ELECTRIC DISTRIBUTION SYSTEMS
ENERGY SERVICES DEPARTMENT

TECHNICAL DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

MAY 2021

Notes:

1. References for UNC-CH Electric Distribution Systems (**UNC-CH EDS**) standards and guidelines would normally be contained in the current version of Section 26 of the N.C. State Construction Office Electrical Guidelines and Policies are contained herein with that same reference section. Section 26 has not been included in its entirety, which includes electrical facilities other than medium voltage and site lighting.
2. Specifications for switchgear, transformers, cable, meters, sight lighting and other equipment are available from **UNC-CH EDS**, on request and when appropriate to the project considered.
3. Please direct questions or concerns regarding design and materials to the **UNC-CH EDS Manager**, telephone **919-962-5244**.
4. Listed standards and guidelines are provided under the authority and direction of the **UNC-CH EDS Manager**.

Figures and Tables Index

DIVISION 26 – ELECTRICAL

260100 General

Description

This division provides information on basic materials and methods for providing and installing electrical service, distribution, lighting, special systems, communications and controls for new construction and renovation projects at The University of North Carolina, Chapel Hill.

Applicable Codes, Regulations, and Standards

- The following codes (latest edition) shall apply:
  - National Electrical Safety Code (**NESC**)
  - National Electrical Code (**NEC**)
  - The State Building Code
  - North Carolina State Construction Office (**SCO**) 2017 Electrical Guidelines and Policies
  - Occupational Safety and Health Act of North Carolina (**OSHANC**)
  - Code of Federal Regulations (**CFR**) 1910.269
  - Code of Federal Regulations (**CFR**) 1946
  - Illuminating Engineering Society (**IES**)
- The following standards shall apply:
  - Underwriters Laboratory (**UL**)
  - Electric Testing Laboratory (**ETL**)
  - National Fire Protection Association (**NFPA**)
  - National Electrical Manufacturers Association (**NEMA**)
  - American National Standards Institute (**ANSI**)
  - Requirements for Fire Detection and Alarm Systems/Smoke Detectors Meeting State Requirements, Department of Insurance, State of North Carolina, Latest Edition.
  - Institute of Electrical and Electronic Engineers (**IEEE**)

Local utility regulations governing connections and metering require an electrical inspection certificate from the State Construction Electrical Inspector, Department of Administration prior to approval for final payment and before energizing any new transformers and electrical service.

Where above guidelines conflict with this specification, the more stringent of the two shall prevail.

Any and all work in streets or sidewalks will require proper permits and traffic control plans should be submitted to NCDOT, Town Engineer and UCD DPS for approval.

EDS shall inspect all new/modified electrical distribution systems infrastructure (i.e. telecommunication ductbanks/manholes, primary electrical ductbanks/manholes, pads for electrical equipment, and associated ground electrodes/welds/loops.). Contractor must call the main EDS phone number: 919-962-8394 for all inspections. All installations must be complete and visible for inspections.

Any exceptions and/or variances from this specification shall be submitted to the UNC-CH EDS Manager for review and approval.

University Construction Drawings shall include the following drawings:

1. Plan and Profile Drawings

a. Normally, prepare plan drawings using a scale of 1" = 50' for the Plan view; prepare profile drawings using 1/4" = 1'. **Note: For congestion areas use 1" = 5' for the Plan view.**

b. Show end points of all ducts.

c. Show ductbank cross sections for each change in separation or conjunction.

d. Show all interference with any below grade installation and/or existing utility conflict in or adjacent to the ductbank route. **Note: All interferences shall be field located for horizontal, vertical, and size dimensions. It is recommended to utilize a Subsurface Utility Engineering (SUE) group for identifying locates from a Quality Level A (QL-A). QL-A provides locating at the highest level of accuracy. It provides information for the precise plan and profile mapping of underground utilities through the nondestructive exposure of underground utilities, and provides the type, size, condition, material and other characteristics of underground features.**

Note: Firms shall call 811 and EDS (919-962-8394) for underground utilities locates. Normal locates requests takes approximately three (3) working days (72 hours minimum, may take longer due to workload and coordination with other utilities).

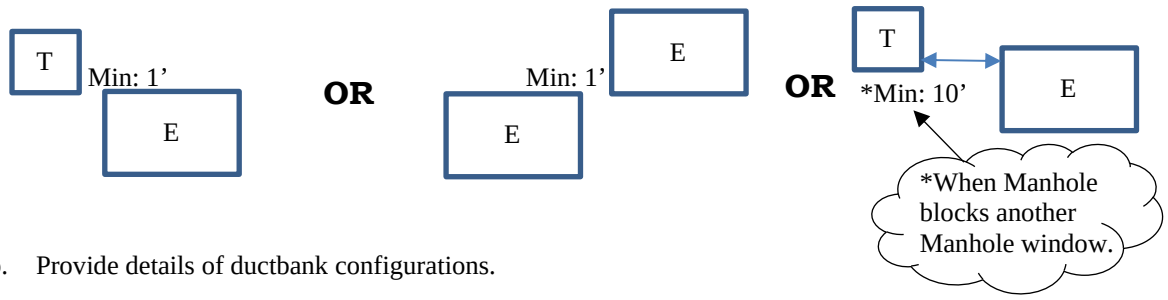
e. Any new designed ductbank shall have a separation clearance as referenced from **Table 1**.

2. Electrical Detail Drawings

a. Include manhole plans as reference from **UNC-CH EDS** standard manhole drawings (Size, Racking, Grounding, Entry Opening).

Note: Any group of electrical and/or telecom manholes shall have a diagonal formation layout as seen from Figure 1.

Figure 1: Electric and/or Telecom Manholes Plan Layouts.



b. Provide details of ductbank configurations.

c. Provide details of manhole construction.

d. Provide details of foundations for pad-mount electrical equipment (switch and/or transformer).

e. Provide details of padmount electrical equipment ground grid.

Note: All detail drawings can be supplied by UNC-CH EDS Engineering group for reference. All drawings shall be reviewed and approved by UNC-CH EDS Engineering group prior to construction. Failure for UNC-CH EDS approval will result with additional costs and/or construction schedule slippage during the Construction phase.

