CITY LIGHT & POWER

HILL AIRFORCE BASE, UT

ELECTRIC SERVICE CONNECTION STANDARDS MANUAL

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SECTION 1.0 INTRODUCTION

The electrical distribution system portion of Hill Air Force Base's utility system was sold to City Light & Power, Inc (CLP) ("System Owner") as part of the U.S. Air Force's Utilities Privatization (UP) program in 2014. CLP is the sole provider of all relevant electric utility services to the installation.

1.1 PURPOSE OF DOCUMENT

This manual contains guidance to establish successful interconnections to the CLP owned electrical system.

1.2 ABBREVIATIONS AND ACRONYMS

AC	Alternating Current
ACSR	Aluminum Conductor, Steel Reinforced
ANSI	American National Standards Institute
CAD	Computer Aided Drafting
CT	Current Transformer
ETAP	Electrical Transient Analysis Program
GOAB	Gang-Operated Air Brake Switch
HP	Horsepower
Hz	Hertz
IEEE	Institute of Electrical and Electronics Engineers
IOC	Instantaneous Overcurrent Trip
KV	Kilovolts
KVA	Kilovolt-Amperes
KVAR	Kilovolt-Amperes Reactive
KW	Kilowatts
KWH	Kilowatt Hours
LTC	Load tap changing
MILCON	Military Construction
MVA	Megavolt-Ampere
MW	Megawatts
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
PF	Power Factor
RMS	Root Mean Square
VFI	Vacuum Fault Interrupter

1.3 TERMS

Available Short-Circuit Current – The maximum current that the power system can deliver through a given circuit point to any negligible impedance short circuit applied at the given point or at any other point that will cause the highest current to flow through the given point.

Backup Protection – A form of protection that operates independently of components in the primary protection circuit. Backup protection is generally only intended to operate if the primary protection fails.

Branch Circuit – The circuit conductors and components between the final overcurrent device protecting the circuit and the equipment.

Bus – The conductor or conductors, usually made of solid copper or aluminum that carries the current and serves as a common connection for two or more circuits.

Circuit Breaker – A device designed to open and close a circuit by manual means and to open the circuit automatically upon a pre-specified current, without damage to itself when properly applied within its rating.

Continuous Rating – The maximum constant load that can be carried continuously without exceeding established temperature rise limitations under prescribed conditions.

Coordination – The application of overcurrent protective devices in series such that (of the devices carrying fault current) only the device nearest the fault will open and the devices closer to the source will remain closed and carry the remaining load.

Electrical Model – The ETAP electrical model is a graphical representation of the electrical distribution system with an embedded database containing all required engineering properties of the modeled equipment. The electrical model is the foundation for all electrical analyses.

Fault, Three-Phase Bolted – A fault in which all three phases short with zero impedance. A three-phase bolted fault produces the highest short circuit currents in virtually all electrical distribution systems. Most short circuit studies conducted to determine maximum available short circuit currents are based on three-phase bolted faults.

Fault, Line-to-Line – A fault in which two phases of a three-phase system short together.

Fault, Line-to-Ground – A fault in which a single phase of a three-phase system shorts to ground; also called a ground fault.

Fault, Double Line-to-Ground – A fault in which two lines of a three-phase system short to ground; also called a line-to-line-to-ground fault.

Interrupting Current – The predicted level of fault current that a protective device will be subjected to in the process of interrupting the fault. For low voltage circuit breakers and fuses, interrupting current shall be interpreted as momentary current since the breaker

interrupting rating is based on momentary current. For high voltage breakers, interrupting current shall be interpreted as interrupting duty current since this is the current to which they are rated.

Interrupting Rating – The maximum current flowing in a circuit protective device (circuit breaker, fuse) for which the device is rated to safely interrupt.

Medium Voltage System – An electrical system having a maximum RMS AC voltage of 1,000V to 15kV. Some documents such as ANSI C84.1 define the medium voltage upper limit as 100kV, but this definition is inappropriate for facility applications.

Overcurrent – A current that exceeds a continuous current rating, including overloads, short circuits and ground faults.

Overcurrent Protection – A form of protection that operates when current exceeds a predetermined value.

Overcurrent Relay – A relay that operates when its input current exceeds a predetermined value.

Power Factor (PF) – The ratio of total watts to total volt-amps.

Primary Protection – First line protection against undesired system conditions.

Selectivity – A general term describing the interrelated performance of relays and breakers and other protective devices; complete selectivity being obtained when a minimum amount of equipment is removed from service for isolation of a fault or other abnormality.

Service Voltage – Voltage at the facility service entrance location.

Short Circuit – An abnormal condition (including an arc) of relatively low impedance, whether made accidentally or intentionally, between two points of different potential.

System Owner (SO) – City Light & Power, Inc. (CLP)

Voltage, Nominal – The standard voltage by which a portion of the electrical power system is designated and to which certain operating characteristics of the system are related. Each nominal system voltage correlates to a portion of the system bounded by transformers and utilization equipment.

Wye Connection – A method of interconnecting the phases of a three-phase system to form a configuration resembling the letter Y, such that one end of each of the windings is connected to a common point (the neutral point) and the other end to its appropriate line terminal.

Point of Demarcation (POD) – A point/location where ownership/liability changes from one party to another.

SECTION 2.0 THREE STAGES OF CLP'S SERVICE CONNECTION PROCESS

To install a service connection efficiently, CLP recommends organizing the project into three (3) distinct phases:

I. Initiation–Getting started
II. Design–Preparing a detailed work plan
III. Construction–CLP facility installation and site restoration

Each phase of the process includes requirements that will enable the project to advance to the next step. As with any construction project, informing CLP promptly of any changes to the requirement will allow our representatives to keep our customers informed if there are related scope changes.

All potential adds or modifications to the existing electrical system due to new service connection requirements must be coordinated with CLP during the customer's project conceptual design phase. CLP must be integrated into the design of all medium voltage and low voltage electrical systems that are within the proximity of CLP points of demarcation. The preferred method for connecting new or modified electrical services to CLP-owned system is to request CLP to design and install the required infrastructure up to the CLP point of demarcation. This method will eliminate the potential for stranded assets that the government will need to maintain until they are properly conveyed to CLP. If the new service connection infrastructure is constructed by a third-party contractor, the new assets will not be owned or operated by CLP until the government conveys them to CLP. The conveyance of such assets is subject to CLP's inspection and acceptance. The conveyance may take months or sometimes years to be completed. In any case, the new infrastructure for the service connection must adhere to CLP specifications, safety requirements and construction standards. If the infrastructure is built by a third-party contractor, CLP will require final design submittals for approval, field inspections, and final as-built drawings of the completed work.

CLP will conduct design review, field inspections, and final connections to the new service at a cost to the customer. The customer must capture this cost in their project scope of work in an early phase of the design. Any fees associated with connecting contractor-constructed infrastructure to CLP's system must be negotiated with CLP during the design phase.

In no event shall a contractor cap, connect to, or otherwise touch the utility owner's infrastructure without the utility owner's express written permission.

2.1 INITIATION

2.1.1 INITIATING A SERVICE CONNECTION

The service connection request begins with a completed service application (See Appendix D). In order for CLP to meet the service date, submittal of the service application as early as possible in the planning process is critical. Allow up to 21-days for CLP to review and respond to a service application.

Copies of the Service Application form are available at the CLP office.

Definition: Point of Demarcation (POD) is a point on the utility system where ownership changes from the utility SO to the facility owner. It is the physical point where CLP responsibility to maintain ends and the service of the customer begins – Refer to Section 1.3.

For planning purposes, CLP is typically responsible for all transmission and distribution lines on base. CLP owns the electrical distribution infrastructure, including poles, switches and transformers.

Note: Special point of demarcation rules apply to unique areas of the base. Please, consult with the CLP point of contact at each location to identify proper points of demarcation.

Submit Site/Building drawings along with the service application. The Site/Building drawings shall include, at a minimum, the following information:

a. A site plan showing water, sewer, storm drain, building line and preferred transformer location. Include driveways and street names.
b. Quantity and Size(s) of transformer(s) requested.
c. Single line drawing of the primary power (existing and new) within the project site.
d. Secondary voltage requirement. The following is the list of typical secondary voltages available in CLP systems:
    i. 1- Phase, 120/240V, 3-wire
    ii. 1- Phase, 240/480V, 3-wire
    iii. 3- Phase, 208Y/120V, 4-wire
    iv. 3- Phase, 480Y/277V, 4-wire

2.1.2 PLANNING THE SERVICE CONNECTION

The formal planning process will begin after receipt of a completed service application.

The information obtained in your service application provides CLP an accurate description of the project, including the anticipated electrical requirements. CLP takes the following steps to address service connection applications:

a. Scoping
    i. **Perform Utility Locate** — Avoid utility conflicts as soon as possible in the process.
    ii. **Outline Scope of Work** — Ensure we understand the project and have all necessary information.
    iii. **Verify Application Information** — Should include a complete set of plans (site and architectural), load information, billing information, and any existing CLP facilities which may require relocating.
    iv. **Specify Transformer Location** — As marked on the site plan. Preferred locations will be considered.
    v. **Develop Preliminary Schedule** — Ensure CLP can meet your requested service date as proposed.

b. Evaluating and Engineering

CLP will evaluate and determine if the existing electrical infrastructure is adequate to meet the request. CLP will then develop an engineering plan or preliminary routing sketch proposing the work plan to meet your request for service.

A site visit may be required to discuss equipment details.

c. Connection Cost Estimating

CLP will estimate the job costs, labor, and materials required to complete the service connection. CLP will then determine the appropriate charges for the work and contact the customer project representative (as indicated in the service application form) with a final job cost and scope of work.

d. Publishing Connection Fee

CLP will send an estimate and preliminary routing sketch to the customer project representative. The estimate will reflect the connection fee for the service request.

The preliminary routing sketch will reflect the agreed upon scope of work, electrical components, and the proposed route for new construction (if required).

e. Signing Contract Agreement

After the submittal review process, the customer project representative shall return the signed estimate/Purchase Order and approved preliminary routing sketch along with the specified service connection initial payment. This step will need to be completed before CLP can move forward.

Please note that anytime CLP is required to deviate from CLP's standard practices and procedures, the service connection requestor will be responsible for all additional costs. For example: design revisions, multiple designs, job scope changes, etc.

For funding allocations and contract administrative purposes, military customers may choose to send funding for CLP's scope of work via Military Interdepartmental Purchase Request (MIPR) to DLA-Energy (UP contract administration). DLA-Energy can then modify the existing UP contract for CLP to complete the service connection work. Once funding is received from the customer, DLA will issue an RFP to CLP for agreed-upon scope of work and validate CLP's estimates based-on pre-negotiated rates.

2.2 DESIGN

2.2.1 VALIDATING

After CLP receives the signed contract and payment, a CLP Representative will contact the requestor to confirm that the initial information is still accurate.

a. **Transformer size** — if it has changed, make sure CLP has the correct transformer size (kVA).

b. **Transformer locations** — let CLP know if the proposed transformer location has changed.

c. **Detailed utility site plans** — confirm that CLP has the final project site plans with all the other on-site utility lines located: fuel, water, sewer, telephone, electric, geothermal systems, etc. Please notify CLP immediately if any detail of the plan requires a change.

2.2.2 Performing Initial Design

If required, CLP will prepare a detailed electric installation design, including the specific plans needed for our construction crews to perform the work. CLP may attend customers design review meetings for Design/Build and Design/Review/Build projects.

2.2.3 Coordinating Design Documents

If required, CLP will send a copy of the final CLP design drawing to the requestor.

2.2.4 Delivering Final Design

Return the signed design drawing (if applicable) and any remaining payment due.

Partial payment may be required before construction work will be scheduled if transformers, switches or other hardware is to be installed.

2.2.5 Permitting

CLP will apply for necessary permits required for the installation of the new service connection as applicable. The time this takes varies, depending on the location and type of permit. Any subsequent changes to the execution of the contract, such as significant changes in connected load, voltage class, transformer location, or inadequate site conditions will delay our work and **may result in additional costs** for re-engineering, design, and/or construction and will have a negative impact on the planned service date.

2.3 CONSTRUCTION

All personnel working on the installation of CLP electrical service lines are trained and certified. If a CLP-approved contractor does the construction work, a CLP inspector will monitor quality control on the site.

2.3.1 Construction Steps

a. Scheduling

Once the site is ready, notify CLP to schedule construction of your project or to monitor quality control over the electric installation. Contact the local CLP Base Installation Manager or Representative. Please have the Job Number and job address ready.

b. Prepping Site

CLP will complete a Dig Permit if required.

c. Verifying Site Conditions

After all existing underground utilities are marked prior to CLP starting construction, CLP may need to dig test holes to verify the depth and location of underground lines to avoid damage during construction.

d. Constructing and Installing

CLP will install the electrical lines. Expect heavy equipment to be working around your facility. Crews from CLP or CLP subcontractor will install the service connection.

Construction equipment may be left overnight. Holes and trenches may be open during construction for connections and safety testing. All trenches and holes will be clearly marked with safety cones and/or safety fencing.

2.3.2 COMMISSIONING

After the construction is complete CLP will conduct commissioning and testing activities for the newly installed components before energization. The extent of such activities varies from basic visual inspections to functional testing and electrical testing depending on the type of equipment installed.

a. Visual Inspections

CLP conducts visual inspections for typical distribution components such as overhead switches, poles, risers, pad-mounted equipment and civil infrastructure to make sure safety, design, and material specification requirements are met.

b. Functional Tests

In addition to visual inspections, all switches, communication devices, controls, and automation components typically undergo detailed functional tests where each component is exercised and operated to ensure safe and proper operation as designed.

c. Electrical Tests

For substation equipment such as large power transformers and switchgear, medium voltage cables, and other components deemed necessary to be tested, in addition to visual inspections and functional testing, CLP will conduct electrical testing as specified by design engineer and manufacturer. All required electrical tests will be conducted per Inter-National Electrical Testing Association (NETA) standards and manufacturer's guidelines.

2.3.3 SITE RESTORATION

CLP will restore your property and will minimize the disturbance of established lawns and pavement wherever practical. While CLP puts much effort so as not to disturb any existing paving, shrubbery, trees, plants, or lawn, it is not always possible.

Once construction is complete, CLP will restore the affected areas of your property as promptly as possible.

d. If a sidewalk or roadway section must be removed, temporary paving may be necessary. It may take several weeks before permanent paving is completed.

e. During winter months, permanent paving may be postponed until the weather is warmer.

The time required for restoration will depend on weather conditions and the extent of the disturbed area.

SECTION 3.0 RESPONSIBILITIES FOR ELECTRIC SERVICE

CLP utilizes Design and Construction Standards based off of the latest Institute of Electrical and Electronics Engineers (IEEE), National Electrical Safety Code (NESC), and National Electrical Code (NEC) requirements. These standards and requirements are followed to decrease the likelihood of loss-of-life and/or equipment damage.

CLP requires all contractors and subcontractors to adhere to these standards.

3.1 STANDARDS GOVERNING INSTALLATION

All service connections will be built to CLP design standards, see Appendix B, C, and D. For connections not covered in these appendices, industry standards will be applied.

The NESC requires specific distances between utility facilities, such as overhead lines, and other structures. The distances vary based on the type of utility facilities and the type of structures being put up. It is the contractor and/or subcontractor's responsibility to determine the distance requirements. Failing to do so creates a dangerous situation that can also be costly to the responsible party to remedy later.

CLP has an open-door policy for any questions customers, contractors, or subcontractors may have. The ultimate goal for CLP is to install an electrical system safe for everyone and that will continue to operate for many decades.

3.2 ADDITIONS AND ALTERATIONS

CLP's electrical system has definite capacity limitations and can be damaged by overloading. Therefore, it is everyone's responsibility to notify CLP before increasing the load requirements or making alterations to the service entrance equipment. CLP will provide the proper equipment on the electrical system to serve the increased capacity. However, if this is done after the initial scope finalization, there may be additional charges or schedule impacts.

3.3 WORKING AROUND HIGH VOLTAGE OVERHEAD LINES

The approach distance and working around high voltage overhead lines by utility or non-utility construction personnel are governed by the Occupational Safety and Health Administration (OSHA), National Electrical Safety Code (NESC), federal, state, or local statutes or regulations.

Call the CLP Base Installation Manager or Representative (Page i) if work needs to be performed that meets the above qualification.

If work must be performed on an overhead utility line, with prior notice and approval, CLP will initiate proper safety measures, which may include the following:

a. Relocating the lines
b. Installing physical barriers to prevent any contact with the lines
c. De-energizing and grounding the lines
d. Other proactive safety steps as necessary
e. Compliance with safety requirements governed by OSHA

It is the worker's responsibility to know and abide by all OSHA and local regulations when working in the vicinity of electrical lines.

SECTION 4.0 SERVICES NOT RELATED TO PERMANENT SERVICE CONNECTIONS

CLP will perform requested services that are not part of the Permanent Service Connections section. These services are covered here but are not limited to the below.

4.1 TEMPORARY ELECTRIC SERVICE

A temporary service connection can be provided that is either overhead or underground where facilities are available for a non-permanent period. That period will be defined by Base Representatives, Contractors, and CLP. Costs will be the responsibility of the requestor to install and remove the services. CLP is flexible and understands temporary services are project specific.

Please contact the CLP Base Installation Manager or Representative (Page i) with any further questions.

4.2 RELOCATION OF CLP LINES AND EQUIPMENT

Projects requiring underground or overhead electrical infrastructure to be relocated should follow Section 2 of this manual.

Please contact the CLP Installation Manager or Representative (Page i) with any further questions.

SECTION 5.0 ELECTRICAL SAFETY AND CODE CLEARANCES

5.1 GENERAL

It is the policy of CLP to operate the electric transmission and distribution system with the highest degree of care for the safety to the public and CLP employees. To ensure the care and safety needed for an electric distribution system, the National Electric Safety Code (NESC) is used for design, construction, maintenance, and operation of the electric system by CLP as well as any applicable practices by the public and private industry. The applicable NESC in effect at the time will apply to new installations and extensions. Existing installations may be altered, replaced for maintenance, or additions made to comply with either the current edition or original requirements of the applicable NESC in effect at the time of original installation as allowed in NESC Rule 013B.

CLP reserves the right to temporarily disconnect service when a hazardous condition is discovered.

5.2 MINIMUM CLEARANCE FROM OVERHEAD LINES

- For the purpose of this section, the term “clearance” means the shortest distance between any two surfaces.
- Minimum clearance between any building or other structure and any overhead transmission line, overhead distribution facility, or electric utility pole will be maintained in accordance with the provisions of the NESC.
- Minimum clearance between signs, chimneys, radio and television antennas, storage tanks and other structures, and any overhead transmission line, overhead distribution facility, or electric utility pole will be maintained in accordance with the provisions of the NESC.
- Minimum clearance over streets, alleys, parking lots, rights-of-way, easements, etc., of overhead transmission and distribution facilities, will be maintained in accordance with provisions of the NESC.
- Minimum clearance between over-height vehicles, including house moving, and any overhead transmission line, overhead distribution facility, or electric utility pole of CLP will be maintained in accordance with the provisions of the NESC.

5.3 EQUIPMENT OPERATION AROUND ENERGIZED FACILITIES

5.3.1 REQUESTS FOR SYSTEM OUTAGES

On a case-by-case basis, CLP may allow individual system elements to be removed from service to accommodate construction or maintenance activities. CLP complies with the HAFB outage planning policy, which includes various forms and scheduling requirements. Under these circumstances, the outage must be planned well in advance, and every effort must be made to minimize the duration of the outage. If at all possible, the construction or maintenance activity shall be conducted in such a manner that the facility can be returned to service immediately in the event of a loss of another system element.

Outages lasting longer than one-week may require the construction of a temporary facility to minimize the required outage time. Outages on system elements that will leave a load serving facility vulnerable under a single additional contingency will require plans to mitigate the next contingency. These plans should restore the load serving capability of the system as soon as possible. All time and material

necessary to develop the contingency plan will be paid for by the requesting party. In the event the contingency plan is executed, the requesting party will pay all time and materials associated with service restoration.

Electric transmission systems present a unique challenge in that outage and restoration times will typically require several weeks. On a case-by-case basis, planned outages for the modification of transmission systems may be granted. However, due to the extended nature of these outages, contingency plans for the restoration of the system must be in place prior to the planned outage. In some cases, an outage may not be granted, and new facilities may need to be constructed before existing facilities may be abandoned.

5.3.2 OVERHEAD

When working near or operating equipment around overhead electrical lines all personnel shall comply with Federal OSHA standards which require that unqualified persons maintain the minimum clearance distances between energized lines/parts and themselves, their tools, their equipment, and all conductive materials. Contacting the line can result in severe injury or death.

If work must be accomplished near an overhead electrical line, call the CLP Base Installation Manager (Page i) for assistance as needed to identify line-operating voltage, do not rely on proximity warning devices such as hook insulators or boom guards. If distribution lines must be de-energized, the customer shall provide a written request to CLP and allow ten (10) business days for CLP to respond to the request.

It is the responsibility of the contractor to apply safety grounds to safely perform work on the de-energized line. CLP does not ground for others to work on the system or assume responsibility for their workers. CLP will de-energize, test, and issue a clearance. Requests to de-energize overhead lines should be submitted early in the requester's planning process and will be reviewed on a case by case basis by CLP and the respective Base Leadership. Transmission outages require a significant level of preplanning and could take weeks to coordinate.

5.3.3 UNDERGROUND

Grading, excavation, ground rod, stake, or post installation work will not be started until an underground facilities location has been completed. Digging into or damaging underground power lines can result in severe injury or death to the operator and others and can cause interruption of service to wide areas. Complete a Base Dig Permit before digging or excavating. Trained personnel from CLP or their designated subcontractor will locate electrical facilities at no cost.

The National Electric Safety Code requires the protection and separation of underground electric supply lines from other structures, including other utilities. Required clearances for parallel utilities and crossings of utilities can be found in the CLP construction standards.

SECTION 6.0 SERVICE-RELATED ELECTRICAL UTILITY SYSTEM DESIGN GUIDELINES

6.1 GENERAL

The intent of this section is to acquaint government system planners and designers with some key design guidelines that CLP uses to identify requirements, scopes of work, and costs for new or modified service connections. Most new construction and renovation projects at the installation require additions and/or modifications to the primary electrical supply system.

Projects requiring service connections pay for changes or additions to the CLP-owned electrical system that are required to service the new or renovated facilities. As it is important to capture all potential costs associated with changes or additions in the initial stages of project planning, this section provides a summary of key technical guidelines and a checklist to help project planners and designers recognize the considerations they must make to adequately evaluate the scope of work and costs associated with obtaining utility power for their projects. Project planners and designers must engage with CLP when developing the project and its power requirements. All design activities outlined in this section must be conducted by CLP unless noted otherwise.

6.2 SERVICE-RELATED MEDIUM VOLTAGE SYSTEM DESIGN GUIDELINES

6.2.1 CAPACITY

All existing distribution system feeders, substations, and utility supplies have limits to how much power they can supply. If nearby distribution feeders or substations are approaching/exceeding their maximum supply capacity, even a small service connection may require significant upgrades to the distribution system before the connection can be made. The following guidelines are key to assess capacity for customer service connections:

a. Estimate new load as accurately as possible (this is completed by customer's planner or designer). Overestimation of building loads may result in unnecessary upgrades to CLP's system and add significant cost to the project.

b. Identify nearby circuits that could be used for the new service connection.

c. Evaluate the circuit capacity and demand to select closest circuit(s) that have the capacity to supply the new service. If the nearby circuits are already loaded to their design capacity, a new circuit may need to be constructed to a nearby switching point or substation. Alternatively, existing feeders may be upgraded to increase capacity.

d. Properly size all new cables/conductors, switches, transformers, and terminations for maximum design load at worst case scenario.

6.2.2 SAFETY AND ENVIRONMENT

For every change made to the electrical system, it is necessary to address design- and operations-specific safety requirements and environmental compliance. The following guidelines are key for ensuring safety and environmental compliance in a service connection design:

a. Understand and specify proper grounding and bonding requirements for poles, switching equipment, cables, vaults, duct banks, and transformers. IEEE standard C2 - National Electrical Safety Code (NESC) provides specific requirements for grounding and bonding medium voltage electrical system components. Considerations must be made to develop a grounding and bonding system that complies with safety codes and is compatible with the existing grounding system.

b. Specify proper transformer configurations – Delta-Wye, Delta-Delta, or Wye-Wye.

c. Consider concentric neutral versus tape shield cables with separate ground cables. CLP's preference is to match existing systems.

d. Make sure that the new system will have adequate overvoltage and overcurrent protection.

e. Consider grounding positions and viewing windows for pad-mounted switches. These features allow operators to ground the switch and visually verify they are open prior to performing any maintenance or troubleshooting activities.

f. Make sure all medium voltage construction such as duct banks, manholes, handholes, pads, poles, insulators, switches, surge arresters, terminations, cable/conductor placement, guying, and grounding systems meet NESC requirements for proper electrical clearance, proper working clearance, adequate access, mechanical/structural integrity, and safe operations.

g. Ensure all low voltage civil and electrical work meets National Electrical Code (NEC) requirements.

h. Use at a minimum all applicable IEEE, ANSI, UFC, and NEC standards when specifying medium voltage apparatuses such as cables, switches, fused cutouts, reclosers, and transformers.

i. Always specify dead-front terminations for pad/vault-mounted switches and transformers.

j. Carefully choose and specify proper insulation material for pad-mounted switches. Air, Oil, SF6, and solid-dielectric are the most common insulation material used for medium voltage apparatuses. Each has pros and cons that may impact safety, operability, environment, and cost.

k. For pad-mounted transformers, consider a less-flammable fluid (i.e. FR3) for the insulation medium as opposed to mineral oil when installing close to buildings.

l. Ensure all apparatuses have adequate voltage ratings, continuous current carrying capacity, and ANSI short-circuit withstand ratings.

m. For overhead systems, identify proper pole size, physical configuration, hardware components, cross arms type and size, guying requirements, avian protection, insulators, and lightning protection that comply with CLP's construction standards.

6.2.3 OPERABILITY

All service connection systems must provide optimal switching, isolation, and restoration functionalities that are easy to operate and maintain in all conditions. The following guidelines are key to consider regarding operability of service connection systems:

a. Do not design underground service tap lines with T-body elbows or Y splices to the main feeder. This makes switching and isolation of the tap line and restoration of main feeder extremely difficult, unsafe, and time consuming to operate. Instead, break off the main feeder

and install a tap line using multi-way pad-mounted or vault-mounted switch that can easily isolate the tap line and restore the main feeder.

b. For overhead service tap lines that serve overhead transformer banks and are short (single pole span) the use of cutout fuses at the service transformer primary may be adequate.

c. For overhead service tap lines that serve overhead transformer banks and run more than one pole span, consider tap line fused cutouts at the location where the tap line connects to the main feeder.

d. For an overhead tap line that routes underground via a riser and feeds to a pad-mounted transformer, make sure to design proper fused cutout for service that is 200A or less and load break switch for service that is greater than 200A at the riser. If the underground run is only a few hundred feet and the service transformer primary has means of load breaking, the riser may be equipped with air-break switches.

e. Specify three-phase pad-mounted transformers with three (3) 2-position on/off load-break switches for proper isolation and restoration for loop-feed configurations.

f. Specify single phase pad-mounted transformers with feed through bushings and one (1) 2-position on/off load break switch for isolation of the transformer windings.

g. Make sure to allocate proper space and access around all medium voltage apparatus.

6.2.4 RESILIENCY

Each service connection system should have capabilities for sensing fault conditions and/or loss of utility, quickly isolating the faulted/dead system, and rerouting power from an unaffected/alternative system. This requires smart technology that can sense, monitor, and perform predefined control logic functions. The following guidelines are key resiliency-specific design guidelines for service connection system:

a. Assess and identify if the new service is critical and requires redundancy. If redundancy is required and there is only a single radial feeder available, consider adding an alternative feeder in the project scope of work. This may require building a new overhead or underground system to the next available supply point.

b. Consider specifying fault indicators at the radial service connection's tap lines, risers, and multi-way switching points. The fault indicators will help operators quickly identify fault locations and restore the unaffected portion of the system.

c. If the service connection point has one or more alternative supplies, consider multi-way pad-/vault-mount switchgear with voltage sensors, motorized switches, and digital relays that can sense loss of utility and automatically switch to an alternative feed.

d. If the service connection is tapped off a looped main feeder using multi-way pad/vault-mounted switchgear, consider specifying the switchgear with SCADA-ready motorized load-break ways for the main feeder and vacuum fault interrupter (VFI) way(s) for the tap line(s) to feed the new service. Such switchgears can be easily incorporated to existing or future

distribution automation and SCADA systems to significantly improve resiliency of the new service and the surrounding system.

6.2.5 PROTECTION

Electrical systems are prone to abnormal conditions such as short circuit, voltage surges, and arc-flash events that are dangerous to personnel and equipment. Lack of proper protection against such events can result in injuries, loss of life, and/or damage to critical electrical assets. Protection systems such as fuses, VFIs, circuit breakers, and/or protective relays must be properly designed and specified for all service connection systems. The following guidelines are key for designing service connection protection systems:

a. All electrical components must have protection for short circuit and voltage surges.

b. For small (500kVA or less) radial overhead service tap lines feeding to overhead transformer banks, consider fused cutouts at the main feeder connection point (if the tap line is longer than one pole span) and at the transformer primary.

c. For large (greater than 500kVA) radial overhead service tap lines and long pole lines feeding overhead transformers and extending more than single pole span, consider an automatic recloser at the main feeder connection point.

d. For underground service connections using multi-way pad/vault-mounted switchgear, specify a VFI with protective relay and controls for the tap line that feeds to the service transformer.

e. Specify fuse protection for any single phase and 3-phase transformers that are smaller than 1000kVA.

f. Specify VFI protection for all service transformers that are 1000kVA or greater. The VFI protection allows better coordinated protection than a fuse and trips all three (3) phases for short circuit faults, eliminating voltage imbalances and negative sequence currents typically present during single phase faults. Voltage and current imbalances negatively impact the functionality and operating life of electronics and equipment, e.g. 3-phase motors.

g. Specify proper sizing and placement of surge arresters to protect critical electrical assets from voltage surges.

h. Specify advanced metering and monitoring devices for service connections greater than 500kVA so CLP can collect metering and power quality data. The data will be utilized for future capacity sizing and power quality improvements.

i. Make sure to specify and plan for system modeling, short-circuit analysis, coordination study, and proper setting/sizing of protective devices as part of the project scope. It is extremely important to ensure proper coordination of the protective devices so overcurrent faults are isolated with minimal impact to the entire system.

6.3 SERVICE CONNECTION PLANNING AND DESIGN CHECKLIST

6.3.1 CAPACITY

- ☐ Estimate electrical load and service transformer size (#of phases, kVA and voltage)
- ☐ Identify nearest feeder or service connection point that has adequate capacity to support estimated electrical load
- ☐ Scope all electrical and civil modifications, adds, and retrofits to connect new service transformer to the existing system service connection point
- ☐ Size all new electrical components to meet ampacity and voltage drop requirements

6.3.2 SAFETY AND ENVIRONMENT

- ☐ Design grounding, neutral, and bonding system
- ☐ Choose dead-front design for pad/vault-mount apparatus
- ☐ Define transformer configuration
- ☐ Identify protective device type and locations
- ☐ Develop major apparatus safety specifications in accordance with applicable standards
- ☐ Verify all electrical components meet safety standards for clearance, electrical ratings, mechanical, structural, access, and operations requirements
- ☐ Specify proper insulation material for pad/vault-mounted switches and transformers

6.3.3 OPERABILITY

- ☐ Identify switching and isolation requirements
- ☐ Specify pad/vault-mounted switches, fused cutouts, load-break switches, or air brake switches
- ☐ Ensure pad-mounted transformers are loop-feed configuration and have proper switching configuration
- ☐ Allocate proper clearance and access around all medium voltage apparatus

6.3.4 RESILIENCY

- ☐ Identify criticality of the new service facility
- ☐ Assess and ensure supply-side redundancy requirements
- ☐ Specify fault indicators
- ☐ Design automation and SCADA-ready switching systems

6.3.5 PROTECTION

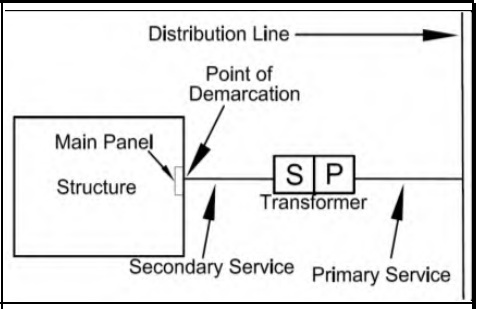
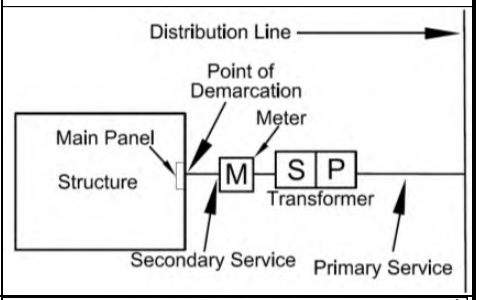
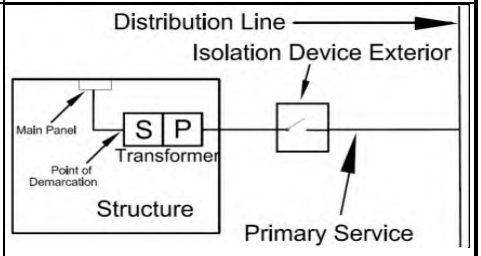
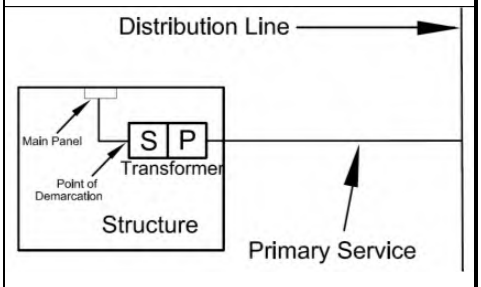
- ☐ Identify short circuit protective device type and placement requirements
- ☐ Identify overvoltage (surge) protection device and placement requirements
- ☐ Specify fuse (for less than 1000kVA) or VFI (for 1000kVA and greater) protection for service transformers
- ☐ Plan advanced metering and monitoring device for new service connection
- ☐ Account for system modeling, load-flow, short circuit, and coordination studies within the project scope

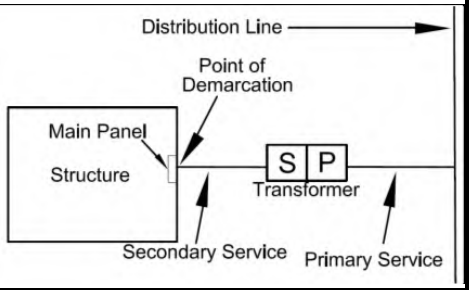
SECTION 7.0 ELECTRICAL SYSTEM OVERVIEW AND SITE-SPECIFIC REQUIREMENTS

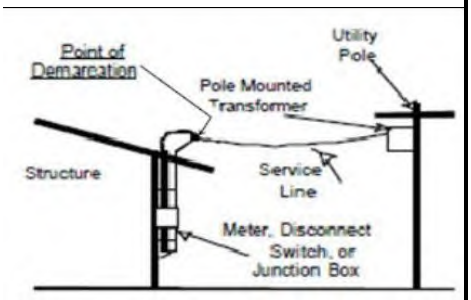
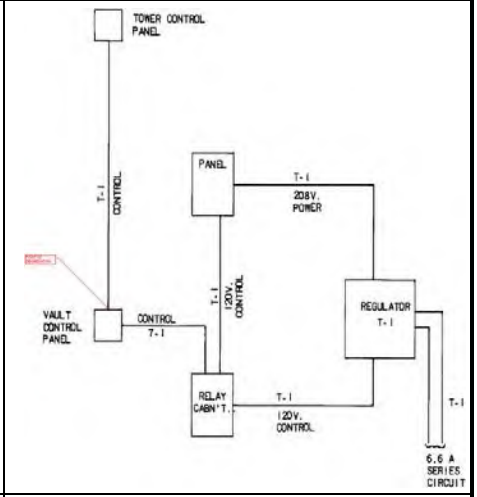
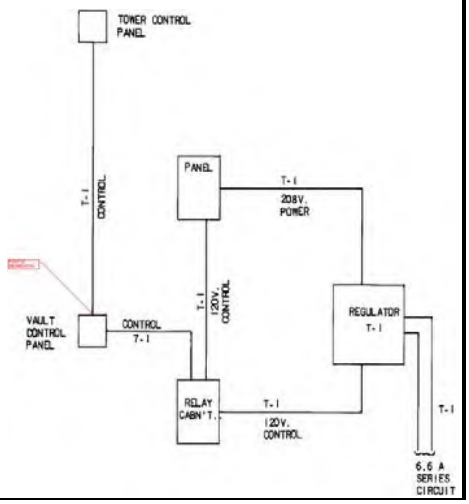
7.1 POINTS OF DEMARCATION

7.1.1 TYPICAL POINTS OF DEMARCATION

Table 7.1: Typical Points of Demarcation

Point of Demarcation	Applicable Scenario	Sketch
Point of demarcation is the load side of the secondary terminals on the transformer.	Pad-mounted transformer located outside of structure with underground service to the structure and no meter exists.	
Point of demarcation is the load side of the secondary terminals on the transformer.	Three-phase metered service.	
Point of demarcation is the load side of the secondary terminals on the transformer.	Transformer located inside of structure and an isolation device is in place with or without a meter. *Note: Utility Owner must be granted 24-hour access to transformer room.*	
Point of demarcation is the load side of the secondary terminals on the transformer.	Transformer located inside of structure with no isolation device in place *Note: Utility Owner must be granted 24-hour access to transformer room.*	

Point of Demarcation	Applicable Scenario	Sketch
Point of demarcation is the secondary terminal of the transformer.	Electric power is provided to a water facility via an overhead service drop. This configuration could be found at facilities dedicated to the water utility such as a water well, pump station, or storage facility.	None
Point of demarcation is the secondary terminal of the transformer.	Electric power is provided to a water facility via an overhead service drop. This configuration could be found at facilities dedicated to the water utility such as a water well, pump station, or storage facility.	None
Point of demarcation is the secondary terminal of the transformer.	Electric power is provided to a water facility via an overhead service drop. This configuration could be found at facilities dedicated to the wastewater utility such as a lift station or wastewater treatment plant.	None
Point of demarcation is the secondary terminal of the transformer	Electric power is provided to a water facility via an overhead service drop. This configuration could be found at facilities dedicated to the wastewater utility such as a lift station or wastewater treatment plant.	None
Point of demarcation is the secondary terminal of the transformer.	Residential service connected to underground secondary line.	

Point of Demarcation	Applicable Scenario	Sketch
Point of demarcation is where the secondary conductor is connected to the weather head.	Overhead service connected to the overhead secondary line.	
The point of demarcation is the point of connection of the tower control run to the lighting vault control panel.	Airfield tower control run from the lighting vault control panel.	
Point of demarcation is the point of connection of the communication leads to the meter.	Meter with communication leads installed at facility.	

7.2 PRIMARY DISTRIBUTION SYSTEM SUMMARY

7.2.1 SYSTEM VOLTAGES

Hill Air Force Base has a primary overhead and underground distribution voltage of 12,470V. The 12,470V system is considered a 4-wire multi-point grounded system. The overhead subtransmission voltage is 46,000V and is a 3-wire delta system.

The HAFB Utah Test and Training Range (UTTR) electrical system is a 3-wire delta single-point grounded system. There is a 4th wire, but it is only to be used as a shield for lightning protection. The distribution voltage at UTTR is 12,470V.

All new service connections will be made at the 12,470V level to maintain high reliability of the 46,000V system.

7.3 PAD-MOUNTED SERVICE TRANSFORMERS

7.3.1 SPECIFICATIONS

New pad-mounted service transformers shall be three-phase unless a single-phase transformer is necessary. Three-phase transformer primary voltage shall be 12,470V delta and single-phase two-bushing 12,470V L-L. Transformers shall be Trusty Tan Federal Paint # (Federal Std 595C): 23530.

Refer to the CLP Pad-mounted Transformer Datasheets for detailed equipment specifications.

7.3.2 MOUNTING AND GROUNDING REQUIREMENTS

Pad-mounted service transformers shall be mounted on a concrete pad.

Grounding shall be a two $^{5}/_{8}$" x 8' (Diameter x Length) copper-clad steel rod installed 2-ft from the pad edge with a #1/0 solid soft-drawn bare copper wire connected between the ground rods to form a ring using exothermic connections. A 4-ft pig tail at the pad is required for termination to the transformer enclosure grounding point.

7.4 POLE-MOUNTED TRANSFORMERS

7.4.1 SPECIFICATIONS

New pole-mounted service transformers shall be single-phase two-bushing 12,470V L-L. For 3-phase configurations, the transformers will be a Delta-wye configuration. Properly sized lightning arresters and fuse cutouts shall be installed on the primary side of every transformer.

Refer to the CLP Pole-mounted Transformer Datasheets for detailed equipment specifications.

7.4.2 MOUNTING AND GROUNDING

Pole-mounted service transformers 50KVA and below shall use a single-hanger bracket. Bond the case of every transformer to the pole ground. Pole ground wire shall be #4 solid soft-drawn bare copper wire connected to a single $^{5}/_{8}$" x 8' (Diameter x Length) copper-clad steel rod installed 4-ft from the pole.

7.5 PAD-MOUNTED SWITCHGEAR

7.5.1 SPECIFICATIONS

New pad-mounted switchgear (PMS) shall be 600A 15KV rated. 200A tap protection shall be specified for all lateral or tap lines. Tap protection will be vacuum fault interrupters (VFI). Each primary way shall be 600A load-break.

Refer to the CLP PMS Datasheets for detailed equipment specifications.

Equipment color: Trusty Tan. Federal Paint # (Federal Std 595C): 23530

7.5.2 MOUNTING AND GROUNDING REQUIREMENTS

New PMS's shall be mounted on a concrete pad or switch vault.

Grounding shall be two $^{5}/_{8}$" x 8' (Diameter x Length) copper-clad steel rods installed 4-ft from the pad edge with a #4/0 stranded soft-drawn bare copper wire connected between the ground rods to form a ring using exothermic connections. The PMS bonding wire shall be #1/0 stranded soft-drawn bare copper wire from both ground rods to the PMS pad. Two 4-ft pig tails at the pad is required for termination to the PMS enclosure grounding points.

7.6 RECLOSERS

7.6.1 SPECIFICATIONS

Reclosers may be used after consulting and approval from CLP. Reclosers shall come with control power transformer (CPT), voltage sensors (as specified in the datasheet) and lightning arresters on the load side and line side of the recloser.

Refer to the CLP Recloser Datasheets for detailed equipment specifications.

7.6.2 MOUNTING AND GROUNDING REQUIREMENTS

New reclosers shall be provided with a steel rack from the manufacturer and capable of a single-pole mount. A #4 solid bare copper wire shall be used for recloser poles.

Refer to the CLP Overhead Construction Standards for detailed construction specifications.

7.7 MEDIUM VOLTAGE UNDERGROUND CABLES

7.7.1 SPECIFICATIONS

New underground cables shall be 15KV rated, EPR, 133% insulation, 1/3 concentric neutral, copper/aluminum for 3 phase applications.

New underground cables shall be 15KV rated, EPR, 133% insulation, full concentric neutral, copper/aluminum for single phase applications.

Standard cable sizes are #1/0 AL, #4/0 CU, 350MCM CU.

Refer to the CLP Cable Datasheets for detailed specifications.

7.7.2 Supporting Underground Infrastructure Requirements

New underground medium-voltage cable shall be installed in Schedule 40 PVC conduit encased with a minimum of 3-in of concrete unless otherwise approved by CLP. Depth of burial shall be a minimum of 36 in below grade measured from the top of the concrete encasement. Any change of direction that is more than five (5) degrees will require the installation of a manhole unless coordinated and approved by CLP. Maximum spacing between manholes or equipment shall not exceed 300 feet unless otherwise approved by CLP.

Underground construction below roads must be pre-approved by CLP. All conduit containing conductors of any voltage including communication circuits that run under streets or parking lots shall be in conduit and concrete encased. Under-road installation methods will be open-cut or directional boring. Turn-ups shall have RGS conduit or fiberglass sweeps when making the transition from underground to overhead high voltage power lines. Only one high voltage riser in RGS per utility pole will be installed. Conduit bend calculations shall be made to provide proper bend radii to reduce conductor pulling tensions.

Directional boring may be used after consulting and approval from CLP. Directional bores shall use 4-in or 6-in HDPE conduit and placed a minimum of 36-in below grade.

New pole risers shall use a GRC sweep and 10’ of vertical GRC conduit. Continuation to the top of the riser shall be completed with schedule 40 Gray PVC conduit. Standoff brackets shall be utilized to support the riser conduit. Bond all above ground metal parts of the riser to the pole ground.

Refer to the CLP Underground Construction Standards for detailed construction specifications.

7.8 MEDIUM VOLTAGE OVERHEAD CONDUCTORS

7.8.1 Specifications

New overhead cables shall be ACSR. Overhead-mounted insulated cable may only be used with prior approval from CLP.

Standard overhead cable sizes are #4, #1/0, 336 ACSR.

7.8.2 Supporting Overhead Infrastructure Requirements

Insulators shall be polymer and rated for a minimum of 25KV for new construction on the 12,470V system. All new design shall withstand 1/2” of radial ice and 4 psf wind, pursuant to NESC Rule 250B heavy loading requirements.

Fiberglass crossarms shall be used at every single and double dead-end pole-top configuration. Wood crossarms may be used for lower mounted riser cutouts. Loading calculations shall be performed to determine correct line equipment load ratings.

Refer to the CLP Overhead Construction Standards for detailed construction specifications.

APPENDIX A: UNDERGROUND SERVICE CONNECTION CONSTRUCTION STANDARDS

The following section of the underground service connection requirements will apply to all CLP underground electrical distribution systems. All construction will be required to meet CLP and Industry Standards.

STANDARDS DRAWING NUMBER	DESCRIPTION
UG-15KV-SWH-3030	15KV PAD-MOUNTED SECTIONALIZING CABINET
UG-15KV-XFR-3050	15KV PAD-MOUNTED TRANSFORMER 3-PHASE
UG-15KV-XFR-3051	15KV PAD-MOUNTED TRANSFORMER 1-PHASE
UG-TYP-CBL-3520	GENERAL UNDERGROUND CABLE INFORMATION
UG-TYP-CBL-3521	GENERAL UNDERGROUND CABLE HARDWARE
UG-TYP-DUC-3550	CONCRETE-ENCASED DUCT BANK
UG-TYP-DUC-3570	TRENCHING
UG-TYP-DUC-3580	BORING
UG-TYP-GND-3600	GENERAL UNDERGROUN GROUNDING
UG-TYP-GND-3601	MANHOLE-HANDHOLE GROUNDING
UG-TYP-GND-3602	PAD-MOUNTED EQUIPMENT GROUNDING
UG-TYP-RSR-3621	RISER U-GUARD
UG-TYP-RSR-3622	UNDERGROUND RISER STAND-OFF CONDUIT
UG-TYP-VLT-3640	MANHOLE - TRAFFIC RATED - 10x6x9
UG-TYP-VLT-3641	MANHOLE - TRAFFIC RATED - 10x6x7
UG-TYP-VLT-3642	MANHOLE - TRAFFIC RATED - 6x8x7
UG-TYP-VLT-3650	MANHOLE - INCIDENTAL TRAFFIC RATED - 7x7x6
UG-TYP-VLT-3651	MANHOLE - INCIDENTAL TRAFFIC RATED - 10x8x7
UG-TYP-VLT-3660	HANDHOLE - 4x4x3
UG-TYP-VLT-3661	HANDHOLE - 5x2.5x3
UG-TYP-VLT-3662	HANDHOLE - 6.5x4x3
UG-TYP-VLT-3663	HANDHOLE - 8x8x4

BILL OF MATERIALS					
ITEM	DESCRIPTION	MANUFACTURER	CATALOG NO.	QUANTITY PER SHEET	
1	8' Ground Rod, 5/8' Diameter	Hubbell	C615880	1	1
2	Connector, Ground Wire	Hubbell	C2030344	1	1
3	Pad, Fiberglass Box	Copper	Gs188422	1	1
4	Tie, 7.6' Cable	3M	CT8RD50-C	9	12
5	Connector, 200A Loadbreak Elbow	Copper	LEJ215DD06T	9	12
6	Fault Indicator	SEL	1-TPRIO100IRJ	9	12
7	Identification Tag	Electromark	N/A	9	12
8	Identification Inserts	Copper	CAB650073EN	9	12
9	Wire, #4 Solid Bare Copper	N/A	N/A	As Required	
10	Tie, 14' Plastic	Electromark	TIE14	9	12
11	Sectionalizing Cabinet	Copper	SEC38423F2153MOG	1	1

Installation Instructions:

A. Complete installation of ducts and turn-ups at the intended location prior to beginning the install of any equipment. Ensure that the area is clear and level with no less than 6" compacted earth, then pull cable through the duct into the intended enclosure area. Coil cable to allow sufficient slack for elbow installation and operation.

B. Install box pad centered over duct turn-ups allowing for the most efficient arrangement of cables. Verify that the pad is level and is not resting on the cables. Backfill around the outside of the pad to a depth of 8"

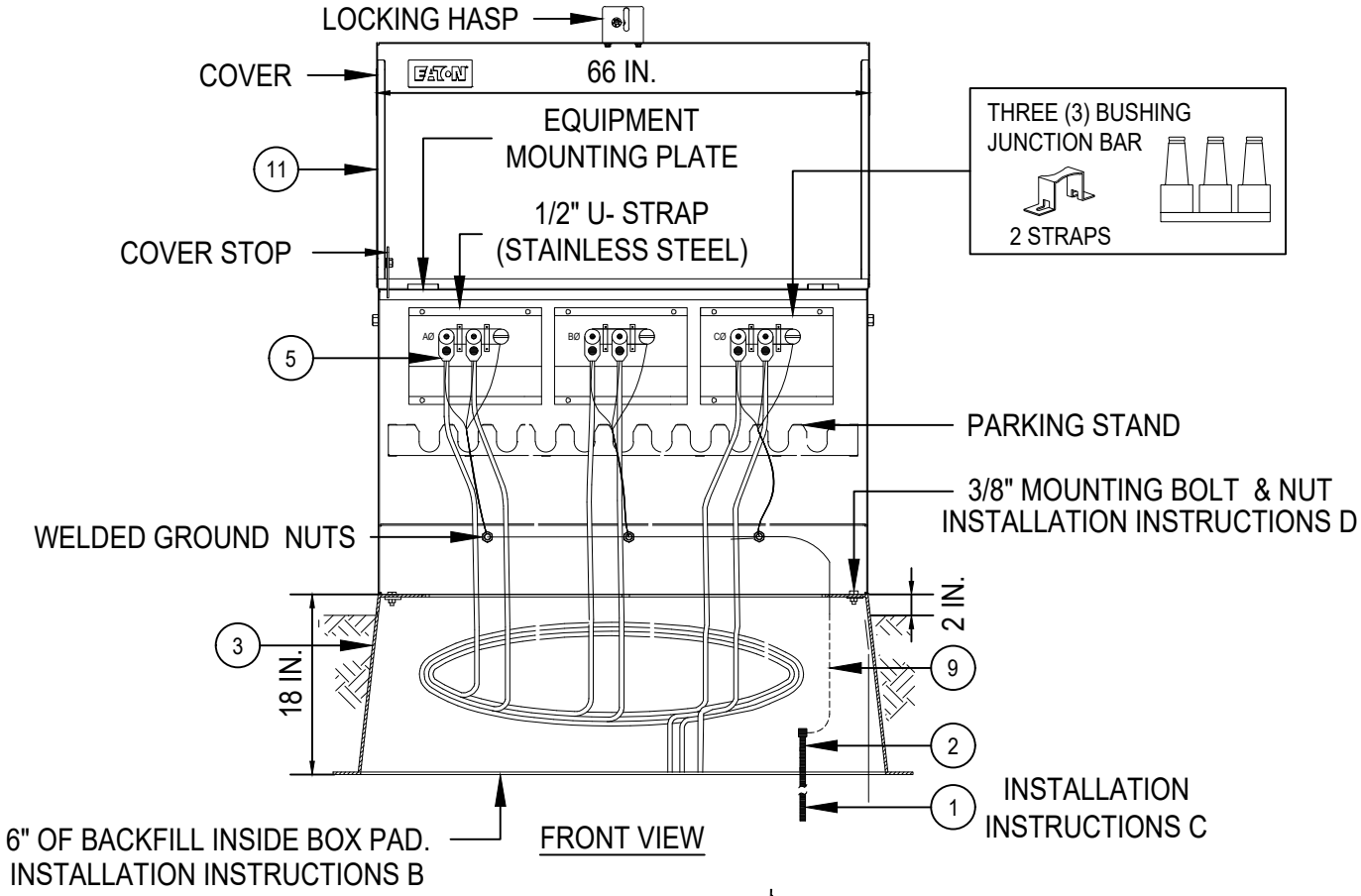
C. Hand-tamp remaining backfill in 6" lifts leaving 2" of box pad exposed above final grade.

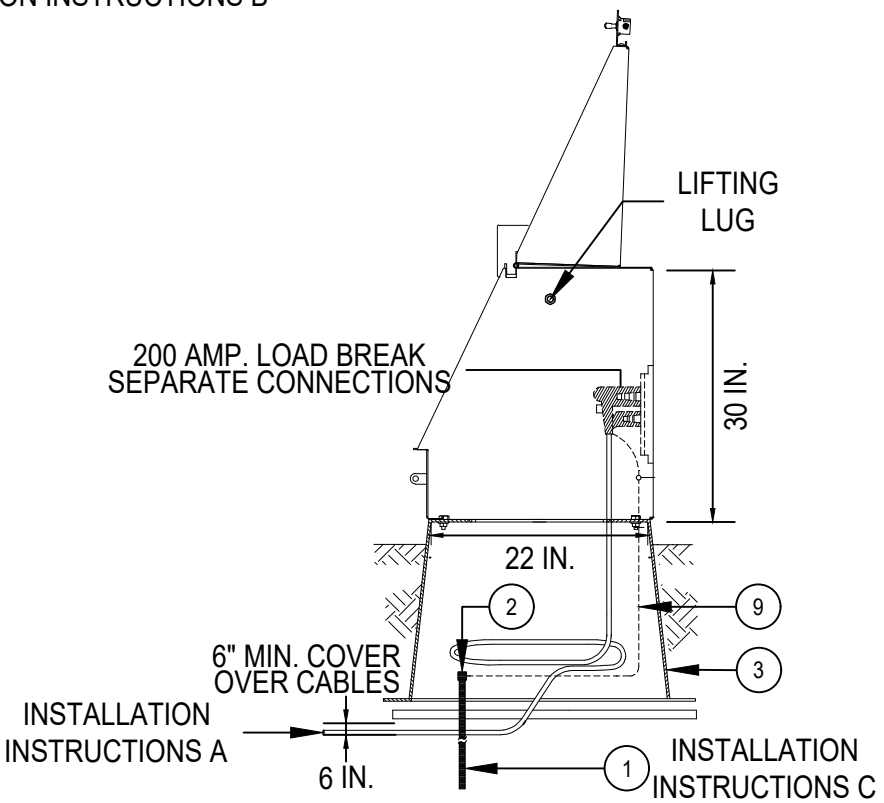
D. Drive ground rod inside pad to a minimum buried depth of 8', making sure it is accessible for future testing.

E. Install appropriate amperage elbow connectors onto cables per elbow manufacturers' instructions.

F. Install elbow-mounted fault indicators per manufacturers' instructions on appropriate elbows.

G. Cable to be tagged with phase and origin/destination.

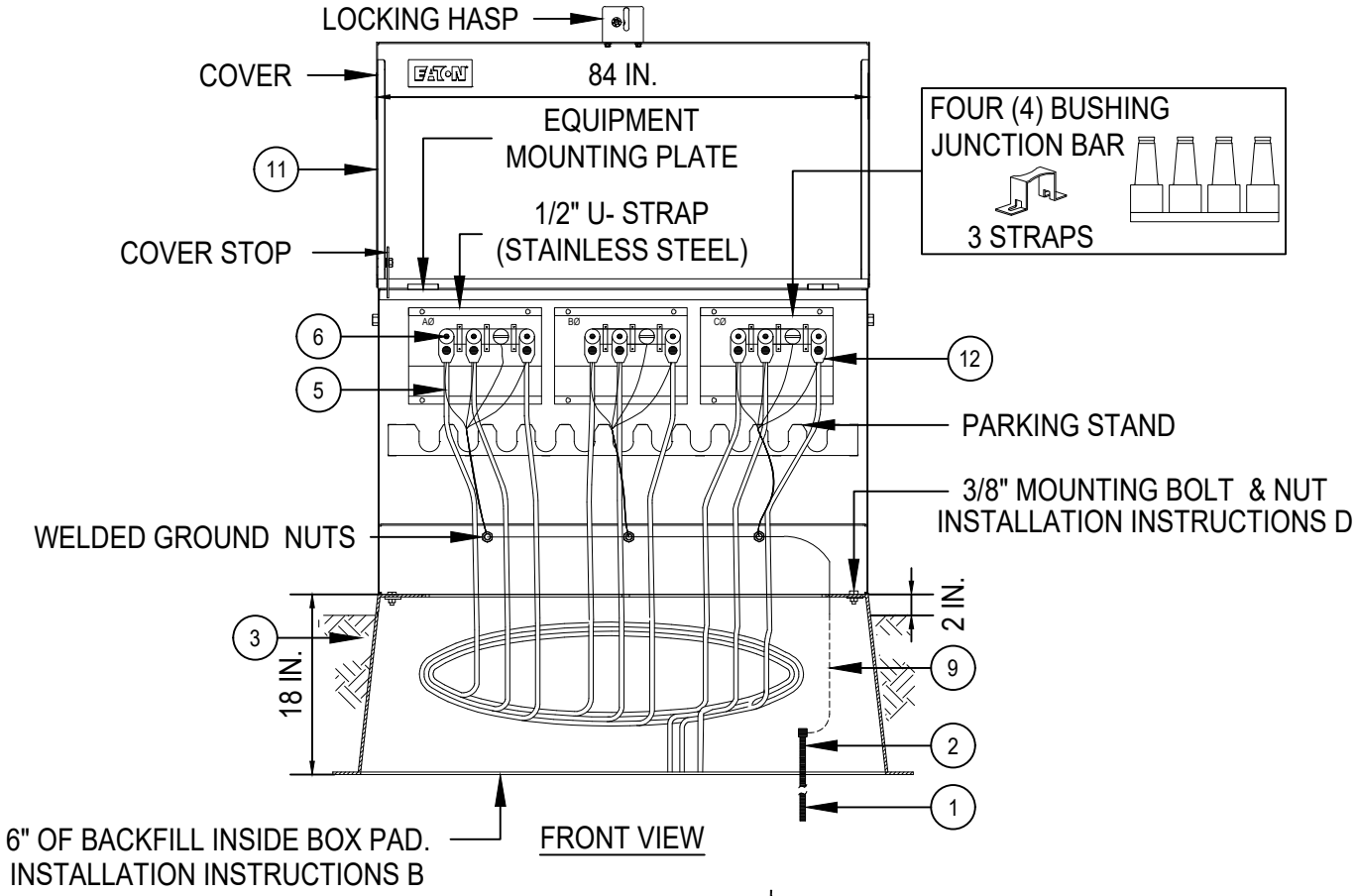


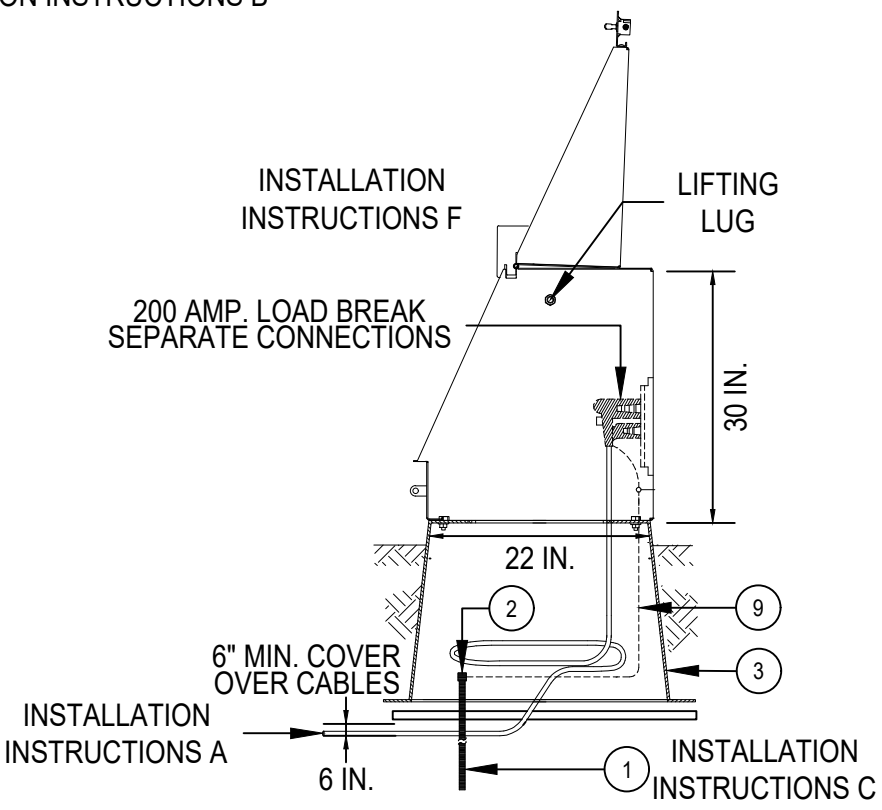


15 KV THREE-WAY SECTIONALIZING CABINET & BOX PAD

Drawing Name	15KV PAD-MOUNTED SECTIONALIZING CABINET			
Drawing #	UG-15KV-SWH-3030	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 2 of 3	Approval Date: 4/15/2022		1

CITY LIGHT & POWER





15 KV FOUR-WAY SECTIONALIZING CABINET & BOX PAD

Drawing Name	15KV PAD-MOUNTED SECTIONALIZING CABINET				
Drawing #	UG-15KV-SWH-3030	Scale : N.T.S.	Approved By: APS	Rev	
City Light & Power Construction Detail Standards	Sheet 3 of 3	Approval Date: 4/15/2022		1	

CITY LIGHT & POWER

BILL OF MATERIALS				
ITEM	DESCRIPTION	MANUFACTURER	CATALOG NO.	QUANTITY
1	Rod, 8’ Ground 5/8” Diameter Copper Clad	Hubbell	C615880	1
2	Connector, Ground Wire	Hubbell	C2030344	1
3	Pad, Plastic for 25-167 kVA	Highline	HL424204-1227V	1
4	Bushing, Secondary Hylug Connection	Cooper	CA800023EN	3
5	Bushing, Secondary Set Screw	Hubbell	ZABW6500L	3
6	Tie 7” Cable	3M	CT8RD50-C	4
7	Connector, 200A Load Break	Cooper	LEJ215DD06T	As Req.
8	Cover, Secondary Bushing Set Screw	Hubbell	ZBC6500	3
9	Indicator, Fault	SEL	1-TPR10100IRJ	1
10	Tape, 3/4” Plastic	N/A	N/A	As Req.
11	Wire, #4 Solid Bare Copper	N/A	N/A	As Req.
12	Compound, Insulating Roll	Cooper	104742	As Req.

Installation Instructions:

A. If the pad has not been installed, drive the ground rod underneath the pad area and allow enough wire to connect from the transformer ground lug halfway around the base of the transformer and attach to the ground rod connector. If the pad has been installed with a ground rod, drive the ground rod in the pad opening using extreme caution to avoid damaging the cable. Use #4 solid copper wire to connect the transformer ground lug to ground rod connector.

NOTE: Critical steps when installing the transformer flat pad are to have it perfectly level and to bury it in the ground. If the pad is not level, the transformer door will not open or close properly. Bury the pad 2" in the ground, which is half of the pad thickness. If the pad is placed on top of the ground, gaps between the pad bottom and the ground could allow unauthorized access to transformer compartment. Also if the pad sits on an unprepped surface and the pad & transformer are hit/bumped by customers, riding mowers, cars, etc., the pad and transformer could shift causing unauthorized access to the transformer compartment and possible safety hazards.

B. Loosen locknuts on the secondary spades and screw in as far as possible, positioning spade at a 60 degree angle. Retighten locknuts on secondary spades.

C. Keep the primary cables away from the secondary bushings. Install the secondary cables behind the primary cables. This means that the secondary cables will be near the transformer tank wall. SPECIAL PRECAUTION - Keep both the primary and secondary cables away from sharp, protruding metal parts, especially the manufacturer's shipping tabs. These metal tabs are welded to the bottom of the oil tank. These tabs are used to bolt the transformer to a pallet for shipping. (See Cable Shaping diagram on page 5)

D. Cut the X_1 and X_3 secondary cables a minimum of 28" above the top surface of the transformer pad.

E. Cut X_2 or neutral cable a minimum of 25" above the top surface of the transformer pad.

F. Remove insulation from the outer jacket on the conductor and clean the conductor thoroughly with a wire brush before installing the hylug.

G. Train the primary cable into its final assembled position against the primary bushing. Cut the cable approximately 24" above the top of primary bushing. [NOTE - This step prepares the cable to have enough slack in the concentric neutral wire to connect to the transformer ground lug.] Expose the concentric neutral wires by removing the outer cable jacket to approximately 12" below the primary bushing. Unwind the concentric neutrals away from primary cable and temporarily bend out of the way.

H. Before making the "final cable cut." Be sure the primary cable can freely move from its primary bushing position to an accessary bracket. Cut the cable squarely at the center line of the primary bushing. Install a 200 Amp load break elbow connector.

I. For jacketed cable, bend concentric neutral wires back over the jacket and secure the wires 1" from the end of the jacket using a cable tie. Make a water seal at the jacket using insulating compound and plastic tape.

J. Twist the concentric neutral wires together to basically form one conductor. The exposed wires should be 30" to 36" in length. This will give enough slack in the concentric neutrals to allow free movement of the 200 Amp elbow. Do not exceed 36" of bare concentric wires. Shape concentric neutrals down in front and then up behind the secondary cables. Attach the concentric neutrals to the transformer ground lug.

Installation Instructions (Continued):

K. This bracket is used for mounting accessary bushings.

L. Cover X_1 and X_3 connections with insulated covers.

M. For an open point transformer, attach the ground straps of two MOV elbow arresters to the ground wire loop using #4 Fargo connectors. Install the two MOV elbow arresters, one on the open transformer bushing and the other on the feed-thru bushing.

N. Cut the X1 and X3 secondary cables a minimum of 28" above the top surface of transformer pad. Cut the X2 or neutral cable a minimum of 25" above the top surface of the transformer pad.

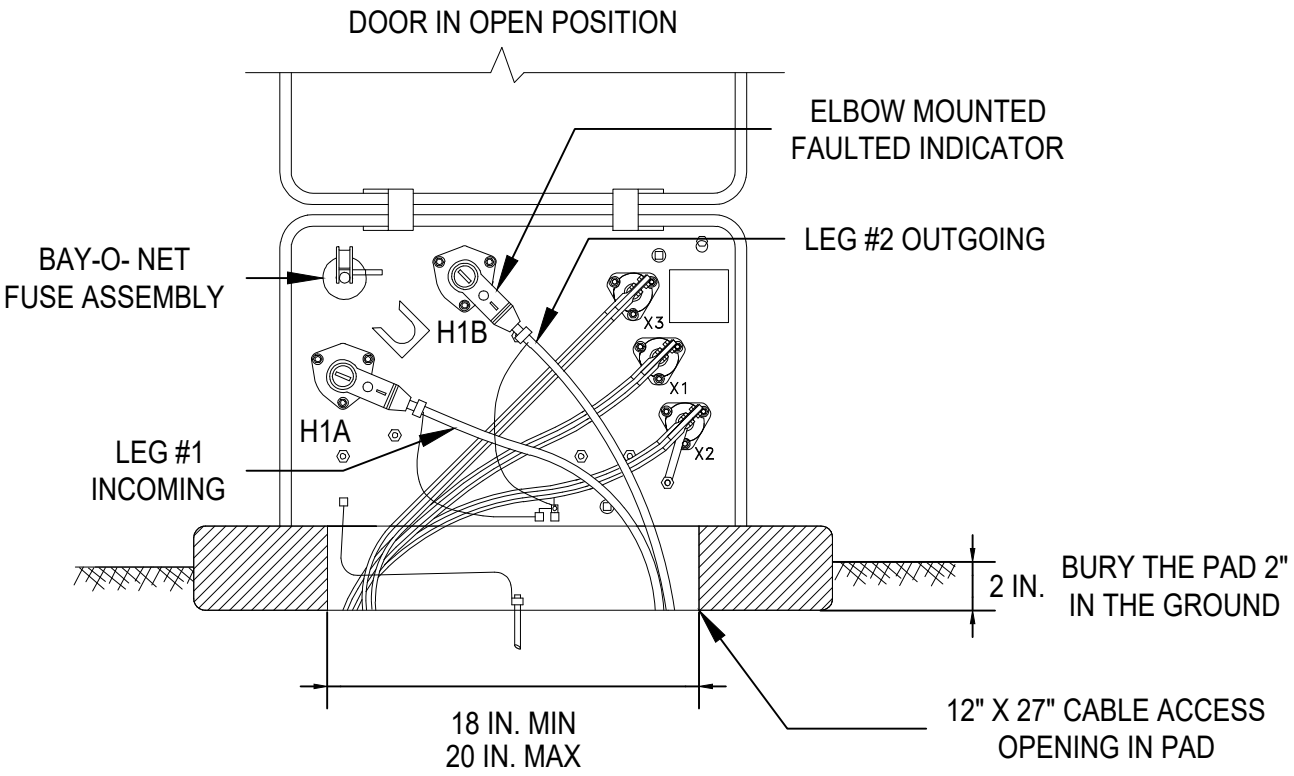
O. Remove 1-1/2" of insulation from the conductor. Thoroughly clean the conductor with a wire brush.

Notes:

A. This particular pad-mounted transformer is equipped with a tank wall mounted Bay-O-Net fuse assembly which protects the transformer and the distribution system.

B. The Bay-O-Net fuse assembly includes a "flapper valve" inside the housing which close as the fuse holder is removed. This flapper valve minimizes oil spillage.

C. The fuse assembly combines hot stick operations with dead-front construction. The fuse holder has load break capability when it is necessary to re-energize the transformer secondary.



1Ø 1-BUSHING PAD-MOUNTED TRANSFORMER WITH BAY-O-NET FUSE ASSEMBLY
SEE NOTES A - O

Drawing Name	15KV PAD-MOUNTED TRANSFORMER 1-PHASE			
Drawing #	UG-15KV-XFR-3051	Scale : N.T.S.	Approved By: APS	Rev
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BILL OF MATERIALS				
ITEM	DESCRIPTION	MANUFACTURER	CATALOG NO.	QUANTITY PER SHEET
				SH. 5
1	Ground Rod	Refer to Std UG-TYP-GND-3600		1
2	Connector, Ground Wire	Hubbell	C2030344	1
3	Pad, Concrete	Ref Sheet 7 of 7 for Typical Pad Sizes		1
4	Bushing, Secondary Hylug Connection	Cooper	CA800023EN	4
5	Tie Cable, 7"	3M	CT8RD50-C	4
6	Connector, 200A Load Break	Cooper	LEJ215DD06T	As Req.
7	Indicator, Fault	SEL	1-TPR10100IRJ	By Request Only
8	Tape, 3/4” Plastic	N/A	N/A	As Req.
9	Wire, #4 Solid Bare Copper	N/A	N/A	As Req.
10	Compound, Insulating Roll	Cooper	104742	As Req.

Note: For pad-mounted transformers Bay-O-Net fuse sizing or vacuum fault interruptor settings contact the site CLP Representative or CLP Engineering.

General Notes:

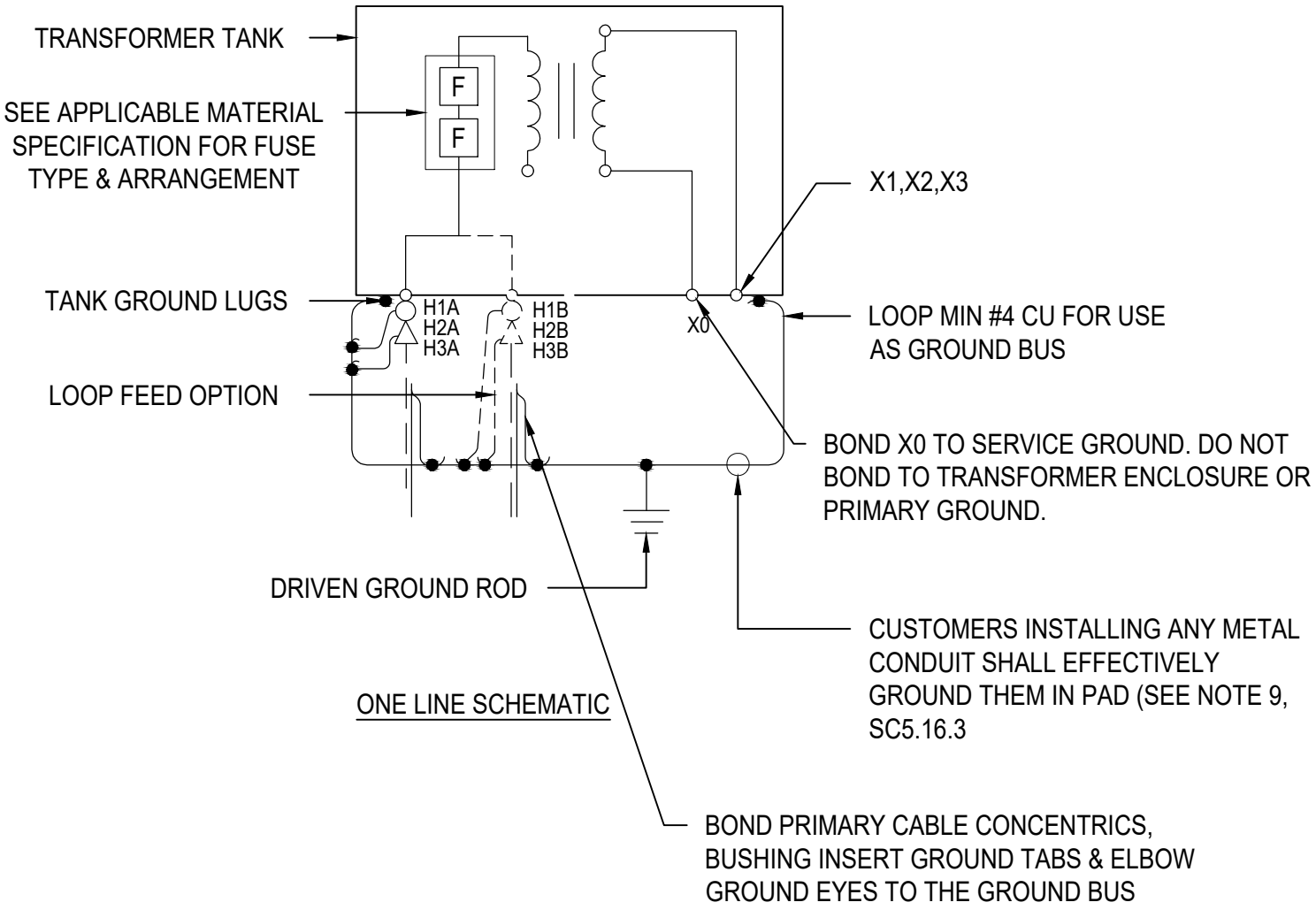
1. All conduits shall be installed per City Light and Power Construction Standards UG-TYP-DUC-3550 Concrete Encased Duct Bank and UG-TYP-DUC-3580 Boring. Refer to UG-TYP-DUC-3570 Trenching for primary/secondary conduit depths, trench backfilling and compaction..
2. For radial feed installation of a loop-type transformer, both primary conduits shall be installed. If one is not used, it shall be stubbed and capped at least 2' out from the front edge of the pad with an 8" UG marker installed above the end.
3. Placement of multiple secondary conduits shall be by rows from back to front, example: row 1 first, then row 2, etc. Fill back row first prior to starting the next row forward, filling front row last or used for future use.
4. Fill in pad conduit openings with quickrete only after cables have been routed and installed. Pea gravel may routinely be used as a filler if needed.
5. Minimum radius of 4" primary conduit vertical bend shall be 36". CLP may require 48" radius GRC bend if necessary for longer pulling length.
6. CLP Engineer to specify for pads poured-in-place when access with precast pad is not available.
7. NESC-314B: Conductive-material ducts and riser guards that enclose electric supply lines, or are exposed to contact with open supply conductors, shall be effectively grounded.
8. When terminating three phase loop feed transformers, cables using conduit on the left side shall be terminated to the HxA bushings. Cables using conduit on the right side shall be terminated to HxB bushings to prevent crossing of primary cables.
9. Leave slack in secondary and primary cables to permit transformer removal and replacement for maintenance, train primary cables to permit parking elbows.
10. Leave sufficient slack on concentric neutrals to allow removing elbows without disconnecting neutrals.
11. Ground loop in all cases shall be installed in front of primary cables.
12. On transformers where an external ground strap is provided that is connected to the neutral bushing, do not bond secondary neutral to the transformer grounding. Bond to the secondary ground cables and verify bonding to load ground. If building ground is not present, then bond to a separate set of grounding electrodes.
13. NESC Rule 384C: Bond all above ground metallic supply and communication enclosures that are separated by 6 feet or less. Use minimum #6 bare copper wire direct buried a minimum 18" below grade, to a suitable bolted or screw connection that can be temporarily opened when locating cables. Treat open ground connections as energized.
14. Each Bay-O-Net fuse assembly includes a "flapper valve" inside the housing which closes as the fuse holder is removed. This flapper valve minimizes oil spillage.
15. If the pad has not yet been installed, and a ground rod system is specified, drive the ground rod underneath the pad area and allow enough wire to connect to the transformer ground lug. If a ground ring system is specified, install the ground ring adjacent to pad, and route ground cable through conduit opening (if using a prefabricated pad). If the pad has been installed without the ground rod or ground ring, drive the ground rod in the pad opening using extreme caution to avoid damaging the cable. Use #1/0 solid copper wire to connect to the transformer ground lug ground rod connector. Leave 6 feet of ground bonding wire for routing/connecting grounding to equipment.

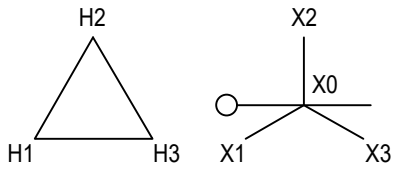
General Notes continued:

18. CAUTION: When replacing a blown fuse, the supply circuit should be opened and closed at a remote location. Do not re-energize a suspected failed transformer or secondary system at the transformer. The fuse could close into the system's maximum fault current.
19. If fault indicators are specified, refer to manufacturer's instructions for fault indicator installation.
20. On transformers having the manufacturer's removable lifting lugs, remove the lugs after installation and store them in the cable compartment. All bolts removed from the lugs must be placed in a plastic bag from which an elbow terminator has been removed and stored with the lugs in the cable compartment. These parts will be needed when the transformer is removed from service. If the manufacturer's lifting bolts and/or lugs cannot be found, remove the transformer from service using lifting plates with 5/8" Grade 8 bolts with nuts.
21. Bury equipment pad a minimum of 2 inches below grade. Also ensure there is a minimum of 3 inches of tamped crushed rock under pad.
22. Pour-in-place pads shall be minimum compressive strength of 3000 psi at 28 days and reinforced with #6 deformed rebar placed overlapped every 12 inches. Maintain a minimum 3 inches from the edges and bottom. Concrete must be allowed to cure to a minimum of 3000 psi before setting any oil-filled equipment on pour-in-place pads.
23. Top surface shall be level. Wood float top and do not leave any depressions.
24. Mineral oil-filled transformers shall meet the below minimum distance from buildings shown below unless specifying FR3 insulation.
    - 24.1. 75 KVA or less: 10 ft
    - 24.2. 76-333 KVA: 20 ft
    - 24.3. Greater than 333 KVA: 30 ft
25. 3-Phase transformers 1000 KVA and above shall have primary VFI protection in place of Bay-O-Net fuses to allow for better overcurrent protection coordination with upstream overcurrent protection devices.

Typical 3-Phase Pad-Mounted Transformers Pad Sizes

Transformer Size	Pad Width (ft)	Pad Depth (ft)	Pad Height (in)
45KVA - 750KVA	6	6	7
1000KVA - 2000KVA	7	7	7
2500KVA - 3000KVA	8	10	10





PHASOR DIAGRAM

Drawing Name	15KV PAD-MOUNTED TRANSFORMER THREE PHASE				
Drawing #	UG-15KV-XFR-3050	Scale : N.T.S.		Approved By: APS	Rev
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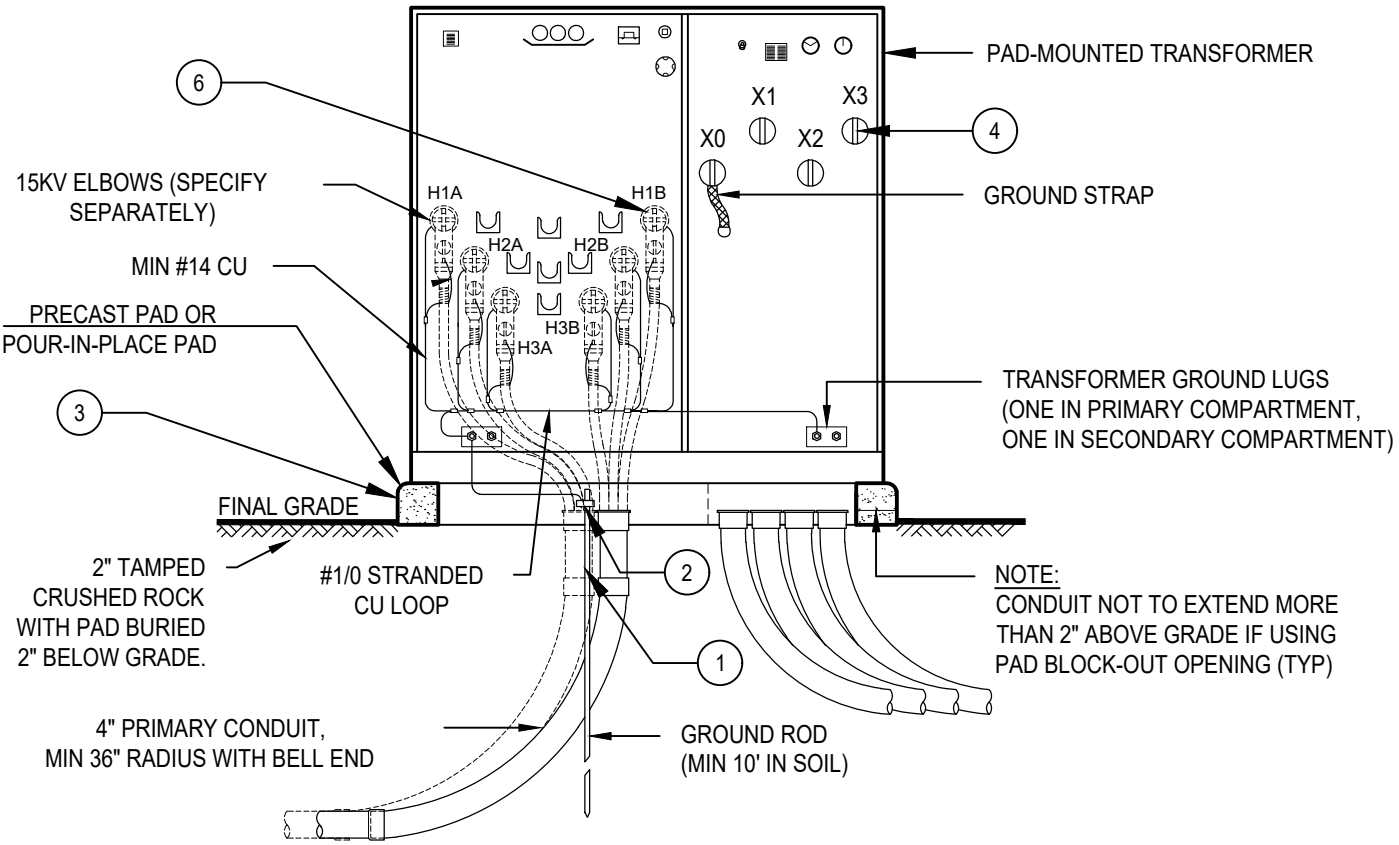
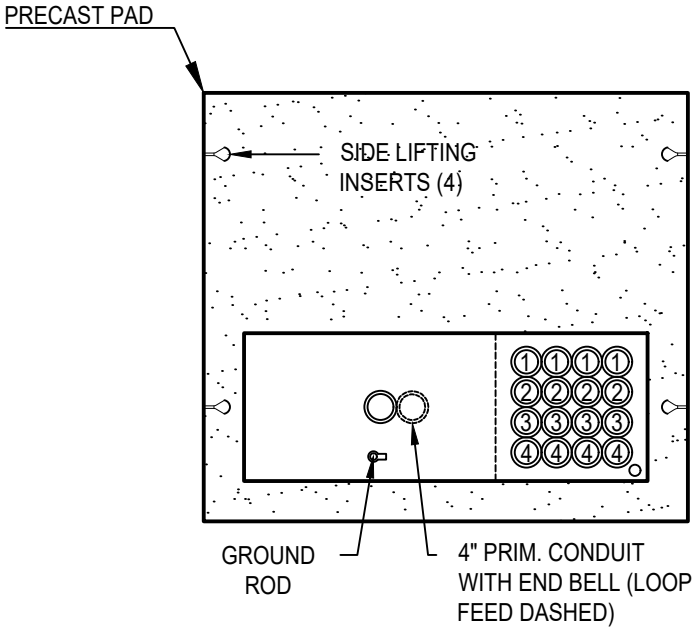
CITY LIGHT & POWER

LOOP FEED





NOTE: THROUGH-PAD CUTOUT DIMENSIONS AND NUMBER OF SECONDARY CONDUITS SHOWN ARE TO BE DETERMINED BY THE PROJECT DESIGN AND TRANSFORMER RECORD DRAWINGS.

