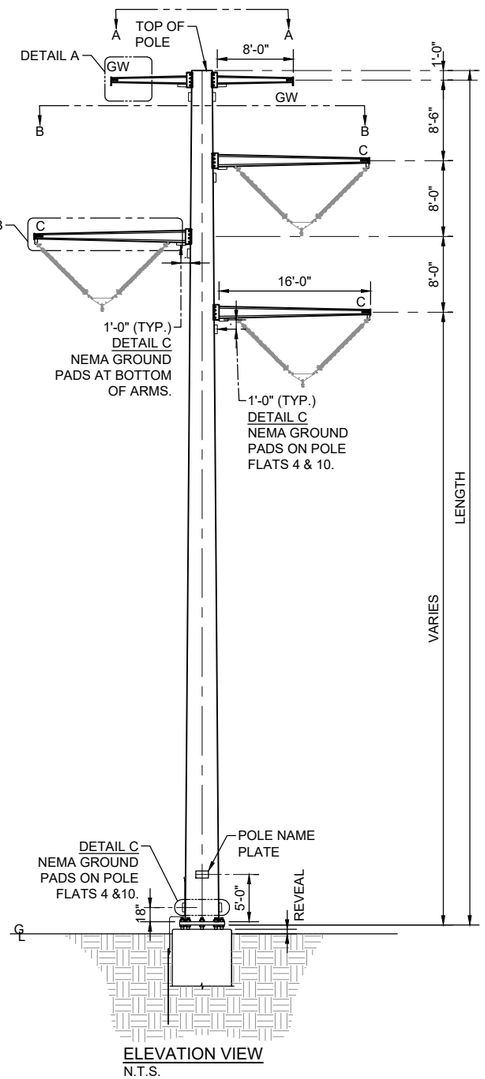
DETAIL A - OPGW / OHGW HORIZONTAL VANG FOR DEADEND ATTACHMENT AND ARM END PLATE FOR SUSPENSION ATTACHMENT
N.T.S.



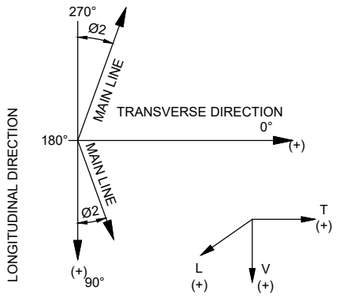
SIDE VIEW ELEVATION

DETAIL B - VANG FOR INSULATOR ON ARM
N.T.S



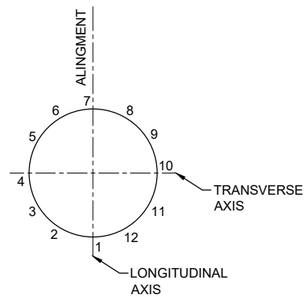


ELEVATION VIEW
N.T.S.

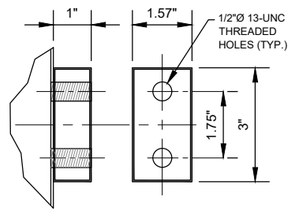


LOAD DIRECTION

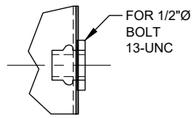
LOAD AXIS



POLE FLAT ORIENTATION



DETAIL C - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S



DETAIL D - RIVNUT 1/2"
N.T.S

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
3. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
4. POLE CAMBERING IS NOT ALLOWED.
5. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
6. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
7. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL D), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0
8. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
9. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
10. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
11. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
12. ALL CONNECTIONS (ARM CONNECTIONS, FLANGES, BASEPLATES, ANCHOR BOLTS, ETC.) MUST BE DESIGNED TO WITHSTAND A MOMENT EQUIVALENT TO 100% MOMENT CAPACITY OF THE SHAFT.
13. STEEL POLES FOR 4752.332 APPENDIX-E (SU-SC-DELTA-ARM-V-03) & 4752.332 APPENDIX-G (SU-SC-VERT-ARM-V-03) SHOULD BE INTERCHANGEABLE FOR THE SAME HEIGHT. THIS MEANS ALL HARDWARE REQUIRED FOR EITHER CONFIGURATION SHOULD BE PRESENT ON THE POLE AND THE POLE PROPERTIES OF BOTH SHALL BE IDENTICAL.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS
4751.120 - V-STRING SPECIFICATION FOR 115KV & 230KV

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

PLS-POLE FILE	*DESIGN TYPE	*SPAN (FT)	*MAX. LINE ANGLE (Ø)	**LOADING TABLE
SU-SC-DELTA-V-030_0-800ft_Dpier	TANGENT SUSP.	0-800	3	SUSP-800
SU-SC-DELTA-V-03_800-1500ft_Dpier	TANGENT SUSP.	0-1500	3	SUSP-1500

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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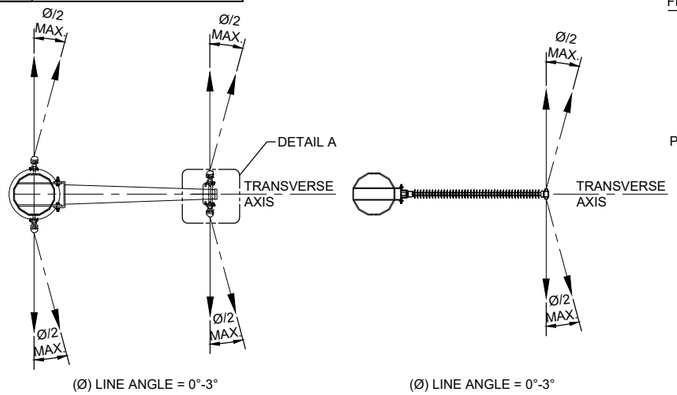
LUMA

TRANSMISSION LINES ENGINEERING
230kV STEEL POLE, TANGENT
SINGLE CIRCUIT, DELTA
WITH ARMS
SU-SC-DELTA-ARM-V-03

PREPARED: VALENTIN VAZQUEZ	LICENSE: 2766	DATE: 08/23/2023	PROJECT NO.: 14F003410000	TEMPLATE: N/A	SCALE: AS SHOWN
REVIEWED: JUAN MIRANDA	LICENSE: 26800	DATE: 10/27/2023	DRAWING: 4752.332 APPENDIX-E		R00
APPROVED: OSCAR VENEGAS	LICENSE: 23125	DATE: 10/27/2023	SHEET 1 OF 1		

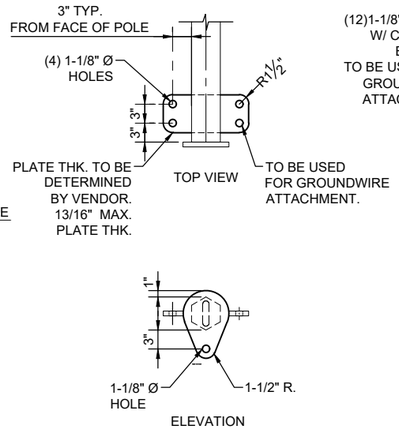


(Ø) LINE ANGLE = 0°-3°

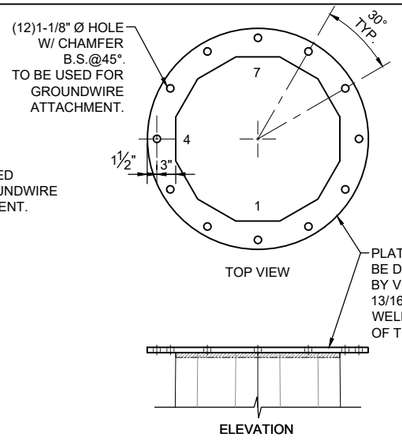
(Ø) LINE ANGLE = 0°-3°

VIEW A-A (OHGW/OPGW)
N.T.S.

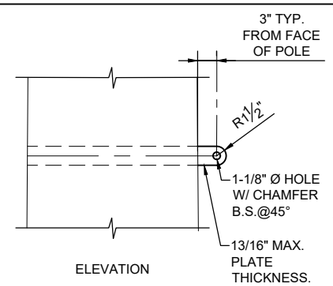
VIEW B-B (CONDUCTORS)
N.T.S.



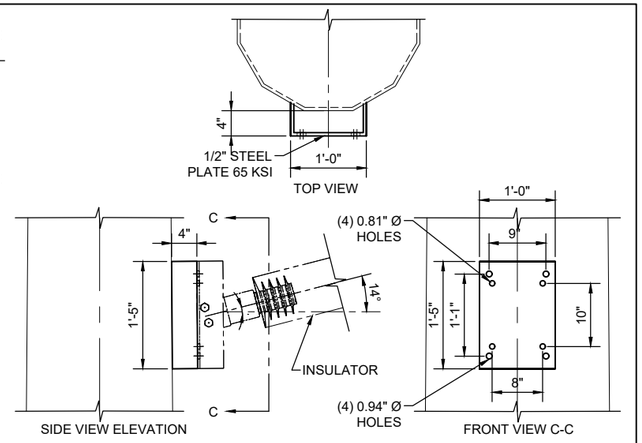
DETAIL A - OPGW / OHGW HORIZONTAL VANG FOR DEADEND ATTACHMENT AND ARM END PLATE FOR SUSPENSION ATTACHMENT
N.T.S.



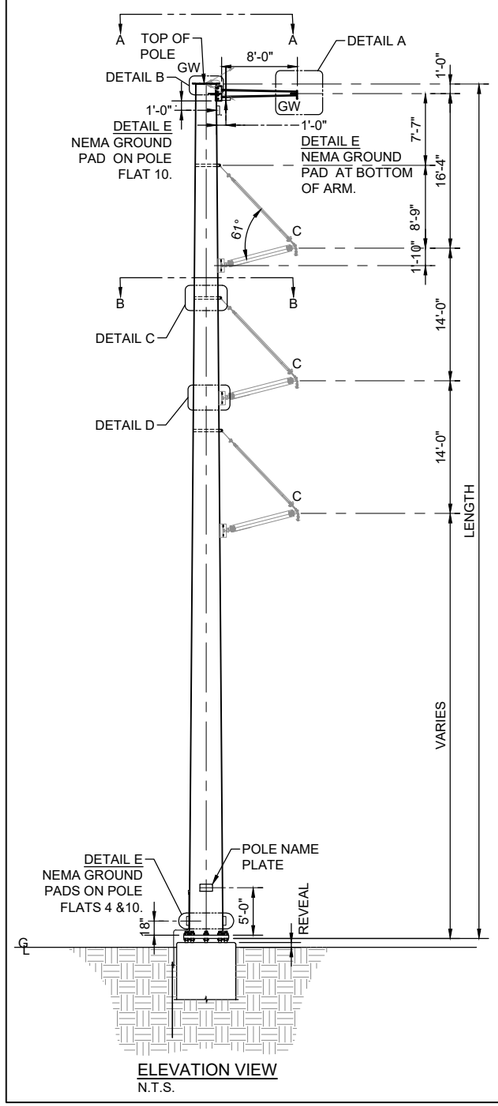
DETAIL B - OPGW/OHGW RING PLATE
N.T.S.