260100-A Service and Distribution

Equipment main distribution panel with digital metering to measure the following:

- Voltage: Phase to neutral and phase to phase.
- Amperage: (True RMS) - each phase and neutral. Fundamental and harmonics through 19th.
- Kilowatt Demand
- Power Factor

Mount one copy of the electrical riser diagram near the main switchgear in the Mechanical Electrical Room under clear protective material. For partial renovations an updated copy of the complete electrical riser shall be provided in plans and mounted in main switchgear room by Contractor.

New and/or Modified Permanent Services

The Contractor is responsible for coordinating and acquiring all local inspections for new and/or modified permanent services. All new and/or modified electrical installations shall be inspected and approved by the **SCO** Electrical Inspector prior to energization. **UNC-CH EDS** shall not energize the building transformer until this approval notice is submitted to **UNC-CH EDS**.

Note: UNC-CH EDS will accept an Engineer of Record inspection only with written permission by the SCO Electrical Inspector. There are no exceptions or variances allowed.

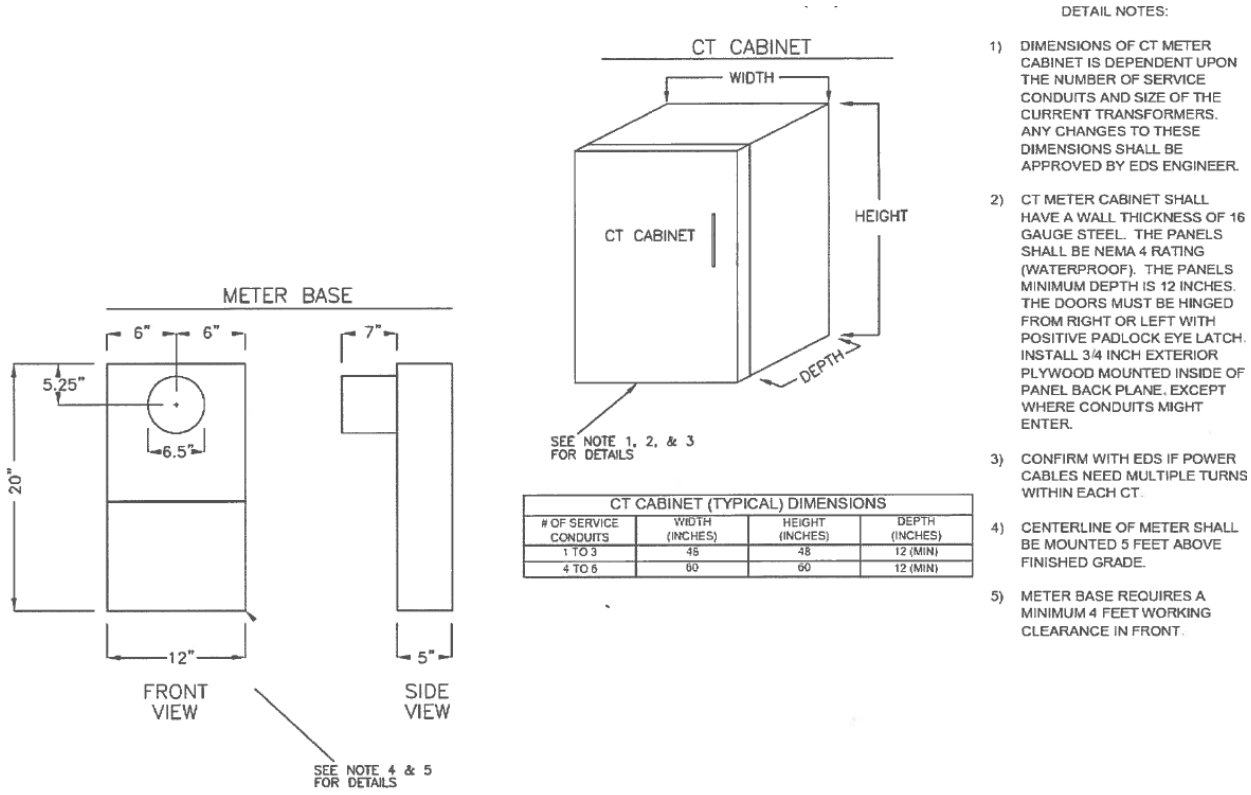
Temporary Services

Standard temporary service is provided for the sole purpose of providing construction power for only the duration of the construction project. All such services shall comply with **NESC, Section 1** and **NEC Article 230**. Such service does not alter service entrance code and safety requirements and shall not be used as a replacement for permanent service.

Temporary Services (where available) will be connected to the University underground electrical distribution system. The service voltage can be **single** phase **240/120 volts**, **three** phase **208/120 volts**, or **three** phase **480/277 volts**. Temporary service costs, payable in advance, are based upon all non-reusable materials, labor to install and remove and appropriate overheads. This cost is a fixed cost, i.e., it is a lump sum cost and must be paid prior to **UNC-CH EDS** providing the temporary service.

Temporary services **320 amperes** and under are metered with self-contained meters. Therefore, they only require a standard meter base, which is furnished by **UNC-CH EDS**. Temporary Services over **320 amperes** require current transformers for metering. This will require a Current Transformer (CT) cabinet, furnished by the Contractor. Reference **Figure 2** for CT cabinet dimensions and requirements.

Figure 2: Meter Base & CT Cabinet Details



CT CABINET (TYPICAL) DIMENSIONS

# OF SERVICE CONDUITS	WIDTH (INCHES)	HEIGHT (INCHES)	DEPTH (INCHES)
1 TO 3	48	48	12 (MIN)
4 TO 6	60	60	12 (MIN)

The Contractor shall contact **UNC-CH EDS** for the location of temporary service equipment, the appropriate size of any CT cabinets, and associated costs for this service. **Temporary service can be provided contingent of the availability of the temporary service capacity and/or system connectivity availability**. This temporary service will be located just inside the construction site fence at an agreed point of delivery as approved by **UNC-CH EDS**. Any damage to or relocation of the temporary service required by the contractor is at the contractor's expense.

UNC-CH EDS will provide one temporary service per site, unless the site qualifies for more than one (**1**) as described in **NEC Article 230**. If more than one temporary service is required, the cost for the second service is payable in advance.

The Contractor is responsible for coordinating and acquiring all local inspections and filing an application for service with the Energy Services Business Office. This filing date must allow adequate time (**~2 Weeks**) for **UNC-CH EDS** to provide the desired service. The construction project will be responsible for paying all monthly billing associated with the specified temporary service. No allowance for such billing will be assumed in the overall electrical bid for any project.