TOP VIEW

TYPICAL 3-PHASE TRANSFORMER PAD & CONDUIT DETAILS

Drawing Name	15KV PAD-MOUNTED TRANSFORMER THREE PHASE			
Drawing #	UG-15KV-XFR-3050	Scale : N.T.S.	Approved By: APS	Rev
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HIGH VOLTAGE CABLE HANDLING AND STORAGE GUIDE

1. Unloading of cable should be accomplished so that equipment used does not contact either the cable surfaces or the protective wrapping. If unloading is accomplished by crane, either the cradle supporting the reel flanges or a shaft through the arbor hole should be used. If a fork is utilized, the forks must lift the reel at 90 degrees to the flange and must be long enough to make complete lifting contact with both flanges. Under no circumstances should the forks contact the cable surface or protective wrapping. For the same reason, a web-sling arrangement should not be used around the conductor as the weight could damage the cable. Under no circumstances should reels be dropped from the delivering vehicle to the ground.
3. Reels should be stored on a hard surface so that the flanges do not sink into the earth, allowing the weight of the reel and cable to rest on the cable surface. In storing, never turn the reel on the flange side for this will result in cable damage. The reels should be stored upright in a rolling position.
4. Cable should be stored in an area where chemical or petroleum products will not be spilled or sprayed on the cable.
5. When a reel of cable is rolled from one point to another, care must be taken to see that there are no objects on the surface area which could contact or damage the cable surface or protective wrapping.
6. If a length of cable has been cut from a reel, the cable end should be immediately resealed to prevent the entrance of moisture. Use cable seal caps (mastic and vinyl tape) .Installed cable that is not immediately terminated should be sealed, especially if left overnight.
7. Cable should be stored in an area away from open flame or other sources of high heat.
8. Reels should be stored in an area where construction equipment, falling or flying objects, or other materials will not contact the cable.
9. If an inclined ramp is used for unloading, the ramp must be wide enough to contact both flanges completely, and stopping of the reels at the bottom shall be accomplished by using the reel flanges, and not the surface of the cable.

INSTALLATION TEMPERATURE GUIDE FOR PRIMARY CABLES

1. The low temperature weakness of primary cables is the semi-conducting strand and insulation shield compounds, which have a much higher brittleness temperature than the TR-XLPE insulation. If a crack initiating in the shield does not propagate through the insulation as might be expected, then immediate failure may not occur and the cable could operate for some time before failure. However, to avoid any possible damage to primary cables while installing or operating cables with elbows at extremely low temperatures, the following guidelines should be used:

A. Minimum temperature of cable during installation for primary TR-XLP with thermosetting semicon shield is -25°C (-13°F).

B. For splicing or terminating primary cables, warm cable ends up to at least 32°F.

C. Primary cables may be operated, such as moving elbows onto a parking stand down to the same low temperature given in "A" above.

MINIMUM BENDING RADIUS

1. The minimum bending radius of primary cable shall be twelve times the overall diameter of the cable.

2. The minimum radius specified is measured to the surface of the cable on the inside of the bend.

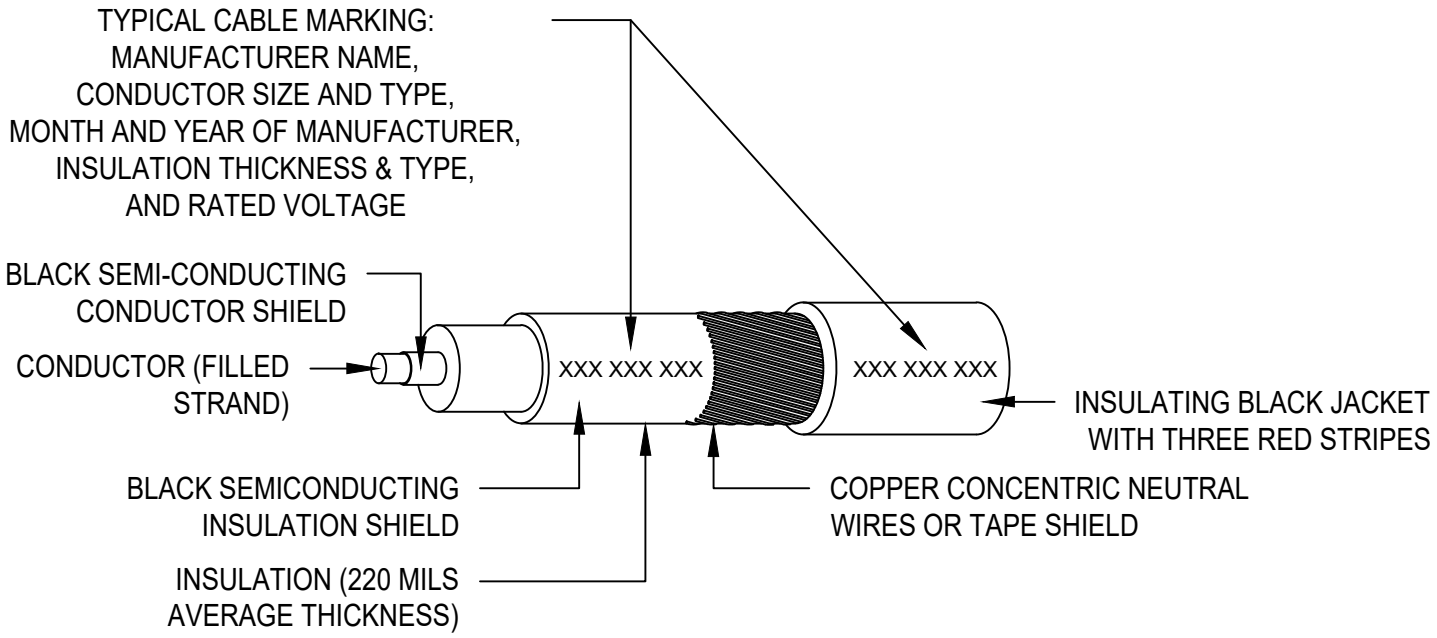
3. These bending radii are to be considered minimum recommended dimensions and are for static bends such as manhole training bends, etc., and do not apply where pulling tensions and sidewall pressures are involved.

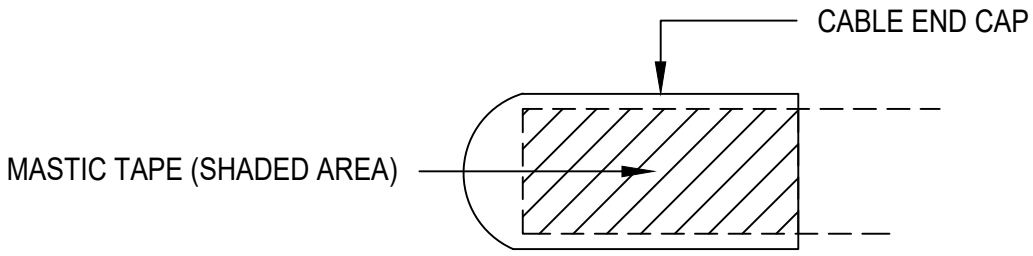
4. To visualize a bending radius, determine the diameter of the cable and multiply by twelve. Use this dimension as the minimum bending radius. Scribe a circle on the floor or in the dirt and form the cable around it. See cable bending radius in the tables on SC5.4.2.

ENERGIZING NEW CABLE

1. Since DC Hipot testing of cable and accessories can lead to insulation damage, this method is NOT recommended for testing cables. A Megger insulation test set should be used to verify continuity and the integrity of the circuit. It is high recommended to use a VLF insulation test set prior to energizing primary trunk line cables.

2. It is recommended, if possible, to energize new cable for one day at rated line voltage, prior to loading.





PRIMARY CABLE END CAP

COLD SHRINK CAP WITHOUT MASTIC FILL

CAP SIZE	CABLE SIZE
2"	#1 SOLID JKTD/ #2 URD 15KV
3"	4/0 - 15/35KV
4"	1000 KCMIL, 15KV

*NOTE:
RECOMMEND END CAP SIZE BASED ON ACTUAL CABLE OUTSIDE DIAMETER (OD) WITHOUT MASTIC WRAP. A LARGER END CAP SIZE MAY BE REQUIRED WITH MASTIC WRAP

COLD SHRINK CAP PREFILLED WITH MASTIC

CAP SIZE	CABLE SIZE	3M PART NUMBER
3"	#2 URD - 500 KCMIL, 15/35KV	QE-3
4"	1000 KCMIL, 15/35KV	QE-4

15KV UD CABLES

INSULATED (133% LEVEL, 220 MIL THICK TRXLPE) SINGLE CONDUCTOR CABLES, COMPRESSED STRANDING OR SOLID, WITH COPPER CONCENTRIC NEUTRAL WIRES, SPECIFY TOTAL QUANTITY IN FEET.

PHASE CONDUCTOR SIZE, TYPE	NEUTRAL CONDUCTOR NO. & SIZE WIRES	AMPACITY DB/ DUCT	DUCT SIZE	CONDUCTOR AREA IN^2/ (MM^2)
#2 CU	6 #14	224/162 (3PH)	3" OR 4"	0.0616 / (39.6)
#1/0 CU	9 #14	284/210 (3PH)	4"	0.1006 / (65.0)
#4/0 CU	18 #14	385/307 (3PH)	4"	0.2018 / (130.6)
250 KCMIL CU	21 #14	410/336 (3PH)	6"	0.2392 / (153.9)
500 KCMIL CU	26 #12	501/471 (3PH)	6"	0.4788 / (307.8)
750 KCMIL CU	25 #10	559/548 (3PH)	6"	0.7204 / (463.5)
1000 KCMIL CU	31 #10	1338/1192 (3PH)[2]	6"	0.9602 / (619.8)

DIMENSIONS/ WEIGHTS OF 15KV CABLES

ITEM DERSCRIPTION	CONDUCTOR OD (IN)	INSULATION OD NOMINAL (IN)	OVERALL CABLE OD (IN) / WGT (LBS/FT)	MINIMUM BENDING RADIUS
#2 CU	0.280	0.77	1.08 / 0.638	13"
#1/0 CU	0.358	0.85	1.15 / 0.837	14"
#4/0 CU	0.507	1.0	1.30 / 1.358	16"
250 KCMIL CU	0.552	1.06	1.38 / 1.572	17"
500 KCMIL CU	0.781	1.29	1.66 / 2.902	20"
750 KCMIL CU	0.958	1.48	1.90 / 4.102	23"
1000 KCMIL CU	1.106	1.62	2.02 / 5.281	25"

35KV UD CABLES

INSULATED (100% LEVEL, 345 MIL THICK TRXLPE) SINGLE CONDUCTOR CABLES, COMPRESSED STRANDING OR SOLID, WITH COPPER CONCENTRIC NEUTRAL WIRES, SPECIFY TOTAL QUANTITY IN FEET.

PHASE CONDUCTOR SIZE, TYPE	NEUTRAL CONDUCTOR NO. & SIZE WIRES	AMPACITY DB/ DUCT	DUCT SIZE	CONDUCTOR AREA IN^2/ (MM^2)
#1/0 AL	6 #14	219/168 (3PH)	4"	0.1006 / (65.0)
#2/0 AL	7 #14	248/191 (3PH)	4"	0.1262 / (81.7)
#4/0 AL	11 #14	314/247 (3PH)	6"	0.2018 / (130.6)
250 KCMIL AL	13 #14	339/271 (3PH)	6"	0.2392 / (153.9)
500 KCMIL AL	25 #14	452/392 (3PH)	6"	0.4788 / (307.8)
750 KCMIL AL	24 #12	517/476 (3PH)	6"	0.7204 / (463.5)
1000 KCMIL AL	31 #12	1120/1072 (3PH)[2]	6"	0.9602 / (619.8)

DIMENSIONS/ WEIGHTS OF 35KV CABLES

ITEM DERSCRIPTION	CONDUCTOR OD (IN)	INSULATION OD NOMINAL (IN)	OVERALL CABLE OD (IN) / WGT (LBS/FT)	MINIMUM BENDING RADIUS
#1/0 AL	0.358	1.10	1.40 / 0.792	17"
#2/0 AL	0.401	1.15	1.47 / 0.861	18"
#4/0 AL	0.507	1.26	1.58 / 1.058	19"
250 KCMIL AL	0.552	1.31	1.70 / 1.224	21"
500 KCMIL AL	0.781	1.54	1.94 / 1.875	24"
750 KCMIL AL	0.958	1.73	2.18 / 2.419	27"
1000 KCMIL AL	1.106	1.88	2.37 / 2.989	29"

35KV UD CABLES

INSULATED (100% LEVEL, 345 MIL THICK TRXLPE) SINGLE CONDUCTOR CABLES, COMPRESSED STRANDING OR SOLID, WITH COPPER CONCENTRIC NEUTRAL WIRES, SPECIFY TOTAL QUANTITY IN FEET.

PHASE CONDUCTOR SIZE, TYPE	NEUTRAL CONDUCTOR NO. & SIZE WIRES	AMPACITY DB/ DUCT	DUCT SIZE	CONDUCTOR AREA IN^2/ (MM^2)
#2 CU	9 #14	224/162 (3PH)	4"	0.0616 / (39.6)
#1/0 CU	11 #14	284/210 (3PH)	4"	0.1006 / (65.0)
#4/0 CU	18 #14	385/307 (3PH)	6"	0.2018 / (130.6)
250 KCMIL CU	21 #14	410/336 (3PH)	6"	0.2392 / (153.9)
500 KCMIL CU	26 #12	501/471 (3PH)	6"	0.4788 / (307.8)
750 KCMIL CU	25 #10	559/548 (3PH)	6"	0.7204 / (463.5)
1000 KCMIL CU	32 #10	1338/1192 (3PH)[2]	6"	0.9602 / (619.8)

DIMENSIONS/ WEIGHTS OF 35KV CABLES

ITEM DERSCRIPTION	CONDUCTOR OD (IN)	INSULATION OD NOMINAL (IN)	OVERALL CABLE OD (IN) / WGT (LBS/FT)	MINIMUM BENDING RADIUS
#2 CU	0.280	1.10	1.40 / 1.071	17"
#1/0 CU	0.358	1.15	1.47 / 1.212	18"
#4/0 CU	0.507	1.26	1.58 / 1.618	19"
250 KCMIL CU	0.552	1.31	1.70 / 1.885	21"
500 KCMIL CU	0.781	1.54	1.94 / 3.258	24"
750 KCMIL CU	0.958	1.73	2.18 / 4.498	27"
1000 KCMIL CU	1.106	1.88	2.37 / 5.579	29"

1. Ampacity is based on 1 circuit per trench/duct bank, 90°C conductor, 25°C ambient, soil rho 90, maximum earth interface approximately 60°C, 75% load factor, triplexed spacing (3PH, 3 phase; 1PH, single phase). See ICEA publication P-53-426 & S-66.524.

2. For 2-per-phase conductor installations of 15kV 1000 kcmil CU cable, the ampacity in duct (same conditions as mentioned above in note 1 except 100% load factor & 75°C earth interface is 1337A.

3. For specify 35kV cables shall consult with CLP engineer for further assist on 35kV, 133% insulation, 420 mils if required for the application.

TEMPORARY CABLE END CAPS FOR WATER SEALING PRIMARY CABLES Aluminum strands can be seriously affected by water. Oxidation takes place, pitting and eroding the aluminum and in some cases, completely oxidizing the strands leaving only a residue. Moisture in cable has been found to be one of the principal causes of "treeing" in the insulation, leading directly to cable failure. Moisture can also migrate to the termination device causing intermittant feeder tripping prior to failure.

Once a small amount of moisture has entered the cable, the damage has begun. Therefore, it is imperative that cable ends never be left exposed to the elements when cable terminations or splices are not immediately going to be made. Every effort must be made to seal exposed cable ends at once to prevent moisture entry.

The cold shrink end caps shown below are for temporarily sealing the ends of aluminum cable during installation and storage to prevent the entry of moisture. In all cases, the cable end must be clean and dry before the cap is installed. Cables shall not be left exposed overnight during installation work.

All cable manufacturers are required by industry standards to seal the ends of all primary underground cable leaving their factory. Cable shipments must be inspected upon arrival for cable damage or loss of the seal caps. Replacement caps shall be installed where missing, to prevent further entry of moisture. Notify CLP Engineering to followup with the supplier.

When installing primary cable end caps that are not prefilled with mastic, wrap the cable area to be sealed with several wraps of mastic tape. Finish by installing the cable end cap per manufacturer's instructions.

TABLE 1: CABLE SUPPORT GRIPS FOR 600V UD AL. TRIPLEX CABLE

Nominal Cable Size	Triplex Cable Diameter	Mfg.	Catalog No.
1/0	1.1060	Bryant	SHC100
2/0	1.1990	Bryant	SHC100
3/0	1.3020	Bryant	SHC125
4/0	1.4210	Bryant	SHC125
250	1.5810	Bryant	SHC150
350	1.7950	Bryant	SHC150
500	2.1170	Bryant	SHC200

TABLE 2: CABLE SUPPORT GRIPS FOR 600V UD AL. QUADRUPLEX CABLE

Nominal Cable Size	Quadruplex Cable Diameter	Mfg.	Catalog No.
1/0	1.2360	Bryant	SHC100
2/0	1.3400	Bryant	SHC125
3/0	1.4560	Bryant	SHC125
4/0	1.5880	Bryant	SHC150
350	2.0060	Bryant	SHC200
500	2.3660	Bryant	SHC200

TABLE 3: CABLE SUPPORT GRIPS FOR 15kV UD TRIPLEX CABLE

Nominal Cable Size	Triplex Cable Diameter	Mfg.	Catalog No.
1/0	1.7840	Bryant	SHC150
250	2.2470	Bryant	SHC200
350	2.5170	Bryant	SHC250
500	2.7860	Bryant	SHC250
750	3.1950	Bryant	SHC300

TABLE 4: CABLE SUPPORT GRIPS FOR 35kV UD TRIPLEX CABLE

Nominal Cable Size	Triplex Cable Diameter	Mfg.	Catalog No.
1/0	3.0380	Bryant	SHC300
250	3.4910	Bryant	SHC300
350	3.7170	Bryant	SHC350
500	4.0510	Bryant	SHC400
750	4.4600	Bryant	SHC400
1000	4.7730	Bryant	SHC450

CABLE SUPPORT GRIPS FOR 15kV & 35kV UD JACKETED CABLE

TABLE 5: TERMINATIONS FOR 15kV UD TRIPLEX CABLE

Nominal Cable Size	Mfg.	Catalog No.
1/0	3M	7652-S-4-40132
250	3M	7663-S-8-40149
350	3M	7664-S-8-40156
500	3M	7665-S-8-40166
750	3M	7665-S-8-40172

TABLE 6: TERMINATIONS FOR 35kV UD TRIPLEX CABLE

Nominal Cable Size	Mfg.	Catalog No.
1/0	3M	7664-S-8-40132
250	3M	7665-S-8-40149
350	3M	7665-S-8-40156
500	3M	7665-S-8-40166
750	3M	7666-S-8-40172
1000	3M	7666-S-8-40178

TERMINATIONS FOR 15kV & 35kV UD JACKETED TRIPLEX CABLE

TABLE 1: 5KV AND GREATER - CONDUIT CROSS-SECTIONS AND BURIED DEPTHS				
Conduit arrangement	Duct size	Trench width (A)	Concrete encasement height (B)	Total trench height (C)
2W X 1H	4 in.	17 in.	10.5 in.	46.5 in.
	6 in.	21 in.	12.5 in.	48.5 in.
2W X 2H	4 in.	17 in.	10.5 in.	46.5 in.
	6 in.	21 in.	21 in.	57 in.
2W X 3H	4 in.	17 in.	10.5 in.	46.5 in.
	6 in.	21 in.	29.5 in.	65.5 in.
3W X 1H	4 in.	17 in.	10.5 in.	46.5 in.
	6 in.	29.5 in.	12.5 in.	48.5 in.
3W X 2H	4 in.	17 in.	29.5 in.	46.5 in.
	6 in.	29.5 in.	21 in.	57 in.
3W X 3H	4 in.	17 in.	10.5 in.	46.5 in.
	6 in.	29.5 in.	29.5 in.	65.5 in.
2W X 4H	4 in.	17 in.	10.5 in.	46.5 in.
	6 in.	29.5 in.	38 in.	74 in.
4W X 2H	4 in.	17 in.	10.5 in.	46.5 in.
	6 in.	38 in.	21 in.	57 in.

Notes:

1. Concrete encased duct bank must be 36 in below grade measured to the top of the upper-most duct.

TABLE 2: 600V - CONDUIT CROSS-SECTIONS AND BURIED DEPTHS				
Conduit arrangement	Duct size	Trench width (A)	Concrete encasement height (B)	Total trench height (C)
2W X 1H	2 in.	13 in.	8.5 in.	37.5 in.
	4 in.	17 in.	10.5 in.	40.5 in.
2W X 2H	2 in.	13 in.	13 in.	42 in.
	4 in.	17 in.	17 in.	47 in.
2W X 3H	2 in.	13 in.	17.5 in.	47.5 in.
	4 in.	17 in.	23.5 in.	53.5 in
3W X 1H	2 in.	17.5 in.	8.5 in.	38.5 in.
	4 in.	23.5 in.	10.5 in.	40.5 in.
3W X 2H	2 in.	17.5 in.	13 in.	43 in.
	4 in.	23.5 in.	17 in.	47 in.
3W X 3H	2 in.	17.5 in.	17.5 in.	47.5 in.
	4 in.	23.5 in.	23.5 in.	53.5 in.
2W X 4H	2 in.	13 in.	22 in.	52 in.
	4 in.	17 in.	30 in.	60 in.
4W X 2H	2 in.	22 in.	13 in.	43 in.
	4 in.	30 in.	17 in.	47 in.

Notes:

1. Concrete encased duct bank must be 18 in below grade measured to the top of the upper-most duct.

Notes:

1. The edge a duct bank is to be a minimum of 2 feet from utility pole, traffic light pole, etc. (See Detail 1)

2. The edge a duct bank is to be a minimum of 3 feet from any fire hydrant. (See Detail 2)

3. The edge of the trench is to be a minimum of 5 feet from retaining walls, building foundations, etc. Special shoring will be required where space is critical. This special shoring should be coordinated with a CLP representative.

4. Do not completely cover sweeps from duct bank to vertical risers at riser poles to reduce difficulty for future pole replacements.

5. Dimensions A, B, and C (Referenced on sheets 6 and 7) are given on Tables 1 and 2 on Sheets 1 and 2.

6. Install spacers every 7 ft. Base spacer and/or intermediate spacers and conduits shall be tied together using line pull polyolefin. Survey stakes shall be used at every base spacer as a tie down to prevent ducts from floating.

7. Ducts shall have a minimum of 3 in. concrete envelope volume. Any trenches exceeding this limit shall be formed on one side (at subcontractor's expense) to minimize cost of encasement and excess trench width. Excess trench width shall be backfilled at the subcontractor's expense. Bottom of the trench shall be uniform, compact and free of debris.

8. Concrete used for duct encasement shall be Portland cement and a minimum 3000 psi at 28 days for under roadways. If not under roadways then 2000 psi is sufficient. Concrete shall be properly vibrated when installed to assure complete flow under, around and between all ducts and to eliminate any air pockets.

9. All underground electrical duct banks shall have warning tape (3" wide by 5 mil. thick) above the duct banks along the entire route within the backfill. The warning tape shall be located approximately 18 in. below the final grade.

10. All duct banks shall use a #4/0 bare copper cable run along the entire length of the top of the duct bank and encased in the concrete envelope. Bare cable shall be bonded to the electrical infrastructure (manhole, handhole, equipment pad grounding) on both sides of the duct bank route.

11. After concrete has taken firmm set, the first 12 in. of backfill shall be free from stones, rock, or other material that might damage the duct banks, cables, or conduits. Selected backfill shall contain no soil material larger than 1/2 in. in diameter. For final backfill and compaction using native soils, compact to 92% maximum Standard Proctor dry density at ±2% of optimum moisture content. Backfill of trenches in existing paved streets shall be native soil whenever economical and mechanically compacted to 95% of maximum Standard Proctor with new base course to match existing or 6 in. depth, whichever is greater.

12. In areas where heavy equipment such as cranes and trucks will be crossing over underground conduit, concrete encasement shall be reinforced by #6 rebar.

5KV to 35KV Duct Clearance Requirements

Horizontal Clearance Requirements:

1. Electric mains shall be located as far as practical from other underground structures. When electric mains are laid parallel to other utilities and/or structures, the minimum clearances below shall be maintained.

   A. *Water mains - 3 ft.
   B. Building walls - 5 ft.
   C. Utility poles - 2 ft.
   D. *Storm and sanitary mains - 3 ft.
   E. Underground vaults - 2 ft. 0 in.
   F. *Gas mains (150 psi or greater) - 10 ft. 0 in.
   G. *Gas distribution - 4 ft.
   H. *Steam - 6 ft.
   I. Electric secondary - 3 ft.

2. Direct-buried street light cables and/or 600V cables shall never be installed with a minimum of 6 in. separation.

Vertical Clearance Requirements (Crossings):

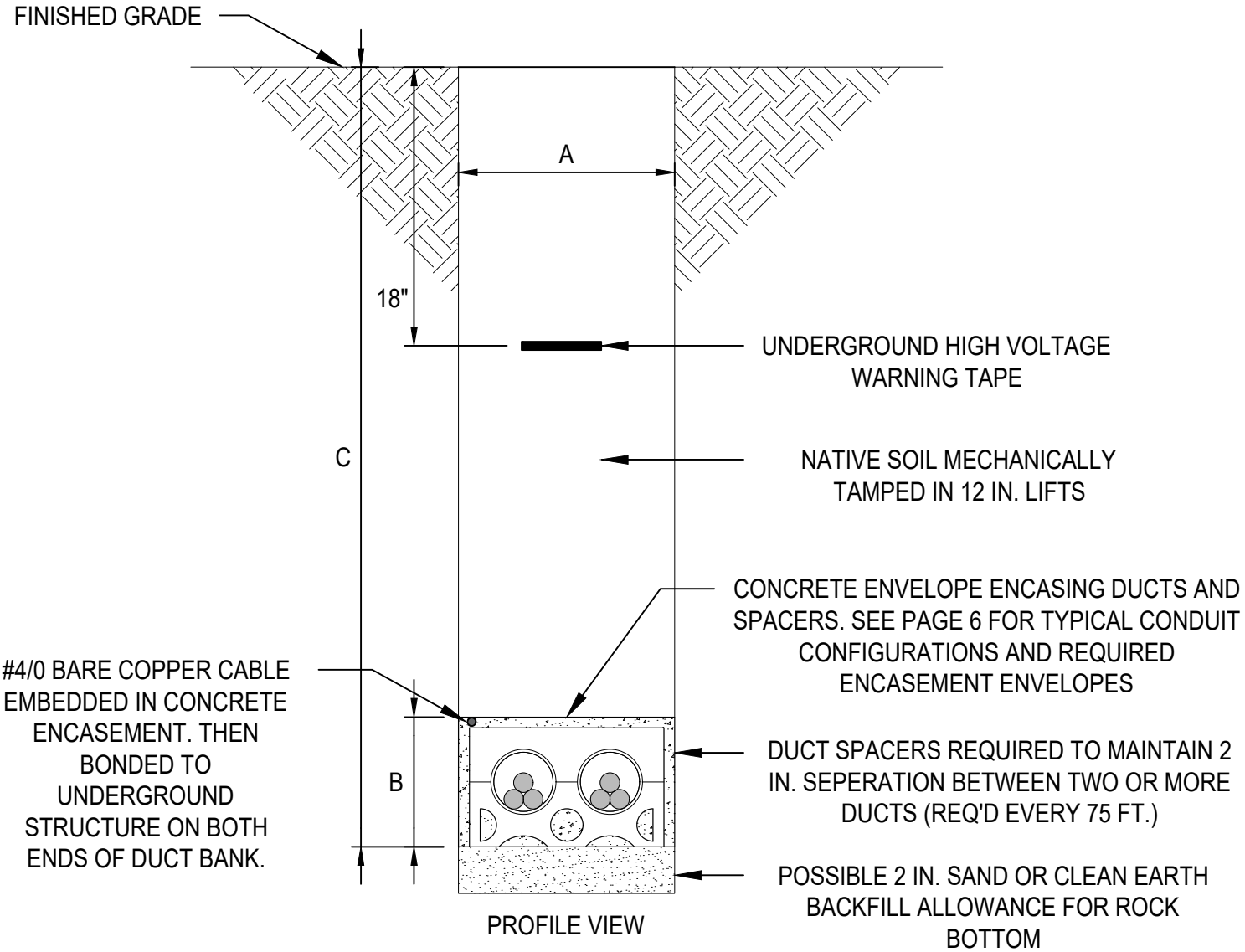
   A. Water mains - 1 ft.
   B. Storm and sanitary mains - 1 ft.
   C. *Gas mains (150 psi or greater) - 5 ft. 0 in.
   D. *Gas distribution - 5 ft.
   E. Steam - Typicall not but consult CLP Engineering
   F. Electric secondary - Do not cross

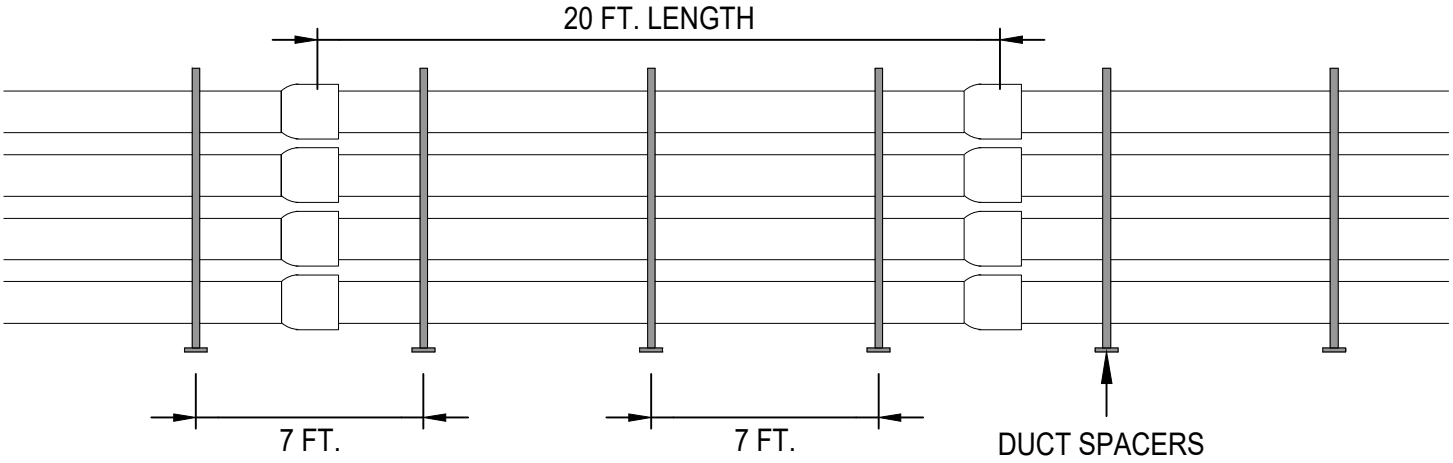
Cover:

1. A minimum required cover, or distance from the top of the cable or duct to final grade, must be:

   A. Street lighting (150V or less): 18 in.
   B. 600V cable: 24 in.
   C. 15kv & 35kv cable: 36 in.

*Note: Reduced clearances to these lines must be approved by CLP Engineering.





FRONT VIEW

DETAIL 4: CONDUIT TRENCH DETAILS

Drawing Name	CONCRETE ENCASED DUCT BANK				
Drawing #	UG-TYP-DUC-3550	Scale : N.T.S.		Approved By: APS	Rev
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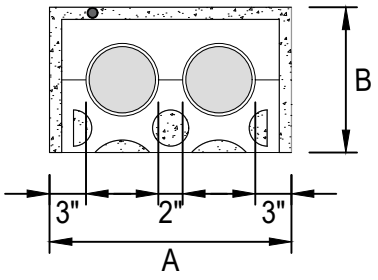
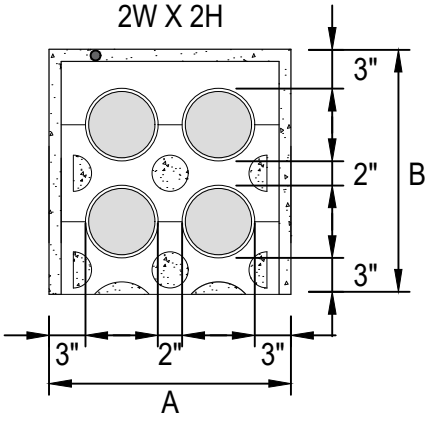
CITY LIGHT & POWER

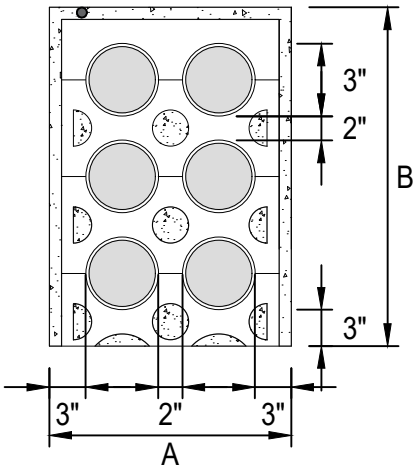
2W X 1H



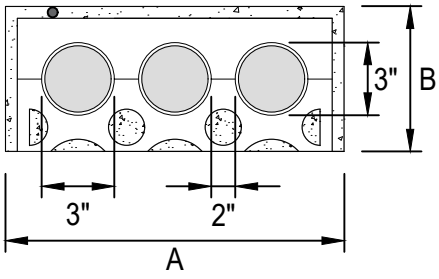
2W X 2H



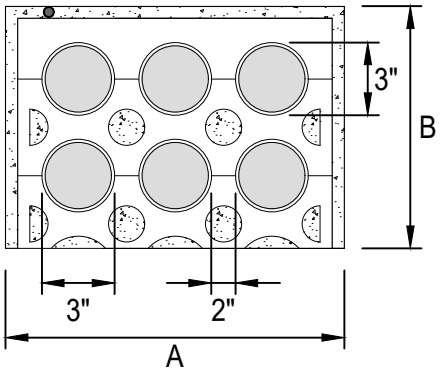
2W X 3H



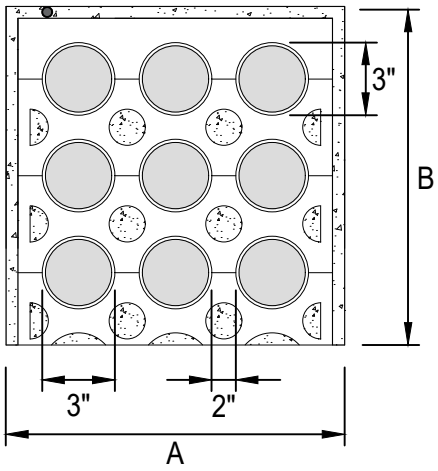
3W X 1H



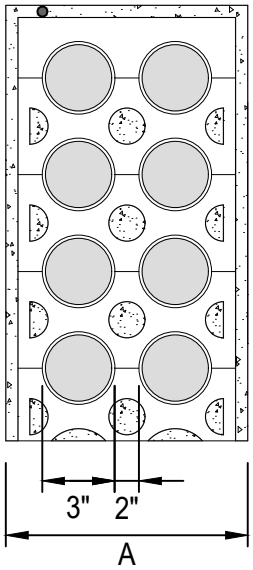
3W X 2H



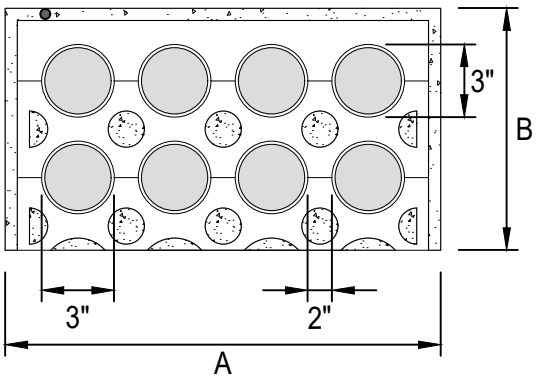
3W X 3H



2W X 4H



4W X 2H



TYPICAL DUCT BANK CONFIGURATIONS

Drawing Name	CONCRETE ENCASED DUCT BANK				
Drawing #	UG-TYP-DUC-3550	Scale : N.T.S.		Approved By: APS	Rev
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CITY LIGHT & POWER

Trenching Requirements:

1. Trench width and depth (minimum cover) are determined by a number of factors such as: cable operating voltage, number and size of cables, separation between facilities being installed and existing facilities, storage of excavated material, and trenching equipment capability and availability.

2. The trench for all electric and communication lines shall be excavated in as straight a line as possible.

3. Earth and paving material removed from a trench shall be piled in such a manner as to avoid unnecessary public inconvenience and complaints, and to avoid silting of adjacent areas, storm sewers, streams, etc. in the event of inclement weather. Earth removed from a trench, suitable for use as a back fill, shall be reasonably protected to prevent excessive drying or wetting.
   a. Excavated material shall never be placed closer than 24 in. from the side of the trench or excavation.
   b. Earth and paving materials shall be piled separately to ensure that only suitable earth is used in back filling the trench. All paving materials removed from a trench shall be hauled away and disposed of properly by the contractor.

4. The trench bottom shall be excavated in a manner to provide a firm continuous bearing surface. The bottom and sides of the trench shall be reasonably smooth and free of rocks, stones, and sharp projections that could damage cables or plastic pipes.
   a. Solid rock or significantly rocky soil shall be removed to a depth of 2 in. below the standard trench depth and the trench shall be back filled and padded with 2 in. of clean earth or sand to prevent any hard points of rock from damaging the cable or plastic pipe. This new material is to be compacted prior to the placement of the new CLP utility.
   b. The bottom of trenches shall be carefully graded so voids or depressions will not exist under the pipe or cable to be installed.

5. Trench width to be a minimum 3 in on each side of conduit or conductor, to provide for proper compaction.

Trench Backfill and Compaction Requirements:

1. Before any backfilling operations are started, perform an inspection of all trenches.

2. Soil materials in the bottom of a trench may cause unequal settlement, the unsatisfactory materials shall be removed and backfilled with selected materials.

3. Check for cable placement, conduit integrity, concrete encasement of conduit when required, adequate bedding/cover over direct buried cables, proper minimum depth, pole and pad risers, cable entrance to and from vaults and pads, secondary pull boxes and service stubs marked with electronic markers to determine that the work has been done in accordance with construction standards and job print specifications.

4. NESC Rule 352A requires the following:
   a. Direct Buried Cable: The bottom of the trench receiving direct-buried cable should be relatively smooth, undisturbed earth, well tamped earth, or sand. When excavation is in rock or rocky soils, the cable should be laid on a protective layer of well-tamped backfill. Backfill within 100mm (4 inches) of the cable should be free of materials that may damage the cable. Backfill should be adequately compacted. Machine compaction should not be used within 150mm (6 inches) of the cable.
   b. Cable in Duct: For cable installed in a duct, the bottom of the trench should be in undisturbed, tamped, or relatively smooth earth. Where the excavation is in rock, the duct should be laid on a protective layer of clean tamped backfill. All backfill should be free of materials that may damage the duct.

5. The first twelve inches of backfill shall be free from stones, rock, or other material that might damage the cable or conduit. Selected backfill shall contain no soil material larger than 1/2" in diameter.

6. Final backfill shall be done in equal increments the length and girth of the trench line.

7. Hand excavate and buttress around all underground utilities exposed during construction.

Trench Backfill and Compaction Requirements (Cont'd):

7. When suitable, as determined by soils test, use native material compacted in accordance with the following:
   a. For cohesive soils, compact to 95% maximum Standard Proctor dry density (ASTM D698) at ±2% of optimum moisture content.
   b. For cohesiveness soils, compact to 95% maximum Modified Proctor dry density (ASTM D1557) at ±2% of optimum moisture content (or 100% maximum Standard Proctor dry density (ASTM D698) at ±2% of optimum moisture content). Prior to and during compaction, materials shall have a moisture content as required to obtain the specified density. Thickness of horizontal layers after compacting shall not be more than 9 in.
   c. Thickness of horizontal layers after compacting shall not be more than 6 inches. If native soils are not suitable for trench backfill and compaction (heavy clay or expansive soil, rock-filled, etc.), use flowable fill, T&D Underground mix #3, Class 5 or 6 base course or similar graded material compacted to the test values specified above.

8. Density tests shall be performed at various depths in the trench to ensure that the required compaction is obtained throughout. For trenches less than 30" in depth, compaction tests shall be taken at the surface and within 18" above the top of conduit or cable. For trenches greater than 30" in depth, density tests shall be taken within 18" of the top of the conduit or cable and at 24" vertical intervals to the top of the trench with the final test at the surface.

9. The frequency of density tests shall be a minimum of 250 linear feet of mainline trench and at each service installed. The number of density tests may be increased if directed by the CLP. If flowable fill is installed as specified on page 4, compaction and density tests are not required.

10. All trench lines shall be restored to the original grade. Any excess soil shall be piled on top of the trench and shall be well compacted. The top surface of the trench backfill shall be relatively smooth. The premises should be left in clean condition and all rock and debris shall be removed from the site. Pavement or walk cuts shall be repaved with material identical to the original surfaces in accordance with local requirements.

11. All ground surfaces shall be restored to match the immediately adjacent surfaces at all work locations.

Flowable Fill Installation Guide:

Flowable fill for utility trench restoration is to be used only as an alternative when native soil is not suitable for backfill. It will set up and provide compaction for quick trench closure.

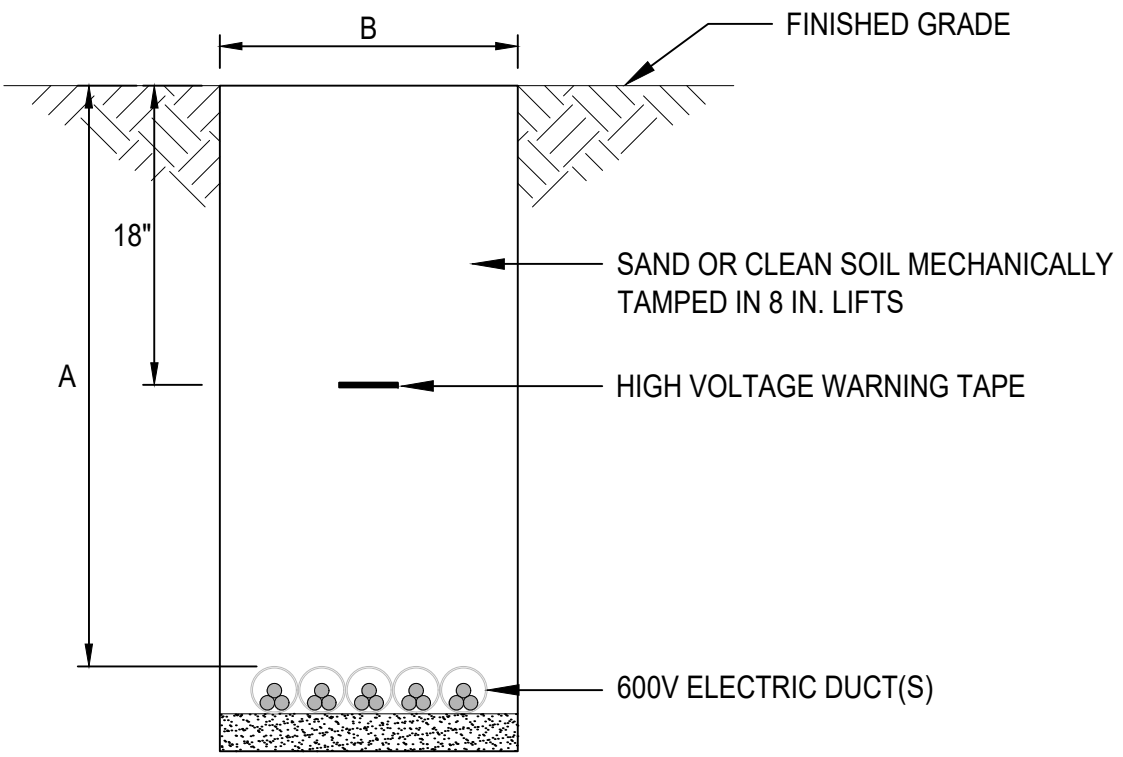
It shall be installed as follows:

1. As the cement truck begins pouring fill mix into the trench, the crew shall start vibrating the mix immediately.

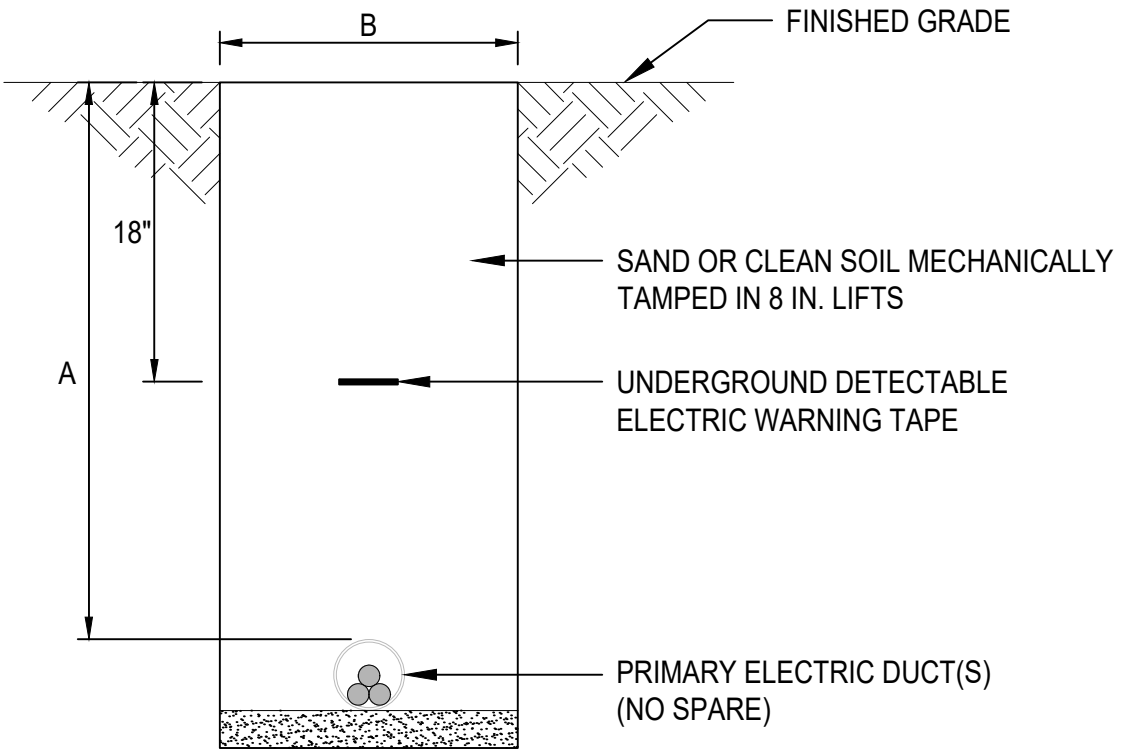
2. To achieve proper hydration of the flowable fill mix, vibrators shall be used in all cases. The use of vibrators is extremely important as it removes excess water from the mix. If vibrators are not used, the flowable fill will not hydrate properly. For proper installation, the use of one vibrator minimum is required for each concrete truck pouring concrete into a trench.

3. All concrete encased ducts using "T&D Underground Mix #1" shall be allowed sufficient time to set up before the flowable fill mix is installed. This is to avoid any intermixing of the two different types of concrete.

4. The normal set-up time for the flowable fill mix to withstand traffic is approximately one hour after installation. Depending upon soil conditions, weather, and temperature, this time may vary. The mix will completely set up in 28 days at approximately 90-120 PSI, when properly hydrated. The set-up time required to resume normal traffic shall be determined by the City Light and Power Representative on the job site.



DETAIL 1: TRENCH CONFIGURATION (SINGLE OR MULTIPLE 600V)



DETAIL 2: TRENCH CONFIGURATION (SINGLE 35KV OR 15KV - NO SPARES)

Drawing Name	TRENCHING			
Drawing #	UG-TYP-DUC-3570	Scale : N.T.S.	Approved By: APS	Rev 1
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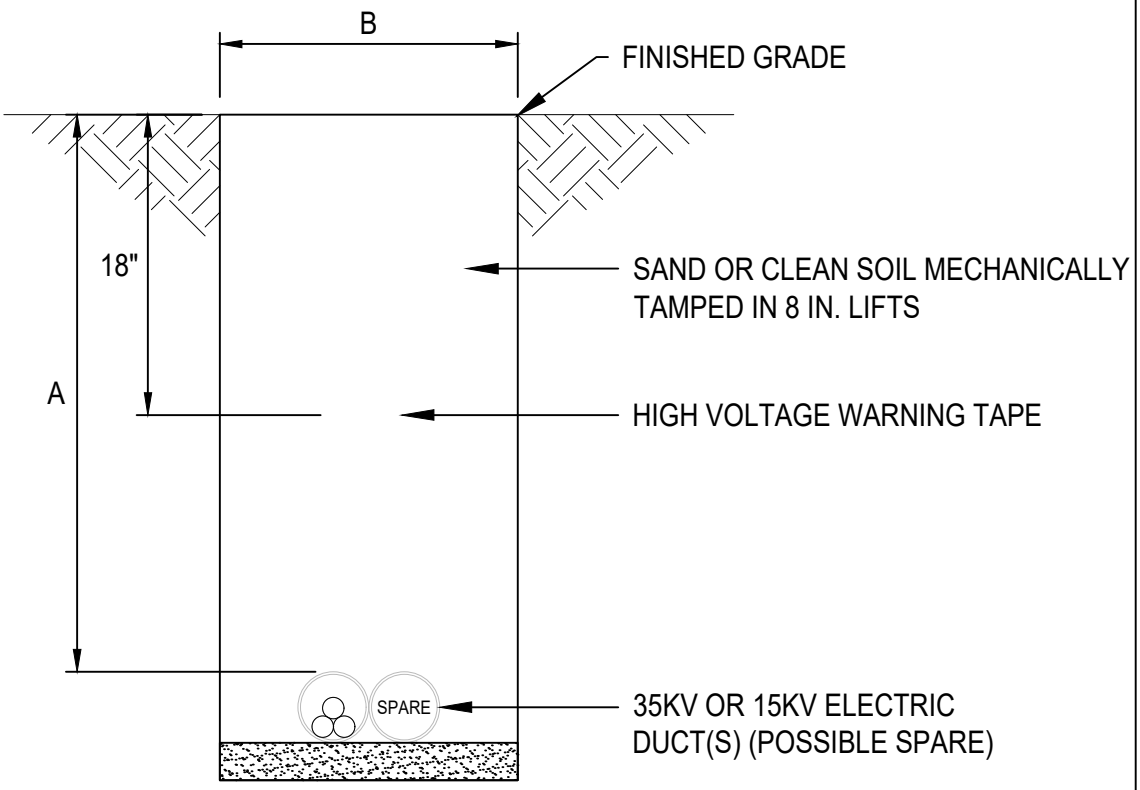
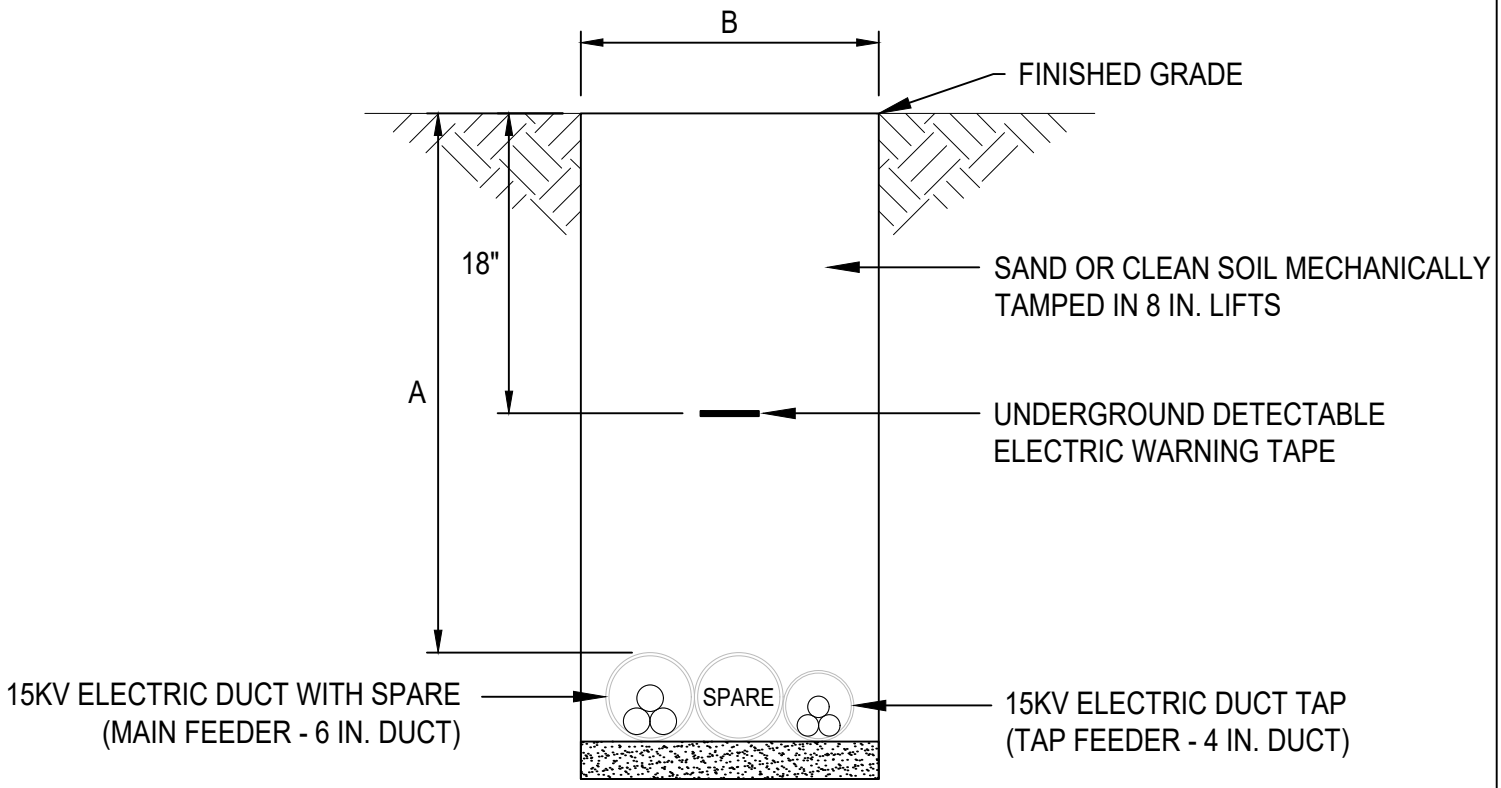


DETAIL 3: TRENCH CONFIGURATION (SINGLE 35kV OR 15kV WITH SPARE)



DETAIL 4: TRENCH CONFIGURATION (15kV FEEDER AND TAP - POSSIBLE SPARE)

Drawing Name	TRENCHING			
Drawing #	UG-TYP-DUC-3570	Scale : N.T.S.	Approved By: APS	Rev
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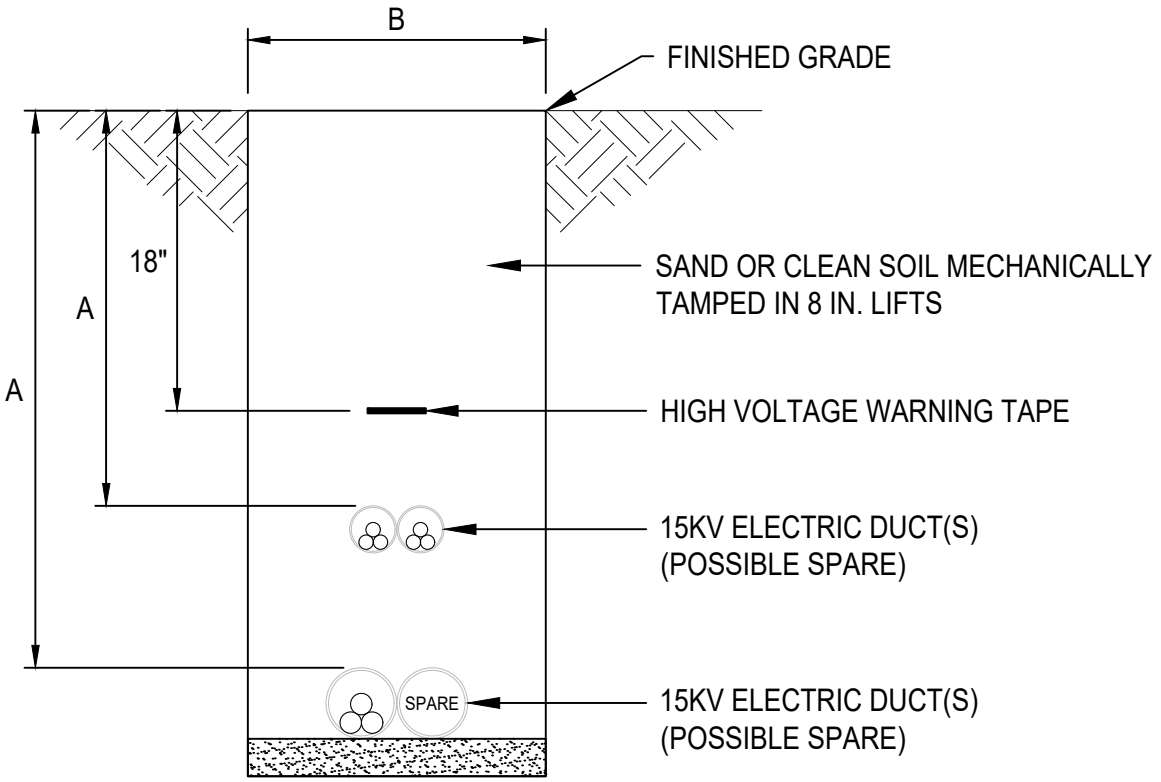
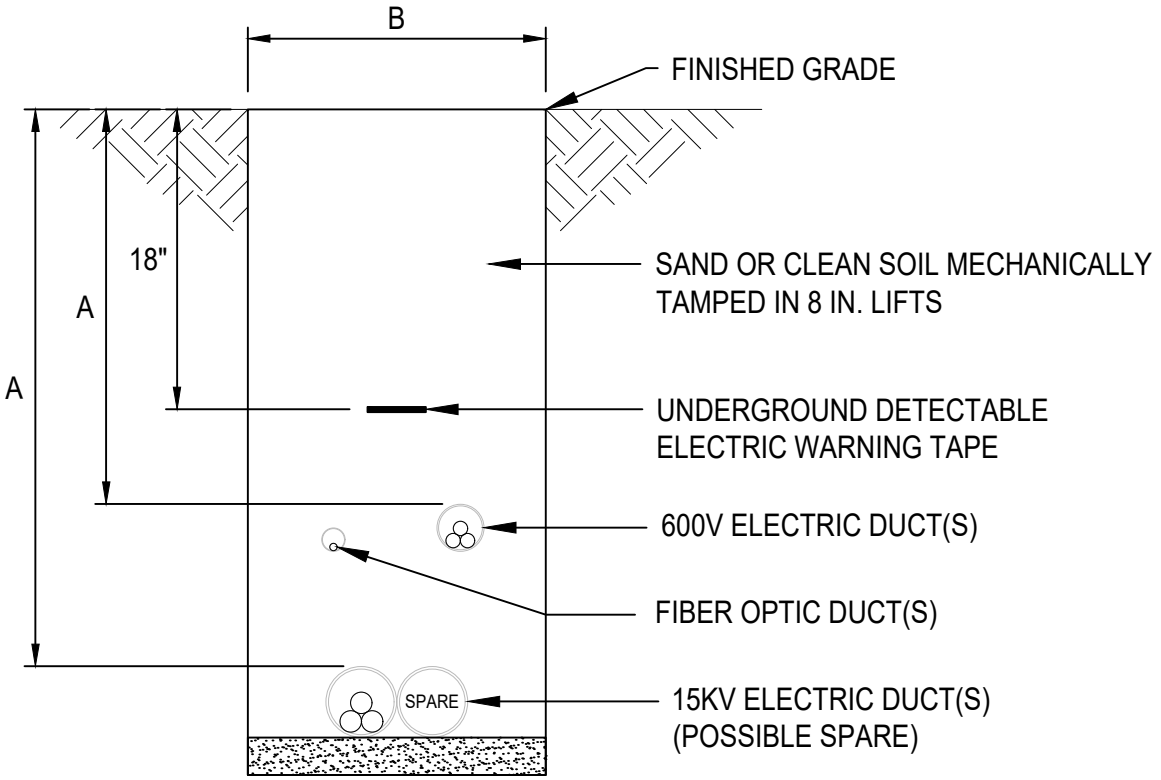
CITY LIGHT & POWER



DETAIL 5: TRENCH CONFIGURATION (15kV AND 600V)



DETAIL 6: TRENCH CONFIGURATION (15kV ,600V AND FIBEROPTIC)

Drawing Name	TRENCHING			
Drawing #	UG-TYP-DUC-3570	Scale : N.T.S.	Approved By: APS	Rev 1
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CITY LIGHT & POWER

General Information:

1. When preparing for a drill run, equal consideration shall be given to properly installing the cable or duct and to the layout of the drill run.
2. The contractor must make every effort to maximize the amount of continuous material installed without splices or duct ends.
3. Planning the run prior to starting the operation will allow large radius sweeps around visible obstructions (starting as far back as possible) rather than abrupt correction at the point of the obstruction.
4. Know where excess drilling fluids are being disposed of, so local environmental regulations are not violated.
5. Cable or duct shall be installed so the proper amount of cover is always maintained. When boring under the road with highly compacted sub-base, increase cover to 4 ft. The cable or duct shall not be installed at other depths without first being authorized by a CLP representative.
6. Minimum horizontal separations for directional bores shall be 3 ft. from existing gas mains and 2 ft. from any other underground utility.
7. Any excavation within 10 ft. of a switchgear or within 5 ft. of a pad-mounted transformer, capacitor, enclosure, or pole shall be dug by hand. No power equipment shall be used near pad-mounted equipment unless authorized by CLP.
8. All cable ends must be sealed before starting any type of boring operation to prevent moisture from entering the cable.
9. If the cable must be installed in rocky soil, it must be intalled in ducts. Only ducts with red striping may be used (which indicates that there are cables inside the duct) in order to meet NESC requirements.
10. Sections of duct shall be butt-fused together; this is the preferred method of joining sections of duct. The fusion shall adhere to the same standards as gas pipe.
11. Duct shall be stored and handled in a manner that minimizes the possibility of the material being damaged. It shall not be stored for extended periods of time in direct sunlight or excessive cold, nor shall it be exposed to fire, cleaning solutions, detergents, solvents, alcohol, or any other corrosive chemicals.
12. The contractor shall repair any sections of duct having kinks or deep scratches (defined as penetrating more than 10% of the average duct wall thickness, see Table 1) by replacing the damaged section.

TABLE 1: MINIMUM DEPTH OF DEEP SCRATCHES (BY DUCT SIZE)

Duct Size	10% of Wall Thickness
4"	.0350"
6"	.0520"
8"	.0710"

Directional Boring Instructions:

1. The contractor must use a cutting fluid to: lubricate and reduce friction in the bore, stabilize the tunnel to prevent collapse, remove solid cuttings from the hole, and cool the drill bit and downhole electronics.
2. The cutting fluid must be totally inert, contain no environmental risk, and be compatible with the environmentally safe material being installed.
3. Straightness of a drill is a major factor in both correctly operating the drill, and installing the material. The contractor must be able to accurately determine the depth and location of the drilling head at all times.
   a. Bore depth/location verification holes may be requested at any time by CLP.
   b. A test hole must always be dug when crossing another utility to locate the depth of the other utility. The test hole shall extend a full 360 degrees around the other utility in order to fully expose its depth.
   c. This test hole must be hand-dug, and extend a minimum of 36 inches around utility equipment.
   d. A minimum horizontal separation of 3 ft. must be maintained from existing gas mains.
   e. A minimum horizontal separation of 2 ft. must be maintained from all other existing utility equipment. If this separation cannot be obtained, then the test holes must be dug over a minimum distance of 50' along the length to verify separation exists, and that utility equipment is not in the test hole. The boring head must be visibly seen passing through the test hole.
   f. The directional bore takeoff must be smooth, on-line, and contain no waves.
4. Feed and exit pits serve two major functions. They act as a basin to contain spills and provide access to the tools and reamers when making connections. Pits shall be large enough to allow the wrenches to turn coupling nuts and deep enough to allow access to the bottom of the drill head or reamer.
   a. Sharp edges shall be cut away at any point where the material being bored may be damaged, including the bore.
   b. The contractor shall have someone attend to the drill or feed pit during installation. This person shall pull the cable or duct from the reel(s), if applicable, to maintain slack and feed the material into the pit as it is installed. While feeding the material into the pit, care shall be taken to ensure that it is not over bend, does not scratch or snag, and does not scrape on the ground. The material must be fed smoothly into the tunnel. The material being installed shall not have any twists or kinks. Look for any cuts, nicks, etc. as the material is being installed.
5. Every effort must be made to avoid cable damage. Slack cable shall be placed on the grass or on soil surfaces, not on streets or sidewalks where it may be exposed to vehicle or pedestrian traffic.
   a. Do not bend cable or duct in a radius less than 12 times that of its diameter.
   b. Inspect cables for cuts or nicks in the jacket prior to installation. Cable with flaws or irregularities shall not be installed without approval from CLP.
   c. Note footage marks at the cable end to be pulled. This number should be recorded to help locate the drilling head, if necessary.
   d. Waterproof the cable end by covering it with insulating compound and plastic tape.
   e. Install the cable grip by installing the basket over the sealed end of the cable. Do not nail the grip to the cable or puncture the cable jacket insulation.
   f. When a conductor pulling eye is used, strip sufficient insulation back from the conductor to install the pulling eye. Tighten the screws or swage pulling eye onto the conductor. Waterproof the cable end to prevent moisture from entering the cable during pulling.

Directional Boring Instructions (Cont'd):

1. Ensure the correct size and type of reamer is used for the soil conditions. Correct sizing of reamers will provide clearance for the material, spoil flow during installation, and will prevent jamming of the material during installation. As a guide, the minimum acceptable reamer size for a given installation shall be 1.5 times the greatest diameter duct or the cable grip.
2. The material to be installed shall be completely pulled on the same day the tunnel is bored to minimize the possibility of tunnel collapse. Pull back shall be in a steady controlled manner. Maintain constant communications with the feed pit personnel.
3. For directional bored ducts that will terminate into a manhole or vault:
   a. At a minimum distance of 10 ft. from the manhole or vault, concrete encase the directional bored duct.
   b. Feeders must be consistently numbered in the same location from manhole to manhole.
4. All ducts must be rodded and mandreled to insure the ducts are free of obstructions. A pulling line with an 1800 lb. tensile strength shall be pulled into each duct for future cable installations.
5. All cable ends shall be sealed at the end of each pull. Pull sufficient slack of cable into each pit to insure the cable can be spliced or terminated.
6. When removing grips, cut off the length of cable or duct where the grip was attached plus an additional 3 ft.
7. If required depth of bored-in conduit cannot be met by the CLP subcontractor, new proposed depth must be approved in advance by a CLP representative. The CLP representative must be notified a minimum of three days in advance of bore start time. The CLP representative may require locate documentation to verify existing infrastructure depths. Potholing may be required at any time, at the discretion of the CLP representative, to prove any bore depth.
8. The CLP subcontractor is to submit a bore log to a CLP representative within 7 days of completion of a bore installation.

1. General

   a. Grounding is the practice of connecting an equipment, device or wiring system with a grounding electrode.
   b. Circuits are grounded for the purpose of limiting the voltage upon the circuit which might otherwise occur through the exposure to lightning or other voltages higher than that for which the circuit is designed. It also limits the maximum potential to ground. Grounding is also provided for the purpose of preventing a potential above ground on exposed conductive materials enclosing or forming part of a line device.

2. Driven Grounds
   a. Refer to other CLP equipment specific grounding standards for specific equipment grounding requirements.
   b. When grounds are required on a 34.5 kV, the maximum ground resistance must not exceed 25 ohms. To achieve this requirement, multiple rods may be required. Deep-driving of coupled rods is preferred. However, where soil conditions do not permit deep-driving, single rods should be installed ten feet apart. The rods will be connected by 1/0 soft drawn stranded bare copper wire buried a minimum of 6 inches. A ground rod clamp will be used to connect the rod to the conductor.

3. Ground Resistance
   a. Maximum ground resistances are as follows:
   i. Equipment on a 34.5 kV system - 25 ohms
   ii. Equipment on a 25KV or lower rated medium distribution system - 10 ohms

INSTALLATION SITE	TYPICAL PER POLE GROUND RODS	GROUND ROD SIZE
Army West Point	1	8' x 1/2"
Joint Base Lewis-McChord	2	10' x 3/4"
Fort Riley	1	8' x 5/8"
Hill Air Force Base	1	8' x 5/8"
March Air Reserve Base	1	8' x 5/8"
Bluegrass Army Depot	1	8' x 5/8"
Keesler Air Force Base	1	8' x 5/8"
Travis Air Force Base	1	8' x 5/8"
Fort Campbell	1	8' x 5/8"

TABLE 1: SITE SPECIFIC POLE GROUNDING REQUIREMENTS

Notes:

A. This standard shall be used when abandoning cables in a manhole.

B. The entire run of abandon cable shall be identified, cut and tagged as described. No manhole or vault shall be left with unidentified abandon cables or equipment.

C. Concrete shall be minimum 28 day compressive strength of 5,000 psi

D. Vaults are designed to meet ASTM C858 and ACI 318 with AASHTO HS-20 load rating

E. Steel reinforcement rods to be ASTM A-615 Grade 60

F. An exothermically welded ground grid ring of 4/0 SDBC cable to be installed around perimeter of vault and will be connected to two 3/4” x 10' copper clad ground rods.

G. All joints to be sealed with 1" dia. butyl rubber or equivalent

H. Crane required for installation

Manhole Setting Depths:

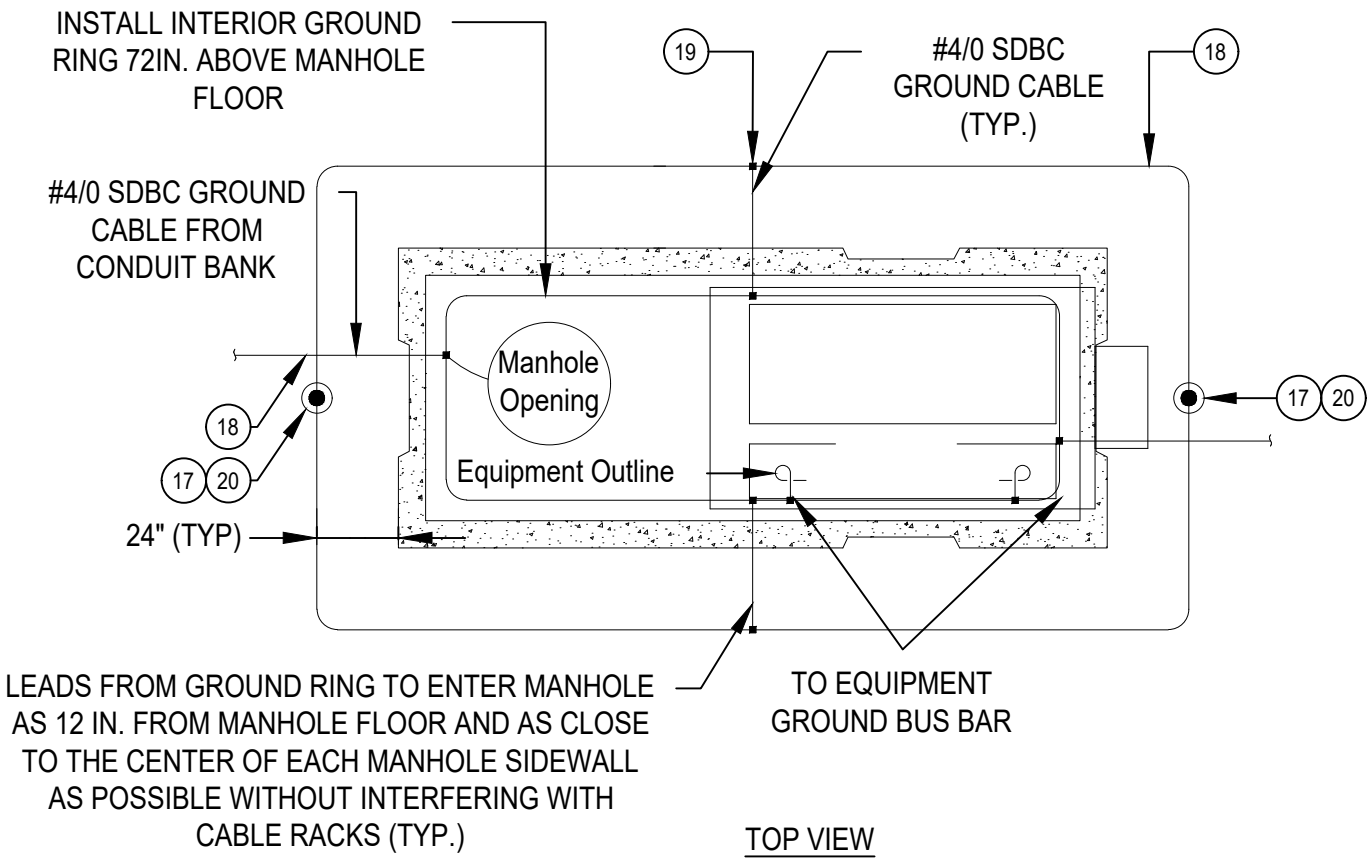
Manhole cover depth should be measured from final grade elevation to the exterior of the manhole roof/cover. Earth cover requirements for line manholes are dependent on traffic type, and should be:

- Areas subject to pedestrian traffic (ie. sidewalks and grass):1 foot
- Areas subject to vehicular traffic (ie. roads, alleys, parking lots):2 feet

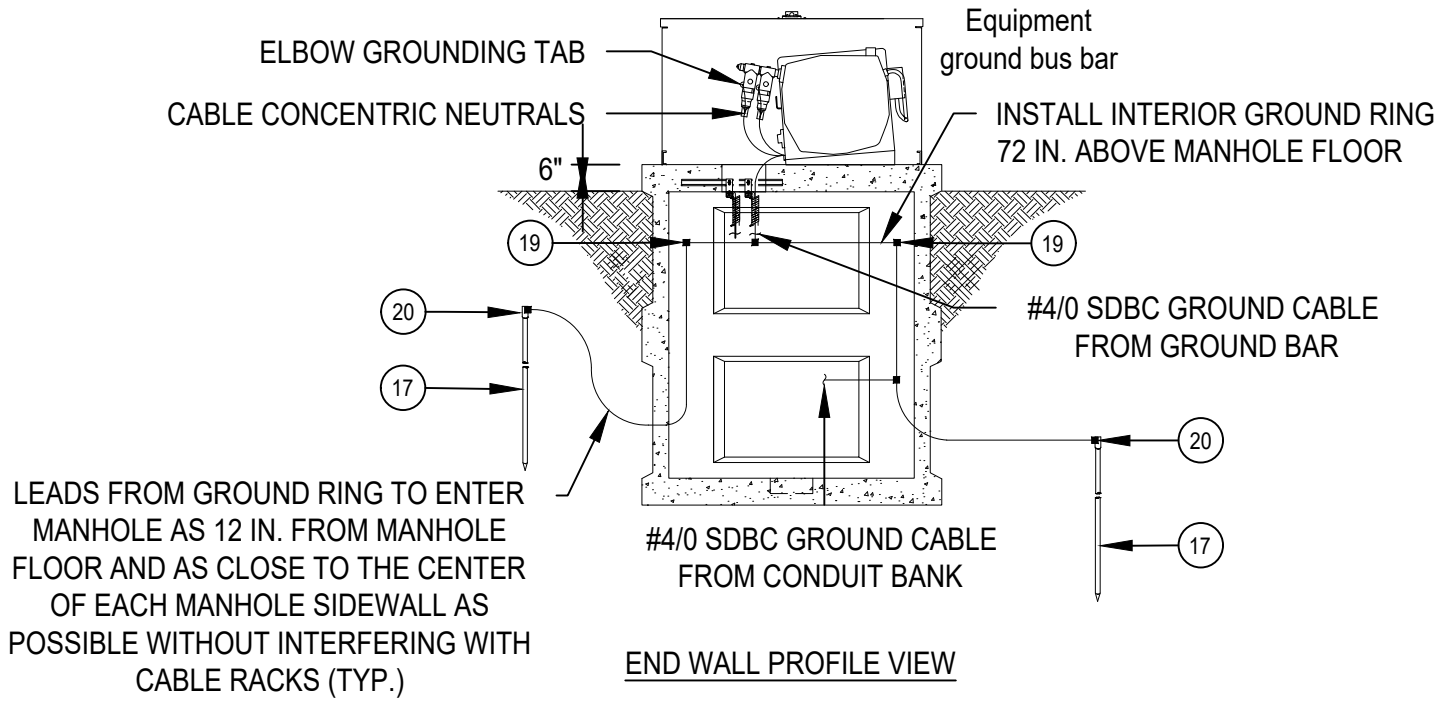
Any areas subject to grade change should be graded prior to installing a manhole

Cable Racking:

Rack cables beginning with communications at the top, 15KV cables in the middle, and 35KV cables toward the bottom. Supply cables will always be racked below any communications cables, and care should be taken to avoid unnecessary cable crossings. All cables in the manhole shall be permanently identified and tagged. A minimum vertical separation of 12 in. must be maintained between supply cables and between communication and supply. In addition, a minimum horizontal clearance of 9 in. must be maintained between supply cables supported on the same cable support hook.



TOP VIEW

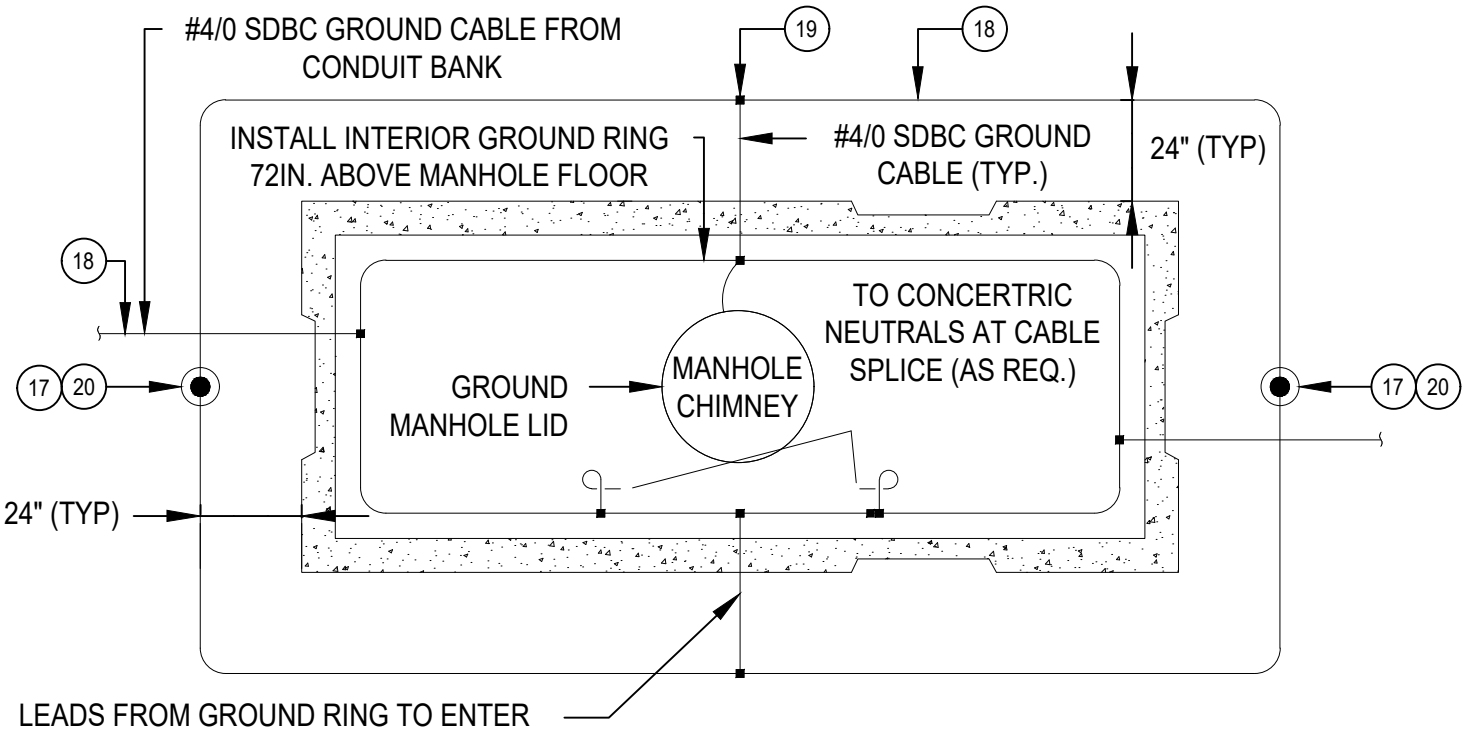


END WALL PROFILE VIEW

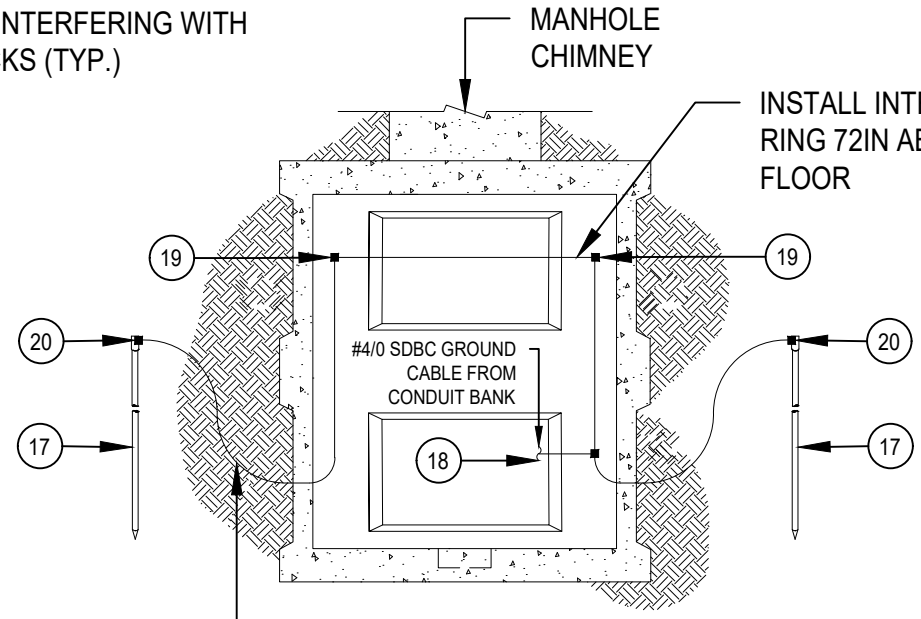
EQUIPMENT MANHOLE GROUNDING DETAIL

Drawing Name	MANHOLE - HANDHOLE GROUNDING			
Drawing #	UG-TYP-VLT-3601	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 2 of 5	Approval Date: 4/15/2022	1

CITY LIGHT & POWER



PLAN VIEW



END WALL PROFILE VIEW

LINE MANHOLE IN EARTH GROUNDING DETAIL

Drawing Name	MANHOLE - HANDHOLE GROUNDING			
Drawing #	UG-TYP-VLT-3601	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards		Sheet 3 of 5	Approval Date: 4/15/2022	

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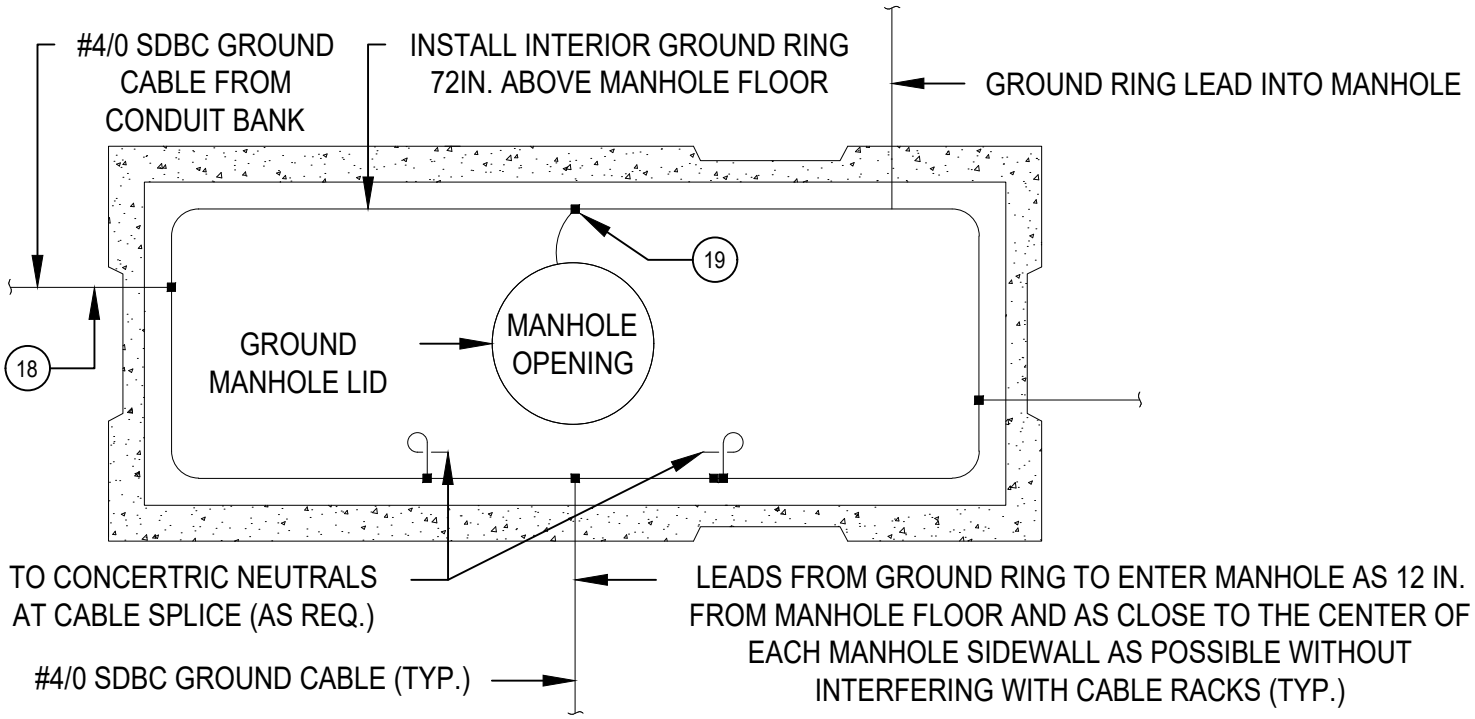
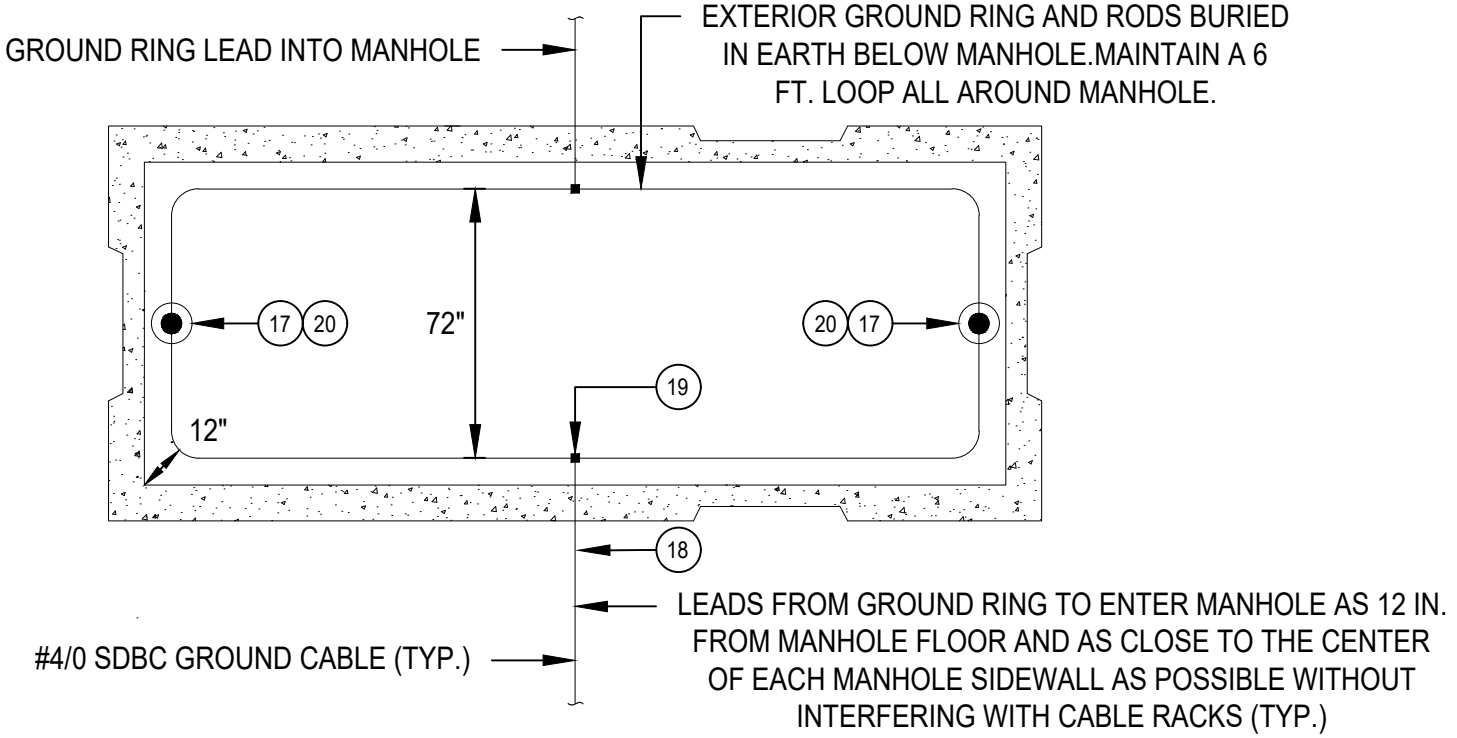


PLAN VIEW

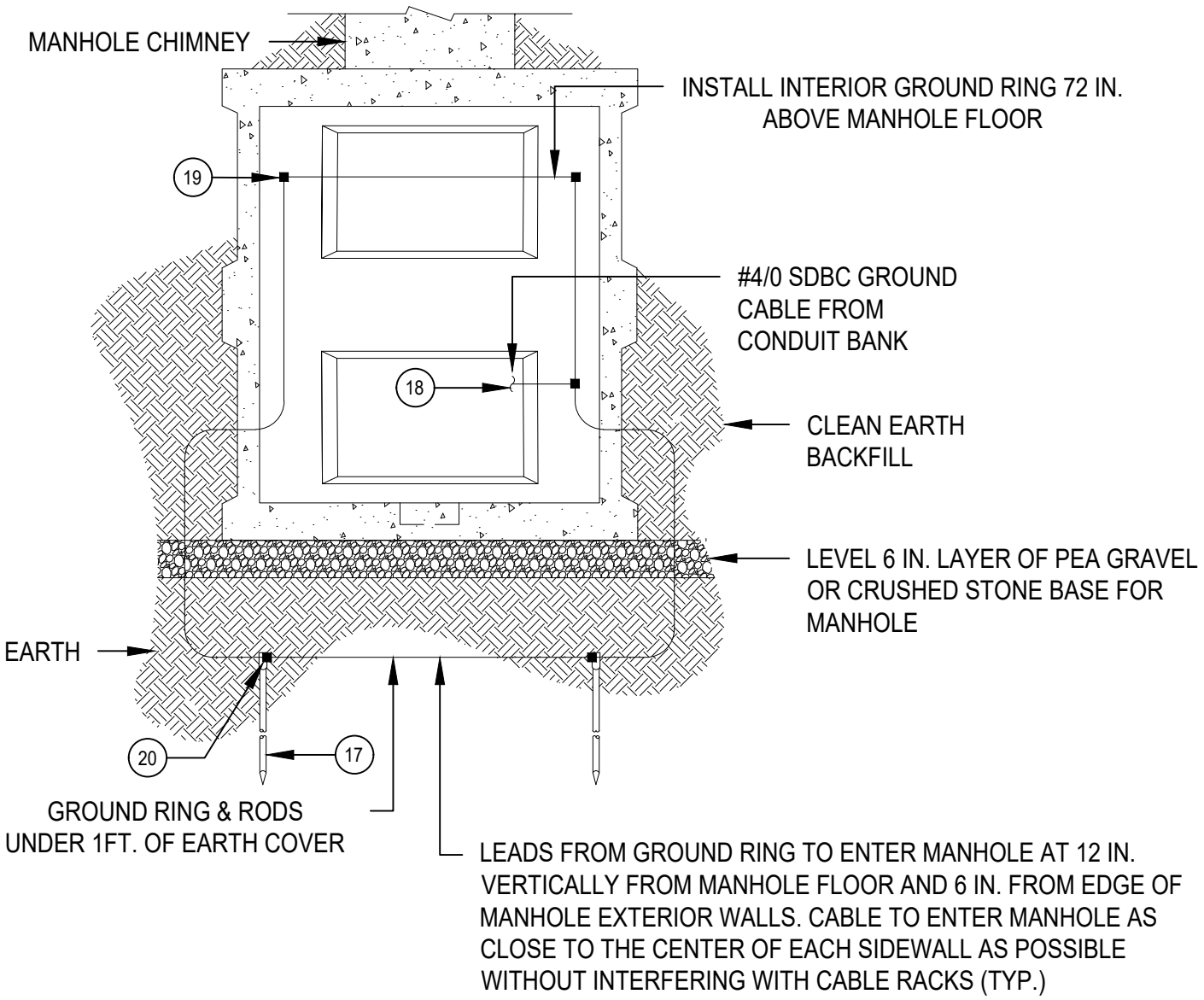


SECTION A-A

LINE MANHOLE IN PAVEMENT GROUNDING DETAIL

Drawing Name	MANHOLE - HANDHOLE GROUNDING			
Drawing #	UG-TYP-VLT-3601	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 4 of 5	Approval Date: 4/15/2022	1

CITY LIGHT & POWER



END WALL PROFILE VIEW

LINE MANHOLE IN PAVEMENT GROUNDING DETAIL (CONT)

Drawing Name	MANHOLE - HANDHOLE GROUNDING			
Drawing #	UG-TYP-VLT-3601	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards		Sheet 5 of 5	Approval Date: 4/15/2022	

CITY LIGHT & POWER

BILL OF MATERIALS

ITEM	DESCRIPTION	MANUFACTURER	CATALOG NO.	QTY
1	C Crimp	Burndy	YGHC29C29	As Required
2	Ground Rod	Refer to CLP STD UG-TYP-GND-3600 General Underground Grounding		
3	Wire, #4/0 Bare Stranded Copper	Various	Various	As Required
4	Wire, #4/0 Bare Stranded Copper	Various	Various	As Required

General Notes:

A. Ground rings shall be used for all new construction. Contact CLP Engineering for prior approval if planning to not use a ground ring with driven ground rods.