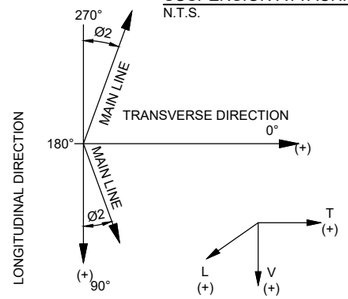


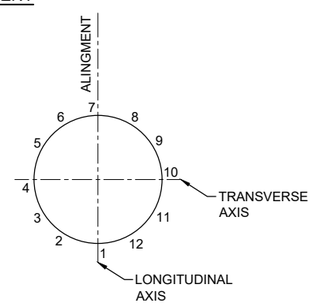
DETAIL C - VANG FOR BRACE ATTACHMENT
N.T.S

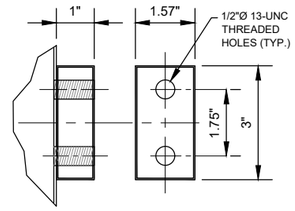


DETAIL D - BRACED POST INSULATOR BRACKET
N.T.S

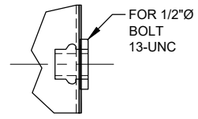








DETAIL E - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S



DETAIL F - RIVNUT 1/2"
N.T.S

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
3. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
4. POLE CAMBERING IS NOT ALLOWED.
5. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
6. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
7. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL F), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0"
8. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
9. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
10. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
11. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
12. LOAD CASE (BROKEN WIRE) TO BE APPLIED ON ONE BROKEN WIRE POSITION AT A TIME, WHILE OTHER WIRES ARE SUBJECTED TO HURRICANE INTACT LOADING. POLE NEEDS TO BE DESIGNED FOR THE WORST COMBINATION.
13. ARM RISE MAY BE ADJUSTED TO FIT ARM CONNECTION ON THE POLE. ATTACHMENT ELEVATION SHALL REMAIN AS SHOWN IN THE ELEVATION VIEW.
14. STEEL POLES FOR 4752.332 APPENDIX-F (SU-SC-VERT-BP) & 4752.332 APPENDIX-O (SU-SC-DELTA-BP) SHOULD BE INTERCHANGEABLE FOR THE SAME HEIGHT. THIS MEANS ALL HARDWARE REQUIRED FOR EITHER CONFIGURATION SHOULD BE PRESENT ON THE POLE AND THE POLE PROPERTIES OF BOTH SHALL BE IDENTICAL.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS
4752.330 - BRACED POST INSULATORS

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

PLS-POLE FILE	*DESIGN TYPE	*SPAN (FT)	*MAX. LINE ANGLE (Ø)	**LOADING TABLE
SU-SC-VERT-BP-03_0-800ft_Dpier	TANGENT SUSP.	0-800	3	SUSP-800
SU-SC-VERT-BP-03_1500ft_Dpier	TANGENT SUSP.	0-1500	3	SUSP-1500

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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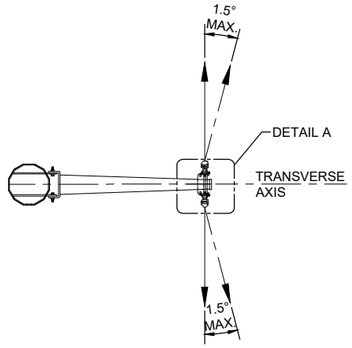
LUMA

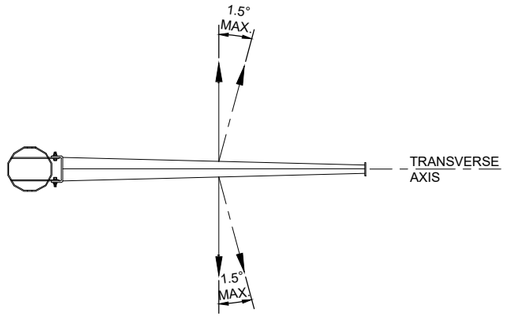
TRANSMISSION LINES ENGINEERING
115kV & 230kV STEEL POLE, TANGENT
SINGLE CIRCUIT, VERTICAL
WITH BRACED POST INSULATORS
SU-SC-VERT-BP

PREPARED: VALENTIN VAZQUEZ	LICENSE: 2766	DATE: 08/23/2023	PROJECT NO.: 14FI003410000	TEMPLATE: N/A	SCALE: AS SHOWN
REVIEWED: JUAN MIRANDA	LICENSE: 26800	DATE: 10/27/2023	DRAWING: 4752.332 APPENDIX-F	
APPROVED: OSCAR VENEGAS	LICENSE: 23125	DATE: 10/27/2023	SHEET 1 OF 1	R00



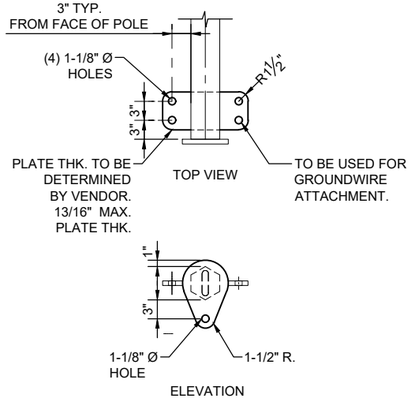
LINE ANGLE = 0°-3°

VIEW A-A (OHGW/OPGW)
N.T.S.

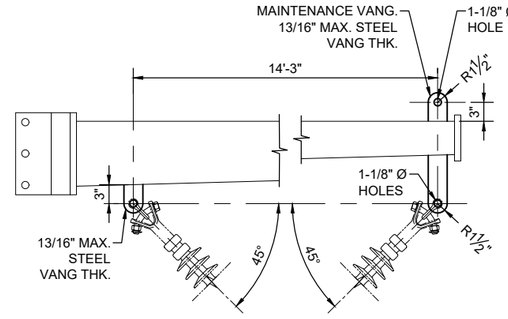


LINE ANGLE = 0°-3°

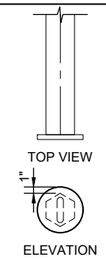
VIEW B-B (CONDUCTORS)
N.T.S.



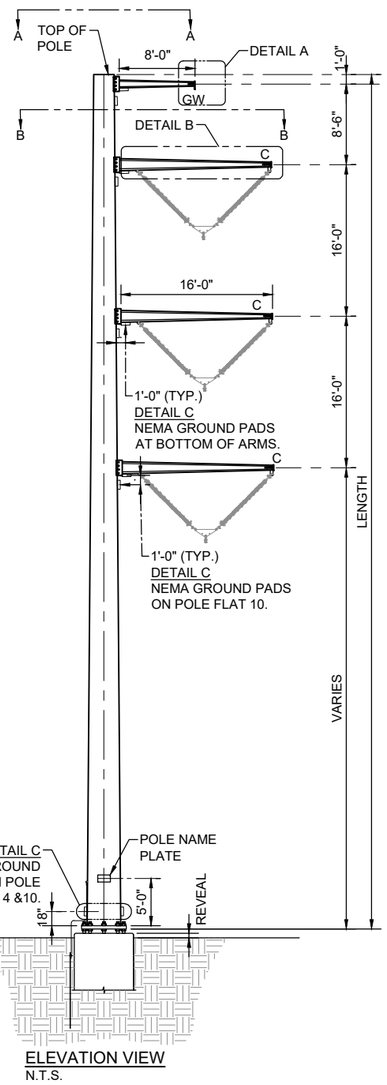
DETAIL A - OPGW / OHGW HORIZONTAL VANG FOR DEADEND ATTACHMENT AND ARM END PLATE FOR SUSPENSION ATTACHMENT
N.T.S.



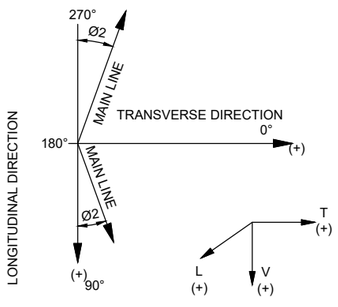
SIDE VIEW ELEVATION



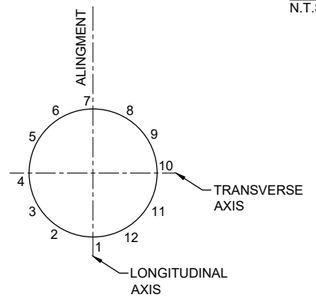
DETAIL B - VANG FOR INSULATOR ON ARM
N.T.S



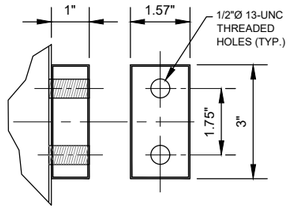
ELEVATION VIEW
N.T.S.



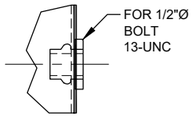
LOAD DIRECTION LOAD AXIS



POLE FLAT ORIENTATION



DETAIL C - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S



DETAIL D - RIVNUT 1/2"
N.T.S

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
3. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
4. POLE CAMBERING IS NOT ALLOWED.
5. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
6. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
7. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL D), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0
8. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
9. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
10. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
11. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
12. ALL CONNECTIONS (ARM CONNECTIONS, FLANGES, BASEPLATES, ANCHOR BOLTS, ETC.) MUST BE DESIGNED TO WITHSTAND A MOMENT EQUIVALENT TO 100% MOMENT CAPACITY OF THE SHAFT.
13. STEEL POLES FOR 4752.332 APPENDIX-E (SU-SC-DELTA-ARM-V-03) & 4752.332 APPENDIX-G (SU-SC-VERT-ARM-V-03) SHOULD BE INTERCHANGEABLE FOR THE SAME HEIGHT. THIS MEANS ALL HARDWARE REQUIRED FOR EITHER CONFIGURATION SHOULD BE PRESENT ON THE POLE AND THE POLE PROPERTIES OF BOTH SHALL BE IDENTICAL.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS
4751.120 - V-STRING SPECIFICATION FOR 115KV & 230KV

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

PLS-POLE FILE	*DESIGN TYPE	*SPAN (FT)	*MAX. LINE ANGLE (Ø)	**LOADING TABLE
SU-SC-VERT-V-030_0-800ft_Dpier	TANGENT SUSP.	0-800	3	SUSP-800
SU-SC-VERT-V-03_1500ft_Dpier	TANGENT SUSP.	0-1500	3	SUSP-1500

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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LUMA

TRANSMISSION LINES ENGINEERING
230kV STEEL POLE, TANGENT
SINGLE CIRCUIT, VERTICAL
WITH ARMS
SU-SC-VERT-ARM-V-03

PREPARED	LICENSE	DATE	PROJECT NO.	TEMPLATE	SCALE
VALENTIN VAZQUEZ	2766	08/23/2023	14F003410000	N/A	AS SHOWN
REVIEWED	LICENSE	DATE	DRAWING		
JUAN MIRANDA	26800	10/27/2023	4752.332 APPENDIX-G		R00
APPROVED	LICENSE	DATE	SHEET 1 OF 1		
OSCAR VENEGAS	23125	10/27/2023			

LOADING TABLE SUSP-800: TANGENT - 800ft - 0-3deg

LOADING CONDITIONS	LOAD FACTOR	STRUCTURE WIND (PSF)	CONDUCTOR (C)			OPGW/OHGW (GW)		
			V	T	L	V	T	L
			(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)
HURRICANE 160MPH	1.1	72.1	1.5	7.6	-	0.5	3.7	-
BROKEN OPGW	1.1	72.1	1.5	7.6	-	0.3	1.9	14.1
BROKEN COND.	1.1	72.1	0.8	3.8	24.7	0.5	3.7	-

22400 LBS CONDUCTOR TENSION @60F, UNDER HURRICANE 160MPH USED FOR ALL CASES IN THIS TABLE.
12800 LBS GROUND WIRE TENSION @60F, UNDER HURRICANE 160MPH USED FOR ALL CASES IN THIS TABLE.

LOADING TABLE SUSP-1500: TANGENT - 1500FT- 0-3DEG

LOADING CONDITIONS	LOAD FACTOR	STRUCTURE WIND (PSF)	CONDUCTOR (C)			OPGW/OHGW (GW)		
			V	T	L	V	T	L
			(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)
HURRICANE 160MPH	1.1	72.1	2.5	13.1	-	0.8	6.3	-
BROKEN OPGW	1.1	72.1	2.5	13.1	-	0.4	3.2	14.1
BROKEN COND.	1.1	72.1	1.3	6.6	24.7	0.8	6.3	-

22400 LBS CONDUCTOR TENSION @60F, UNDER HURRICANE 160MPH USED FOR ALL CASES IN THIS TABLE.
12800 LBS GROUND WIRE TENSION @60F, UNDER HURRICANE 160MPH USED FOR ALL CASES IN THIS TABLE.