The Contractor shall provide a structure of enough strength and height to accept the appropriate overhead or underground supply conductors and to comply with appropriate local and **NEC** codes for height, voltage, clearances and utilization of power.

The temporary service shall be inspected and approved by the SCO Electrical Inspector prior to energization. UNC-CH EDS will require approval from the SCO Inspector before energizing the temporary service connection. Failure to do so will cause a delay at no fault to the University.

Utility Metering

All electrical installations are typically metered for Kilowatt Hours (**KWH)** for utilities billing purposes at the transformer. **UNC-CH EDS** will furnish and install all pad mounted transformer metering equipment including meter, meter base, current transformers, potential transformers and wiring. Cost of this installation will be included in the project cost.

Submit all electrical installations requiring special metering, to **UNC-CH EDS** for approval.

260100-B Photovoltaic Solar Power Generation

Photovoltaic solar cell power generation panels may be considered for installation on campus buildings or facilities. The design of such installations shall be in accordance with the ENERGY SERVICES SOLAR ELECTRIC GENERATION POLICY **(SE-01, effective date: 3/18/2019, refer to Appendix A)**.

2605(13&19) Wire and Cable

The minimum size wire conductor is **12 AWG** for premises wiring. **Exception: 16 AWG and 14 AWG are acceptable for control and/or signal circuitry as allowed by the NEC and the Department of Administration.** Branch circuit wiring shall be sized for a maximum of **3 % voltage drop**. Fully loaded multi-outlet receptacle circuits shall be assumed in sizing wiring for receptacle outlets.

- Insulation for premises wiring is **THHN** for dry locations; **THWN** for wet.
- All conductors, without exception, shall be copper. Aluminum is strictly prohibited.
- Size all neutral wires for **3 phase** systems equal to or larger wire size than the phase conductors. All **Single phase** branch circuits must have a dedicated neutral conduit for each circuit.
- No more than one **(1)** conductor for each phase plus individual neutrals and an equipment grounding conductor are allowed in a conduit.
- All wireways shall contain code sized equipment grounding conductor. All power wiring shall be in conduit. Conduit shall not be run in slab except where specifically approved and indicated in plans.
- **MC, AC or "BX" cables are not allowed.**

UNC-CH EDS will specify, furnish, install, terminate, splice and test all medium voltage **(15 KV)** cable. Cable will be single conductor, copper shielded, ethylene propylene rubber **(EPR)** insulated power cable rated **15 KV**. Installation will include separate **600 volt** neutral.

Although not prohibited by the **NEC** do **not** mix conductors serving two separate power systems **(i.e., 208/120 volt and 480/277 volt)** in the same raceway, pull box or junction box. **Exception: Where control wiring is a different voltage from power for the same system. In this case the insulation voltage rating of these conductors shall be higher than the highest voltage system within the same race.**

- Color code system wiring for standard clockwise rotation is shown below:

	208/120 volt systems	**408/277 volt system**
o	Phase A -- Black	Phase A -- Brown
o	Phase B -- Red	Phase B -- Orange
o	Phase C -- Blue	Phase C -- Yellow
o	Neutral -- White	Neutral -- Gray
o	Ground -- Green	Ground – Green

260533 Conduits

Telecommunications Conduits must comply with the following:

All specifications noted in **Section 260543** Conduits-Primary Service (**15 KV**) apply such as spacers, standard coupling kits, slip coupling kits, and terminator kits.

Install as per the manufacturer's instructions. All installation requirements as stated in **Section 260543**, for handling, supporting, terminating, testing and sealing procedures, apply.

260543 Conduits-Primary Service (15 kV)

Approved Contractors

UNC-Chapel Hill EDS has special requirements for any Contractor or Subcontractor installing duct-banks, transformer pads, switch pads, and similar facilities that will ultimately be part of its joint electric/telecommunications distribution system. Therefore, UNC-CH EDS requires the following for all **Approved** Contractors.

- Any such Contractor or Subcontractor must have a North Carolina General Contractor's License with a Public Utility - Electrical - Ahead of the Point of Delivery - Unlimited Classification per the North Carolina Licensing Board for General Contractors, Rules and Regulations, North Carolina Administrative Code, Title 21; Chapter 12.

- All such Contractor(s) or Subcontractor(s) must also be able to demonstrate to the satisfaction of the **UNC-CH EDS Manager** or the **Manager** appointees, through references or prior project work at the University. The Contractor(s) or Subcontractor(s) must have adequate, directly related experience to properly perform the electrical distribution construction work requested.

Note: The Contractor possessing the required license and meeting the experience test described must perform the work themselves. UNC-CH EDS has the right to cease work (at no penalty, fine, and/or change order) when a Contractor (or the Contractor hired Subcontractor) doesn't obtain the appropriate license and/or demonstrate satisfactory work per UNC-CH EDS construction standards.

Detailed Ductbank Specifications:

A. Trenching and Excavations

- All utilities shall be located prior to any trenching and excavation. The Contractor is required to call **811** and **UNC-CH EDS** Main Phone Number (**919-962-8394**).

  Note: Normal Locate Requests takes approximately three (3) working days (72 hours minimum, may take longer due to workload and coordination with other utilities) to complete and are good no more than 10 days after the utilities are located.

- Excavation and backfill shall conform to NC State Construction Office Guidelines except that heavy-duty, hydraulic-operated compaction equipment shall not be used.
- An erosion control permit must be approved by the University and NC Department of Environmental Quality (DEQ) prior to work.
- A tree protection plan shall be approved by the UNC Grounds Department prior to excavation.
- Trenches should be cut neatly, uniformly and as straight as field conditions permit, sloping uniformly to required pitch with smooth walls.
- Bottom of trenches to be smooth; uniform and free of loose dirt, rocks or other debris. Mud shall be mucked out and replaced with dry dirt or stone as needed. The bottom of the trench shall be properly compacted.
- Trench walls that have collapsed or where large rocks have been removed shall be formed with plywood to maintain a uniform side of the concrete encasement and to reduce concrete overflow.
- All Electrical trenches must allow acceptable separation from other underground conflicting utilities as referenced from **Table 1**.