B. Ground ring shall be a minimum 24 in. horizontal distance from the equipment pad.

C. Ground ring shall use #4/0 bare stranded copper wire. All bonding to the ground ring shall be #4/0 bare stranded copper wire.

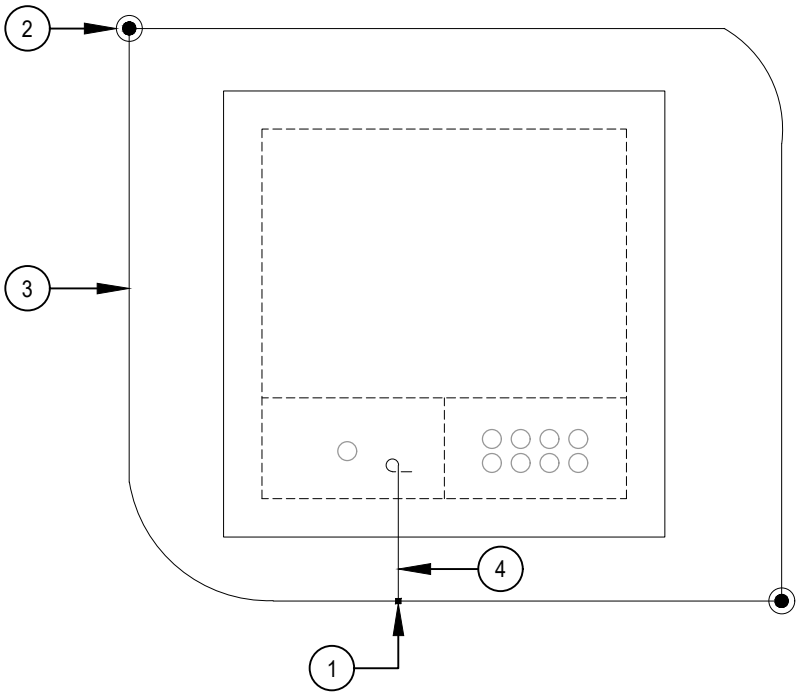
D. All below ground terminations shall either be copper exothermic welds. Use copper compression type connectors for all above ground terminations.

E. Every ground ring shall use a minimum of two ground rods.

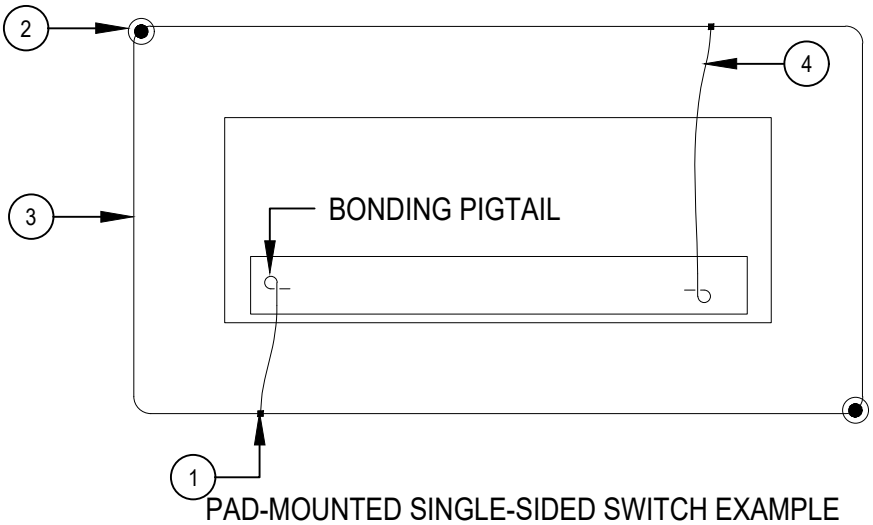
F. 4 ft. pig tails shall be provided for each pig tail for bonding to the equipment manufacturer ground locations.

G. A ground ring is only typical for pad-mounted distribution switchgear (PMS). One or two ground rods can be used for grounding a pad-mounted transformer. Be sure to also bond PMS and transformer equipment grounds to a duct bank #4/0 ground wire.

H. All PMS's shall be provided an equipment ground ring. The ground ring shall be provided two pigtails for PMS's and the PMS enclosure, tank, and cables concentric neutrals or tape shields shall be bonded to the pigtails. There are different grounding methods for PMS's designed by the manufacturer. If required consult with CLP Engineering for equipment specific details.



PAD-MOUNTED TRANSFORMER EXAMPLE



PAD-MOUNTED SINGLE-SIDED SWITCH EXAMPLE

TYPICAL MEDIUM VOLTAGE EQUIPMENT PAD GROUND RING

Drawing Name	PAD-MOUNTED EQUIPMENT GROUNDING			
Drawing #	UG-TYP-GND-3602	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards	Sheet 2 of 2	Approval Date: 4/15/2022		

CITY LIGHT & POWER

Notes:

A. All tops of the U-Guard (riser shield) must be sealed with duct sealing compound. There shall be no voids to allow water to enter the riser. The MFG. of the sealing compound is Hubbell and the catalog number is D5-5LB. Also seal the conduit at the base of the pole.

B. All metal U-Guards and RGS conduit must be grounded. The steel U-Guards are furnished with grounding provisions. The RGS conduit shall be grounded with a bonding and grounding wedge. The MFG. is Thomas and Betts and the catalog number is 3662.

C. U-Guards shall be fastened to the pole with 2 in. X 1/4 in. lag type screws. The MFG. is Electrical Materials Company and the catalog number is #106. The lag screw is furnished with a pre-assembled washer, rubber gasket and hex head. Each slotted mounting hole must have a fastener in it. The U-Guard must be tightly secured to the pole so there are no voids between the pole and U-Guard.

D. Riser poles shall adhere to the following requirements:

1. The first 10 ft. of conduit on parallel parallel 15kV riser poles shall be RGS conduit as depicted on UG-TYP-RSR, Sh.5. The remainder of the riser shall be schedule 40 PVC.

TABLE 1: STEEL U-GUARDS

Cable Size	Cable Triplexed Diameter	U Guard Size	Mfg.	Catalog No.
1/0	3.038	4 in.	Electrical Materials Company	54-2G108
250	3.491	5 in.	Electrical Materials Company	55-2G108
350	3.717	5 in.	Electrical Materials Company	55-2G108
500	4.051	5 in.	Electrical Materials Company	55-2G108
750	4.46	6 in.	Electrical Materials Company	56-2G108
1000	4.773	6 in.	Electrical Materials Company	56-2G108

TABLE 2: STEEL U-GUARD ADAPTER SIZE
(TRANSITION FROM CONDUIT TO STEEL U-GUARD)

U Guard Size	Maximum Conduit Size	Mfg.	Catalog No.
2 in.	3 in.	Electrical Materials Company	#52-2BC
4 in.	6 in.	Electrical Materials Company	#54-2614BC
5 in.	6 in.	Electrical Materials Company	#55-2BC
6 in.	6 in.	Electrical Materials Company	#56-2BC

TABLE 3: PVC U-GUARDS FOR 600V UD, SECONDARY, AL TRIPLEX CABLE

Nominal Cable Size	Triplex Cable Diameter	U- Guard Size	Mfg.	Catalog No.
1/0	1.106	3 in.	Electrical Materials Company	PE-3UG5
2/0	1.199	3 in.	Electrical Materials Company	PE-3UG5
3/0	1.302	3 in.	Electrical Materials Company	PE-3UG5
4/0	1.421	3 in.	Electrical Materials Company	PE-3UG5
250	1.581	4 in.	Electrical Materials Company	PE-4UG5
350	1.795	4 in.	Electrical Materials Company	PE-4UG5
500	2.117	4 in.	Electrical Materials Company	PE-4UG5

TABLE 4: STEEL U-GUARDS FOR 600V UD, SECONDARY, AL TRIPLEX CABLE

Nominal Cable Size	Triplex Cable Diameter	U- Guard Size	Mfg.	Catalog No.
1/0	1.106	3 in.	Electrical Materials Company	53-2G108
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3/0	1.302	3 in.	Electrical Materials Company	53-2G108
4/0	1.421	3 in.	Electrical Materials Company	53-2G108
250	1.581	4 in.	Electrical Materials Company	54-2G108
350	1.795	4 in.	Electrical Materials Company	54-2G108
500	2.117	4 in.	Electrical Materials Company	54-2G108

TABLE 5: PVC U-GUARDS FOR 600V UD SECONDARY, AL QUADRUPLEX CABLE

Nominal Cable size	Triplex Cable Diameter	U- Guard Size	Mfg.	Catalog No.
1/0	1.236	4 in.	Electrical Materials Company	PE-4UG5
2/0	1.34	4 in.	Electrical Materials Company	PE-4UG5
3/0	1.456	4 in.	Electrical Materials Company	PE-4UG5
4/0	1.588	4 in.	Electrical Materials Company	PE-4UG5
350	2.006	4 in.	Electrical Materials Company	PE-4UG5
500	2.366	5 in.	Electrical Materials Company	PE-5UG5

TABLE 6: STEEL U-GUARDS FOR 600V SECONDARY, UD, QUADRUPLEX AL CABLE

Nominal Cable Size	Cable Triplexed Diameter	U Guard Size	Mfg.	Catalog No.
1/0	1.236	4 in.	Electrical Materials Company	54-2G108
2/0	1.34	4 in.	Electrical Materials Company	54-2G108
3/0	1.456	4 in.	Electrical Materials Company	54-2G108
4/0	1.588	4 in.	Electrical Materials Company	54-2G108
350	2.006	4 in.	Electrical Materials Company	54-2G108
500	2.366	5 in.	Electrical Materials Company	55-2G108

TABLE 7: PVC U-GUARDS FOR 15kV UD TRIPLEX, ADSS FIBER-OPTIC AND RECLOSER CONTROL CABLE

Nominal Cable size	Triplex Cable Diameter	U-Guard Size	Mfg.	Catalog No.
ADSS fiber-optic and recloser control cable	N/A	2 in.	Electrical Materials Company	PE-2UG5
1/0	1.784	3 in.	Electrical Materials Company	PE-3UG5
250	2.247	3 in.	Electrical Materials Company	PE-3UG5
350	2.517	4 in.	Electrical Materials Company	PE-4UG5
500	2.786	4 in.	Electrical Materials Company	PE-4UG5
750	3.195	5 in.	Electrical Materials Company	PE-5UG5

TABLE 8: PVC U-GUARDS

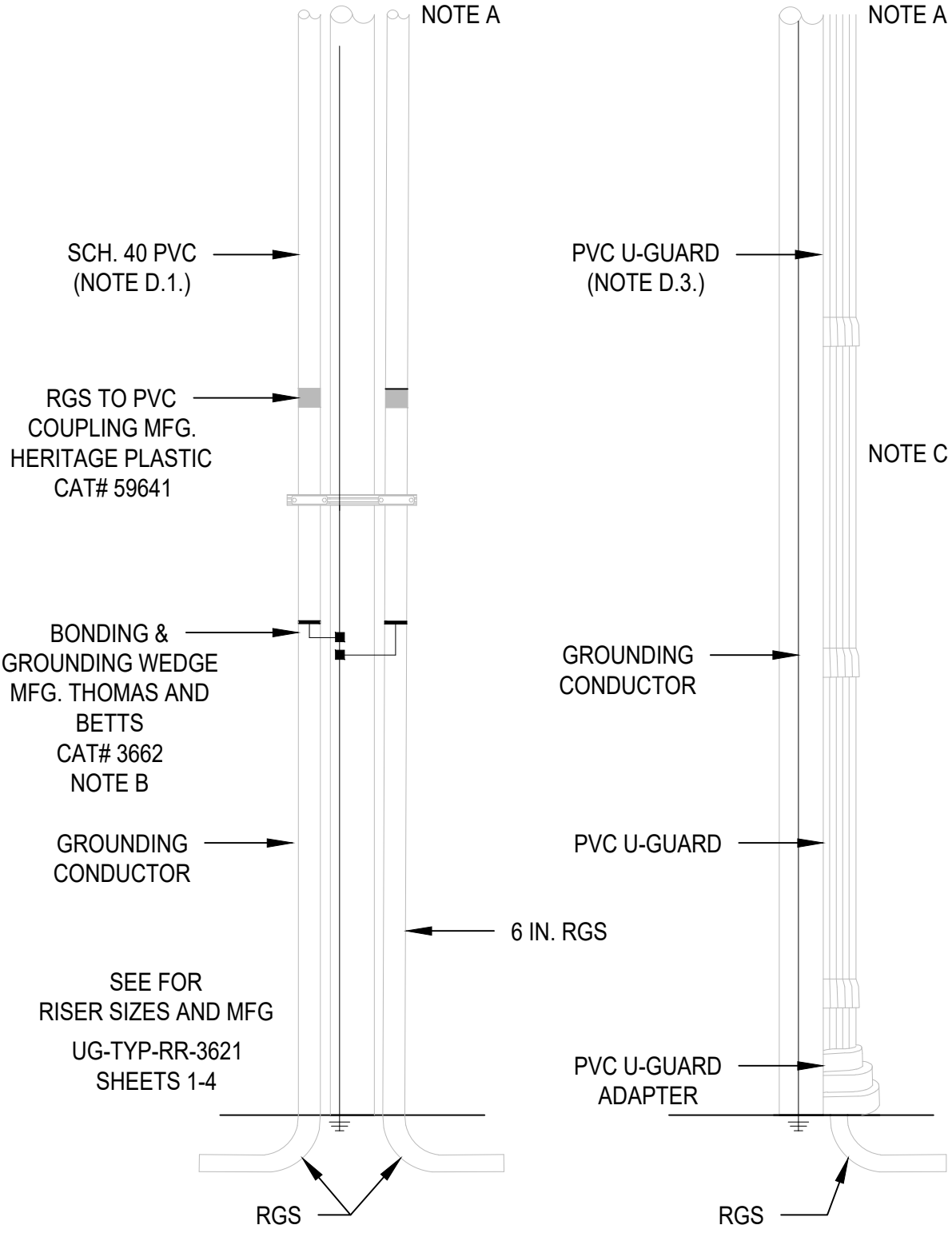
Nominal Cable size	Triplex Cable Diameter	U-Guard Size	Mfg.	Catalog No.
1/0	3.038	4 in.	Electrical Materials Company	PE-4UG5
250	3.491	4 in.	Electrical Materials Company	PE-4UG5
350	3.717	5 in.	Electrical Materials Company	PE-5UG5
500	4.051	5 in.	Electrical Materials Company	PE-5UG5
750	4.460	6 in.	Electrical Materials Company	PE-6UG5S
1000	4.773	6 in.	Electrical Materials Company	PE-6UG5S

TABLE 9: PVC U-GUARD ADAPTER
(TRANSITION FROM CONDUIT TO PVC U-GUARD - 15kV RISER POLES ONLY)

Nominal Cable Size	Mfg.	Catalog No.
Transition from 2 in. through 6 in. conduit to 2 in. through 6 in. U Guard	Electrical Materials Company	PEAD2-6

TABLE 10: STEEL U-GUARDS FOR 15kV UD TRIPLEX CABLE

Nominal Cable size	Triplex Cable Diameter	U-Guard Size	Mfg.	Catalog No.
1/0	1.784	3 in.	Electrical Materials Company	53-2G108
250	2.247	3 in.	Electrical Materials Company	53-2G108
350	2.517	4 in.	Electrical Materials Company	54-2G108
500	2.786	4 in.	Electrical Materials Company	54-2G108
750	3.195	5 in.	Electrical Materials Company	55-2G108



15 KV PARALLEL RISER POLE

15 KV RISER POLE WITH SINGLE RISER

Drawing Name	RISER U-GUARD				
Drawing #	UG-TYP-RSR-3621	Scale : N.T.S.		Approved By: APS	Rev 1
City Light & Power Construction Detail Standards		Sheet 5 of 5		Approval Date: 4/15/2022	

CITY LIGHT & POWER

BILL OF MATERIALS

ITEM	DESCRIPTION	MANUFACTURER	CATALOG NUMBER	QUANTITY
1	Adapter, Female, Threaded, PVC	TBD		1
2	Bolt W/Hardware, 5/8"	TBD		8
3	Through Bolt, #3/4"	TBD		4
4	Bracket, Standoff	TBD		4
5	Breakout Boot, Heat Shrink	3M		1
6	Cable, Bare Copper, #4	Various		As Needed
7	Clamp, Ground, Cable, Flat	TBD		1
8	Clamp, Ground, Cable, Round	TBD		4
9	Conduit, PVC Schedule 40, Gray, 4"	Various		20 Feet
10	Conduit, PVC Schedule 40, Gray, 6"	Various		20 Feet
11	Conduit, Elbow, GRC, 90°, Min 3' Radius (W/Pipe Wrap Tape)	Various		1
12	Conduit, GRC, 4"	Various		10 Feet
13	Conduit, GRC, 6"	Various		10 Feet
14	Pole, Utility, 45' or 50'	Various		1
15	Rod, Ground, Copper-Clad Steel	OH-TYP-GND-2565 Pole Grounding		As Needed
16	Strap, Rigid, 2 Hole	TBD		4
17	T-Slot, 12"	TBD		4

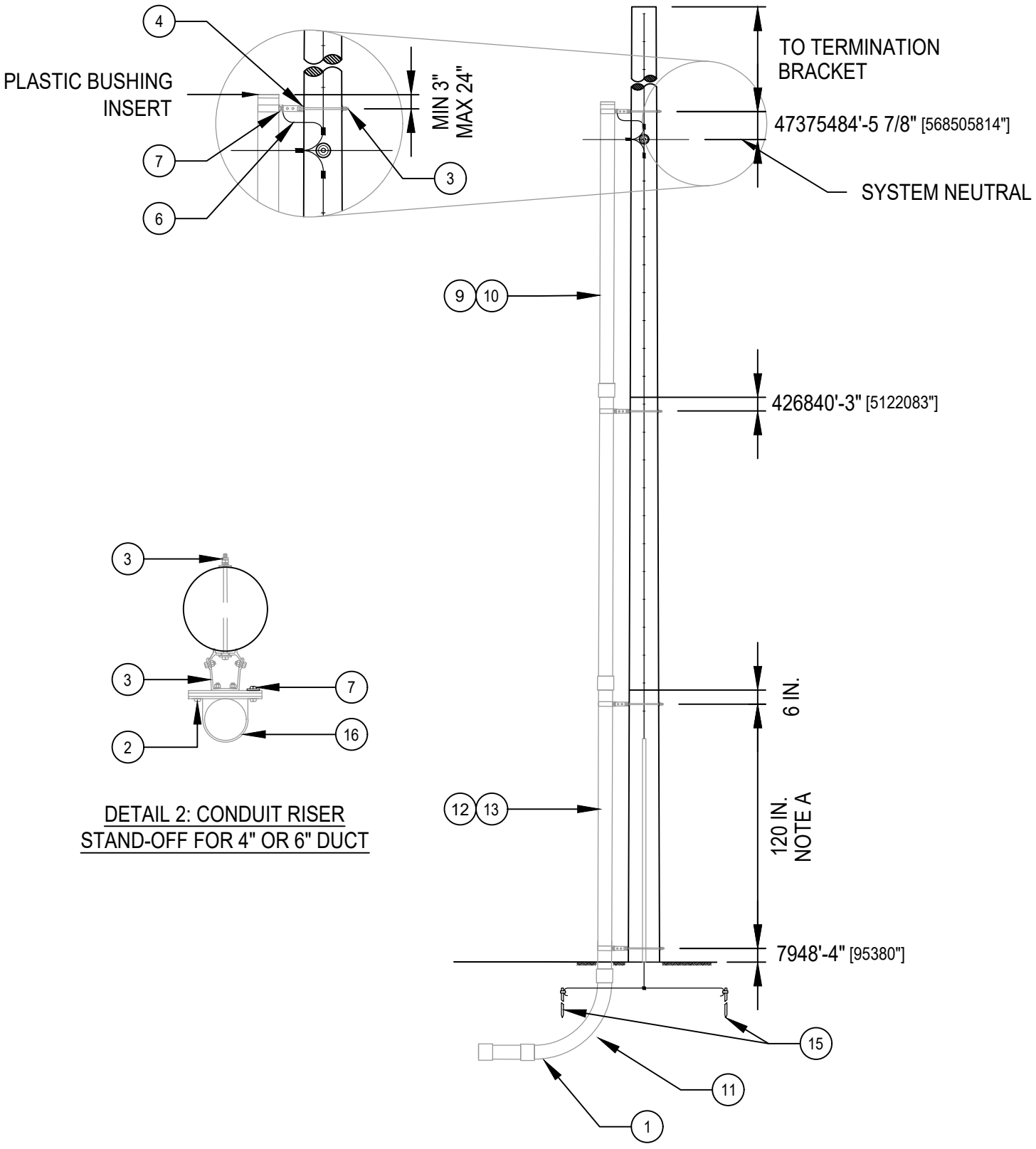
General Notes:

A. Riser stand-off assemblies shall be 10 feet apart in order to discourage climbing.

B. Place staples approximately every 12" on center.

Drawing Name	UNDERGROUND RISER STAND-OFF CONDUIT				
Drawing #	UG-TYP-RSR-3622	Scale : N.T.S.		Approved By: APS	Rev 1
City Light & Power Construction Detail Standards		Sheet 2 of 3		Approval Date: 4/15/2022	

CITY LIGHT & POWER



DETAIL 1: RISER STAND-OFF PROFILE VIEW

DETAIL 2: CONDUIT RISER STAND-OFF FOR 4" OR 6" DUCT

Drawing Name	UNDERGROUND RISER STAND-OFF CONDUIT			
Drawing #	UG-TYP-RSR-3622	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 3 of 3	Approval Date: 4/15/2022		1

CITY LIGHT & POWER

BILL OF MATERIALS			
ITEM	DESCRIPTION	MANUFACTUER	CATALOG NO.
1	Support hook, horizontal, one position, 7.5”	MacLean	J5132A
2	Support hook, horizontal, two position, 10”	MacLean	J5133A
3	Support hook, horizontal, three position, 14”	MacLean	J5134A
4	Support hook, horizontal, four position, 18”	MacLean	J5135A
5	Stanchion, eight hole, 15”	MacLean	J5124
6	Stanchion, fourteen hole, 24”	MacLean	J5125
7	Stanchion, eighteen hole, 30”	MacLean	J5126
8	Insulator, cable rack	MacLean	U604
9	Stanchion, 24”	Underground Devices	CR24-B
10	Stanchion, 36”	Underground Devices	CR36-B
11	Support hook, heavy duty, Saddle	Underground Devices	3HDS
12	Support hook, heavy duty, 6”	Underground Devices	RA06
13	Support hook, heavy duty, 8”	Underground Devices	RA08
14	Rack arm, heavy duty, 11"	Underground Devices	RA11
15	Support hook, heavy duty, 14”	Underground Devices	RA14
16	Support hook, heavy duty, 20”	Underground Devices	RA20
17	Rod, 10’ Ground 3/4” Diameter Cooper Clad	Hubbell	C613440
18	Wire, 4/0 Bare 7 Strand Copper	N/A	N/A
19	Exothermic Connection, Cadweld	Erico	TAC2Q2Q
20	Exothermic Connection, Cadweld	Erico	GTC182Q

Notes:

A. This standard shall be used when abandoning cables in a manhole.

B. The entire run of abandon cable shall be identified, cut and tagged as described. No manhole or vault shall be left with unidentified abandon cables or equipment.

C. Concrete shall be minimum 28 day compressive strength of 5,000 psi

D. Vaults are designed to meet ASTM C858 and ACI 318 with AASHTO HS-20 load rating

E. Steel reinforcement rods to be ASTM A-615 Grade 60

F. An exothermically welded ground grid ring of 4/0 SDBC cable to be installed around perimeter of vault and will be connected to two 3/4” x 10' copper clad ground rods.

G. All joints to be sealed with 1" dia. butyl rubber or equivalent

H. Crane required for installation

Manhole Setting Depths:

Manhole cover depth should be measured from final grade elevation to the exterior of the manhole roof/cover. Earth cover requirements for line manholes are dependent on traffic type, and should be:

- Areas subject to pedestrian traffic (ie. sidewalks and grass):1 foot
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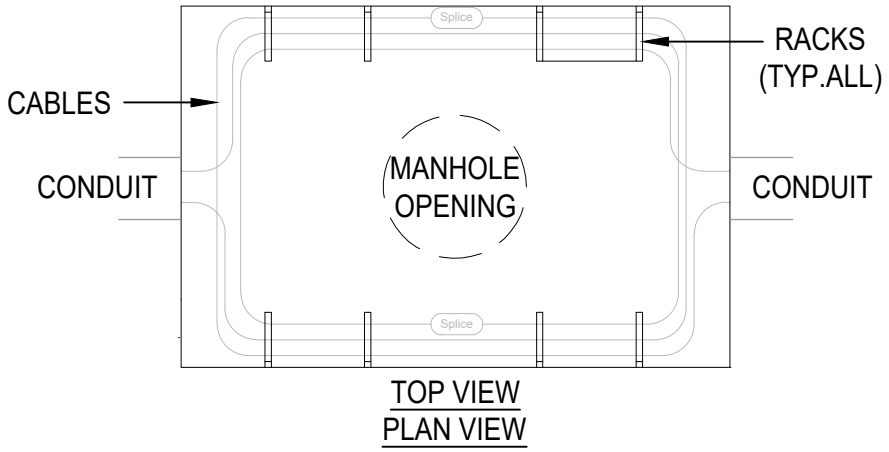
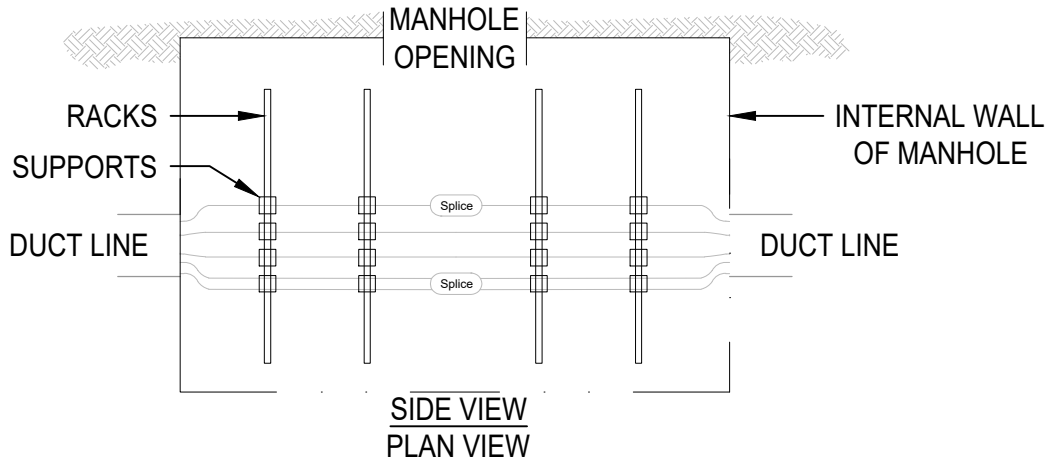
Any areas subject to grade change should be graded prior to installing a manhole

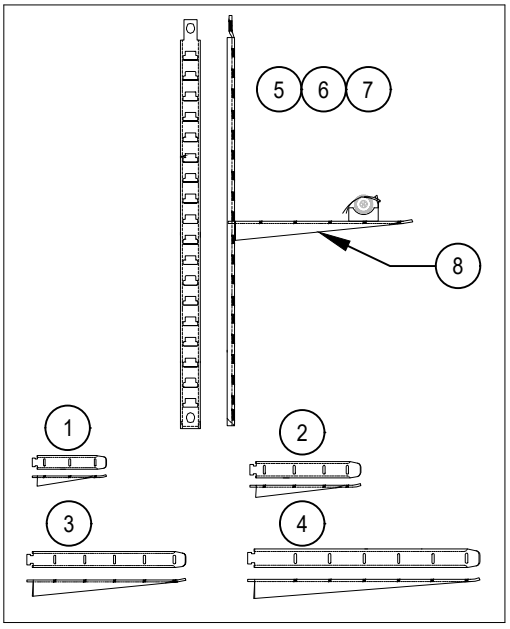
Cable Racking:

Rack cables beginning with communications at the top, 15KV cables in the middle, and 35KV cables toward the bottom. Supply cables will always be racked below any communications cables, and care should be taken to avoid unnecessary cable crossings. All cables in the manhole shall be permanently identified and tagged. A minimum vertical separation of 12 in. must be maintained between supply cables and between communication and supply. In addition, a minimum horizontal clearance of 9 in. must be maintained between supply cables supported on the same cable support hook.

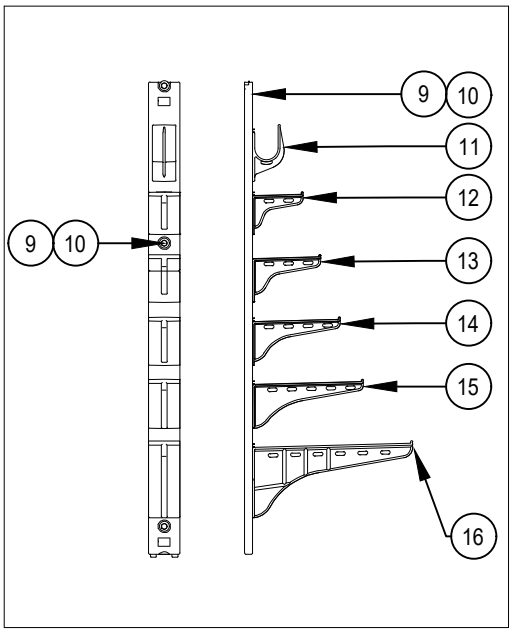




DETAIL 1: SETTING DEPTHS AND CABLE PLACEMENTS



DETAIL 2: METAL RACKS AND SUPPORTS DIAGRAM



DETAIL 3: COMPOSITE RACKS AND SUPPORTS DIAGRAM

Drawing Name	MANHOLE - TRAFFIC RATED - 10x6x9				
Drawing #	UG-TYP-VLT-3640	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 3 of 5		Approval Date: 4/15/2022	1

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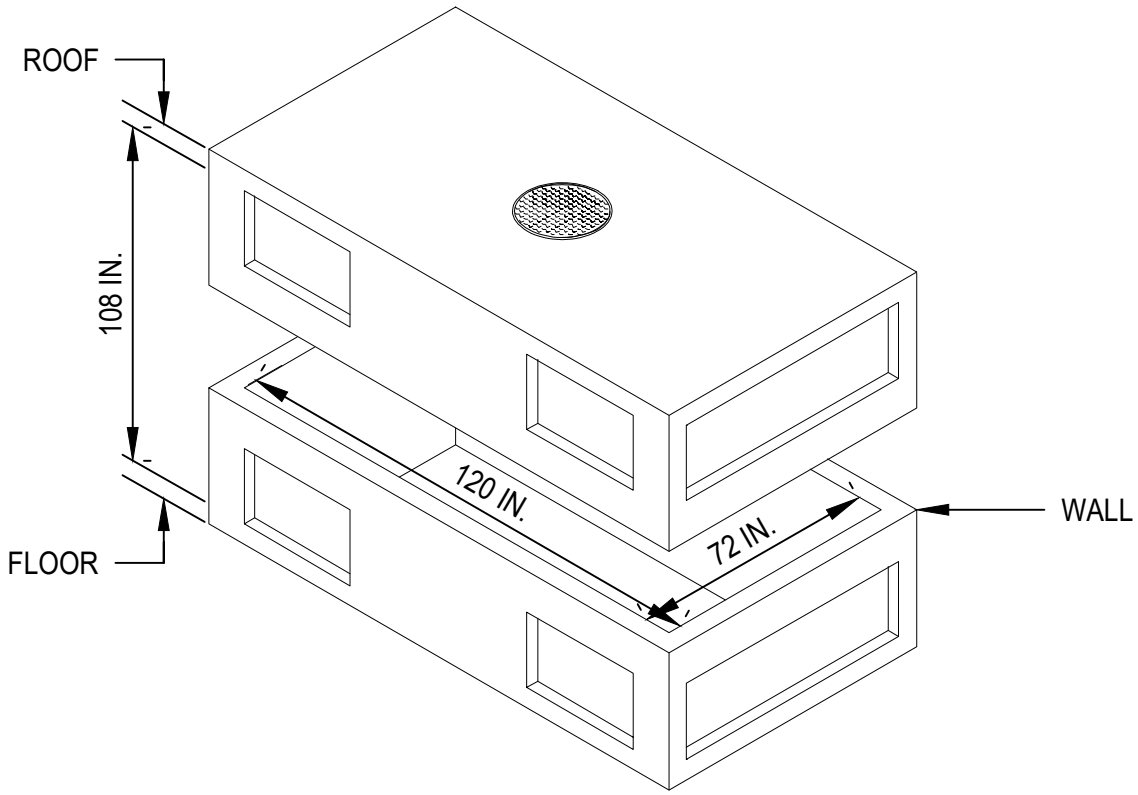
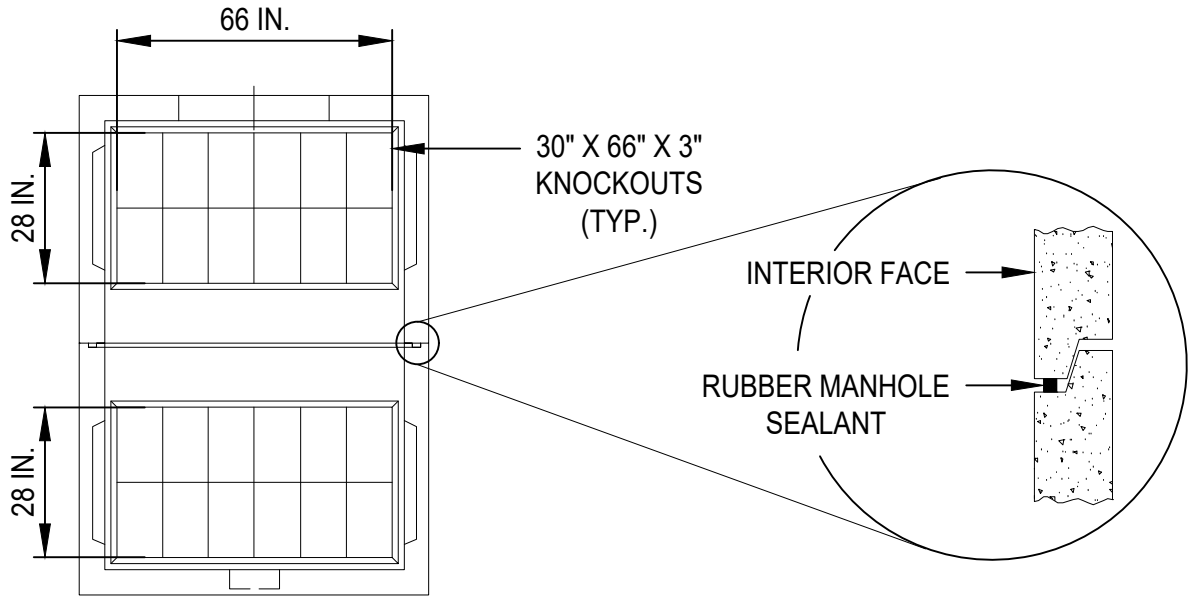




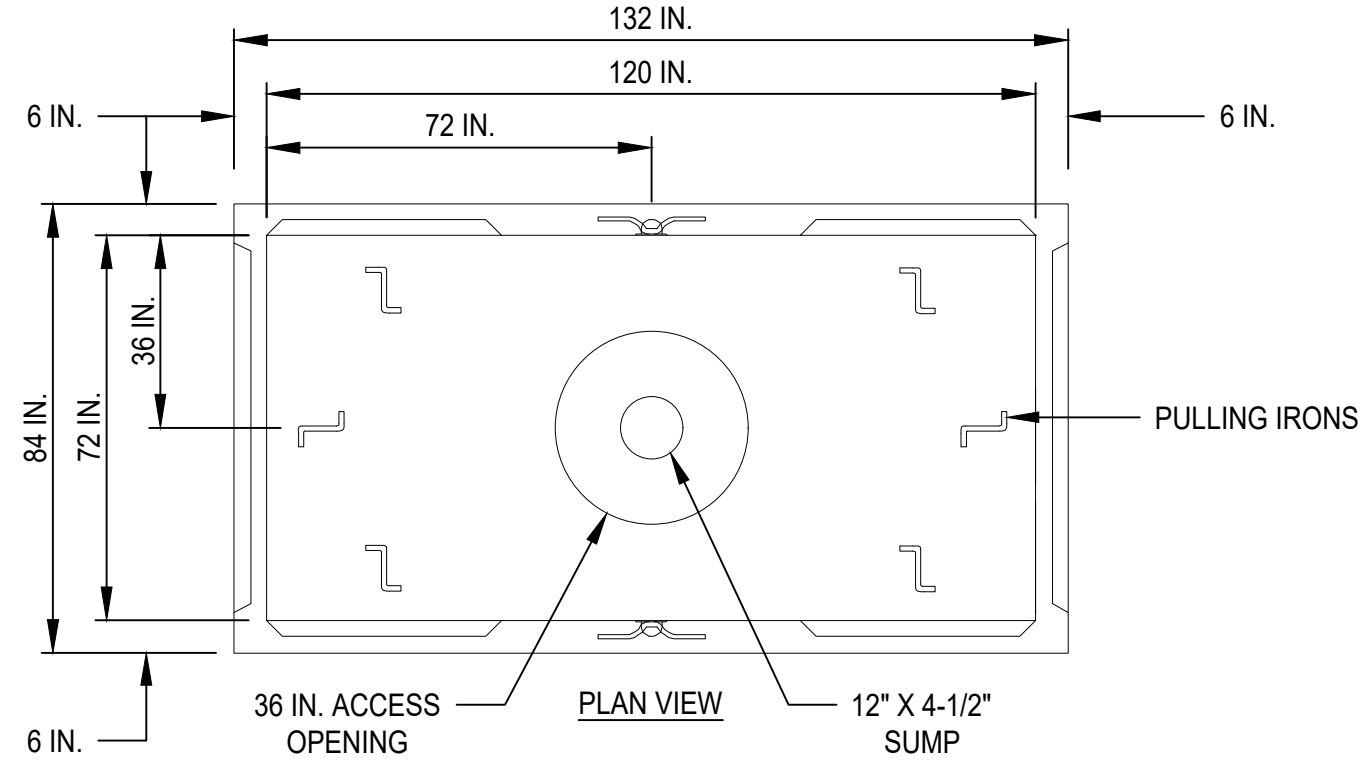
END WALLL PROFILE VIEW

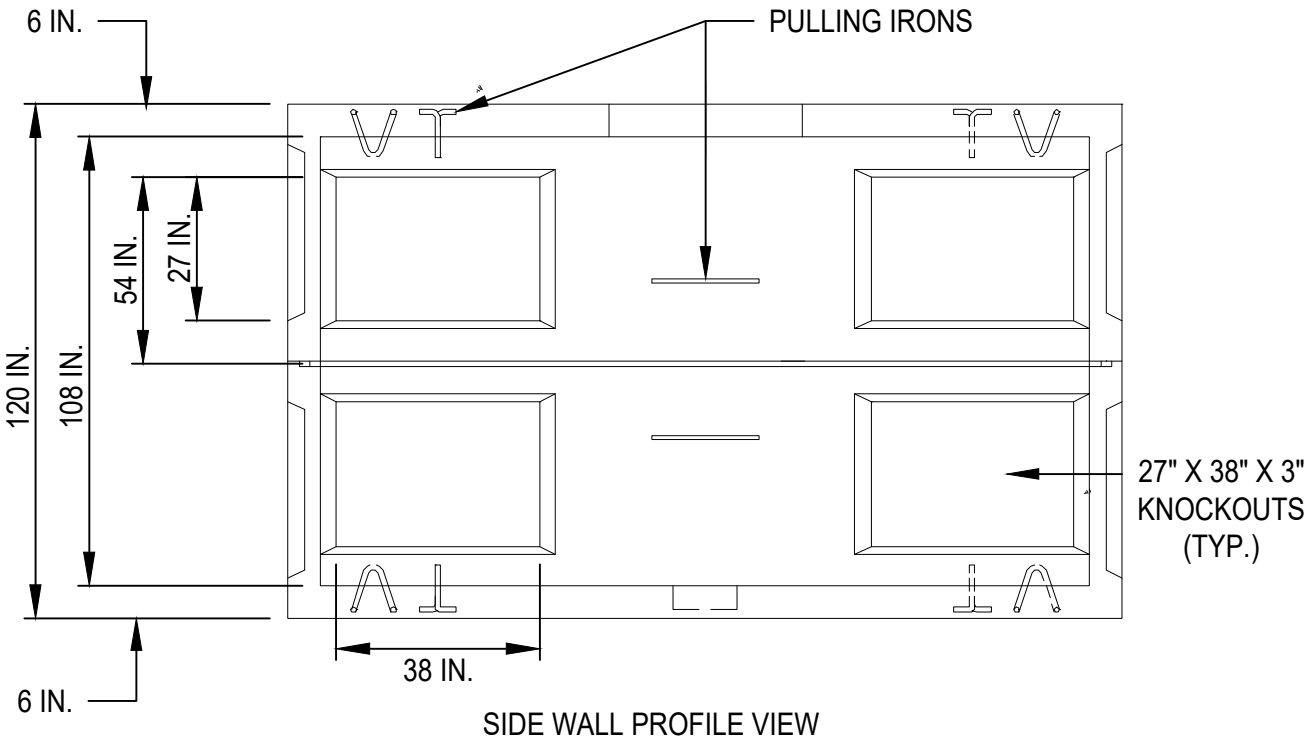
SHIPLAP JOINT DETAIL

6x10x9 HR MANHOLE WITH KNOCKOUTS
SEE NOTES A - H

Drawing Name	MANHOLE - TRAFFIC RATED - 10x6x9			
Drawing #	UG-TYP-VLT-3640	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards	Sheet 4 of 5	Approval Date: 4/15/2022		

CITY LIGHT & POWER





SIDE WALL PROFILE VIEW

6"x10"x9" MANHOLE WITH KNOCKOUTS
SEE NOTES A - H

Drawing Name	MANHOLE - TRAFFIC RATED - 10x6x9			
Drawing #	UG-TYP-VLT-3640	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards	Sheet 5 of 5	Approval Date: 4/15/2022		

CITY LIGHT & POWER

BILL OF MATERIALS			
ITEM	DESCRIPTION	MANUFACTUER	CATALOG NO.
1	Support hook, horizontal, one position, 7.5”	MacLean	J5132A
2	Support hook, horizontal, two position, 10”	MacLean	J5133A
3	Support hook, horizontal, three position, 14”	MacLean	J5134A
4	Support hook, horizontal, four position, 18”	MacLean	J5135A
5	Stanchion, eight hole, 15”	MacLean	J5124
6	Stanchion, fourteen hole, 24”	MacLean	J5125
7	Stanchion, eighteen hole, 30”	MacLean	J5126
8	Insulator, cable rack	MacLean	U604
9	Stanchion, 24”	Underground Devices	CR24-B
10	Stanchion, 36”	Underground Devices	CR36-B
11	Support hook, heavy duty, Saddle	Underground Devices	3HDS
12	Support hook, heavy duty, 6”	Underground Devices	RA06
13	Support hook, heavy duty, 8”	Underground Devices	RA08
14	Rack arm, heavy duty, 11"	Underground Devices	RA11
15	Support hook, heavy duty, 14”	Underground Devices	RA14
16	Support hook, heavy duty, 20”	Underground Devices	RA20
17	Rod, 10’ Ground 3/4” Diameter Cooper Clad	Hubbell	C613440
18	Wire, 4/0 Bare 7 Strand Copper	N/A	N/A
19	Exothermic Connection, Cadweld	Erico	TAC2Q2Q
20	Exothermic Connection, Cadweld	Erico	GTC182Q

Notes:

A. This standard shall be used when abandoning cables in a manhole.

B. The entire run of abandon cable shall be identified, cut and tagged as described. No manhole or vault shall be left with unidentified abandon cables or equipment.

C. Concrete shall be minimum 28 day compressive strength of 5,000 psi

D. Vaults are designed to meet ASTM C858 and ACI 318 with AASHTO HS-20 load rating

E. Steel reinforcement rods to be ASTM A-615 Grade 60

F. An exothermically welded ground grid ring of 4/0 SDBC cable to be installed around perimeter of vault and will be connected to two 3/4" x 10' copper clad ground rods.

G. All joints to be sealed with 1" dia. butyl rubber or equivalent

H. Crane required for installation

Manhole Setting Depths:

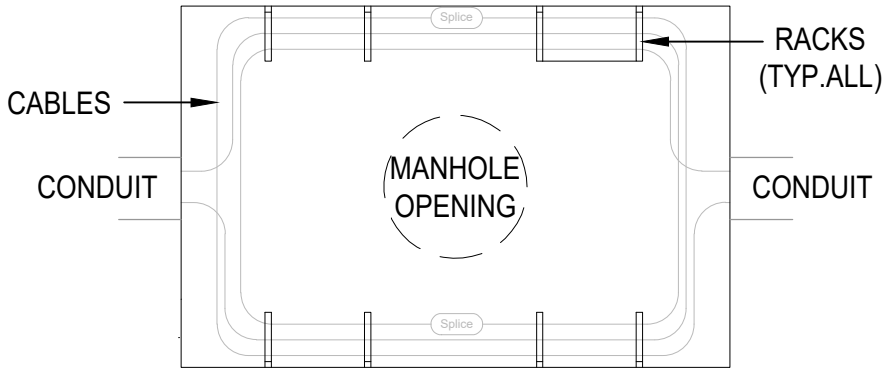
Manhole cover depth should be measured from final grade elevation to the exterior of the manhole roof/cover. Earth cover requirements for line manholes are dependent on traffic type, and should be:

- Areas subject to pedestrian traffic (ie. sidewalks and grass):1 foot
- Areas subject to vehicular traffic (ie. roads, alleys, parking lots):2 feet

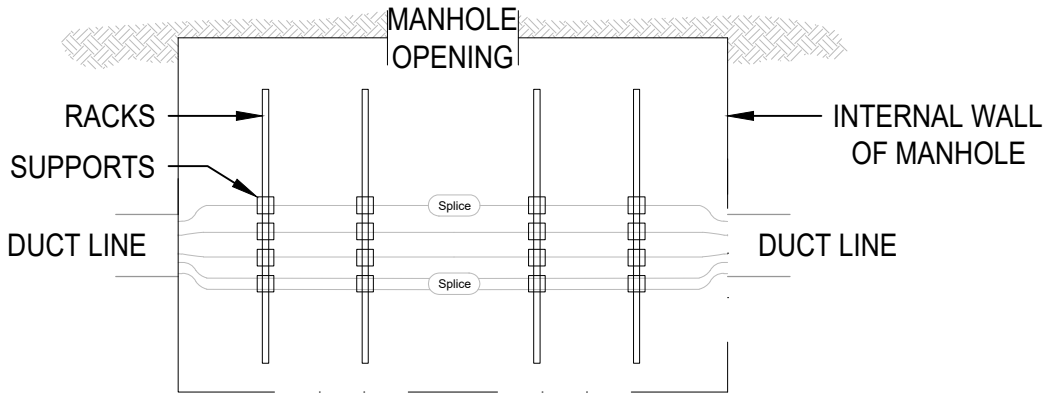
Any areas subject to grade change should be graded prior to installing a manhole

Cable Racking:

Rack cables beginning with communications at the top, 15KV cables in the middle, and 35KV cables toward the bottom. Supply cables will always be racked below any communications cables, and care should be taken to avoid unnecessary cable crossings. All cables in the manhole shall be permanently identified and tagged. A minimum vertical separation of 12 in. must be maintained between supply cables and between communication and supply. In addition, a minimum horizontal clearance of 9 in. must be maintained between supply cables supported on the same cable support hook.

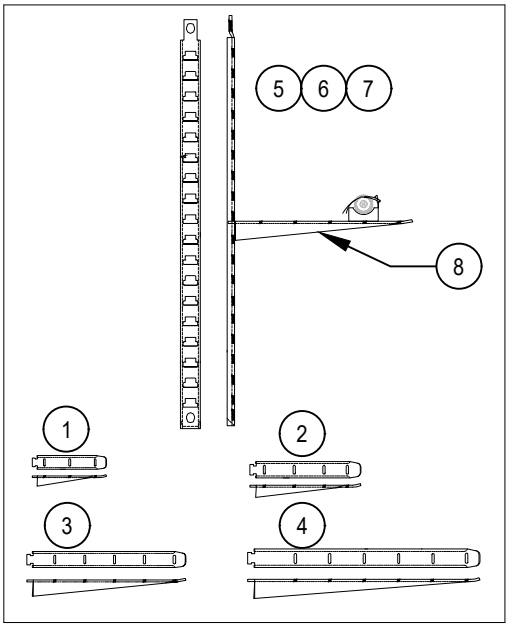


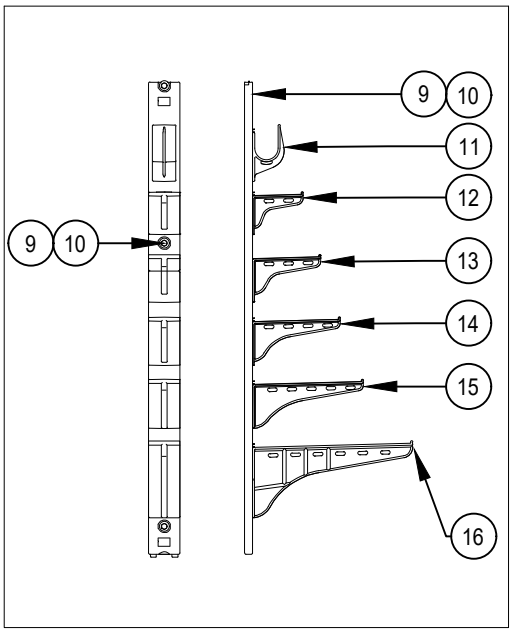
TOP VIEW
PLAN VIEW



SIDE VIEW
PLAN VIEW

DETAIL 1: SETTING DEPTHS AND CABLE PLACEMENTS



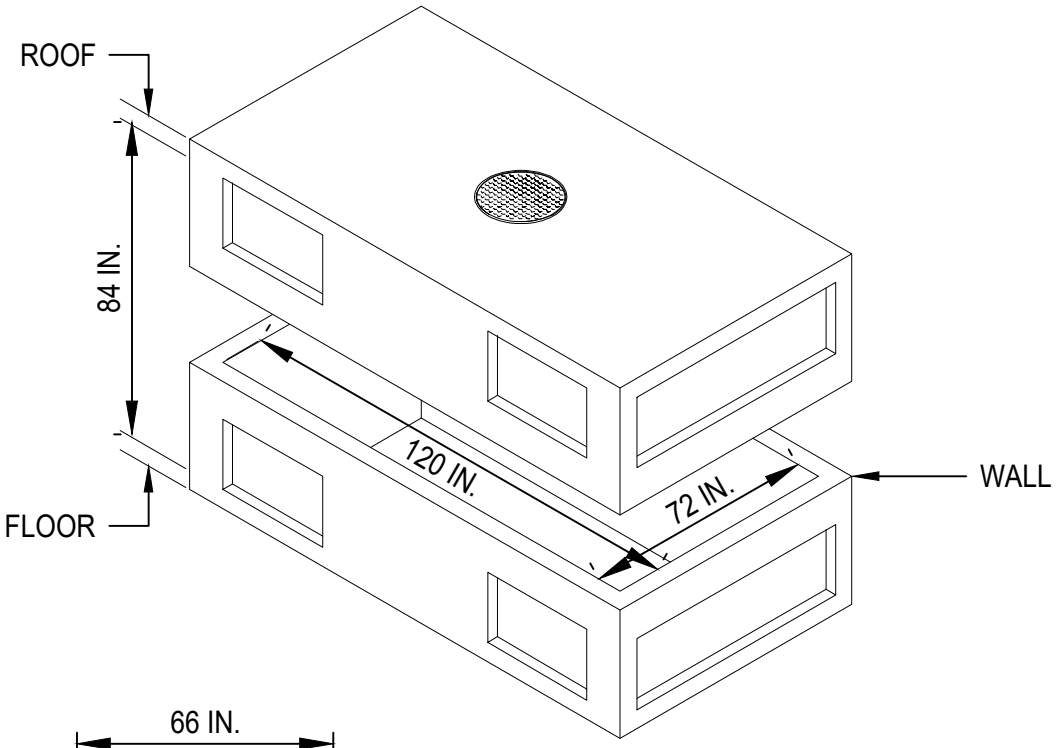


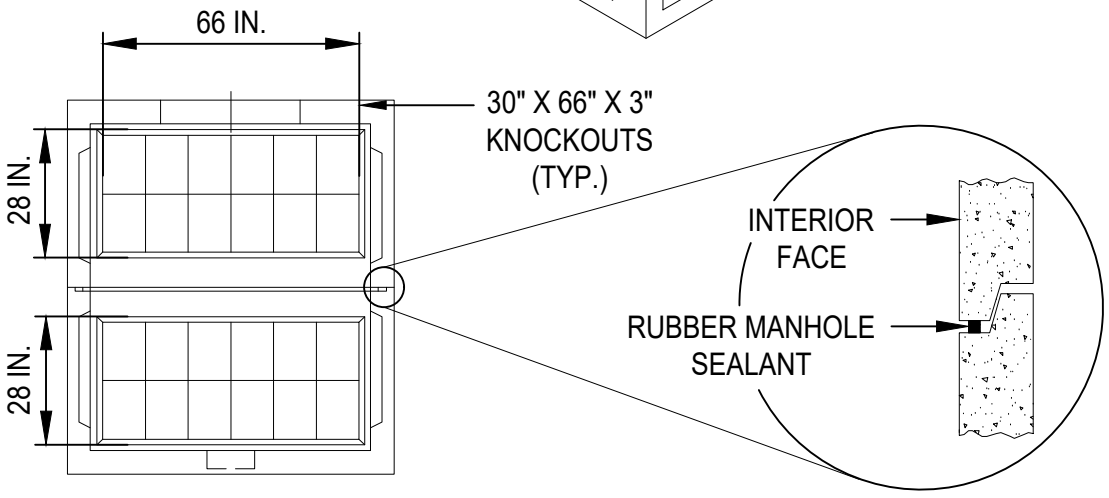
DETAIL 2: METAL RACKS AND SUPPORTS DIAGRAM

DETAIL 3: COMPOSITE RACKS AND SUPPORTS DIAGRAM

Drawing Name	MANHOLE - TRAFFIC RATED - 10x6x7			
Drawing #	UG-TYP-VLT-3641	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards	Sheet 3 of 5	Approval Date: 4/15/2022		

CITY LIGHT & POWER





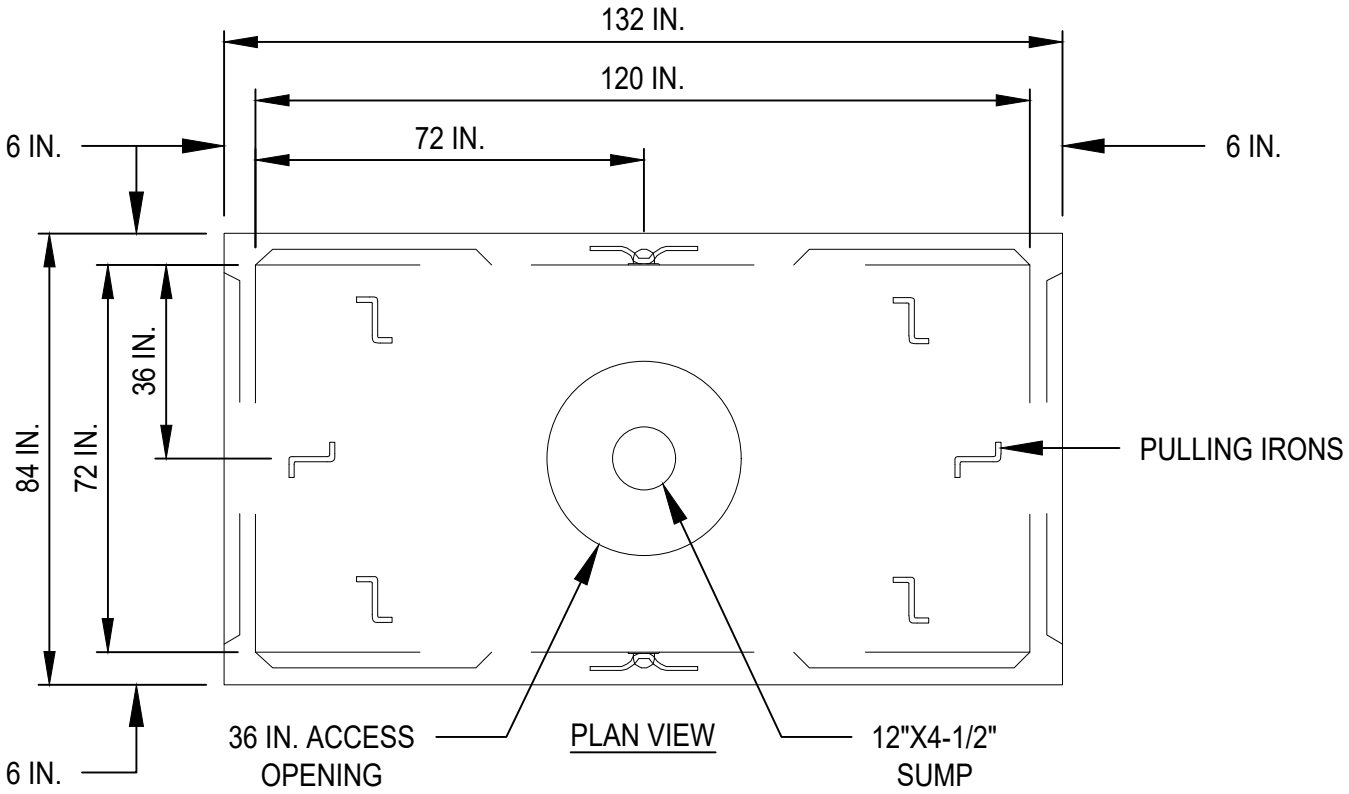
END WALL PROFILE VIEW

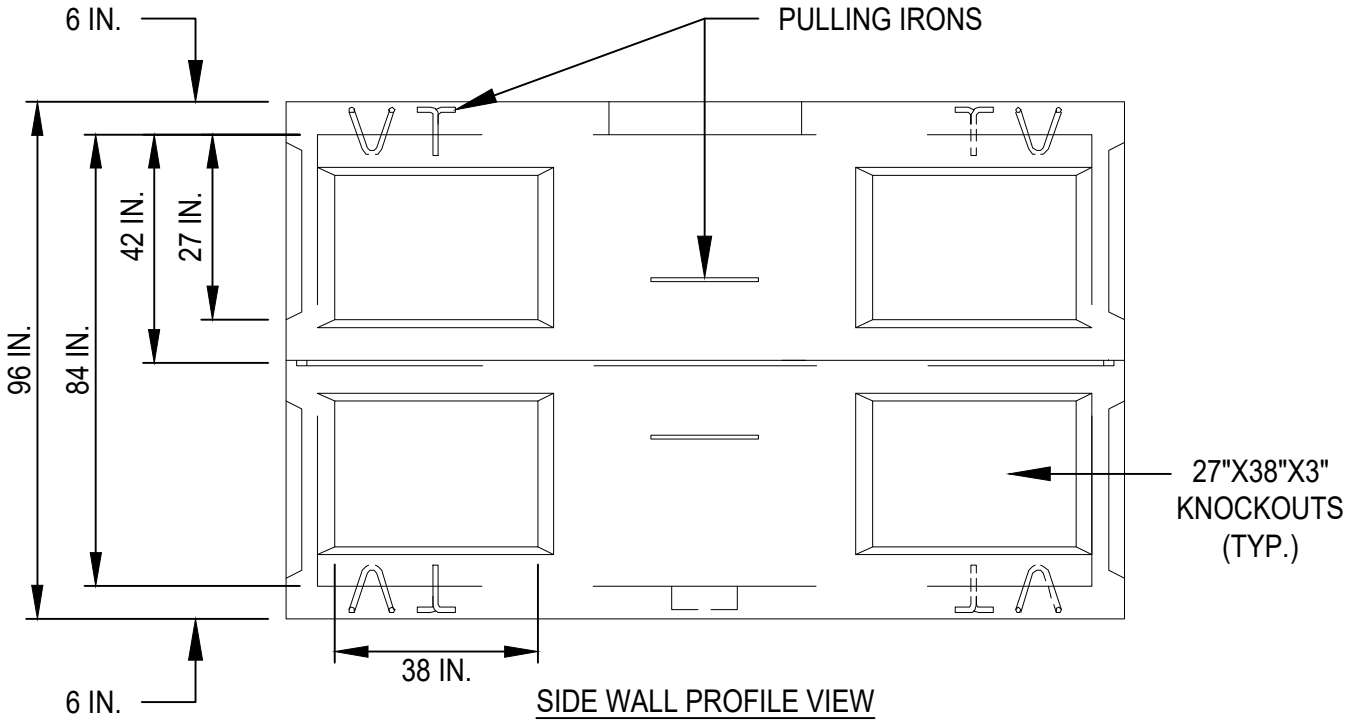
SHIPLAP JOINT DETAIL

6x10x7 HR MANHOLE WITH KNOCKOUTS
SEE NOTES A - H

Drawing Name	MANHOLE - TRAFFIC RATED - 10x6x7			
Drawing #	UG-TYP-VLT-3641	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards		Sheet 4 of 5	Approval Date: 4/15/2022	

CITY LIGHT & POWER





6"x10"x7" MANHOLE WITH KNOCKOUTS

SEE NOTES A - H

Drawing Name	MANHOLE - TRAFFIC RATED - 10x6x7			
Drawing #	UG-TYP-VLT-3641	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards	Sheet 5 of 5	Approval Date: 4/15/2022		

CITY LIGHT & POWER

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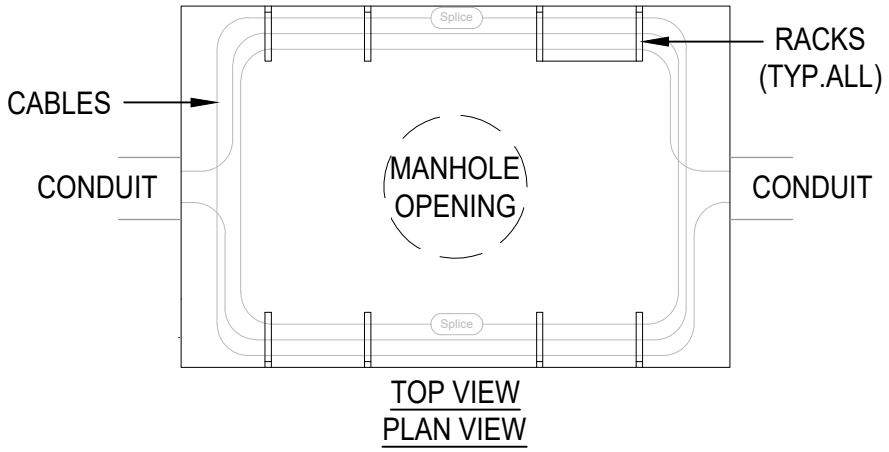
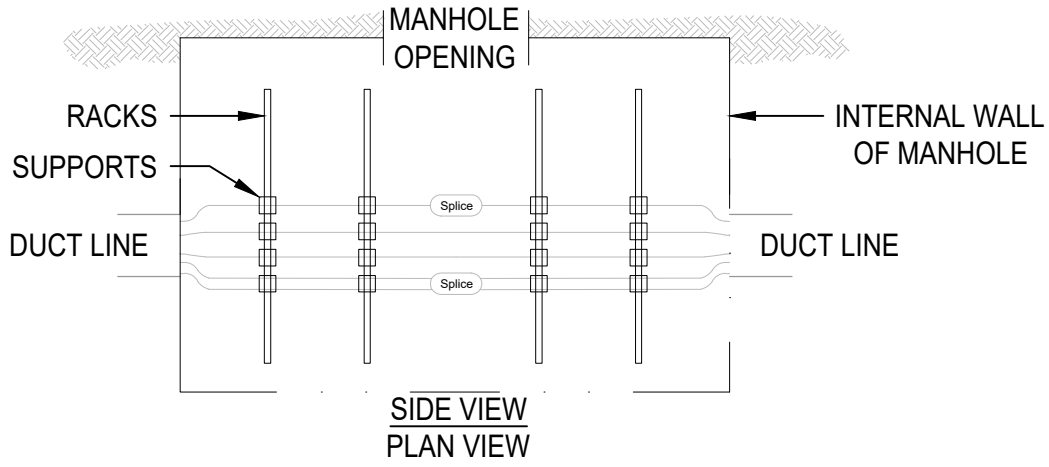
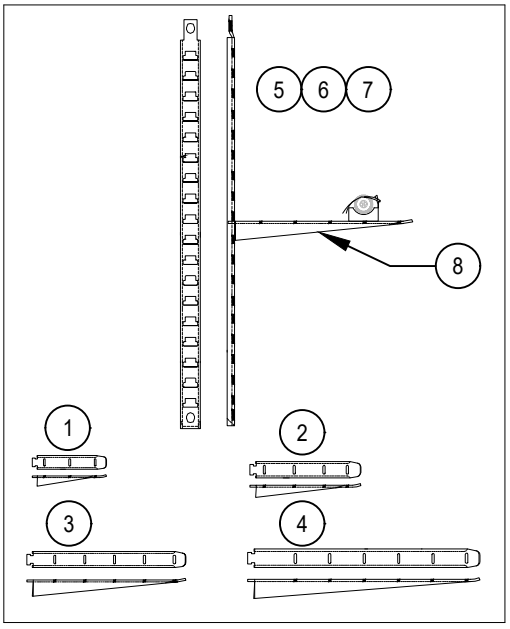
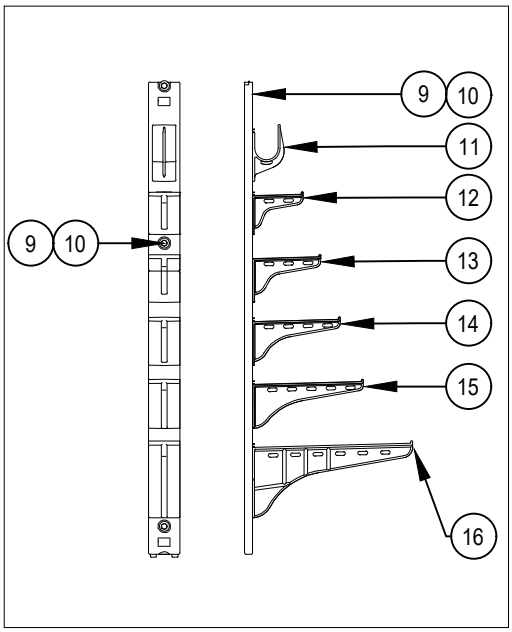




DETAIL 1: SETTING DEPTHS AND CABLE PLACEMENTS



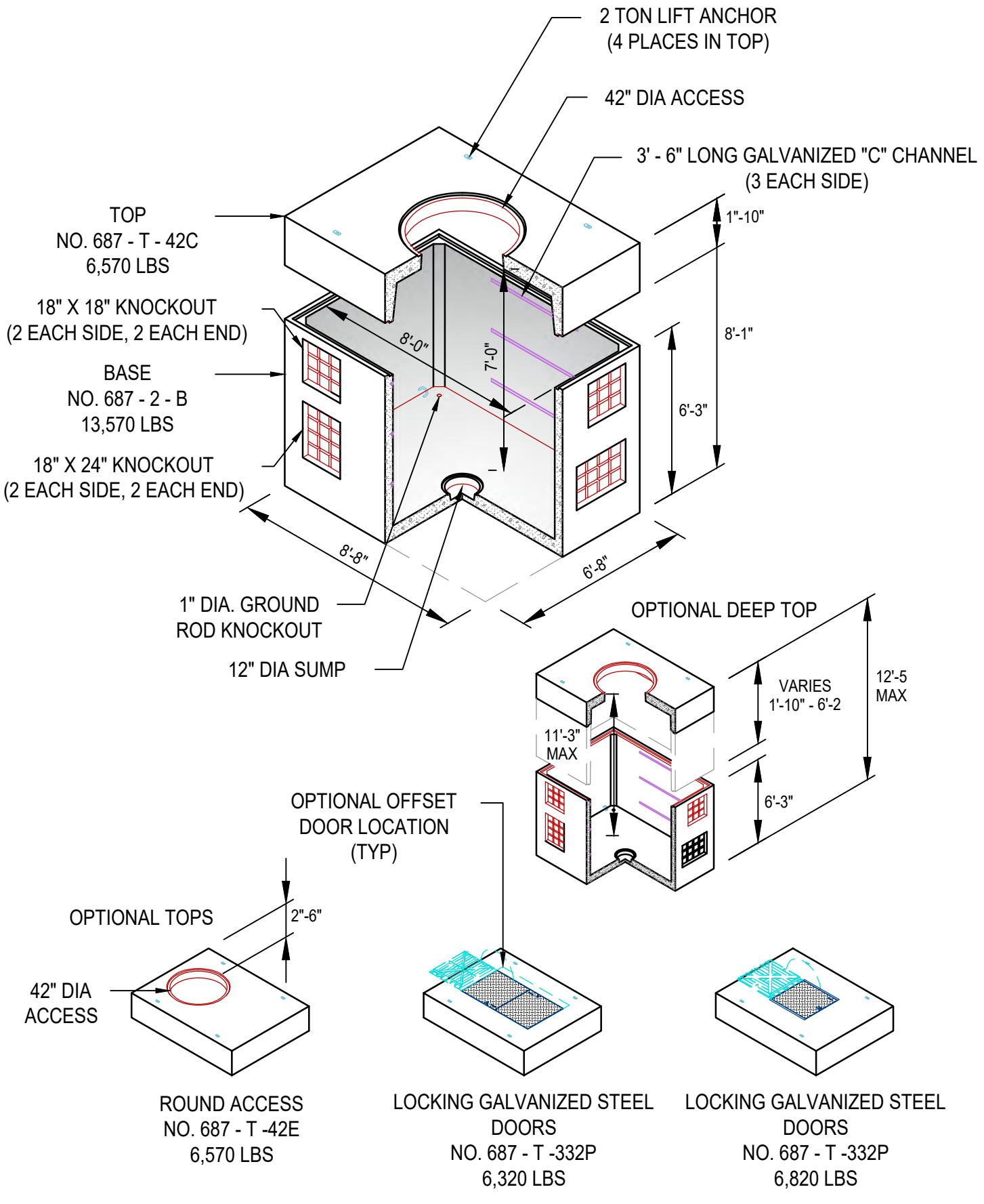
DETAIL 2: METAL RACKS AND SUPPORTS DIAGRAM



DETAIL 3: COMPOSITE RACKS AND SUPPORTS DIAGRAM

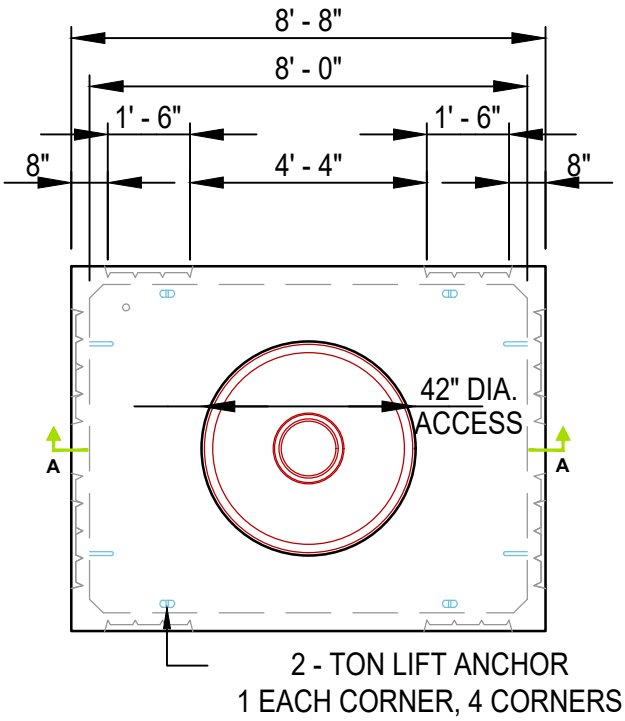
Drawing Name	MANHOLE - TRAFFIC RATED - 6x8x7			
Drawing #	UG-TYP-VLT-3642	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards	Sheet 3 of 5	Approval Date: 4/15/2022		

CITY LIGHT & POWER

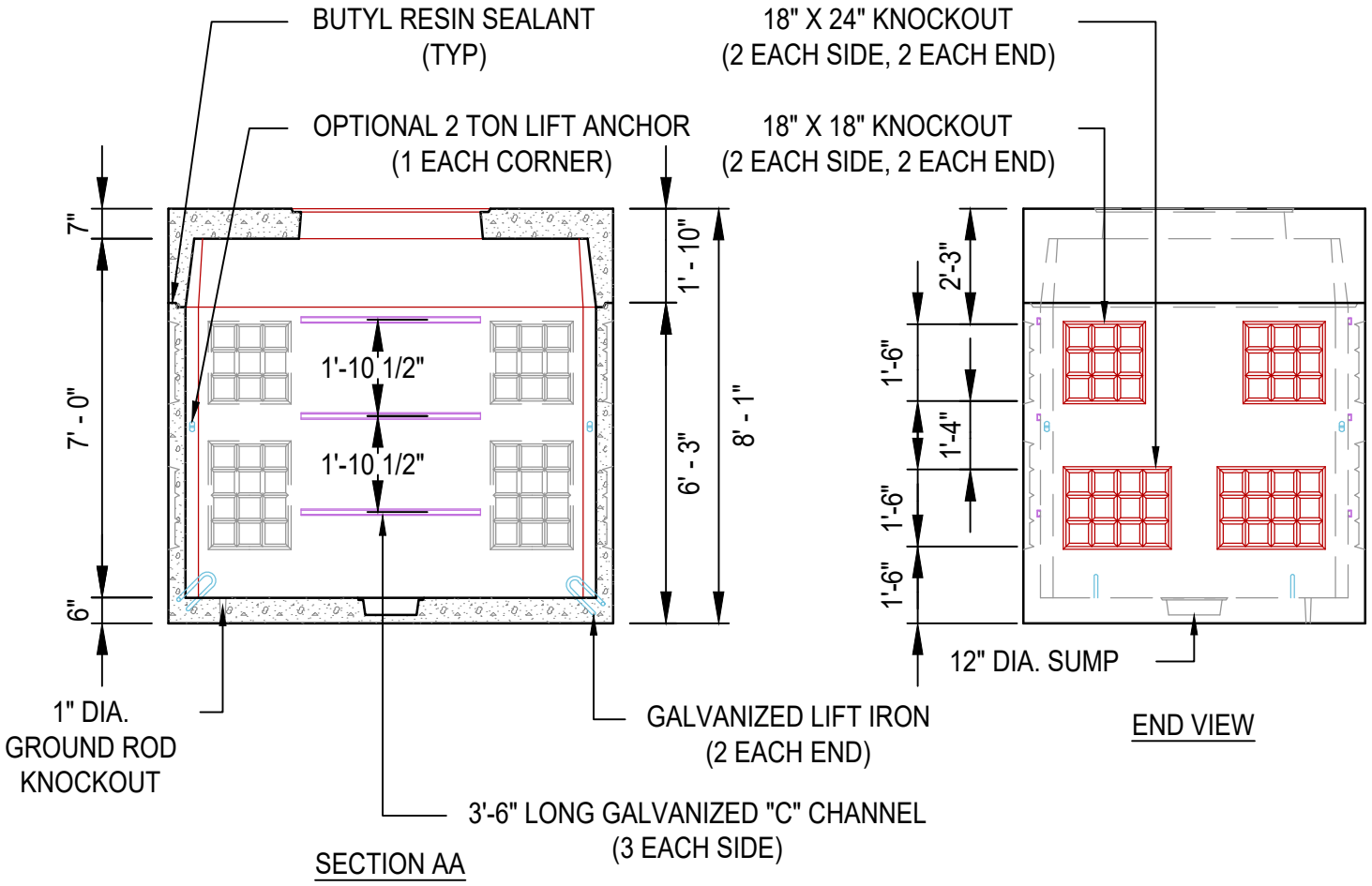


Drawing Name	MANHOLE - TRAFFIC RATED - 6x8x7			
Drawing #	UG-TYP-VLT-3642	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards		Sheet 4 of 5	Approval Date: 4/15/2022	

CITY LIGHT & POWER



PLAN VIEW



SECTION AA

END VIEW

Drawing Name	MANHOLE - TRAFFIC RATED - 6x8x7				
Drawing #	UG-TYP-VLT-3642	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 5 of 5		Approval Date: 4/15/2022	1

CITY LIGHT & POWER

BILL OF MATERIALS			
ITEM	DESCRIPTION	MANUFACTUER	CATALOG NO.
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9	Stanchion, 24”	Underground Devices	CR24-B
10	Stanchion, 36”	Underground Devices	CR36-B
11	Support hook, heavy duty, Saddle	Underground Devices	3HDS
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14	Rack arm, heavy duty, 11"	Underground Devices	RA11
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17	Rod, 10’ Ground 3/4” Diameter Cooper Clad	Hubbell	C613440
18	Wire, 4/0 Bare 7 Strand Copper	N/A	N/A
19	Exothermic Connection, Cadweld	Erico	TAC2Q2Q
20	Exothermic Connection, Cadweld	Erico	GTC182Q

Notes:

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B. The entire run of abandon cable shall be identified, cut and tagged as described. No manhole or vault shall be left with unidentified abandon cables or equipment.