LOADING TABLE DE-1: STRAIN - 0-30 DEG 15K - 1600FT

LOADING CONDITIONS	LOAD FACTOR	STRUCTURE WIND (PSF)	CONDUCTOR (CA)			OPGW/OHGW (GWA)			CONDUCTOR (CB)			OPGW/OHGW (GWB)		
			V	T	L	V	T	L	V	T	L	V	T	L
			(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)
HURRICANE 160MPH, INTACT 30 DEG	1.1	72.1	1.5	10.6	16.0	0.5	5.4	9.2	1.5	10.6	-16.0	0.5	5.4	-9.2
CONSTRUCTION, 0DEG	1.5	4.5	2.0	0.4	5.3	0.7	0.2	2.1	0.3	-	-	0.2	-	-
BROKEN OPGW, 0DEG	1.1	72.1	1.5	6.3	16.5	0.5	3.0	9.5	0.3	-	-	0.2	-	-
BROKEN COND., 0DEG	1.1	72.1	1.5	6.3	16.5	0.5	3.0	9.5	0.3	-	-	0.2	-	-

15000 LBS CONDUCTOR TENSION @60F, UNDER HURRICANE 160MPH AND BROKEN WIRE.
12800 LBS GROUND WIRE TENSION @60F, UNDER HURRICANE 160MPH USED FOR ALL CASES IN THIS TABLE.
8600 LBS GROUND WIRE TENSION @60F, UNDER HURRICANE 160MPH AND BROKEN WIRE.
3500 LBS CONDUCTOR TENSION @60F, CONSTRUCTION CASE.
1400 LBS GROUND WIRE TENSION @60F, CONSTRUCTION CASE

LOADING TABLE DE-2: STRAIN - 0-30 DEG 22.4K - 1600FT & TERMINAL DE- 0-60 DEG 15K - 1600FT

LOADING CONDITIONS	LOAD FACTOR	STRUCTURE WIND (PSF)	CONDUCTOR (CA)			OPGW/OHGW (GWA)			CONDUCTOR (CB)			OPGW/OHGW (GWB)		
			V	T	L	V	T	L	V	T	L	V	T	L
			(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)
HURRICANE 160MPH, INTACT 30 DEG & 22.4K	1.1	72.1	1.5	12.7	23.9	0.5	6.6	13.7	1.5	12.7	-23.9	0.5	6.6	-13.7
CONSTRUCTION, 0 DEG & 22.4K	1.5	4.5	2.0	0.4	9.3	0.7	0.2	6.8	0.3	-	-	0.2	-	-
BROKEN OPGW, 0 DEG & 22.4K	1.1	72.1	1.5	6.3	24.7	0.5	3.0	14.1	0.3	-	-	0.2	-	-
BROKEN COND. 0 DEG & 22.4K	1.1	72.1	1.5	6.3	24.7	0.5	3.0	14.1	0.3	-	-	0.2	-	-
HURRICANE 160MPH, INTACT 60 DEG & 15K	1.1	72.1	1.5	14.6	14.3	0.5	7.7	8.2	1.5	14.6	-14.3	0.5	7.7	-8.2
HURRICANE 160MPH, DE 60 DEG & 15K	1.2	78.6	1.6	15.9	15.6	0.5	8.4	9.0	0.3	-	-	0.2	-	-
HURRICANE 160MPH, DE 0 DEG & 15K	1.2	78.6	1.6	6.9	18.0	0.5	3.2	10.4	0.3	-	-	0.2	-	-

22400 LBS CONDUCTOR TENSION @60F, UNDER HURRICANE 160MPH AND BROKEN WIRE 22.4K CASES.
12800 LBS GROUND WIRE TENSION @60F, UNDER HURRICANE 160MPH AND BROKEN WIRE 22.4K CASES.
6200 LBS CONDUCTOR TENSION @60F, CONSTRUCTION CASE.
4500 LBS GROUND WIRE TENSION @60F, CONSTRUCTION CASE.
15000 LBS CONDUCTOR TENSION @60F, UNDER HURRICANE 160MPH AND BROKEN WIRE 15K CASES.
8600 LBS GROUND WIRE TENSION @60F, UNDER HURRICANE 160MPH AND BROKEN WIRE 15K CASES.

LOADING TABLE DE-3: TERMINAL DE- 0-60 DEG 22.4K - 1600FT & TERMINAL DE- 60-90 DEG 15K - 1600FT

LOADING CONDITIONS	LOAD FACTOR	STRUCTURE WIND (PSF)	CONDUCTOR (CA)			OPGW/OHGW (GWA)			CONDUCTOR (CB)			OPGW/OHGW (GWB)		
			V	T	L	V	T	L	V	T	L	V	T	L
			(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)
HURRICANE 160MPH, INTACT 60 DEG & 22.4K	1.1	72.1	1.5	18.6	21.4	0.5	10.0	12.2	1.5	18.6	-21.4	0.5	10.0	-12.2
HURRICANE 160MPH, DE 60 DEG & 22.4K	1.2	78.6	1.6	20.3	23.3	0.5	10.9	13.4	0.3	-	-	0.2	-	-
HURRICANE 160MPH, DE 0 DEG & 22.4K	1.2	78.6	1.6	6.9	26.9	0.5	3.2	15.4	0.3	-	-	0.2	-	-
HURRICANE 160MPH, INTACT 90 DEG & 15K	1.1	72.1	1.5	18.0	11.7	0.5	9.7	6.7	1.5	18.0	-11.7	0.5	9.7	-6.7
HURRICANE 160MPH, DE 90 DEG & 15K	1.2	78.6	1.6	19.6	12.8	0.5	10.5	7.3	0.3	-	-	0.2	-	-

22400 LBS CONDUCTOR TENSION @60F, UNDER HURRICANE 160MPH AND BROKEN WIRE 22.4K CASES.
12800 LBS GROUND WIRE TENSION @60F, UNDER HURRICANE 160MPH AND BROKEN WIRE 22.4K CASES.
15000 LBS CONDUCTOR TENSION @60F, UNDER HURRICANE 160MPH AND BROKEN WIRE 15K CASES.
8600 LBS GROUND WIRE TENSION @60F, UNDER HURRICANE 160MPH AND BROKEN WIRE 15K CASES.

LOADING TABLE DE-4: TERMINAL DE- 60-90 DEG 22.4K - 1600FT

LOADING CONDITIONS	LOAD FACTOR	STRUCTURE WIND (PSF)	CONDUCTOR (CA)			OPGW/OHGW (GWA)			CONDUCTOR (CB)			OPGW/OHGW (GWB)		
			V	T	L	V	T	L	V	T	L	V	T	L
			(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)	(KIPS)
HURRICANE 160MPH, INTACT 90 DEG & 22.4K	1.1	72.1	1.5	23.7	17.5	0.5	12.9	10.0	1.5	23.7	-17.5	0.5	12.9	-10.0
HURRICANE 160MPH, DE 90 DEG & 22.4K	1.2	78.6	1.6	25.9	19.1	0.5	14.1	10.9	0.3	-	-	0.2	-	-
HURRICANE 160MPH, DE 60 DEG & 22.4K	1.2	78.6	1.6	20.3	23.3	0.5	10.9	13.4	0.3	-	-	0.2	-	-

22400 LBS CONDUCTOR TENSION @60F, UNDER HURRICANE 160MPH USED FOR ALL CASES IN THIS TABLE.
12800 LBS GROUND WIRE TENSION @60F, UNDER HURRICANE 160MPH USED FOR ALL CASES IN THIS TABLE.

LOADING NOTES:

1. ALL LOADS IN THE TABLE INCLUDE OVERLOAD FACTORS INCLUDING STRUCTURE WIND PRESSURE.
2. WIND PRESSURE SHALL BE APPLIED IN THE DIRECTION THAT PRODUCES MAXIMUM STRESSES.
3. FOR CONSTRUCTION LOAD CASES, THE DEFLECTION OF THE STRUCTURE SHALL BE RESTRICTED TO 2% OF THE POLE HEIGHT.
4. MAXIMUM DEFLECTION OF THE POLE SHALL BE RESTRICTED TO 8% OF THE POLE HEIGHT UNDER ALL INTACT CASES
5. BROKEN WIRE LOAD CASE SHALL BE APPLIED FOR ONE WIRE POSITION AT A TIME. FOR THE INTACT WIRE POSITIONS USE HURRICANE INTACT LOADING.
6. THE CONSTRUCTION LOAD CASE CONSIDERS A DE CONDITION UNDER 3PSF WIND AND 60F WEATHER CONDITIONS, WERE ALL AHEAD OR ALL BACK WIRES ARE INSTALLED.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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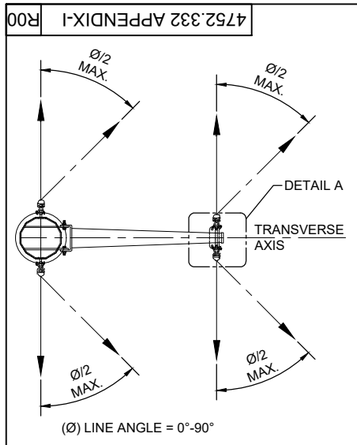
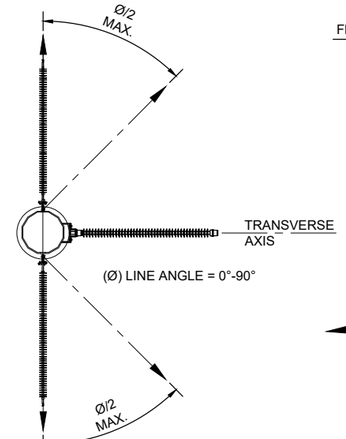
LUMA

TRANSMISSION LINES ENGINEERING
115kV & 230kV STEEL POLES
STRUCTURE LOADS

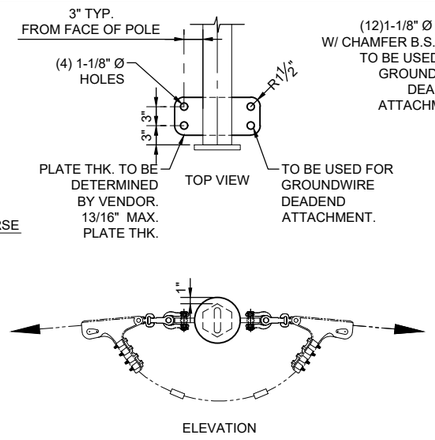
PREPARED: VALENTIN VAZQUEZ	LICENSE: 2766	DATE: 08/17/2023	PROJECT NO.: 14F003410000	TEMPLATE: N/A	SCALE: AS SHOWN
REVIEWED: JUAN MIRANDA	LICENSE: 26800	DATE: 10/27/2023	DRAWING: 4752.332 APPENDIX-H		R00
APPROVED: OSCAR VENEGAS	LICENSE: 23125	DATE: 10/27/2023	SHEET 1 OF 1		



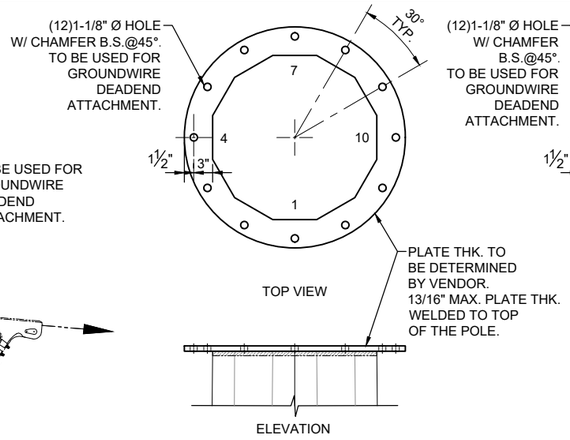
VIEW A-A (OHGW/OPGW)
N.T.S.



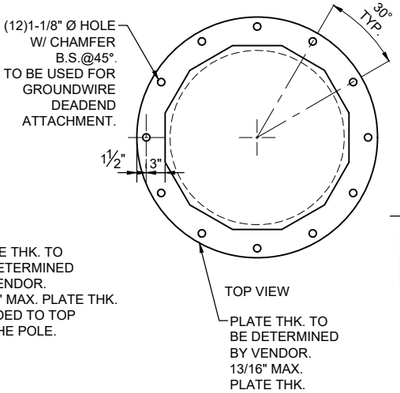
VIEW B-B (CONDUCTORS)
N.T.S.



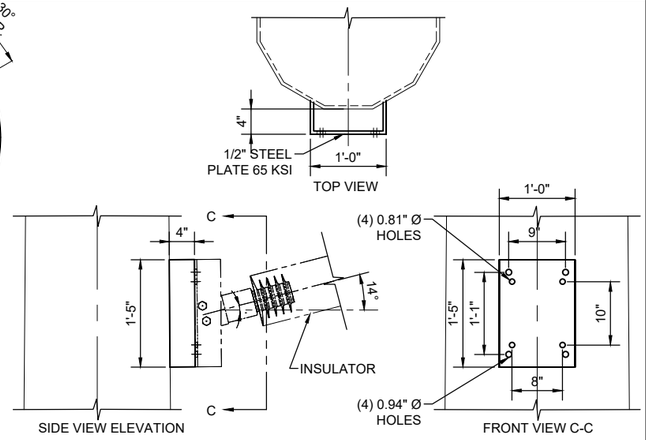
DETAIL A - OPGW ARM END PLATE
N.T.S.