Table 1: Separation of Underground Lines from Other Underground Utilities

Electrical	Water	Sanitary Sewer Service	Sanitary Main or lines > 8' deep	Force Main	Storm Drain	Natural Gas	Steam or Hot Water	Telecom.
Minimum Separation at Perpendicular Crossing (Units in Inches)								
12	18	18	18	18	18	18	24	12
Minimum Separation for Parallel Crossing (Units in Inches)								
12	36	36	60	36	36	60	60	12

B. Back Filling

- All back-fill material shall be clean, dry, and free of rock, concrete, and other construction debris.
- Backfill shall be tamped in layers per NC **SCO** Guidelines.
- When a ductbank is installed through cut rock; at least three (3) inches of clean backfill such as sand, fine gravel or crush and run shall be placed in the bottom of the trench and properly compacted before conduits are installed.
- Any ductbank through existing or proposed asphalt or concrete must be completely back filled with **flowable fill** to avoid future settling.

C. Rock Removal

Rock excavation includes removal of rocks or boulders larger than ½ **cu. yard** in volume and that occurs in beds, ledges, stratified or unstratified masses or in singular deposits. Qualifying rock or boulders are those which cannot be removed by heavy-duty rock excavating machinery or equipment without the use of a ram hoe, symmetrical drilling, blasting or ripping.

Removal costs for rock shall be based on unit prices included in the Contract Documents. A specific rock allowance may be requested on a project by project basis.

D. Conduits

All conduit runs used for primary voltage (**15 kV**) cables shall be **PVC Schedule 40** or **Rigid Galvanized Steel** as specified in project documents. Typical conduit shall have a nominal (minimum inside) diameter of six (**6**) inches. Other size conduits may be required depending on the project needs. All conduits shall have one belled end per length.

Terminate all conduit end points in switching cabinets and at transformer pads no less than **2 inches** and no more than **4 inches** above grade or a finished slab. Use of steel conduit when required coverage is unattainable shall be approved by the UNC Facilities Construction Manager and UNC-CH EDS Engineering group. Reference **Figure 3** for further illustration.

Terminate all PVC conduit end points in utility holes, switching cabinets, transformers, hand holes and buildings with end bells. The bell end of the conduits that enter manhole and handhole walls shall be flush with the wall. Seal conduit entrances into utility holes, hand holes and buildings on the end bell side of the entry. Plug all conduit entry end points with expandable reusable conduit plugs capable of withstanding 15 PSI minimum hydrostatic pressure. All conduit plugs shall have pull strings **(as referenced in the note below)** connected at both ends. As an example, UNC Electric Distribution Systems uses blank plugs made by Jackmoon USA Inc. a division of Tyco Electronics. Refer to **Figure 3** & **Figure 4** for further illustration.

Note: All PVC conduits must terminate to manholes, hand holes or connect to the equipment pad. Stub out ductbank sections are not acceptable, unless the variance is approved by the UNC-CH EDS Manager.

Note: Waterproof marking cord shall be installed using ½ inch wide 1250 -pound tensile test cord (marked at least every foot), equivalent to NEPTCO Inc. MuleTape Part # WP1250P, in all ducts, including spares, after thoroughly rodding, clearing and swabbing all lines free of any and all obstructions. DO NOT splice, tie or otherwise join shorter lengths together. Only a whole, unbroken length of tape to be installed in each duct.

Figure 3: Electrical Conduits End Point Stubbed Up with End Bells and Plugs.

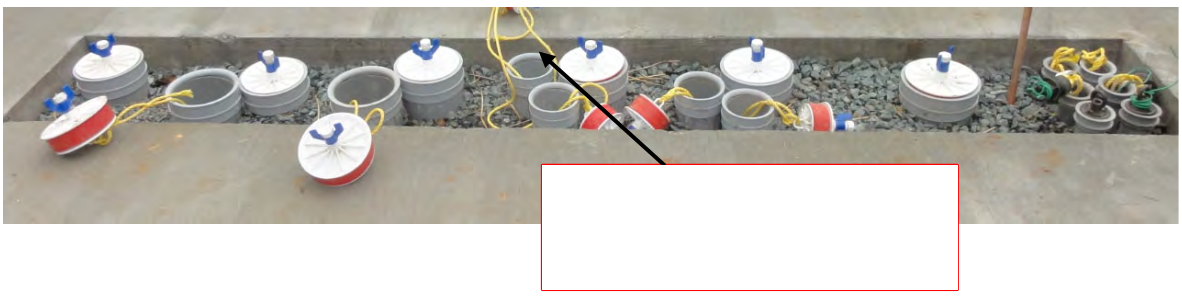
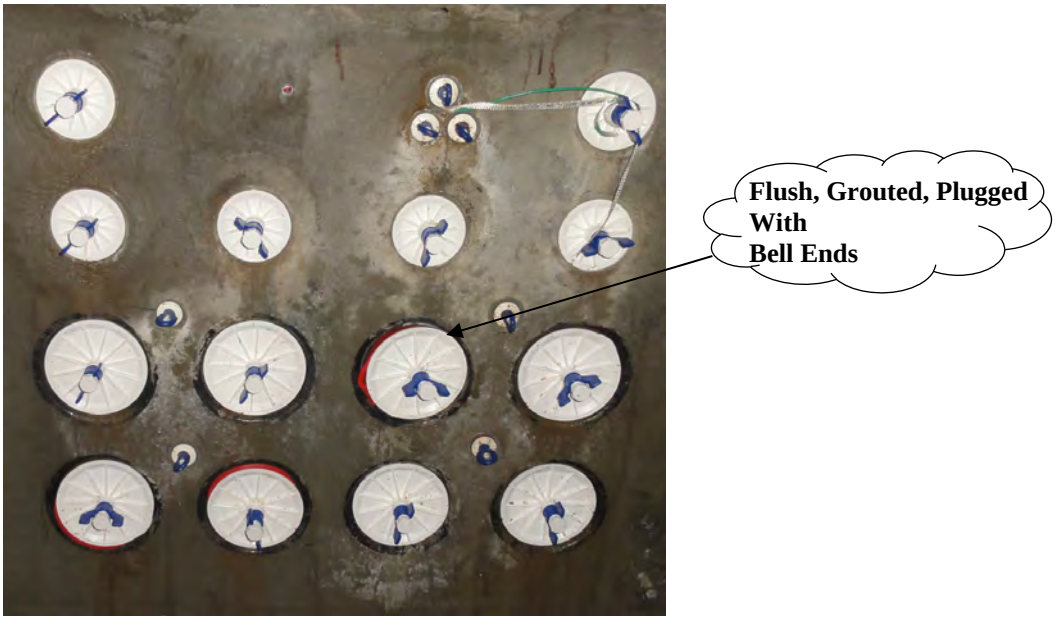


Figure 4: Electrical Conduits Terminate to Existing Manhole



Note: Any exceptions shall be submitted to UNC-CH EDS Engineering group for review and approval.