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D. Vaults are designed to meet ASTM C858 and ACI 318 with AASHTO HS-20 load rating

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H. Crane required for installation

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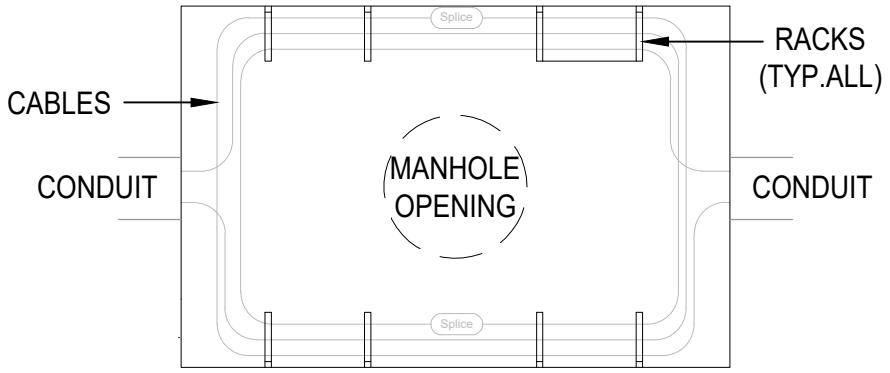
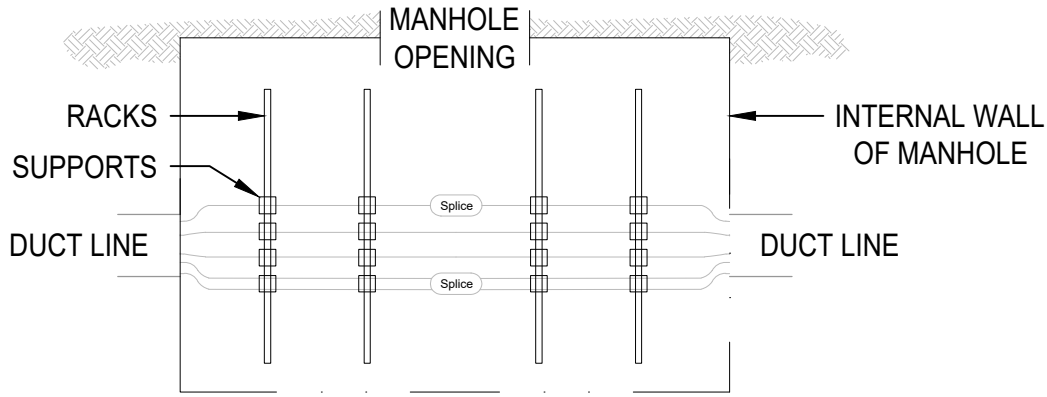
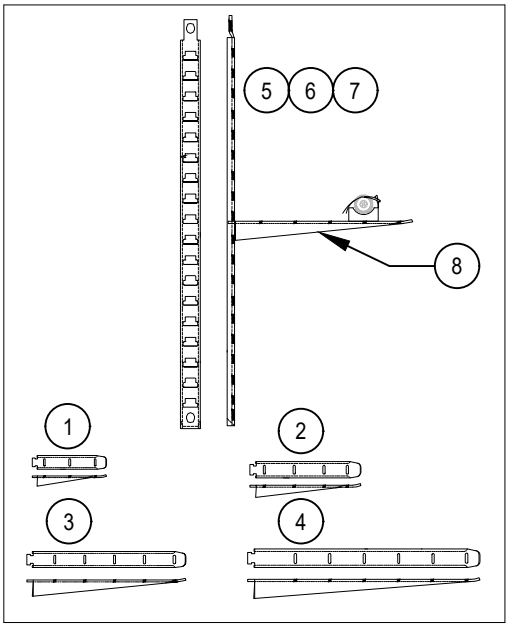


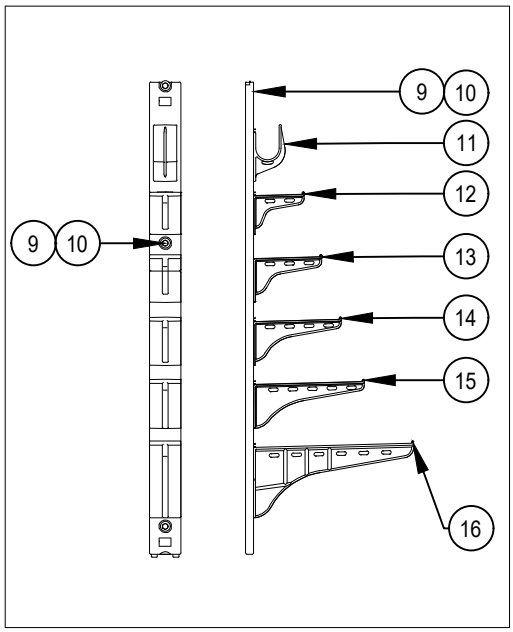
TOP VIEW
PLAN VIEW



SIDE VIEW
PLAN VIEW

DETAIL 1: SETTING DEPTHS AND CABLE PLACEMENTS



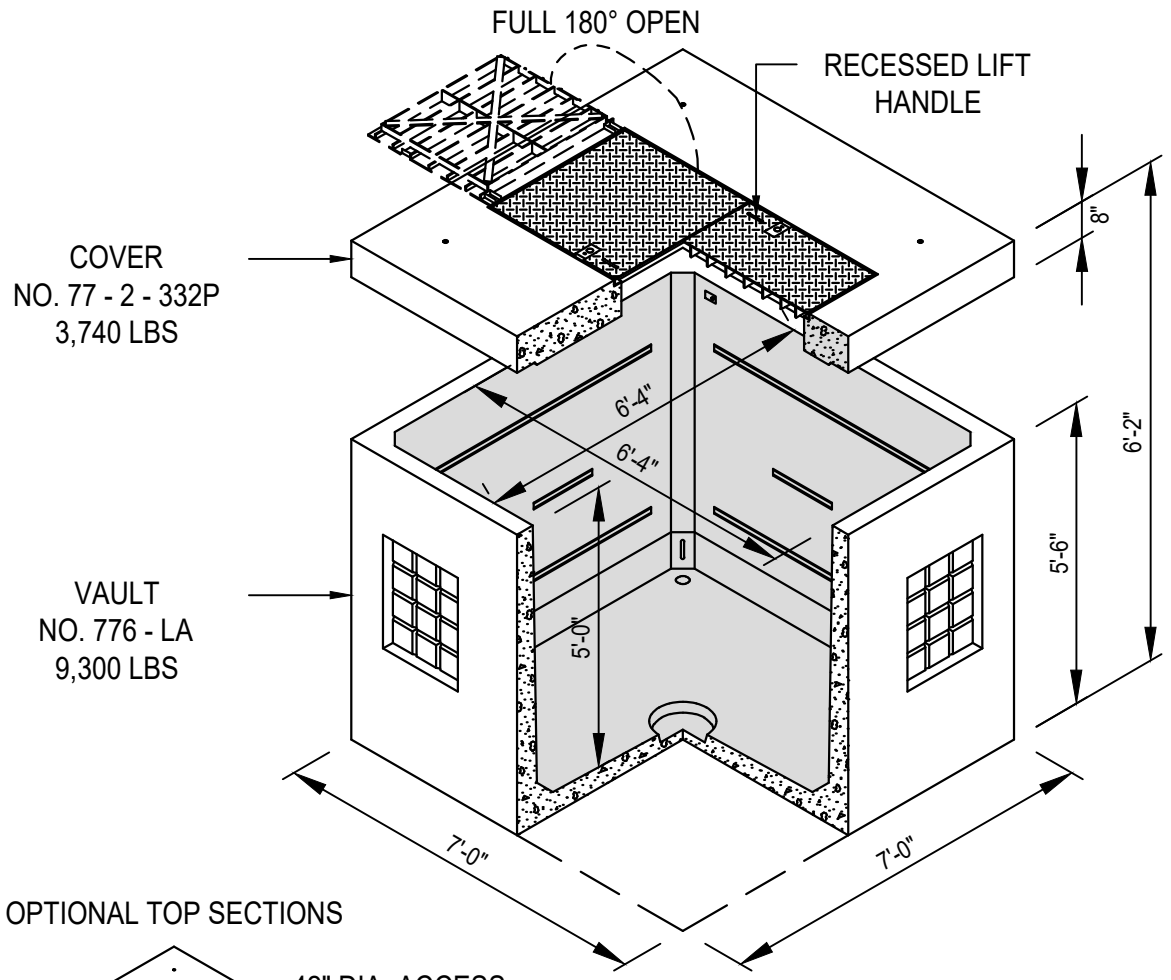


DETAIL 2: METAL RACKS AND SUPPORTS DIAGRAM

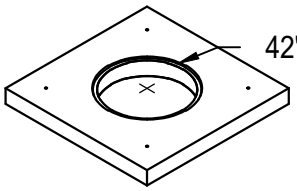
DETAIL 3: COMPOSITE RACKS AND SUPPORTS DIAGRAM

Drawing Name	MANHOLE - INCIDENTAL TRAFFIC RATED - 7x7x6			
Drawing #	UG-TYP-VLT-3650	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards		Sheet 3 of 5	Approval Date: 4/15/2022	

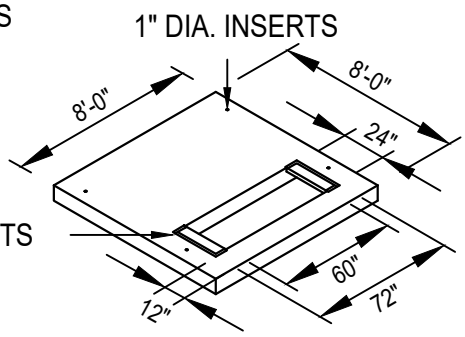
CITY LIGHT & POWER



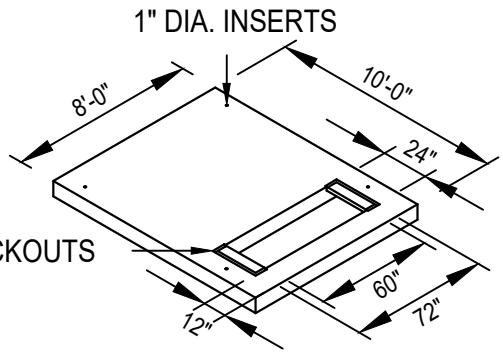
OPTIONAL TOP SECTIONS



ROUND ACCESS
OPENING
NO. 77 - 42C
4,150 LBS



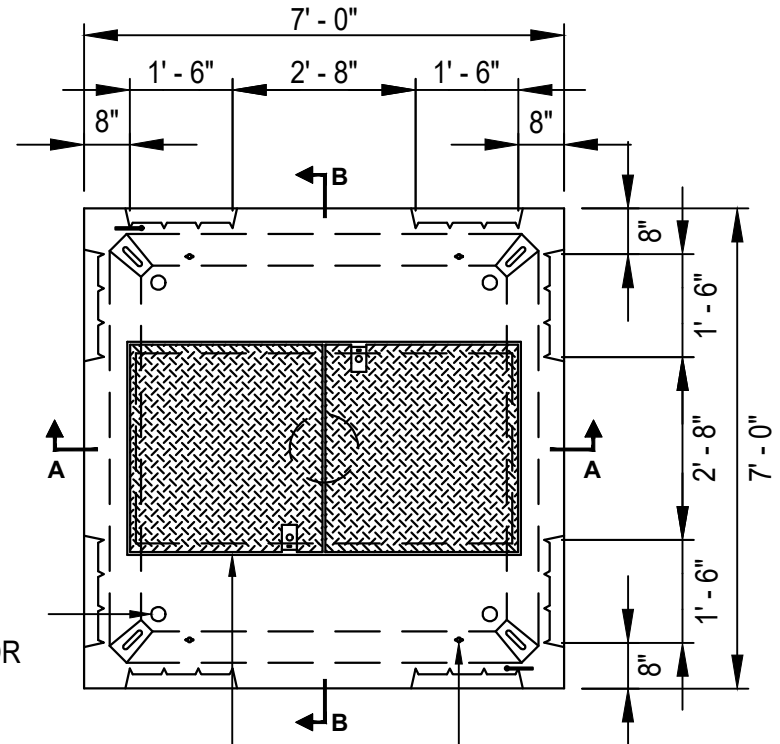
PADMOUNT TOP
NO. 77 - 88 - 2460
PSE CODE #7918001
(BASE & COVER ASSEMBLY)
4,900 LBS



PADMOUNT TOP
NO. 77 - 810 - 2460
PSE CODE #7918000
(BASE & COVER ASSEMBLY)
6,500 LBS

Drawing Name	MANHOLE - INCIDENTAL TRAFFIC RATED - 7x7x6			
Drawing #	UG-TYP-VLT-3650	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards		Sheet 4 of 5	Approval Date: 4/15/2022	

CITY LIGHT & POWER

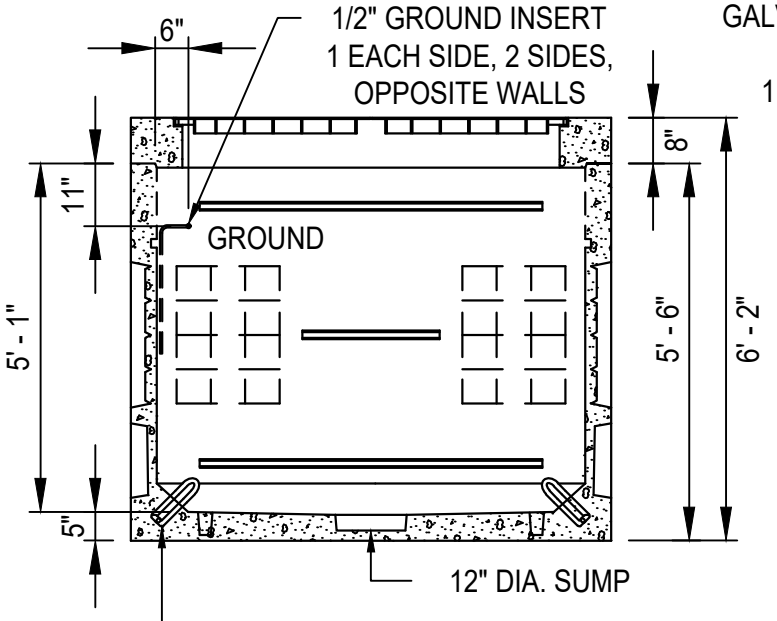


2 1/2" DIA. GROUND ROD KNOCKOUT 4 PLACES IN FLOOR

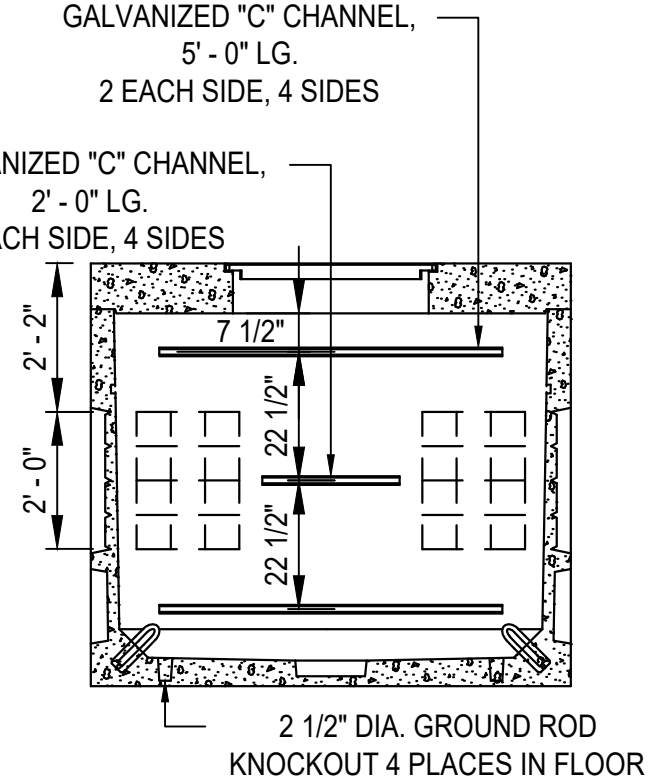
SPRING ASSISTED GALVANIZED DIAMOND PLATE COVER WITH LOCKING LATCH

PLAN VIEW

3/4" DIA. LIFT INSERTS 4 PLACES IN TOP WITH U.V. CAPS



SECTION AA



SECTION BB

Drawing Name	MANHOLE - INCIDENTAL TRAFFIC RATED - 7x7x6				
Drawing #	UG-TYP-VLT-3650	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 5 of 5		Approval Date: 4/15/2022	1

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A. This standard shall be used when abandoning cables in a manhole.

B. The entire run of abandon cable shall be identified, cut and tagged as described. No manhole or vault shall be left with unidentified abandon cables or equipment.

C. Concrete shall be minimum 28 day compressive strength of 5,000 psi

D. Vaults are designed to meet ASTM C858 and ACI 318 with AASHTO HS-20 load rating

E. Steel reinforcement rods to be ASTM A-615 Grade 60

F. An exothermically welded ground grid ring of 4/0 SDBC cable to be installed around perimeter of vault and will be connected to two 3/4” x 10' copper clad ground rods.

G. All joints to be sealed with 1" dia. butyl rubber or equivalent

H. Crane required for installation

Manhole Setting Depths:

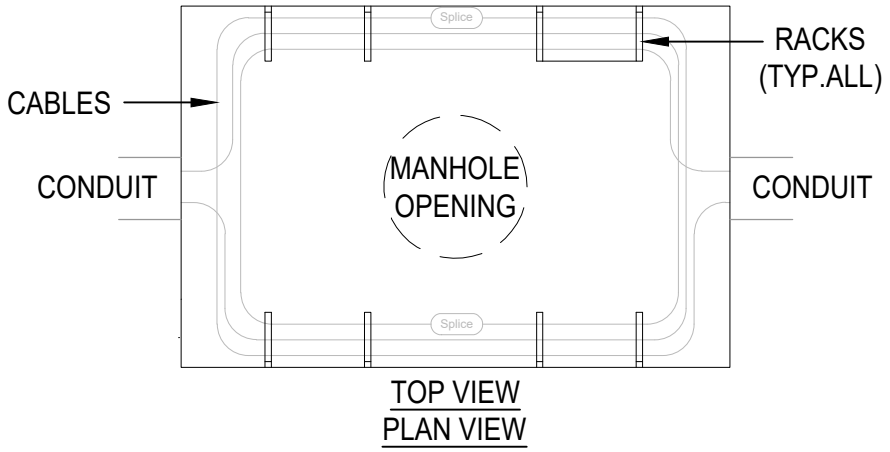
Manhole cover depth should be measured from final grade elevation to the exterior of the manhole roof/cover. Earth cover requirements for line manholes are dependent on traffic type, and should be:

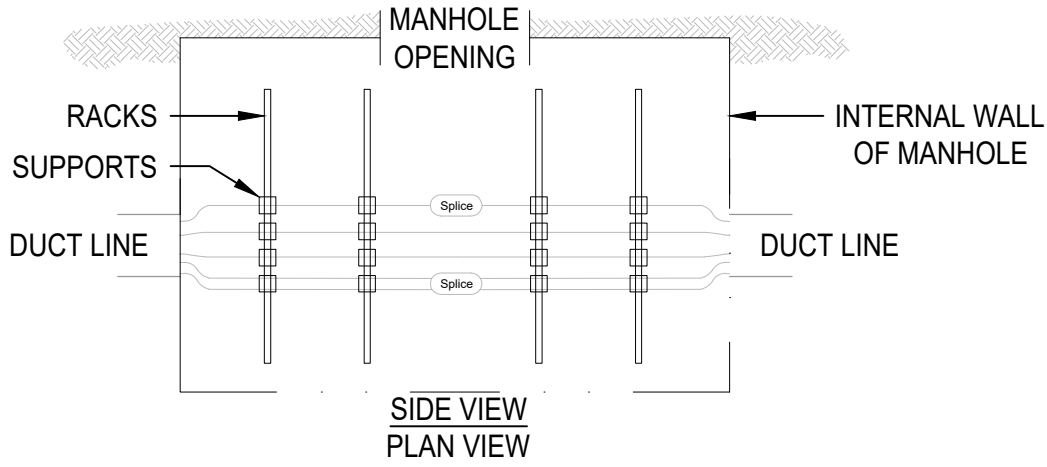
- Areas subject to pedestrian traffic (ie. sidewalks and grass):1 foot
- Areas subject to vehicular traffic (ie. roads, alleys, parking lots):2 feet

Any areas subject to grade change should be graded prior to installing a manhole

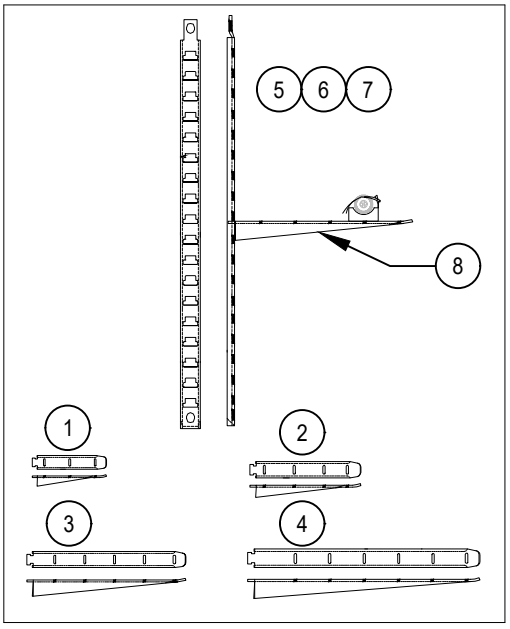
Cable Racking:

Rack cables beginning with communications at the top, 15KV cables in the middle, and 35KV cables toward the bottom. Supply cables will always be racked below any communications cables, and care should be taken to avoid unnecessary cable crossings. All cables in the manhole shall be permanently identified and tagged. A minimum vertical separation of 12 in. must be maintained between supply cables and between communication and supply. In addition, a minimum horizontal clearance of 9 in. must be maintained between supply cables supported on the same cable support hook.

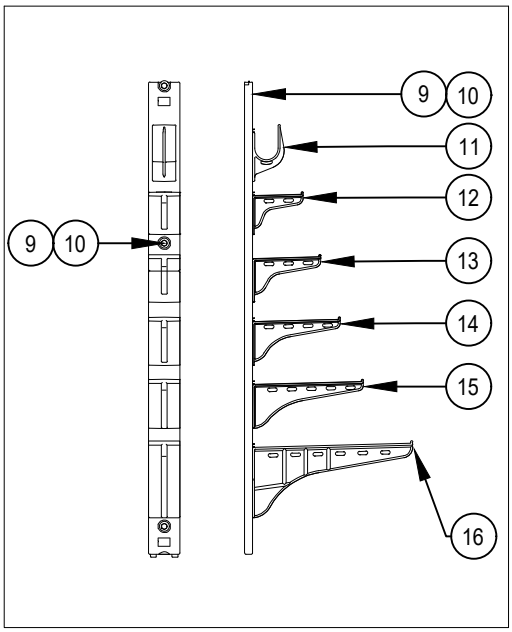




DETAIL 1: SETTING DEPTHS AND CABLE PLACEMENTS

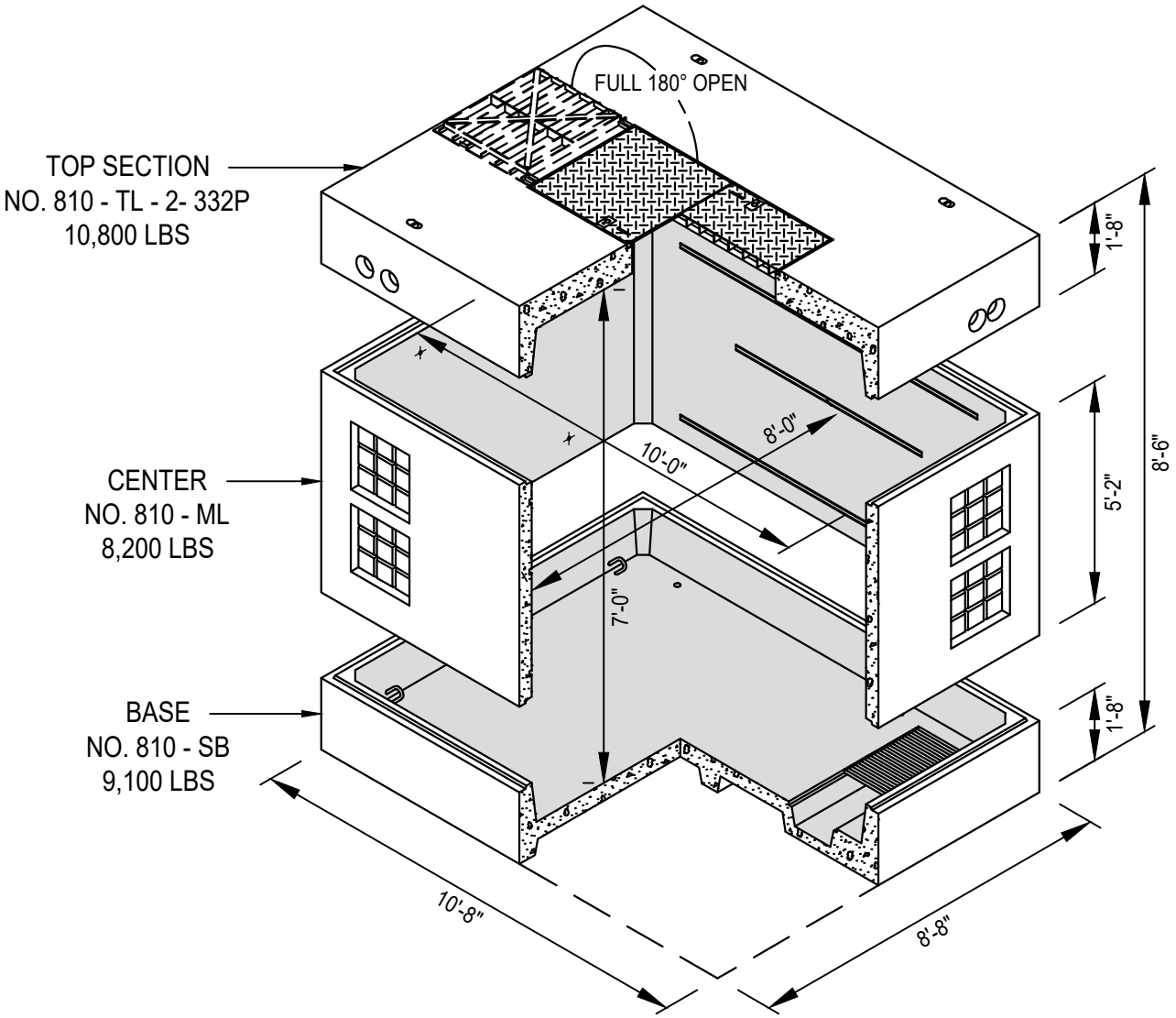


DETAIL 2: METAL RACKS AND SUPPORTS DIAGRAM



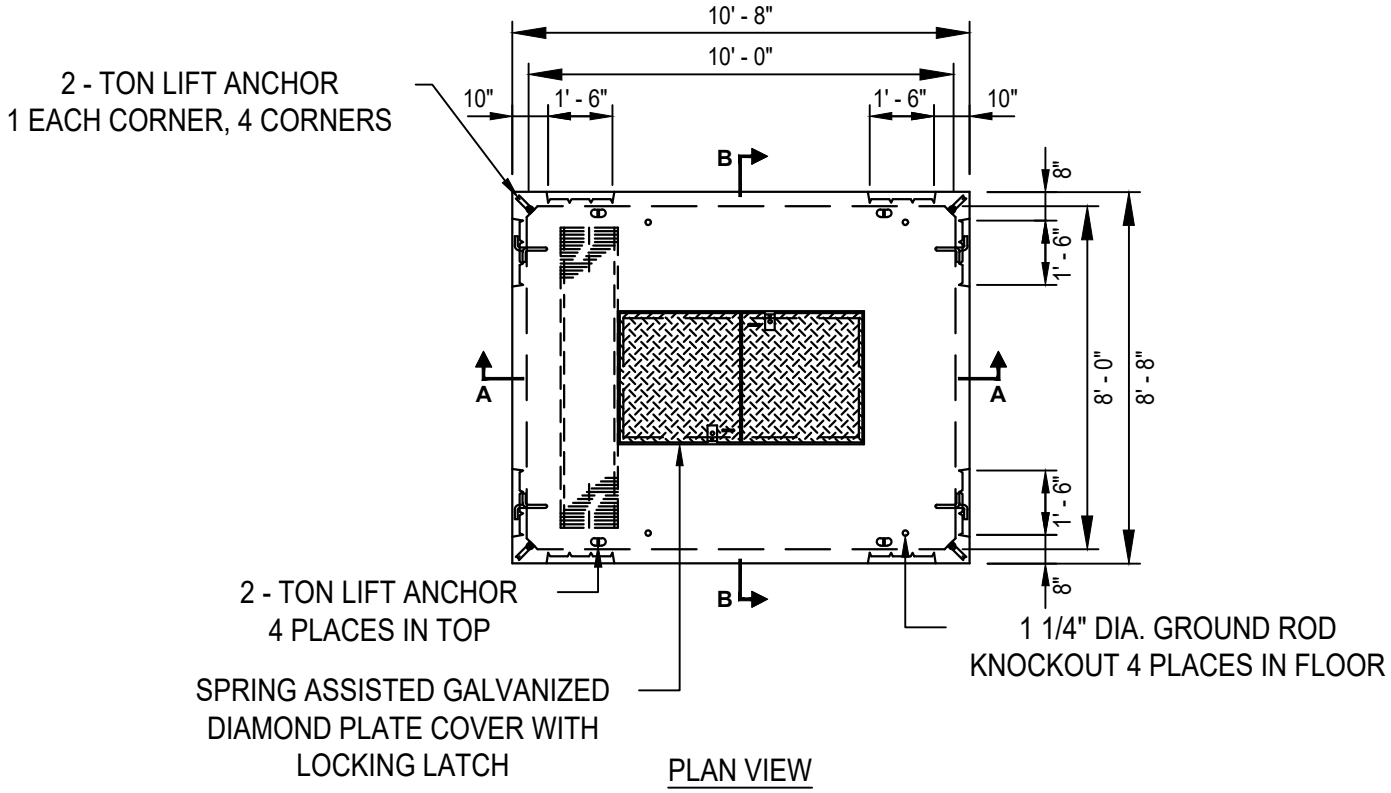
DETAIL 3: COMPOSITE RACKS AND SUPPORTS DIAGRAM

Drawing Name	MANHOLE - INCIDENTAL TRAFFIC RATED - 10x8x7			
Drawing #	UG-TYP-VLT-3651	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards	Sheet 3 of 5	Approval Date: 4/15/2022		

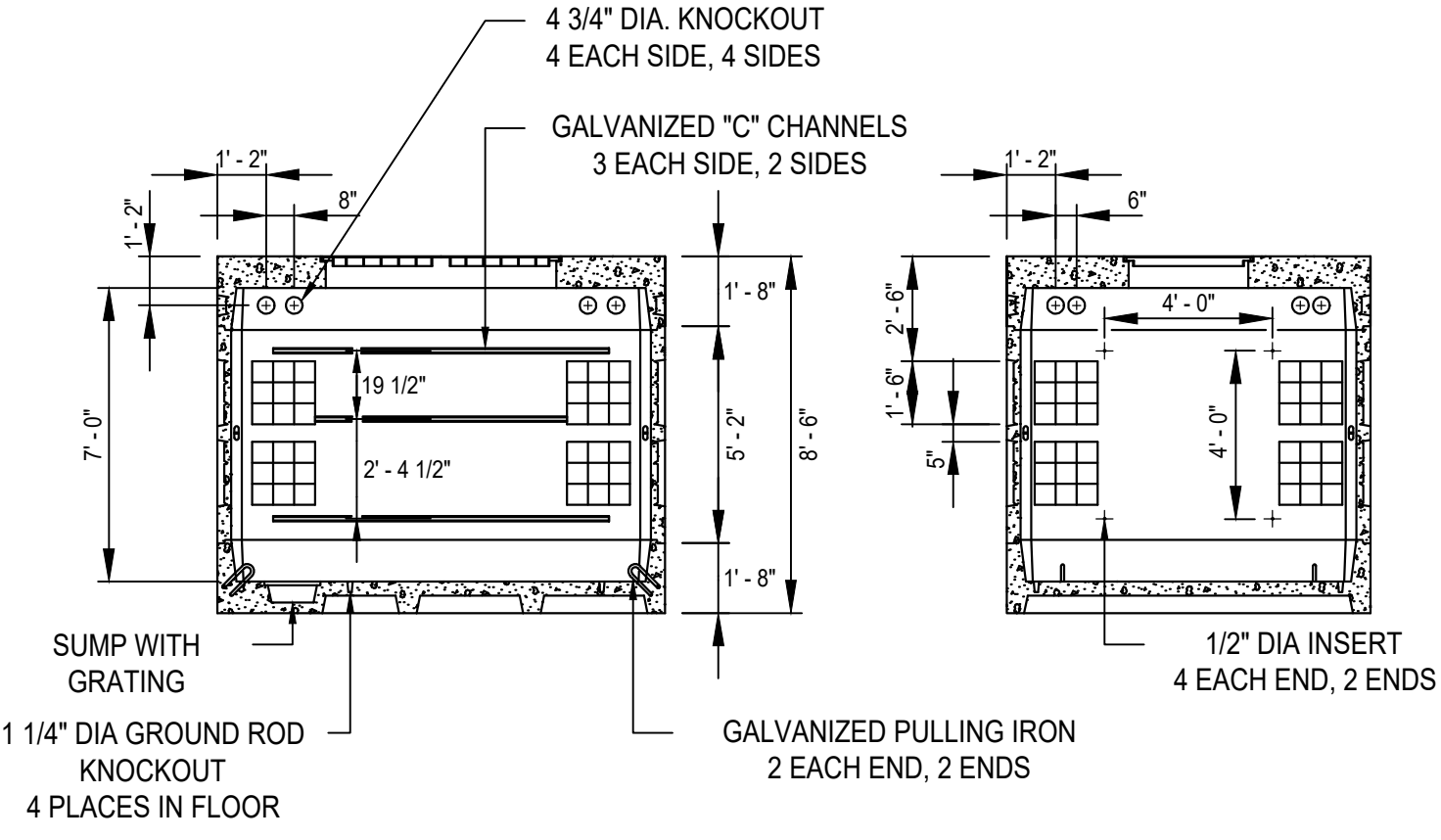


Drawing Name	MANHOLE - INCIDENTAL TRAFFIC RATED - 10x8x7				
Drawing #	UG-TYP-VLT-3651	Scale : N.T.S.		Approved By: APS	Rev 1
City Light & Power Construction Detail Standards		Sheet 4 of 5		Approval Date: 4/15/2022	

CITY LIGHT & POWER



PLAN VIEW



SECTION AA

SECTION BB

Drawing Name	MANHOLE - INCIDENTAL TRAFFIC RATED - 10x8x7				
Drawing #	UG-TYP-VLT-3651	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 5 of 5		Approval Date: 4/15/2022	1

CITY LIGHT & POWER

Notes:

A. Tier 8, rated 12,000 lbs.

B. Approximate weight (with covers) is approximately 1,500 lbs., approximate weight (box only) is 800 lbs.

C. Required 6” base layer of pea gravel or crushed stone to allow water drainage

D. Do not loop cables in box

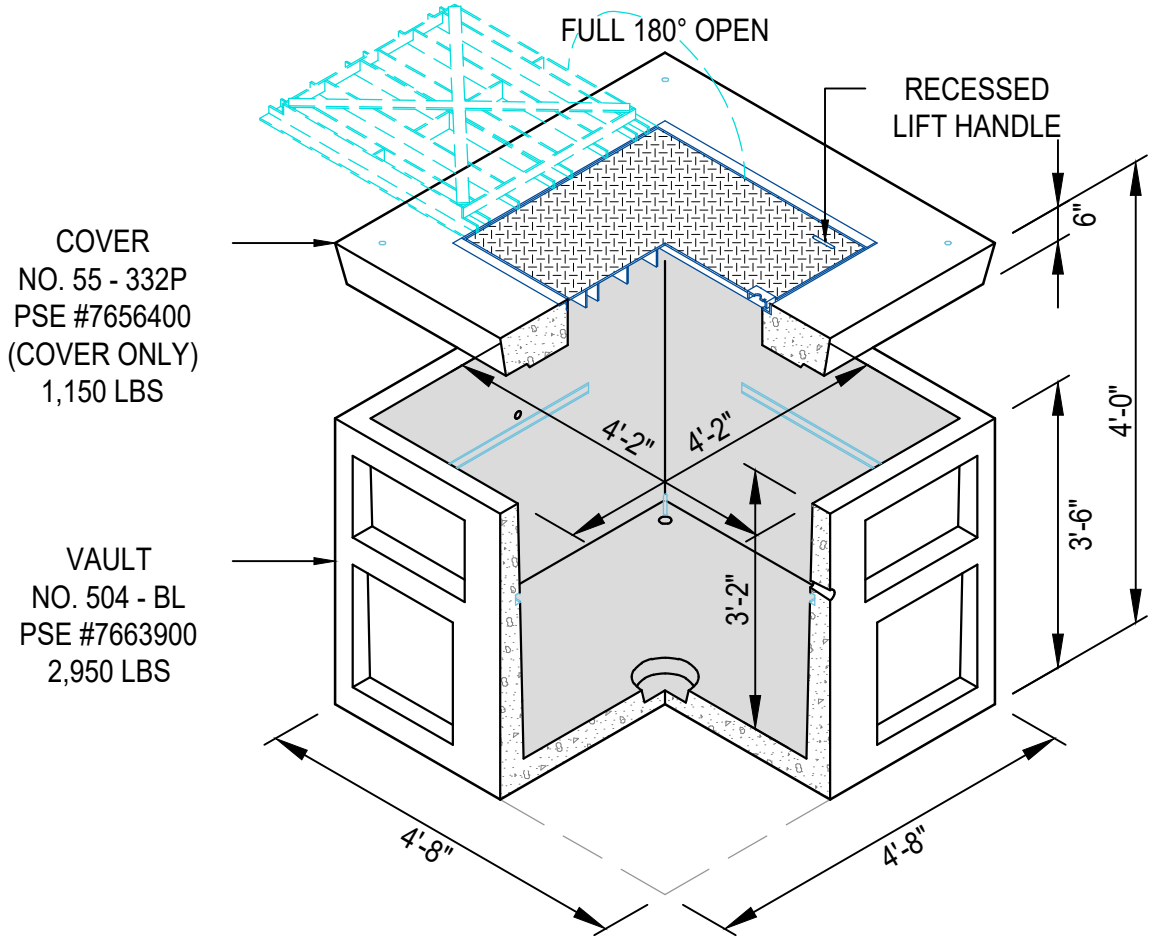
E. Only install directional bore duct into box walls

F. Approximate weight (with covers) is approximately 925 lbs.; approximate weight (box only) is 535 lbs.

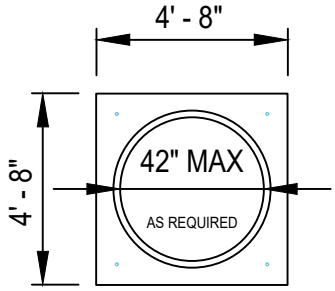
G. Approximate weight (with covers) is approximately 630 lbs.; approximate weight (box only) is 375 lbs.

H. Tier 22, 33,750 lbs. rated

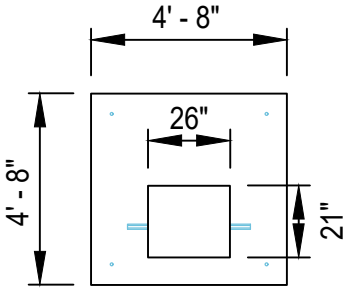
I. Approximate weight (with covers) is approximately 540 lbs., approximate weight (box only) is 370 lbs.



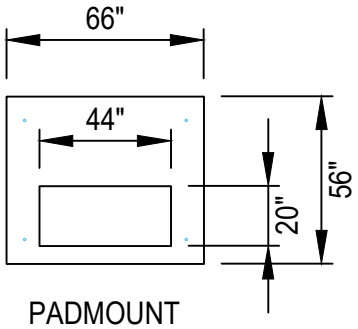
OPTIONAL TOP SECTIONS



ROUND ACCESS
NO. 55 - 42C
(SHOWN)
766 LBS



PADMOUNT
NO. 55 - 2126
1,500 LBS
PSE CODE #7658500

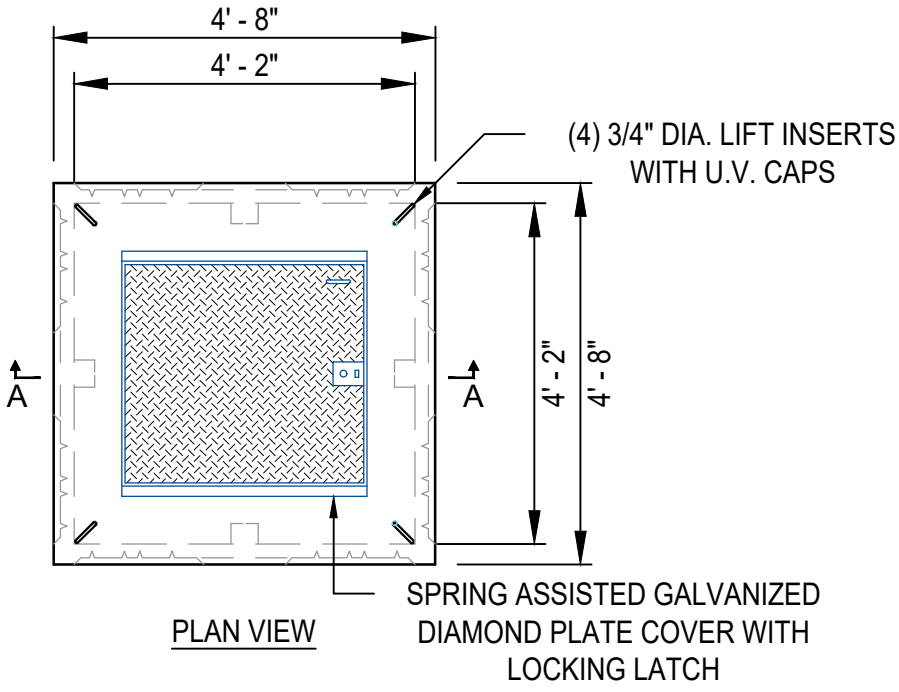


PADMOUNT
NO. 55 - 2044
1,550 LBS
PSE CODE #7655200

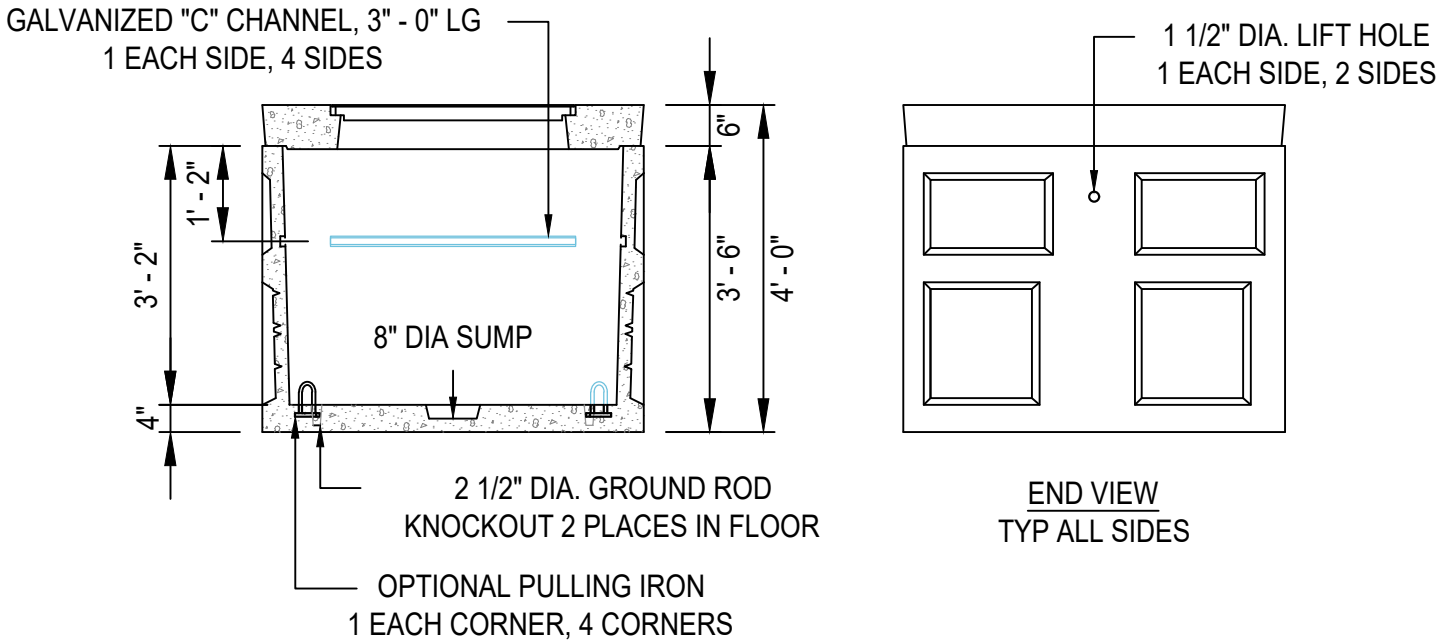
48"x78" TIER 8 15KV SPLICE BOX FOR USE WITH 6" DUCT
SEE NOTES A, C - F

Drawing Name	HANDHOLE - 4x4x3			
Drawing #	UG-TYP-VLT-3660	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards		Sheet 2 of 3	Approval Date: 4/15/2022	

CITY LIGHT & POWER



PLAN VIEW



END VIEW
TYP ALL SIDES

SECTION AA

30" X 60" TIER 8 15KV SPLICE BOX FOR USE
WITH 4" DUCT
SEE NOTES A, C - E, G

Drawing Name	HANDHOLE - 4x4x3				
Drawing #	UG-TYP-VLT-3660	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 3 of 3		Approval Date: 4/15/2022	1

CITY LIGHT & POWER

Notes:

A. Tier 8, rated 12,000 lbs.

B. Approximate weight (with covers) is approximately 1,500 lbs., approximate weight (box only) is 800 lbs.

C. Required 6” base layer of pea gravel or crushed stone to allow water drainage

D. Do not loop cables in box

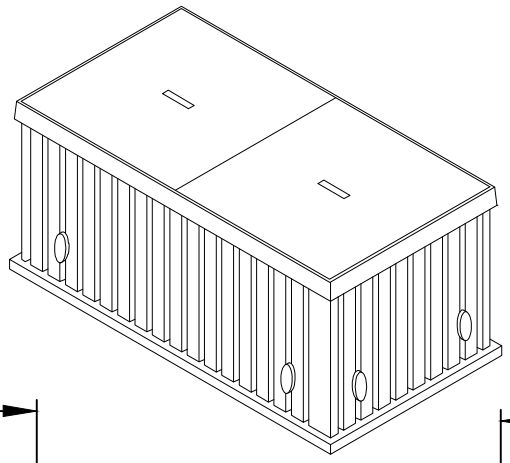
E. Only install directional bore duct into box walls

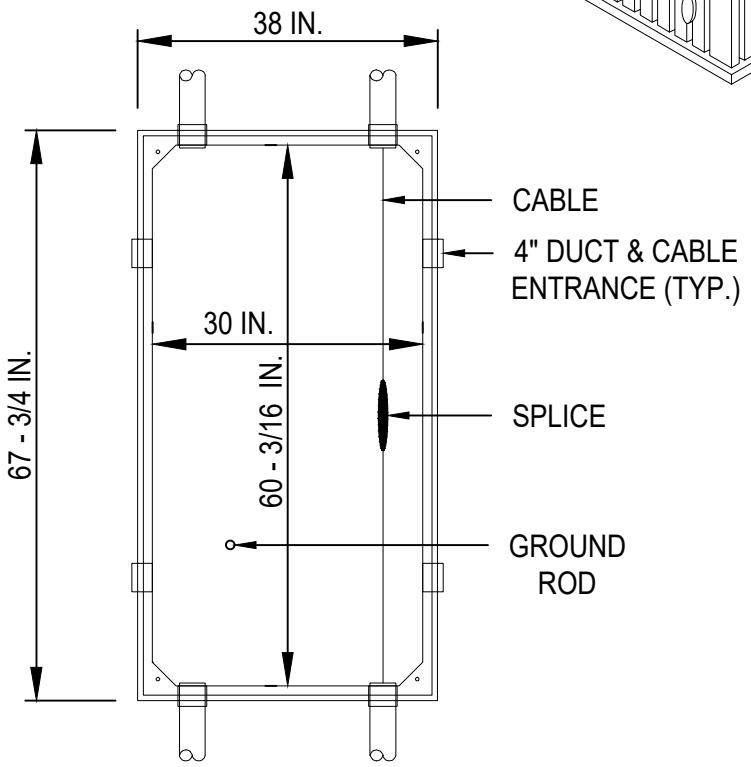
F. Approximate weight (with covers) is approximately 925 lbs.; approximate weight (box only) is 535 lbs.

G. Approximate weight (with covers) is approximately 630 lbs.; approximate weight (box only) is 375 lbs.

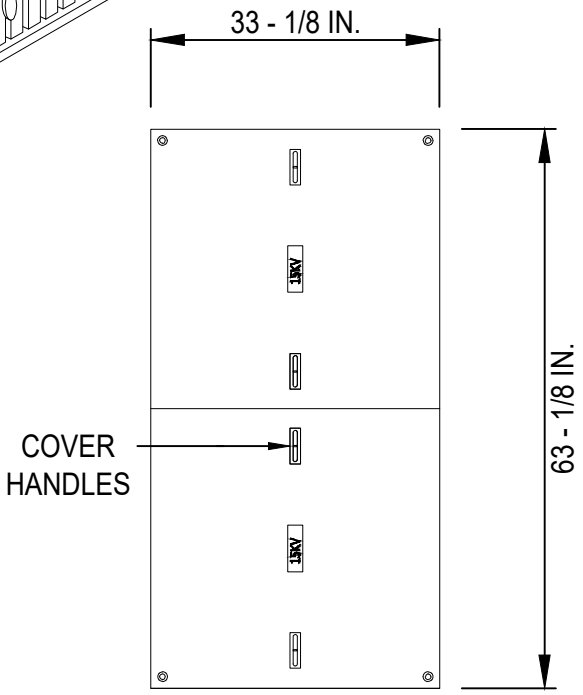
H. Tier 22, 33,750 lbs. rated

I. Approximate weight (with covers) is approximately 540 lbs., approximate weight (box only) is 370 lbs.

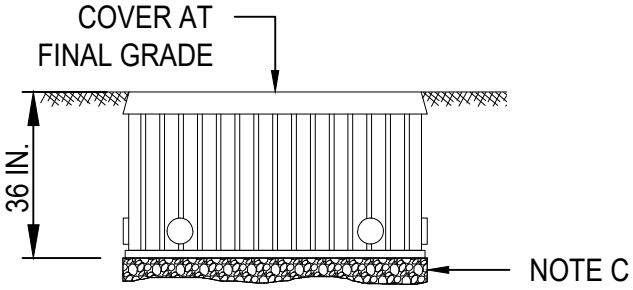




PLAN VIEW - BOX



PLAN VIEW - TWO PIECE COVER



ELEVATION VIEW

30"x60" TIER 8 15KV SPLICE BOX FOR USE WITH 4" DUCT

SEE NOTES A, C - E, G

Drawing Name	HANDHOLE - 5x2.5x3				
Drawing #	UG-TYP-VLT-3661	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 2 of 2		Approval Date: 4/15/2022	1

CITY LIGHT & POWER

Notes:

A. Tier 8, rated 12,000 lbs.

B. Approximate weight (with covers) is approximately 1,500 lbs., approximate weight (box only) is 800 lbs.

C. Required 6” base layer of pea gravel or crushed stone to allow water drainage

D. Do not loop cables in box

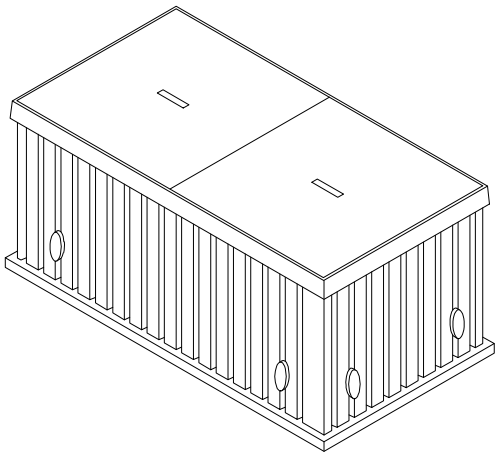
E. Only install directional bore duct into box walls

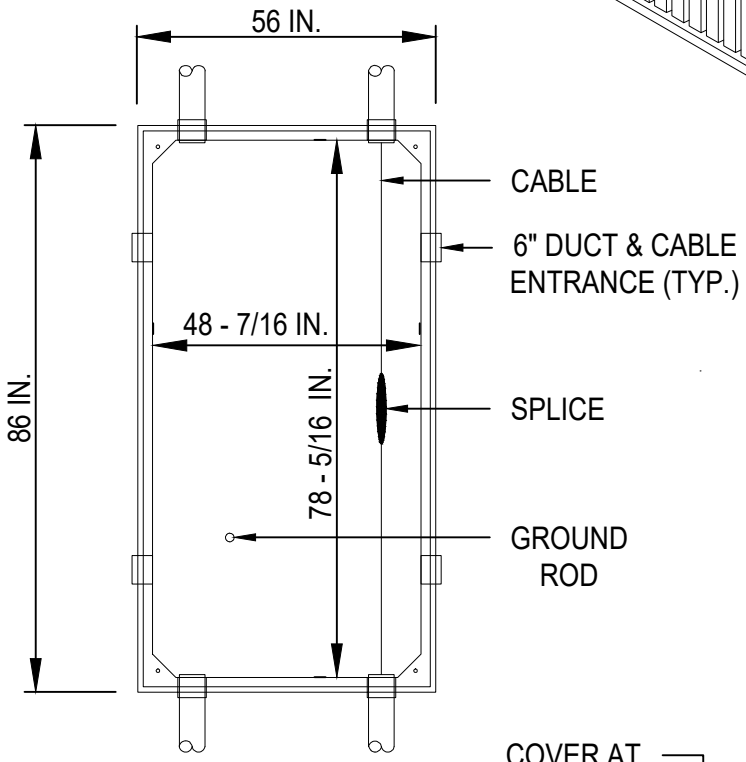
F. Approximate weight (with covers) is approximately 925 lbs.; approximate weight (box only) is 535 lbs.

G. Approximate weight (with covers) is approximately 630 lbs.; approximate weight (box only) is 375 lbs.

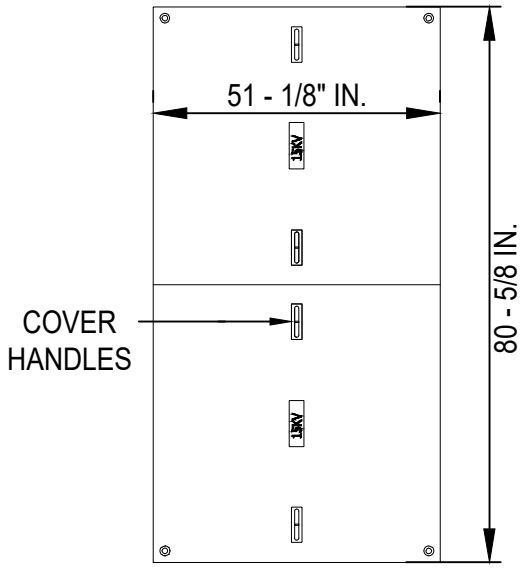
H. Tier 22, 33,750 lbs. rated

I. Approximate weight (with covers) is approximately 540 lbs., approximate weight (box only) is 370 lbs.

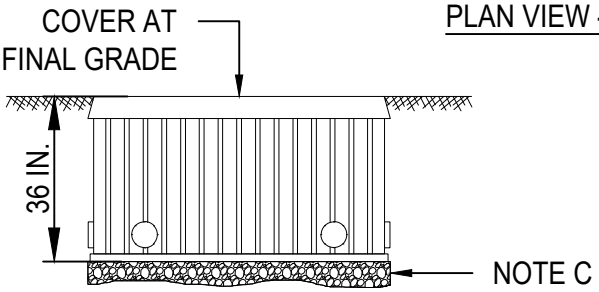




PLAN VIEW - BOX



PLAN VIEW - TWO PIECE COVER



ELEVATION VIEW

48"X78" TIER 8 15KV SPLICE BOX FOR USE WITH 6" DUCT
SEE NOTES A, C - F

Drawing Name	HANDHOLE - 6.5x4x3				
Drawing #	UG-TYP-VLT-3662	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 2 of 2		Approval Date: 4/15/2022	1

CITY LIGHT & POWER

Notes:

A. Tier 8, rated 12,000 lbs.

B. Approximate weight (with covers) is approximately 1,500 lbs., approximate weight (box only) is 800 lbs.

C. Required 6” base layer of pea gravel or crushed stone to allow water drainage

D. Do not loop cables in box

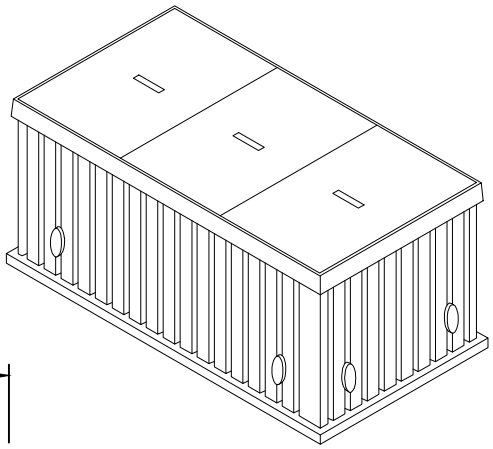
E. Only install directional bore duct into box walls

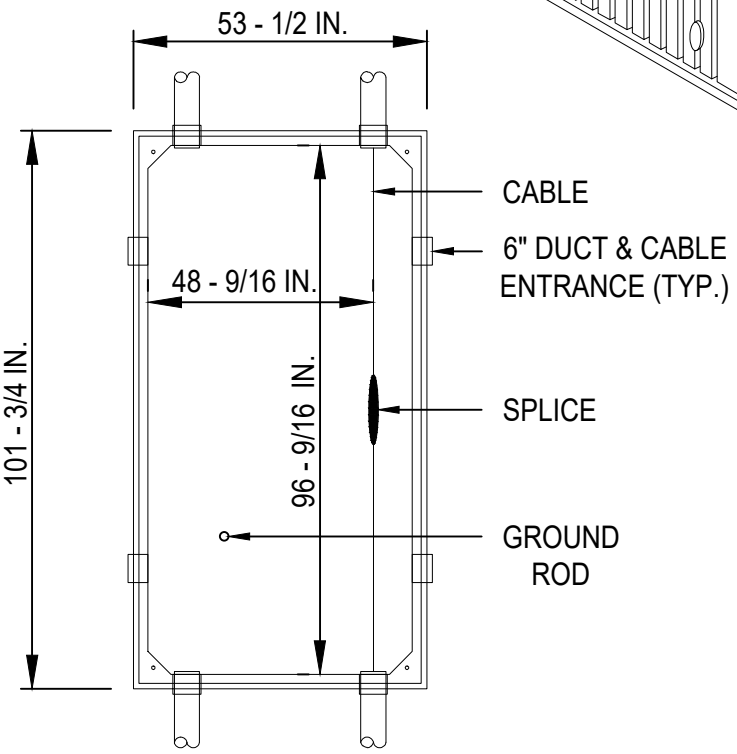
F. Approximate weight (with covers) is approximately 925 lbs.; approximate weight (box only) is 535 lbs.

G. Approximate weight (with covers) is approximately 630 lbs.; approximate weight (box only) is 375 lbs.

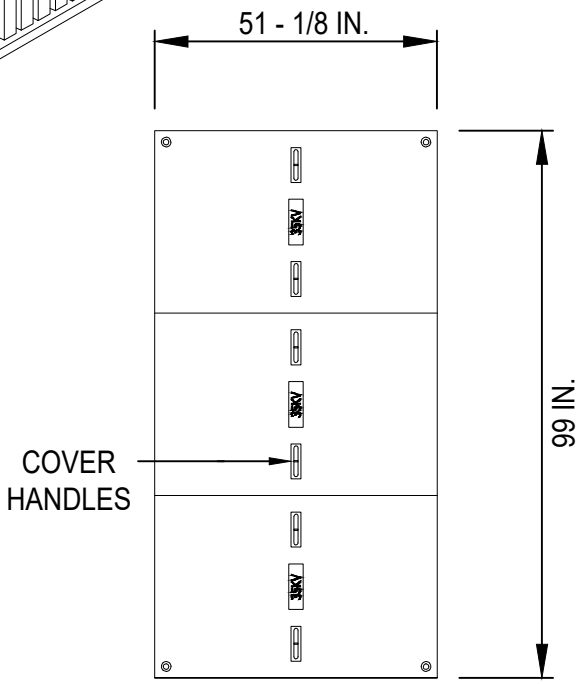
H. Tier 22, 33,750 lbs. rated

I. Approximate weight (with covers) is approximately 540 lbs., approximate weight (box only) is 370 lbs.

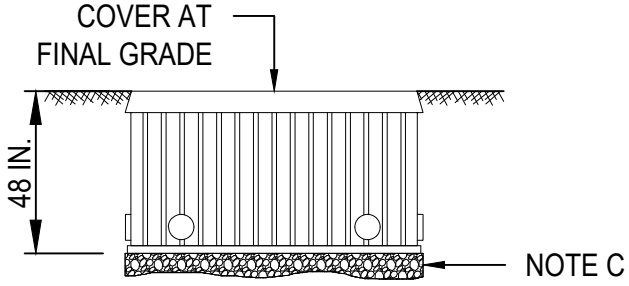




PLAN VIEW - BOX



PLAN VIEW - THREE PIECE COVER



ELEVATION VIEW

35KV SPLICE BOX 48"X96" TIER 8
SEE NOTES A - E

Drawing Name	HANDHOLE - 8x8x4				
Drawing #	UG-TYP-VLT-3663	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 2 of 2		Approval Date: 4/15/2022	1

CITY LIGHT & POWER

APPENDIX B: OVERHEAD SERVICE CONNECTION CONSTRUCTION STANDARDS

The following section of the overhead service connection requirements will apply to all CLP overhead electrical distribution systems. All construction will be required to meet CLP and Industry Standards.

STANDARDS DRAWING NUMBER	DESCRIPTION
OH-15KV-POL-2011	TWO-PHASE TANGENT HORIZONTAL
OH-15KV-POL-2012	TWO-PHASE DEADEND HORIZONTAL
OH-15KV-POL-2021	TWO-PHASE TAP FROM 3-PHASE LINE
OH-15KV-POL-2030	THREE-PHASE DOUBLE DEADEND HORIZONTAL
OH-15KV-POL-2031	THREE-PHASE DOUBLE DEADEND VERTICAL
OH-15KV-POL-2040	THREE-PHASE HEAVY ANGLE VERTICAL
OH-15KV-POL-2050	THREE-PHASE JUNCTION HORIZONTAL
OH-15KV-POL-2060	THREE-PHASE TANGENT HORIZONTAL
OH-15KV-POL-2061	THREE-PHASE TANGENT VERTICAL
OH-15KV-RSR-2090	THREE-PHASE PRIMARY RISER TRANSITION - HORIZONTAL
OH-15KV-RSR-2091	THREE-PHASE RISER TRANSITION - HORIZONTAL
OH-15KV-RSR-2093	TWO-PHASE RISER TRANSITION - HORIZONTAL
OH-15KV-RSR-2100	THREE-PHASE DOUBLE PRIMARY RISER TRANSITION
OH-15KV-XFR-2121	TWO-PHASE TRANSFORMER
OH-15KV-XFR-2140	THREE-PHASE TRANSFORMERS - CLUSTER MOUNTED
OH-TYP-ARR-2200	DISTRIBUTION LINE ARRESTERS
OH-TYP-CBL-2530	GENERAL OVERHEAD CABLE INFORMATION
OH-TYP-CBL-2531	GENERAL OVERHEAD CABLE HARDWARE
OH-TYP-FIN-2553	OVERHEAD MOUNTED FAULT INDICATORS
OH-TYP-FUS-2551	CUTOUTS
OH-TYP-GND-2560	GENERAL OVERHEAD GROUNDING
OH-TYP-GND-2565	POLE GROUNDING
OH-TYP-GUY-2600	GENERAL GUYING INFORMATION
OH-TYP-GUY-2605	DOWN GUY
OH-TYP-GUY-2607	SPAN GUY
OH-TYP-GUY-2608	PUSH BRACE
OH-TYP-INS-2554	INSULATORS
OH-TYP-POL-2640	POLES
OH-TYP-SAG-2650	GENERAL SAG TENSION INFORMATION
OH-TYP-SAG-2660	STRINGING TABLES - ACSR

STANDARDS DRAWING NUMBER	DESCRIPTION
OH-TYP-SAG-2661	STRINGING TABLES - ACSR SLACK SPAN
OH-TYP-SAG-2690	STRINGING TABLES - TRIPLEX AND QUADPLEX CABLE
OH-TYP-XRM-2645	CROSSARMS

BILL OF MATERIALS

Item	Material Description	Mfg.	Catalog No.	Quantity per Sheet		
				Sh.3	Sh.4	Sh.5
1	Arrester, 15kV, heavy duty	See OH-15KV-ARR-2200_Distribution Line Arresters		3	3	-
2	Arrester, surge,10kV, MCOV	See OH-15KV-ARR-2200_Distribution Line Arresters		-	-	3
3	Bolt, 3/4 in., D/A, length as required	Hubbell	Various	2	-	-
4	Bolt, 3/8 in., X 4-1/2 in.	Hubbell	863412	-	-	2
5	Bolt, 5/8 in., D/A, length as required	Hubbell	Various	6	6	5
6	Brace, flat, steel, 30 in.	Hubbell	7132	-	-	2
7	Bracket, NEMA B bracket for mounting cutouts, surge arresters, terminations	Hubbell	PSC2061042	6	9	9
8	Clamp, side-opening, spring-loaded, straight line deadend	MacLean	Various	3	-	-
9	Crossarm, 10 ft., fiberglass, dead-end	PUPI	DA3000120E4B9X2	1	-	-
10	Crossarm, 10 ft., fiberglass, tangent	PUPI	TB22001200032	2	3	2
11	Crossarm, 10 ft., wood	Various	Various	3	3	1
12	Cutout, 15kV, 100A, load break	See OH-TYP-FUS-2551_Cutouts		3	3	3
13	Guard, wildlife	See OH-TYP-ANL-2510 Wildlife Protection		3	3	3
14	Insulator, 15kV, pin type, ANSI Class 55-4 (polymer)	See OH-TYP-INS-2554_Insulators		-	3	3
15	Insulator, 15kV, suspension (polymer)	See OH-TYP-INS-2554_Insulators		3	-	-
16	Nut, 3/4 in., oval eye	Hubbell	6503	1	-	-
17	Nut, 5/8 in.,oval eye	Hubbell	6502	2	3	-
18	Pin, 3/4 in., steel	Hubbell	4705P	-	3	3
19	Riser shield	See UG-TYP-RSR-3621-Riser Uguards		As required		
20	Screw, lag, pilot point, 1/2 in. X 4 in.	Hubbell	508754	-	-	1
21	Shield, duct	Electrical Materials Company	27-1 Black	1	1	1
22	Strain, 12 in., fiberglass	Hubbell	GS16012CPSC	1	-	-
23	Support, cable positioner	Hubbell	CCS820	3	3	3
24	Termination, 15kV	3M	Various	3	3	3
25	Tubing, wildlife (Stinger cover)	See OH-TYP-ANL-2510_Wildlife Protection		As required		
26	Washer, 2-1/4 in. sq., curved	Hubbell	681012	6	6	5
27	Washer, 2-1/4 in. sq., flat	Hubbell	6813	-	-	1
28	Washer, 3 in. sq., curved	Hubbell	682212	2	-	-
29	Wedge Tap and Stirrup Assembly	Ampact	600464	3	3	3
30	Clamp, Hot Line Tap	Hubbell	P1520AA	3	3	3

Drawing Name	THREE-PHASE RISER TRANSITION - HORIZONTAL			
Drawing #	OH-15KV-RSR-2091	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards	Sheet 1 of 5	Approval Date: 03/10/2021		

CITY LIGHT & POWER

Notes:

A. Use tap wire equivalent to the load rating of the UG cable from terminations to disconnects and from disconnects to primary.

B. Neutral, triplex or top wire of open wire secondary.

C. Install #6 soft drawn, solid, copper wire from system neutral to driven ground. If the pole has arresters, reclosers, switches, or transformers attached to it, install #4 soft drawn, solid, covered copper wire instead.

D. Install 1/0 soft drawn, covered copper wire alongside of UG cables and secure with 7 in. black cable ties approximately every 8 inches. Connect one end to the concentric neutrals and surge arrester ground lead as shown in Detail 1. Connect the other end to the system neutral. A separate connection must be made from each wire to the system neutral. Substituting a concentric neutral or tape shield ground is also acceptable.

E. Use #6 soft drawn covered copper wire for primary arrester taps.

F. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

G. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

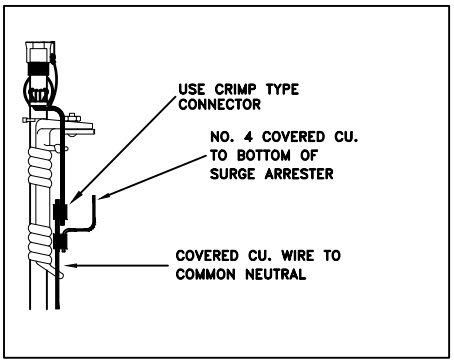
H. All tap wire and surge arrester primary taps must be covered with elastomer tubing (stinger cover).

I. Wildlife guards installed at all terminations.

J. Double nut all D/A bolts.

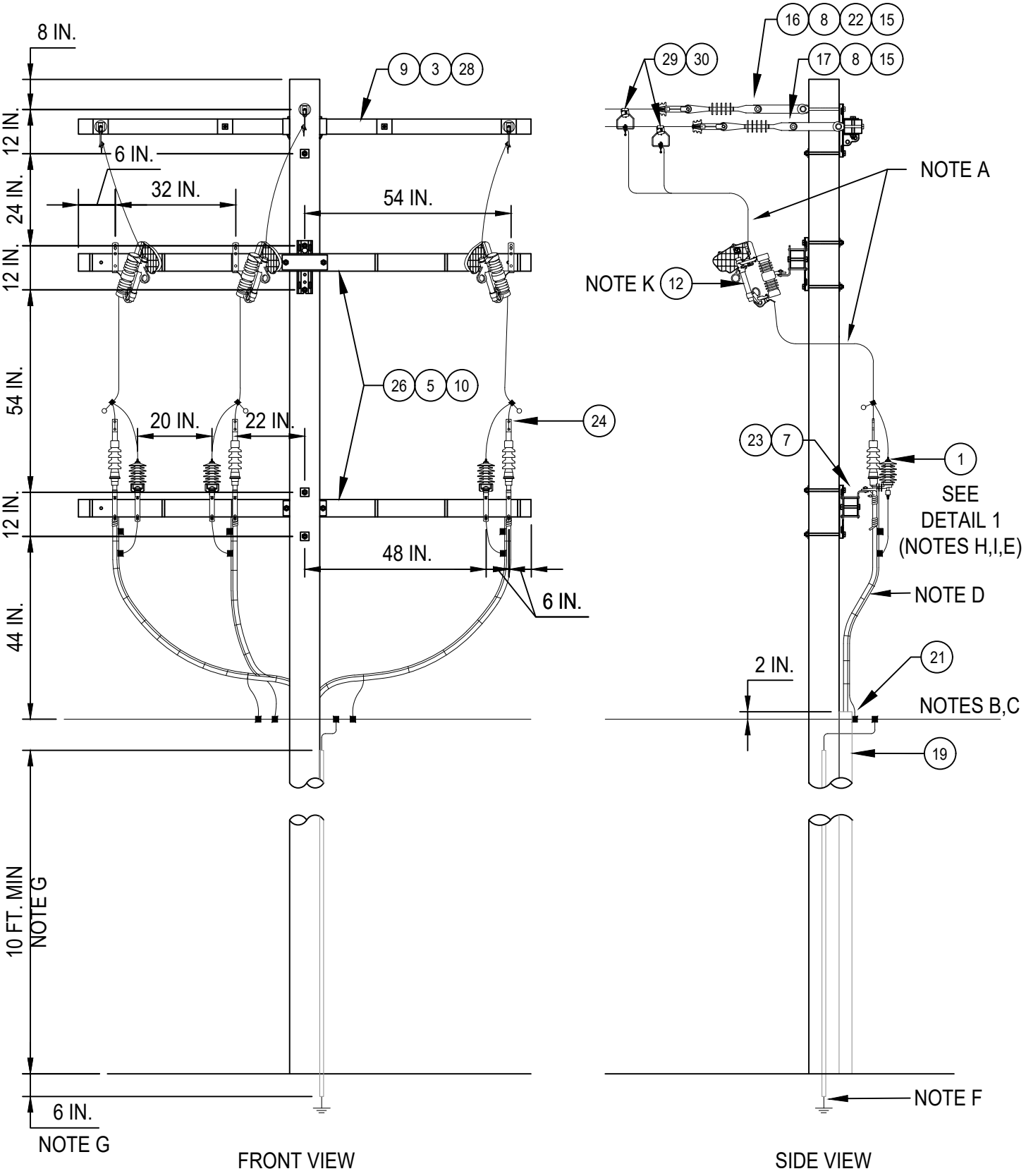
K. Rotate cutout frame slightly towards pole. This will expel the fuse link away from the operator in the event that the fuse blows.

L. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.



DETAIL 1: SURGE ARRESTER GROUNDING

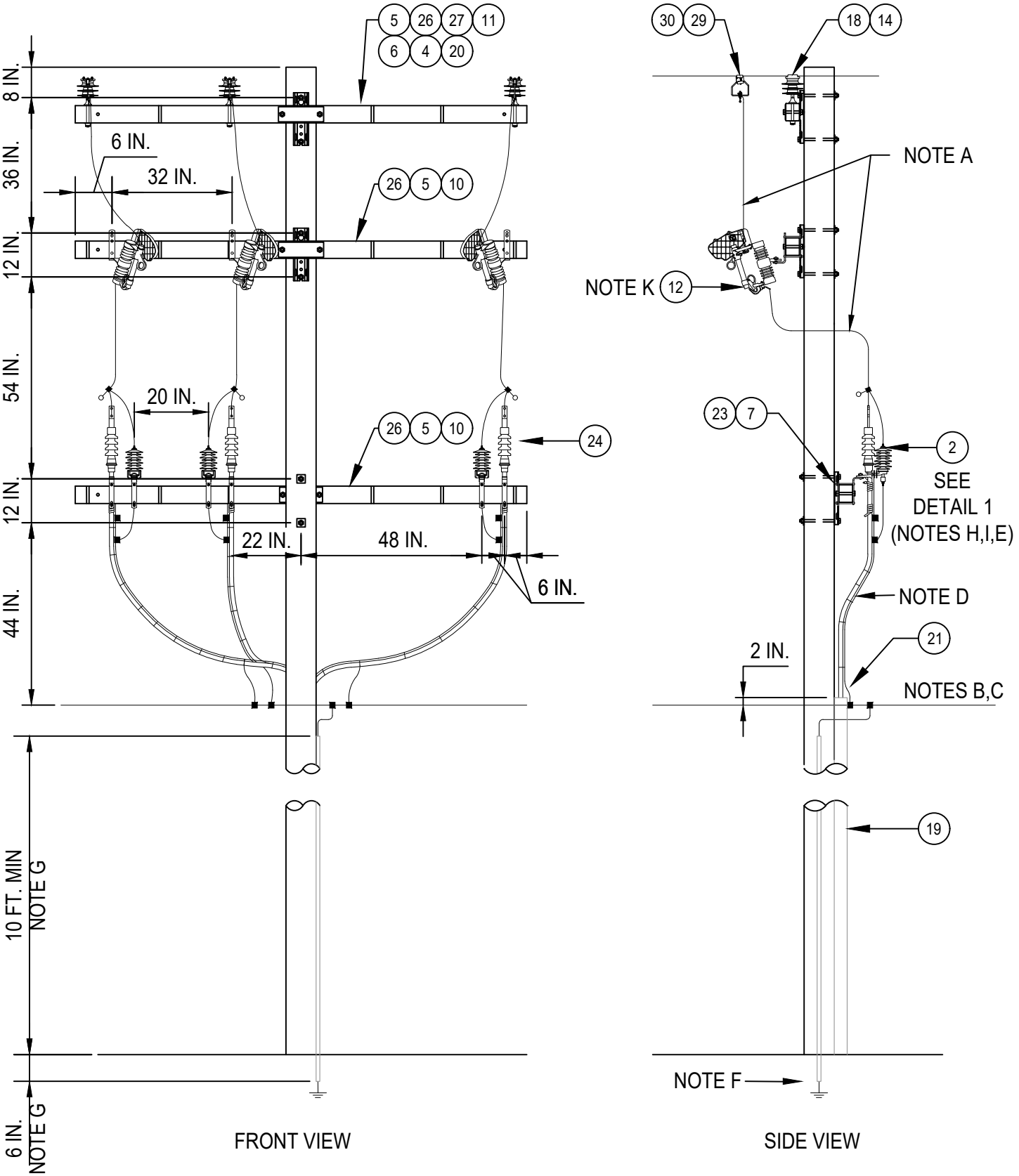
Drawing Name	THREE-PHASE RISER TRANSITION - HORIZONTAL				
Drawing #	OH-15KV-RSR-2091	Scale : N.T.S.	Approved By: APS	Rev	CITY LIGHT & POWER
City Light & Power Construction Detail Standards	Sheet 2 of 5	Approval Date: 03/10/2021		1	



THREE-PHASE DEADEND UNDERGROUND RISER POLE WITH CUTOUTS

Drawing Name	THREE-PHASE RISER TRANSITION - HORIZONTAL			
Drawing #	OH-15KV-RSR-2091	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 3 of 5	Approval Date: 03/10/2021		1

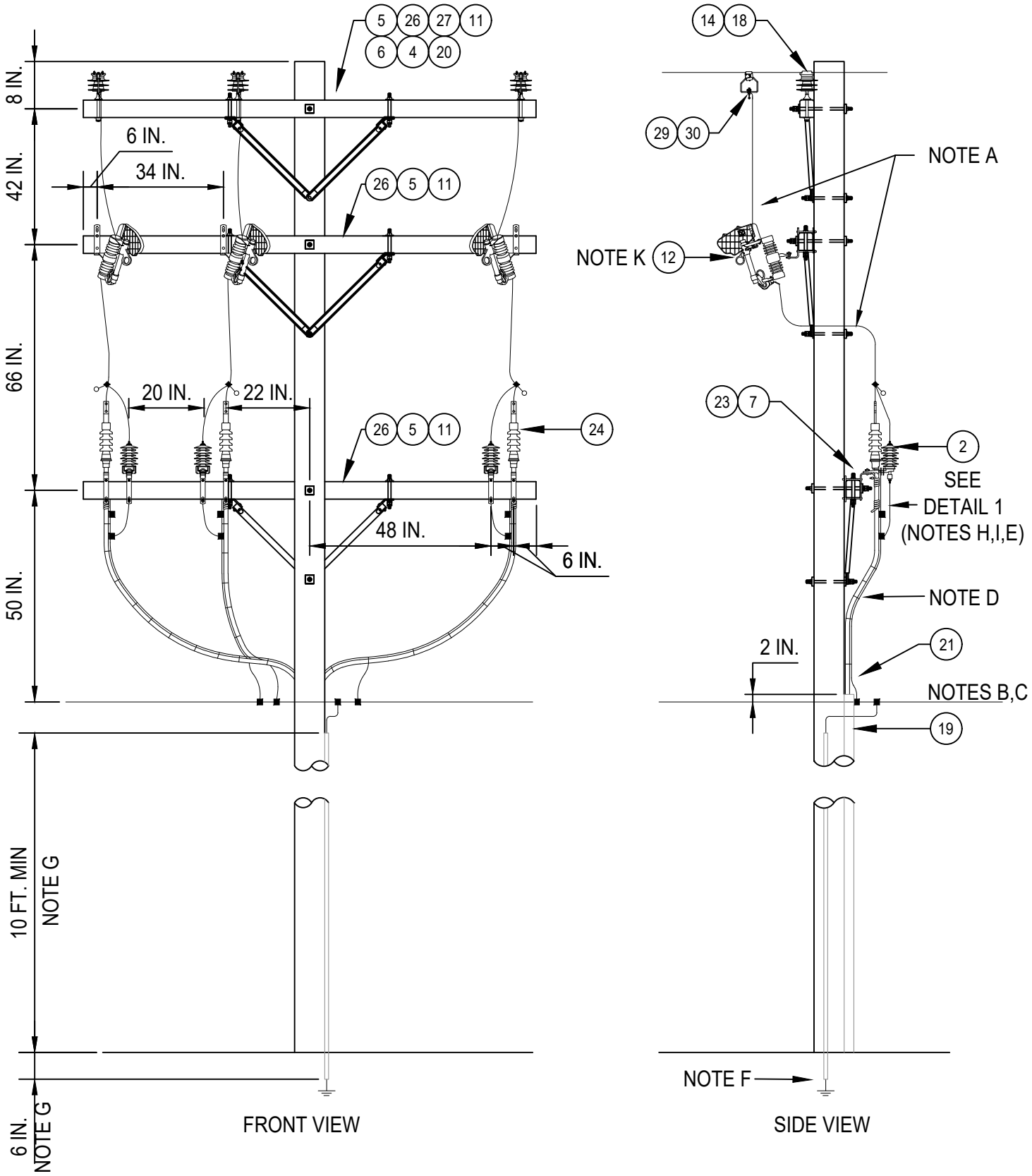
CITY LIGHT & POWER



THREE-PHASE TANGENT UNDERGROUND RISER POLE WITH CUTOUTS - FIBERGLASS CROSSARM

Drawing Name	THREE-PHASE RISER TRANSITION - HORIZONTAL			
Drawing #	OH-15KV-RSR-2091	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 4 of 5	Approval Date: 03/10/2021		1

CITY LIGHT & POWER



THREE-PHASE TANGENT UNDERGROUND RISER POLE WITH CUTOUTS-WOOD CROSSARM

Drawing Name	THREE-PHASE RISER TRANSITION - HORIZONTAL			
Drawing #	OH-15KV-RSR-2091	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 5 of 5	Approval Date: 03/10/2021		1

CITY LIGHT & POWER

BILL OF MATERIALS

Item	Material Description	Mfg.	Catalog No.	Quantity per Sheet		
				Sh.3	Sh.4	Sh.5
1	Arrester, 12kV, heavy duty	MacLean	ZHP010-0000100	2	2	-
2	Arrester, surge,10kV, MCOV	MacLean	ZRP010-0000100	-	-	2
3	Bolt, 3/4 in., D/A, length as required	Hubbell	As required	2	-	-
4	Bolt, 3/8 in., X 4-1/2 in.	Hubbell	863412	-	-	2
5	Bolt, 5/8 in., D/A, length as required	Hubbell	As required	4	4	5
6	Brace, flat, steel, 30 in.	Hubbell	7132	-	-	2
7	Bracket, NEMA B bracket for mounting cutouts, surge arresters, terminations	Hubbell	PSC2061042	4	6	6
8	Clamp, side-opening, spring-loaded, straight line deadend	MacLean	As required	2	-	-
9	Crossarm, 10 ft., fiberglass, dead-end	* OH-TYP-XRM-2645_Crossarms		1	-	-
10	Crossarm, 10 ft., fiberglass, tangent	* OH-TYP-XRM-2645_Crossarms		2	3	2
11	Crossarm, 10 ft., wood	TBD	TBD	3	3	1
12	Cutout, 15kV, 100A, load break	Hubbell	CP730114PB	2	2	2
13	Guard, wildlife	See OH-TYP-ANL-2510 Wildlife Protection		2	2	2
14	Insulator, 15kV, pin type, ANSI Class 55-4 (polymer)	Hendrix	HPI-15F	-	2	2
15	Insulator, 15kV, suspension (polymer)	Hubbell	4010150215	2	-	-
16	Nut, 3/4 in., oval eye	Hubbell	6503	1	-	-
17	Nut, 5/8 in.,oval eye	Hubbell	6502	2	3	-
18	Pin, 3/4 in., steel	Hubbell	4705P	-	3	3
19	Riser shield	See UG-TYP-RSR-3621-Riser Uguards		As required		
20	Screw, lag, pilot point, 1/2 in. X 4 in.	Hubbell	508754	-	-	1
21	Shield, duct	Electrical Materials Company	27-1 Black	1	1	1
22	Strain, 12 in., fiberglass	Hubbell	GS16012CPSC	1	-	-
23	Support, cable positioner	Hubbell	CCS820	2	2	2
24	Termination, 15kV	3M	As required	2	2	2
25	Tubing, wildlife (Stinger cover)	Salisbury by Honeywell	58-50SC	As required		
26	Washer, 2-1/4 in. sq., curved	Hubbell	681012	6	6	5
27	Washer, 2-1/4 in. sq., flat	Hubbell	6813	-	-	1
28	Washer, 3 in. sq., curved	Hubbell	682212	2	-	-

Drawing Name	TWO-PHASE RISER TRANSITION - HORIZONTAL			
Drawing #	OH-15KV-RSR-2093	Scale : N.T.S.	Approved By: APS	Rev 0
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Notes:

A. Use tap wire equivalent to the load rating of the UG cable from terminations to disconnects and from disconnects to primary.

B. Neutral, triplex or top wire of open wire secondary.

C. Install #6 soft drawn, solid, covered copper wire from system neutral to driven ground. If the pole has arresters or reclosers attached to it, install #4 soft drawn, solid, covered copper wire instead.

D. Install 1/0 soft drawn, covered copper wire alongside of UG cables and secure with 7 in. black cable ties approximately every 8 inches. Connect one end to the concentric neutrals and surge arrester ground lead as shown in Detail 1. Connect the other end to the system neutral. A separate connection must be made from each wire to the system neutral. Substituting a concentric neutral or tape shield ground is also acceptable.