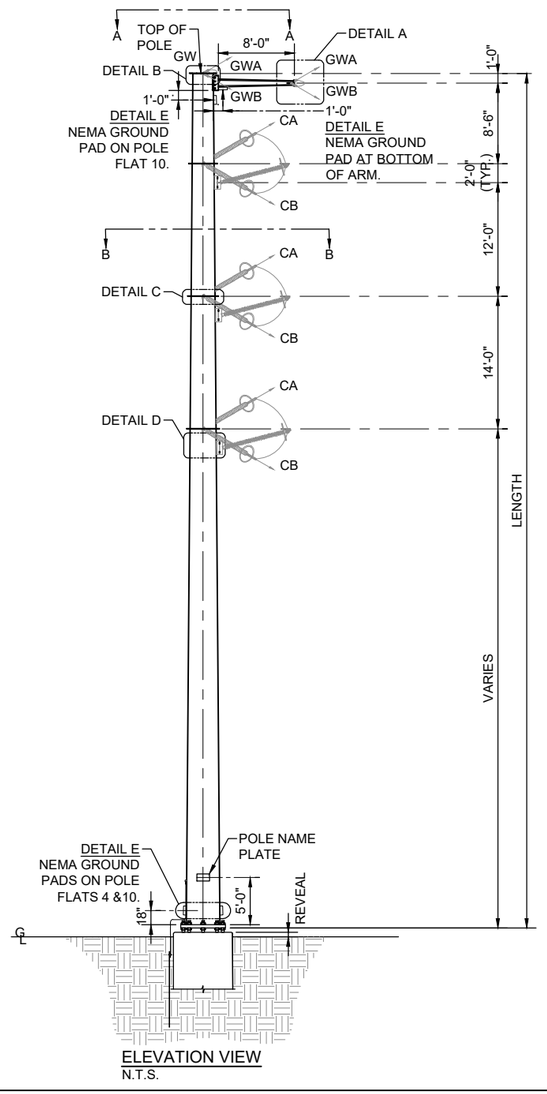
DETAIL B - OPGW/OHGW RING PLATE
N.T.S.



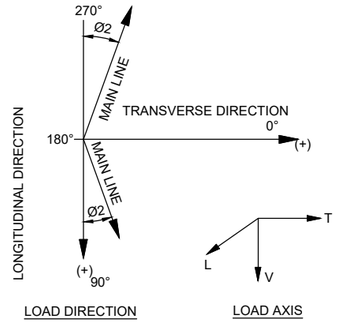
DETAIL C - COND. RING PLATE
N.T.S



DETAIL D - JUMPER POST INSULATOR BRACKET
N.T.S

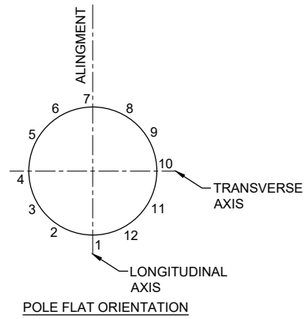


ELEVATION VIEW
N.T.S.

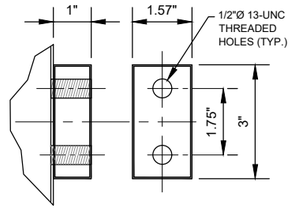


LOAD DIRECTION

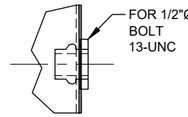
LOAD AXIS



POLE FLAT ORIENTATION



DETAIL E - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S



DETAIL F - RIVNUT 1/2"
N.T.S

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
3. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
4. POLE CAMBERING IS NOT ALLOWED.
5. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
6. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
7. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL F), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0"
8. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
9. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
10. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
11. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
12. ALL CONNECTIONS (ARM CONNECTIONS, FLANGES, BASEPLATES, ANCHOR BOLTS, ETC.) MUST BE DESIGNED TO WITHSTAND A MOMENT EQUIVALENT TO 100% MOMENT CAPACITY OF THE SHAFT.
13. ARM RISE MAY BE ADJUSTED TO FIT ARM CONNECTION ON THE POLE. ATTACHMENT ELEVATION SHALL REMAIN AS SHOWN IN THE ELEVATION VIEW.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

PLS-POLE FILE	*DESIGN TYPE	*DESIGN TENSION	*MAX. LINE ANGLE (Ø)	*SPAN (FT)	**LOADING TABLE
SC-VERT-DE-1	STRAIN DE	15K	30	1,500	DE-1
***SC-VERT-DE-2	TERMINAL DE	15K	60	1,500	DE-2
	STRAIN DE	22.4K	30	1,500	
***SC-VERT-DE-3	TERMINAL DE	15K	90	1,500	DE-3
	TERMINAL DE	22.4K	60	1,500	
SC-VERT-DE-4	TERMINAL DE	22.4K	90	1,500	DE-4

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.
***SHALL BE DESIGNED FOR BOTH CONDITIONS, AS LISTED IN THE TABLE.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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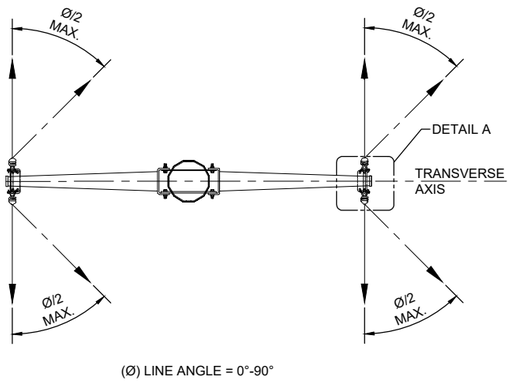
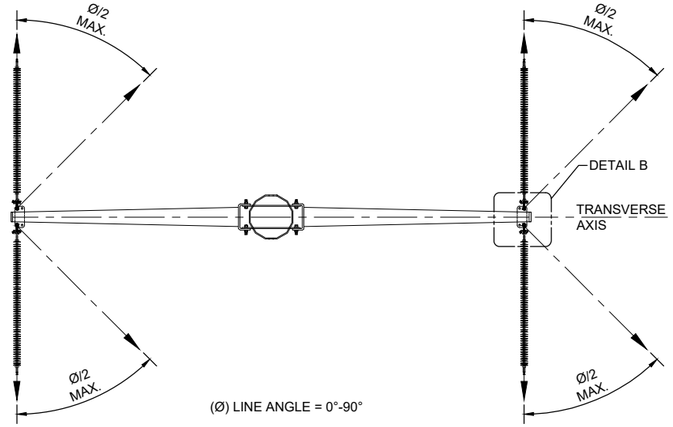
LUMA

TRANSMISSION LINES ENGINEERING
115kV & 230kV STEEL POLE, DEADEND
SINGLE CIRCUIT, VERTICAL
WITH LINE POST INSULATORS
DE-SC-VERT

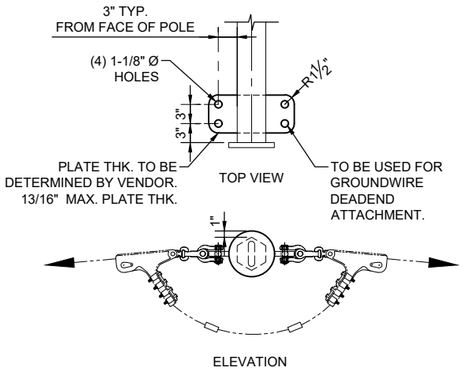
PREPARED	LICENSE	DATE	PROJECT NO.	TEMPLATE	SCALE
VALENTIN VAZQUEZ	2766	08/22/2023	14F003410000	N/A	AS SHOWN
REVIEWED	LICENSE	DATE	DRAWING		
JUAN MIRANDA	26800	10/27/2023	4752.332 APPENDIX-I		R00
APPROVED	LICENSE	DATE	SHEET 1 OF 1		
OSCAR VENEGAS	23125	10/27/2023			



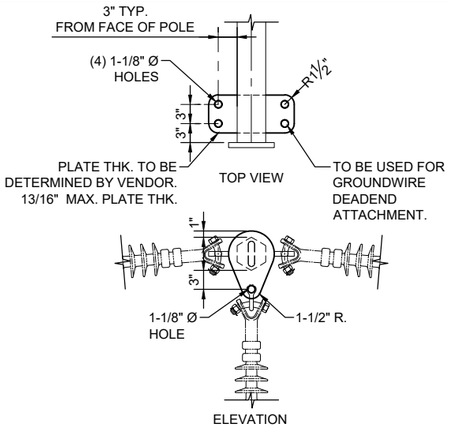
VIEW A-A (OHGW/OPGW)
N.T.S.



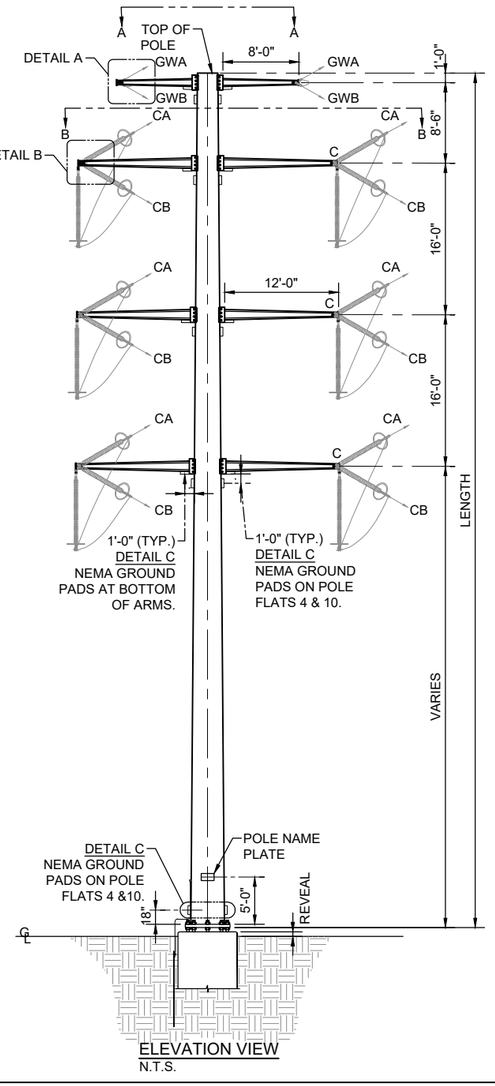
VIEW B-B (CONDUCTORS)
N.T.S.



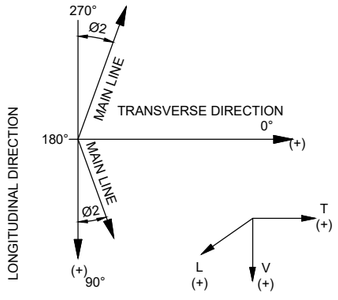
DETAIL A - OPGW ARM END PLATE
N.T.S.



DETAIL B - COND. ARM END PLATE
N.T.S.

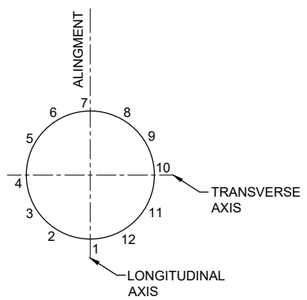


ELEVATION VIEW
N.T.S.