E. Conduit – In – Casing Construction (Jack & Bore)

The conduit-in-case construction procedure is a solution to the problem of laying power/communication cables under a surface obstruction without disrupting traffic or riverbed. The basic procedure shall be used:

1. Excavate and shore pits on both sides of the surface obstruction.
2. Bore under the surface obstruction connect the excavated pits and install a steel casing
3. Place conduits within the steel casing
4. There shall be a **bore spacer** designed for a casing that is straight and true.
5. It is essential that the bore spacers are held in place relative to the conduit. Use one bore spacer for every five **(5)** feet of ductbank.
6. Inject grout into the area between the conduits and steel casing. **Be mindful of other utilities within the grout injection area(s). The Contractor shall not allow the excess grout to protrude other utilities.**
7. The ductbank must be held in position at both ends to accommodate possible uneven thrust loads that may be generated during grout operation.
8. Allow the grout to cure.

Note: The steel casing is usually pushed into place with hydraulic jacks while the earth ahead of the casing is removed with special boring machines.

Note: The shore pits layout and bore spacer details shall be submitted for review and approval by UNC-CH EDS Engineering group.

F. Bends and Sweeps

All conduit bends shall be factory made bends (i.e. 11.25º, 22.5º, 30 º, 45º, and 90º). **All factory elbows shall have a minimum "standard" radius by size, as prescribed by NEMA.**
All field bends (approved by UNC-CH EDS) shall be made only with approved equipment identified for that purpose and have a minimum standard radius by size, as prescribed by NEC Table 2, Chapter 9.

Use of special radius bends and elbows are encouraged. Special radius bends and elbows are those which have a larger (gentler) radius than the standard radius. Schedule **40** PVC shall be used for field bends.

The inside of conduits shall be beveled slightly when conduits are cut or when joining two different schedules of PVC conduit to prevent conductors from snagging on the inside edge.

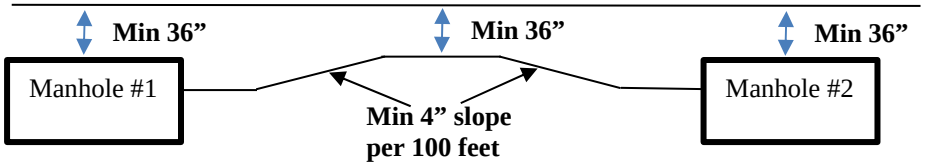
All ductbank runs where the cumulative (∑) effect of bends or elbows exceeds **180 degrees (degrees includes vertical and horizontal bends)** must be approved by the UNC Project Manager and **UNC-CH EDS Engineering group**. All bends **"Under No Circumstances"** should the cumulative (∑**)** effect of field bends and factory elbows between termination points **exceed 270 degrees** or conduit lengths **exceeds 500 feet** between manholes.

Dimensions

Ducts should be pitched to drain toward manholes and hand holes and away from buildings and equipment. Minimum slope shall be **4 inches in 100 feet**. Where necessary to achieve this between manholes, ducts should be sloped from a high point in the run to drain in both directions (See **Figure 5** for Reference)

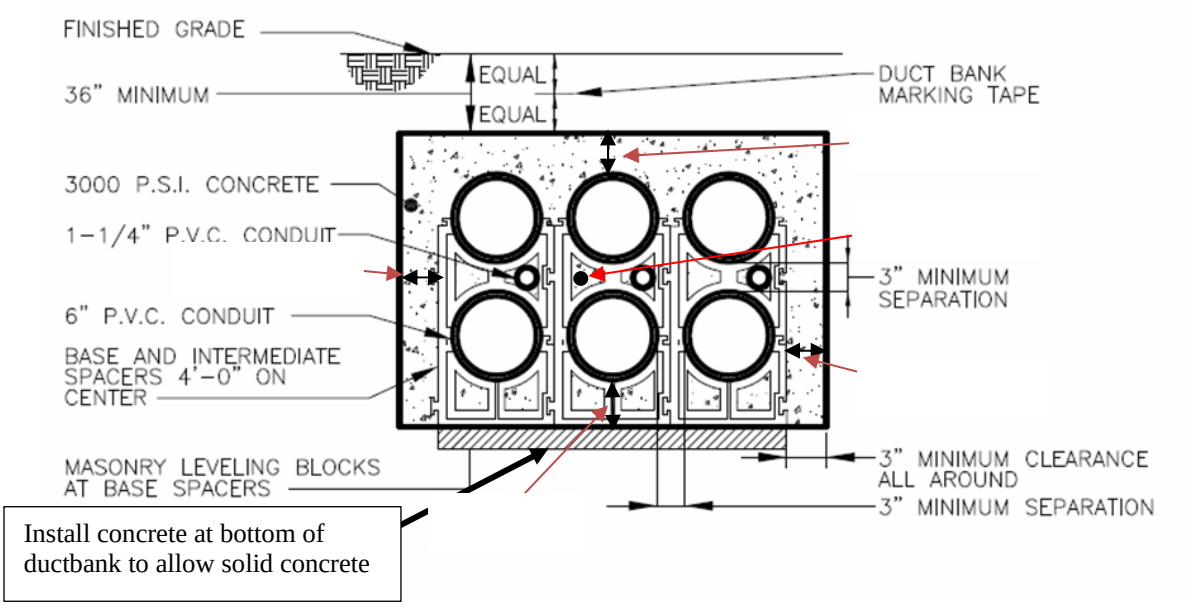
Design depth for the top surface of all ductbanks is **36 inches** (minimum) below finished grade or concrete. The entire ductbank length shall include a Tracer wire installed within the ducts spacers as illustrated from **Figure 6.** This Tracer wire shall include a **20 feet** tail extension at each final destination (i.e. manhole(s), handhole(s), vault(s), transformer pad, and/or switch pad(s).

Figure 5: Ductbank Sloped Between Manholes



Encase all PVC conduit in concrete, with a minimum **3 inch** spacing between the outside of adjacent conduits, a minimum of **3 inches** envelope around the ductbank, and a minimum of **3½ inches** of concrete on the bottom of the ductbank. This is accomplished using only approved ductbank conduit spacers. **Do not use other means, material or devices to achieve the required spacing.** Refer to **Figure 6** for illustration.