E. Use No. 6 soft drawn covered copper wire for primary arrester taps.

F. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

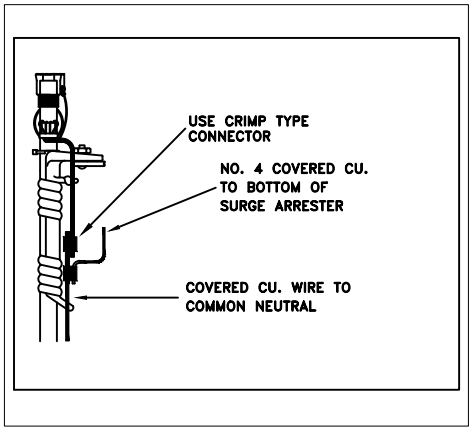
G. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

H. All tap wire and surge arrester primary taps must be covered with elastomer tubing (stinger cover).

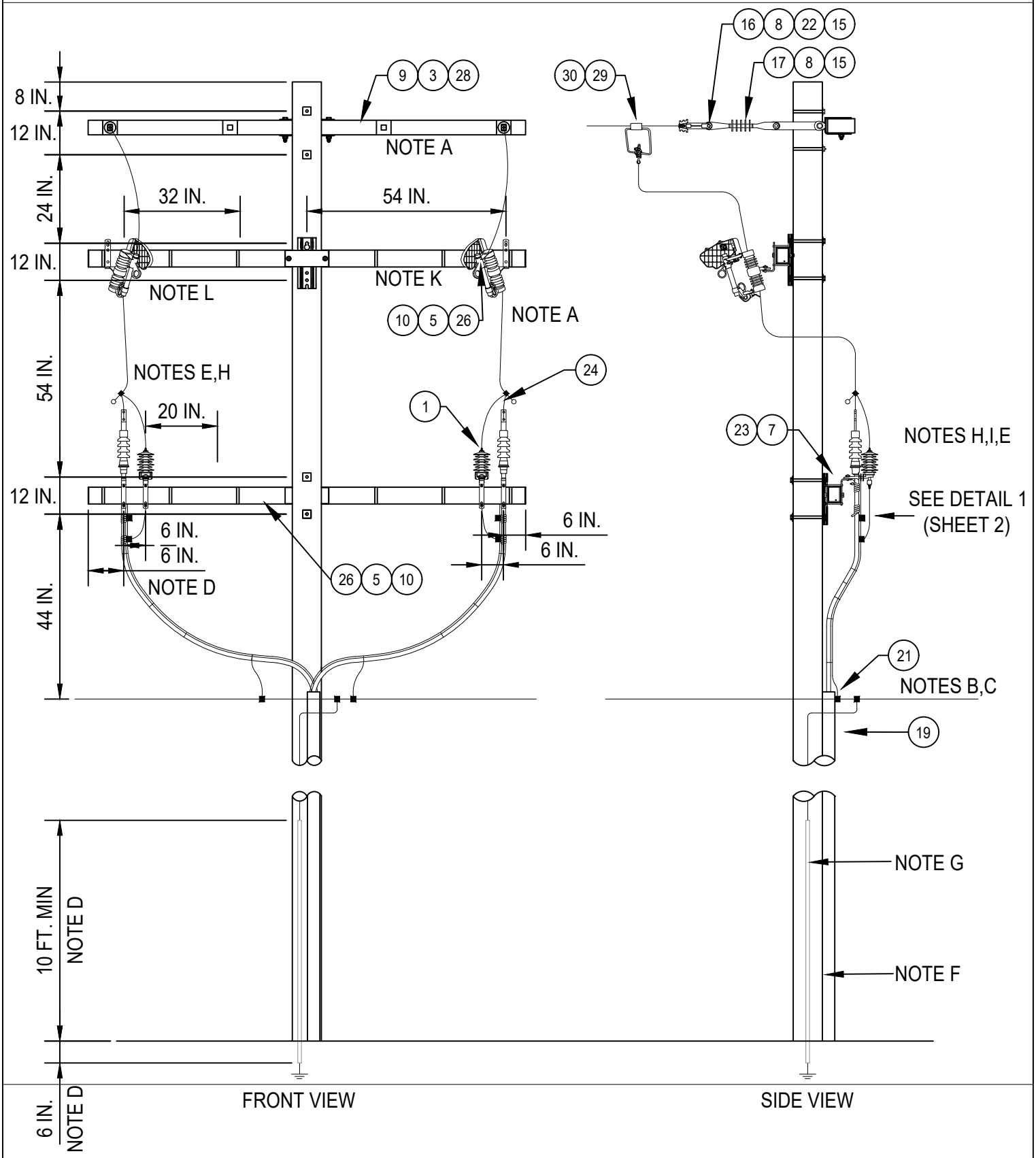
I. Wildlife guards installed at all terminations.

J. Double nut all D/A bolts.

K. Rotate cutout frame slightly towards pole. This will expel the fuse link away from the operator in the event that the fuse blows.



DETAIL 1: SURGE ARRESTER GROUNDING



TWO-PHASE DEADEND UNDERGROUND RISER POLE WITH CUTOUTS

Drawing Name	TWO-PHASE RISER TRANSITION - HORIZONTAL			
Drawing #	OH-15KV-RSR-2093	Scale : N.T.S.	Approved By: APS	Rev
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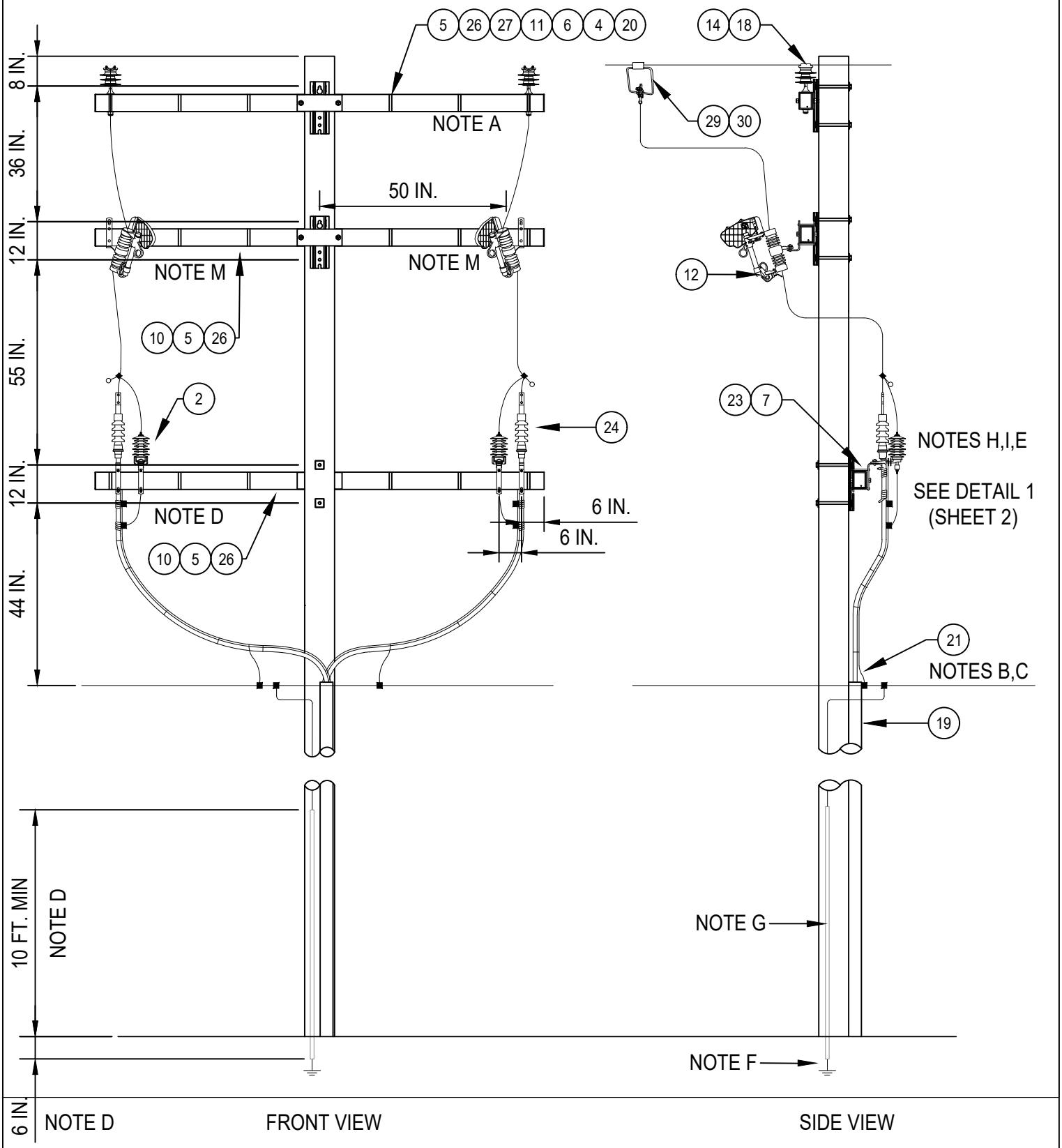
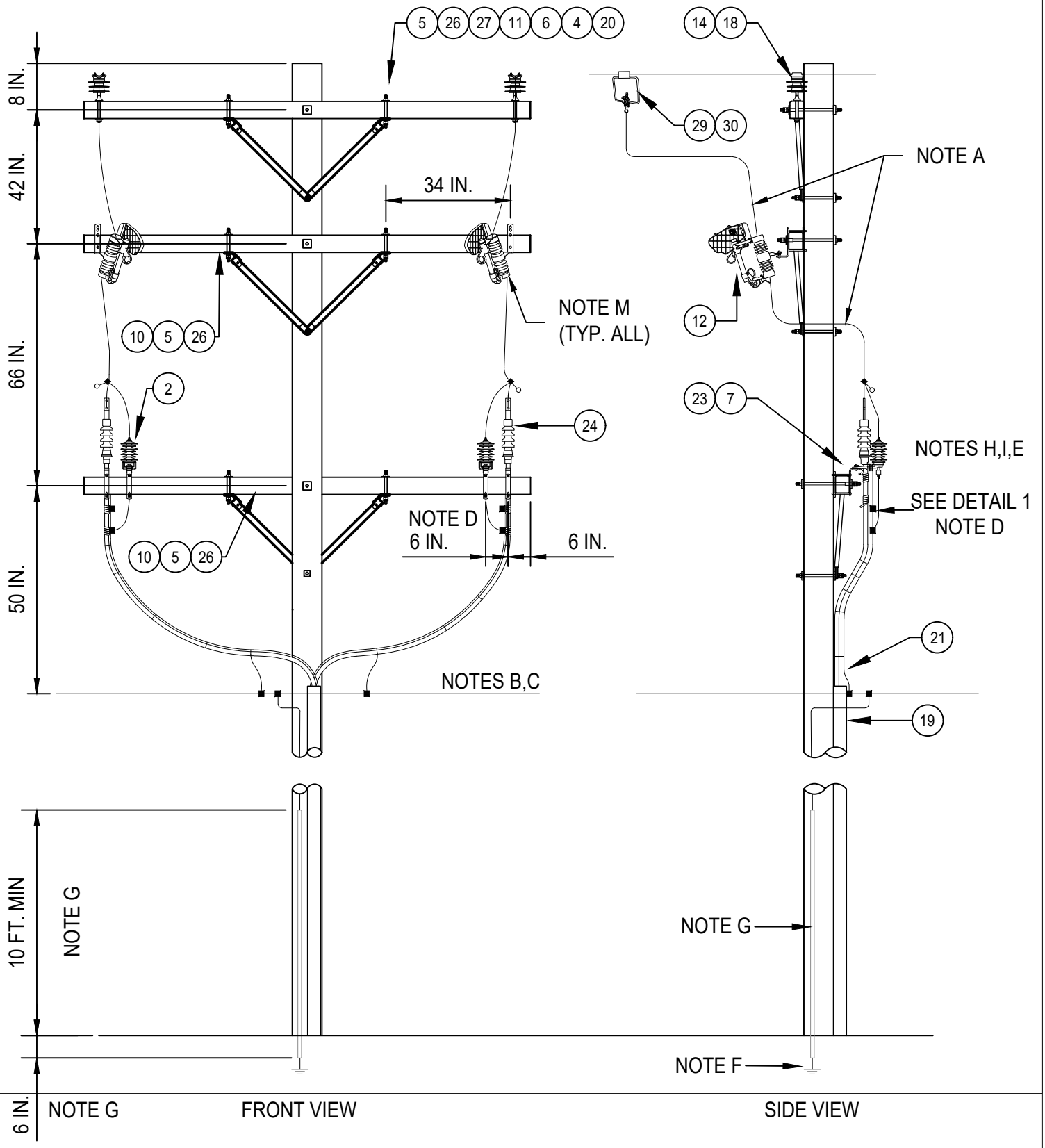
CITY LIGHT & POWER



TWO-PHASE TANGENT UNDERGROUND RISER POLE WITH CUTOUTS-FIBERGLASS CROSSARM

Drawing Name	TWO-PHASE RISER TRANSITION - HORIZONTAL			
Drawing #	OH-15KV-RSR-2093	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 4 of 5	Approval Date: 03/10/2021		0

CITY LIGHT & POWER



TWO-PHASE TANGENT UNDERGROUND RISER POLE WITH CUTOUTS-WOOD CROSSARM

Drawing Name	TWO-PHASE RISER TRANSITION - HORIZONTAL			
Drawing #	OH-15KV-RSR-2093	Scale : N.T.S.	Approved By: APS	Rev
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CITY LIGHT & POWER

BILL OF MATERIALS

Item	Material Description	Mfg.	Catalog No.	Quantity Per Sheet		
				Sh.3	Sh.4	Sh.5
1	Arrester, surge 10 kV MCOV	See OH-15KV-ARR-2200_Distribution Line Arresters		3	3	3
2	Bolt, 3/4 in. D/A length as required	Hubbell	Various	2	-	-
3	Bolt, 3/8 in. X 4-1/2 in.	Hubbell	863412	-	-	2
4	Bolt, 5/8 in. D/A length as required	Hubbell	Various	6	9	9
5	Brace, flat steel 30 in.	Hubbell	7132	-	-	2
6	Bracket, 24 in. conduit standoff	Alumo-Form	9-CS0-24	As required		
7	Bracket, NEMA B bracket for mounting cutouts, surge arresters and terminations	Hubbell	PSC2061042	9	9	9
8	Clamp, side opening spring loaded straight line deadend	MacLean	Various	3	-	-
9	Crossarm, 10 ft. fiberglass deadend	PUPI	DA3000120E4B9X2	1	-	-
10	Crossarm, 10 ft. fiberglass tangent	PUPI	TB22001200032	-	1	-
11	Crossarm, 12 ft. fiberglass tangent	PUPI	TB2000144	2		
12	Crossarm, wood 10 ft.	Various	Various	-	-	1
13	Guard, wildlife	See OH-TYP-ANL-2510_Wildlife Protection		As required		
14	Insulator, 15 kV pin type ANSI Class 55-4 (polymer)	Hendrix	HPI-15F	-	3	3
15	Insulator, 15 kV suspension (polymer)	Hubbell	4010150215	3	-	-
16	Nut, 3/4 in. oval eye	Hubbell	6503	1	-	-
17	Nut, 5/8 in. oval eye	Hubbell	6502	2	-	-
18	Pin, 3/4 in. steel	Hubbell	4705P	-	3	3
19	Riser shield	See UG-TYP-RSR-3621_Riser Uguard		As required		

Drawing Name	THREE-PHASE DOUBLE PRIMARY RISER TRANSITION				
Drawing #	OH-15KV-RSR-2100	Scale : N.T.S.	Approved By: APS	Rev	CITY LIGHT & POWER
City Light & Power Construction Detail Standards		Sheet 1 of 5	Approval Date: 03/10/2021	1	

BILL OF MATERIALS (CONTINUED)

Item	Material Description	Mfg.	Catalog No.	Quantity Per Sheet		
				Sh.3	Sh.4	Sh.5
20	Screw lag, pilot point 1/2 in. X 4 in.	Hubbell	508754	-	-	1
21	Shield, duct	Electrical Materials Company	27-1 Black	2	2	2
22	Strain, 12 in. fiberglass	Hubbell	GS16012CPSC	1	-	-
23	Strap, conduit for 5 in. riser	Various		As required		
24	Support grip, Heavy duty	Bryant	Various	2	2	2
25	Support, cable positioner	Hubbell	CCS820	6	6	6
26	Switch, disconnect 15 kV 600 amp	Hubbell	M3D66BLR	3	3	3
27	Termination, 15 kV	3M	Various	6	6	6
28	Tubing, wildlife (Stinger cover)	Salisbury by Honeywell	58-50SC	As required		
29	Washer, 2-1/4 in. sq. curved	Hubbell	681012	6	9	9
30	Washer, 2-1/4 in. sq. flat	Hubbell	6813	-	-	1
31	Washer, 3 in. sq. curved	Hubbell	682212	2	-	-

Notes:

A. Use tap wire equivalent to the load rating of the UG cable from terminations to disconnects and from disconnects to primary.

B. Neutral, triplex or top wire of open wire secondary.

C. Install no. 4 soft drawn solid covered copper wire from system neutral to driven ground.

D. Install 1/0 covered copper soft drawn wire alongside of UG cables and secure with 7 inch black cable ties approximately every 8 inches. Connect one end to the concentric neutrals and surge arrester ground lead as shown in detail. Connect the other end to the system neutral. A separate connection must be made from each wire to the system neutral.

E. Use no. 4 covered soft drawn copper wire for primary arrester taps.

F. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

G. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

H. In areas sensitive to wildlife, all tap wire and surge arrester primary taps must be covered with elastomer tubing (stinger cover).

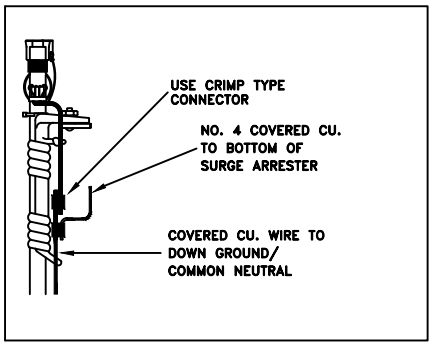
I. Wildlife guards must be installed at all terminations.

J. Ampact connectors must be used for all primary feeder to primary feeder transitions. Use stirrup and hotline clamps for all lateral and tap lines coming off of primaries.

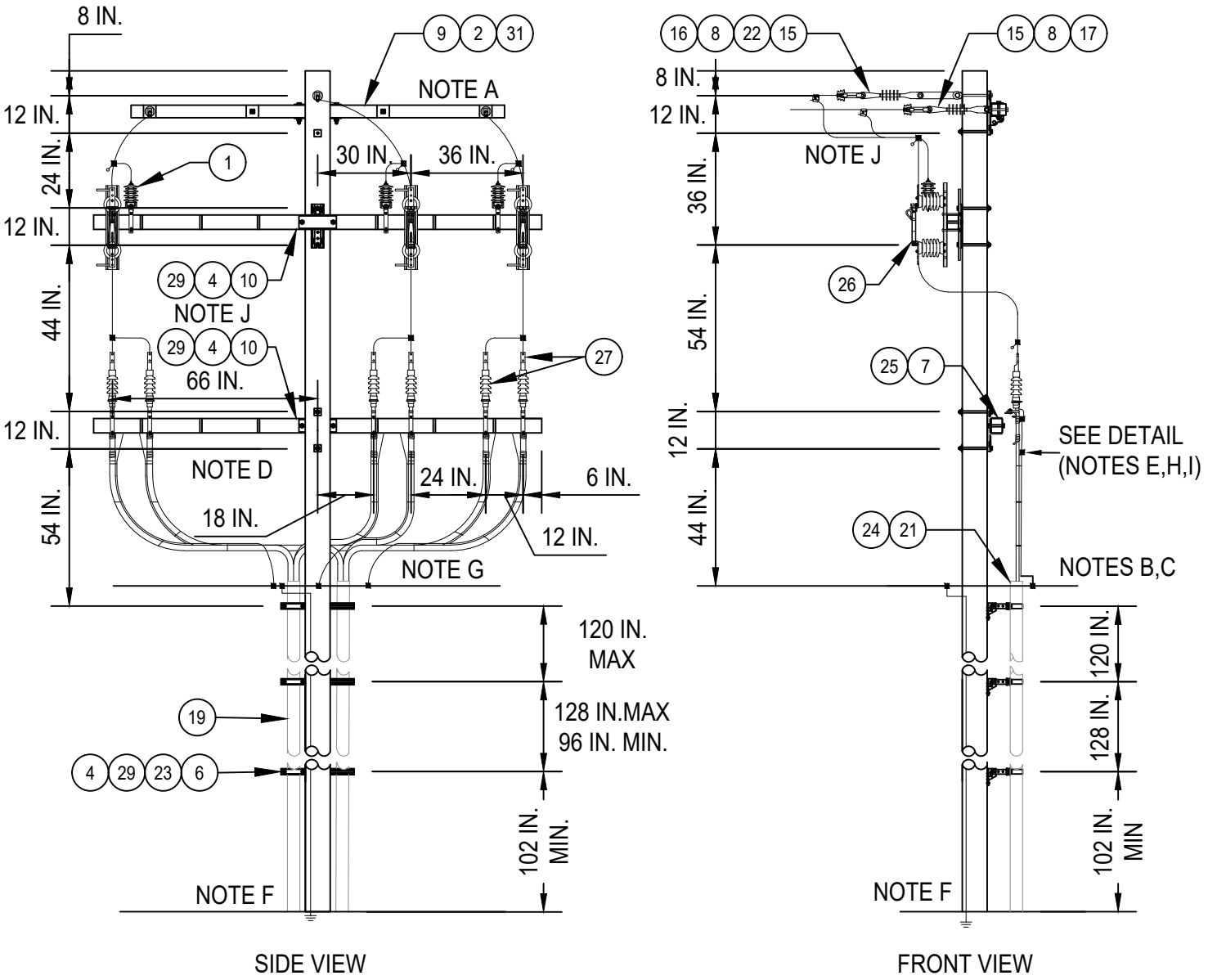
K. Double nut all D/A bolts.

L. If overbuild is present on the pole, position B phase in pin hole outside of the steel braces.

M. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.



DETAIL 1: SURGE ARRESTER GROUNDING



THREE-PHASE DEADEND POLE
PARALLEL UNDERGROUND RISERS WITH DISCONNECTS

Drawing Name	THREE-PHASE DOUBLE PRIMARY RISER TRANSITION			
Drawing #	OH-15KV-RSR-2100	Scale : N.T.S.	Approved By: APS	Rev
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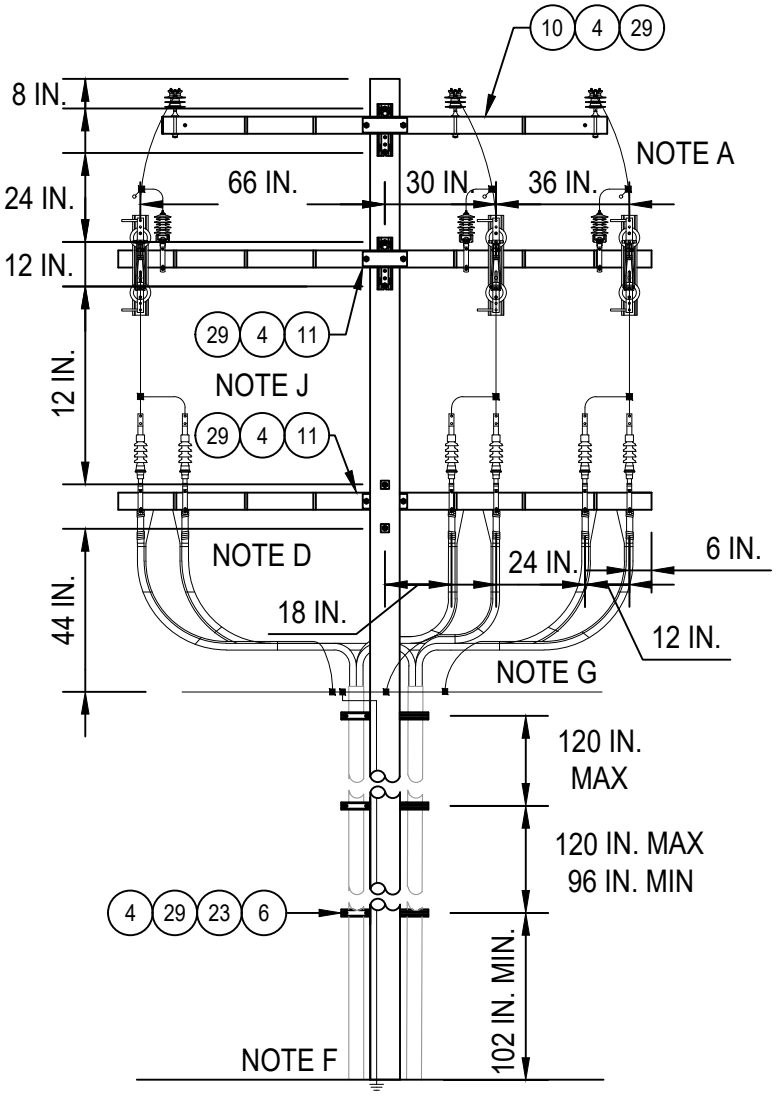
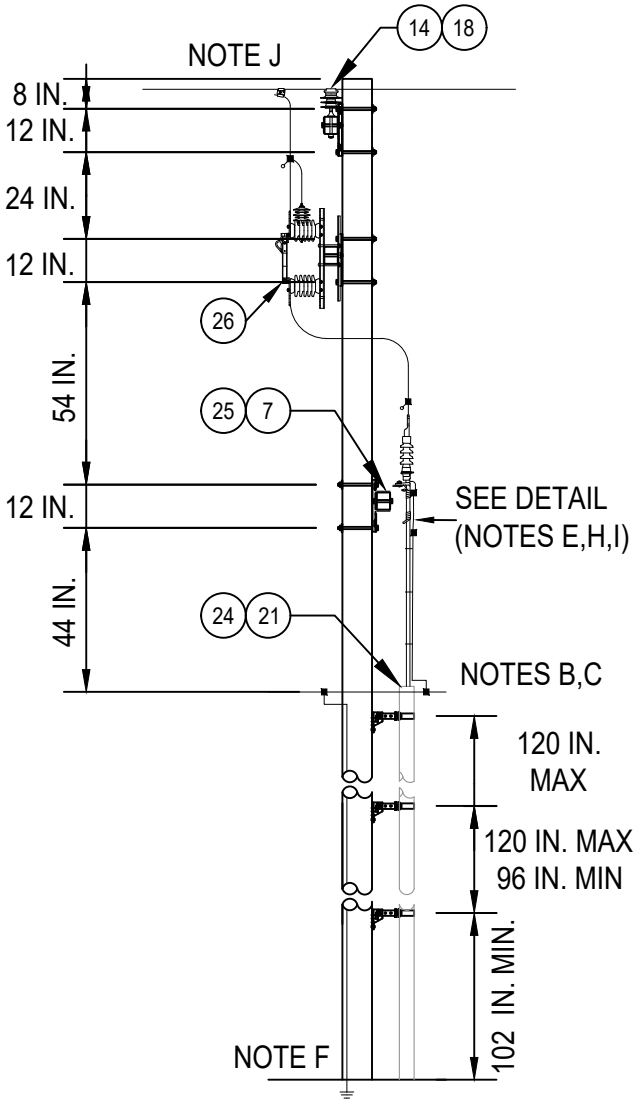
CITY LIGHT & POWER



SIDE VIEW



FRONT VIEW

THREE-PHASE TANGENT POLE
PARALLEL UNDERGROUND RISERS WITH DISCONNECTS

Drawing Name	THREE-PHASE DOUBLE PRIMARY RISER TRANSITION			
Drawing #	OH-15KV-RSR-2100	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 5 of 5	Approval Date: 03/10/2021		1

CITY LIGHT & POWER

BILL OF MATERIALS

Item	Material Description	Mfg.	Catalog No.	Quantity per Sheet		
				3	4	5
1	Assembly, Wedge Stirrup	Ampact	Various	2	2	2
2	Bolt, Machine, 5/8 in. x Length as required	Hubbell	Various	2	2	2
3	Brace, Crossarm, 48 in. span x 24 in. drop, sold as pair	As required		-	1	1
4	Bracket, NEMA B bracket for mounting cutouts, surge arresters, terminations	Hubbell	PSC2061042	2	2	2
5	Clamp, Hot Line	Hubbell	Various	2	2	2
6	Clevis, Spool	Hubbell	337	1	1	1
7	Crossarm, Fiberglass, Tangent, 10 ft.	PUPI	TB22001200032	1	1	-
8	Crossarm, Wood, 8 ft.	Various	Various	-	1	-
9	Crossarm, Wood, 10 ft.	Various	Various	-	-	1
10	Cutout, 15 kV, 100 amp, load break	Hubbell	CP730114PB	2	2	2
11	Guard, Wildlife	See OH-TYP-ANL-2510_Wildlife Protection		2	2	2
12	Arrester	Various	Various	-	2	2
13	Insulator, Spool type, ANSI Class 53-2, Polymer	Hubbell	C9091032PG	1	1	1
14	Transformer, Dual-bushing	Various	Various	1	1	1
15	Tubing, Wildlife (Stinger cover)	See OH-TYP-ANL-2510_Wildlife Protection		As Required		
16	Washer, Square, Curved, 2-1/4 in.	Hubbell	681012	8	6	6
17	Washer, Square, Flat, 2-1/4 in.	Hubbell	6813	-	1	1

Notes:

A. System neutral.

B. Install #6 soft drawn, solid, copper wire from system neutral to driven ground. If the pole has arresters, reclosers, switches, or transformers attached to it, install #4 soft drawn, solid, covered copper wire instead.

C. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

D. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

E. In areas sensitive to wildlife, all tap wire and surge arrester primary taps must be covered with elastomer tubing (stinger cover).

F. Wildlife guards must be installed at all primary transformer bushings.

G. Rotate cutout frame slightly towards pole. This will expel the fuse link away from the operator in the event that the fuse blows.

H. The standard depicts the transformer secondary leads secured to a clevis. The use of a clevis may not be appropriate for all conductor sizes.

I. 75 KVA and larger transformers require 3/4 in. machine bolts and 3/4 in. sq. curved washers.

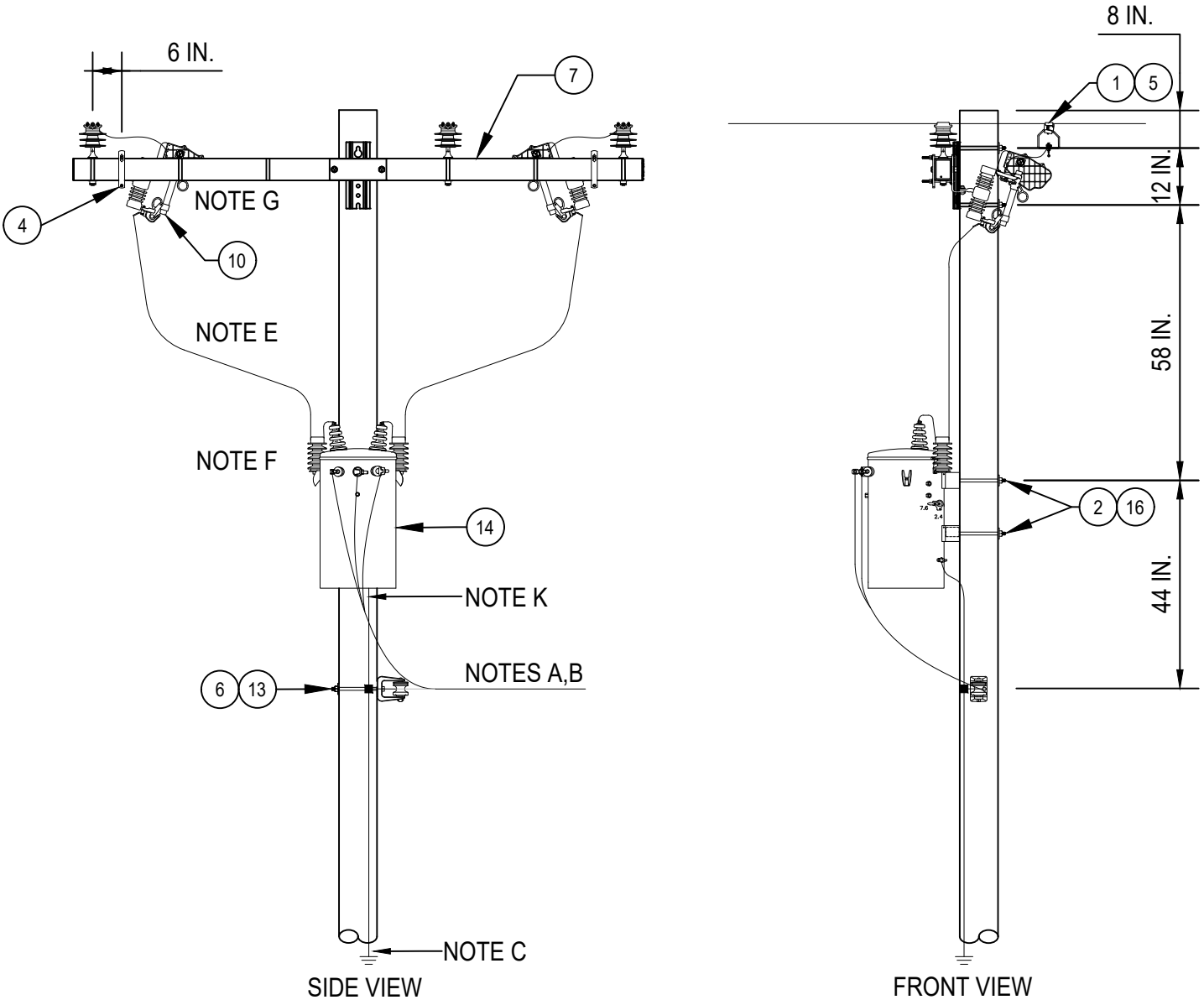
J. Double nut all D/A bolts.

K. Install no. 4, soft drawn, solid, covered copper wire from the system neutral to the neutral of the single-phase transformer.

L. If overbuild is present on the pole, position B phase in pin hole outside of the steel braces.

M. If the pole is anchored, position pole top pin on same side of pole as the guy attachment. The cutout and the primary transformer tap must be opposite the anchor.

N. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.



THREE-PHASE TANGENT POLE WITH TWO-PHASE TRANSFORMER
10 FT FIBERGLASS CROSSARM

Drawing Name	TWO-PHASE TRANSFORMER				
Drawing #	OH-15KV-XFR-2121	Scale : N.T.S.	Approved By: APS	Rev	
City Light & Power Construction Detail Standards	Sheet 3 of 5	Approval Date: 04/16/2021	0		

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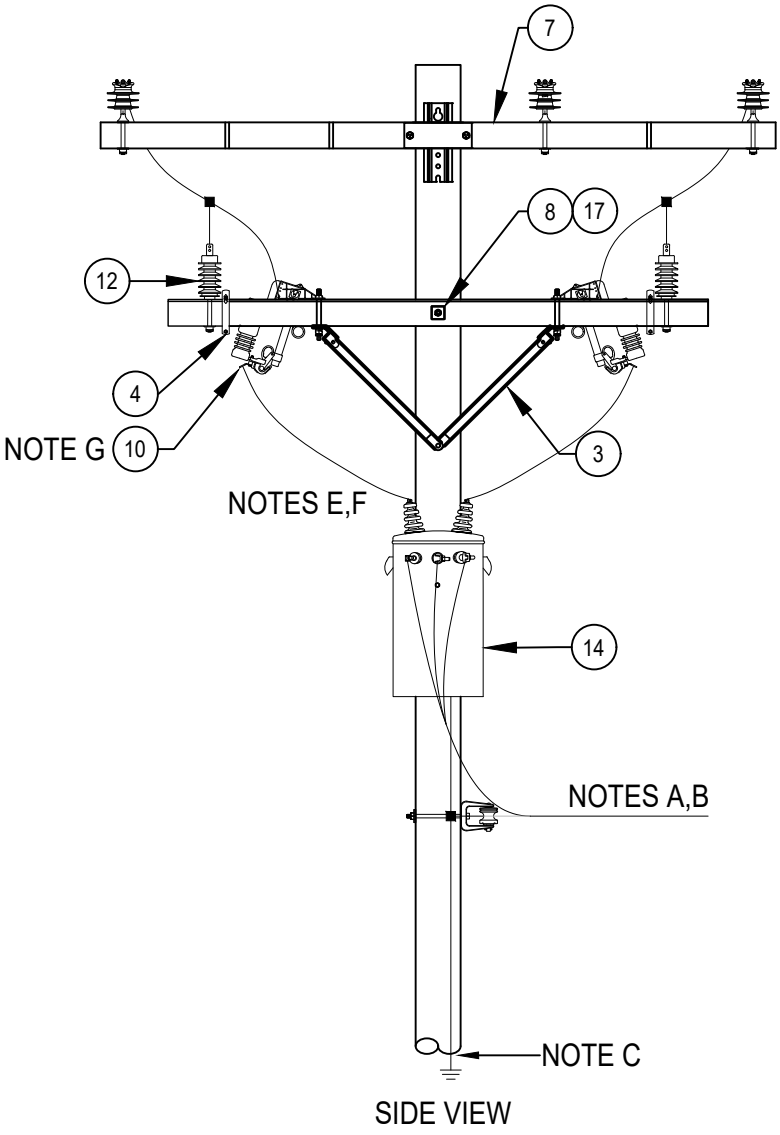
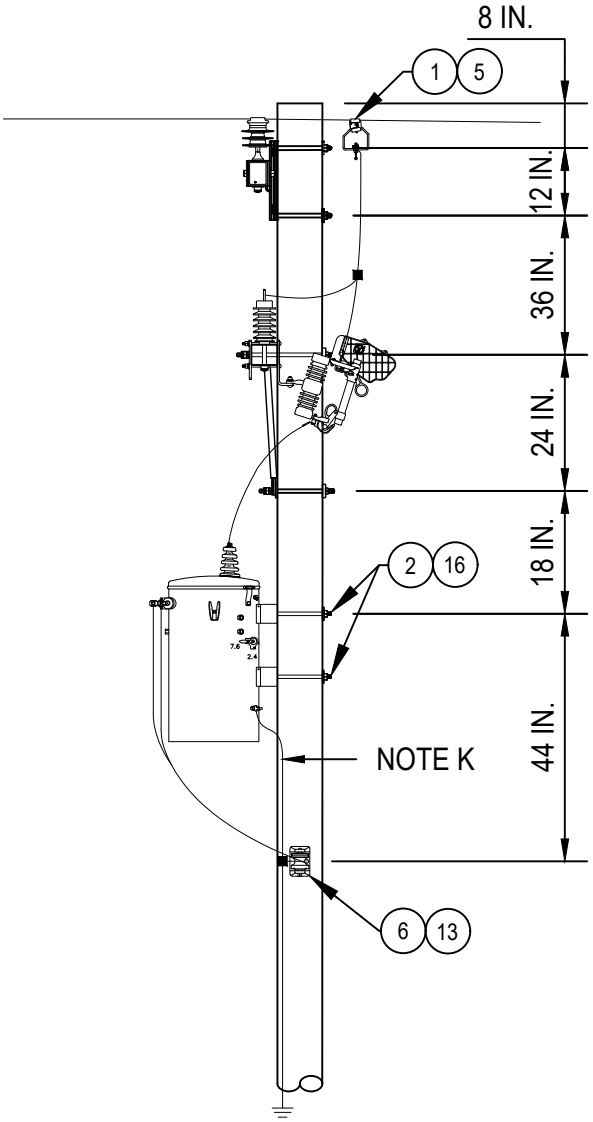


SIDE VIEW

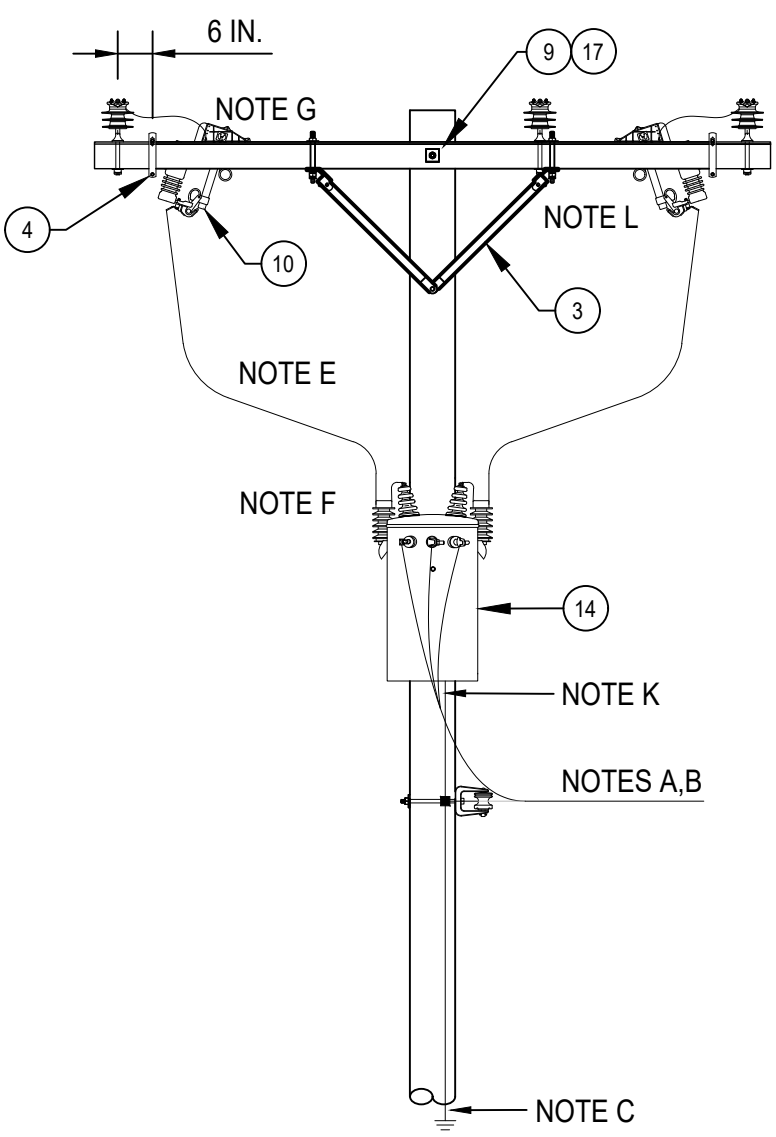


FRONT VIEW

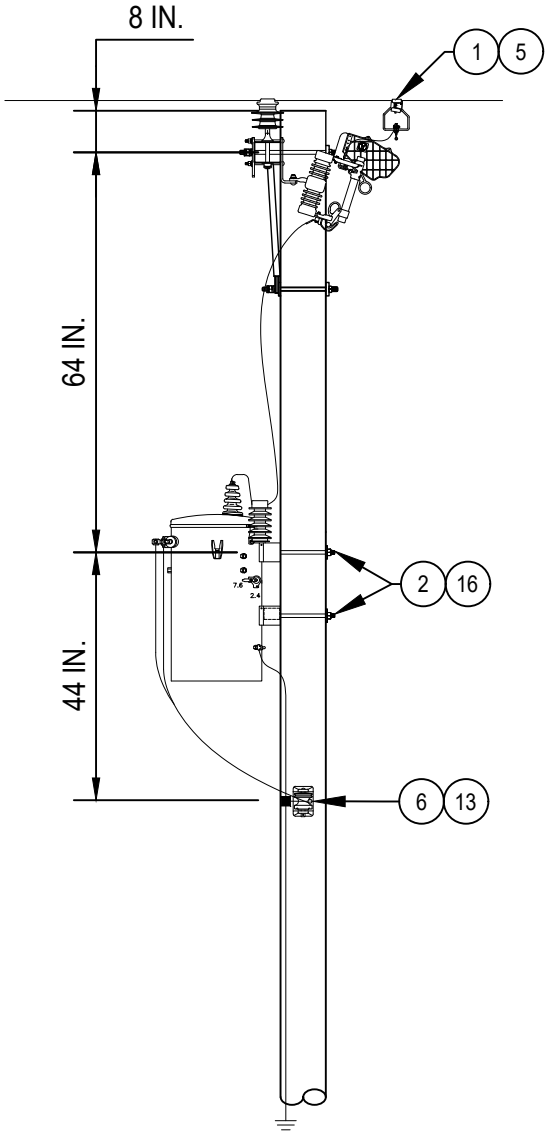
THREE-PHASE TANGENT POLE WITH TWO-PHASE TRANSFORMER
10 FT FIBERGLASS AND 8 FT WOOD CROSSARMS

Drawing Name	TWO-PHASE TRANSFORMER				
Drawing #	OH-15KV-XFR-2121	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 4 of 5		Approval Date: 04/16/2021	0

CITY LIGHT & POWER



SIDE VIEW



FRONT VIEW

THREE-PHASE TANGENT POLE WITH TWO-PHASE TRANSFORMER
10 FT WOOD CROSSARM

Drawing Name	TWO-PHASE TRANSFORMER				
Drawing #	OH-15KV-XFR-2121	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 5 of 5		Approval Date: 04/16/2021	0

CITY LIGHT & POWER

BILL OF MATERIALS

Item	Material Description	Mfg.	Catalog No.	Quantity per Sheet					
				3	4	5	6	7	8
1	Arrester, surge, 8.4kV MCOV, 10kA, heavy duty	MacLean	ZHP010-0000100	3	3	3	3	3	3
2	Assembly, wedge stirrup	Ampact	Various	3	3	3	3	3	3
3	Bolt, D/A, 3/4 in., length as required	Hubbell	Various	6	4	6	6	4	6
4	Bolt, D/A, 5/8 in., length as required	Hubbell	Various	-	4	3	-	4	3
5	Brace, Crossarm, 48 in. span X 24 in. drop, sold as pair	Various		-	1	-	-	1	-
6	Bracket, cluster mount	Hubbell	DT8C1L	1	1	1	1	1	1
7	Bracket, NEMA B, (for mounting cutouts, surge arresters and terminations)	Hubbell	PSC2061042	3	3	3	3	3	3
8	Clamp, Hot Line	Hubbell	Various	3	3	3	3	3	3
9	Clamp, side-opening, spring-loaded, straight-line deadend	Maclean	Various	-	-	3	-	-	3
10	Clevis, spool	Hubbell	337	1	1	1	1	1	1
11	Crossarm, fiberglass, deadend, 10 ft.	PUPI	DA3000120E4B9X2	-	-	1	-	-	1
12	Crossarm, fiberglass, tangent, 10 ft.	PUPI	TB22001200032	2	1	1	2	1	1
13	Crossarm, wood, 10 ft.	Various		-	1	-	-	1	-
14	Cutout, 15 kV, 100 amp, load break	See OH-TYP-FUS-2551_Cutouts		3	3	3	3	3	3
15	Guard, wildlife	See OH-TYP-ANL-2510_WildlifeProtection		As needed					
16	Insulator, 15 kV, pin type, ANSI Class 55-4, polymer	See OH-TYP-INS-2554_Insulators		3	3	3	3	3	3
17	Insulator, 15 kV, suspension, polymer	See OH-TYP-INS-2554_Insulators		-	-	3	-	-	3
18	Insulator, spool type, polymer, ANSI Class 53-2	Hubbell	C9091032PG	1	1	1	1	1	1
19	Nut, oval eye, 5/8 in.	Hubbell	6502	-	-	3	-	-	3
20	Pin, steel, 3/4 in.	Hubbell	4705P	3	3	3	3	3	3
21	Strain, fiberglass, 12 in.	Hubbell	GS16012CPSC	-	-	1	-	-	1
22	Transformer, single-phase, dual-bushing	Various		3	3	3	-	-	-
23	Transformer, single-phase, single-bushing	Various		-	-	-	3	3	3
24	Tubing, wildlife, Stinger cover	See OH-TYP-ANL-2510_WildlifeProtection		As required					
25	Washer, curved, 2-1/4 in. sq., for 5/8 in. bolt	Hubbell	681012	-	2	1	-	2	1
26	Washer, flat, 2-1/4 in. sq., for 5/8 in. bolt	Hubbell	6813	-	1	2	-	1	2
27	Washer, curved, 3 in. sq., for 3/4 in. bolt	Hubbell	682212	6	4	6	6	4	6
28	Washer, round, for 3/4 in. bolt	Hubbell	6806	12	10	12	12	10	12

Drawing Name	THREE-PHASE TRANSFORMERS - CLUSTER MOUNTED			
Drawing #	OH-15KV-XFR-2140	Scale : N.T.S.	Approved By: APS	Rev 1
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CITY LIGHT & POWER

Notes:

A. Install #6 soft drawn, solid, copper wire from system neutral to driven ground. If the pole has arresters, reclosers, switches, or transformers attached to it, install #4 soft drawn, solid, covered copper wire instead.

B. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

C. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

D. In areas sensitive to wildlife, all tap wire and surge arrester primary taps must be covered with elastomer tubing (stinger cover).

E. Rotate cutout frame slightly towards pole. This will expel the fuse link away from the operator in the event that the fuse blows.

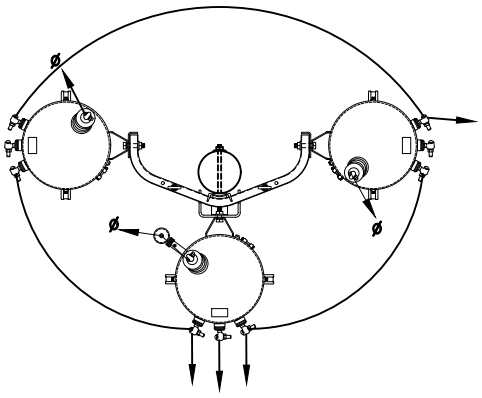
F. The standard depicts the transformer secondary leads secured to a clevis. The use of a clevis may not be appropriate for all conductor sizes.

G. Double nut all D/A bolts.

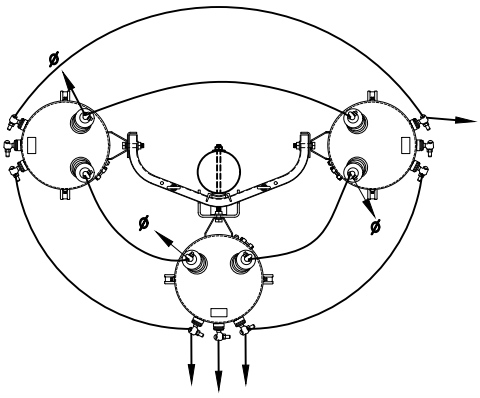
H. If overbuild is present on the pole, position B phase in pin hole outside of the steel braces.

I. Install no. 4 soft drawn solid covered copper wire from system neutral to neutral of 3 phase.

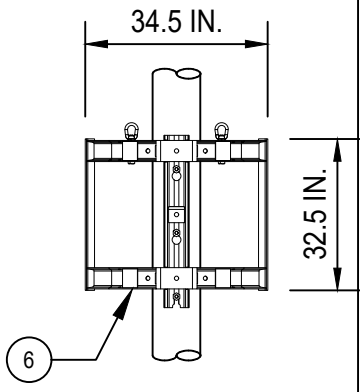
J. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.



DETAIL 1: SECTION A - A



DETAIL 2: SECTION B - B



DETAIL 3: CLUSTER MOUNT BRACKET

Drawing Name	THREE-PHASE TRANSFORMERS - CLUSTER MOUNTED			
Drawing #	OH-15KV-XFR-2140	Scale : N.T.S.	Approved By: APS	Rev
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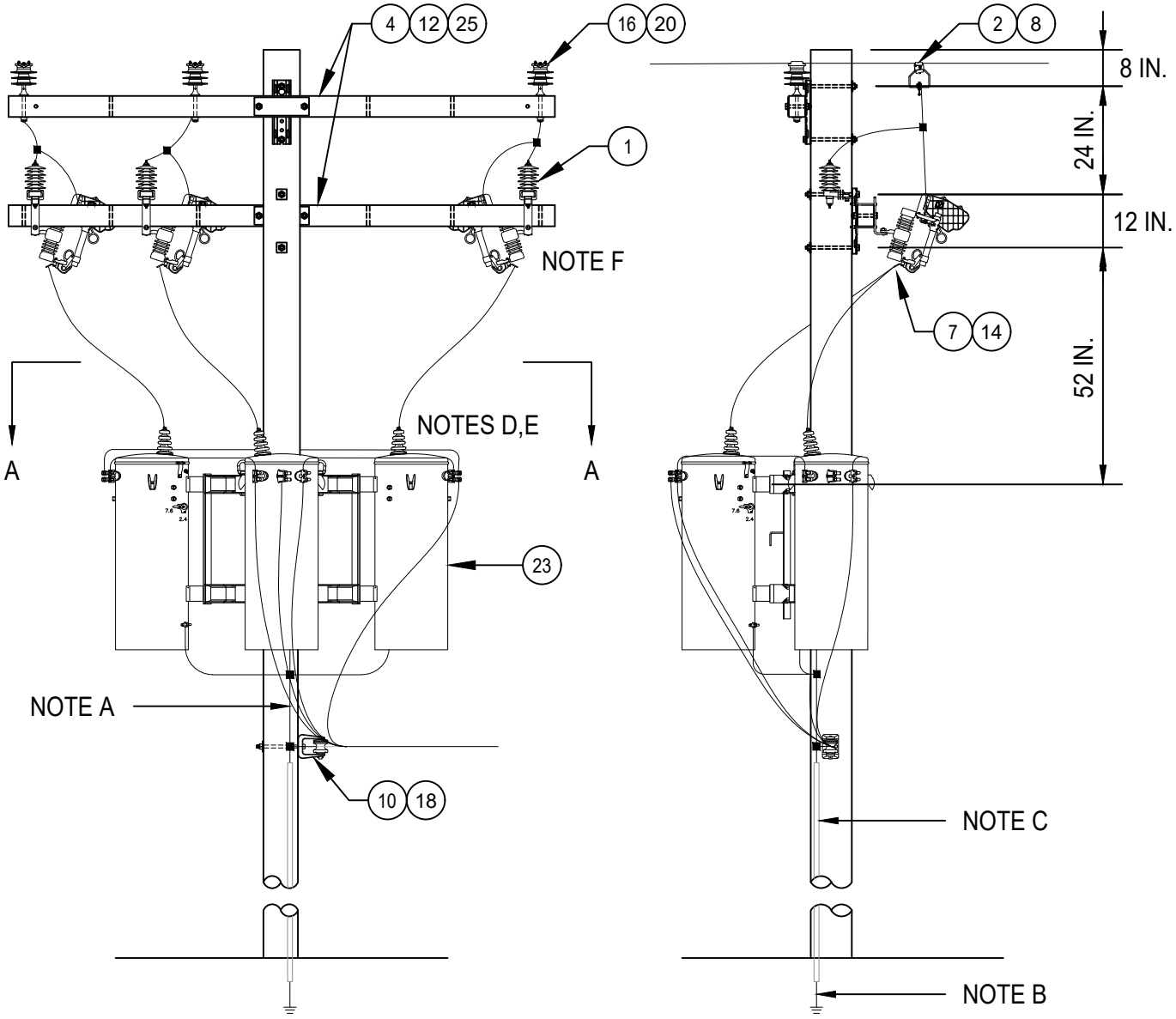
CITY LIGHT & POWER



TANGENT POLE SINGLE-BUSHING TRANSFORMER - CLUSTER-MOUNT FRAMING
FIBERGLASS CROSSARMS

Drawing Name	THREE-PHASE TRANSFORMERS - CLUSTER MOUNTED			
Drawing #	OH-15KV-XFR-2140	Scale : N.T.S.	Approved By: APS	Rev
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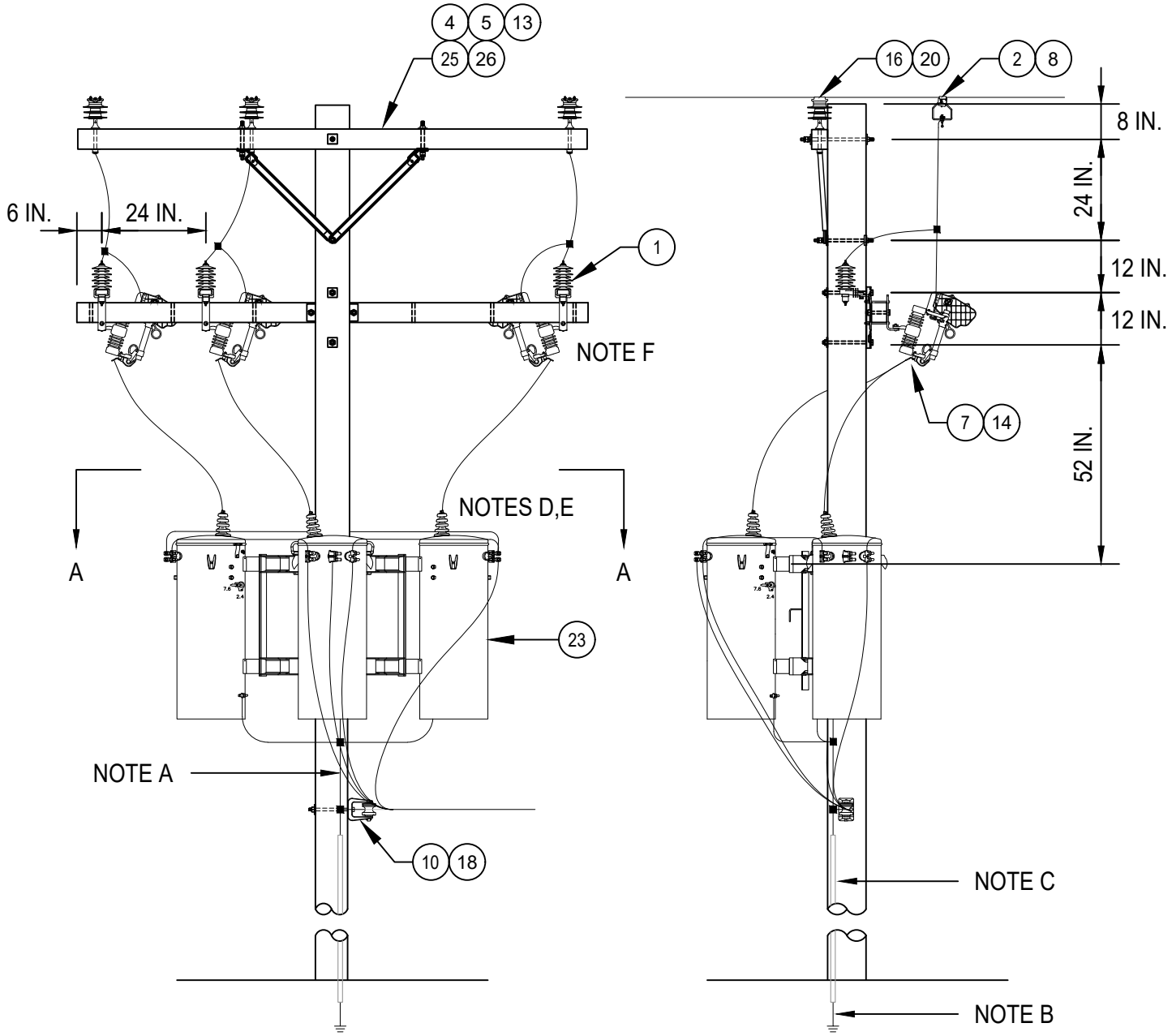
CITY LIGHT & POWER



FRONT VIEW

SIDE VIEW

TANGENT POLE SINGLE-BUSHING TRANSFORMER - CLUSTER-MOUNT FRAMING
FIBERGLASS AND WOOD CROSSARMS

Drawing Name	THREE-PHASE TRANSFORMERS - CLUSTER MOUNTED			
Drawing #	OH-15KV-XFR-2140	Scale : N.T.S.	Approved By: APS	Rev
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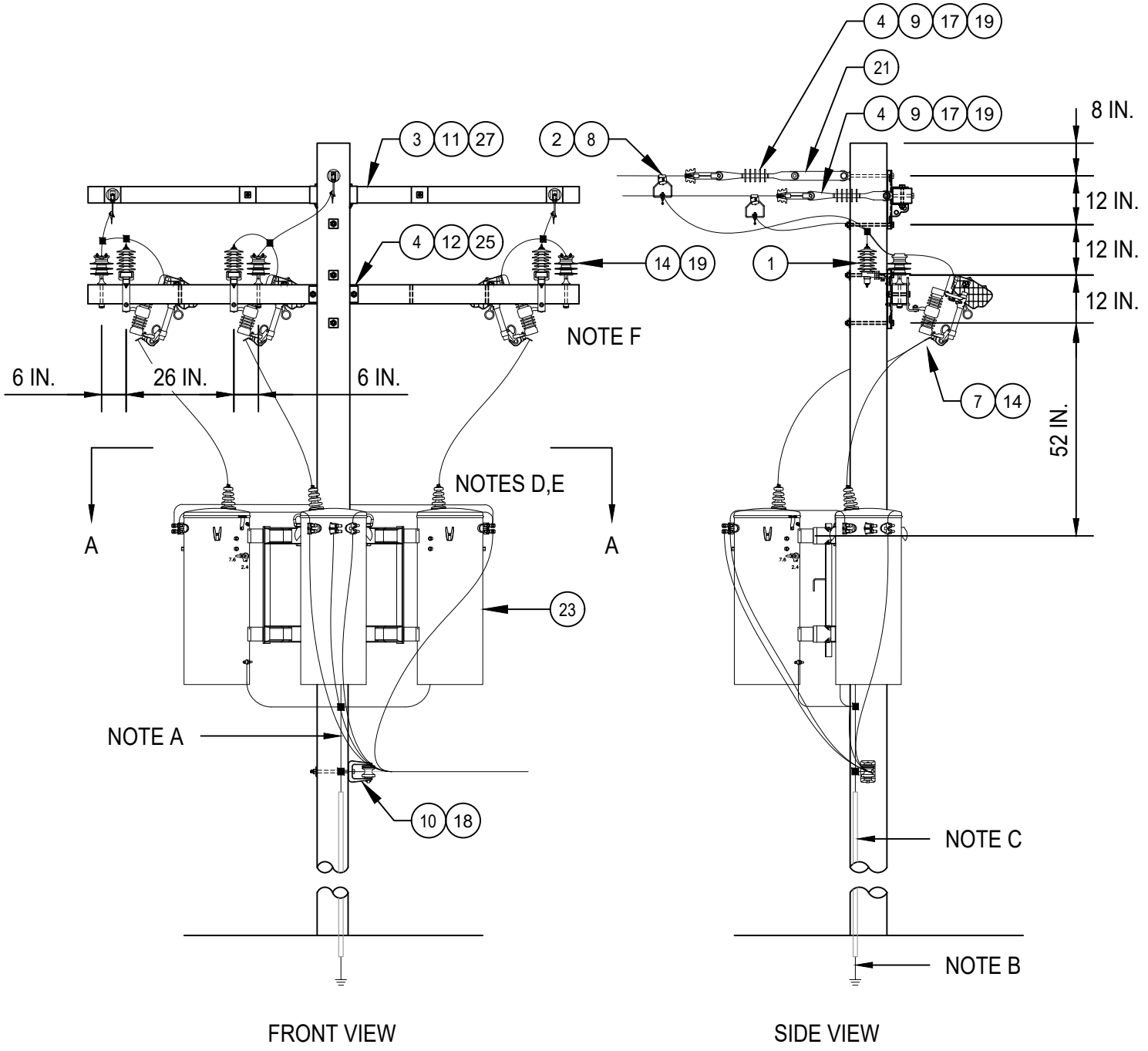
CITY LIGHT & POWER



DEADEND POLE SINGLE-BUSHING TRANSFORMER - CLUSTER-MOUNT FRAMING
FIBERGLASS CROSSARMS

Drawing Name	THREE-PHASE TRANSFORMERS - CLUSTER MOUNTED			
Drawing #	OH-15KV-XFR-2140	Scale : N.T.S.	Approved By: APS	Rev 1
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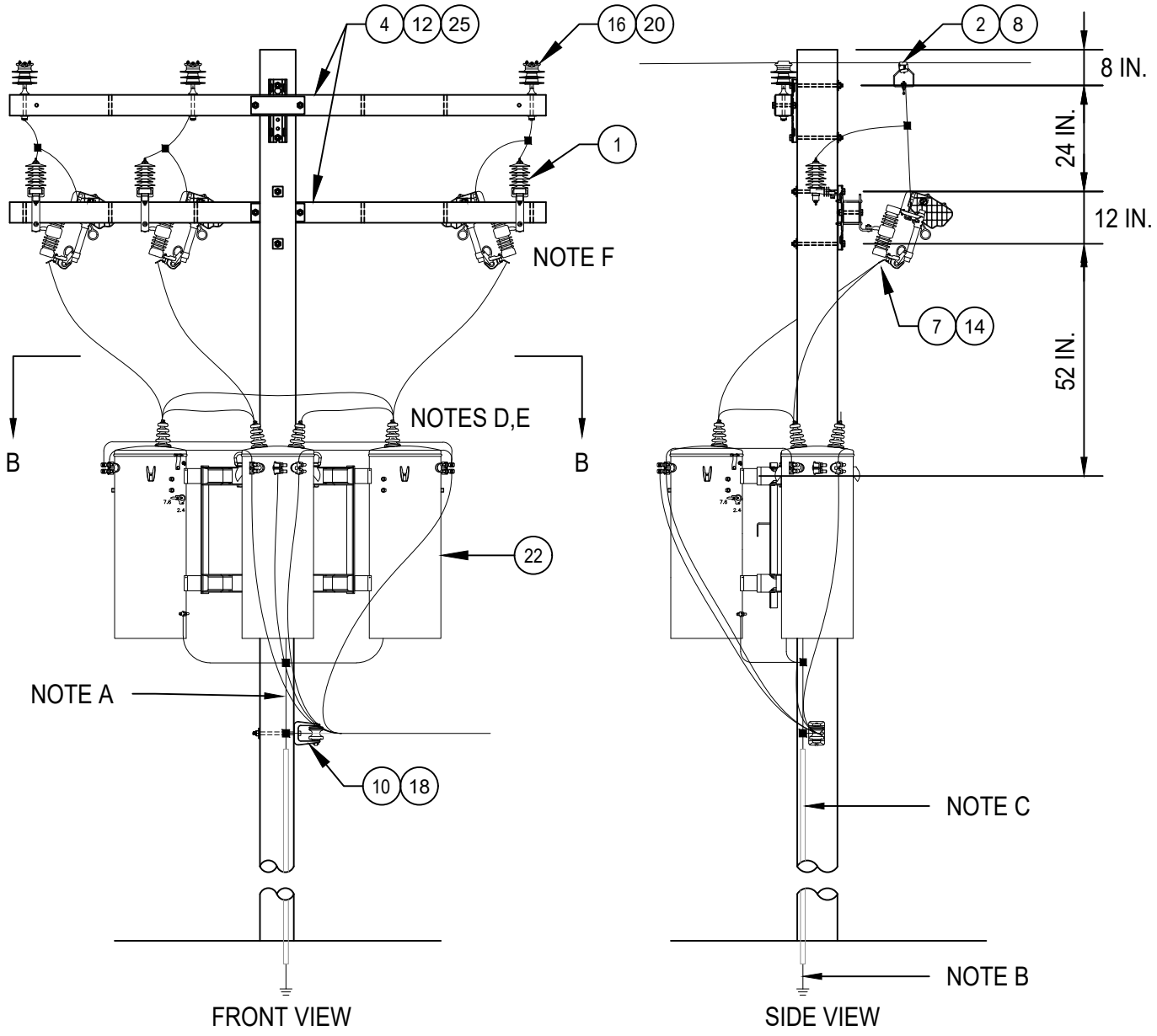
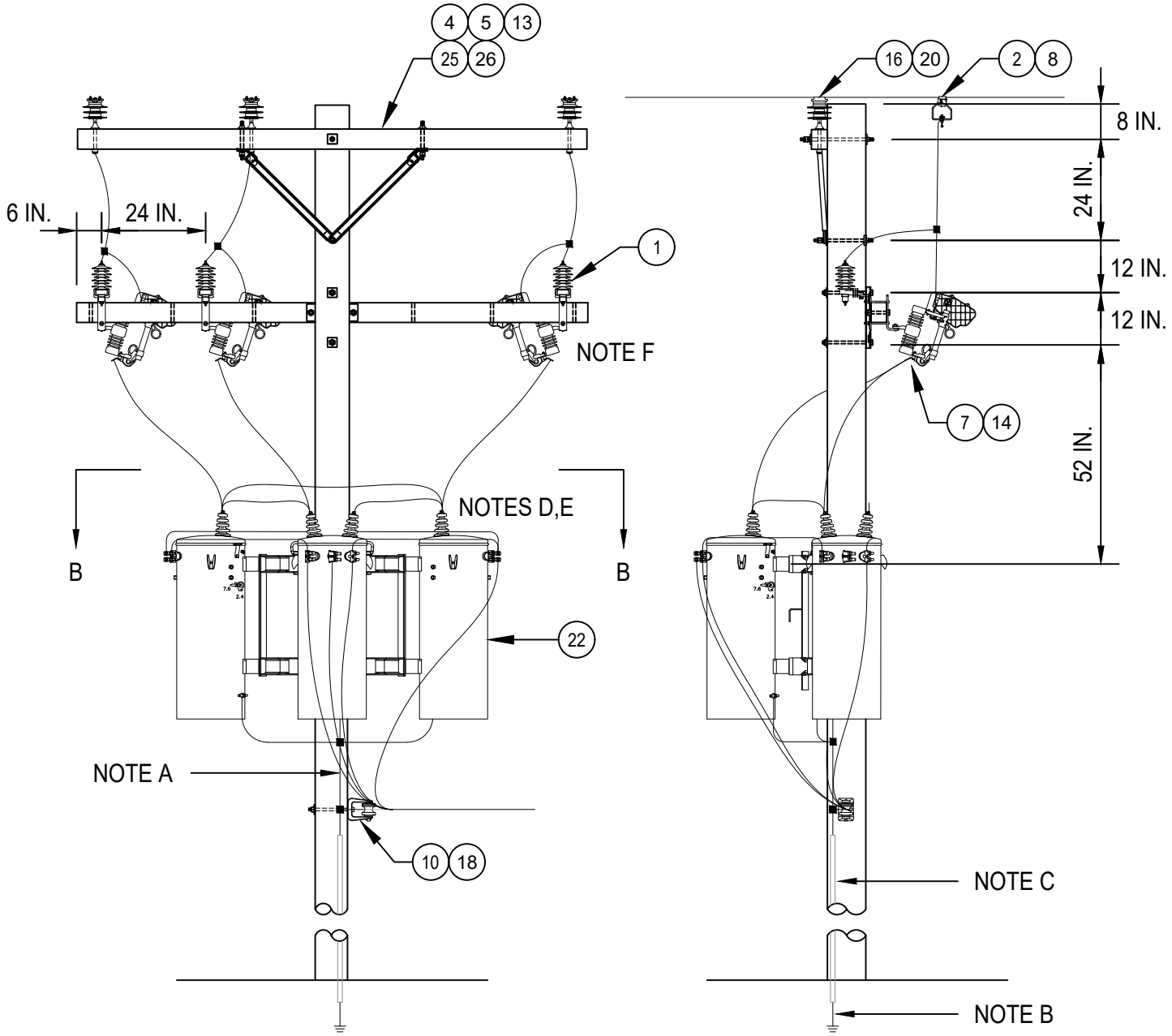
CITY LIGHT & POWER



TANGENT POLE DUAL-BUSHING TRANSFORMER - CLUSTER-MOUNT FRAMING
FIBERGLASS CROSSARMS

Drawing Name	THREE-PHASE TRANSFORMERS - CLUSTER MOUNTED			
Drawing #	OH-15KV-XFR-2140	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 6 of 8	Approval Date: 05/04/2021		1

CITY LIGHT & POWER



FRONT VIEW

SIDE VIEW

TANGENT POLE DUAL-BUSHING TRANSFORMER - CLUSTER-MOUNT FRAMING
FIBERGLASS CROSSARM AND WOOD CROSSARM

Drawing Name	THREE-PHASE TRANSFORMERS - CLUSTER MOUNTED			
Drawing #	OH-15KV-XFR-2140	Scale : N.T.S.	Approved By: APS	Rev
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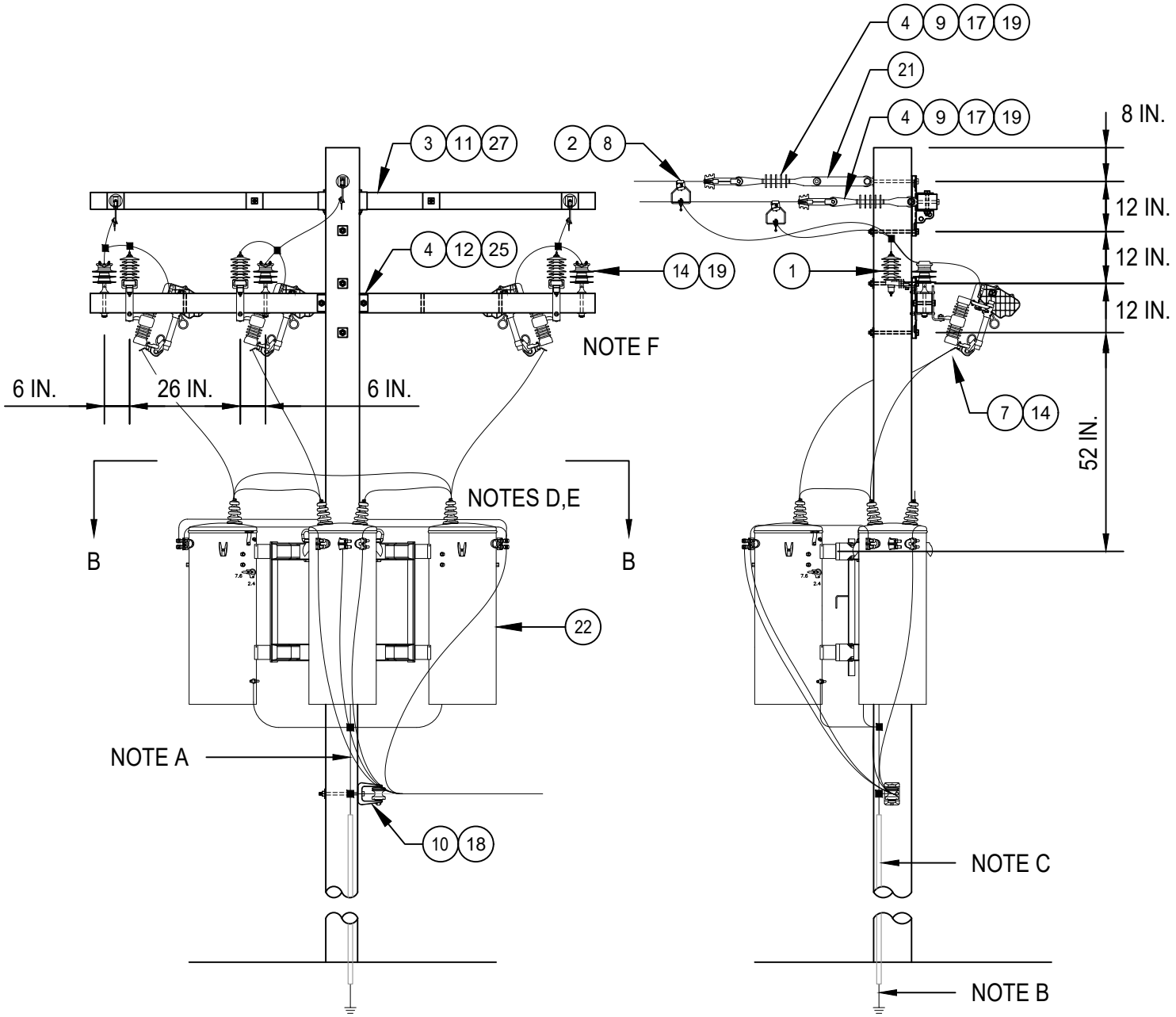
CITY LIGHT & POWER



DEADEND POLE DUAL-BUSHING TRANSFORMER CLUSTER-MOUNT FRAMING
FIBERGLASS CROSSARMS

Drawing Name	THREE-PHASE TRANSFORMERS - CLUSTER MOUNTED			
Drawing #	OH-15KV-XFR-2140	Scale : N.T.S.	Approved By: APS	Rev
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CITY LIGHT & POWER

TABLE 1: CLP RECOMMENDED RATINGS FOR DISTRIBUTION METAL-OXIDE SURGE ARRESTERS

Installation	System Grounding Configuration	System Nominal Voltage (kV) (P-P/P-G)	Recommended Arrester Selection kV rated (MCOV)
Joint Base Lewis-McChord (JBLM)	Three Wire Unigrounded System	13.8/7.97	15 (12.7)
Hill AFB (HAFB)	Four Wire Multi-Grounded	12.47/7.2	12 (10.2)
Hill AFB - UTTR	Four Wire Multi-Grounded	12.47/7.2	12 (10.2)
Hill AFB - LMTA	Four Wire Multi-Grounded	12.47/7.2	12 (10.2)
Travis AFB (TAFB)	Four Wire Impedance Grounded	12.47/7.2	15 (12.7)
March Air Reserve Base (MARB)	Three Wire Unigrounded System	13.8/7.97	15 (12.7)
Fort Riley (FTR)	Four Wire Multi-Grounded	12.47/7.2	12 (10.2)
Fort Campbell (FTC)	Four Wire Multi-Grounded	24.94/14.4	24 (19.5)
	Four Wire Multi-Grounded	12.47/7.2	12 (10.2)
Blue Grass Army Depot (BGAD)	Three Wire Unigrounded System	12.47/7.2	15 (12.7)
Keesler Air Force Base (KAFB)	Four Wire Multi-Grounded	22.86/13.2	24 (19.5)
	Four Wire Multi-Grounded	4.16/2.4	6 (5.1)
Army West Point (AWP)	Four Wire Multi-Grounded	13.8/7.97	15 (12.7)
	Four Wire Multi-Grounded	13.2/7.62	12 (10.2)
	Four Wire Multi-Grounded	4.16/2.4	6 (5.1)
Aberdeen Proving Ground (APG)	Four Wire Multi-Grounded	13.8/7.97	15 (12.7)
	Four Wire Multi-Grounded	4.16/2.4	6 (5.1)

TABLE 2: CLP RECOMMENDED ARRESTERS FOR DISTRIBUTION METAL-OXIDE SURGE ARRESTERS

Installation	Recommended Arrester Selection kV rated (MCOV)	Cooper 10kA Heavy Duty Arrester	Hubbell 20kA Heavy Duty Arrester	MacLean 10kA Heavy Duty Arrester
Joint Base Lewis-McChord (JBLM)	15 (12.7)	UHS15070XXXXXXX	213713-XXXX	ZHP015-XXXXXXX
Hill AFB (HAFB)	12 (10.2)	UHS12060XXXXXXX	213710-XXXX	ZHP012-XXXXXXX
Hill AFB - UTTR	12 (10.2)	UHS12060XXXXXXX	213710-XXXX	ZHP012-XXXXXXX
Hill AFB - LMTA	12 (10.2)	UHS12060XXXXXXX	213710-XXXX	ZHP012-XXXXXXX
Travis AFB (TAFB)	15 (12.7)	UHS15070XXXXXXX	213713-XXXX	ZHP015-XXXXXXX
March Air Reserve Base (MARB)	15 (12.7)	UHS15070XXXXXXX	213713-XXXX	ZHP015-XXXXXXX
Fort Riley (FTR)	12 (10.2)	UHS12060XXXXXXX	213710-XXXX	ZHP012-XXXXXXX
Fort Campbell (FTC)	24 (19.5)	UHS24100XXXXXXX	213720-XXXX	ZHP024- XXXXXXX
	12 (10.2)	UHS12060XXXXXXX	213710-XXXX	ZHP012-XXXXXXX
Blue Grass Army Depot (BGAD)	15 (12.7)	UHS15070XXXXXXX	213713-XXXX	ZHP015-XXXXXXX
Keesler Air Force Base (KAFB)	24 (19.5)	UHS24100XXXXXXX	213720-XXXX	ZHP024- XXXXXXX
	6 (5.1)	UHS09050XXXXXXX	213705-XXXX	ZHP006- XXXXXXX
	15 (12.7)	UHS15070XXXXXXX	213713-XXXX	ZHP015-XXXXXXX
	12 (10.2)	UHS12060XXXXXXX	213710-XXXX	ZHP012-XXXXXXX
	6 (5.1)	UHS09050XXXXXXX	213705-XXXX	ZHP006- XXXXXXX
Aberdeen Proving Ground (APG)	15 (12.7)	UHS15070XXXXXXX	213713-XXXX	ZHP015-XXXXXXX
	6 (5.1)	UHS09050XXXXXXX	213705-XXXX	ZHP006- XXXXXXX

Notes:

A. Above part numbers are incomplete and shown below as “X” in the part number. Refer to the manufacturer's website for complete ordering information. It is recommended to order a fully insulated arrester base bracket with each arrester for continued line operation in the event that an arrester fails.

Conductor description	Ampacity
1/0 ACSR 6/1 strand	242 AMPS
4/0 ACSR 6/1 strand	357 AMPS
336.4 ACSR 18/1 strand	579 AMPS
556.5 ACSR 24/7 strand	760 AMPS
795 AAC 37 strand	878 AMPS

TABLE 1: ACSR AND AAC ALLOWABLE AMPACITIES

Conductor description	Ampacity
1/0 7 strand	310 AMPS
4/0 7 strand	480 AMPS
250 19 strand	530 AMPS
350 19 strand	650 AMPS
500 37 strand	810 AMPS
750 61 strand	1040 AMPS

TABLE 2: BARE COPPER ALLOWABLE AMPACITIES

Conductor description	Ampacity
1/0 7 strand	305 AMPS
4/0 7 strand	465 AMPS
250 19 strand	520 AMPS
350 19 strand	640 AMPS
500 37 strand	785 AMPS
750 61 strand	995 AMPS

TABLE 3: COVERED COPPER ALLOWABLE AMPACITIES

Conductor size	Mfg.	Catalog no.
No. 6 through 1/0 ACSR No. 4 through 3/0 AAC	MacLean	HDSO-47
No. 4 through 4/0 ACSR No. 2 through 4/0 AAC	MacLean	HDSO-57
No. 2 through 336.4 ACSR No. 1 through 350AAC	MacLean	HDSO-70
336.4 through 954 ACSR 397.5 through 1,000 AAC	MacLean	HDSO-116

Table 1: Clamp, Side-Opening, Spring-Loaded, Straight Line Deadend
(Note A)

Conductor size	Allowable angle	Mfg.	Catalog no.
1/0 ACSR 6/1 neutral	0 to 15 degrees	Hubbell	TTSB416671
4/0 ACSR 6/1 neutral	0 to 15 degrees	Hubbell	TTSB416671
336.4 ACSR 18/1 neutral	0 to 15 degrees	Hubbell	TTSB416671
1/0 ACSR 6/1 neutral	16 to 60 degrees	Hubbell	AAC301
4/0 ACSR 6/1 neutral	16 to 60 degrees	Hubbell	AAC301
336.4 ACSR 18/1 neutral	16 to 60 degrees	Hubbell	AAC301

Table 2: Suspension Clamps for Neutral
(Note B)

Conductor size	Allowable angle	Mfg.	Catalog no.
1/0 ACSR 6/1	31 to 60 degrees	Hubbell	AAC301
4/0 ACSR 6/1	31 to 60 degrees	Hubbell	AAC301
336.4 ACSR 18/1	31 to 60 degrees	Hubbell	AAC301
556.5 ACSR	31 to 60 degrees	Hubbell	AAC10490N
795 AAC	31 to 60 degrees	Hubbell	AAC10490N

Table 3: Suspension Clamps for Primary
(Note B)

Notes:

A. The deadend clamps are for use with AAC and ACSR conductors only. They are not to be used for deadending copper conductors.

B. Angles exceeding 60° require a double deadend.

SUSPENSION AND DEADEND CLAMPS

Conductor size	Mfg.	Catalog no.
1/0 ACSR 6/1	Preformed Line Products	UTF-1205
4/0 ACSR 6/1	Preformed Line Products	UTF-1208
336.4 ACSR 18/1	Preformed Line Products	UTF-1210

Table 4: Preformed Top Ties
(Note A)

Conductor size	Mfg.	Catalog no.
1/0 ACSR 6/1	Preformed Line Products	EZSTC-275
4/0 ACSR 6/1	Preformed Line Products	EZSTC-278
336.4 ACSR 18/1	Preformed Line Products	EZSTC-280

Table 5: Preformed Side Ties
(Note A)

Notes:

A. The preformed tie wires listed above are for use with F neck insulators only.

B. Preformed tie wires shall be used on all 13.8kV pin type insulators.

PREFORMED TIE WIRES

Larger wire size	Smaller wire size	AMPACT Catalog #	Shell color code	Shell catalog #
795 AAC 37 strand	#6 ACSR 6/1	1-602121-4	Yellow	69338-4
	#4 ACSR 6/1	1-602121-3	Yellow	69338-4
	#2 ACSR 6/1	1-602121-2	Yellow	69338-4
	1/0 ACSR 6/1	1-602121-1	Yellow	69338-4
	4/0 ACSR 6/1	602121-8	Yellow	69338-4
	336.4 ACSR 18/1	602121-6	Yellow	69338-4
	556.5 ACSR 24/7	602121-3	Yellow	69338-4
	795 AAC 37 strand	602121-1	Yellow	69338-4
556.5 ACSR 24/7	#6 ACSR 6/1	2-602031-2	Yellow	69338-4
	#4 ACSR 6/1	2-602031-1	Yellow	69338-4
	#2 ACSR 6/1	1-602031-9	Yellow	69338-4
	1/0 ACSR 6/1	1-602031-7	Yellow	69338-4
	4/0 ACSR 6/1	1-602031-5	Yellow	69338-4
	336.4 ACSR 18/1	1-602031-3	Yellow	69338-4
	556.5 ACSR 24/7	1-602031-2	Yellow	69338-4
336.4 ACSR 18/1	#6 ACSR 6/1	602380	Blue	69338-1
	#4 ACSR 6/1	602380-1	Blue	69338-1
	#2 ACSR 6/1	602380-2	Blue	69338-1
	1/0 ACSR 6/1	602380-3	Blue	69338-1
	4/0 ACSR 6/1	602380-6	Blue	69338-1
	336.4 ACSR 18/1	602380-7	Blue	69338-1

Table 6: AMPACT Connectors
(AAC to AAC, AAC to ACSR, ACSR TO ACSR)

Note:

AMPACT connectors consist of a wedge member and a tapered C member. The connectors are furnished with an inhibitor (oxide inhibiting compound). The presence of the inhibitor is a critical component for making a reliable electrical connection. The AMPACT connectors are color coded to eliminate confusion regarding the shell (cartridge) to use. AMPACT has two power actuated tools to drive the wedge in the C member. The small AMPACT tools is used for red, white and blue coded connectors. The large AMPACT tool is used for yellow coded taps only. The correct tool must be used to provide a good electrical connection.