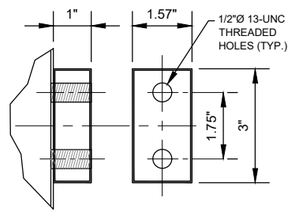


LOAD DIRECTION

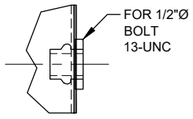
LOAD AXIS



POLE FLAT ORIENTATION



DETAIL C - 2 HOLES NEMA
GROUND PAD STAINLESS STEEL
N.T.S



DETAIL D - RIVNUT 1/2"
N.T.S

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
3. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
4. POLE CAMBERING IS NOT ALLOWED.
5. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
6. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
7. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL D), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0"
8. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
9. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
10. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
11. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
12. ALL CONNECTIONS (ARM CONNECTIONS, FLANGES, BASEPLATES, ANCHOR BOLTS, ETC.) MUST BE DESIGNED TO WITHSTAND A MOMENT EQUIVALENT TO 100% MOMENT CAPACITY OF THE SHAFT.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

PLS-POLE FILE	*DESIGN TYPE	*DESIGN TENSION	*MAX. LINE ANGLE (Ø)	*SPAN (FT)	**LOADING TABLE
DC-ARMS-DE-1	STRAIN DE	15K	30	1,500	DE-1
***DC-ARMS-DE-2	TERMINAL DE	15K	60	1,500	DE-2
	STRAIN DE	22.4K	30	1,500	
***DC-ARMS-DE-3	TERMINAL DE	15K	90	1,500	DE-3
	TERMINAL DE	22.4K	60	1,500	
DC-ARMS-DE-4	TERMINAL DE	22.4K	90	1,500	DE-4

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.
***SHALL BE DESIGNED FOR BOTH CONDITIONS, AS LISTED IN THE TABLE.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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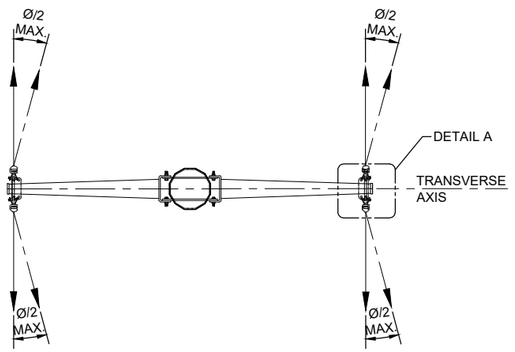
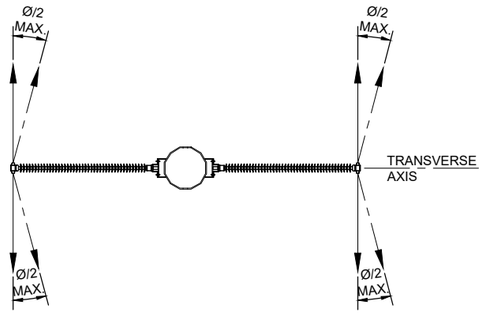
LUMA

TRANSMISSION LINES ENGINEERING
115kV & 230kV STEEL POLE, DEADEND
DOUBLE CIRCUIT, VERTICAL
WITH ARMS
DE-DC-VERT-ARM

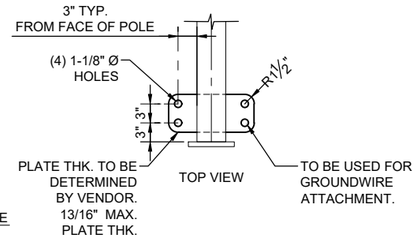
PREPARED	LICENSE	DATE	PROJECT NO.	TEMPLATE	SCALE
VALENTIN VAZQUEZ	2766	08/17/2023	14F003410000	N/A	AS SHOWN
REVIEWED	LICENSE	DATE	DRAWING		
JUAN MIRANDA	26800	10/27/2023	4752.332 APPENDIX-J		R00
APPROVED	LICENSE	DATE	SHEET 1 OF 1		
OSCAR VENEGAS	23125	10/27/2023			

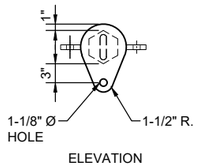


(Ø) LINE ANGLE = 0°-3°

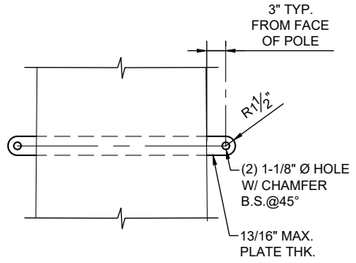


(Ø) LINE ANGLE = 0°-3°

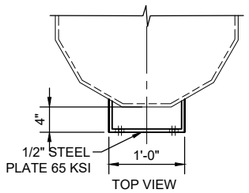




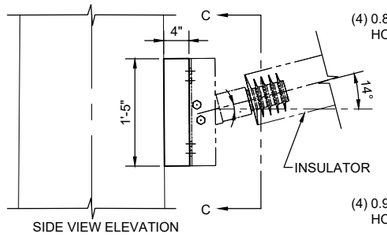
ELEVATION



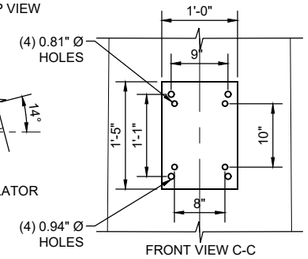
ELEVATION



TOP VIEW

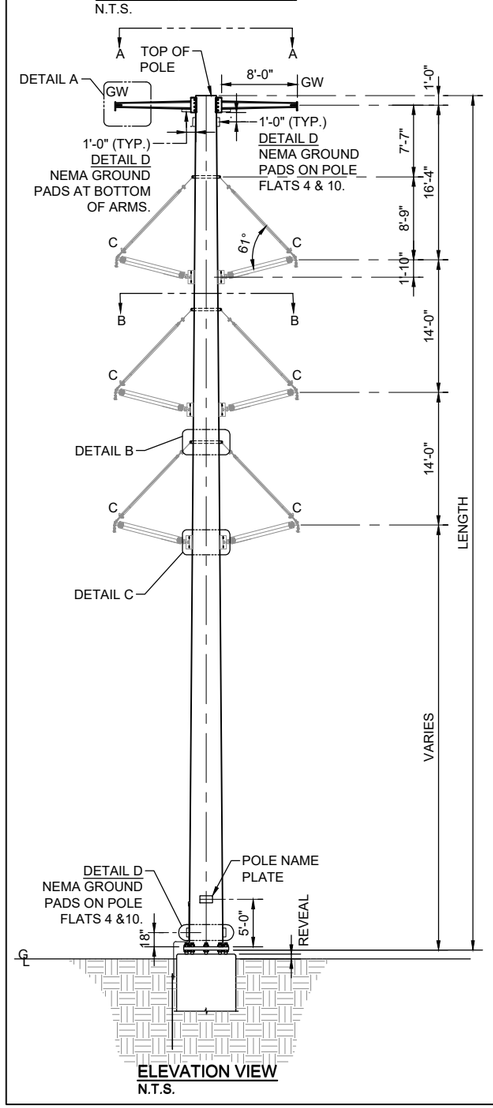


SIDE VIEW ELEVATION



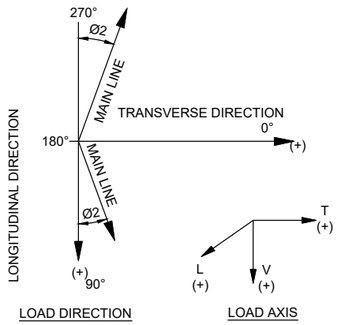
FRONT VIEW C-C

VIEW A-A (OHGW/OPGW)
N.T.S.



ELEVATION VIEW
N.T.S.

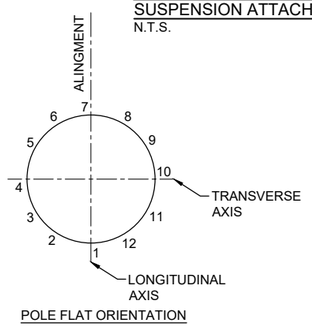
VIEW B-B (CONDUCTORS)
N.T.S.



LOAD DIRECTION

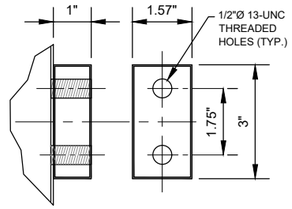
LOAD AXIS

DETAIL A - OPGW / OHGW HORIZONTAL VANG FOR DEADEND ATTACHMENT AND ARM END PLATE FOR SUSPENSION ATTACHMENT
N.T.S.

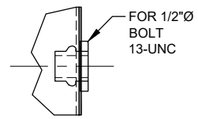


POLE FLAT ORIENTATION

DETAIL B - VANG FOR BRACE ATTACHMENT
N.T.S



DETAIL C - BRACED POST INSULATOR BRACKET
N.T.S



DETAIL D - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S

DETAIL E - RIVNUT 1/2"
N.T.S

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
3. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
4. POLE CAMBERING IS NOT ALLOWED.
5. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
6. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
7. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL E), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0"
8. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
9. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
10. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
11. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
12. LOAD CASE (BROKEN WIRE) TO BE APPLIED ON ONE BROKEN WIRE POSITION AT A TIME, WHILE OTHER WIRES ARE SUBJECTED TO HURRICANE INTACT LOADING. POLE NEEDS TO BE DESIGNED FOR THE WORST COMBINATION.
13. ALL CONNECTIONS (ARM CONNECTIONS, FLANGES, BASEPLATES, ANCHOR BOLTS, ETC.) MUST BE DESIGNED TO WITHSTAND A MOMENT EQUIVALENT TO 100% MOMENT CAPACITY OF THE SHAFT.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS
4752.330 - BRACED POST INSULATORS
4751.120 - V-STRING SPECIFICATION FOR 115KV & 230KV

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

PLS-POLE FILE	*DESIGN TYPE	*SPAN (FT)	*MAX. LINE ANGLE (Ø)	**LOADING TABLE
SU-DC-VERT-BP-03_0-800ft_Dpier	TANGENT SUSP.	0-800	3	SUSP-800
SU-DC-VERT-BP-03_1500ft_Dpier	TANGENT SUSP.	0-1500	3	SUSP-1500

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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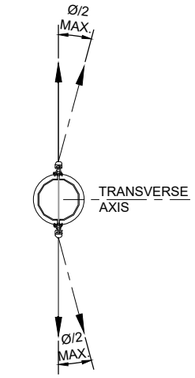
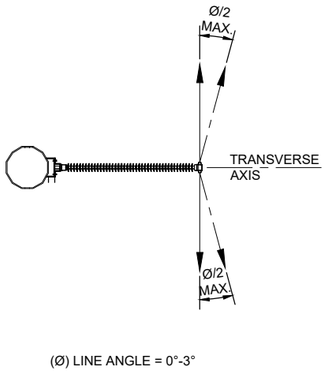
LUMA

TRANSMISSION LINES ENGINEERING
115kV & 230kV STEEL POLE, TANGENT
DOUBLE CIRCUIT, VERTICAL
WITH BRACED POST INSULATORS
SU-DC-VERT-BP

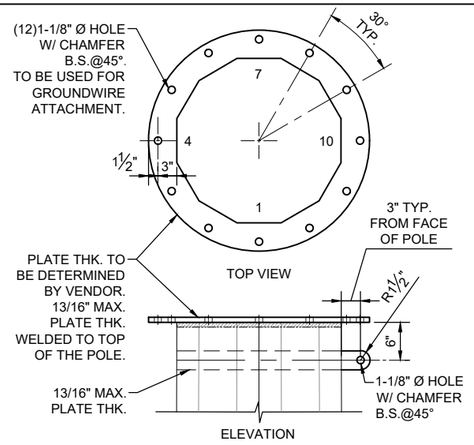
PREPARED: VALENTIN VAZQUEZ	LICENSE: 2766	DATE: 08/21/2023	PROJECT NO.: 14FI003410000	TEMPLATE: N/A	SCALE: AS SHOWN		
REVIEWED: JUAN MIRANDA	LICENSE: 26800	DATE: 10/27/2023	DRAWING: 4752.332 APPENDIX-K				R00
APPROVED: OSCAR VENEGAS	LICENSE: 23125	DATE: 10/27/2023	SHEET 1 OF 1				