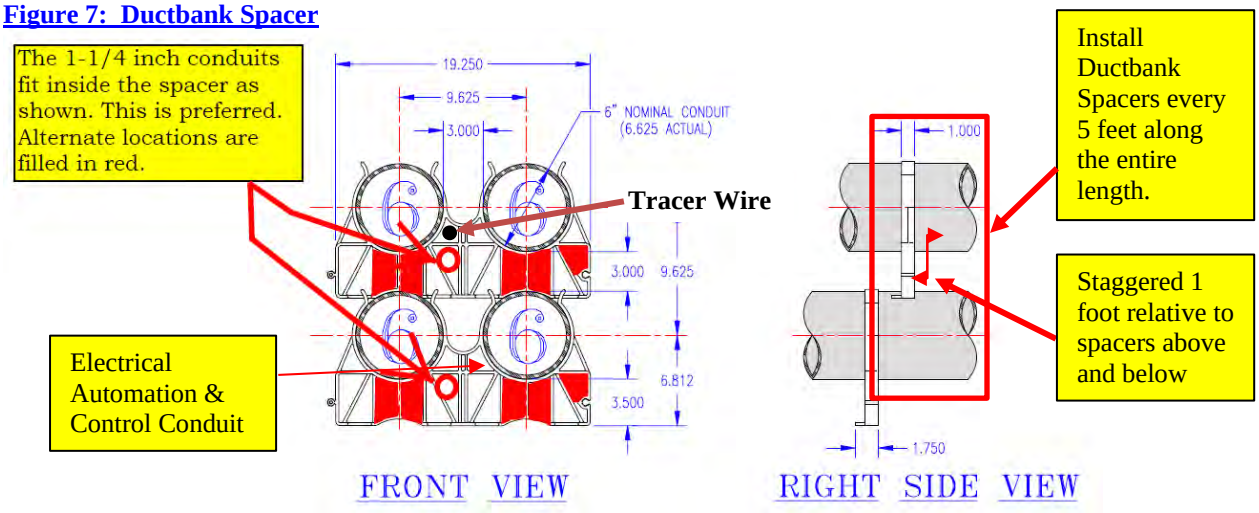
Figure 6: Concrete Encased Ductbank



Note: The UNC-CH Electric Distribution System approved ductbank spacer is the Underground Devices, Inc. "WUNPEECE" spacer, web site www. Udevices.com. No other spacer is acceptable. See Figure 7 for Reference. All other spaces depicted in other Figures are for reference only.

Apply ductbank conduit spacers along each level of conduits no more than **5 feet** apart. This provides required support in a manner which will minimize the creation of sheer joints, spacers at any given conduit level shall be staggered **1 foot** relative to spacers at conduit levels above and below. Sheer joints are created when the spacers per each conduit level are applied all at the same point along the ductbank run. This creates a weak **"joint"** (wall of spacers) in the ductbank, due to the lack of concrete. Conduit spacers to the earth and to ducts should be secured or anchored to prevent floating during placement of concrete. Steel or tie wires shall not be used as they may form conductive or magnetic loops around ducts or duct groups. Refer to **Figure 7** for illustration.

Figure 7: Ductbank Spacer

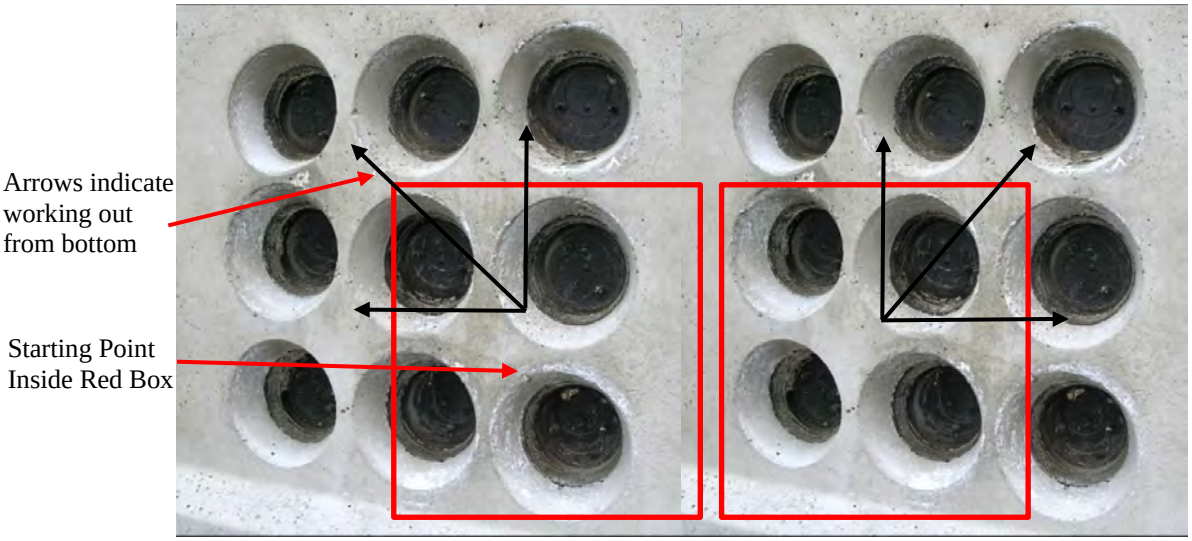


Preferred Spacer: UDI 6W30-2

Electric automation and control **(1-1/4")** conduits shall be placed within the open space of the conduit spacers and secured with plastic tie wraps. Reference **Figure 7** for illustration.

If manholes and/or vaults come with existing Duct terminators, then the ductbank must start from the bottom center. Reference **Figure 8** for illustration. If, the ductbank conduit count is less than the maximum number of terminators then the spare terminators on the manhole shall be the upper terminators.

Figure 8: Ductbank Starting Point for Manhole and/or Vaults with Duct Terminators



G. Concrete

All concrete shall be **3000 PSI** or greater, **28-day** compressive strength, with a slump at point of placement of **4** inches maximum and **3** inches minimum.

The top surface of the concrete ductbank envelope shall be raked smooth and level. The concrete shall be vibrated throughout in order to reduce and/or eliminate any air pockets when pouring and smoothing concrete to level.

At the end of each day's pour, stop concrete at a **45 degrees** angle and install reinforcing bars **(minimum of six (6))** to strengthen the transition to future duct extensions.