Larger wire size	Smaller wire size	AMPACT Catalog #	Shell color code	Shell catalog #
4/0 ACSR 6/1	#6 ACSR 6/1	600455	Blue	69338-1
	#4 ACSR 6/1	600456	Blue	69338-1
	#2 ACSR 6/1	600411	Blue	69338-1
	1/0 ACSR 6/1	600458	Blue	69338-1
	4/0 ACSR 6/1	600466	Blue	69338-1
1/0 ACSR 6/1	#6 ACSR 6/1	602283-2	White	69338-5
	#4 ACSR 6/1	602283-1	White	69338-5
	#2 ACSR 6/1	602283	White	69338-5
	1/0 ACSR 6/1	600403	Blue	69338-1
#2 ACSR 6/1	#6 ACSR 6/1	602283-3	White	69338-5
	#4 ACSR 6/1	602283-2	White	69338-5
	#2 ACSR 6/1	602283-1	White	69338-5
#4 ACSR 6/1	#6 ACSR 6/1	602283-4	White	69338-5
	#4 ACSR 6/1	602283-3	White	69338-5
#6 ACSR 6/1	#6 ACSR 6/1	602283-4	White	69338-5

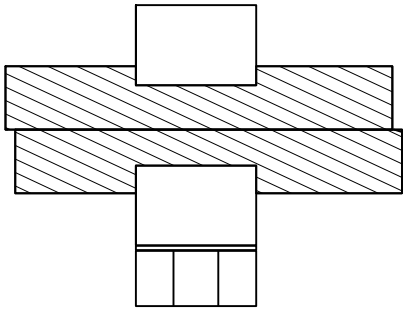
Table 6: AMPACT Connectors (Cont.)
(AAC to AAC, AAC to ACSR, ACSR TO ACSR)

Larger wire size	Smaller wire size	AMPACT Catalog #	Shell color code	Shell catalog #
795 AAC 37 strand	#6 Cu	1-602121-4	Yellow	69338-4
	#4 Cu	1-602121-3	Yellow	69338-4
	#2 Cu	1-602121-2	Yellow	69338-4
	1/0 Cu. 7 strand	1-602121-1	Yellow	69338-4
	4/0 Cu. 7 strand	602121-8	Yellow	69338-4
	250 Cu. 19 strand	602121-7	Yellow	69338-4
	350 Cu. 19 strand	602121-6	Yellow	69338-4
	500 Cu. 37 Strand	602121-4	Yellow	69338-4
	750 Cu. 61 strand	602121-1	Yellow	69338-4
556.5 ACSR 24/7	#6 Cu	2-602031-2	Yellow	69338-4
	#4 Cu	2-602031-1	Yellow	69338-4
	#2 Cu	2-602031-0	Yellow	69338-4
	1/0 Cu. 7 strand	1-602031-8	Yellow	69338-4
	4/0 Cu. 7 strand	1-602031-5	Yellow	69338-4
	250 Cu. 19 strand	1-602031-4	Yellow	69338-4
	350 Cu. 19 strand	1-602031-3	Yellow	69338-4
	500 Cu. 37 Strand	1-602031-2	Yellow	69338-4
	750 Cu. 61 strand	602121-4	Yellow	69338-4
336.4 ACSR 18/1	#6 Cu	602014	Yellow	69338-4
	#4 Cu	602013	Yellow	69338-4
	#2 Cu	602000	Yellow	69338-4
	1/0 Cu. 7 strand	602001	Yellow	69338-4
	4/0 Cu. 7 strand	602004	Yellow	69338-4
	250 Cu. 19 strand	602006	Yellow	69338-4
	350 Cu. 19 strand	602007	Yellow	69338-4

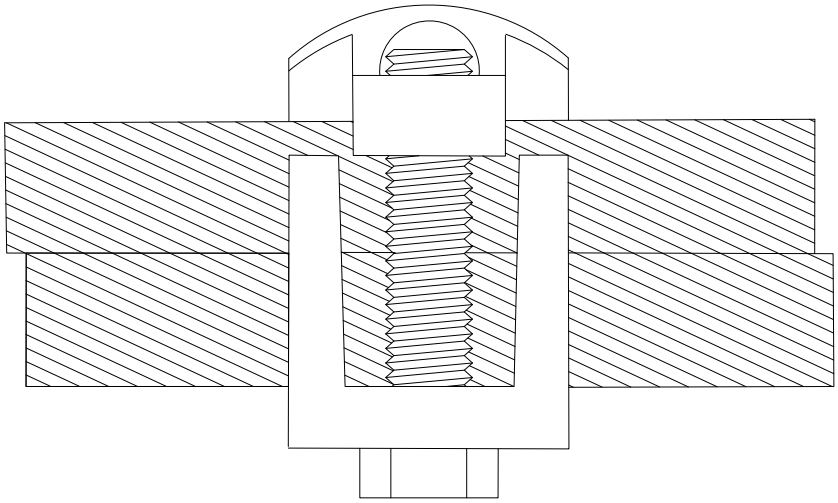
Table 7: AMPACT Connectors
(AAC to Copper, ACSR to Copper)

Larger wire size	Smaller wire size	AMPACT Catalog #	Shell color code	Shell catalog #
4/0 ACSR 6/1	#6 Cu	600455	Blue	69338-1
	#4 Cu	600456	Blue	69338-1
	#2 Cu	600411	Blue	69338-1
	1/0 Cu. 7 strand	600458	Blue	69338-1
	4/0 Cu. 7 strand	600466	Blue	69338-1
	250 Cu. 19 strand	602046-7	Blue	69338-1
1/0 ACSR 6/1	#6 Cu	600446	Blue	69338-1
	#4 Cu	600447	Blue	69338-1
	#2 Cu	600403	Blue	69338-1
	1/0 Cu. 7 strand	600403	Blue	69338-1
	4/0 Cu. 7 strand	600458	Blue	69338-1
#2 ACSR 6/1	#6 Cu	602283-3	White	69338-5
	#4 Cu	602283-2	White	69338-5
	#2 Cu	602283-1	White	69338-5
	1/0 Cu. 7 strand	602283	White	69338-5
#4 ACSR 6/1	#6 Cu	602283-4	White	69338-5
	#4 Cu	602283-3	White	69338-5
	#2 Cu	602283-2	White	69338-5
#6 ACSR 6/1	#6 Cu	602283-4	White	69338-5
	#4 Cu	602283-4	White	69338-5

Table 7: AMPACT Connectors (Cont.)
(AAC to Copper, ACSR to Copper)



TYPE 1
CARNEY TYPE



TYPE 2
2-BOLT TYPE

AWG. DIA.	#10 0.102 IN.	#8 0.129 IN.	#6 0.162 IN.	#4 0.204 IN.	#2 0.292 IN.	1/0 0.398 IN.	4/0 0.563 IN.	336.4 KCMIL 0.684 IN.	556.5 KCMIL 0.914 IN.	795 KCMIL 1.026 IN.
#4 0.204 IN.	MANUFACTURER: BLACKBURN CATALOG ID: VGC12					MANUFACTURER: BLACKBURN CATALOG ID: VGC2010				
#2 0.292 IN.	MANUFACTURER: BLACKBURN CATALOG ID: VGC3020									
1/0 0.398 IN.										
4/0 0.563 IN.	MANUFACTURER: BURNDY CATALOG ID: KVS28A									
336.4 KCMIL 0.684 IN.		MANUFACTURER: BURNDY CATALOG ID: KVS31A								
556.5 KCMIL 0.914 IN.		MANUFACTRER: BURNDY CATALOG ID: KV44A								
795 KCMIL 1.026 IN.										MANUFACTURER: BURNDY CATALOG ID: KVS44A

BOLTED CONNECTORS COPPER TO COPPER SECONDARY

Drawing Name	GENERAL OVERHEAD CABLE HARDWARE			
Drawing #	OH-TYP-CBL-2531	Scale : N.T.S.	Approved By: APS	Rev 1
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CITY LIGHT & POWER

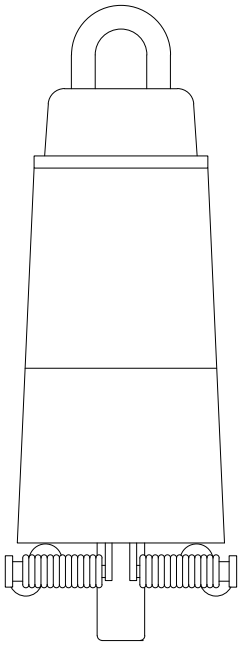
BILL OF MATERIALS				
ITEM	DESCRIPTION	MANUFACTURER	CATALOG NO.	QUANTITY
1	Indicator, Fault, Overhead	SEL	AR360	As Needed

Notes:

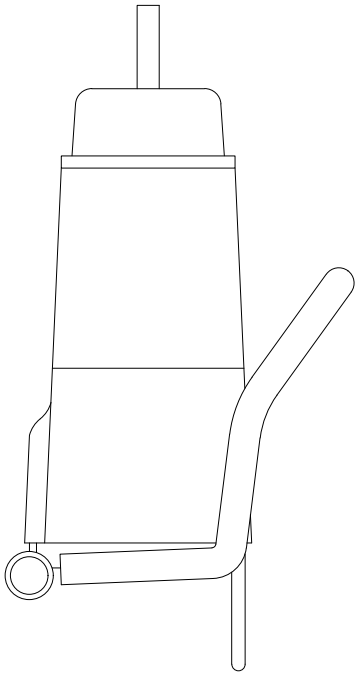
A. SEL AR360 fault indicators are to be used exclusively at CLP for overhead applications.

B. Purchasing and placement of fault indicators are as needed. Contact CLP engineering for placement recommendations.

C. Manufacturer instructions for programming and installation come with every unit. Contact CLP engineering if instructions were not provided with the order or if clarifications are needed.



TOP VIEW



SIDE VIEW

DETAIL 1: FAULT INDICATOR - SEL AR360

Drawing Name	OVERHEAD MOUNTED FAULT INDICATORS			
Drawing #	OH-TYP-FIN-2553	Scale : N.T.S.	Approved By: APS	Rev 0
City Light & Power Construction Detail Standards	Sheet 1 of 1	Approval Date: 05/04/2021		

CITY LIGHT & POWER

TABLE 1: CLP RECOMMENDED DISTRIBUTION POLYMER 100A FUSED CUTOUTS

Installation	System Nominal Voltage (P-P/P-G) (KV)	Voltage Rating (KV)	ABB Part No.	Hubbell Part No.
Joint Base Lewis-McChord (JBLM)	13.8/7.97	15	AJ11TR3N12K0	CP710112-EBF
Hill AFB (HAFB)	12.47/7.2	15	AJ11TR3N12K0	CP710112-EBF
Hill AFB - UTTR	12.47/7.2	15	AJ11TR3N12K0	CP710112-EBF
Hill AFB - LMTA	12.47/7.2	15	AJ11TR3N12K0	CP710112-EBF
Travis AFB (TAFB)	12.47/7.2	15	AJ11TR3N12K0	CP710112-EBF
March Air Reserve Base (MARB)	13.8/7.97	15	AJ11TR3N12K0	CP710112-EBF
Fort Riley (FTR)	12.47/7.2	15	AJ11TR3N12K0	CP710112-EBF
Fort Campbell (FTC)	24.94/14.4	38, 36	X4JRFFTM12K	CP710613-EBF
	12.47/7.2	15	AJ11TR3N12K0	CP710112-EBF
Blue Grass Army Depot (BGAD)	12.47/7.2	15	AJ11TR3N12K0	CP710112-EBF
Keesler Air Force Base (KAFB)	22.86/13.2	27	AJ21TR2N12K0	CP710213-EBF
	4.16/2.4	15	AJ11TR3N12K0	CP710112-EBF
Army West Point (AWP)	13.8/7.97	15	AJ11TR3N12K0	CP710112-EBF
	13.2/7.62	15	AJ11TR3N12K0	CP710112-EBF
	4.16/2.4	15	AJ11TR3N12K0	CP710112-EBF
Aberdeen Proving Ground (APG)	13.8/7.97	15	AJ11TR3N12K0	CP710112-EBF
	4.16/2.4	15	AJ11TR3N12K0	CP710112-EBF

Notes:

1. Fuse links ordered separately.
2. All cutouts interrupt ratings are below. If a higher interrupt rating is required contact CLP engineering.
   - 2.1. ABB 15KV, 27KV, 38KV: 10KA
   - 2.2. Hubbell 15KV: 10KA
   - 2.3. Hubbell 27KV, 36KV: 12KA
3. No arc chutes are specified. If arc chutes are required for load breaking contact CLP engineering.
4. Cutouts specified for 100A fuse holder and NEMA B crossarm bracket with 6" carriage bolts.
5. Cutouts have an option for 300A disconnect blade.
6. ABB options use a rotatable bottom terminal.
7. Hubbell options use a small eyebolt.
8. Wildlife protection is provided with each cutout.

TABLE 1: CLP RECOMMENDED DISTRIBUTION POLYMER 200A FUSED CUTOUTS

Installation	System Nominal Voltage (P-P/P-G) (KV)	Voltage Rating (KV)	ABB Part No.	Hubbell Part No.
Joint Base Lewis-McChord (JBLM)	13.8/7.97	15	AJ11TR3N32K0	CP710143-LBF
Hill AFB (HAFB)	12.47/7.2	15	AJ11TR3N32K0	CP710143-LBF
Hill AFB - UTTR	12.47/7.2	15	AJ11TR3N32K0	CP710143-LBF
Hill AFB - LMTA	12.47/7.2	15	AJ11TR3N32K0	CP710143-LBF
Travis AFB (TAFB)	12.47/7.2	15	AJ11TR3N32K0	CP710143-LBF
March Air Reserve Base (MARB)	13.8/7.97	15	AJ11TR3N32K0	CP710143-LBF
Fort Riley (FTR)	12.47/7.2	15	AJ11TR3N32K0	CP710143-LBF
Fort Campbell (FTC)	24.94/14.4	38, 36	Not Available	CP710643-LBF
	12.47/7.2	15	AJ11TR3N32K0	CP710143-EBF
Blue Grass Army Depot (BGAD)	12.47/7.2	15	AJ11TR3N32K0	CP710143-LBF
Keesler Air Force Base (KAFB)	22.86/13.2	27	AJ21TR2N32K0	CP710243-LBF
	4.16/2.4	15	AJ11TR3N32K0	CP710143-LBF
Army West Point (AWP)	13.8/7.97	15	AJ11TR3N32K0	CP710143-LBF
	13.2/7.62	15	AJ11TR3N32K0	CP710143-LBF
	4.16/2.4	15	AJ11TR3N32K0	CP710143-LBF
Aberdeen Proving Ground (APG)	13.8/7.97	15	AJ11TR3N32K0	CP710143-LBF
	4.16/2.4	15	AJ11TR3N32K0	CP710143-LBF

Notes:

1. Fuse links ordered separately.
2. All cutouts interrupt ratings are below. If a higher interrupt rating is required contact CLP engineering.
   - 2.1. ABB 15KV, 27KV: 10KA
   - 2.2. Hubbell 15KV, 27KV, 36KV: 12KA
3. No arc chutes are specified. If arc chutes are required for load breaking contact CLP engineering.
4. Cutouts specified for 200A fuse holder and NEMA B crossarm bracket with 6" carriage bolts.
5. Cutouts have an option for 300A disconnect blade.
6. ABB options use a rotatable bottom terminal.
7. Hubbell options use a large eyebolt.
8. Wildlife protection is provided with each cutout.

A. General

a. Grounding is the practice of connecting an equipment device or wiring system with a grounding electrode.

b. Circuits are grounded for the purpose of limiting the voltage upon the circuit which might otherwise occur through the exposure to lightning or other voltages higher than that for which the circuit is designed; and to limit the maximum potential to ground due to normal voltage. Grounding is also provided for the purpose of preventing a potential above ground on exposed conductive materials enclosing or forming a part of a line device.

B. Driven Grounds

a. Refer to CLP Standard OH-TYP-GND-2565 Pole Grounding for specific pole grounding requirement.
b. All new or renewed poles where a common neutral/system neutral is present must have a No. 4 covered soft drawn Cu wire installed from the common neutral/system neutral to a driven ground. Not all CLP electrical distribution systems are multipoint grounded wye configuration. Consult with CLP Engineering for Site specific grounding before construction.
c. Poles supporting 34.5 kV, 46 kV or 60kV equipment and all riser poles require a 1/0 soft drawn stranded covered Cu. grounding conductor. If a common neutral/system neutral is present, the 1/0 grounding conductor must be connected to it. Grounding requirements are detailed in Section A standards where applicable.
d. When grounds are required on a 34.5 kV, 46kV or 60kV system, the maximum ground resistance must not exceed 25 ohms. To achieve this requirement, multiple rods may be required. Deep-driving of coupled rods is preferred. However, where soil conditions do not permit deep-driving, single rods should be installed ten feet apart. The rods will be connected by 1/0 soft drawn stranded bare copper wire buried a minimum of 6 inches. A ground rod clamp will be used to connect the rod to the conductor.

C. Equipment Grounding/System Neutral

a. The following line equipment shall be grounded by proper connection to a driven ground and to the common neutral conductor when the latter is available:
i. All transformer cases
ii. Reclosers
iii. Surge arresters
iv. Switch bases and operating handles on gang-operated load interrupter switches.
v. Aluminum beams on all equipment platforms
b. All streetlight brackets must be grounded.
c. In addition to the above, CLP requires a grounding conductor to be installed at every pole supporting a system neutral.

D. Ground Resistance

a. Maximum ground resistances are as follows:
i. Equipment on a 34.5 kV, 46 k, or 60kV subtransmission system - 25 ohms
ii. Equipment on a 12.47kV or 13.8 kV distribution system - 10 ohms.

Drawing Name	GENERAL OVERHEAD GROUNDING			
Drawing #	OH-TYP-GND-2560	Scale : N.T.S.	Approved By: APS	Rev 1
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CITY LIGHT & POWER

Notes:

A. When installing section ground rods, use driving stud.

B. All ground rods shall be copper-clad.

C. Install #6 soft drawn, solid, copper wire from system neutral to driven ground. If the pole has arresters, reclosers, switches, or transformers attached to it, install #4 soft drawn, solid, covered copper wire instead.

D. Install molding over the grounding conductor, from 10 ft. above grade to 6 in below grade. Secure with staples every 24 inches.

E. When installing two or more ground rods, install a minimum 6 ft apart.

F. Install grounding rods a minimum every other pole and at each pole where arresters, reclosers, transformers, and/or switches are installed on the pole.

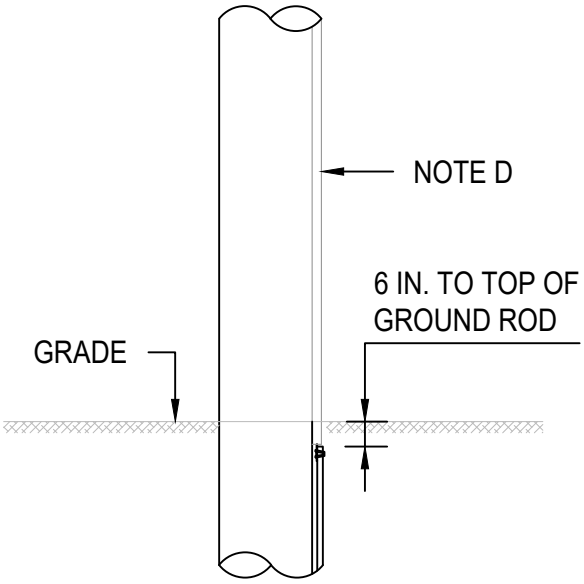
G. When a Construction Standard calls for a single ground rod, install two ground rods for ground rods buried in 100% gravel or hydraulic sand as the predominate.

H. Install all ground rods for pole grounding a minimum 12 in below grade.

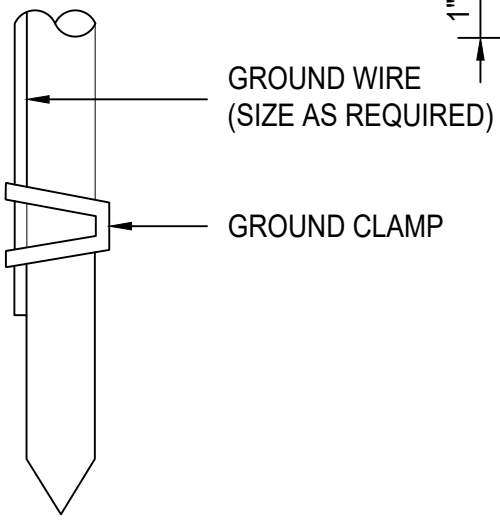
I. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.

INSTALLATION SITE	TYPICAL PER POLE GROUND RODS	GROUND ROD SIZE
Army West Point	1	8' x 1/2"
Joint Base Lewis McChord	2	10' x 3/4"
Fort Riley	1	8' x 5/8"
Hill Air Force Base	1	8' x 5/8"
March Air Reserve Base	1	8' x 5/8"
Bluegrass Army Depot	1	8' x 5/8"
Keesler Air Force Base	1	8' x 5/8"
Travis Air Force Base	1	8' x 5/8"
Fort Campbell	1	8' x 5/8"

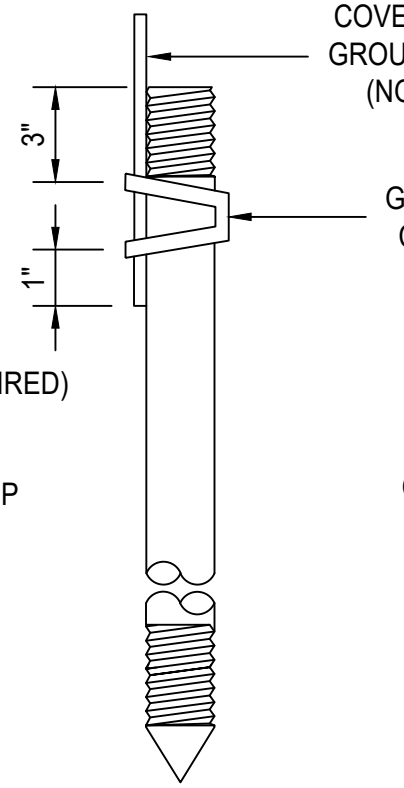
TABLE 1: SITE SPECIFIC POLE GROUNDING REQUIREMENTS



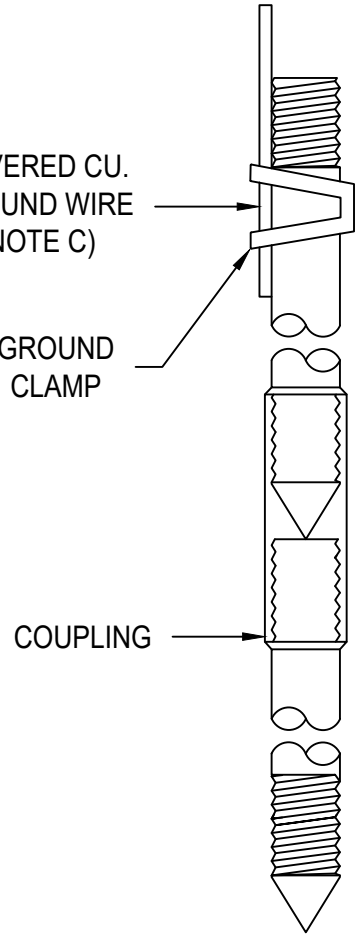
DETAIL 1: POLE GROUND ROD



DETAIL 2: POLE GROUND ROD



DETAIL 3: POLE GROUND ROD



DETAIL 4: 8FT. POLE GROUND ROD

GROUND ROD DETAILS - GROUND ROD

Drawing Name	POLE GROUNDING				
Drawing #	OH-TYP-GND-2565	Scale : N.T.S.	Approved By: APS	Rev	CITY LIGHT & POWER
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Notes:

A. Fiberglass guy strain insulators are installed to protect the public and CLP construction personnel from injury should a guy contact an energized conductor or rigid live part:
   a. Guy insulators must be positioned such that if the guy breaks at any point, or if energized conductors, guys, or span wires become slack, the energized portion of the guy will be out of the reach of the public.
   b. Guy insulators must be installed below the lowest conductor in an anchor guy and for a head guy, an insulator must be positioned so it falls below the lowest conductor should the guy break.

B. A sufficient number of 12 ft. fiberglass guy strain insulators must be installed so that the lowest fiberglass insulator extends a minimum of 4 ft. below the lowest primary and or primary rigid live part should the guy break and hang straight down the pole. This requirement applies to 5 kV, 15 kV, and 35 kV voltages. The insulator must be positioned in the anchor so that in the event the guy breaks and hangs straight down the pole, the insulator will be below the lowest conductor and positioned a minimum distance of 10 ft. above the ground.

C. Anchor guys installed to support secondary conductors, CLP field spun aerial cable and CLP fiber optic cable require a fiberglass guy strain insulator. The guy strain insulator must be installed below the lowest conductor and positioned a minimum of 10 ft. above the ground should the guy hang straight down the pole.

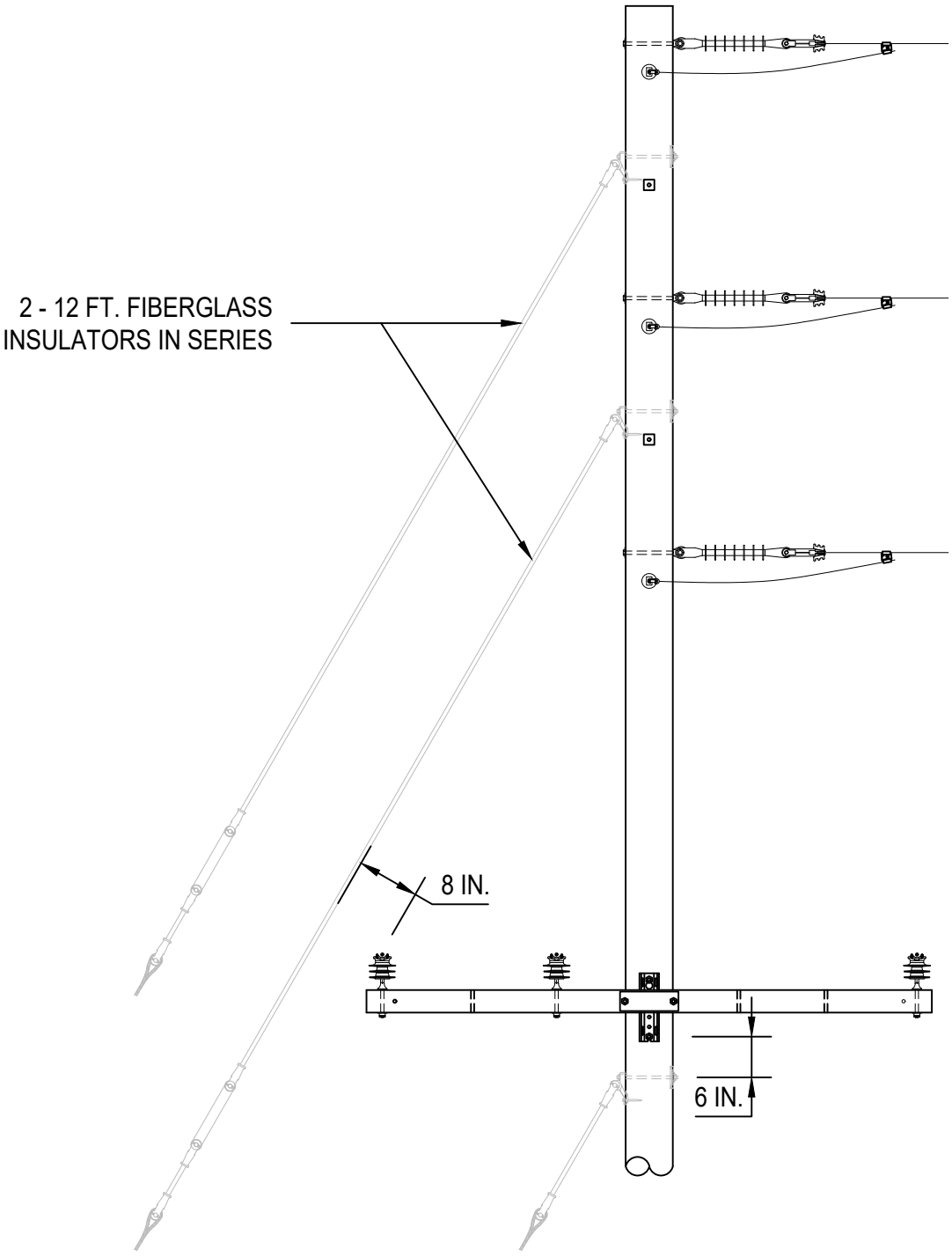
D. All guy strands must have a yellow guy marker installed.

E. Anchor guys or head guys passing by distribution conductors/rigid live parts must maintain a minimum clearance of 8 inches.

F. Anchor guys or head guys passing by 35 kV conductors/rigid parts must maintain a minimum clearance of 14 inches.

G. Insulators must extend below primary conductors a min. of 4 feet; install a 6 in. link between insulators.

H. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.



GUY INSULATOR REQUIREMENTS

GUY MARKERS AND GUY CLEARANCE

Drawing Name	GENERAL GUYING INFORMATION			
Drawing #	OH-TYP-GUY-2600	Scale : N.T.S.	Approved By: APS	Rev
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Typical Guying Assemblies	APG	AWP	BGAD	FTC	FTR	HAFB	JBLM	KAFB	MARB	TAFB
16,000-lbs Guying Assembly (16K)					X	X	X	X	X	X
21,000-lbs Guying Assembly (21K)	X	X	X	X						

TABLE 1: TYPICAL PRIMARY VOLTAGE POLE DOWN GUY ASSEMBLIES BY CLP SITE

Typical Anchors	APG	AWP	BGAD	FTC	FTR	HAFB	JBLM	KAFB	MARB	TAFB
Anchor, Plate, 18" Plate Diameter, 8' rod, 3/4" Diameter Rod						X	X			
Anchor, Expanding, 10" Anchor Hole, 3/4" Diameter Rod										
Anchor, Single Helix PISA, 8" Helix, 5/8" Threads					X					
Anchor, Single Helix PISA, 10" Helix, 1" Threads					X					
Anchor, Single Helix PISA, 12" Helix, 1" Threads										
Anchor, Twin Helix PISA, 8" Helix, 1" Threads										

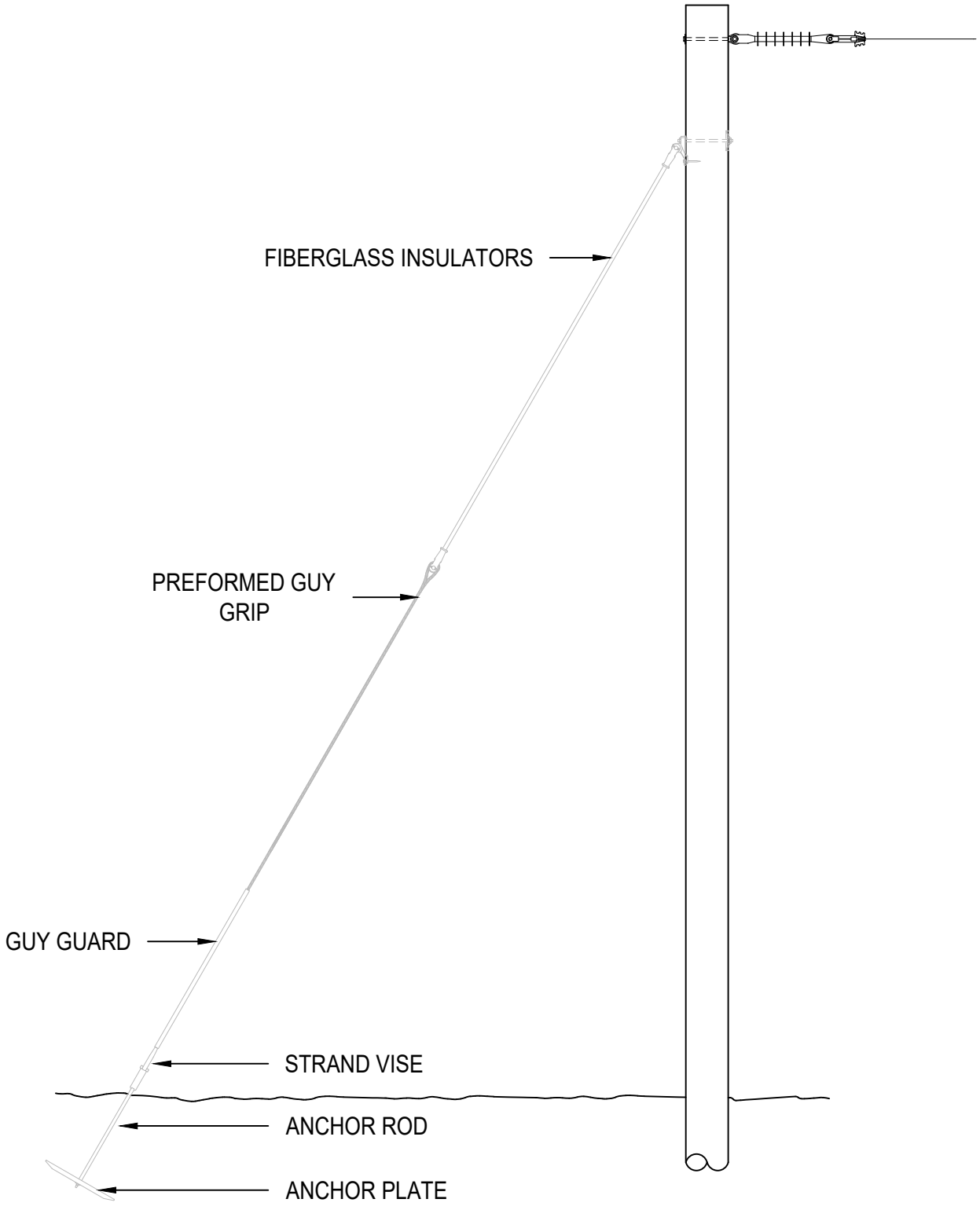
TABLE 2: TYPICAL PRIMARY VOLTAGE POLE DOWN GUY ANCHORS BY CLP SITE

DESCRIPTION	QUANTITY
5/8" D/A Through Bolt, Square Curved Washers, Nuts (Upper Pole Eye Plate Fastener)	2
Combination Pole Eye Hook/Plate, 16,000-lbs, Ductile Iron, Hot Dip Galvanized, 13/16" Upper, 13/16" Lower, 13/16" Clevis	1
72" Fiberglass Guy Strain Insulator, 16,000-lbs, Ductile Iron, Hot Dip Galvanized, Clevis 1st End Fitting, Thimble Eye + Roller 2nd End Fitting	As Req
Dead-end Preform Grip, 5/8", Matched Guy Wire Material	1
3/8" EHS Guy Wire, Stranded Galvanized Steel	As Req
Strand Vice Dead-end, 3/8", EHS	1
Anchor Rod, 7' Length, Type/Diameter to Match Anchor	1
Guy Guard, Yellow	1

TABLE 3: TYPICAL 16,000-LB DOWN GUY ASSEMBLY

DESCRIPTION	QUANTITY
3/4" D/A Through Bolt, Square Curved Washers, Nuts (Upper Pole Eye Plate Fastener)	2
Combination Pole Eye Hook/Plate, 21,000-lbs, Ductile Iron, Hot Dip Galvanized, 13/16" Upper, 13/16" Lower, 13/16" Clevis	1
72" Fiberglass Guy Strain Insulator, 21,000-lbs, Ductile Iron, Hot Dip Galvanized, Clevis 1st End Fitting, Thimble Eye + Roller 2nd End Fitting	As Req
Dead-end Preform Grip, 7/16", Matched Guy Wire Material	1
7/16" EHS Guy Wire, Stranded Galvanized Steel	As Req
Strand Vice Dead-end, 7/16", EHS	1
Anchor Rod, 7' Length, Type/Diameter to Match Anchor	1
Guy Guard, Yellow	1

TABLE 4: TYPICAL 21,000-LB DOWN GUY ASSEMBLY



ANCHOR GUYS - GUY STRAIN INSULATORS

Drawing Name	DOWN GUY				
Drawing #	OH-TYP-GUY-2605	Scale : N.T.S.		Approved By: APS	Rev 1
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Typical Guying Assemblies	APG	AWP	BGAD	FTC	FTR	HAFB	JBLM	KAFB	MARB	TAFB
16,000-lbs Guying Assembly (16K)					X	X	X	X	X	X
21,000-lbs Guying Assembly (21K)	X	X	X	X						

TABLE 1: TYPICAL PRIMARY VOLTAGE POLE SPAN GUY ASSEMBLIES BY CLP SITE

Typical Anchors	APG	AWP	BGAD	FTC	FTR	HAFB	JBLM	KAFB	MARB	TAFB
Anchor, Plate, 3/4" Diameter Rod						X	X			
Anchor, Expanding, 10" Anchor Hole, 3/4" Diameter Rod										
Anchor, Single Helix PISA, 8" Helix, 5/8" Threads					X					
Anchor, Single Helix PISA, 10" Helix, 1" Threads					X					
Anchor, Single Helix PISA, 12" Helix, 1" Threads										
Anchor, Twin Helix PISA, 8" Helix, 1" Threads										

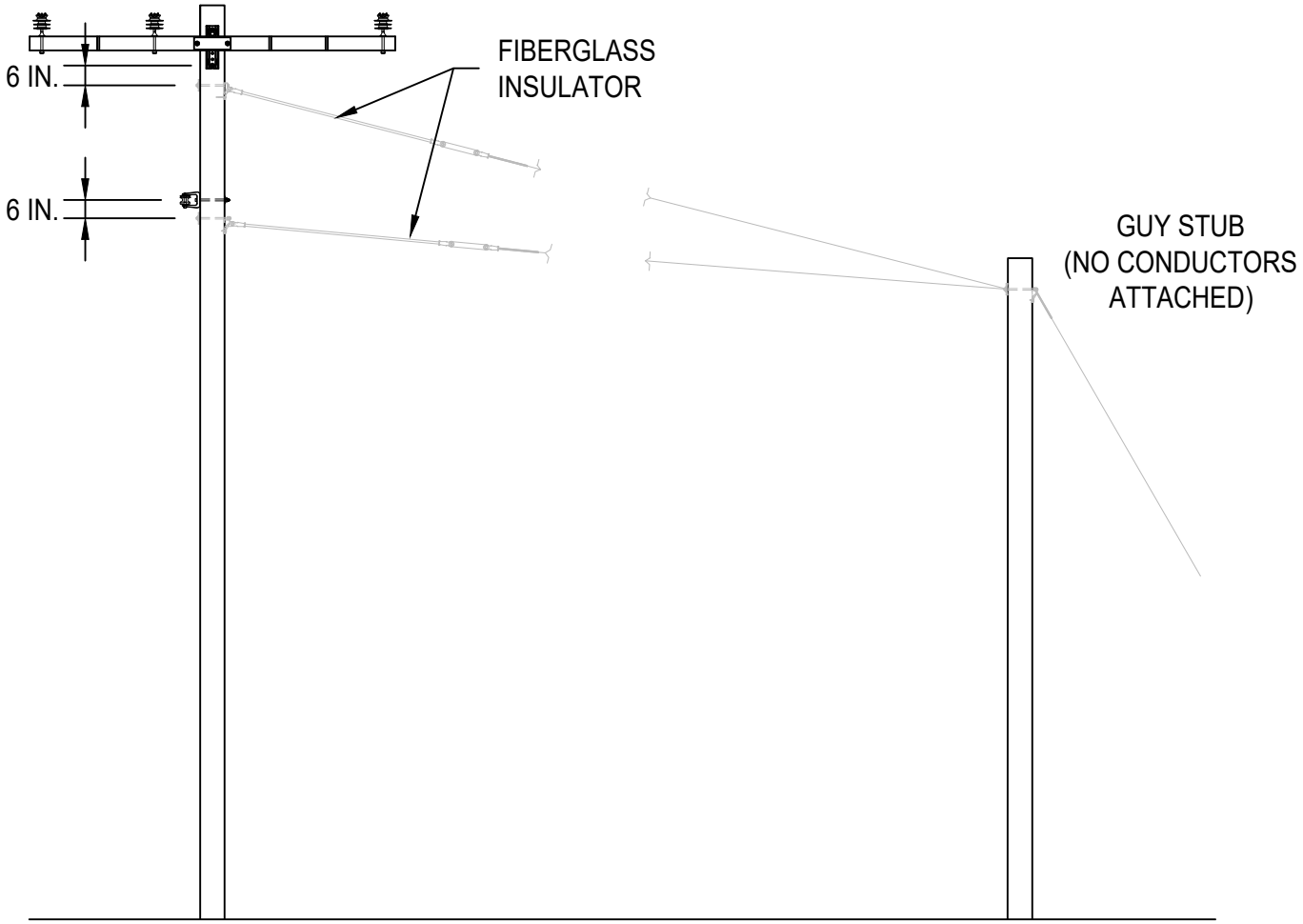
TABLE 2: TYPICAL PRIMARY VOLTAGE POLE SPAN GUY ANCHORS BY CLP SITE

DESCRIPTION	QUANTITY
5/8" D/A Through Bolt, Square Curved Washers, Nuts (Upper Pole Eye Plate Fastener)	2
Combination Pole Eye Hook/Plate, 16,000-lbs, Ductile Iron, Hot Dip Galvanized, 13/16" Upper, 13/16" Lower, 13/16" Clevis	2
72" Fiberglass Guy Strain Insulator, 16,000-lbs, Ductile Iron, Hot Dip Galvanized, Clevis 1st End Fitting, Thimble Eye + Roller 2nd End Fitting	As Req
Dead-end Preform Grip, 5/8", Matched Guy Wire Material	As Req
3/8" EHS Guy Wire, Stranded Galvanized Steel	As Req
Strand Vice Dead-end, 3/8", EHS	1
Anchor Rod, 7' Length, Type/Diameter to Match Anchor	1
Guy Guard, Yellow	1
Class 4 Guy Pole	1

TABLE 3: TYPICAL 16,000-LB SPAN GUY ASSEMBLY

DESCRIPTION	QUANTITY
3/4" D/A Through Bolt, Square Curved Washers, Nuts (Upper Pole Eye Plate Fastener)	2
Combination Pole Eye Hook/Plate, 21,000-lbs, Ductile Iron, Hot Dip Galvanized, 13/16" Upper, 13/16" Lower, 13/16" Clevis	2
72" Fiberglass Guy Strain Insulator, 21,000-lbs, Ductile Iron, Hot Dip Galvanized, Clevis 1st End Fitting, Thimble Eye + Roller 2nd End Fitting	As Req
Dead-end Preform Grip, 7/16", Matched Guy Wire Material	As Req
7/16" EHS Guy Wire, Stranded Galvanized Steel	As Req
Strand Vice Dead-end, 7/16", EHS	1
Anchor Rod, 7' Length, Type/Diameter to Match Anchor	1
Guy Guard, Yellow	1
Class 4 Guy Pole	1

TABLE 4: TYPICAL 21,000-LB SPAN GUY ASSEMBLY



HEAD GUYS PRIMARY AND SECONDARY - GUY STUB
(NO CONDUCTORS ATTACHED)

Drawing Name	SPAN GUY				
Drawing #	OH-TYP-GUY-2607	Scale : N.T.S.		Approved By: APS	Rev
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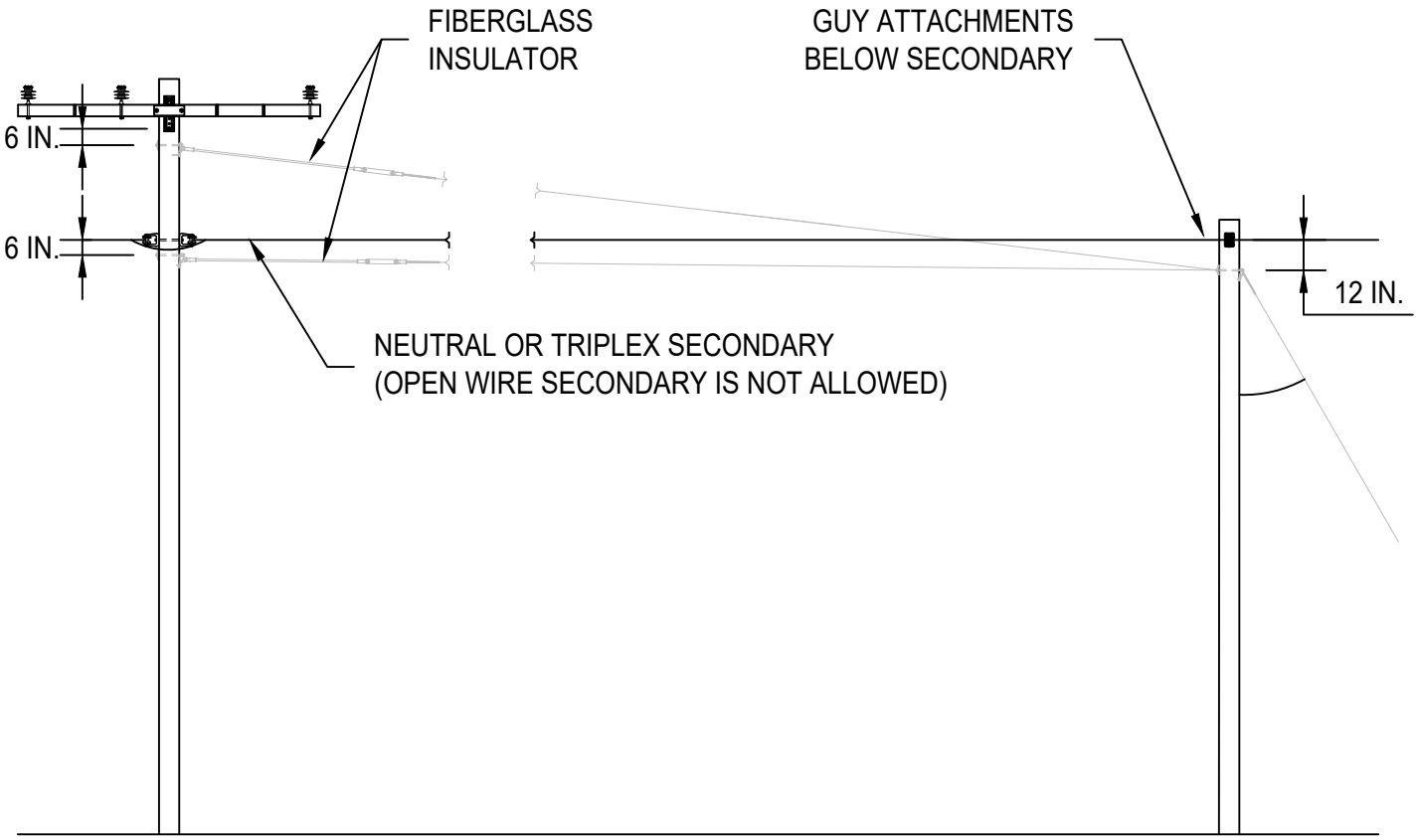

HEAD GUYS PRIMARY AND SECONDARY - NEUTRAL, TRIPLEX SECONDARY

Drawing Name	SPAN GUY			
Drawing #	OH-TYP-GUY-2607	Scale : N.T.S.	Approved By: APS	Rev
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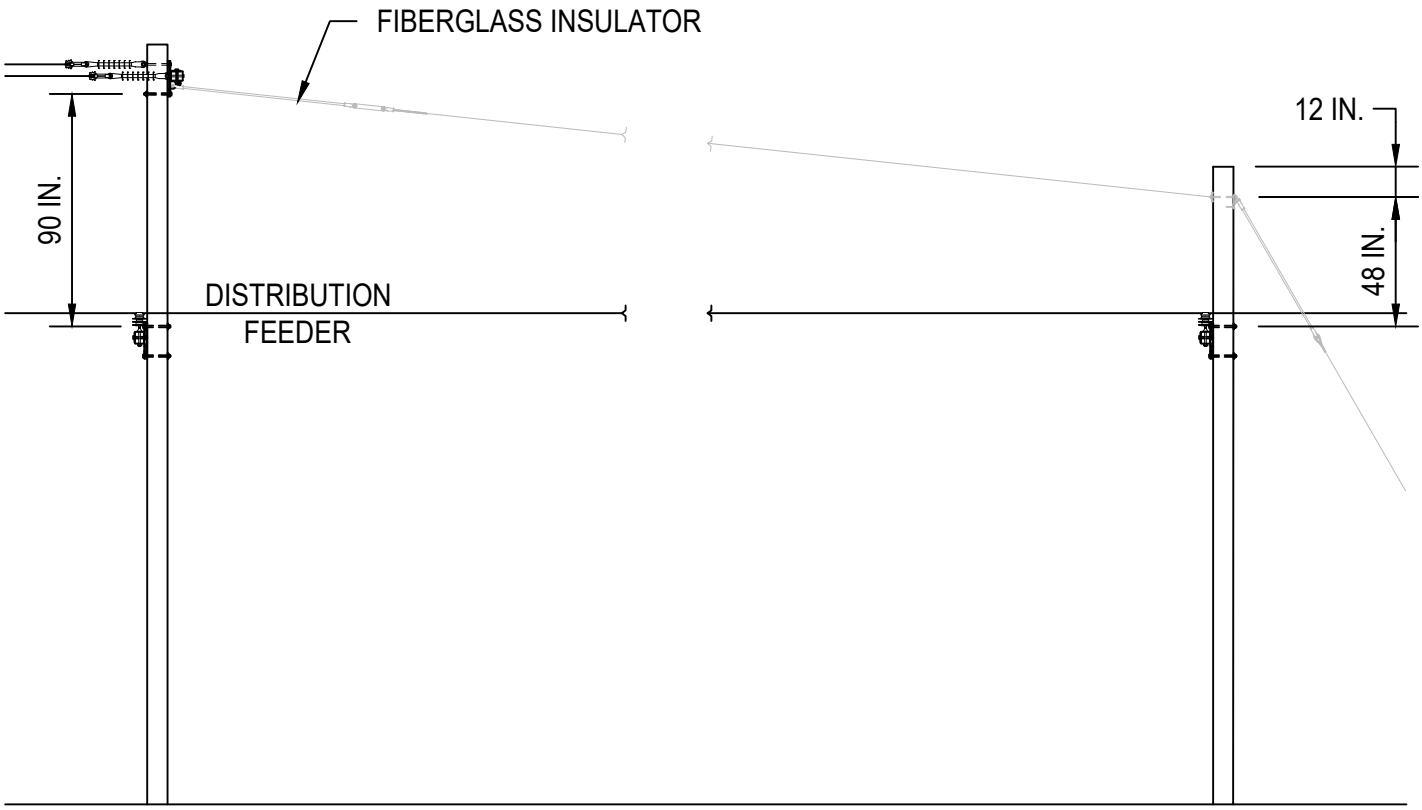

HEAD GUYS PRIMARY AND SECONDARY - DISTRIBUTION FEEDER

Drawing Name	SPAN GUY			
Drawing #	OH-TYP-GUY-2607	Scale : N.T.S.	Approved By: APS	Rev 1
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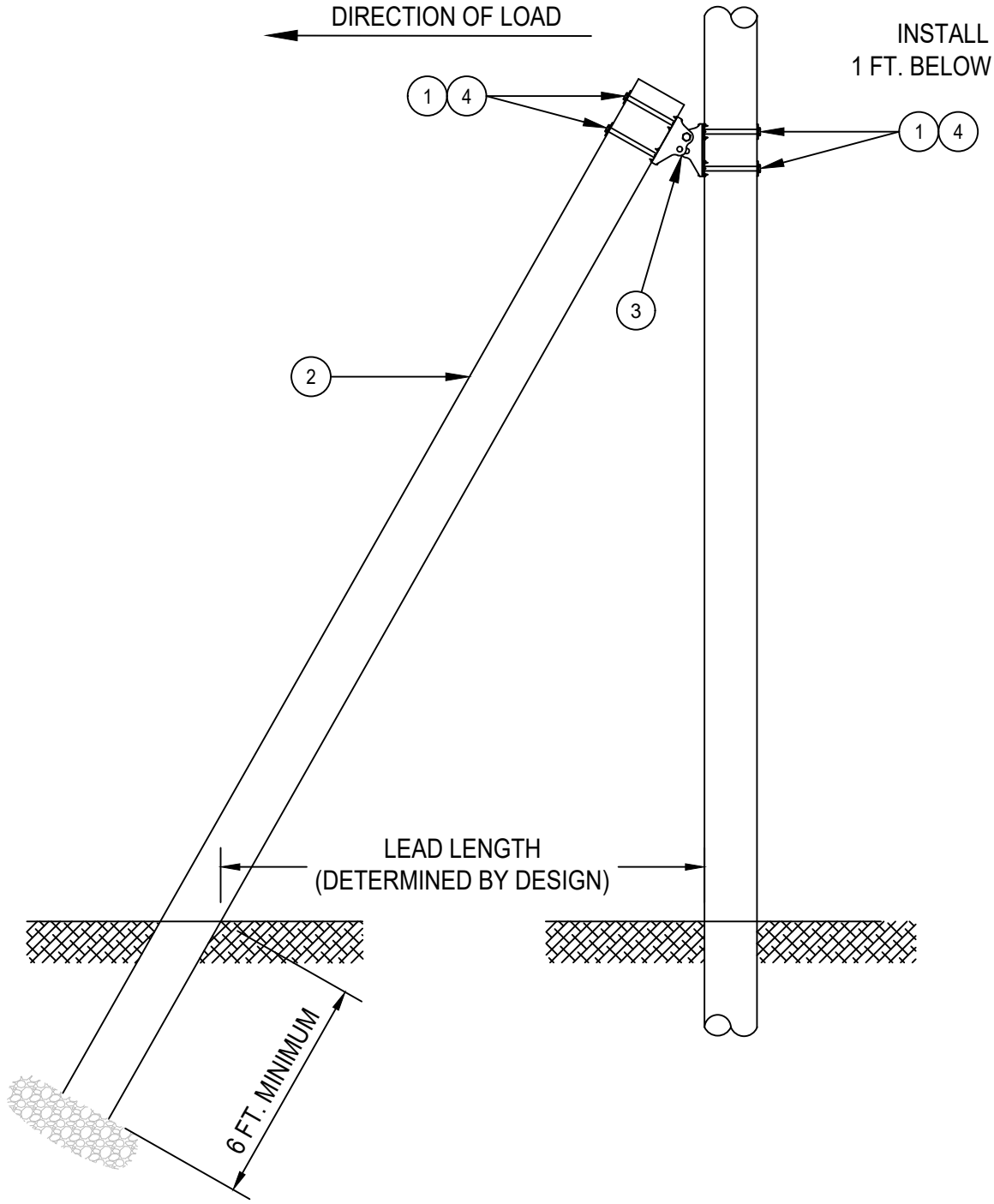


USE 6 IN. OF CR6 IN BOTTOM OF
PUSH BRACE HOLE

BILL OF MATERIALS

Items	Material Description	Mfg.	Catalog No.	Quantity
1	Bolt, D/A, 3/4 in. x length as required	Hubbell	Various	4
2	Pole, Wood, Class 1	Various		1
3	Push Brace	Hubbell	SG611	1
4	Washer, sq. curved, 3 in.	Hubbell	682212	4

Drawing Name	PUSH BRACE			
Drawing #	OH-TYP-GUY-2608	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards	Sheet 1 of 1	Approval Date: 03/10/2021		

CITY LIGHT & POWER

TABLE 1: CLP RECOMMENDED DISTRIBUTION POLYMER PIN INSULATORS

Installation	System Nominal Voltage (P-P/P-G) (KV)	Insulator Rating (KV)	Hendrix Part No.	Preformed Line Products Part No.
Joint Base Lewis-McChord (JBLM)	13.8/7.97	15	HPI-15VTP	IP-15-VTU
Hill AFB (HAFB)	12.47/7.2	25	HPI-25VTP-01	IP-25-VTU1
Hill AFB - UTTR	12.47/7.2	25	HPI-25VTP-01	IP-25-VTU1
Hill AFB - LMTA	12.47/7.2	25	HPI-25VTP-01	IP-25-VTU1
Travis AFB (TAFB)	12.47/7.2	25	HPI-25VTP-01	IP-25-VTU1
March Air Reserve Base (MARB)	13.8/7.97	25	HPI-25VTP-01	IP-25-VTU1
Fort Riley (FTR)	12.47/7.2	15	HPI-25VTP-01	IP-15-VTU
Fort Campbell (FTC)	24.94/14.4	35	HPI-35VTP-01	IP-35-VTU1
	12.47/7.2	15	HPI-25VTP-01	IP-15-VTU
Blue Grass Army Depot (BGAD)	12.47/7.2	15	HPI-25VTP-01	IP-15-VTU
Keesler Air Force Base (KAFB)	22.86/13.2	25	HPI-25VTP-01	IP-25-VTU1
	4.16/2.4	15	HPI-15VTP	IP-15-VTU
Army West Point (AWP)	13.8/7.97	15	HPI-25VTP-01	IP-15-VTU
	13.2/7.62	15	HPI-25VTP-01	IP-15-VTU
	4.16/2.4	15	HPI-15VTP	IP-15-VTU
Aberdeen Proving Ground (APG)	13.8/7.97	15	HPI-25VTP-01	IP-15-VTU
	4.16/2.4	15	HPI-15VTP	IP-15-VTU

Notes:

1. All insulators are vise type and do not require wire ties.
2. All insulators use a 1" pin for mounting.
3. 15KV insulators are ANSI Class 55-3, 55-4.
4. 25KV insulators are ANSI 55-5.
5. 35KV insulators are ANSI 55-6.
6. Insulators are specified for universal applications. The insulators use a nylon insert that can be used with bare copper, bare aluminum, or jacketed conductors.

TABLE 2: CLP RECOMMENDED DISTRIBUTION POLYMER DEADEND INSULATORS

Installation	System Nominal Voltage (P-P/P-G) (KV)	Insulator Rating (KV)	MacLean Part No.	Hubbell Part No.
Joint Base Lewis-McChord (JBLM)	13.8/7.97	15	DS-15M	8010280215
Hill AFB (HAFB)	12.47/7.2	25	DS-25M	8010280215
Hill AFB - UTTR	12.47/7.2	25	DS-25M	8010280215
Hill AFB - LMTA	12.47/7.2	25	DS-25M	8010280215
Travis AFB (TAFB)	12.47/7.2	25	DS-25M	8010280215
March Air Reserve Base (MARB)	13.8/7.97	25	DS-25M	8010280215
Fort Riley (FTR)	12.47/7.2	15	DS-15M	8010150215
Fort Campbell (FTC)	24.94/14.4	35	DS-35M	8010350215
	12.47/7.2	15	DS-15M	8010150215
Blue Grass Army Depot (BGAD)	12.47/7.2	15	DS-15M	8010150215
Keesler Air Force Base (KAFB)	22.86/13.2	25	DS-25M	8010280215
	4.16/2.4	15	DS-15M	8010150215
Army West Point (AWP)	13.8/7.97	15	DS-15M	8010150215
	13.2/7.62	15	DS-15M	8010150215
	4.16/2.4	15	DS-15M	8010150215
Aberdeen Proving Ground (APG)	13.8/7.97	15	DS-15M	8010150215
	4.16/2.4	15	DS-15M	8010150215

Notes:

1. Deadend insulators have rotated end fittings.
2. Deadend insulators can be further configured depending on application. Refer to the manufacturer's catalog for further part number configurations.

TABLE 3: CLP RECOMMENDED DISTRIBUTION POLYMER LINE POST INSULATORS

Installation	System Nominal Voltage (P-P/P-G) (KV)	Insulator Rating (KV)	MacLean Part No.	Hubbell Part No.
Joint Base Lewis-McChord (JBLM)	13.8/7.97	15	H040U0004MXSS002	80S0150K09
Hill AFB (HAFB)	12.47/7.2	25	H040U0006MXSS003	80S0250K09
Hill AFB - UTTR	12.47/7.2	25	H040U0006MXSS003	80S0250K09
Hill AFB - LMTA	12.47/7.2	25	H040U0006MXSS003	80S0250K09
Travis AFB (TAFB)	12.47/7.2	25	H040U0006MXSS003	80S0250K09
March Air Reserve Base (MARB)	13.8/7.97	25	H040U0006MXSS003	80S0250K09
Fort Riley (FTR)	12.47/7.2	15	H040U0004MXSS002	80S0150K09
Fort Campbell (FTC)	24.94/14.4	35	H040U0008MXSS004	80S0280K09
	12.47/7.2	15	H040U0004MXSS002	80S0150K09
Blue Grass Army Depot (BGAD)	12.47/7.2	15	H040U0004MXSS002	80S0150K09
Keesler Air Force Base (KAFB)	22.86/13.2	25	H040U0006MXSS003	80S0250K09
	4.16/2.4	15	H040U0004MXSS002	80S0150K09
Army West Point (AWP)	13.8/7.97	15	H040U0004MXSS002	80S0150K09
	13.2/7.62	15	H040U0004MXSS002	80S0150K09
	4.16/2.4	15	H040U0004MXSS002	80S0150K09
Aberdeen Proving Ground (APG)	13.8/7.97	15	H040U0004MXSS002	80S0150K09
	4.16/2.4	15	H040U0004MXSS002	80S0150K09

Notes:

1. All insulators are universal clamp type that can be used for vertical or horizontal applications. If this clamp type is not preferred please contact CLP engineer.
2. Insulators will require proper manufacturer specific studs and mounting brackets for particular application.

Class	1	2	3	4	5	
Minimum circumference at pole top (in.)	27	25	23	21	19	
Length of pole (ft.)	Setting depth of pole (ft.)	Minimum circumference of pole at 6 ft. from butt (in.)				
30	5	36.5	34	32	29.5	27.5
35	5.5	39	36.5	34	31.5	29
40	6	41	38.5	36	33.5	31
45	6.5	43	4.5	37.5	35	32.5
50	7	45	42	39	36.5	34
55	7.5	46.5	43.5	40.5	38	
60	8	48	45	42	39	
65	8.5	49.5	46.5	43.5	40.5	
70	9	51	48	45	41.5	
75	9.5	52.5	49	46		
80	10	54	50.5	47		
85	10.5	55	51.5	48		
90	11	56	53	49		
95	11.5	57	54			

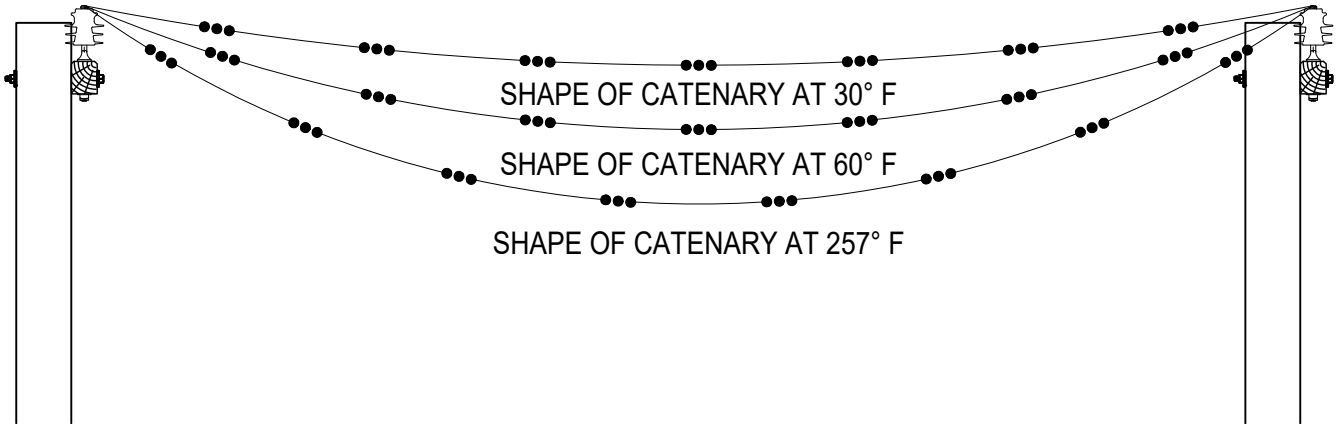
TABLE 1: DIMENSIONS AND STANDARD SETTING DEPTH OF CLASS 1 - CLASS 5 POLES

Class		H6	H5	H4	H3	H2	H1
Minimum circumference at pole top (in.)		39	37	35	33	31	29
Length of pole (ft.)	Setting depth of pole (ft.)	Minimum circumference of pole at 6 ft. from butt (in.)					
45	6.5	58.5	56	53.5	51	48.5	45.5
50	7	61	58.5	55.5	53	50.5	47.5
55	7.5	63.5	60.5	58	55	52	49.5
60	8	65.5	62.5	59.5	57	54	51
65	8.5	67.5	64.5	61.5	58.5	55.5	52.5
70	9	69	66.5	63.5	60.5	57	54
75	9.5	71	68	65	62	59	55.5
80	10	72.5	69.5	66.5	63.5	60	57
85	10.5	74.5	71.5	68	65	61.5	58.5
90	11	76	73	69.5	66.5	63	59.5
95	11.5	77.5	74.5	71	67.5	64.5	61

TABLE 2: DIMENSIONS AND STANDARD SETTING DEPTH OF CLASS H6 - CLASS H1 POLES

CONDUCTOR SAGGING REQUIREMENTS

Energized conductors of subtransmission and distribution lines must be placed in a manner that totally safeguards the public from electrical hazards. With time, temperature, weather conditions, and tension, conductors elongate changing their original position after installation. Despite the effects of weather and loading on a line, the conductors must remain at a safe distance from buildings, other objects, and people passing underneath them. To ensure safety, the height of the conductor above the ground or any other object must be known under all wind, ice, and temperature conditions. Because of conductor characteristics, conductors take the form of a catenary between the supporting structures. The shape of the catenary changes with conductor temperature, ice and wind, and time as depicted below.



To ensure vertical and horizontal clearances are maintained under all weather and electrical loading, and to ensure the breaking strength of the conductor is not exceeded, the behavior of the conductor must be incorporated into the design. The behavior of the conductor is determined by sag and tension calculations which predict the behavior of conductors based on tension limits under varying loading conditions.

To assure structures are not overloaded and to maintain safe clearances, it is necessary to assume ice, wind, and electrical loads on a conductor. The National Electrical Safety Code (NESC) specifies three weather loading conditions that are applied to the loading components for the purpose of determining structure strength:

- Heavy
- Medium
- Light

The loading district defines the temperature, the amount of ice and wind to use for determining the strength of poles, conductors, guys, attachment hardware, etc. City Light and Power (CLP) designs/constructs using the Heavy Loading Zone for all CLP sites. CLP must consider its lines to be at a temperature of 0° F, with a 1/2 inch of radial ice, and a 4 PSF wind blowing at a right angle to the conductors.

Sag and tension charts were developed based on the heavy loading requirements. CLP selected design tensions that are approximately 15% to 25% of the rated breaking strength of the conductor. Design tension is defined as the tension of the conductor at 0° F with 1/2 inch of radial ice, and a 4 PSF wind. Tensions within this range keep conductor vibrations to a minimum, thus reducing conductor fatigue. The design tension is used to determine strength requirements for supporting structures, conductor fasteners, and anchoring components.

Conductor Sagging Requirements (cont.)

The sag and tension charts depict conductor:

- Design tension
- Initial Sag
- Final Sag
- Tensions under various sag conditions

The initial sag and the corresponding tension is used by overhead line mechanics to sag conductors. Final sags are used by designers to calculate vertical clearances of the conductor above roadways, buildings, and other supporting structures. Final sag data is also used to calculate the clearances between conductors at the low point of sag. In addition, final sag data is used to calculate the horizontal displacement of conductors under wind conditions.

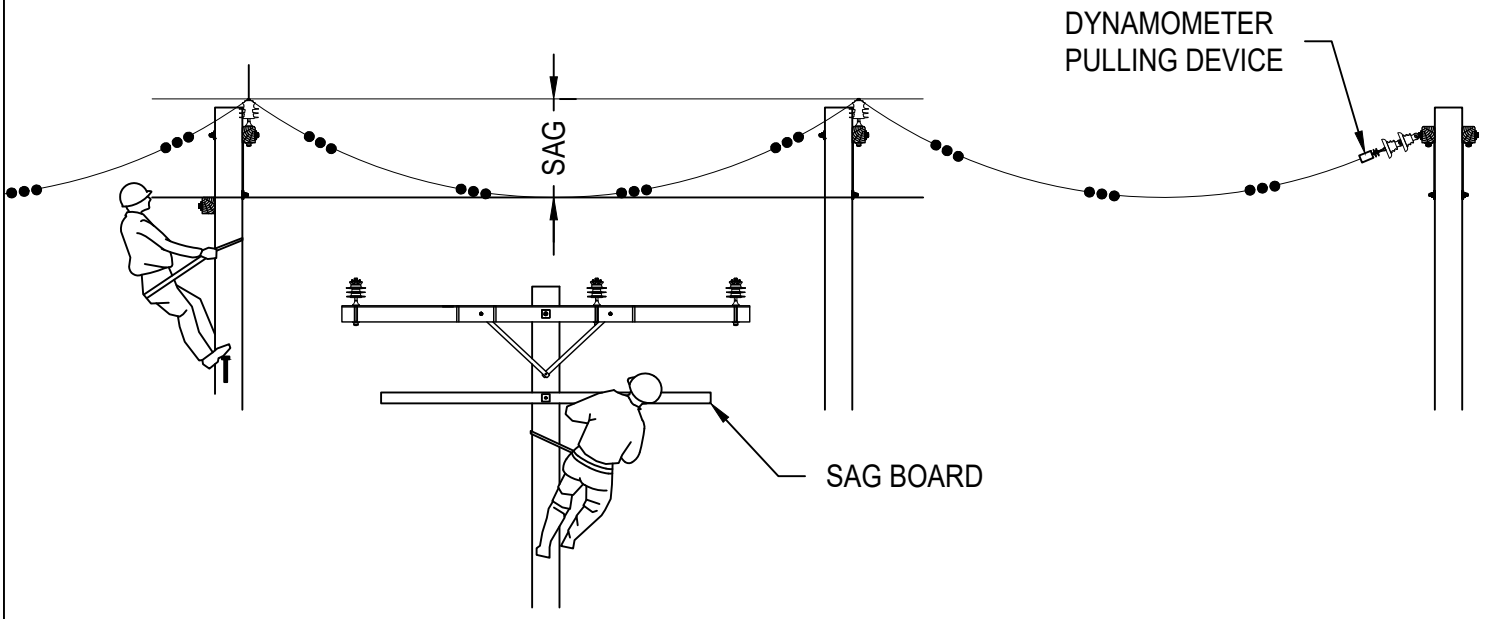
Several methods are used to sag overhead conductors:

- The stop watch method
- Sagging boards to measure vertical sag
- The dynamometer to measure conductor tension

The two most common methods are sagging boards and the measurement of tension with a dynamometer. Both methods will be discussed. However, **CLP requires the dynamometer method to be used when sagging conductors on CLP infrastructure.**

Correct Sag is Critical

If conductors are not sagged correctly the integrity of the system may be jeopardized. For example, lets say that a 150 foot span of 336.4 ACSR conductor required 18 inches of initial sag at a conductor temperature of 60° F. Instead of sagging the conductor at 18 inches, the conductor was sagged at 9 inches. By reducing the amount of sag to 9 inches, the design tension will be approximately doubled. The doubling of the design tension will overload the anchoring systems and conductor fasteners and will eventually lead to a system failure. On the other hand, lets assume that the sag was doubled. In this case, clearances to other supporting structures would not be adequate.



Sagging Boards Method

Sagging boards are straight edges that are placed a specific distance down the structure to measure sag. The boards must extend the same horizontal distance from the structure as the conductor supports. The following process is to be used when using sagging boards:

- Select two level spans
- The distance between the structures should be as close as possible to the length of the ruling span.
- Cut a 30 inch piece of conductor and suspend it at approximately the same elevation as the conductor to be sagged.
- Insert a thermometer into the 30 inch piece of conductor. The thermometer should remain in position for at least 15 minutes.
- Once the temperature has been obtained, refer to the initial sag data on the sag and tension data sheet. Find the conductor sag for the corresponding span length and temperature.
- Measure the distance on the poles in the sagging span from the conductor attachment point down the structure.
- Place sagging boards at this point.
- Sight down the sagging boards while a line mechanic at the pulling structure pulls the conductor. When the bottom of the conductor is sighted even with the sagging boards, stop the pulling operation.
- Check at least one more span to assure proper sag. If the correct sag is measured the sagging operation is complete.

Dynamometer Method

The dynamometer is a device used to measure the tension in a conductor for the purpose of sagging. The dynamometer is placed in series with a pulling grip placed on the conductor and a pulling device, such as a coffin hoist, on the dead-end structure. The following process demonstrates the use of a dynamometer for sagging overhead conductors:

- Cut a 30 inch piece of conductor and suspend it at approximately the same elevation as the conductor to be sagged.
- Insert a thermometer into the 30 inch piece of conductor. The thermometer should remain in position for at least 15 minutes.
- Once the temperature has been obtained, refer to the initial tension data on the sag and tension data sheet. Find the conductor tension for the corresponding span length and temperature.
- Place the dynamometer in series with the conductor and pulling device on the dead-end structure.
- Pull the conductor until the tension matches the tension found on the sag and tension data sheet.
- Verify that the conductor is correctly sagged by placing sagging boards on one span and checking vertical sag.
- If the sag is verified the process is complete.

Conductor: #6 ACSR 6/1 strand (Code word Turkey)
Weight: 0.0361 lbs/ft
Diameter: 0.198 in
RBS: 1190 lbs
Design tension: 286 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 100' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
50	0-10	0-11	0-11	0-11	0-11	0-11	0-11	1-0	1-0	1-0	1-0	-
75	1-11	2-0	2-0	2-1	2-1	2-2	2-2	2-2	2-2	2-3	2-3	-
100	3-6	3-7	3-7	3-8	3-9	3-9	3-10	3-11	3-11	3-11	4-0	-
125	5-5	5-6	5-8	5-9	5-10	5-11	6-0	6-1	6-1	6-2	6-3	-
150	7-10	8-0	8-2	8-4	8-5	8-7	8-8	8-9	8-10	8-11	9-0	-
TENSION in lbs	13	13	13	12	12	12	12	12	12	11	11	-

Drawing Name	STRINGING TABLES - ACSR				
Drawing #	OH-TYP-SAG-2660	Scale : N.T.S.	Approved By: APS	Rev	CITY LIGHT & POWER
City Light & Power Construction Detail Standards	Sheet 1 of 21	Approval Date: 03/10/2021	0		

Conductor: #4 ACSR 6/1 strand (Code word Swan)
Weight: 0.0574 lbs/ft
Diameter: 0.250 in
RBS: 1860
Design tension: 446 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 100' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
50	0-5	0-6	0-6	0-6	0-7	0-7	0-7	0-7	0-8	0-8	0-8	-
75	1-0	1-1	1-2	1-2	1-3	1-4	1-4	1-5	1-5	1-5	1-6	-
100	1-10	1-11	2-0	2-2	2-3	2-4	2-5	2-6	2-7	2-7	2-8	-
125	2-10	3-0	3-2	3-4	3-6	3-7	3-9	3-10	4-0	4-1	4-1	-
150	4-0	4-4	4-7	4-10	5-0	5-2	5-5	5-7	5-9	5-10	5-11	-
TENSION in lbs	40	37	35	34	32	31	30	29	28	28	27	-

Conductor: #2 ACSR 6/1 strand (Code word Sparrow)
Weight: 0.0913 lbs/ft
Diameter: 0.316 in
RBS: 2850 lbs
Design tension: 684 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 100' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
50	0-2	0-2	0-3	0-3	0-4	0-4	0-4	0-5	0-5	0-5	0-6	-
75	0-4	0-5	0-6	0-7	0-8	0-9	0-10	0-11	1-0	1-0	1-1	-
100	0-8	0-9	0-11	1-1	1-3	1-4	1-6	1-7	1-9	1-10	1-11	-
125	1-0	1-2	1-5	1-8	1-11	2-1	2-4	2-6	2-8	2-10	2-11	-
150	1-5	1-9	2-1	2-5	2-9	3-1	3-4	3-7	3-10	4-1	4-3	-
TENSION in lbs	182	148	124	106	94	84	77	71	66	62	61	-

Span length in feet	Initial sag 150' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
100	1-5	1-5	1-6	1-7	1-8	1-8	1-9	1-9	1-10	1-11	1-11	-
125	2-2	2-3	2-4	2-6	2-7	2-8	2-9	2-9	2-10	2-11	3-0	-
150	3-1	3-3	3-5	3-7	3-8	3-9	3-11	4-0	4-2	4-3	4-4	-
175	4-3	4-6	4-8	4-10	5-0	5-2	5-4	5-6	5-7	5-9	5-10	-
200	5-7	5-10	6-1	6-4	6-6	6-9	6-11	7-2	7-4	7-6	7-8	-
TENSION in lbs	82	78	75	72	70	68	66	64	62	61	60	-

Conductor: #2 ACSR 7/1 strand (Code word Sparate)
Weight: 0.1067 lbs/ft
Diameter: 0.325 in
RBS: 3640 lbs
Design tension: 874 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 150' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
100	0-10	0-11	1-0	1-1	1-2	1-3	1-3	1-4	1-5	1-5	1-6	-
125	1-4	1-5	1-7	1-8	1-9	1-11	2-0	2-1	2-2	2-3	2-4	-
150	1-10	2-1	2-3	2-5	2-7	2-9	2-10	3-0	3-2	3-3	3-5	-
175	2-6	2-10	3-1	3-4	3-6	3-8	3-11	4-1	4-3	4-5	4-7	-
200	3-4	3-8	4-0	4-4	4-7	4-10	5-1	5-4	5-7	5-10	6-0	-
TENSION in lbs	161	145	133	124	116	110	105	100	96	92	89	-

Span length in feet	Initial sag 200' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
150	2-7	2-8	2-10	2-11	3-0	3-1	3-2	3-2	3-3	3-4	3-5	-
175	3-6	3-8	3-10	3-11	4-1	4-2	4-3	4-4	4-6	4-7	4-8	-
200	4-7	4-10	5-0	5-2	5-4	5-5	5-7	5-8	5-10	5-11	6-1	-
225	5-10	6-1	6-4	6-6	6-9	6-11	7-1	7-3	7-5	7-6	7-8	-
250	7-2	7-6	7-9	8-1	8-3	8-6	8-8	8-11	9-1	9-4	9-6	-
TENSION in lbs	116	111	107	103	101	98	96	94	92	90	88	-

Conductor: #1/0 ACSR 6/1 strand (Code word Raven)
Weight: 0.1453 lbs/ft
Diameter: 0.398 in
RBS: 4380 lbs
Design tension: 900 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 100' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
50	0-1	0-2	0-2	0-3	0-3	0-3	0-4	0-4	0-5	0-5	0-5	-
75	0-3	0-4	0-5	0-6	0-7	0-8	0-9	0-9	0-10	0-11	1-0	-
100	0-6	0-7	0-9	0-10	1-0	1-2	1-3	1-5	1-6	1-8	1-9	-
125	0-9	0-11	1-1	1-4	1-7	1-9	2-0	2-2	2-4	2-7	2-9	-
150	1-1	1-4	1-7	1-11	2-3	2-7	2-10	3-2	3-5	3-8	3-11	-
TENSION in lbs	371	306	253	212	182	160	143	130	120	112	105	-

Span length in feet	Initial sag 150' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
100	1-1	1-2	1-3	1-3	1-4	1-5	1-5	1-6	1-7	1-7	1-8	-
125	1-8	1-9	1-11	2-0	2-1	2-2	2-3	2-4	2-5	2-6	2-7	-
150	2-4	2-7	2-9	2-10	3-0	3-2	3-3	3-5	3-6	3-8	3-9	-
175	3-3	3-6	3-9	3-11	4-1	4-3	4-5	4-7	4-9	4-11	5-1	-
200	4-3	4-7	4-10	5-1	5-4	5-7	5-10	6-0	6-3	6-6	6-8	-
TENSION in lbs	172	160	150	142	136	130	125	120	116	113	109	-

Conductor: #1/0 ACSR 6/1 strand (Code word Raven)
Weight: 0.1453 lbs/ft
Diameter: 0.398 in
RBS: 4380 lbs
Design tension: 1050 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 200' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
150	1-8	1-10	1-11	2-0	2-2	2-3	2-4	2-5	2-6	2-7	2-8	-
175	2-4	2-5	2-7	2-9	2-11	3-0	3-2	3-4	3-5	3-7	3-8	-
200	3-0	3-3	3-5	3-7	3-9	4-0	4-2	4-4	4-6	4-8	4-10	-
225	3-10	4-1	4-4	4-7	4-10	5-0	5-3	5-6	5-8	5-11	6-1	-
250	4-8	5-0	5-4	5-8	5-11	6-2	6-6	6-9	7-0	7-3	7-6	-
TENSION in lbs	242	226	213	202	192	183	175	168	162	157	152	-

Conductor: #4/0 ACSR 6/1 strand (Code word Penguin)
Weight: 0.2911 lbs/ft
Diameter: 0.563 in
RBS: 8350 lbs
Design tension: 2000 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 150' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
100	0-3	0-4	0-4	0-5	0-6	0-7	0-8	0-9	0-10	0-10	0-11	-
125	0-5	0-6	0-7	0-8	0-9	0-10	1-0	1-1	1-3	1-4	1-6	-
150	0-7	0-8	0-10	0-11	1-1	1-3	1-5	1-7	1-9	2-0	2-2	-
175	0-10	0-11	1-1	1-3	1-5	1-8	1-11	2-2	2-5	2-8	2-11	-
200	1-1	1-3	1-5	1-8	1-11	2-2	2-6	2-10	3-2	3-6	3-10	-
TENSION in lbs	1323	1171	1024	888	766	662	579	511	458	416	382	-

Span length in feet	Initial sag 200' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
150	0-11	1-0	1-1	1-3	1-4	1-6	1-7	1-9	1-10	2-0	2-1	-
175	1-3	1-4	1-6	1-8	1-10	2-0	2-2	2-4	2-6	2-8	2-10	-
200	1-7	1-9	2-0	2-3	2-5	2-8	2-11	3-1	3-4	3-6	3-8	-
225	2-0	2-3	2-6	2-10	3-1	3-4	3-8	3-11	4-2	4-5	4-8	-
250	2-6	2-9	3-1	3-6	3-10	4-2	4-6	4-10	5-2	5-6	5-9	-
TENSION in lbs	919	816	729	657	597	547	506	471	442	417	395	-

Conductor: #4/0 ACSR 6/1 strand (Code word Penguin)
Weight: 0.2911 lbs/ft
Diameter: 0.563 in
RBS: 8350 lbs
Design tension: 2200 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 250' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
200	1-7	1-9	1-11	2-1	2-3	2-5	2-7	2-9	2-11	3-0	3-2	-
225	2-0	2-3	2-5	2-8	2-10	3-1	3-3	3-6	3-8	3-10	4-0	-
250	2-6	2-9	3-0	3-3	3-6	3-9	4-0	4-3	4-6	4-9	5-0	-
275	3-1	3-4	3-8	4-0	4-3	4-7	4-11	5-2	5-6	5-9	6-0	-
300	3-8	4-0	4-4	4-9	5-1	5-5	5-10	6-2	6-6	6-10	7-2	-
TENSION in lbs	903	822	753	694	643	600	564	532	504	480	459	-

Conductor: 336 ACSR 18/1 strand (Code word Merlin)
Weight: 0.3652 lbs/ft
Diameter: 0.684 in
RBS: 8680 lbs
Design tension: 2200 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 150' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
100	0-4	0-5	0-6	0-7	0-8	0-9	0-10	1-0	1-1	1-2	1-3	-
125	0-6	0-8	0-9	0-11	1-1	1-3	1-4	1-6	1-8	1-9	1-11	-
150	0-9	0-11	1-1	1-4	1-6	1-9	2-0	2-2	2-4	2-7	2-9	-
175	1-1	1-3	1-6	1-9	2-1	2-5	2-8	2-11	3-3	3-6	3-9	-
200	1-4	1-8	1-11	2-4	2-9	3-1	3-6	3-10	4-2	4-6	4-10	-
TENSION in lbs	1331	1116	933	785	672	586	523	473	434	403	377	-

Span length in feet	Initial sag 200' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
150	1-1	1-3	1-5	1-7	1-8	1-10	2-0	2-1	2-3	2-4	2-5	-
175	1-6	1-9	1-11	2-1	2-4	2-6	2-8	2-10	3-0	3-2	3-4	-
200	2-0	2-3	2-6	2-9	3-0	3-3	3-6	3-9	3-11	4-2	4-4	-
225	2-6	2-10	3-2	3-6	3-10	4-2	4-5	4-9	5-0	5-3	5-6	-
250	3-1	3-6	3-11	4-4	4-9	5-1	5-6	5-10	6-2	6-6	6-9	-
TENSION in lbs	925	815	729	659	604	559	522	491	464	441	421	-

Conductor: 336 ACSR 18/1 strand (Code word Merlin)
Weight: 0.3652 lbs/ft
Diameter: 0.684 in
RBS: 8680 lbs
Design tension: 2500 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial Sag 250' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
200	1-9	2-0	2-2	2-4	2-7	2-9	2-11	3-1	3-3	3-5	3-7	-
225	2-3	2-6	2-9	3-0	3-3	3-6	3-8	3-11	4-1	4-4	4-6	-
250	2-9	3-1	3-5	3-8	4-0	4-3	4-7	4-10	5-1	5-4	5-7	-
275	3-4	3-9	4-1	4-6	4-10	5-2	5-6	5-10	6-2	6-5	6-9	-
300	4-0	4-5	4-11	5-4	5-9	6-2	6-7	6-11	7-4	7-8	8-0	-
TENSION in lbs	1026	924	840	772	715	667	627	592	562	536	519	-

Conductor: 477 ACSR 18/1 strand (Code word Pelican)
Weight: 0.5180 lbs/ft
Diameter: 0.814 in
RBS: 11800 lbs
Design tension: 2900 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial Sag 150' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
100	0-4	0-5	0-6	0-7	0-8	0-9	0-10	0-11	1-0	1-1	1-2	-
125	0-6	0-7	0-9	0-10	1-0	1-2	1-4	1-6	1-7	1-9	1-10	-
150	0-9	0-10	1-0	1-3	1-6	1-8	1-11	2-1	2-4	2-6	2-8	-
175	1-0	1-2	1-5	1-8	2-0	2-3	2-7	2-10	3-2	3-5	3-8	-
200	1-4	1-7	1-10	2-2	2-7	3-0	3-5	3-9	4-1	4-5	4-9	-
TENSION in lbs	1987	1680	1401	1175	999	866	767	691	632	584	546	-