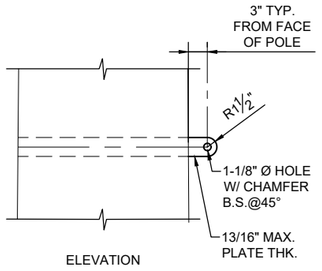


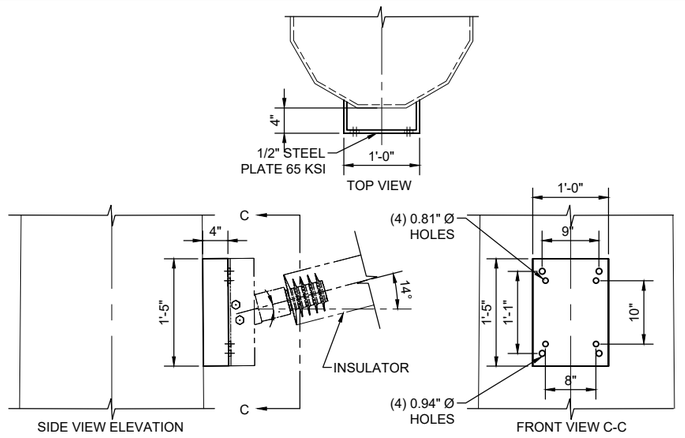
(Ø) LINE ANGLE = 0°-3°

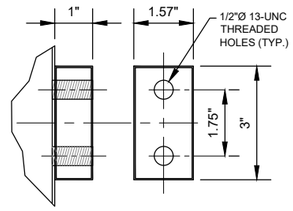


(Ø) LINE ANGLE = 0°-3°

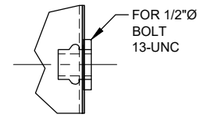








DETAIL D - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S



DETAIL E - RIVNUT 1/2"
N.T.S

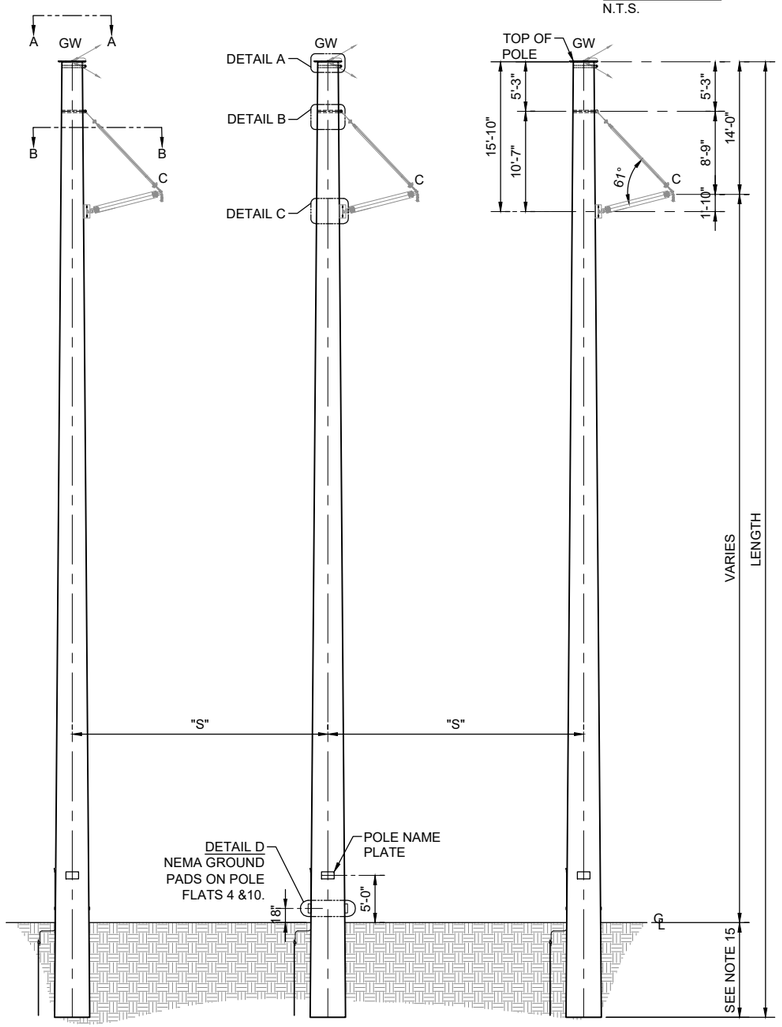
VIEW A-A (OHGW/OPGW)
N.T.S.

VIEW B-B (CONDUCTORS)
N.T.S.

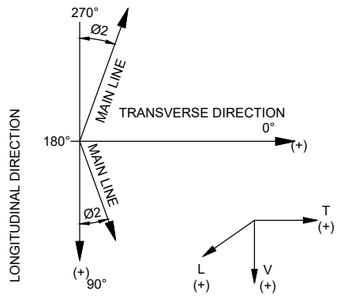
DETAIL A - OPGW / OHGW RING PLATE FOR DEADEND ATTACHMENT AND VANG FOR SUSPENSION ATTACHMENT.
N.T.S.

DETAIL B - VANG FOR BRACE ATTACHMENT
N.T.S

DETAIL C - BRACED POST INSULATOR BRACKET
N.T.S

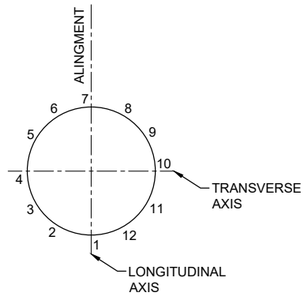


ELEVATION VIEW
N.T.S.



LOAD DIRECTION

LOAD AXIS



POLE FLAT ORIENTATION

PLS-POLE FILE	*DESIGN TYPE	*SPAN (FT)	*MAX. LINE ANGLE (Ø)	"S" (FT)	**LOADING TABLE
SU_3 POLE-POST-03_0-800ft_EMBED	TANGENT SUSP.	0-800	3	TBD	SUSP-800

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. ALL 3 POLES SHOULD BE DESIGNED AND MANUFACTURED IDENTICALLY, INCLUDING ATTACHMENT HARDWARE.
3. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
4. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
5. POLE CAMBERING IS NOT ALLOWED. .
6. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
7. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
8. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL E), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0"
9. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
10. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
11. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
12. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
13. LOAD CASE (BROKEN WIRE) TO BE APPLIED ON ONE BROKEN WIRE POSITION AT A TIME, WHILE OTHER WIRES ARE SUBJECTED TO HURRICANE INTACT LOADING. POLE NEEDS TO BE DESIGNED FOR THE WORST COMBINATION.
14. EMBEDMENT DEPTH TO BE CONSIDERED SHALL BE 10% OF THE OVERALL LENGTH + 6FT.
15. PROVIDE GROUND SLEEVE AND CORROSION PROTECTION AS SPECIFIED IN 4752.332 115KV AND 230 STEEL POLE SPECIFICATIONS.
16. AE TO VERIFY ADEQUATE SHIELDING OF PHASES. MIDDLE POLE SHALL CARRY A SHIELD WIRE IF SHIELDING IS NOT ADEQUATE FOR LARGER SPACING BETWEEN POLE. SPACING "S" TO BE DETERMINED BY THE AE FIRM ACCORDING TO THE FIELD CONDITIONS AND CLEARANCES REQUIRED FOR THE STRUCTURE.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS
4752.330 - BRACED POST INSULATORS

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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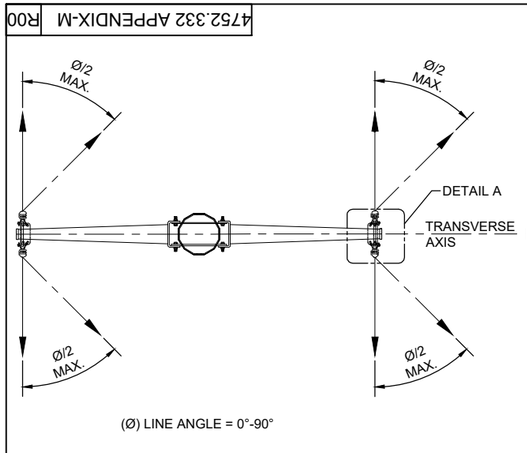
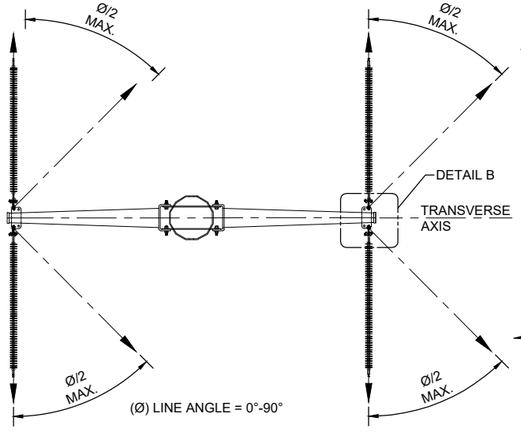
LUMA

TRANSMISSION LINES ENGINEERING
115kV & 230kV STEEL POLE, TANGENT
SINGLE CIRCUIT, 3-POLE
WITH BRACED POST INSULATORS
HSU-SC-3P-HORIZ-010

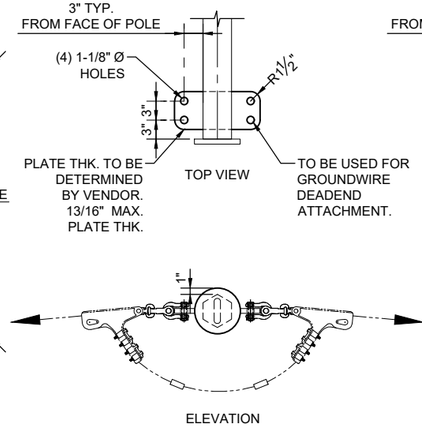
PREPARED: VALENTIN VAZQUEZ	LICENSE: 2766	DATE: 08/16/2023	PROJECT NO.: 14F003410000	TEMPLATE: N/A	SCALE: AS SHOWN
REVIEWED: JUAN MIRANDA	LICENSE: 26800	DATE: 10/27/2023	DRAWING: 4752.332 APPENDIX-L		R00
APPROVED: OSCAR VENEGAS	LICENSE: 23125	DATE: 10/27/2023	SHEET 1 OF 1		



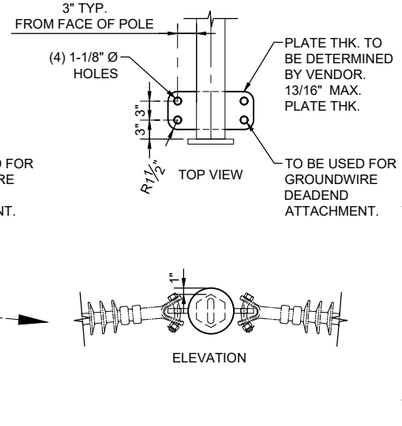
VIEW A-A (OHGW/OPGW)
N.T.S.



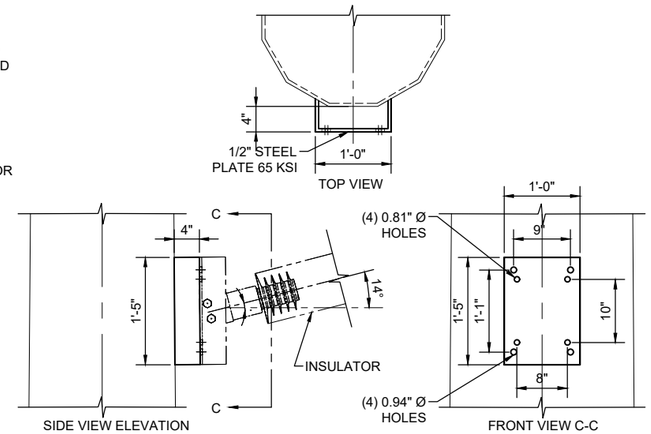
VIEW B-B (CONDUCTORS)
N.T.S.



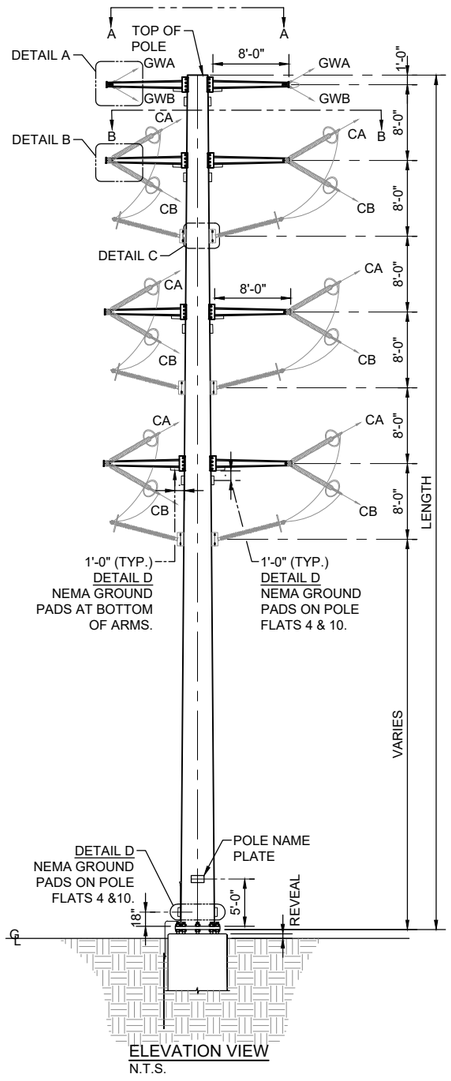
DETAIL A - OPGW ARM END PLATE
N.T.S.



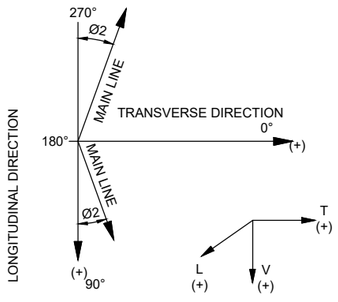
DETAIL B - COND. ARM END PLATE
N.T.S.