H. Marking, Testing and Inspecting

Mark all ductbank runs with a warning tape, installed no less than **6 inches** and no more than **12 inches** above the top of the ductbank concrete. Place warning tape along the approximate center line of the ductbank run. Warning tape shall be permanent, bright-colored, continuous printed, plastic tape compounded for direct burial not less than **6 inches wide** and **4 mils thick**. Printed legend shall be indicative of general type of underground line below.

As part of acceptance testing, all conduits, including spares, shall be proof tested using an appropriately sized aluminum and/or steel mandrel **approved and witnessed** by **UNC-CH EDS**. The mandrel shall be a solid cylindrical type mandrel as referenced from **Table 2**.

Table 2: Aluminum Test Mandrels

Condux Toll Free: 1-800-533-2077 Phone: 1-507-387-6576
Fax: 1-507-387-1442 Email: conduxinfo@condux.com

Aluminum Test Mandrels

Part	Duct Size		Body Length		Max O.D.		Load Capacity	
Number	(in)	(mm)	(in)	(mm)	(in)	(mm)	(lbs)	(N)
08059515	11/2	38	1.74	44	1.18	30	2,200	9,786
08059520	2	51	2.40	61	1.62	41	2,200	9,786
08059525	21/2	64	2.98	76	2.00	51	2,200	9,786
08059530	3	76	3.50	89	2.37	61	2,200	9,786
08059535	31/2	89	4.10	104	2.75	70	4,500	20,016
08059540	4	102	4.84	123	3.25	83	4,500	20,016
08059550	5	127	5.98	152	4.00	102	4,500	20,016
08059560	6	152	7.08	180	4.75	121	4,500	20,016
08059580	8	203	9.44	240	6.375	162	4,500	20,016

In addition to the SCO Electrical Inspector, UNC-EDS shall inspect conduit installations prior to concrete encasement or backfill. If a weather event occurs prior to concrete encasement, then UNC-EDS shall re-inspect ductbank. Failure to receive this inspection could result in demolition and rebuild of the ductbank.

I. Telecommunications Duct Systems

All specifications noted above in the "Detailed Ductbank Specifications" **(Section 260543)** apply to telecommunications duct systems.

Telecommunications conduit needs vary. Telecommunications utilizes multiple conduit bundles designed to fit standard size conduit spacers. These bundles are to be secured together utilizing plastic tie wraps to prevent conduit sagging, bending, and movement.

All ductbanks installed for the sole use of telecommunications cables shall include a suitable locating wire.

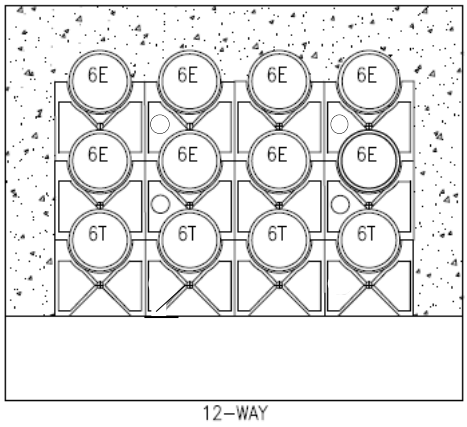
Multi-cell conduits are not allowed and should not be used for ductbank installations. Contractor or Owner may request a variance for UNC-CH EDS approval.

J. Joint Telecommunications and Electrical Duct Systems

Telecommunications and Electrical conduits may run parallel and utilize the same concrete encased ductbank based on the following requirements.

All Telecommunication conduits shall be below all electrical conduits when within the same encased ductbank. Reference **Figure 9** for further illustration.

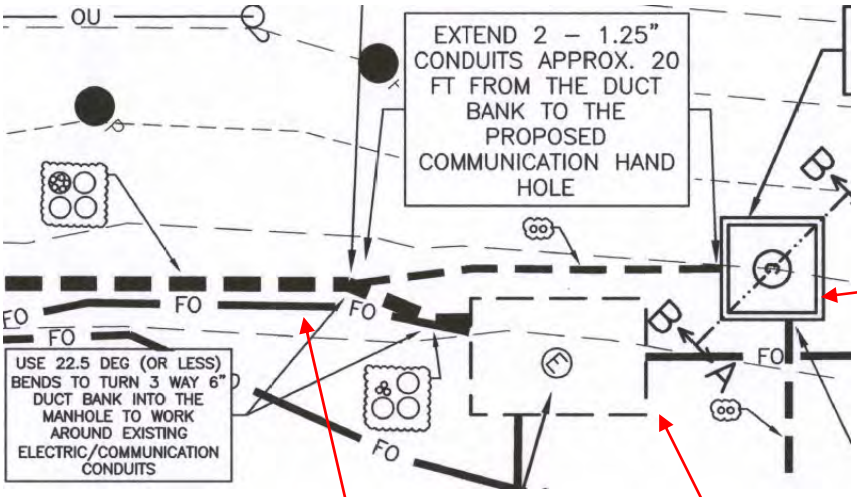
Figure 9: Joint Ductbank with Electric and Telecommunication Cross Section Detail



6E = Electric
6T = Telephone

The Telecommunication conduits and the Electrical conduits must separate and utilize their specified manholes (Telecom conduits run to Telecom Manhole, Electric conduits and Electrical controls conduits run to Electric Manhole). Reference **Figure 10** for further details.

Figure 10: Joint Ductbank with Electric and Telecommunication Manhole Separation



Telecommunication Handhole or Manhole

E/T Joint Ductbank **Electrical Manhole**

Note: Any existing joint use manholes "Planned to be Abandoned" must be separated into two separate manholes (Telecom and Electric) when altered by a Construction project.

K. Manholes and/or Vaults

Telecommunication, electric distribution and electric transmission manholes shall consist of preformed concrete top and bottom elements with knockouts for ductbank installations. Each manhole shall be consistent with the specifications provided by **UNC-CH EDS Engineering group** for each new installation.

Minimum cover over manholes shall be **36 inches** below finished grade **and** level. Reference **Figure 5** for further illustration.

Manholes and/or Vaults shall be left clean of debris, water, mud and soil, with all ductbank entrances sealed as per specifications. Also, all Electrical Manhole and/or Vaults that are beneath a surface (**other than dirt**) shall have **6 feet** by **6 feet** square equipment access hatch with removable means.