Span length in feet	Initial Sag 200' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
150	1-0	1-1	1-3	1-5	1-7	1-8	1-10	2-0	2-1	2-3	2-4	-
175	1-4	1-6	1-8	1-11	2-1	2-4	2-6	2-8	2-10	3-0	3-2	-
200	1-9	2-0	2-3	2-6	2-9	3-0	3-3	3-6	3-9	3-11	4-2	-
225	2-2	2-6	2-10	3-2	3-6	3-10	4-1	4-5	4-8	5-0	5-3	-
250	2-8	3-1	3-6	3-11	4-4	4-8	5-1	5-5	5-10	6-2	6-6	-
TENSION in lbs	1515	1319	1162	1037	940	860	796	742	698	660	627	-

Conductor: 477 ACSR 18/1 strand (Code word Pelican)
Weight: 0.5180 lbs/ft
Diameter: 0.814 in
RBS: 11800 lbs
Design tension: 3300 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial Sag 250' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
200	1-6	1-9	1-11	2-1	2-4	2-6	2-8	2-10	3-0	3-2	3-4	-
225	1-11	2-2	2-5	2-8	2-11	3-2	3-5	3-7	3-10	4-1	4-3	-
250	2-5	2-8	3-0	3-4	3-7	3-11	4-2	4-6	4-9	5-0	5-3	-
275	2-11	3-3	3-8	4-0	4-4	4-9	5-1	5-5	5-9	6-1	6-4	-
300	3-5	3-10	4-4	4-9	5-2	5-8	6-0	6-5	6-10	7-2	7-7	-
TENSION in lbs	1692	1507	1351	1225	1121	1036	966	906	854	810	772	-

Conductor: 556 ACSR 24/7 strand (Code word Parakeet)
Weight: 0.7169 lbs/ft
Diameter: 0.914 in
RBS: 19800 lbs
Design tension: 3500 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial Sag 150' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
100	0-4	0-5	0-6	0-7	0-8	0-9	0-10	0-11	1-0	1-1	1-2	-
125	0-7	0-8	0-9	0-11	1-0	1-2	1-4	1-5	1-7	1-8	1-9	-
150	0-10	0-11	1-1	1-3	1-6	1-8	1-10	2-1	2-3	2-5	2-7	-
175	1-1	1-4	1-6	1-9	2-0	2-3	2-6	2-10	3-0	3-3	3-6	-
200	1-5	1-8	2-0	2-4	2-8	3-0	3-4	3-8	4-0	4-3	4-7	-
TENSION in lbs	2470	2118	1817	1594	1362	1205	1082	983	905	840	787	-

Span length in feet	Initial Sag 200' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
150	1-0	1-2	1-3	1-5	1-6	1-8	1-9	1-11	2-0	2-1	2-3	-
175	1-5	1-7	1-9	1-11	2-1	2-3	2-5	2-7	2-9	2-11	3-0	-
200	1-10	2-0	2-3	2-6	2-9	2-11	3-2	3-4	3-7	3-9	4-0	-
225	2-3	2-7	2-10	3-2	3-5	3-9	4-0	4-3	4-6	4-9	5-0	-
250	2-10	3-2	3-6	3-11	4-3	4-7	4-11	5-3	5-7	5-11	6-2	-
TENSION in lbs	1990	1771	1588	1439	1317	1218	1134	1063	1002	950	905	-

Conductor: 556 ACSR 24/7 strand (Code word Parakeet)
Weight: 0.7169 lbs/ft
Diameter: 0.914 in
RBS: 19800 lbs
Design tension: 4400 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial Sag 250' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
200	1-3	1-5	1-7	1-9	1-11	2-1	2-3	2-5	2-7	2-9	2-11	-
225	1-8	1-10	2-0	2-3	2-5	2-8	2-11	3-1	3-4	3-6	3-8	-
250	2-0	2-3	2-6	2-9	3-0	3-3	3-7	3-10	4-1	4-4	4-7	-
275	2-5	2-9	3-0	3-4	3-8	4-0	4-4	4-8	4-11	5-3	5-6	-
300	2-11	3-3	3-7	4-0	4-4	4-9	5-2	5-6	5-11	6-3	6-7	-
TENSION in lbs	2776	2500	2250	2035	1856	1704	1573	1465	1372	1293	1225	-

Conductor: 556 ACSR 26/7 strand (Code word Dove)
Weight: 0.7660 lbs/ft
Diameter: 0.927 in
RBS: 22600 lbs
Design tension: 3600 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial Sag 150' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
100	0-4	0-5	0-6	0-7	0-8	0-9	0-10	0-11	0-11	1-0	1-1	-
125	0-7	0-8	0-9	0-11	1-0	1-2	1-3	1-5	1-6	1-7	1-9	-
150	0-10	1-0	1-1	1-3	1-5	1-8	1-10	2-0	2-2	2-4	2-6	-
175	1-2	1-4	1-6	1-9	2-0	2-3	2-5	2-8	2-11	3-2	3-4	-
200	1-6	1-8	2-0	2-3	2-7	2-11	3-3	3-6	3-10	4-1	4-5	-
TENSION in lbs	2576	2245	1945	1698	1491	1325	1194	1088	1001	930	871	-

Span length in feet	Initial Sag 200' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
150	1-0	1-2	1-3	1-5	1-6	1-7	1-9	1-10	2-0	2-1	2-2	-
175	1-5	1-7	1-9	1-11	2-1	2-3	2-4	2-6	2-8	2-10	2-11	-
200	1-10	2-0	2-3	26	2-8	2-11	3-1	3-4	3-6	3-8	3-10	-
225	2-4	2-7	2-10	3-1	3-5	3-8	3-11	4-2	4-5	4-8	4-11	-
250	2-10	3-2	3-6	3-10	4-2	4-6	4-10	5-2	5-5	5-9	6-0	-
TENSION in lbs	2100	1887	1707	1557	1431	1326	1239	1163	1097	1042	993	-

Conductor: 556 ACSR 26/7 strand (Code word Dove)
Weight: 0.7660 lbs/ft
Diameter: 0.927 in
RBS: 22600 lbs
Design tension: 4700 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial Sag 250' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
200	1-3	1-4	1-6	1-7	1-9	1-11	2-1	2-3	2-5	2-7	2-9	-
225	1-6	1-8	1-10	2-1	2-3	2-5	2-8	2-10	3-1	3-3	3-5	-
250	1/11/2021	2-1	2-4	2-6	2-9	3-0	3-3	3-6	3-9	4-0	4-3	-
275	2-4	2-6	2-10	3-1	3-4	3-8	4-0	4-3	4-7	4-10	5-2	-
300	2-9	3-0	3-4	3-8	4-0	4-4	4-9	5-1	5-5	5-10	6-2	-
TENSION in lbs	3156	2864	2593	2360	2153	1975	1824	1694	1582	1486	1404	-

Span length in feet	Initial Sag 300' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
250	2-2	2-4	2-7	2-9	2-11	3-2	3-4	3-6	3-8	3-11	4-1	-
275	2-7	2-10	3-1	3-4	3-7	3-10	4-0	4-3	4-6	4-8	4-11	-
300	3-1	3-5	3-8	3-11	4-3	4-6	4-9	5-1	5-4	5-7	5-10	-
325	3-8	4-0	4-4	4-8	5-0	5-4	5-7	5-11	6-3	6-7	6-10	-
350	4-3	4-7	5-0	5-5	5-9	6-2	6-6	6-11	7-3	7-7	8-0	-
TENSION in lbs	2759	2541	2349	2182	2037	1910	1800	1701	1616	1540	1473	-

Conductor: 715 ACSR 26/7 strand (Code word Starling)
Weight: 0.9848 lbs/ft
Diameter: 1.051 in
RBS: 28400 lbs
Design tension: 3800 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial Sag 150' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
100	0-6	0-6	0-7	0-8	0-9	0-10	0-11	1-0	1-0	1-1	1-2	-
125	0-9	0-10	0-11	1-1	1-2	1-3	1-5	1-6	1-7	1-9	1-10	-
150	1-1	1-2	1-4	1-6	1-8	1-10	2-0	2-2	2-4	2-6	2-7	-
175	1-5	1-8	1-10	2-1	2-4	2-6	2-9	3-0	3-2	3-5	3-7	-
200	1-11	2-2	2-5	2-9	3-0	3-4	3-7	3-11	4-2	4-5	4-8	-
TENSION in lbs	2606	2299	2035	1815	1638	1490	1372	1271	1187	1116	1065	-

Span length in feet	Initial Sag 200' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
150	1-3	1-5	1-6	1-7	1-9	1-10	1-11	2-0	2-2	2-3	2-4	-
175	1-9	1-11	2-0	2-2	2-4	2-6	2-7	2-9	2-11	3-0	3-2	-
200	2-3	2-5	2-8	2-10	3-1	3-3	3-5	3-7	3-9	3-11	4-1	-
225	2-10	3-1	3-4	3-7	3-10	4-1	4-4	4-7	4-9	5-0	5-3	-
250	3-6	3-10	4-2	4-6	4-9	5-1	5-4	5-8	5-11	6-2	6-5	-
TENSION in lbs	2183	2004	1853	1724	1614	1519	1437	1365	1302	1247	1196	-

Conductor: 715 ACSR 26/7 strand (Code word Starling)
Weight: 0.9848 lbs/ft
Diameter: 1.051 in
RBS: 28400 lbs
Design tension: 5400 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial Sag 250' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
200	1-4	1-5	1--7	1-8	1-10	2-0	2-2	2-4	2-5	2-7	2-9	-
225	1-8	1-10	2-0	2-2	2-4	2-6	2-9	2-11	3-1	3-3	3-6	-
250	2-1	2-3	2-5	2-8	2-11	3-1	3-4	3-7	3-10	4-1	4-3	-
275	2-6	2-9	3-0	3-3	3-6	3-9	4-1	4-4	4-8	4-11	5-2	-
300	2-11	3-3	3-6	3-10	4-2	4-6	4-10	5-2	5-6	5-10	6-2	-
TENSION in lbs	3756	3435	3143	2887	2661	2463	2293	2142	2012	1899	1800	-

Span length in feet	Initial Sag 300' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
250	2-4	2-6	2-8	2-10	3-0	3-2	3-5	3-7	3-9	3-11	4-1	-
275	2-9	3-0	3-3	3-5	3-8	3-10	4-1	4-4	4-6	4-9	4-11	-
300	3-4	3-7	3-10	4-1	4-4	4-7	4-10	5-2	5-5	5-7	5-10	-
325	3-11	4-2	4-6	4-9	5-1	5-5	5-9	6-0	6-4	6-7	6-11	-
350	4-6	4-10	5-2	5-7	5-11	6-3	6-8	7-0	7-4	7-8	8-0	-
TENSION in lbs	3350	3113	2902	2716	2552	2405	2276	2162	2061	1971	1889	-

Conductor: 795 ACSR 26/7 strand (Code word Drake)
Weight: 1.0940 lbs/ft
Diameter: 1.051 in
RBS: 31500 lbs
Design tension: 4000 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial Sag 150' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
100	0-6	0-7	0-8	0-9	0-9	0-10	0-11	1-0	1-1	1-2	1-2	-
125	0-9	0-11	1-0	1-1	1-3	1-4	1-5	1-7	1-8	1-9	1-10	-
150	1-2	1-3	1-5	1-7	1-9	1-11	2-1	2-3	2-5	2-7	2-8	-
175	1-6	1-9	1-11	2-2	2-5	2-8	2-10	3-1	3-3	3-6	3-7	-
200	2-0	2-3	2-7	2-10	3-2	3-5	3-9	4-0	4-3	4-6	4-9	-
TENSION in lbs	2733	2414	2143	1923	1742	1592	1470	1368	1281	1208	1157	-

Span length in feet	Initial Sag 200' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
150	1-4	1-5	1-7	1-8	1-9	1-11	2-0	2-1	2-2	2-3	2-4	-
175	1-10	2-0	2-1	2-3	2-5	2-7	2-8	2-10	3-0	3-1	3-3	-
200	2-4	2-7	2-9	2-11	3-2	3-4	3-6	3-8	3-10	4-0	4-2	-
225	3-0	3-3	3-6	3-9	4-0	4-3	4-5	4-8	4-11	5-1	5-4	-
250	3-8	4-0	4-4	4-7	4-11	5-3	5-6	5-9	6-1	6-4	6-7	-
TENSION in lbs	2321	2138	1983	1851	1739	1640	1556	1480	1415	1356	1304	-

Conductor: 795 ACSR 26/7 strand (Code word Drake)
Weight: 1.0940 lbs/ft
Diameter: 1.051 in
RBS: 31500 lbs
Design tension: 6000 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial Sag 250' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
200	1-3	1-4	1-6	1-8	1-9	1-11	2-1	2-3	2-5	2-6	2-8	-
225	1-7	1-9	1-11	2-1	2-3	2-5	2-8	2-10	3-0	3-2	3-5	-
250	2-0	2-2	2-4	2-7	2-9	3-0	3-3	3-6	3-9	3-11	4-2	-
275	2-5	2-7	2-10	3-1	3-4	3-8	3-11	4-3	4-6	4-9	5-1	-
300	2-10	3-1	3-5	3-8	4-0	4-4	4-8	5-0	5-4	5-8	6-0	-
TENSION in lbs	4345	3980	3639	3336	3068	2834	2632	2453	2299	2164	2048	-

Span length in feet	Initial Sag 300' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
250	2-2	2-4	2-6	2-8	2-11	3-1	3-3	3-5	3-7	3-9	4-0	-
275	2-8	2-10	3-1	3-3	3-6	3-9	3-11	4-2	4-4	4-7	4-10	-
300	3-2	3-5	3-8	3-11	4-2	4-5	4-8	4-11	5-2	5-5	5-8	-
325	3-8	4-0	4-3	4-7	4-11	5-2	5-6	5-10	6-1	6-5	6-8	-
350	4-3	4-7	4-11	5-4	5-8	6-0	6-5	6-9	7-1	7-5	7-9	-
TENSION in lbs	3922	3636	3380	3158	2958	2779	2626	2487	2365	2256	2158	-

Conductor: 795 ACSR 26/7 strand (Code word Drake)
Weight: 1.0940 lbs/ft
Diameter: 1.051 in
RBS: 31500 lbs
Design tension: 7000 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial Sag 350' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
300	2-7	2-9	2-11	3-2	3-4	3-7	3-9	4-0	4-3	4-5	4-8	-
325	3-0	3-3	3-5	3-8	3-11	4-2	4-5	4-8	4-11	5-2	5-5	-
350	3-6	3-9	4-0	4-3	4-7	4-10	5-2	5-5	5-9	6-0	6-4	-
375	4-0	4-4	4-7	4-11	5-3	5-7	5-11	6-3	6-7	6-11	7-3	-
400	4-7	4-11	5-3	5-7	6-0	6-4	6-9	7-1	7-6	7-10	8-3	-
TENSION in lbs	4799	4477	4180	3911	3668	3446	3254	3078	2923	2783	2656	-

Span length in feet	Initial Sag 400' Ruling Span Sag in Feet-Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
350	3-9	4-0	4-3	4-6	4-9	5-0	5-3	5-6	5-8	5-11	6-2	-
375	4-4	4-7	4-11	5-2	5-5	5-9	6-0	6-3	6-7	6-10	7-1	-
400	4-11	5-3	5-7	5-10	6-2	6-6	6-10	7-2	7-5	7-9	8-1	-
425	5-7	5-11	6-3	6-7	7-0	7-4	7-8	8-1	8-5	8-9	9-1	-
450	6-3	6-8	7-0	7-5	7-10	8-3	8-7	9-0	9-5	9-10	10-2	-
TENSION in lbs	4437	4181	3945	3734	3540	3368	3212	3070	2940	2823	2717	-

Drawing Name	STRINGING TABLES - ACSR				
Drawing #	OH-TYP-SAG-2660	Scale : N.T.S.	Approved By: APS	Rev	CITY LIGHT & POWER
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Conductor: #1/0 ACSR 6/1 strand (Code word Raven)
Weight: 0.1453 lbs/ft
Diameter: 0.398 in
RBS: 4380 lbs
Design tension: 100 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 20' Slack Span Sag in Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
20	7	7	7	7	7	8	8	8	8	8	8	-
TENSION in lbs	13	13	12	12	12	11	11	11	11	11	11	-

Conductor: #1/0 ACSR 6/1 strand (Code word Raven)
Weight: 0.1453 lbs/ft
Diameter: 0.398 in
RBS: 4380 lbs
Design tension: 200 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 40' Slack Span Sag in Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
40	13	13	14	14	14	15	15	15	16	16	16	-
TENSION in lbs	27	26	26	25	25	24	23	23	22	22	22	-

Note: For Final Sag values contact CLP Engineering.

Conductor: #1/0 ACSR 6/1 strand (Code word Raven)
Weight: 0.1453 lbs/ft
Diameter: 0.398 in
RBS: 4380 lbs
Design tension: 300 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 60' Slack Span Sag in Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
60	19	19	20	21	21	22	22	23	23	23	23	-
TENSION in lbs	42	41	39	38	37	36	35	35	34	34	33	-

Conductor: #1/0 ACSR 6/1 strand (Code word Raven)
Weight: 0.1453 lbs/ft
Diameter: 0.398 in
RBS: 4380 lbs
Design tension: 400 lbs at 0º F, ½ in radial ice, 4 lb/ft^2 wind

Span length in feet	Initial sag 80' Slack Span Sag in Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
80	24	25	26	27	28	28	29	30	30	31	31	-
TENSION in lbs	57	55	53	52	50	49	48	47	46	46	45	-

Note: For Final Sag values contact CLP Engineering.

Conductor: 4/0 ACSR 6/1 strand (Code word Penguin)
Weight per ft.: 0.291 lbs.
Diameter: 0.563 inches
Design tension: 100 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial sag 20' Slack Span Sag in Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
20	8	8	9	9	9	9	9	9	9	9	10	-
TENSION in lbs	21	21	20	20	20	19	19	19	19	19	18	-

Conductor: 4/0 ACSR 6/1 strand (Code word Penguin)
Weight per ft.: 0.291 lbs.
Diameter: 0.563 inches
Design tension: 200 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial sag 40' Slack Span Sag in Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
40	16	17	17	17	18	18	18	18	19	9	10	-
TENSION in lbs	43	42	41	40	40	39	38	38	38	19	18	-

Note: For Final Sag values contact CLP Engineering.

Drawing Name	STRINGING TABLES - ACSR SLACK SPAN				
Drawing #	OH-TYP-SAG-2661	Scale : N.T.S.	Approved By: APS	Rev	CITY LIGHT & POWER
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Conductor: 4/0 ACSR 6/1 strand (Code word Penguin)
Weight per ft.: 0.291 lbs.
Diameter: 0.563 inches
Design tension: 300 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial sag 60' Slack Span Sag in Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
60	24	25	25	26	26	27	27	27	28	28	28	-
TENSION in lbs	65	63	62	61	60	59	58	57	57	56	56	-

Conductor: 4/0 ACSR 6/1 strand (Code word Penguin)
Weight per ft.: 0.291 lbs.
Diameter: 0.563 inches
Design tension: 400 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial sag 80' Slack Span Sag in Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
80	32	33	33	34	35	35	36	36	37	37	37	-
TENSION in lbs	87	86	84	82	81	79	78	77	76	76	75	-

Note: For Final Sag values contact CLP Engineering.

Conductor: 336.4 ACSR 18/1 strand (Code word Marlin)
Weight per ft.: 0.365 lbs.
Diameter: 0.684 inches
Design tension: 100 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial sag 20' Slack Span Sag in Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
20	0	9	10	10	10	10	10	10	10	10	10	-
TENSION in lbs	24	23	23	23	22	22	22	22	22	22	21	-

Conductor: 336.4 ACSR 18/1 strand (Code word Marlin)
Weight per ft.: 0.365 lbs.
Diameter: 0.684 inches
Design tension: 200 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial sag 40' Slack Span Sag in Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
40	18	19	19	19	20	20	20	20	20	20	21	-
TENSION in lbs	48	47	46	45	45	44	44	44	43	43	43	-

Note: For Final Sag values contact CLP Engineering.

Drawing Name	STRINGING TABLES - ACSR SLACK SPAN				
Drawing #	OH-TYP-SAG-2661	Scale : N.T.S.	Approved By: APS	Rev	CITY LIGHT & POWER
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Conductor: 336.4 ACSR 18/1 strand (Code word Marlin)
Weight per ft.: 0.365 lbs.
Diameter: 0.684 inches
Design tension: 300 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial sag 60' Slack Span Sag in Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
60	28	28	28	29	29	30	30	30	30	31	31	-
TENSION in lbs	72	71	69	68	68	67	66	65	65	65	64	-

Conductor: 336.4 ACSR 18/1 strand (Code word Marlin)
Weight per ft.: 0.365 lbs.
Diameter: 0.684 inches
Design tension: 400 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial sag 80' Slack Span Sag in Inches for Fahrenheit temperature of:											
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	
80	37	37	38	38	39	39	40	40	41	41	41	-
TENSION in lbs	96	95	93	92	90	89	88	87	86	86	85	-

Note: For Final Sag values contact CLP Engineering.

Drawing Name	STRINGING TABLES - ACSR SLACK SPAN			
Drawing #	OH-TYP-SAG-2661	Scale : N.T.S.	Approved By: APS	Rev 1
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Conductor: 3/0 triplex with a 1/0 AAC neutral (Code word Fulgar)
Weight per ft.: 0.535 lbs.
Diameter: 1.150 inches
Design tension: 2,000 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial Sag 150' Ruling Span Sag in Inches for Fahrenheit Temperature of:										
	0º	10º	20º	30º	40º	50º	60º	70º	80º	90º	100º
75	3	3	4	4	4	4	5	5	5	6	6
100	6	6	6	7	7	8	8	9	9	10	11
125	9	9	10	11	11	12	13	14	15	16	17
150	13	13	14	15	16	17	18	20	21	22	24
175	17	18	19	21	22	23	25	27	29	31	33
200	23	24	25	27	29	31	33	35	37	40	43
225	29	30	32	34	36	39	41	44	47	50	54
TENSION in lbs	1423	1343	1265	1189	1116	1046	980	917	859	805	756

Note: For Final Sag values contact CLP Engineering.

Conductor: No. 2 triplex with a No. 2 ACSR Neutral (Code word Conch)
Weight per ft.: 0.267 lbs.
Diameter: 0.770 inches
Design tension: 1,350 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial Sag 150' Ruling Span Sag in Inches for Fahrenheit Temperature of:										
	0º	10º	20º	30º	40º	50º	60º	70º	80º	90º	100º
75	3	3	3	3	3	4	4	4	5	5	5
100	5	5	5	6	6	6	7	7	8	9	9
125	7	8	8	9	9	10	11	12	13	14	15
150	11	11	12	13	14	15	16	17	18	20	21
175	15	15	16	17	18	20	21	23	25	27	29
200	19	20	21	23	24	26	28	30	32	35	38
225	24	25	27	29	31	33	35	38	41	44	48
TENSION in lbs	845	800	754	709	663	619	576	535	496	460	427

Note: For Final Sag values contact CLP Engineering.

Conductor: 3/0 quadruplex with a 3/0 6201 alloy neutral (Code word Trotter)
Weight per ft.: 0.813 lbs.
Diameter: 1.350 inches
Design tension: 2,500 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial Sag 150' Ruling Span Sag in Inches for Fahrenheit Temperature of:										
	0º	10º	20º	30º	40º	50º	60º	70º	80º	90º	100º
75	4	4	5	5	5	6	6	6	12	13	13
100	7	7	8	9	9	10	10	11	12	13	13
125	11	12	13	13	14	15	16	17	19	20	21
150	16	17	18	19	21	22	24	25	27	28	30
175	21	23	25	26	28	30	32	34	36	39	41
200	28	30	32	34	37	39	42	45	48	50	53
225	36	38	41	43	47	50	53	57	60	64	67
TENSION in lbs	1738	1626	1520	1421	1328	1242	1164	1092	1027	969	916

Note: For Final Sag values contact CLP Engineering.

Conductor: 4/0 triplex with a 2/0 6201 alloy neutral (Code word Arca)
Weight per ft.: 0.647 lbs.
Diameter: 1.260 inches
Design tension: 2,000 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial Sag 150' Ruling Span Sag in Inches for Fahrenheit Temperature of:										
	0º	10º	20º	30º	40º	50º	60º	70º	80º	90º	100º
75	4	5	5	5	6	6	7	7	7	8	8
100	8	9	9	10	10	11	12	13	13	14	15
125	12	13	14	15	16	17	18	20	21	22	23
150	18	19	21	22	23	25	27	28	30	31	33
175	24	26	28	30	32	34	36	38	41	43	45
200	32	34	37	39	42	44	47	50	53	56	59
225	40	43	46	49	53	56	60	63	67	71	74
TENSION in lbs	1216	1137	1062	994	931	874	822	775	732	694	660

Note: For Final Sag values contact CLP Engineering.

Conductor: 4/0 quadruplex with a 4/0 6201 alloy neutral (Code word Walking)
Weight per ft.: 0.983 lbs.
Diameter: 1.490 inches
Design tension: 2,500 lbs. at 0º F, ½ in. radial ice, 4 lb. per sq. ft. wind

Span length in feet	Initial Sag 150' Ruling Span Sag in Inches for Fahrenheit Temperature of:										
	0º	10º	20º	30º	40º	50º	60º	70º	80º	90º	100º
75	5	6	6	7	7	7	8	8	9	9	9
100	10	10	11	12	12	13	14	15	15	16	17
125	15	16	17	18	19	21	22	23	24	25	26
150	22	23	25	25	28	30	31	33	35	36	38
175	30	32	34	34	38	40	43	45	47	49	52
200	39	41	44	44	50	53	56	59	62	64	67
225	49	52	56	56	63	67	71	74	78	82	85
TENSION in lbs	1529	1429	1339	1258	1184	1119	1059	1006	959	916	877

Note: For Final Sag values contact CLP Engineering.

SITE SPECIFIC PUPI FIBERGLASS CROSSARMS FOR 15KV RATED APPLICATIONS				
INSTALLATION	10 FT TANGENT	10 FT DEADEND	8 FT TANGENT	8 FT DEADEND
Army West Point	TB220012005X2	DA3000120E4B9X2	-	-
Bluegrass Army Depot	TB220012005X2	DA3000120E4B9X2	-	-
Fort Campbell	TB220012005X2	DA3000120E4B9X2	-	-
Fort Riley	TB220012005X2	DA3000120E4B9X2	-	-
Hill Air Force Base	TB220012005X2	DA3000120E4B9X2	-	-
Joint Base Lewis-McChord	TB220012005X3	DA3000120X4B9X3	TB100009604X3	DA2000096X3B7X3
Keesler Air Force Base	TB220012005X2	DA3000120E4B9X2	-	-
March Air Reserve Base	TB220012005X2	DA3000120E4B9X2	-	-
Travis Air Force Base	TB220012005X2	DA3000120E4B9X2	-	-

Drawing Name	CROSSARMS				
Drawing #	OH-15KV-ARM-2645	Scale : N.T.S.	Approved By: APS	Rev	CITY LIGHT & POWER
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BILL OF MATERIALS

ITEM	MATERIAL DESCRIPTION	MFG.	CATALOG NO.	QUANTITY			
				SH.3	SH.4	SH.5	SH.6
1	Bolt, 3/8 in. X 4-1/2 in.	Hubbell	863412	2	2	-	-
2	Bolt, 5/8 in. D/A length as required	Hubbell	As required	1	2	2	4
3	Brace, flat steel 32 in. L x 0.203 in. T x 1.22 in. W	Hubbell	7032	2	-	-	-
4	Brace, flat steel, 32 in. L x 0.25in T	Hubbell	7132	-	4	-	-
5	Bracket, NEMA B bracket for mounting cutouts, surge arresters, terminations	Hubbell	PSC2061042	-	2	-	2
6	Clamp, side opening spring loaded straight line deadend	MacLean	As required	-	4	-	4
7	Crossarm, wood 8 ft.	Various	Various	1	2	-	-
8	Cutout, 15 kV	* OH-TYP-FUS-2551_Cutouts		-	2	-	2
9	Insulator, 15 kV pin type ANSI Class 55-4 (polymer)	* OH-TYP-INS-2554_Insulators		2	2	2	2
10	Insulator, 15 kV suspension (polymer)	* OH-TYP-INS-2554_Insulators		-	2	-	2
11	Link, 6 in. extension	MacLean	J2520	2	2	-	2
12	Pin, 3/4 in. steel	Hubbell	4705P	2	2	2	2
13	Screw lag, pilot point 1/2 in. X 4 in.	Hubbell	508754	1	1	-	-
14	Washer, 2-1/4 in. sq. curved	Hubbell	681012	1	1	2	4
15	Washer, 2-1/4 in. sq. flat	Hubbell	6813	1	1	-	-
16	Crossarm, 10 ft. fiberglass tangent	* OH-TYP-XRM-2645_Crossarms		-	-	1	2
17	Assembly, Wedge Stirrup	Ampact	Various	-	4	-	4
18	Clamp, Hotline	Hubbell	Various	-	4	-	4

* Reference separate CLP Construction Standard.

Notes:

A. Neutral, triplex or top wire of open wire secondary.

B. Install #6 soft drawn, solid, covered copper wire from system neutral to driven ground. If the pole has arresters or reclosers attached to it, install #4 soft drawn, solid, covered copper wire instead.

C. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

D. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

E. Double-nut all D/A bolts.

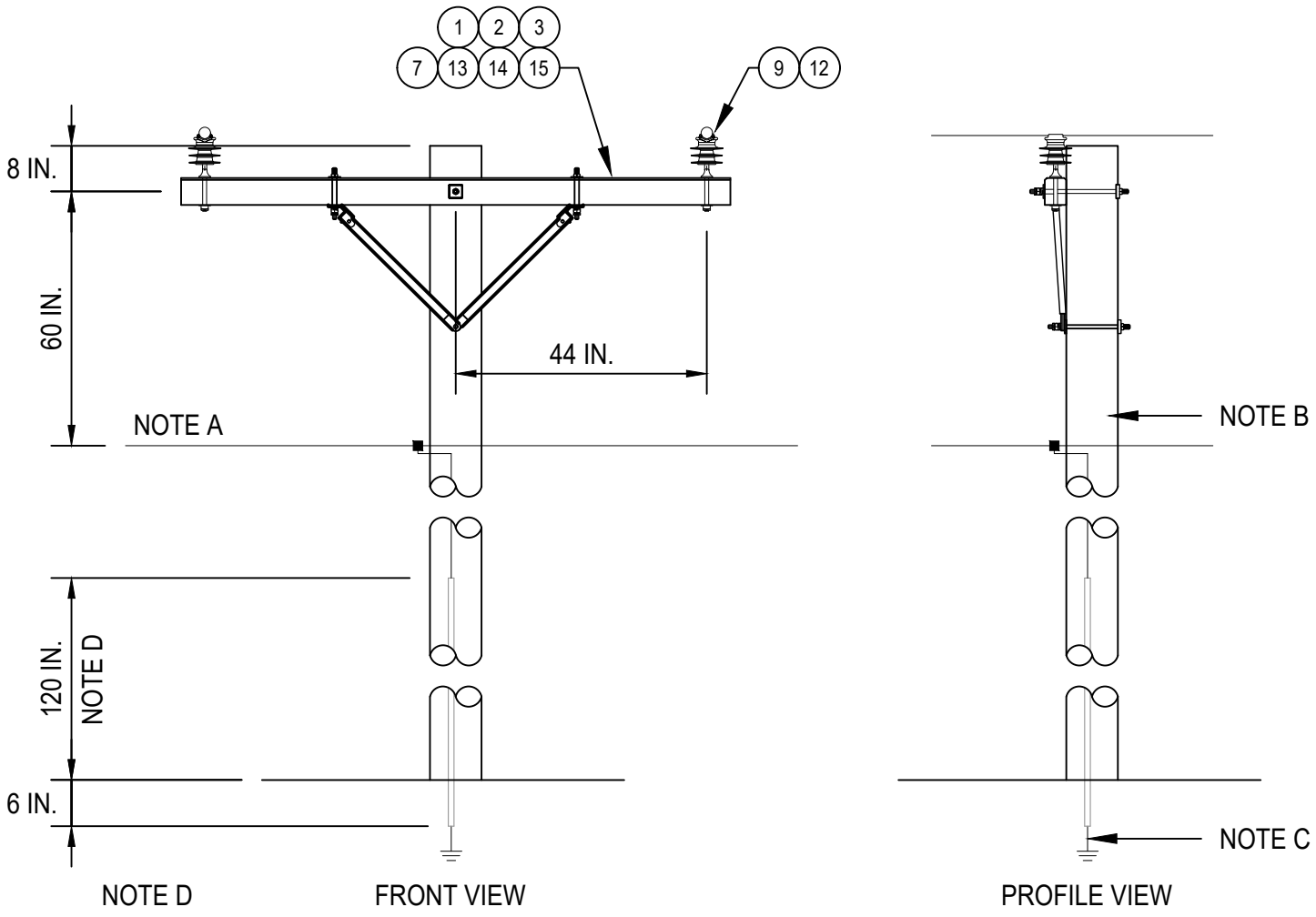
F. Rotate cutout frame slightly towards pole. This will expel the fuse link away from the operator in the event that the fuse blows.

G. Install floating deadends on line side of pole. Cutouts shall also be installed on line side of pole.

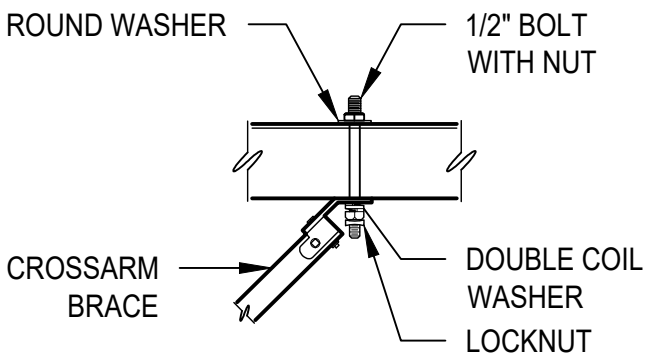
H. Refer to standards OH-TYP-GUY-2600-GuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.

CONDUCTOR SIZE	CONDUCTOR DESIGN TENSION (LBS.)	MAX. ANGLE DEFLECTION
1/0 ACSR	1,000	4°
4/0 ACSR	2,000	3°
336.4 ACSR	2,500	3°

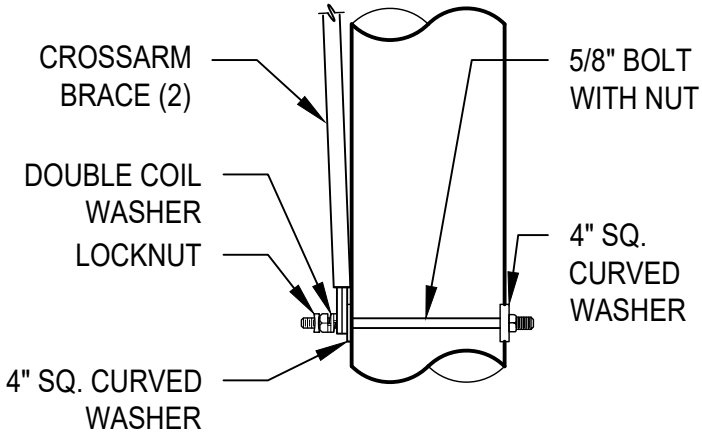
TABLE 1 : MAXIMUM ALLOWABLE ANGLES OF DEFLECTION
(WOOD CROSSARM, 200 FT. RULING SPAN LINES)



TWO-PHASE TANGENT AND ANGLE POLE - WOOD CROSSARM



DETAIL 1: CROSSARM BRACE ATTACHMENT AT CROSSARM



DETAIL 2: CROSSARM BRACE ATTACHMENT AT POLE

Drawing Name	TWO-PHASE TANGENT HORIZONTAL			
Drawing #	OH-15KV-POL-2011	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 3 of 6	Approval Date: 03/10/2021		0

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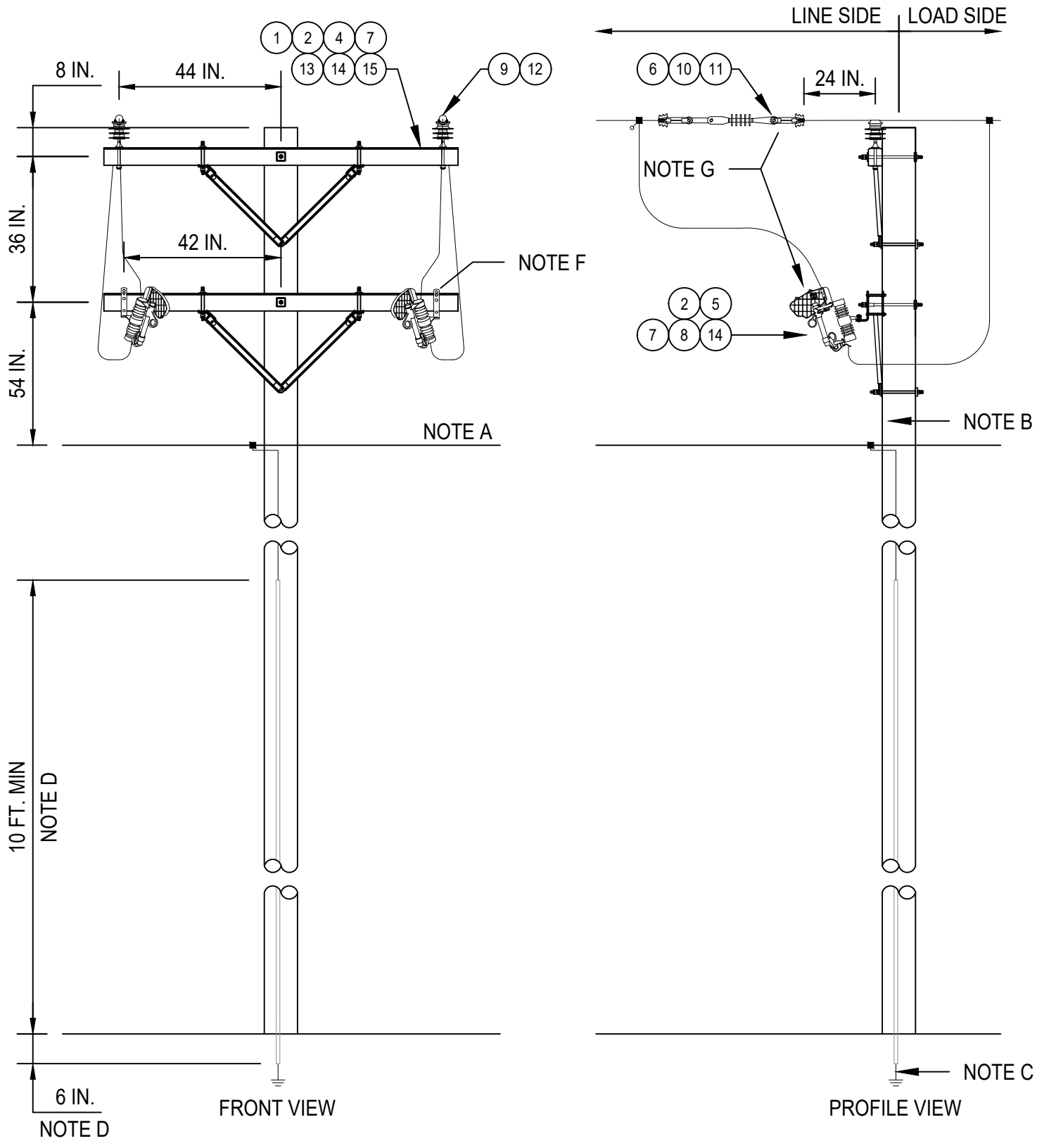
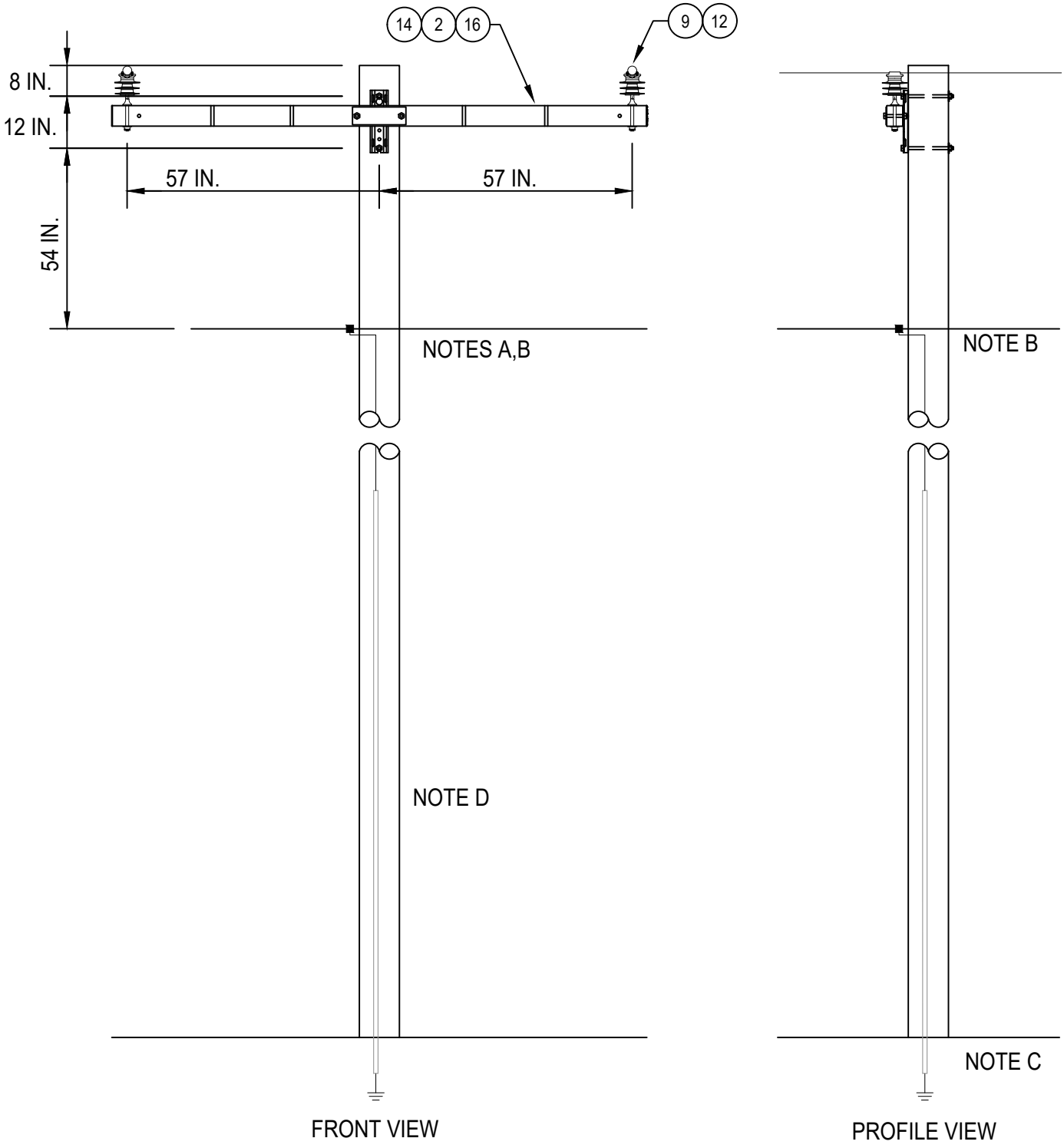


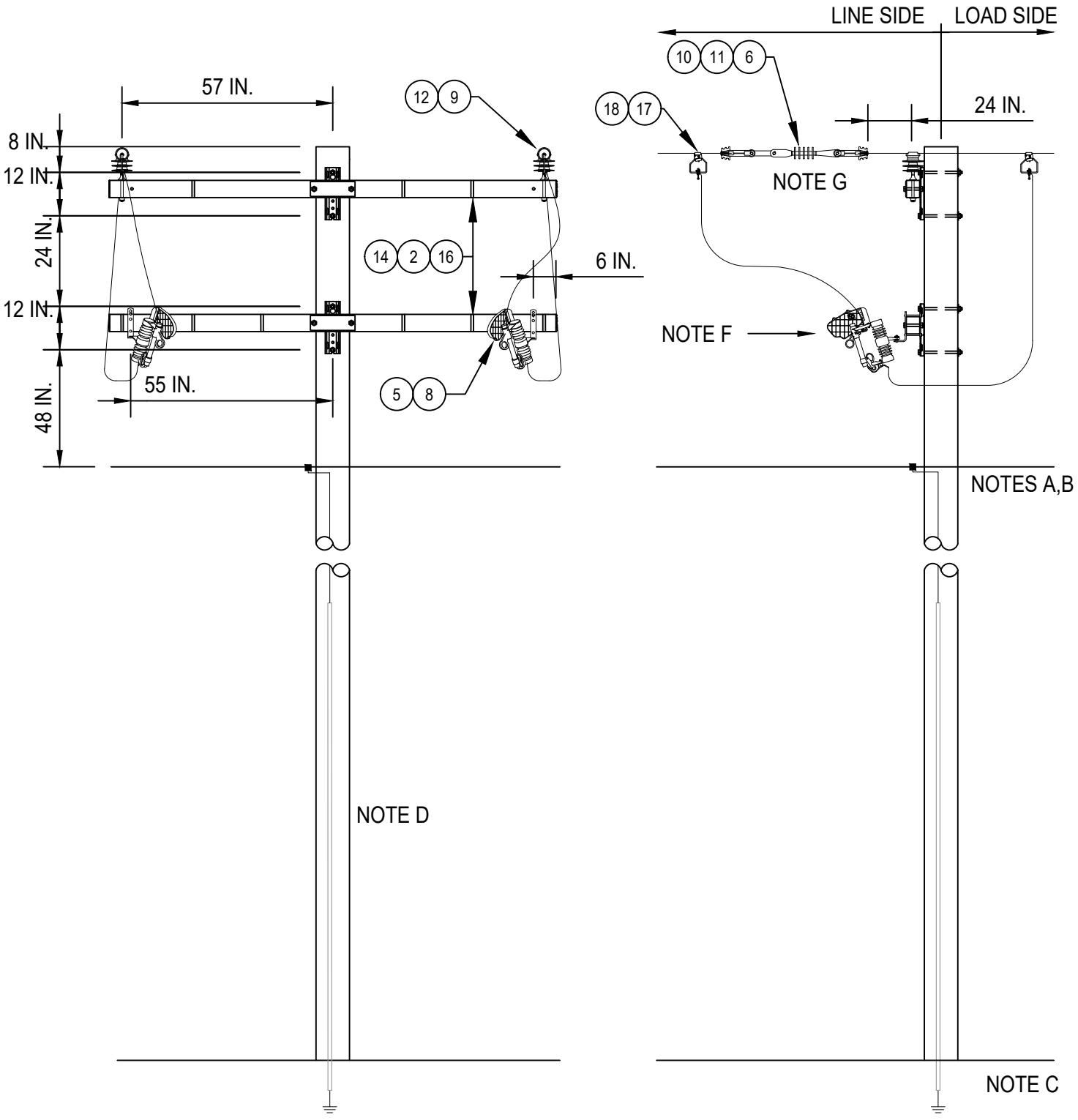
TWO-PHASE TANGENT POLE WITH FUSES - WOOD CROSSARMS

Drawing Name	TWO-PHASE TANGENT HORIZONTAL				
Drawing #	OH-15KV-POL-2011	Scale : N.T.S.	Approved By: APS	Rev	CITY LIGHT & POWER
City Light & Power Construction Detail Standards	Sheet 4 of 6	Approval Date: 03/10/2021	0		



TWO-PHASE TANGENT POLE - FIBERGLASS CROSSARM

Drawing Name	TWO-PHASE TANGENT HORIZONTAL			
Drawing #	OH-15KV-POL-2011	Scale : N.T.S.	Approved By: APS	Rev 0
City Light & Power Construction Detail Standards	Sheet 5 of 6	Approval Date: 03/10/2021		



TWO-PHASE TANGENT POLE WITH FUSES - FIBERGLASS CROSSARMS

Drawing Name	TWO-PHASE TANGENT HORIZONTAL			
Drawing #	OH-15KV-POL-2011	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 6 of 6	Approval Date: 03/10/2021		0

CITY LIGHT & POWER

BILL OF MATERIALS				
Item	Material Description	Mfg.	Catalog No.	Quantity
1	Bolt, 3/4 in. D/A length as required	Various	As required	2
2	Washer, 3x3x1/4 in. sq. curved, bolt dia. 3/4 in.	Various	As required	2
3	Clamp, side opening spring-loaded straight line deadend	MacLean	As required	2
4	Crossarm, 8 ft. fiberglass deadend	* OH-TYP-XRM-2645_Crossarms		1
5	Insulator, 15 kV suspension (polymer)	Hubbell	4010150215	2

* Reference separate CLP Construction Standard.

Notes:

A. Neutral, triplex or top wire of open wire secondary.

B. Install #6 soft drawn, solid, covered copper wire from system neutral to driven ground. If the pole has arresters or reclosers attached to it, install #4 soft drawn, solid, covered copper wire instead.

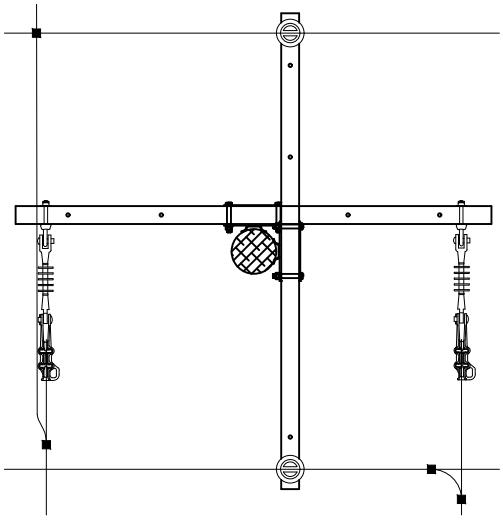
C. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

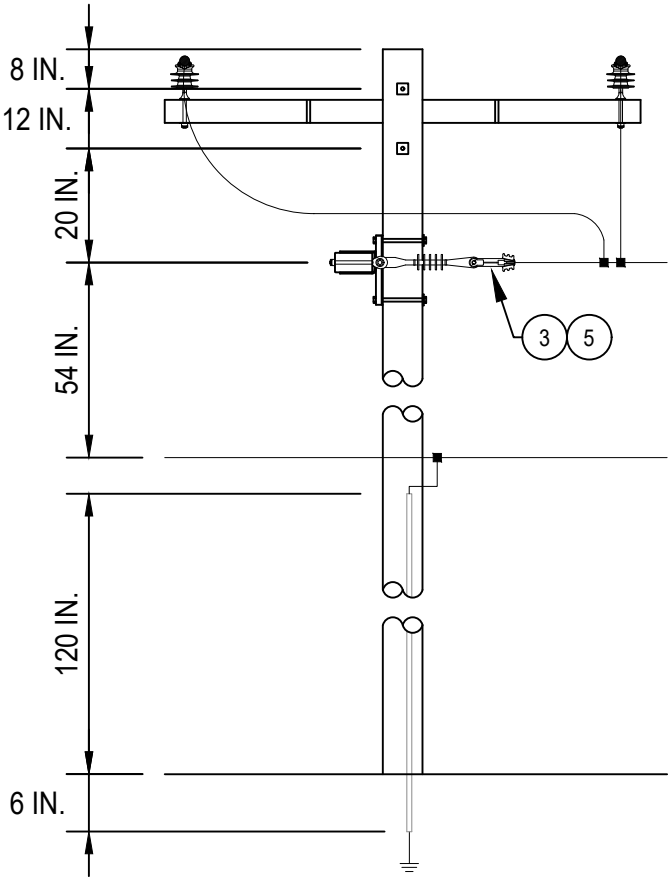
D. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

E. Double nut all D/A bolts.

F. Rotate cutout frame slightly towards pole. This will expel the fuse link away from the operator in the event that the fuse blows.

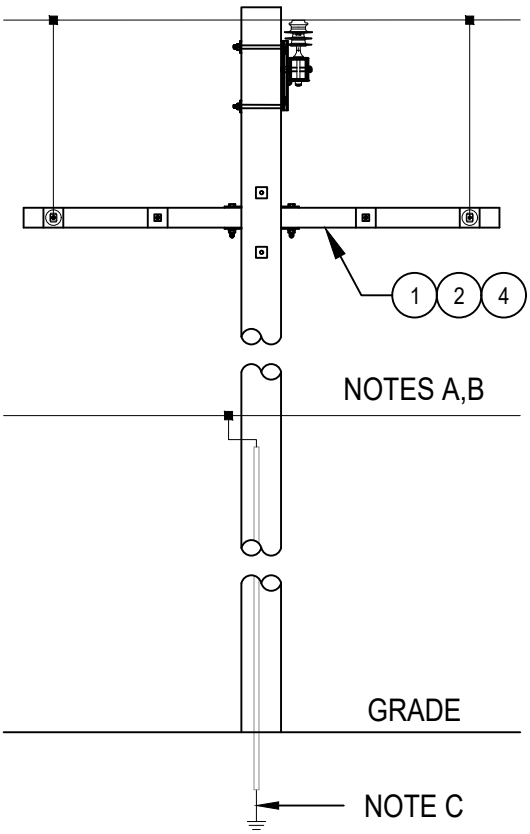
G. Refer to standards OH-TYP-GUY-2600-GuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.





NOTE D

FRONT VIEW



PROFILE VIEW

Drawing Name	TWO-PHASE DEADEND HORIZONTAL				
Drawing #	OH-15KV-POL-2012	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 2 of 2		Approval Date: 03/10/2021	0

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BILL OF MATERIALS

Item	Material Description	Mfg.	Catalog No.	Quantity		
				Sh.3	Sh.4	Sh.5
1	Assembly, wedge stirrup	Ampact	Various	2	2	2
2	Bolt, D/A, 3/4 in., length as required	Hubbell	Various	4	2	2
3	Bolt, D/A, 5/8 in., length as required	Hubbell	Various	2	6	6
4	Brace, Crossarm, 48 in. span X 24 in. drop, sold as pair	Various		-	1	1
5	Bracket, NEMA B, (for mounting cutouts, surge arresters and terminations)	Hubbell	PSC2061042	0	0	2
6	Clamp, Hot Line	Hubbell	Various	2	2	2
7	Connector, Wedge	Ampact	Various	2	2	2
8	Crossarm, fiberglass, deadend, 8 ft.	See OH-TYP-XRM-2645_Crossarms		1	1	1
9	Crossarm, fiberglass, tangent, 10 ft.	See OH-TYP-XRM-2645_Crossarms		1	-	-
10	Crossarm, wood, 10 ft.	Various		-	1	1
11	Cutout, 15kV, 100A, load break	See OH-TYP-FUS-2551_Cutouts		-	-	2
12	Insulator, 15 kV, pin type, ANSI Class 55-4, polymer	See OH-TYP-INS-2554_Insulators		3	3	4
13	Insulator, 15 kV, suspension, polymer	See OH-TYP-INS-2554_Insulators		2	2	2
14	Pin, 3/4 in., steel	Hubbell	4705P	3	3	4
15	Washer, curved, 2-1/4 in. sq., for 5/8 in. bolt	Hubbell	681012	-	2	2
16	Washer, flat, 2-1/4 in. sq., for 5/8 in. bolt	Hubbell	6813	-	1	1
17	Washer, curved, 3 in. sq., for 3/4 in. bolt	Hubbell	682212	4	2	2
18	Washer, round, for 3/4 in. bolt	Hubbell	6806	4	2	2

Notes:

A. Neutral, triplex or top wire of open wire secondary.

B. Install #6 soft drawn, solid, copper wire from system neutral to driven ground. If the pole has arresters, reclosers, switches, or transformers attached to it, install #4 soft drawn, solid, covered copper wire instead.

C. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

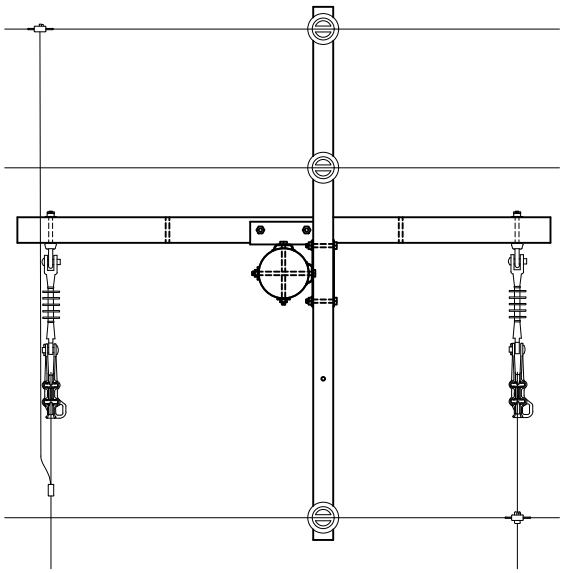
D. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

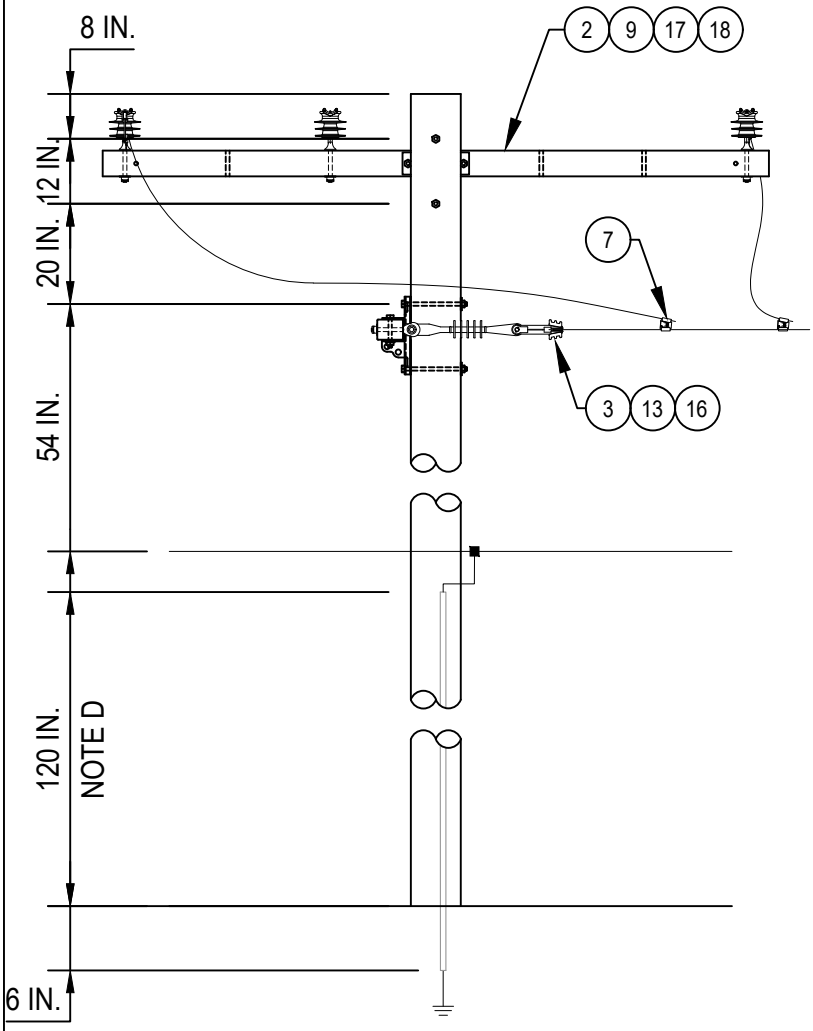
E. Double nut all D/A bolts.

F. Rotate cutout frame slightly towards pole. This will expel the fuse link away from the operator in the event that the fuse blows.

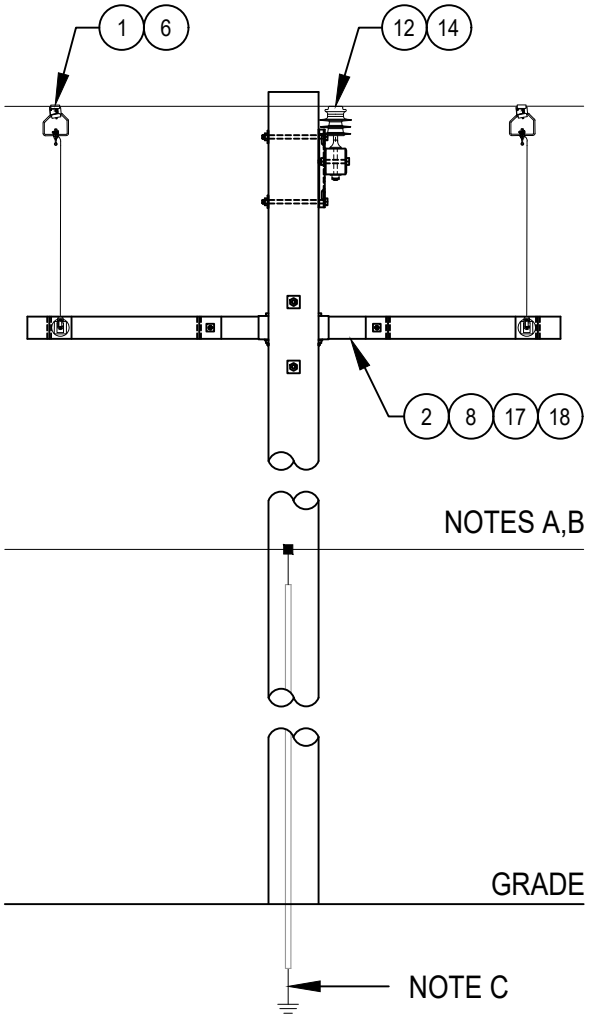
G. Only use fourth post and insulator for training of phases on other side of pole (opposite of tap line)

H. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.





FRONT VIEW



PROFILE VIEW

TWO-PHASE TAP FROM A THREE-PHASE LINE - FIBERGLASS CROSSARM

Drawing Name	TWO-PHASE TAP FROM THREE-PHASE LINE			
Drawing #	OH-15KV-POL-2021	Scale : N.T.S.	Approved By: APS	Rev
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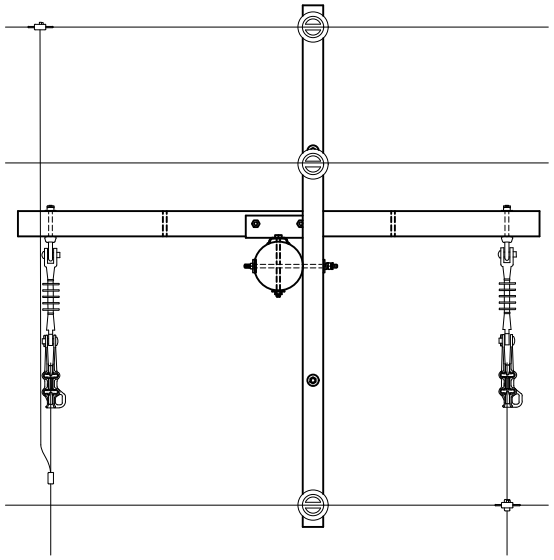
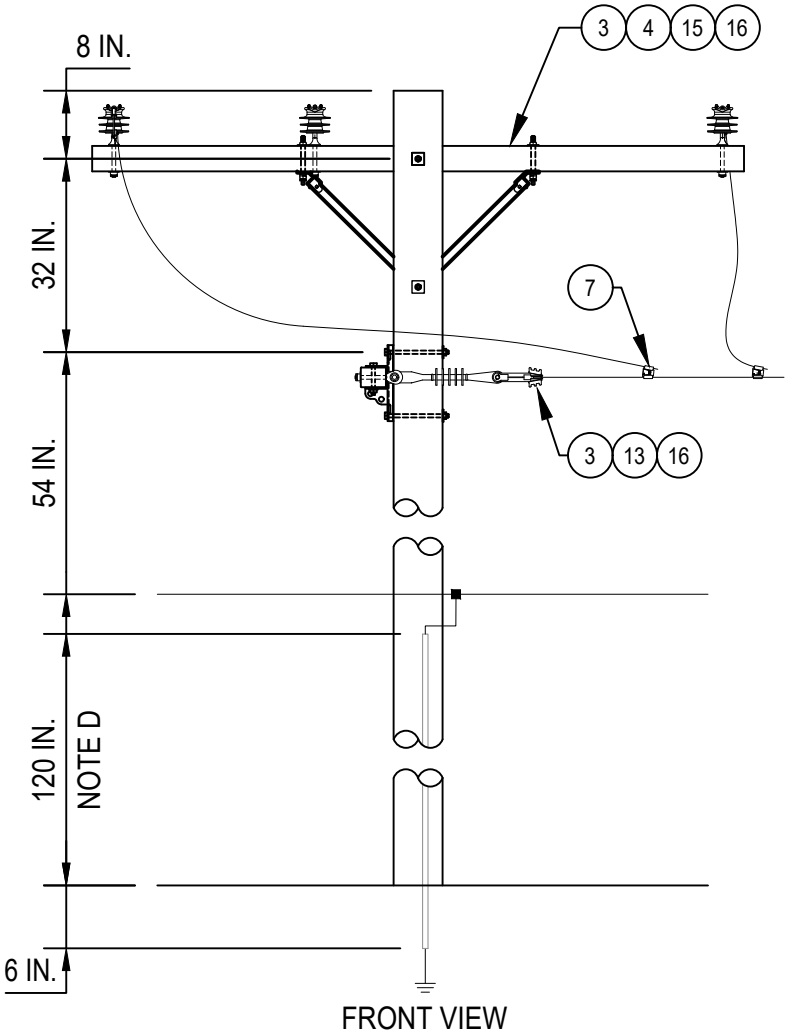
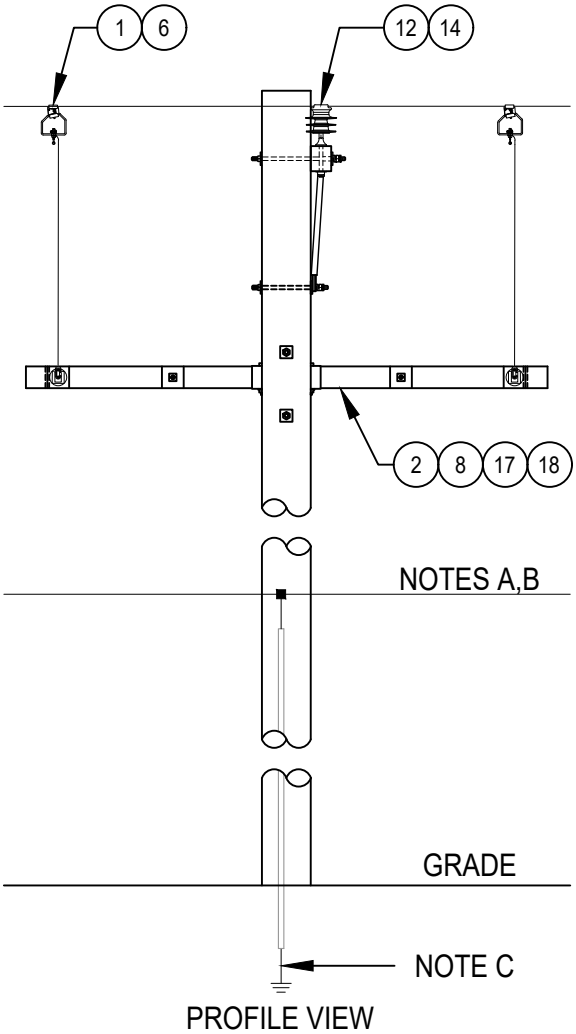
CITY LIGHT & POWER





FRONT VIEW

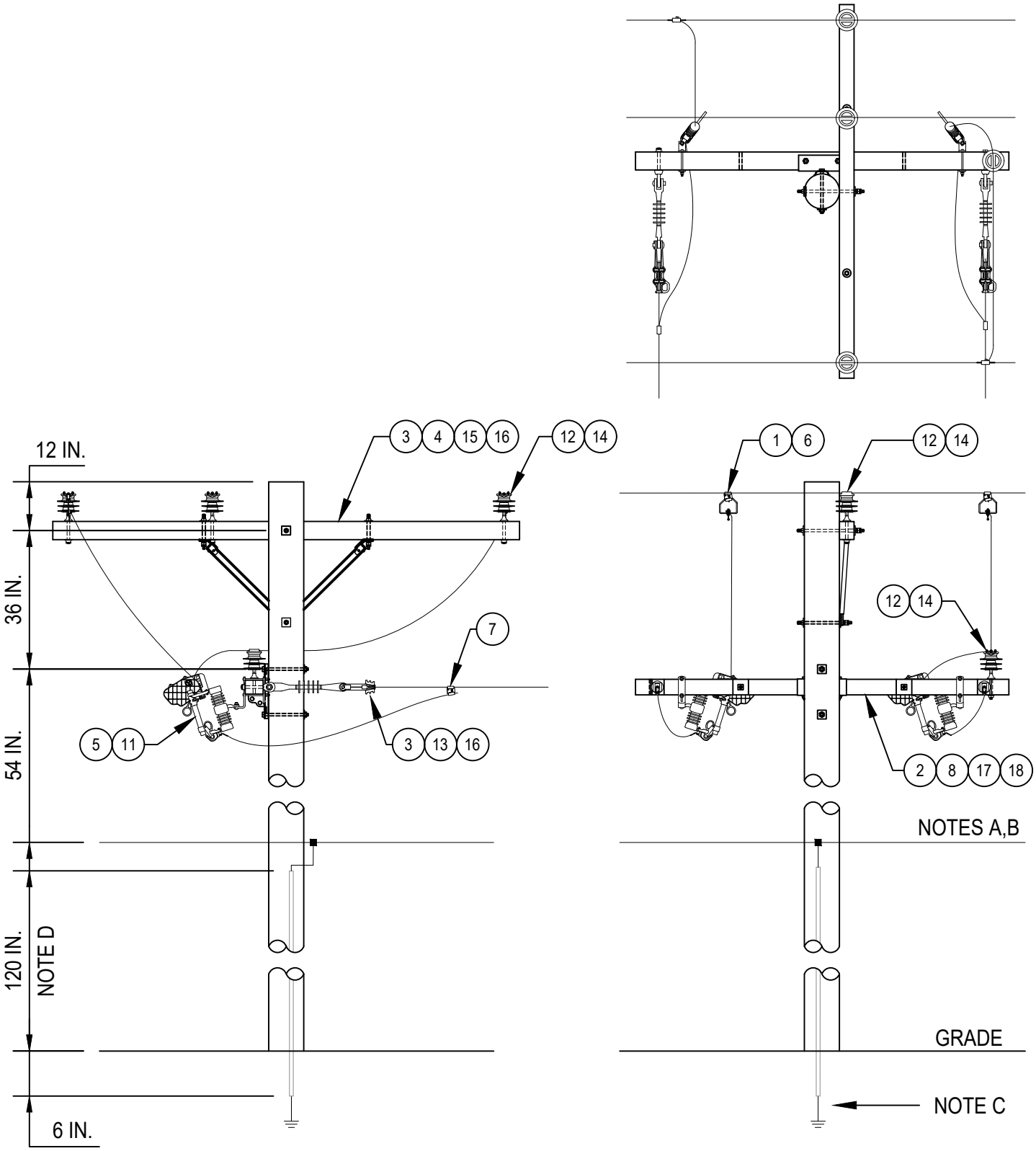


PROFILE VIEW

TWO-PHASE TAP FROM A THREE-PHASE LINE - WOOD CROSSARM

Drawing Name	TWO-PHASE TAP FROM THREE-PHASE LINE			
Drawing #	OH-15KV-POL-2021	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 4 of 5	Approval Date: 04/20/2021		0

CITY LIGHT & POWER



PROFILE VIEW

FRONT VIEW

TWO-PHASE TAP FROM A THREE-PHASE LINE - WOOD CROSSARM WITH CUTOUTS

Drawing Name	TWO-PHASE TAP FROM THREE-PHASE LINE			
Drawing #	OH-15KV-POL-2021	Scale : N.T.S.	Approved By: APS	Rev
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CITY LIGHT & POWER

BILL OF MATERIALS				
Item	Material Description	Mfg.	Catalog No.	Quantity
1	Crossarm, deadend, fiberglass, 10 ft.	PUPI	DA3000120E4B9X2	1
2	Bolt, 3/4 in. D/A, length as required	Hubbell	Various	2
3	Washer, 3 in. sq. curved	Hubbell	682212	2
4	Insulator, suspension, 15kV, polymer	See OH-TYP-INS-2554_Insulators		6
5	Nut, 5/8 in. oval eye	Hubbell	6502	4
6	Clamp, side-opening, spring-loaded, straight line deadend	MacLean	Various	6
7	Strain, 12 in., fiberglass	Hubbell	GS16012CPSC	2
8	Insulator, pin type, 15kV, ANSI Class 55-4, polymer	See OH-TYP-INS-2554_Insulators		3
9	Pin, 3/4 in. steel	Hubbell	4705P	3
10	Nut, 3/4 in. oval eye	Hubbell	6503	2
11	Connector, Wedge	Ampact	Various	6
12	Switch, Disconnect	Hubbell	M3D-96BCL	3
13	Guard, Wildlife	See OH-TYP-ANL-2510_Wildlife Protection		As required
14	Tubing, Wildlife (Stinger cover)	See OH-TYP-ANL-2510_Wildlife Protection		As required

Notes:

A. Neutral, triplex, or top wire of open wire secondary.

B. Install #6 soft drawn, solid, copper wire from system neutral to driven ground. If the pole has arresters, reclosers, switches, or transformers attached to it, install #4 soft drawn, solid, covered copper wire instead.

C. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

D. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

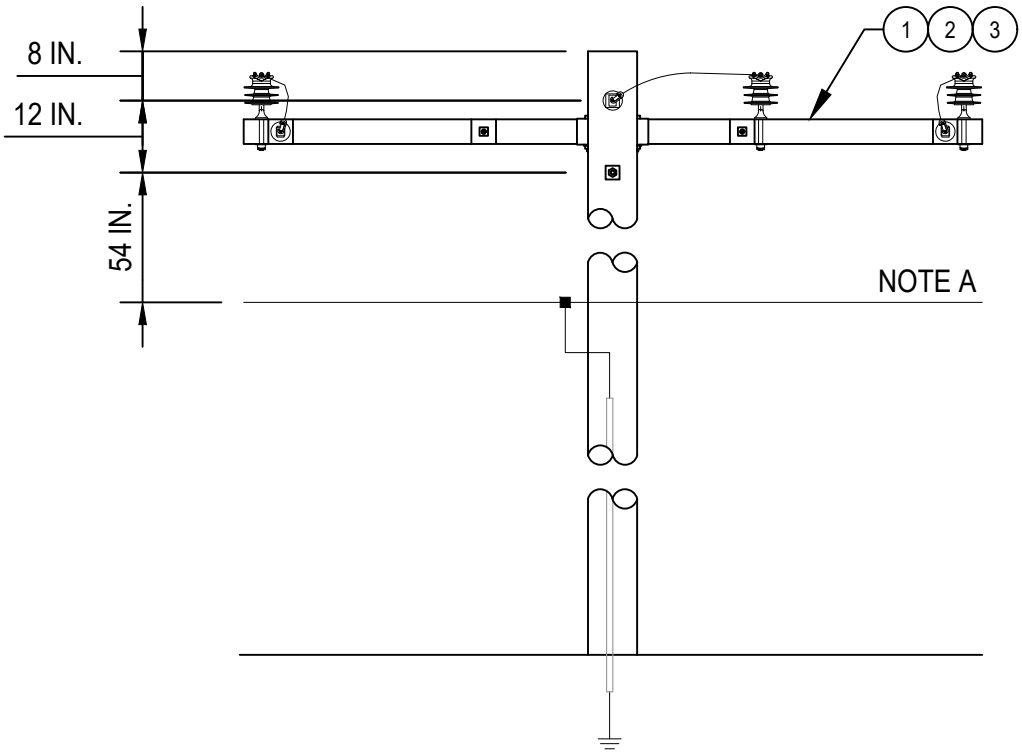
E. Double nut all D/A bolts.

F. Ampact wedge connectors must be used for primary taps.

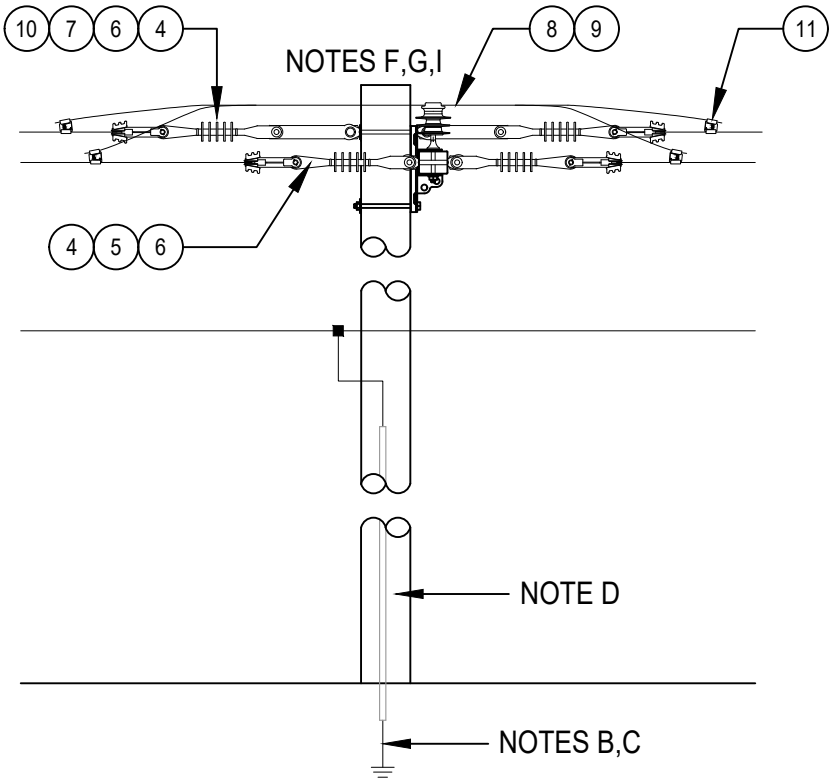
G. All connections shall be made inside of dead-end clamp. Do not make taps beyond dead-end clamp.

H. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.

I. In areas sensitive to wildlife, all taps must be covered with elastomer tubing (stinger cover).



SIDE VIEW

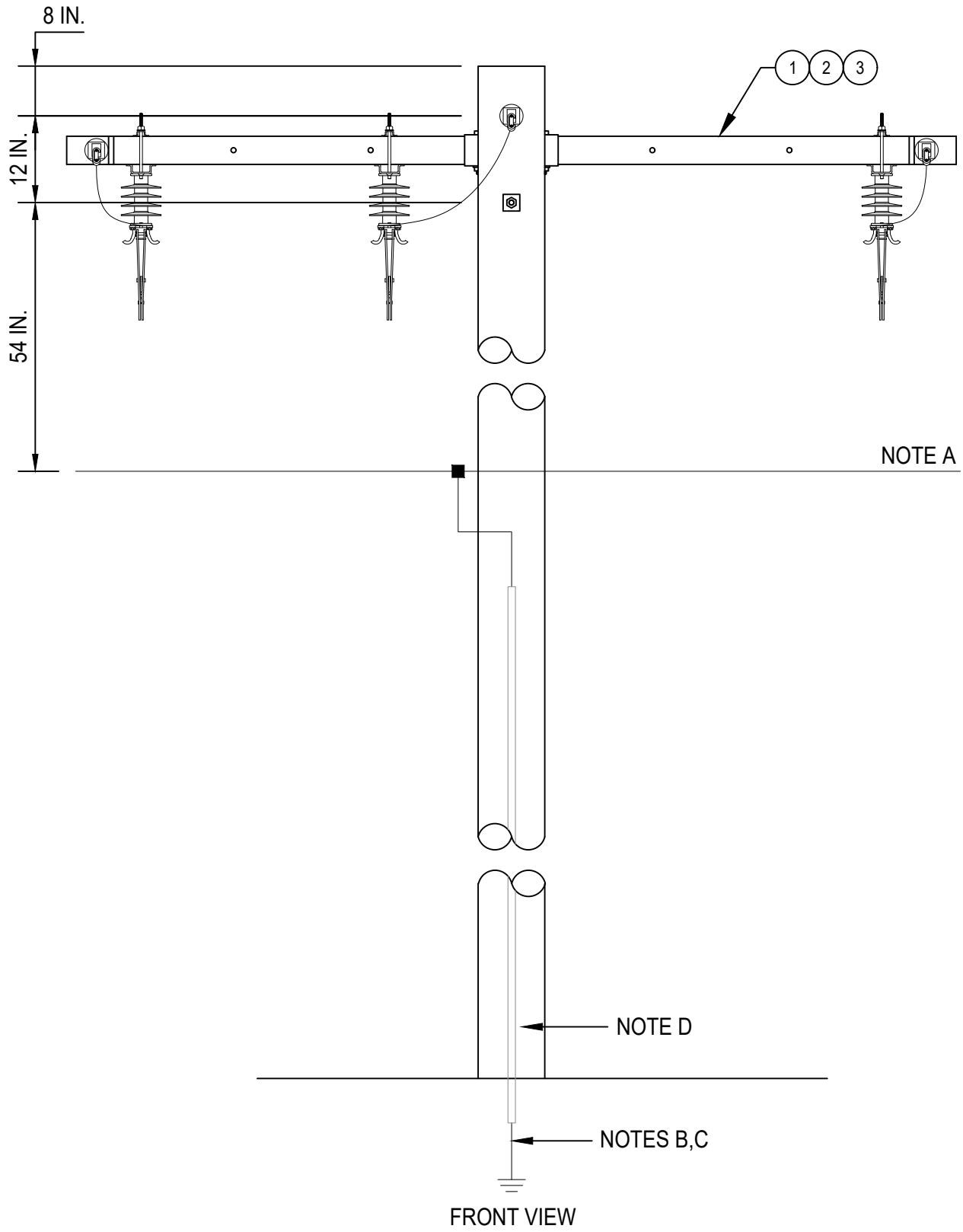


FRONT VIEW

THREE-PHASE DOUBLE DEADEND, HORIZONTAL
FIBERGLASS CROSSARM

Drawing Name	THREE-PHASE DOUBLE DEADEND - HORIZONTAL			
Drawing #	OH-15KV-POL-2030	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 2 of 4	Approval Date: 03/10/2021		1

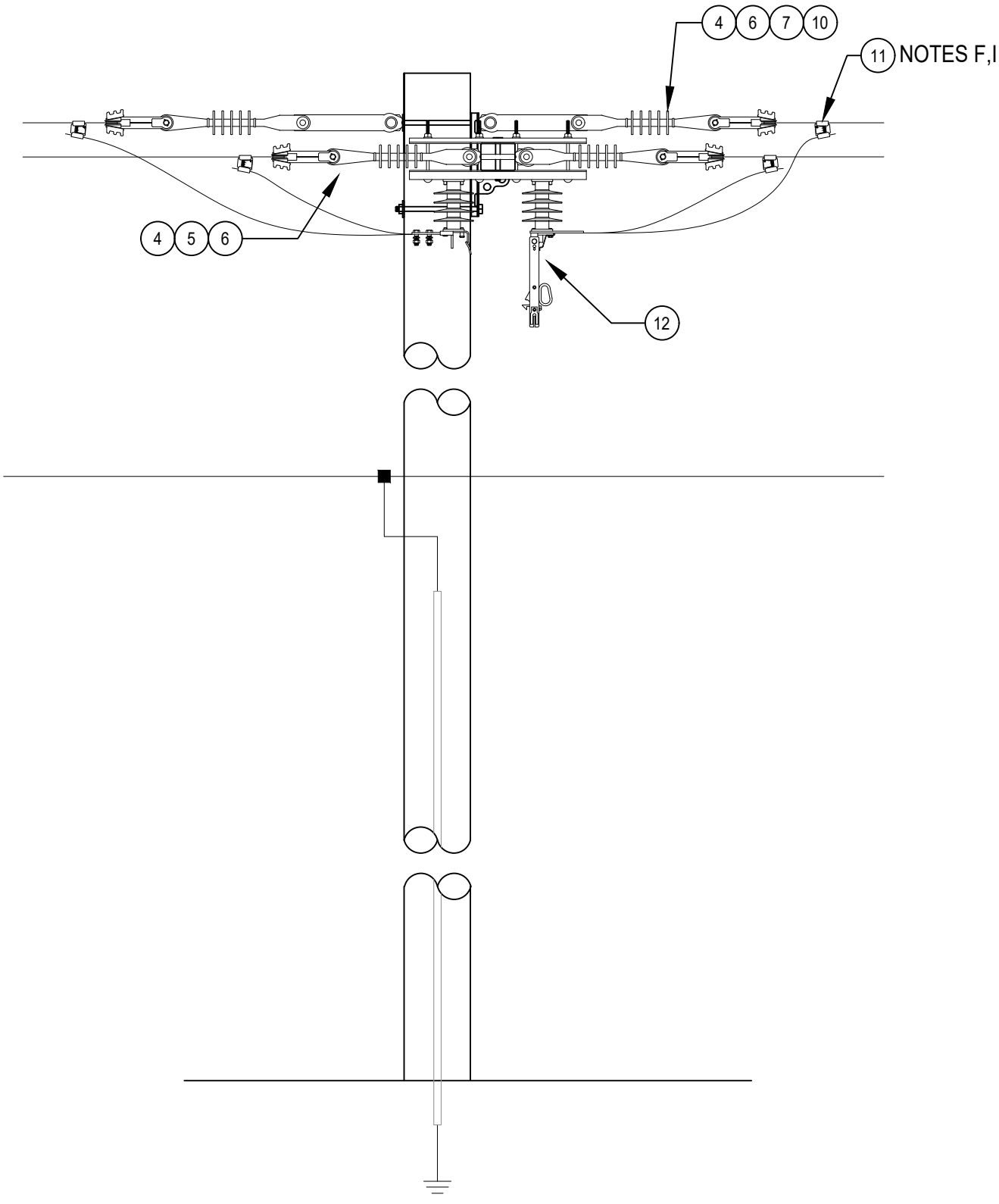
CITY LIGHT & POWER



THREE-PHASE DOUBLE DEADEND, HORIZONTAL
FIBERGLASS CROSSARM - WITH DISCONNECT SWITCH

Drawing Name	THREE-PHASE DOUBLE DEADEND - HORIZONTAL			
Drawing #	OH-15KV-POL-2030	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 3 of 4	Approval Date: 03/10/2021		1

CITY LIGHT & POWER



SIDE VIEW

THREE-PHASE DOUBLE DEADEND, HORIZONTAL
FIBERGLASS CROSSARM - WITH DISCONNECT SWITCH

Drawing Name	THREE-PHASE DOUBLE DEADEND - HORIZONTAL			
Drawing #	OH-15KV-POL-2030	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 4 of 4	Approval Date: 03/10/2021		1

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BILL OF MATERIALS				
Item	Material Description	Mfg.	Catalog No.	Quantity
1	Insulator, 15 kV pin type ANSI Class 55-4 (polymer)	See OH-TYP-INS-2554_Insulators		3
2	Pin, 3/4 in. steel stub	Hubbell	PS893P	3
3	Bolt, D/A, 5/8 IN.	Hubbell	Various	6
4	Washer, 2-1/4 sq. curved	Hubbell	681012	6
5	Bracket, fiberglass equipment 24 in.	MacLean	G1HDA524AT	3
6	Nut, 5/8 in. oval eye	Hubbell	6502	6
7	Strain, 12 in. fiberglass	Hubbell	GS16012CPSC	6
8	Clamp, side-opening, spring-loaded, straight line deadend	MacLean	Various	6
9	Insulator, 15 kV suspension (polymer)	See OH-TYP-INS-2554_Insulators		6
10	Connector, Wedge	Ampact	Various	6

Notes:

A. Neutral, triplex, or top wire of open wire secondary.

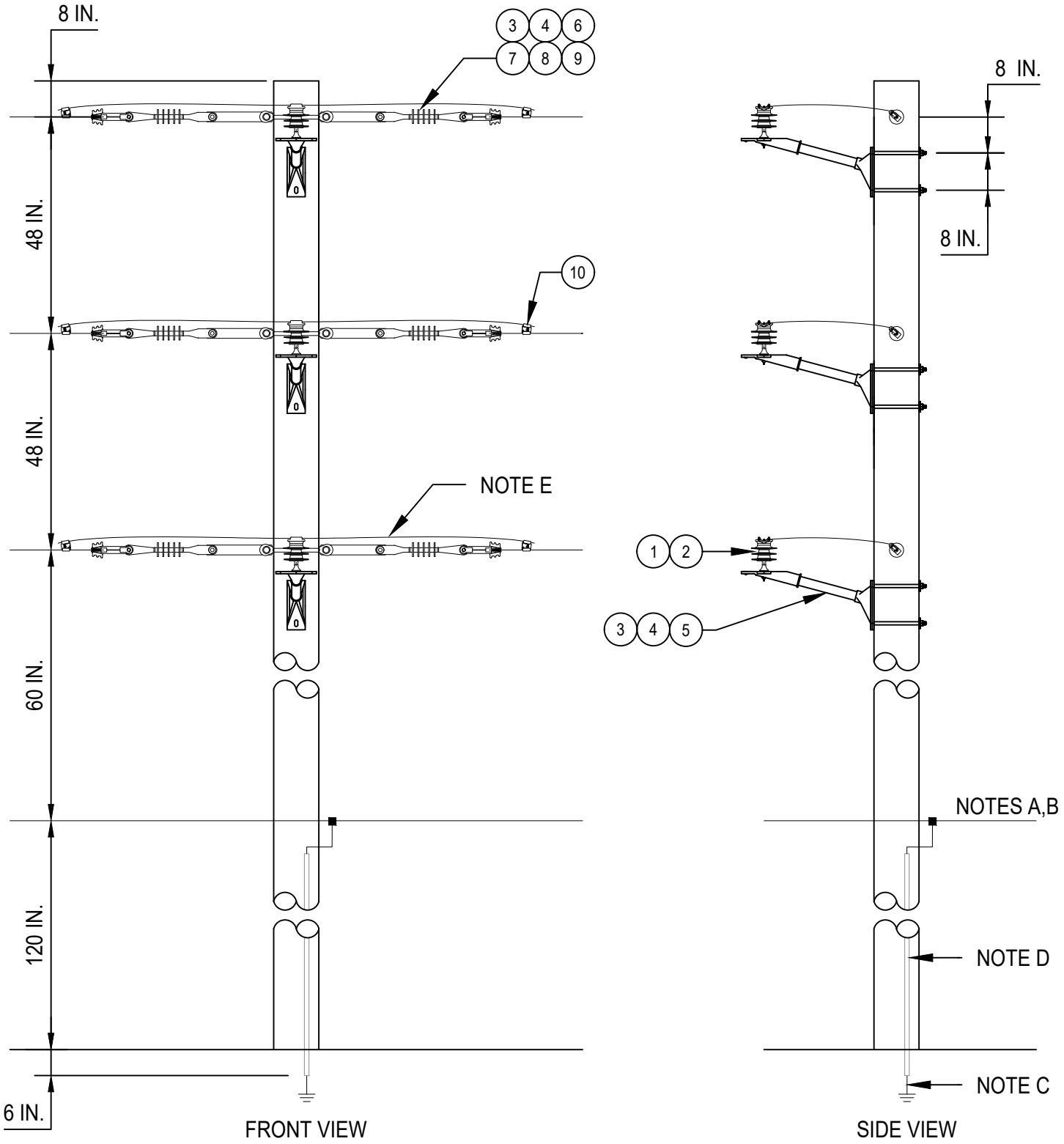
B. Install #6 soft drawn, solid, copper wire from system neutral to driven ground. If the pole has arresters, reclosers, switches, or transformers attached to it, install #4 soft drawn, solid, covered copper wire instead.

C. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

D. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

E. Double nut all D/A bolts.

F. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.



THREE-PHASE LINE
VERTICAL CONSTRUCTION

Drawing Name	THREE-PHASE DOUBLE DEADEND VERTICAL			
Drawing #	OH-15KV-POL-2031	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards	Sheet 2 of 2	Approval Date: 03/10/2021		

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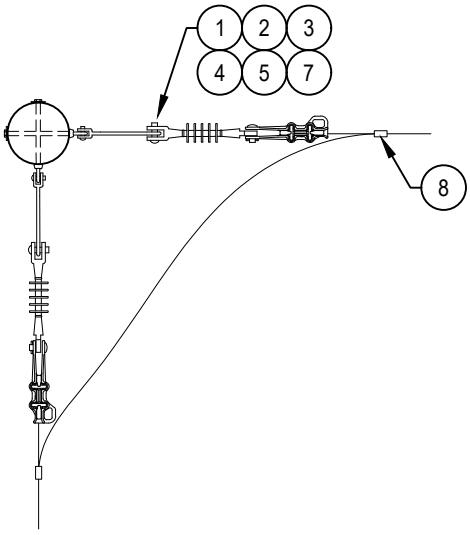
BILL OF MATERIALS

Item	Material Description	Mfg.	Catalog No.	Quantity Per Sheet	
				Suspension	Deadend
1	Insulator, 15kV suspension (polymer)	See OH-TYP-INS-2554_Insulators		3	6
2	Bolt, 5/8 in. D/A length as required	Hubbell	Various	3	6
3	Washer, 2-1/4in. sq. curved	Hubbell	681012	6	12
4	Nut, 5/8 in. oval eye	Hubbell	6502	3	6
5	Clamp, side-opening, spring-loaded, straight line deadend	MacLean	Various	-	6
6	Clamp, suspension	Hubbell	Various	3	-
7	Strain, 12 in. fiberglass	Hubbell	GS16012CPSC	3	6
8	Connector, Wedge	Ampact	Various	-	6

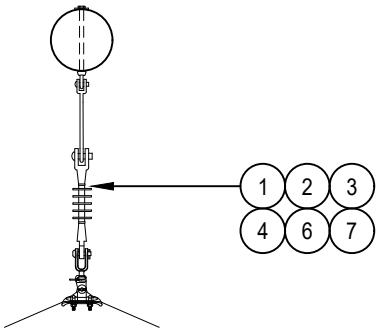
Drawing Name	THREE-PHASE HEAVY ANGLE VERTICAL				
Drawing #	OH-15KV-POL-2040	Scale : N.T.S.	Approved By: APS	Rev	CITY LIGHT & POWER
City Light & Power Construction Detail Standards	Sheet 1 of 3	Approval Date: 03/10/2021		1	

Note:

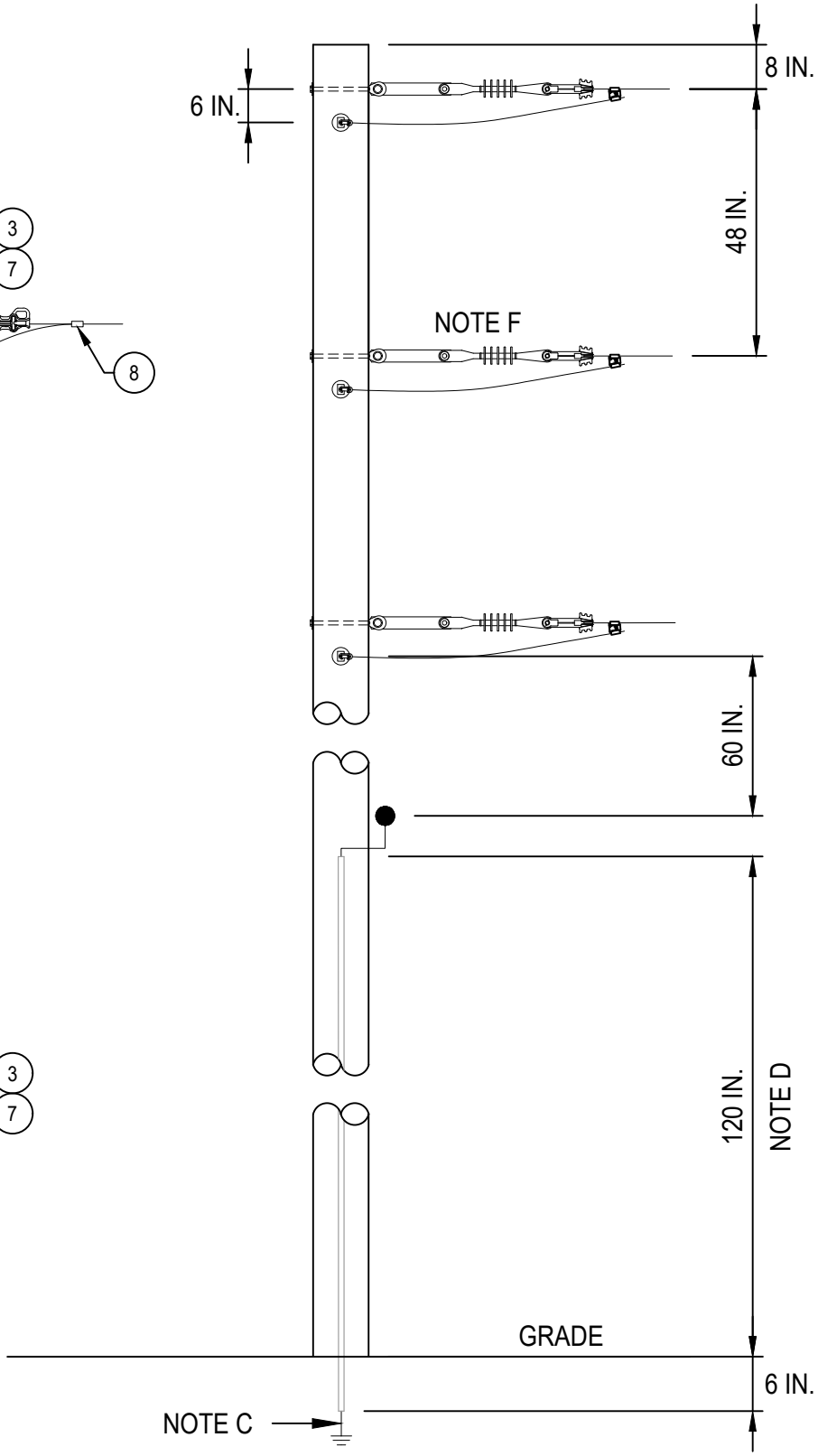
A. Neutral, triplex, or top wire, of open wire secondary.
B. Install #6 soft drawn, solid, copper wire from system neutral to driven ground. If the pole has arresters, reclosers, switches, or transformers attached to it, install #4 soft drawn, solid, covered copper wire instead.
C. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.
D. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.
E. Double nut all D/A bolts.
F. Ampact wedge connectors must be used for primary taps.
G. For vertical corner construction use suspension insulators for 31°-60° line angles, and deadend insulators for 61°-90° line angles.
H. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.



DETAIL 1: DEADEND
(SEE NOTE G)



DETAIL 2: SUSPENSION
(SEE NOTE G)



Drawing Name	THREE-PHASE HEAVY ANGLE VERTICAL				
Drawing #	OH-15KV-POL-2040	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 3 of 3		Approval Date: 03/10/2021	1

CITY LIGHT & POWER

BILL OF MATERIALS

Item	Material Description	Mfg.	Catalog No.	Quantity Per Sheet					
				3	4	5	6	7	8
1	Bolt, 3/4 in., D/A, length as required	Hubbell	Various	4	2	2	-	-	4
2	Bolt, 3/8 in. X 4-1/2 in.	Hubbell	863412	-	-	-	-	4	-
3	Bolt, 5/8 in. D/A length as required	Hubbell	Various	-	2	2	4	2	2
4	Brace, Crossarm, 48 in. span x 24 in. drop, sold as pair	Various		-	-	-	-	2	-
5	Bracket, NEMA B bracket for mounting cutouts, surge arresters, terminations	Hubbell	PSC2061042	-	-	3	-	-	-
6	Clamp, side opening spring loaded straight line deadend	MacLean	Various	6	3	3	-	-	3
7	Connector, Wedge	Ampact	Various	6	6	6	6	6	6
8	Crossarm, 10 ft. fiberglass deadend	PUPI	DA3000120E4B9X2	2	1	1	-	-	2
9	Crossarm, 10 ft. fiberglass tangent	PUPI	TB22001200032	-	1	1	2	-	1
10	Crossarm, wood 10 ft.	Various		-	-	-	-	2	-
11	Cutout, 15 kV 100 amp load break	See OH-TYP-FUS-2551_Cutouts		-	-	3	-	-	-
12	Insulator, 15 kV pin type ANSI Class 55-4 (polymer)	See OH-TYP-INS-2554_Insulators		2	4	5	6	6	7
13	Insulator, 15 kV suspension (polymer)	See OH-TYP-INS-2554_Insulators		6	3	3	-	-	3
14	Nut, 3/4 in. oval eye	Hubbell	6503	2	1	1	-	-	1
15	Nut, 5/8 in. oval eye	Hubbell	6502	4	2	2	-	-	2
16	Pin, 3/4 in. steel	Hubbell	4705P	2	4	5	6	6	7
17	Tubing, Wildlife (Stinger cover)	See OH-TYP-ANL-2510_Wildlife Protection		As Required					
18	Washer 3 in. sq. curved	Hubbell	682212	4	2	2	-	-	4
19	Washer, 2-1/4 in. sq. curved	Hubbell	681012	-	2	2	4	2	2
20	Washer, 2-1/4 in. sq. flat	Hubbell	6813	-	-	-	-	2	-

Drawing Name	THREE-PHASE JUNCTION HORIZONTAL			
Drawing #	OH-15KV-POL-2050	Scale : N.T.S.	Approved By: APS	Rev 1
City Light & Power Construction Detail Standards	Sheet 1 of 8	Approval Date: 05/20/2021		

CITY LIGHT & POWER

Notes:

A. Neutral, triplex or top wire of open wire secondary.

B. Install #6 soft drawn, solid, copper wire from system neutral to driven ground. If the pole has arresters, reclosers, switches, or transformers attached to it, install #4 soft drawn, solid, covered copper wire instead.

C. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

D. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

E. Double nut all D/A bolts.

F. Ampact wedge connectors must be used for primary taps.

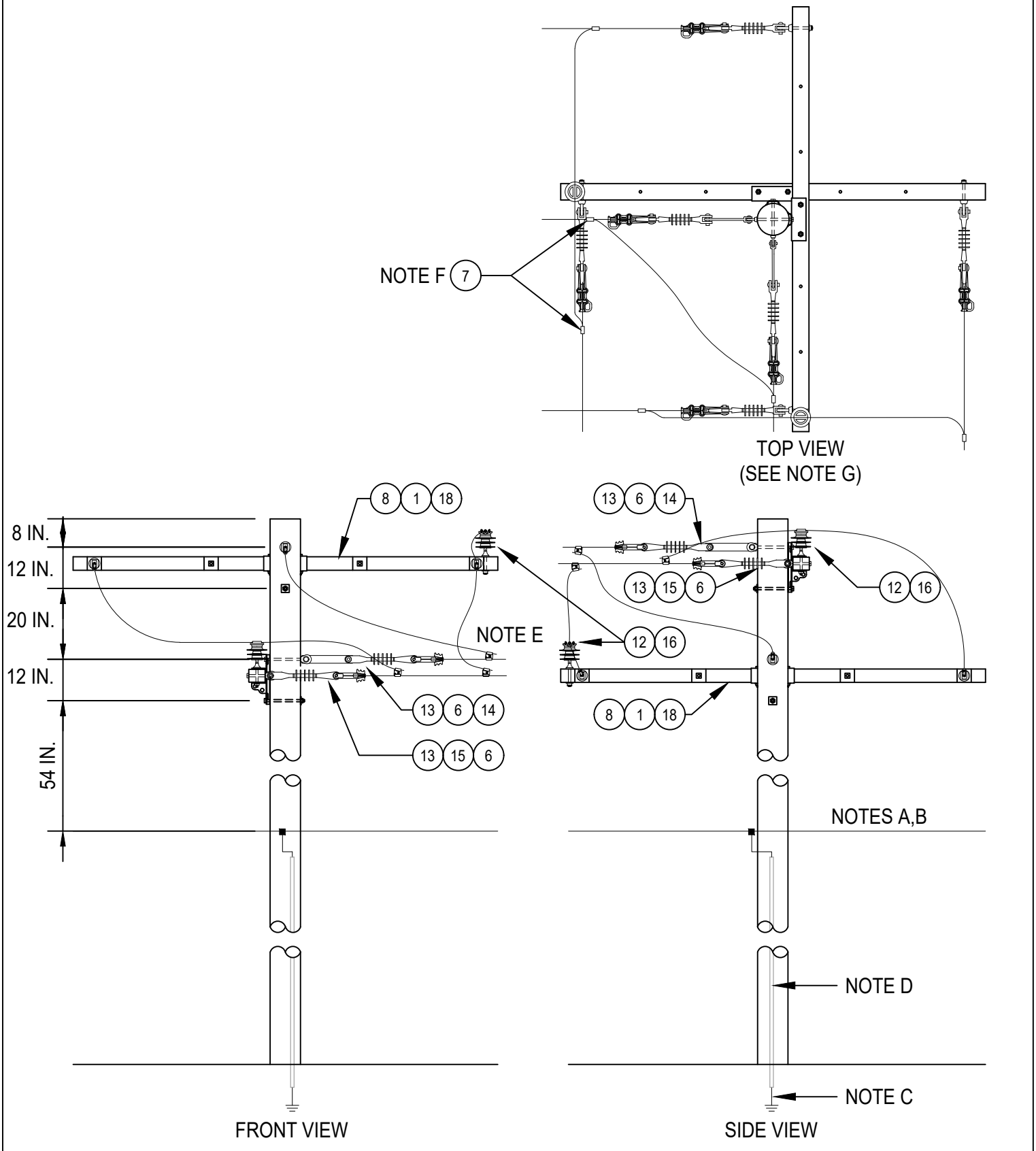
G. The top view depicts the reverse crossarm (lower crossarm) perpendicular to the top crossarm. This position may not be appropriate for all circumstances. For example, if the lower conductors are at an angle other than 90 degrees to the top conductors, the reverse crossarm should be rotated so it is perpendicular to the direction of the lower conductors.

H. If overbuild is present on the pole, position B phase in pin hole outside of the steel braces.

I. Rotate cutout frame slightly towards pole. This will expel the fuse link away from the operator in the event that the fuse blows.

J. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.

K. In areas sensitive to wildlife, all taps must be covered with elastomer tubing (stinger cover).



THREE-PHASE, TWO-WAY JUNCTION POLE
FIBERGLASS CROSSARMS

Drawing Name	THREE-PHASE JUNCTION HORIZONTAL			
Drawing #	OH-15KV-POL-2050	Scale : N.T.S.	Approved By: APS	Rev
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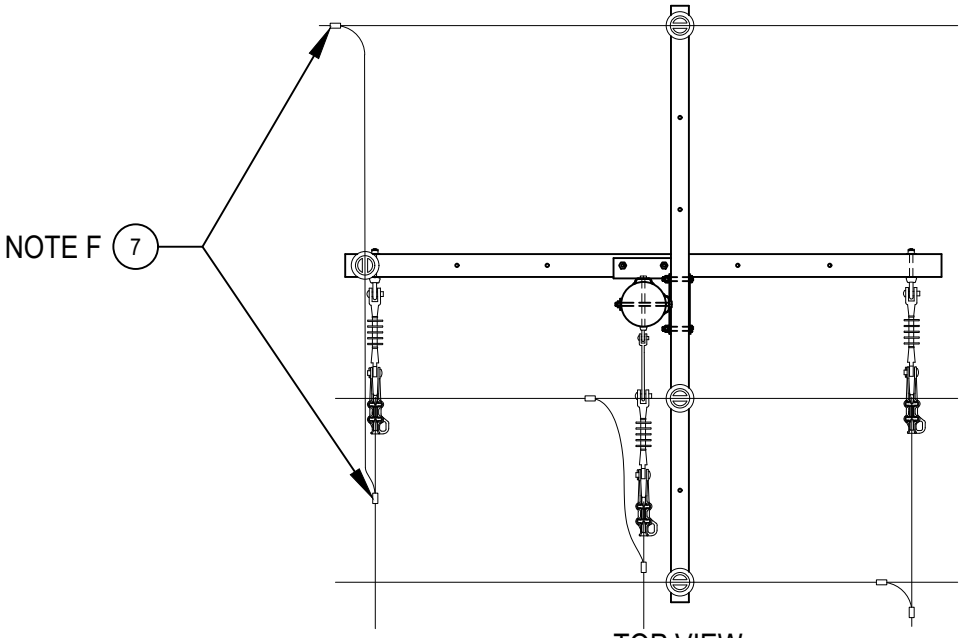
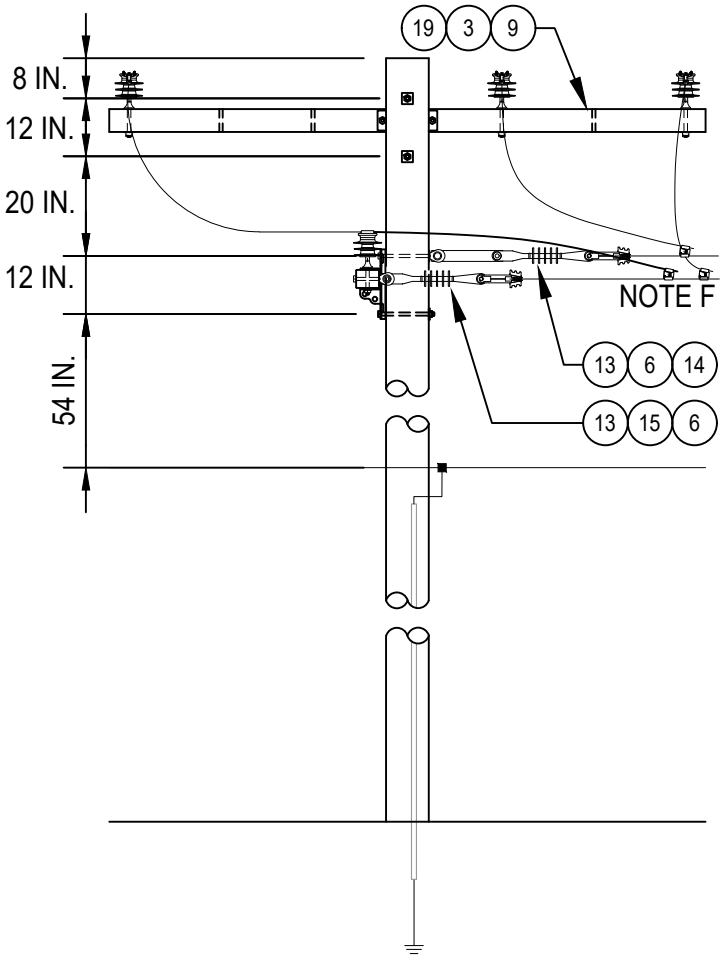
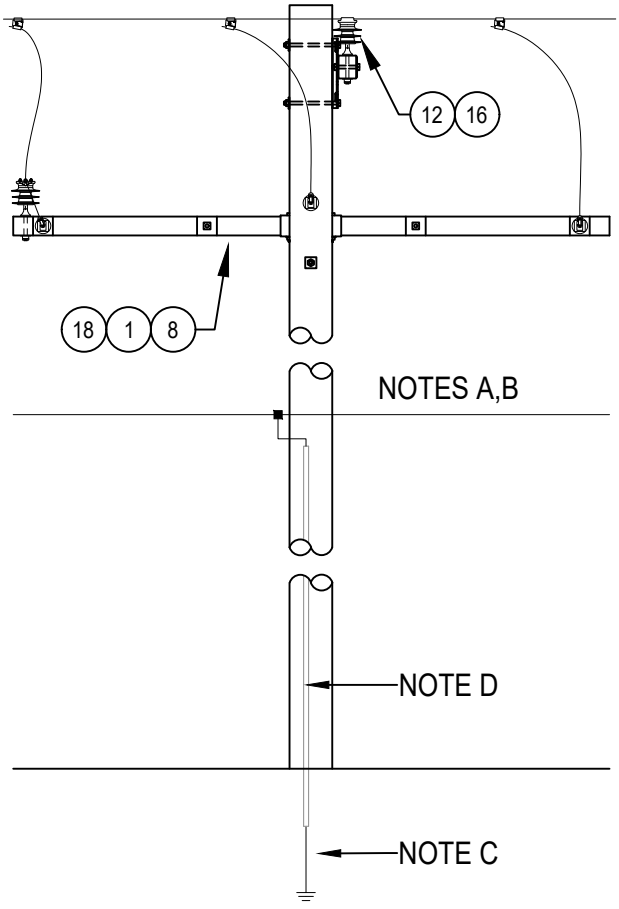


TOP VIEW
(SEE NOTE G)



FRONT VIEW



SIDE VIEW

THREE- PHASE, THREE-WAY JUNCTION POLE
FIBERGLASS CROSSARMS

Drawing Name	THREE-PHASE JUNCTION HORIZONTAL			
Drawing #	OH-15KV-POL-2050	Scale : N.T.S.	Approved By: APS	Rev
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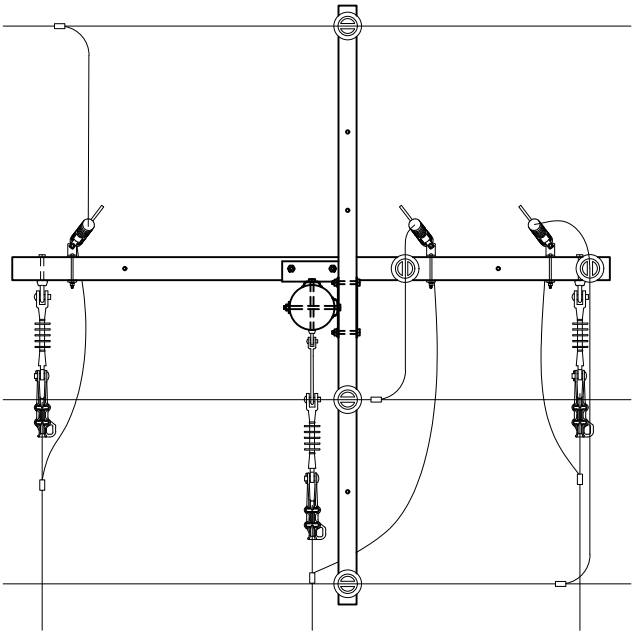
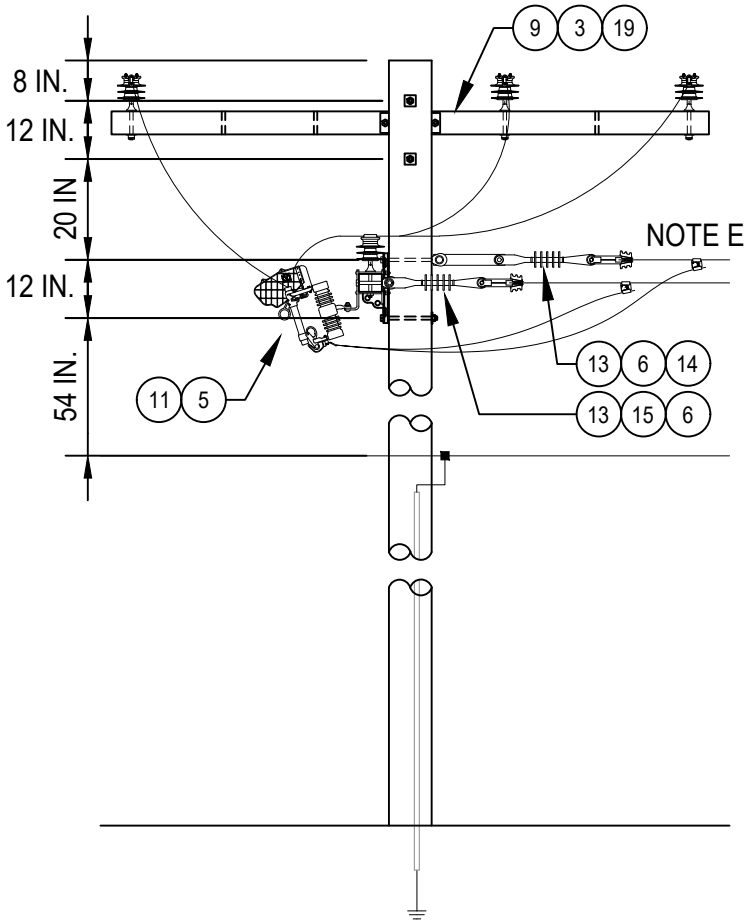
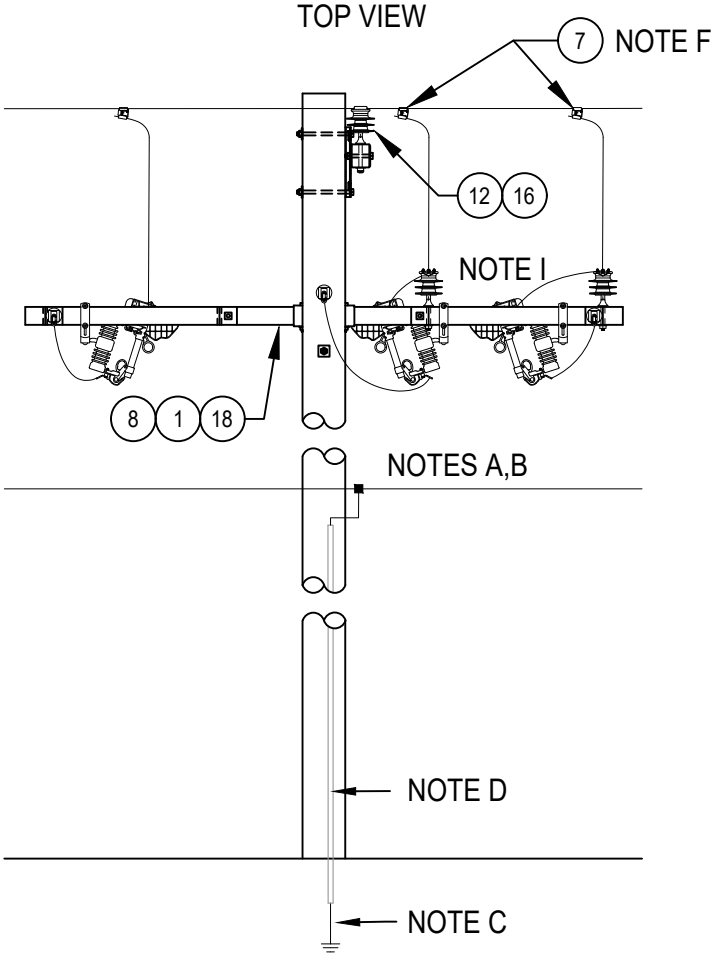
CITY LIGHT & POWER



TOP VIEW



FRONT VIEW

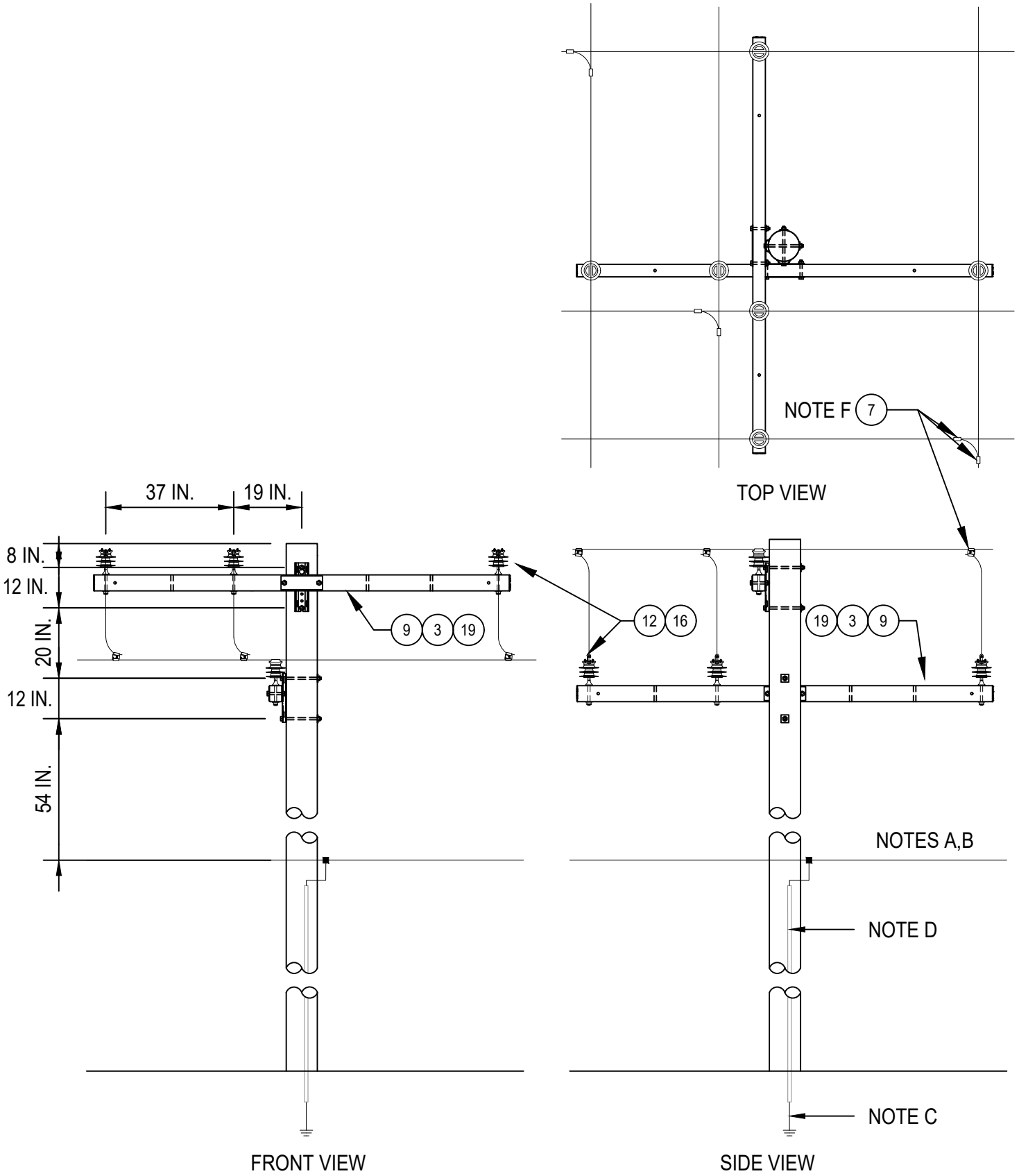


SIDE VIEW

THREE-PHASE, THREE-WAY JUNCTION POLE
FIBERGLASS CROSSARMS - WITH CUTOUTS

Drawing Name	THREE-PHASE JUNCTION HORIZONTAL			
Drawing #	OH-15KV-POL-2050	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 5 of 8	Approval Date: 05/20/2021	1

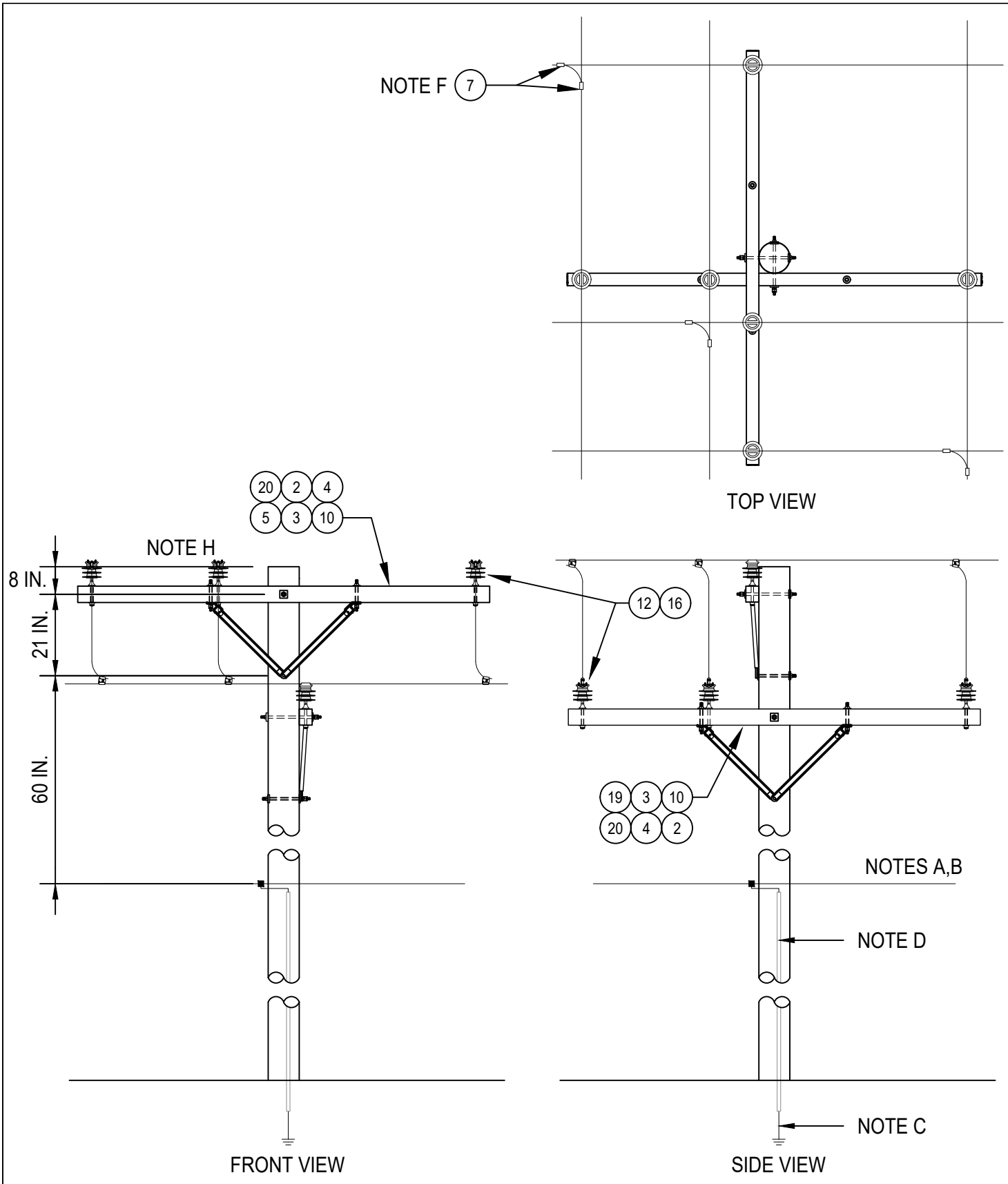
CITY LIGHT & POWER



THREE-PHASE, FOUR-WAY JUNCTION POLE
FIBERGLASS CROSSARMS

Drawing Name	THREE-PHASE JUNCTION HORIZONTAL			
Drawing #	OH-15KV-POL-2050	Scale : N.T.S.	Approved By: APS	Rev
City Light & Power Construction Detail Standards	Sheet 6 of 8	Approval Date: 05/20/2021		1

CITY LIGHT & POWER



THREE-PHASE, FOUR-WAY JUNCTION POLE
WOOD CROSSARMS

Drawing Name	THREE-PHASE JUNCTION HORIZONTAL			
Drawing #	OH-15KV-POL-2050	Scale : N.T.S.	Approved By: APS	Rev 1
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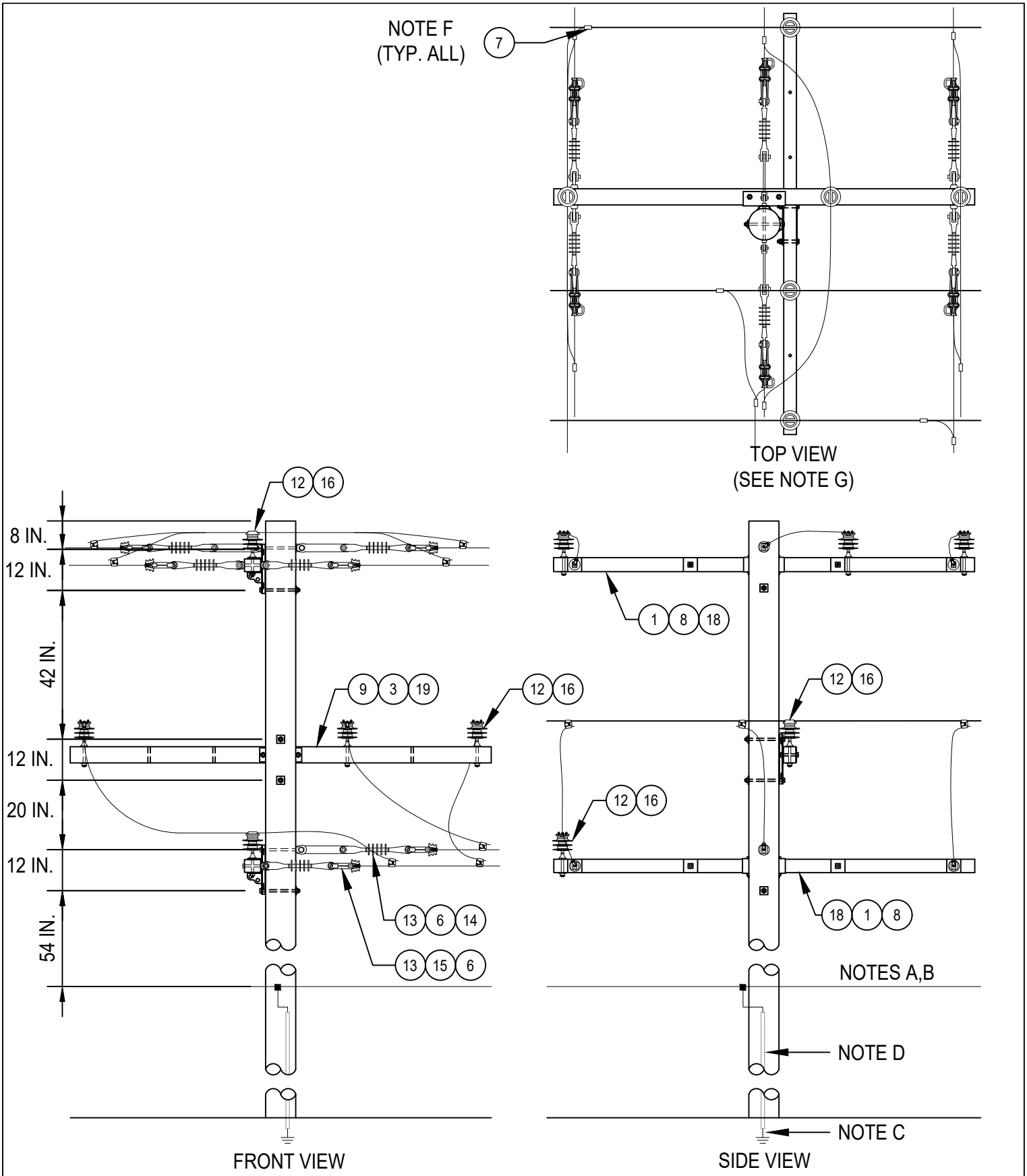

THREE-PHASE, FIVE-WAY JUNCTION POLE
FIBERGLASS CROSSARMS

Drawing Name	THREE-PHASE JUNCTION HORIZONTAL			
Drawing #	OH-15KV-POL-2050	Scale : N.T.S.	Approved By: APS	Rev
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BILL OF MATERIALS

Item	Material Description	Mfg.	Catalog No.	Quantity			
				Sh.3	Sh.4	Sh.5	Sh.6
1	Bolt, 3/8 in. X 4-1/2 in.	Hubbell	863412	-	2	-	2
2	Bolt, 5/8 in. D/A length as required	Hubbell	Various	2	1	4	3
3	Brace, flat steel 32 in. L x 0.203 in. T x 1.22 in. W	Hubbell	7032	-	2	-	-
4	Brace, flat steel, 32 in. L x 0.25in T	Hubbell	7132	-	-	-	2
5	Bracket, NEMA B bracket for mounting cutouts, surge arresters, terminations	Hubbell	PSC2061042	-	-	3	3
6	Clamp, side opening spring loaded straight line deadend	MacLean	Various	-	-	6	6
7	Crossarm, 10 ft. fiberglass tangent	See OH-TYP-XRM-2645_Crossarms		1	-	2	1
8	Crossarm, wood 10 ft.	Various		-	1	-	1
9	Cutout, 15 kV 100 amp load break	See OH-TYP-FUS-2551_Cutouts		-	-	3	3
10	Insulator, 15 kV pin type ANSI Class 55-4 (polymer)	See OH-TYP-INS-2554_Insulators		3	3	3	3
11	Insulator, 15 kV suspension (polymer)	See OH-TYP-INS-2554_Insulators		-	-	3	3
12	Link, 6 in. extension	MacLean	J2520	-	-	3	3
13	Pin, 3/4 in. steel	Hubbell	4705P	3	3	3	3
14	Screw lag, pilot point 1/2 in. X 4 in.	Hubbell	508754	-	1	-	1
15	Washer, 2-1/4 in. sq. curved	Hubbell	681012	2	1	4	1
16	Washer, 2-1/4 in. sq. flat	Hubbell	6813	-	1	-	1
17	Assembly, Wedge Stirrup	Ampact	Various	-	-	6	6
18	Clamp, Hotline	Hubbell	Various	-	-	6	6

Notes:

A. Neutral, triplex or top wire of open wire secondary.

B. Install #6 soft drawn, solid, copper wire from system neutral to driven ground. If the pole has arresters, reclosers, switches, or transformers attached to it, install #4 soft drawn, solid, covered copper wire instead.

C. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

D. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

E. Double-nut all D/A bolts.

F. Rotate cutout frame slightly towards pole. This will expel the fuse link away from the operator in the event that the fuse blows.

G. Install floating deadends on line side of pole. Cutouts shall also be installed on line side of pole.

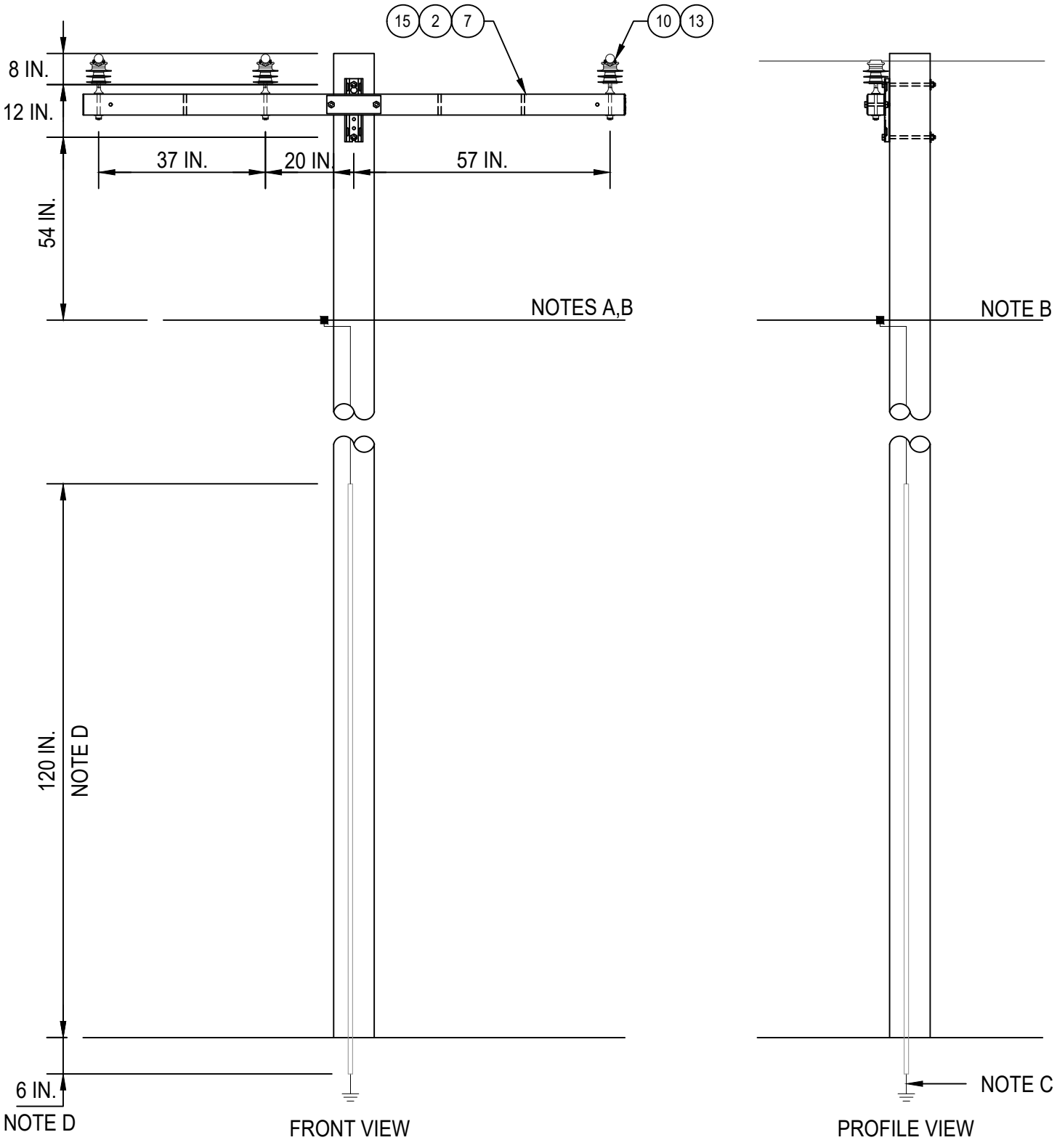
H. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.

CONDUCTOR SIZE	CONDUCTOR DESIGN TENSION (LBS.)	MAX. ANGLE DEFLECTION
1/0 ACSR	1,000	60°
4/0 ACSR	2,000	45°
336.4 ACSR	2,500	35°
556.5 ACSR	3,000	28°

TABLE 1 : MAXIMUM ALLOWABLE ANGLES OF DEFLECTION
(FIBERGLASS CROSSARM, 200 FT. RULING SPAN LINES)

CONDUCTOR SIZE	CONDUCTOR DESIGN TENSION (LBS.)	MAX. ANGLE DEFLECTION
1/0 ACSR	1,000	4°
4/0 ACSR	2,000	3°
336.4 ACSR	2,500	3°

TABLE 2 : MAXIMUM ALLOWABLE ANGLES OF DEFLECTION
(WOOD CROSSARM, 200 FT. RULING SPAN LINES)



THREE-PHASE TANGENT POLE - FIBERGLASS CROSSARM

Drawing Name	THREE-PHASE TANGENT HORIZONTAL			
Drawing #	OH-15KV-POL-2060	Scale : N.T.S.	Approved By: APS	Rev
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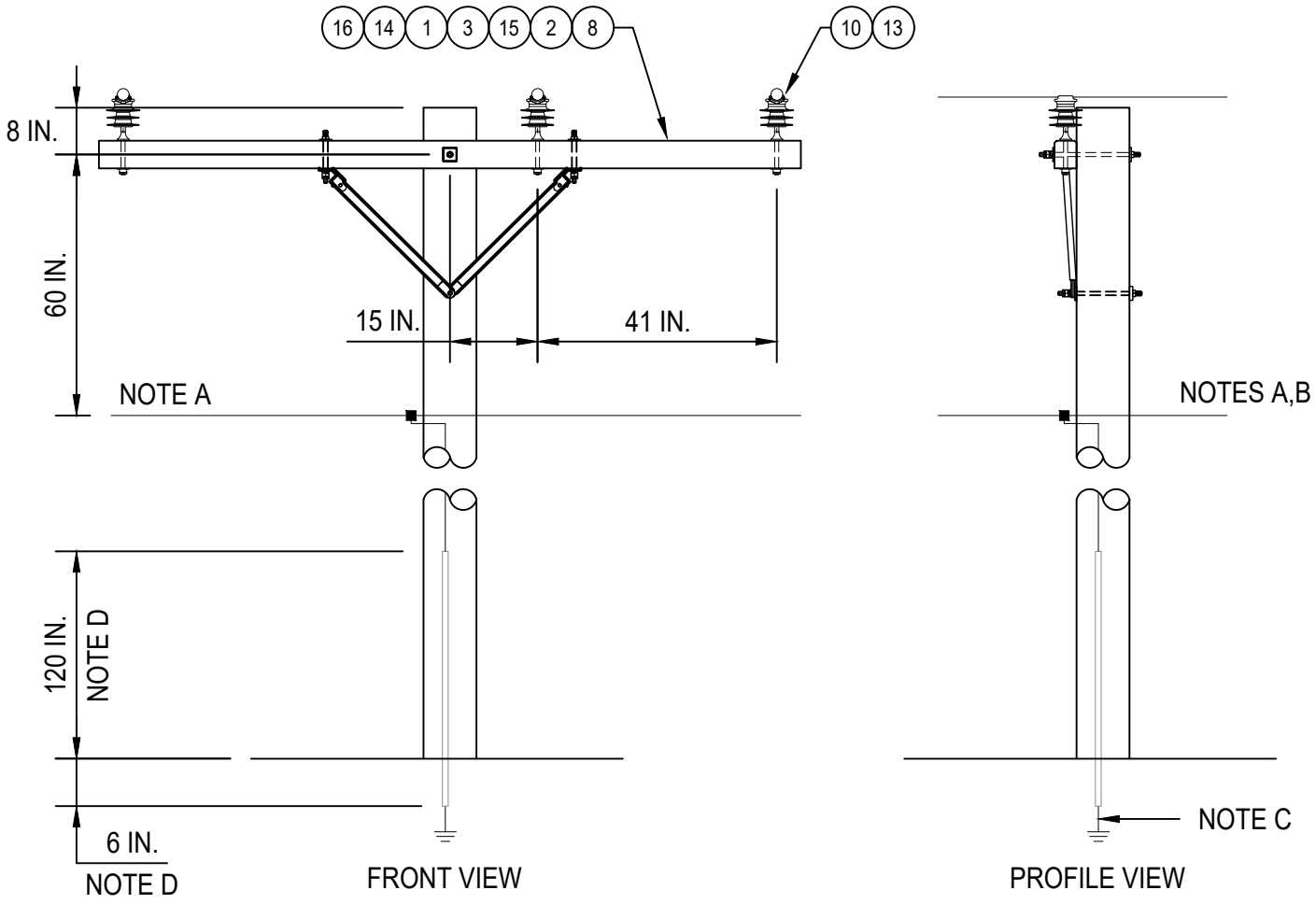
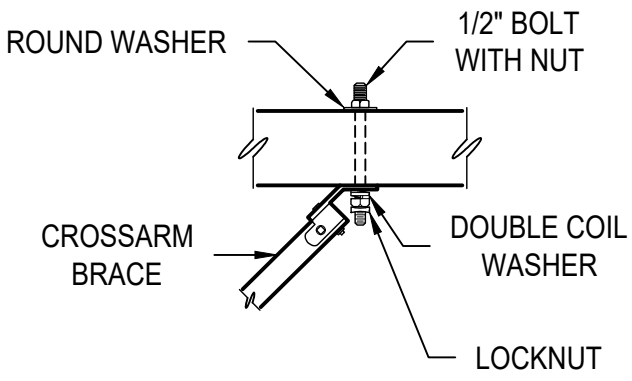
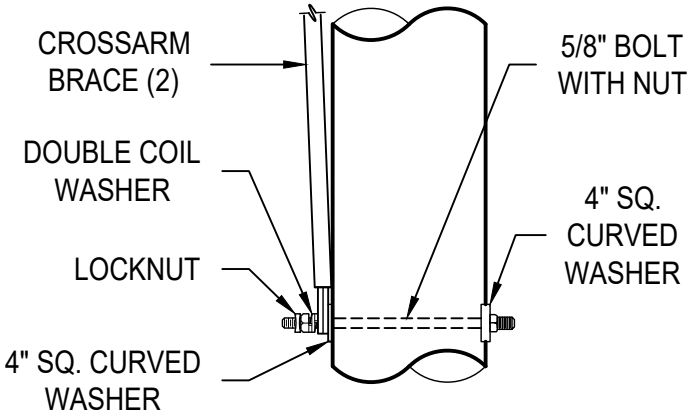


THREE-PHASE TANGENT POLE - WOOD CROSSARM



DETAIL 1: CROSSARM BRACE ATTACHMENT AT CROSSARM



DETAIL 2: CROSSARM BRACE ATTACHMENT AT POLE

Drawing Name	THREE-PHASE TANGENT HORIZONTAL				
Drawing #	OH-15KV-POL-2060	Scale : N.T.S.	Approved By: APS	Rev	CITY LIGHT & POWER
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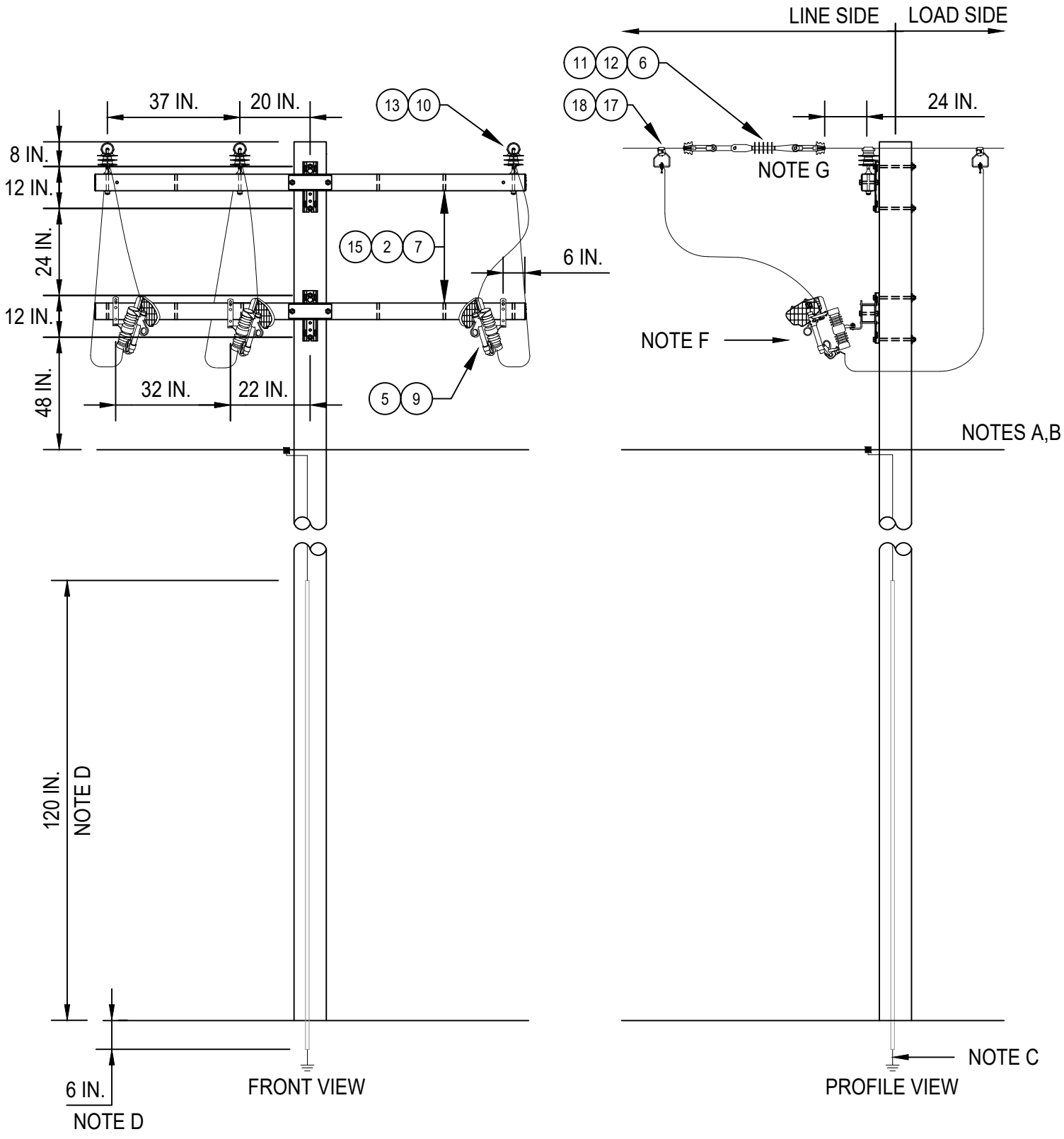

THREE-PHASE TANGENT POLE WITH FUSES - FIBERGLASS CROSSARM

Drawing Name	THREE-PHASE TANGENT HORIZONTAL				
Drawing #	OH-15KV-POL-2060	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 5 of 6		Approval Date: 03/10/2021	1

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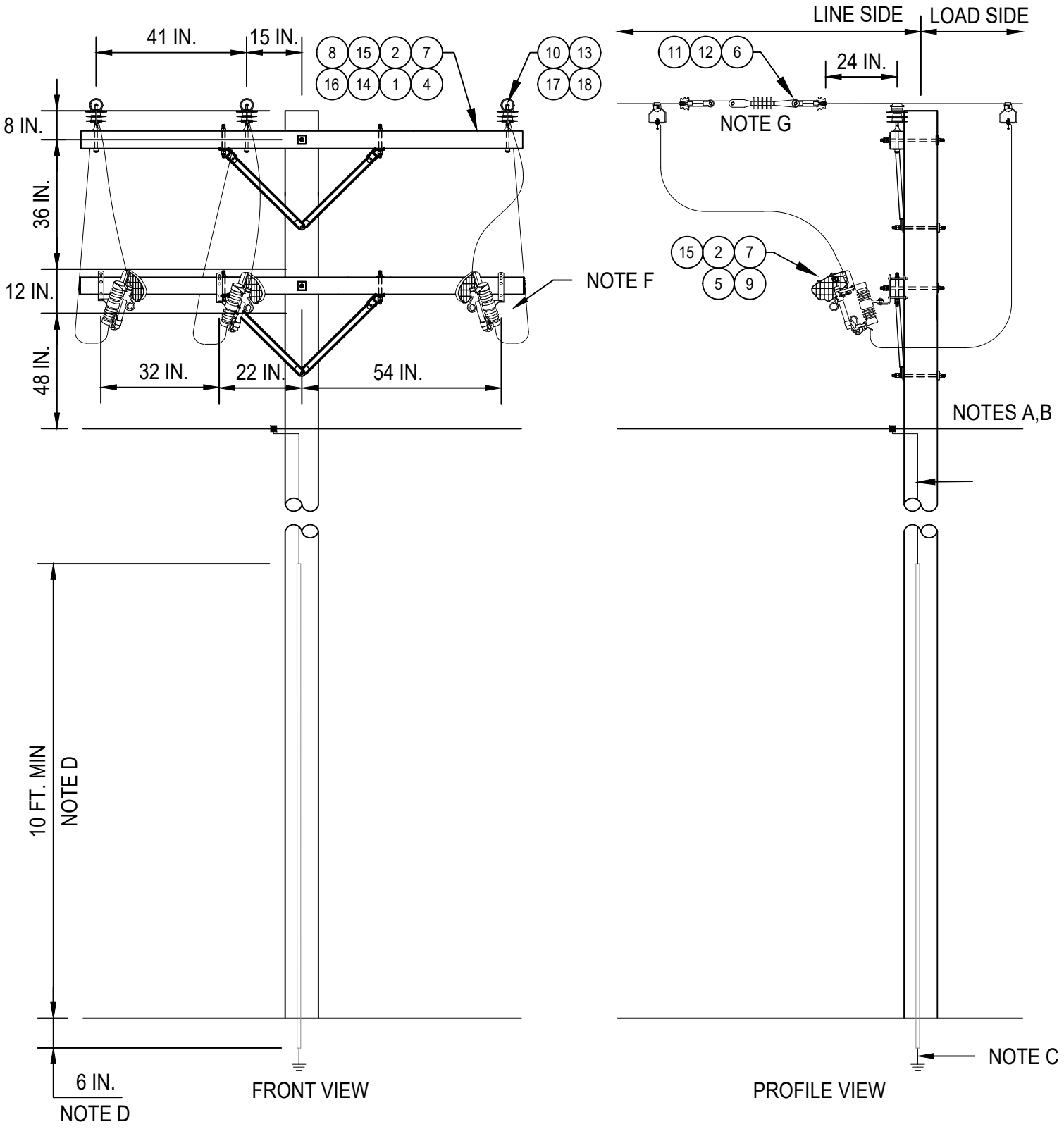

THREE-PHASE TANGENT POLE WITH FUSES - WOOD CROSSARM

Drawing Name	THREE-PHASE TANGENT HORIZONTAL				
Drawing #	OH-15KV-POL-2060	Scale : N.T.S.	Approved By: APS	Rev	CITY LIGHT & POWER
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BILL OF MATERIALS				
Item	Material Description	Mfg.	Catalog No.	Quantity
1	Insulator, 15kV, ANSI Class 55-4, polymer	See OH-TYP-INS-2554_Insulators		3
2	Pin, 3/4 in. steel stub	Hubbell	PS893P	3
3	Bolt, D/A, 5/8 in.	Hubbell	Various	6
4	Washer, 2-1/4 in. sq. curved	Hubbell	681012	6
5	Bracket, fiberglass equipment, 24 in.	MacLean	G1HDA524AT	3

Notes:

A. Neutral, triplex, or top wire of open-wire secondary.

B. Install #6 soft drawn, solid, copper wire from system neutral to driven ground. If the pole has arresters, reclosers, switches, or transformers attached to it, install #4 soft drawn, solid, covered copper wire instead.

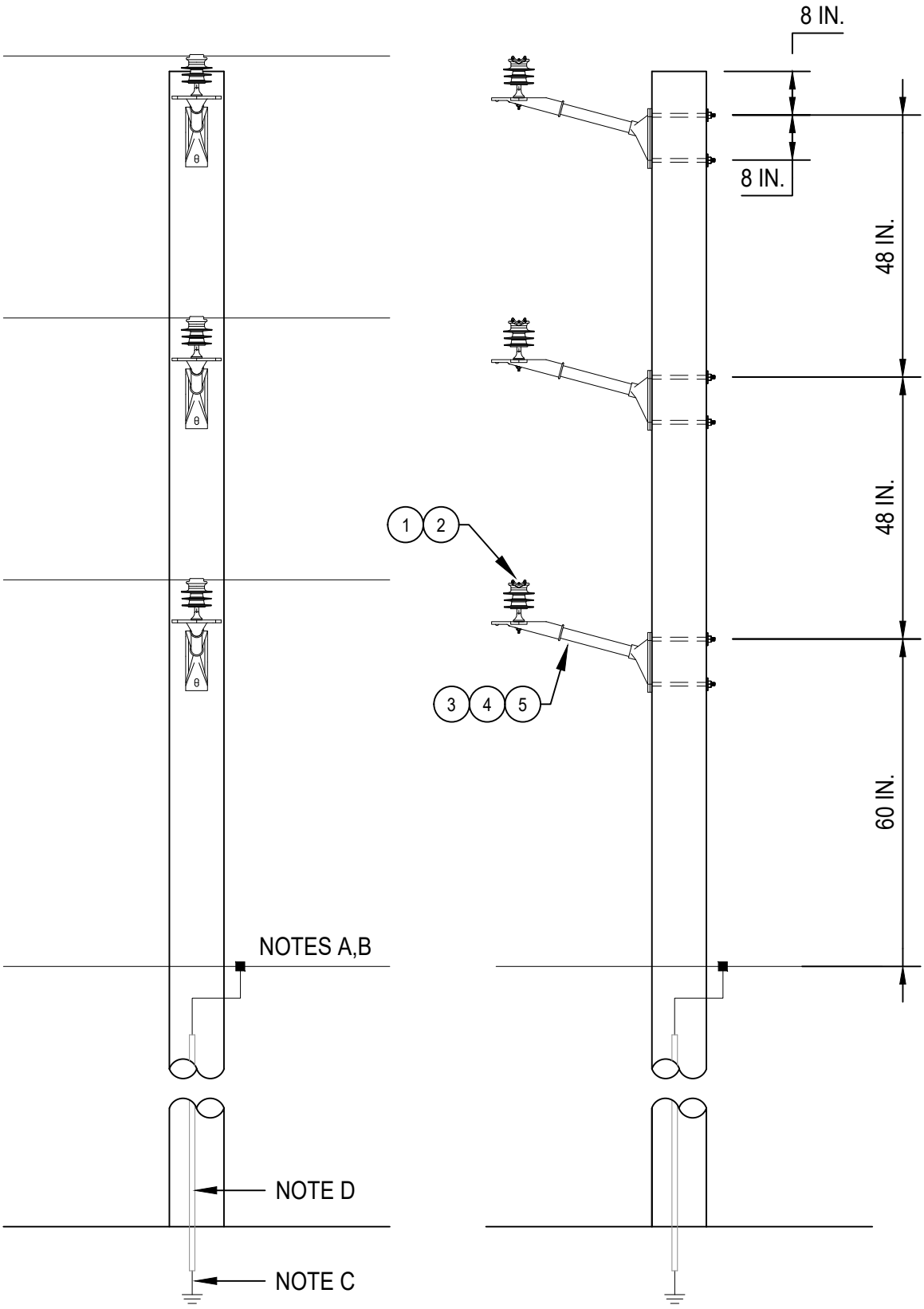
C. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

D. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

E. This framing is only used when phases need to be transitioned from one side of the pole to the other, for the purpose of matching like phases.

F. Double nut all D/A bolts.

G. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.



Drawing Name	THREE-PHASE TANGENT VERTICAL			
Drawing #	OH-15KV-POL-2061	Scale : N.T.S.	Approved By: APS	Rev
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BILL OF MATERIALS

Item	Material Description	Mfg.	Catalog No.	Quantity	
				Sheet 3	Sheet 4
1	Arrester, surge, heavy-duty, 8.4kV MCOV, 10kA	See OH-TYP-ARR-2200_Distribution Line Arresters		3	3
2	Bolt, D/A, 3/4 in., length as required	Hubbell	Various	2	-
3	Bolt, 3/8 in. X 4-1/2 in.	Hubbell	863412	-	-
4	Bolt, D/A, 5/8 in., length as required	Hubbell	Various	6	6
5	Brace, flat steel 30 in.	Hubbell	7032	-	-
6	Bracket, NEMA B bracket for mounting cutouts, surge arresters and terminations	Hubbell	PSC2061042	6	6
7	Clamp, side-opening spring-loaded, straight-line deadend	MacLean	Various	3	-
8	Crossarm, fiberglass, deadend, 10 ft.	PUPI	DA3000120E4B9X2	1	-
9	Crossarm, fiberglass, tangent, 10 ft.	PUPI	TB22001200032	2	3
10	Crossarm, wood, 10 ft.	Various		-	-
11	Guard, wildlife	See OH-TYP-ANL-2510 Wildlife Protection		As required	
12	Insulator, pin type, ANSI Class 55-4, polymer, 15kV	See OH-TYP-INS-2554_Insulators		-	3
13	Insulator, suspension, polymer silicone, 15kV	See OH-TYP-INS-2554_Insulators		3	-
14	Nut, oval eye, 3/4 in.	Hubbell	6503	1	-
15	Nut, oval eye, 5/8 in.	Hubbell	6502	2	-
16	Pin, steel, 3/4 in	Hubbell	4705P	-	3
17	Riser shield	See UG-TYP-RSR-3621-Riser Uguard		As required	
18	Screw lag, pilot point, 1/2 in. X 4 in.	Hubbell	508754	-	-
19	Shield, duct	Electrical Materials Company	27-1 Black	1	1
20	Strain, fiberglass, 12 in.	Hubbell	GS16012CPSC	1	-
21	Support, cable positioner	Hubbell	CCS820	3	3
22	Switch, disconnect, 15kV, 600A	Hubbell	M3D66BCL	3	3
23	Termination, 15kV	3M	Various	3	3
24	Tubing, wildlife (Stinger cover)	See OH-TYP-ANL-2510 Wildlife Protection		As required	
25	Washer, curved, 2-1/4 in. sq.	Hubbell	681012	6	6
26	Washer, sq. flat, 2-1/4 in. sq	Hubbell	6813	-	-
27	Washer, curved, 3 in. sq.	Hubbell	682212	2	-
28	Connector, Wedge	Ampact	Various	3	3

Drawing Name	THREE-PHASE PRIMARY RISER TRANSITION - HORIZONTAL			
Drawing #	OH-15KV-RSR-2090	Scale : N.T.S.	Approved By: APS	Rev 1
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Notes:

A. Use tap wire equivalent to the load rating of the UG cable from terminations to disconnects and from disconnects to primary.

B. Neutral, triplex or top wire of open wire secondary.

C. Install #6 soft drawn, solid, copper wire from system neutral to driven ground. If the pole has arresters, reclosers, switches, or transformers attached to it, install #4 soft drawn, solid, covered copper wire instead.

D. Install 1/0 covered, soft drawn, copper wire alongside of UG cables and secure with 7 inch black cable ties approximately every 8 inches. Connect one end to the concentric neutrals and surge arrester ground lead as shown in Detail 1. Connect the other end to the system neutral. A separate connection must be made from each wire to the system neutral.

E. Use No. 4 soft drawn, covered copper wire for primary arrester taps.

F. Install copper-clad ground rod. For site-specific size, refer to OH-TYP-GND-2565_PoleGrounding.

G. Install molding over the grounding conductor, from 10 ft. above grade to 6 in. below grade. Secure with staples every 24 inches.

H. In areas sensitive to wildlife, all tap wire and surge arrester primary taps must be covered with elastomer tubing (stinger cover).

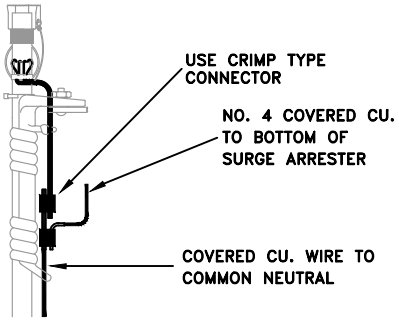
I. Wildlife guards must be installed at all terminations.

J. Ampact wedge connectors must be used for all primary feeder to primary feeder transitions.

K. Double-nut all D/A bolts.

L. If overbuild is present on the pole, position B phase in pin hole outside of the steel braces.

M. Refer to standards OH-TYP-GUY-2600-GeneralGuyingInformation, OH-TYP-GUY-2605-DownGuy, and OH-TYP-GUY-2607-SpanGuy, for guying information.



DETAIL:1 SURGE ARRESTER GROUNDING

Drawing Name	THREE-PHASE PRIMARY RISER TRANSITION - HORIZONTAL			
Drawing #	OH-15KV-RSR-2090	Scale : N.T.S.	Approved By: APS	Rev
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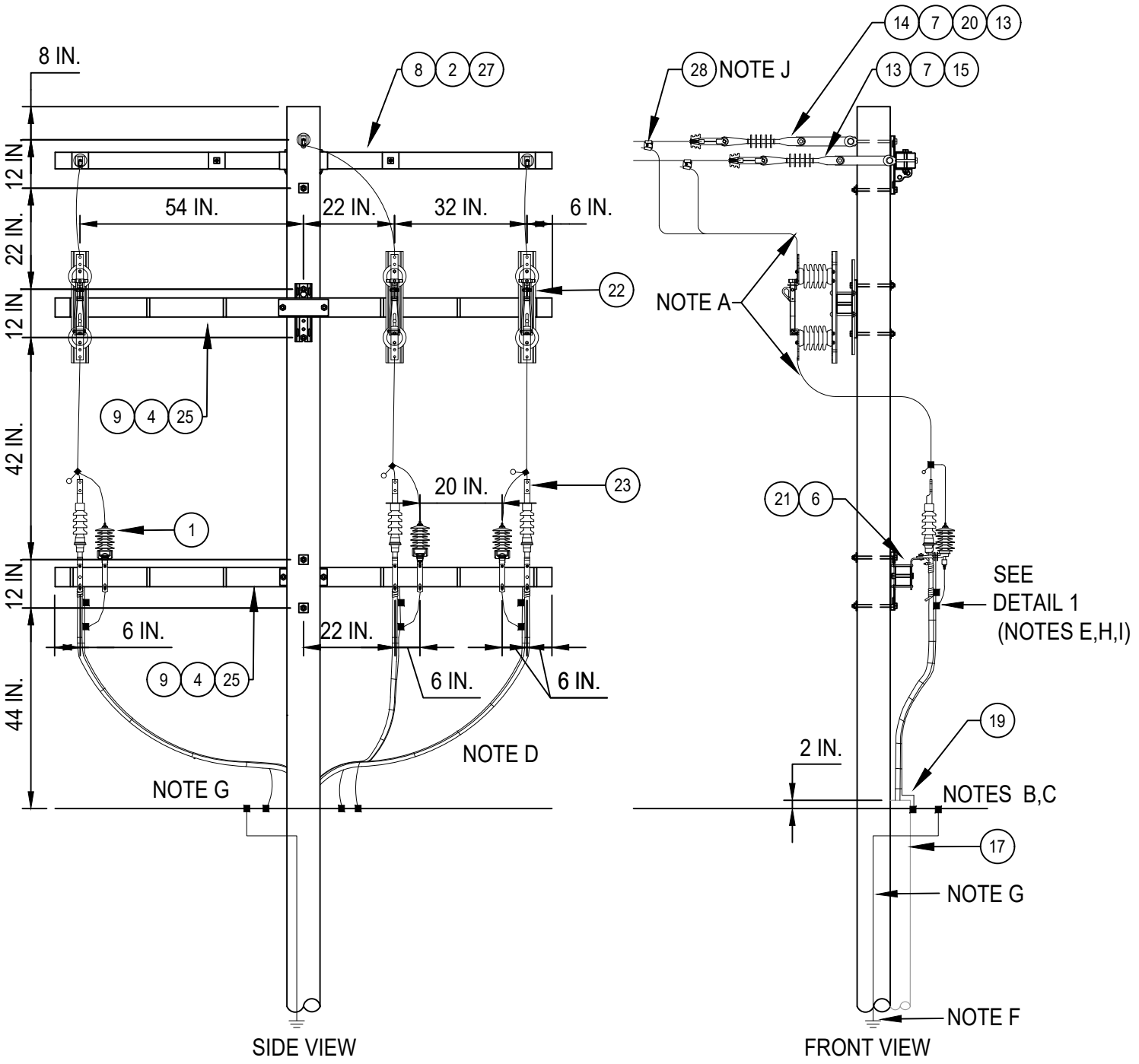

THREE-PHASE DEADEND UNDERGROUND RISER POLE WITH DISCONNECTS

Drawing Name	THREE-PHASE PRIMARY RISER TRANSITION - HORIZONTAL				
Drawing #	OH-15KV-RSR-2090	Scale : N.T.S.		Approved By: APS	Rev
City Light & Power Construction Detail Standards		Sheet 3 of 4		Approval Date: 03/10/2021	1

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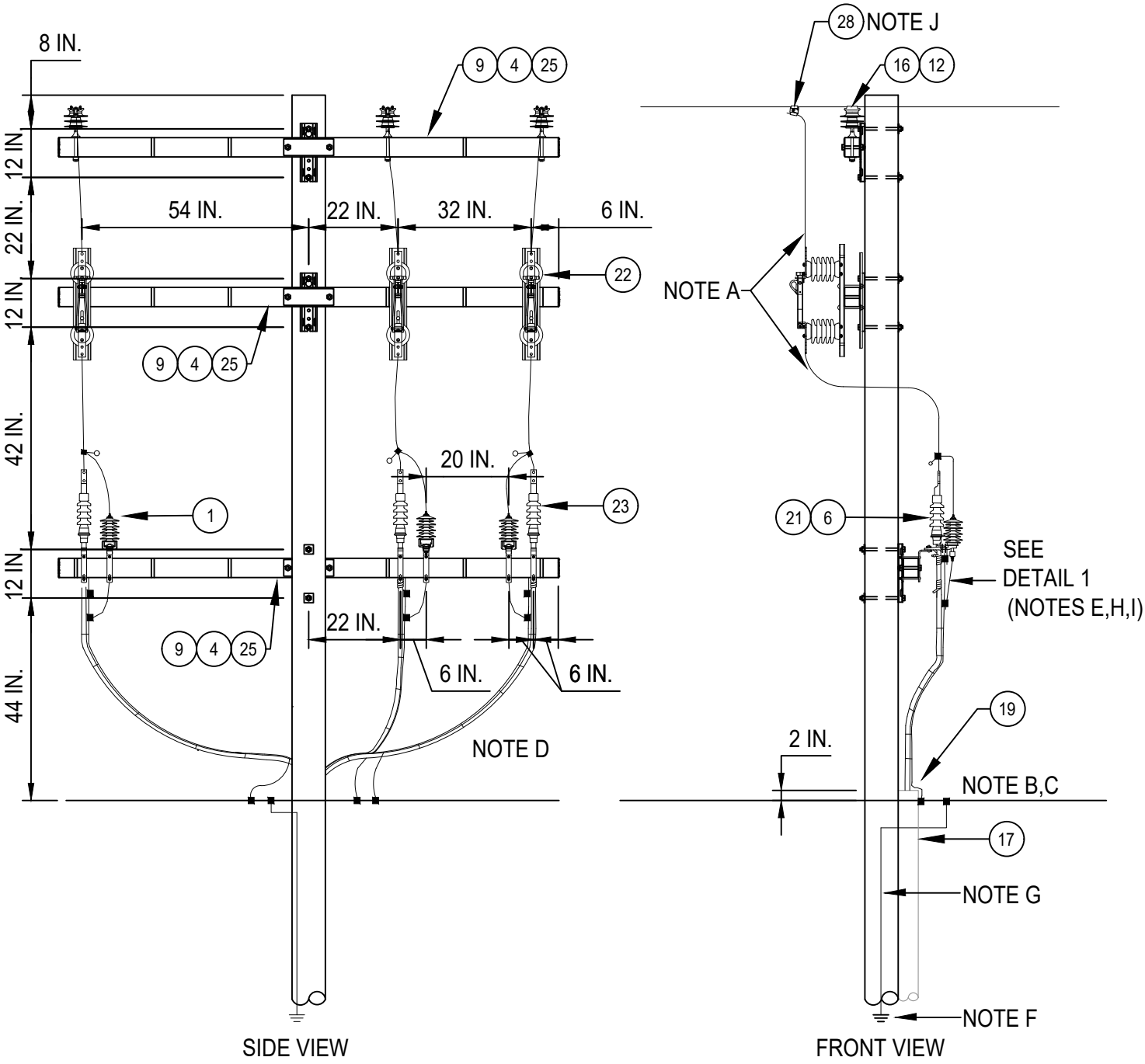

THREE-PHASE TANGENT UNDERGROUND RISER POLE WITH DISCONNECTS

Drawing Name	THREE-PHASE PRIMARY RISER TRANSITION - HORIZONTAL			
Drawing #	OH-15KV-RSR-2090	Scale : N.T.S.	Approved By: APS	Rev
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APPENDIX C: TYPICAL EQUIPMENT SPECIFICATIONS FOR SERVICE CONNECTIONS

The following section for typical equipment specification for service connections will apply to all CLP electrical distribution systems. All specifications will be required to meet CLP and Industry Standards.

DATASHEET NUMBER	DESCRIPTION
E-DSH-002	UNDERGROUND PRIMARY CABLE
E-DSH-006A	PAD-MOUNTED DISTRIBUTION TRANSFORMER 1 PHASE
E-DSH-006B	PAD-MOUNTED DISTRIBUTION TRANSFORMER 3 PHASE
E-DSH-007	OVERHEAD DISTRIBUTION TRANSFORMER
E-DSH-008	PAD-MOUNTED SWITCH
E-DHS-009	RECLOSER

APPENDIX D: CLP SERVICE APPLICATION

A separate service application is required to be filled out to obtain new service or modify an existing service.

Service/Connection/Quote Request
Customer Input Form

Request Date:_____ Project Title: _____

1. This form is used to request any CLP-Hill AFB support, service, connection approval or a "Connection Fee Quote."
For routine projects requiring a detailed cost estimate: After request for Connection Fee Quote" or proposal, **please allow 21 days** forCLP to provide a formal proposal. This form will document all new connections to the Hill AFB electrical distribution system. CLP can perform civil work such as duct bank and concrete pad installation, but pricing will be significantly lower if contractor does that work. This form, with associated attachments, will also be used to document any customer changes to previously requested scopes of work.

2. PROJECT INFORMATION:

Date Permanent Service Required:_____ Date Temp Service Required: _____

Are you requesting a Connection Fee Quote?_____ Date Connection Quote Fee Required: _____

Project Title:_____Project Location (Street/Bldg #):_____Gov Proj Mgr Name: _____

CLP Scope of Work (**What exactly do you want CLP to do?…e.g transformer sizes, voltages, locations**?): _____

_____

_____

3. CONTACT INFORMATION

Person CLP will contact to set up site meeting and send communications regarding the project:

Name:_____ Company: _____

Phone:_____Cell Phone:_____Email: _____

Street Address:_____

City:_____State:_____Zip: _____

ADDITIONAL INFORMATION (*Attach as needed*):_____

_____

_____

REQUESTOR'S SIGNATURE: _____

Please Email Completed Service Application along with applicable electronic versions of drawings, specifications, and other documents to: mgh@clpinc.com, tjc@clpinc.com and/or cmb@clpinc.com.

CLP Mailing *Address: 7814 North Drive, Hill Air Force Base, UT 84056. Phone: (801) 660-2255*