DETAIL C - JUMPER POST INSULATOR BRACKET
N.T.S

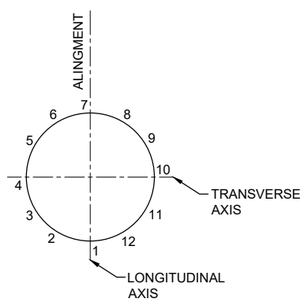


ELEVATION VIEW
N.T.S.

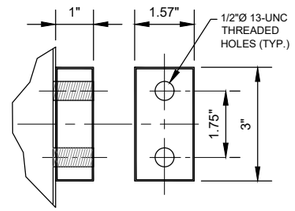


LOAD DIRECTION

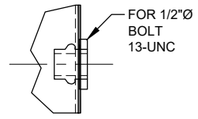
LOAD AXIS



POLE FLAT ORIENTATION



DETAIL D - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S



DETAIL E - RIVNUT 1/2"
N.T.S

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
3. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
4. POLE CAMBERING IS NOT ALLOWED.
5. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
6. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
7. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL E), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0"
8. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
9. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
10. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
11. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
12. ALL CONNECTIONS (ARM CONNECTIONS, FLANGES, BASEPLATES, ANCHOR BOLTS, ETC.) MUST BE DESIGNED TO WITHSTAND A MOMENT EQUIVALENT TO 100% MOMENT CAPACITY OF THE SHAFT.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

PLS-POLE FILE	*DESIGN TYPE	*DESIGN TENSION	*MAX. LINE ANGLE (Ø)	*SPAN (FT)	**LOADING TABLE
DC-SHORTARMS-DE-1	STRAIN DE	15K	30	1,500	DE-1
***DC-SHORTARMS-DE-2	TERMINAL DE	15K	60	1,500	DE-2
	STRAIN DE	22.4K	30	1,500	
***DC-SHORTARMS-DE-3	TERMINAL DE	15K	90	1,500	DE-3
	TERMINAL DE	22.4K	60	1,500	
DC-SHORTARMS-DE-4	TERMINAL DE	22.4K	90	1,500	DE-4

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.
***SHALL BE DESIGNED FOR BOTH CONDITIONS, AS LISTED IN THE TABLE.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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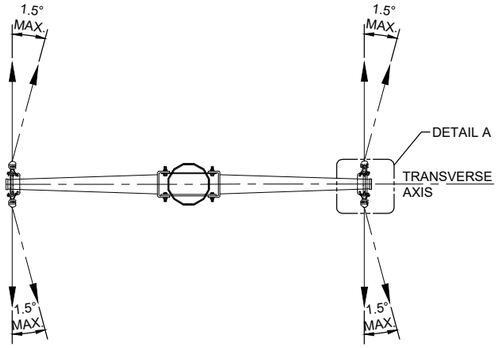
LUMA

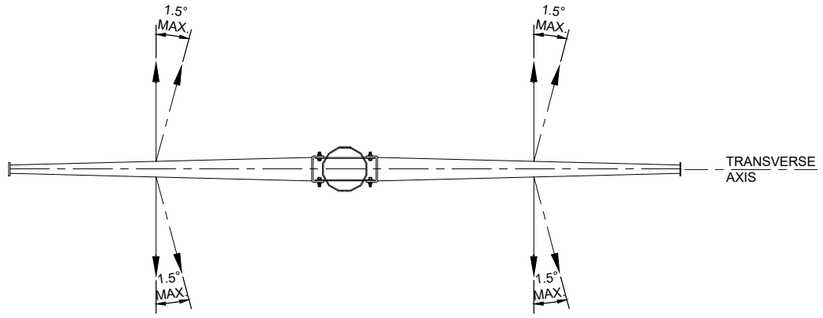
TRANSMISSION LINES ENGINEERING
115kV & 230kV STEEL POLE, DEADEND
DOUBLE CIRCUIT, VERTICAL
WITH SHORT ARMS
DE-DC-VERT-SHORTARM

PREPARED	LICENSE	DATE	PROJECT NO.	TEMPLATE	SCALE
VALENTIN VAZQUEZ	2766	08/18/2023	14F003410000	N/A	AS SHOWN
REVIEWED	LICENSE	DATE	DRAWING		
JUAN MIRANDA	26800	10/27/2023	4752.332 APPENDIX-M		R00
APPROVED	LICENSE	DATE	SHEET 1 OF 1		
OSCAR VENEGAS	23125	10/27/2023			



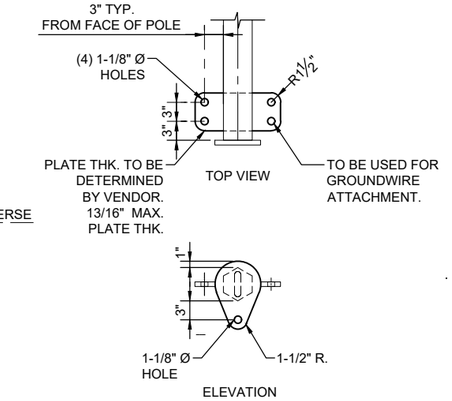
LINE ANGLE = 0°-3°

VIEW A-A (OHGW/OPGW)
N.T.S.

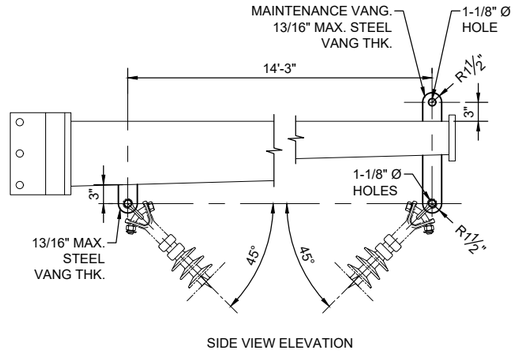


LINE ANGLE = 0°-3°

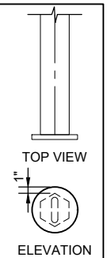
VIEW B-B (CONDUCTORS)
N.T.S.



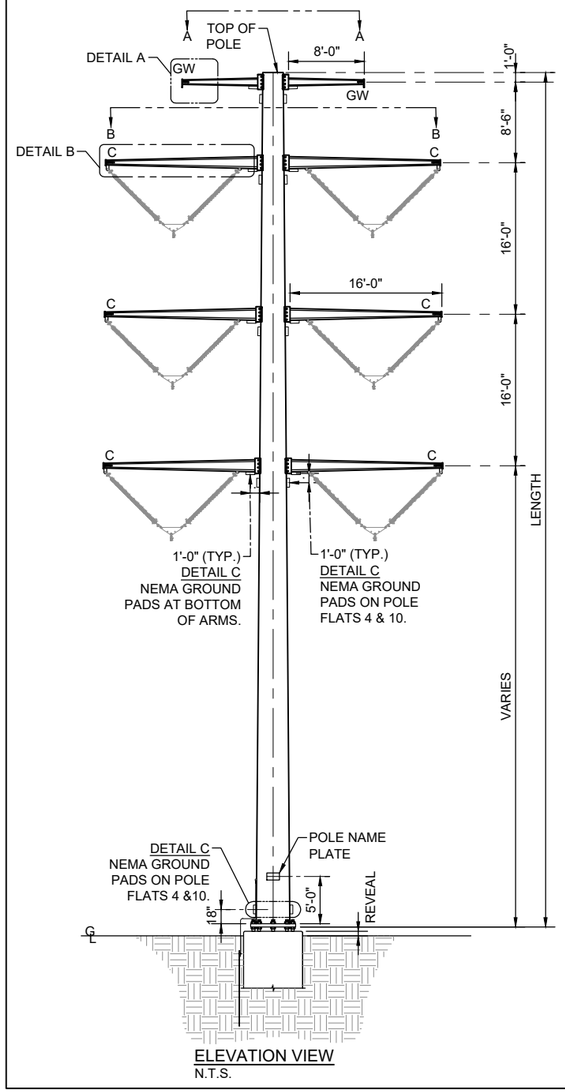
DETAIL A - OPGW / OHGW HORIZONTAL VANG FOR DEADEND ATTACHMENT AND ARM END PLATE FOR SUSPENSION ATTACHMENT
N.T.S.



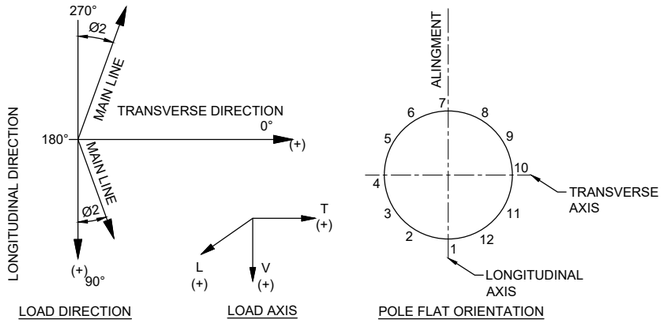
SIDE VIEW ELEVATION



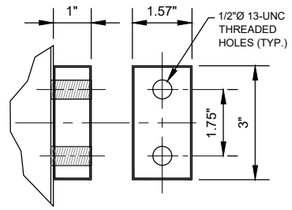
DETAIL B - VANG FOR INSULATOR ON ARM
N.T.S



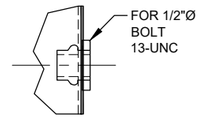
ELEVATION VIEW
N.T.S.



LOAD DIRECTION | LOAD AXIS | POLE FLAT ORIENTATION



DETAIL C - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S



DETAIL D - RIVNUT 1/2"
N.T.S

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
3. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
4. POLE CAMBERING IS NOT ALLOWED.
5. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
6. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
7. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL D), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0"
8. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
9. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
10. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
11. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
12. ALL CONNECTIONS (ARM CONNECTIONS, FLANGES, BASEPLATES, ANCHOR BOLTS, ETC.) MUST BE DESIGNED TO WITHSTAND A MOMENT EQUIVALENT TO 100% MOMENT CAPACITY OF THE SHAFT.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS
4751.120 - V-STRING SPECIFICATION FOR 115KV & 230KV

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

PLS-POLE FILE	*DESIGN TYPE	*SPAN (FT)	*MAX. LINE ANGLE (Ø)	**LOADING TABLE
SU-DC-VERT-V-03_0-800ft_Dpier	TANGENT SUSP.	0-800	3	SUSP-800
SU-DC-VERT-V-03_1500ft_Dpier	TANGENT SUSP.	0-1500	3	SUSP-1500

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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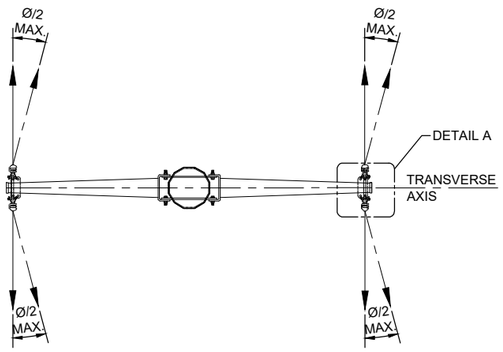
LUMA

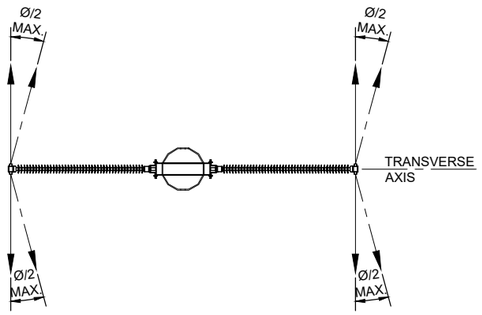
TRANSMISSION LINES ENGINEERING
230kV STEEL POLE, TANGENT
DOUBLE CIRCUIT, VERTICAL
WITH ARMS
SU-DC-VERT-ARM-V-03

PREPARED: VALENTIN VAZQUEZ	LICENSE: 2766	DATE: 08/21/2023	PROJECT NO.: 14F003410000	TEMPLATE: N/A	SCALE: AS SHOWN
REVIEWED: JUAN MIRANDA	LICENSE: 26800	DATE: 10/27/2023	DRAWING: 4752.332 APPENDIX-N		R00
APPROVED: OSCAR VENEGAS	LICENSE: 23125	DATE: 10/27/2023	SHEET 1 OF 1		



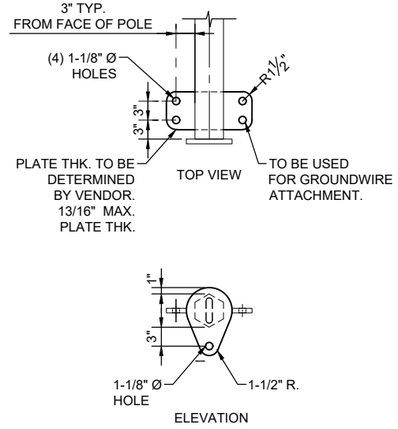
(Ø) LINE ANGLE = 0°-3°

VIEW A-A (OHGW/OPGW)
N.T.S.

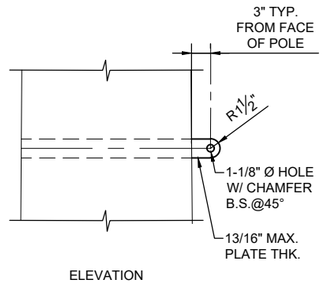


(Ø) LINE ANGLE = 0°-3°

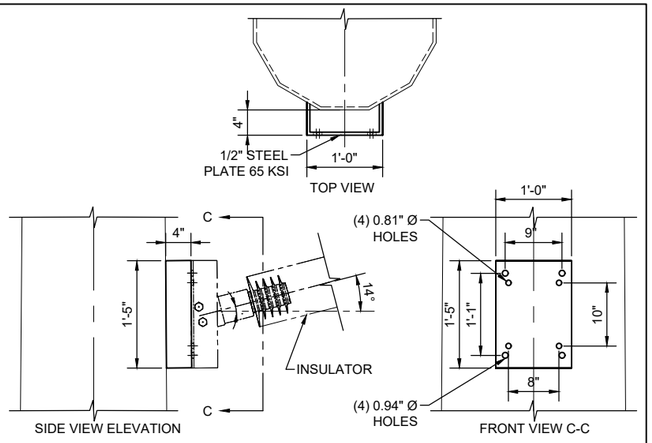
VIEW B-B (CONDUCTORS)
N.T.S.



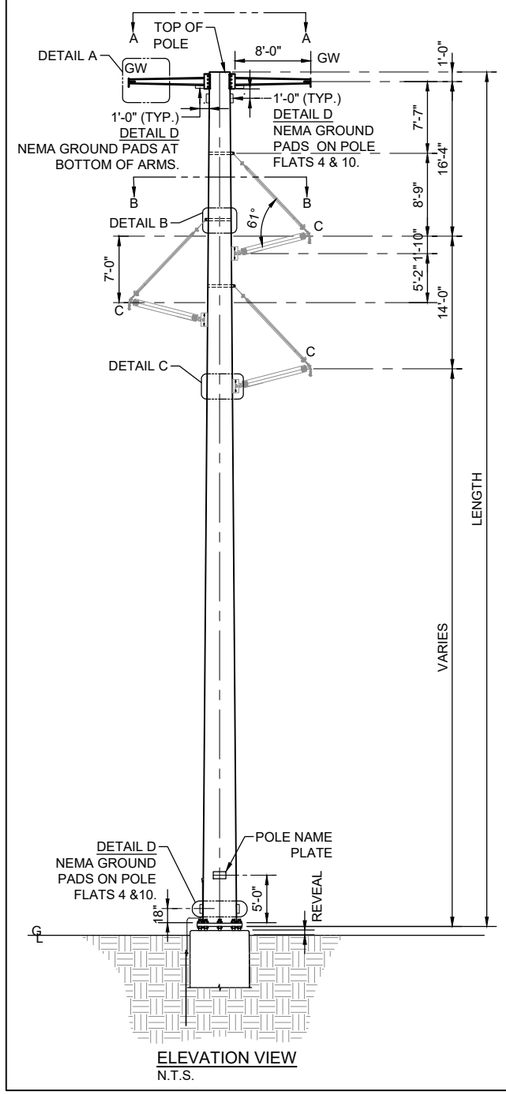
DETAIL A - OPGW / OHGW HORIZONTAL VANG FOR DEADEND ATTACHMENT AND ARM END PLATE FOR SUSPENSION ATTACHMENT
N.T.S.



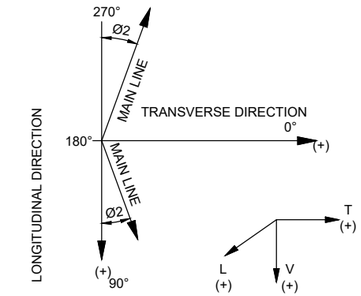
DETAIL B - VANG FOR BRACE ATTACHMENT
N.T.S



DETAIL C - BRACED POST INSULATOR BRACKET
N.T.S

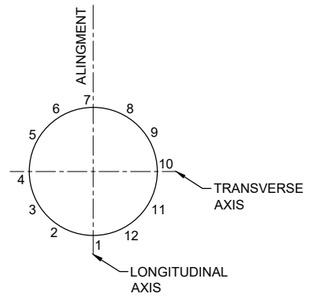


ELEVATION VIEW
N.T.S.

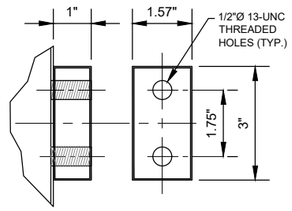


LOAD DIRECTION

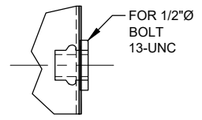
LOAD AXIS



POLE FLAT ORIENTATION



DETAIL D - 2 HOLES NEMA GROUND PAD STAINLESS STEEL
N.T.S



DETAIL E - RIVNUT 1/2"
N.T.S

NOTES:

1. THIS DRAWING COVERS DIMENSION REQUIREMENTS FOR THE DESIGN OF A CUSTOM TUBULAR STEEL TRANSMISSION LINE POLE. IT SHALL BE USED IN CONJUNCTION WITH LUMA'S SPECIFICATION FOR 115kV & 230 kV STEEL TRANSMISSION POLES, DOCUMENT 4752.332, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH DOCUMENT 4752.332, THE REQUIREMENTS OF THIS DOCUMENT SHALL TAKE PRECEDENCE.
2. THE STRUCTURE SHALL BE DESIGNED TO WITHSTAND, WITHOUT CONDUCTORS, THE HURRICANE WIND LOAD CASE APPLIED IN ANY DIRECTION.
3. THE POLE FINISH SHALL BE HOT-DIP GALVANIZED, IN ACCORDANCE WITH LUMA'S SPECIFICATION DOCUMENT 4752.332.
4. POLE CAMBERING IS NOT ALLOWED.
5. SLIP JOINTS ARE PREFERABLE FOR CURRENT POLE DESIGN. FLANGED JOINTS TO BE USED ONLY IF SLIP JOINT DOES NOT PROVIDE ENOUGH STRENGTH.
6. STEPS AND RELATED HARDWARE PER 4752.332 STEEL POLE SPECIFICATIONS FOR 115KV AND 230KV.
7. MANUFACTURER SHALL PROVIDE STANDARD 1/2" UNC RIVNUTS (DETAIL E), COMPATIBLE WITH LUMA'S STANDARD LAG AND PLATE AS PER DIAGRAM. THE RIVNUTS MUST BE INSTALLED AT THE FACTORY. CONNECTORS LOCATION (RIVNUT OR 1/2" WELDED NUT, DIMENSIONS FROM TOP OF POLE):
   GROUND CONNECTOR: 1'-0",
   GROUND CONNECTOR: 10'-0"
   GROUND CONNECTOR: 30'-0"
   GROUND CONNECTOR: EVERY 10'-0" AFTER 30'-0"
8. POLE SHALL BE MANUFACTURED IN SECTIONS IF LENGTH EXCEEDS 50FT. EACH SECTION SHOULD HAVE A MAXIMUM OF 50 FT.
9. SLIP JOINT SHALL BE LOCATED TO NOT INTERFERE WITH WIRE/EQUIPMENT ATTACHMENTS. THE POLE SHALL HAVE A SUITABLE SLIP JOINT MARKED FOR PROPER SECTION MATCHING.
10. MANUFACTURER SHALL BE RESPONSIBLE FOR APPLYING WIND LOADS IN THE DIRECTION THAT PRODUCES THE GREATEST LOAD TO THE STRUCTURE.
11. LIFTING VANGS TO BE CONSIDERED PER SPECIFICATION 4752.332.
12. LOAD CASE (BROKEN WIRE) TO BE APPLIED ON ONE BROKEN WIRE POSITION AT A TIME, WHILE OTHER WIRES ARE SUBJECTED TO HURRICANE INTACT LOADING. POLE NEEDS TO BE DESIGNED FOR THE WORST COMBINATION.
13. ARM RISE MAY BE ADJUSTED TO FIT ARM CONNECTION ON THE POLE. ATTACHMENT ELEVATION SHALL REMAIN AS SHOWN IN THE ELEVATION VIEW.
14. STEEL POLES FOR 4752.332 APPENDIX-F (SU-SC-VERT-BP) & 4752.332 APPENDIX-O (SU-SC-DELTA-BP) SHOULD BE INTERCHANGEABLE FOR THE SAME HEIGHT. THIS MEANS ALL HARDWARE REQUIRED FOR EITHER CONFIGURATION SHOULD BE PRESENT ON THE POLE AND THE POLE PROPERTIES OF BOTH SHALL BE IDENTICAL.

REFERENCE STANDARDS:

4751.001 - TRANSMISSION LINES DESIGN DESIGN CRITERIA
4752.332 - 115KV & 230KV STEEL POLE SPECIFICATIONS
4752.330 - BRACED POST INSULATORS

REFERENCE DRAWINGS:

4752.332 APPENDIX-H - 115KV & 230KV STEEL POLES STRUCTURE LOADS

PLS-POLE FILE	*DESIGN TYPE	*SPAN (FT)	*MAX. LINE ANGLE (Ø)	**LOADING TABLE
SU-SC-DELTA-BP-03_0-800ft_Dpier	TANGENT SUSP.	0-800	3	SUSP-800
SU-SC-DELTA-BP-03_1500ft_Dpier	TANGENT SUSP.	0-1500	3	SUSP-1500

*THESE ARE STANDARD DESIGN RECOMMENDATIONS ONLY. AE FIRMS ARE NOT LIMITED TO THESE RANGES AND CRITERIA. AE IS RESPONSIBLE FOR DESIGN ADEQUACY FOR THE SITE SPECIFIC STRUCTURE LOCATIONS. DESIGN TENSIONS ARE BASED ON HURRICANE 160 MPH CASE.
**REFER TO DRAWING 4752.332 APPENDIX-H FOR STRUCTURE LOADING.

* CONTRIBUTOR: T. BHAKTA

NO.	DATE	REVISION DESCRIPTION	PROJECT NO.
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LUMA

TRANSMISSION LINES ENGINEERING
115kV & 230kV STEEL POLE, TANGENT
SINGLE CIRCUIT, DELTA
WITH BRACED POST INSULATORS
SU-SC-DELTA-BP

PREPARED: VALENTIN VAZQUEZ	LICENSE: 2766	DATE: 10/04/2023	PROJECT NO.: 14F0003410000	TEMPLATE: N/A	SCALE: AS SHOWN
REVIEWED: JUAN MIRANDA	LICENSE: 26800	DATE: 10/27/2023	DRAWING: 4752.332 APPENDIX-O		R00
APPROVED: OSCAR VENEGAS	LICENSE: 23125	DATE: 10/27/2023	SHEET 1 OF 1		

4752.332 115-230 kV Steel Pole Structure Specifications

Final Audit Report 2023-11-21

Created:	2023-11-21
By:	Koral Caro Rivera (koral.carorivera@lumapr.com)
Status:	Signed
Transaction ID:	CBJCHBCAABAAjTscBpfp_mRWqR6LuCY1cnl97-5gsRmO

"4752.332 115-230 kV Steel Pole Structure Specifications" History

Document created by Koral Caro Rivera (koral.carorivera@lumapr.com)
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Signer oscar.venegas@lumapr.com entered name at signing as Oscar E Venegas
2023-11-21 - 6:25:25 PM GMT

Document e-signed by Oscar E Venegas (oscar.venegas@lumapr.com)
Signature Date: 2023-11-21 - 6:25:27 PM GMT - Time Source: server- Signature captured from device with phone number XXXXXXX2079

Agreement completed.
2023-11-21 - 6:25:27 PM GMT