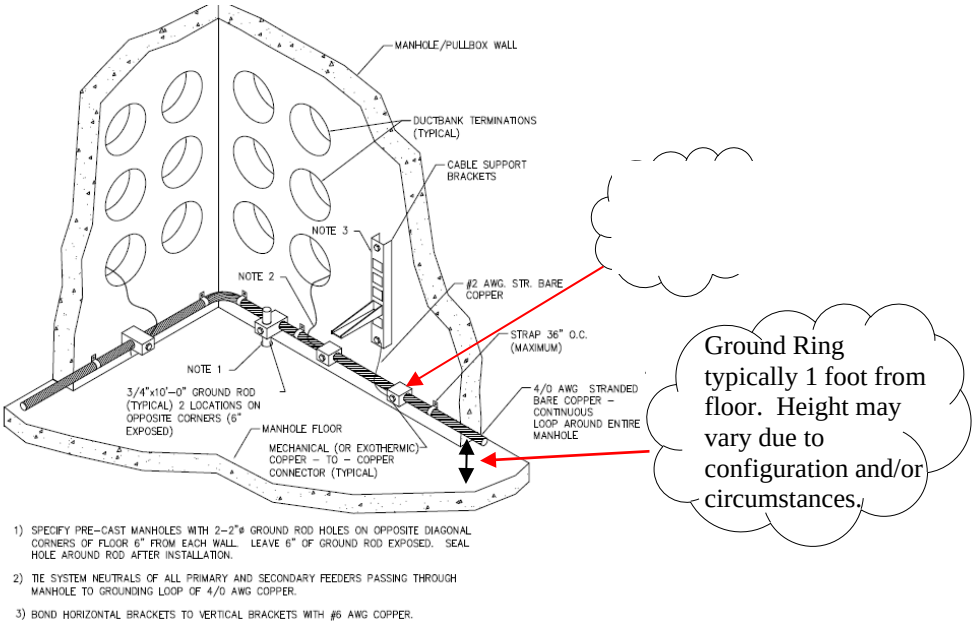
An Electrical Manhole shall be a Precast Electric Manhole with a minimum **8' width x 12' length x 7' deep (Inside Dimensions) rated for HS-20 highway rating**. This precast manhole shall include a **36 inches** diameter **manhole entry ring (round) cover** and sump window at the manhole center bottom. **No Manhole entry ladder is required.**

All Electrical Manholes and/or Vaults shall have metal cable racks bonded to the **4/0 AWG** continuous ground ring. Each electrical manhole shall be grounded by **¾" x 10'** ground rods located at two **(2)** locations on the opposite corners within the manhole. Reference **Figure 11** for illustration.

All Engineer designed (**custom**) Electrical Manholes and/or Vaults shall have pulling irons installed on each top/bottom center wall location. The customer Electrical Manholes and/or Vaults shall include cable racks installed along each side wall. Also, all custom Electrical Manholes and/or Vaults shall be reviewed and approved by **UNC-CH EDS Engineering group**.

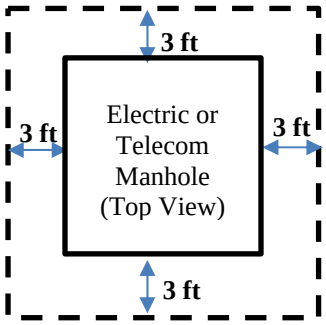
Note: All Electrical Manhole and/or Vaults shall have no combustible material (i.e. plywood, sheetrock, wood paneling, plaster, drywall, etc...) installed.

Figure 11: Manhole Grounding and Loop



Each Manhole shall have a minimum working space of three **(3)** feet per each side. There shall be no structure or object installed within this area as referenced from **Figure 12**. **Note: concrete, gravel, backfill (flowable fill), or asphalt is acceptable within this area.**

Figure 12: Electric or Telecom Manhole Working Clearance



Note: If the working clearance above is not feasible then seek UNC-CH EDS approval for the minimum acceptable working clearance.

L. Abandoned Ductbanks and/or Manholes

No existing manholes can be removed and relocated to a different location. A new manhole and ductbank must be installed with rerouted routes. All new ductbanks must include the same number of ducts and add ducts intended for the new/renovated building use.

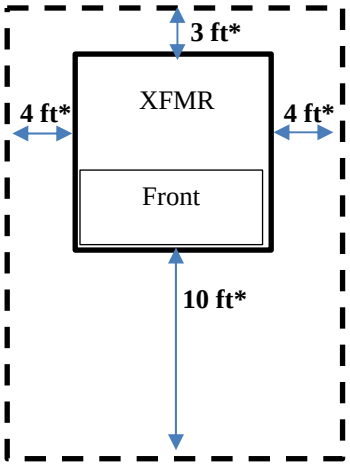
Any Abandoned ductbanks that needs to be demolished must be addressed by the **UNC-CH EDS Engineering group** prior to work. If abandoned ductbanks demolishing is approved, then the Contractor must treat the abandoned ductbank as energized. The Contractor must verify no utility cables are within the abandoned ductbank area.

Note: All abandoned ductbanks that are modified by construction project must be plugged and installed with locating ball and tracer wire attached. Contractor must contact UNC-CH EDS for inspection before backfilling abandoned ductbank section.

261219 Transformers - Pad Mounted

Transformers shall be dead front, loop feed, pad mounted design. **UNC-CH EDS** shall provide transformers for connection between the UNC **15 kV** primary cable system and the building service. Transformers shall be located no closer to any building surface than **4.0'** and more than **10'** from any window. The transformers shall have a working clearance as illustrated from **Figure 13**.

Figure 13: Minimum Working Clearance for Padmount Transformers



- **UNC-CH EDS shall provide and install connectors to terminate Contractor installed service conductors on the transformer secondary spade terminals.**
- **UNC-CH EDS shall make the final service conductor connections to the transformer secondary spade terminals.**
- ***Working Clearance shall be clear with no obstacles (i.e. fences, walls, vegetation, etc…) and level. There shall not be more than one (1) foot drop from top of equipment pad to grade level.**
- **Working Clearance shall always be accessible and allow Large Utility Vehicles to obtain access for Rigging (i.e. Cranes) and pulling cables. Typically, this accessible space needs to be approximately 30 feet wide by 50 feet long.**

The costs of service transformers are included as part of the project cost. **UNC-CH EDS Engineering group** will provide the cost for the installation to the project designer for inclusion in the project. **UNC-CH EDS Engineering group** will make the size determination for all transformers installed on the campus for all service connections.

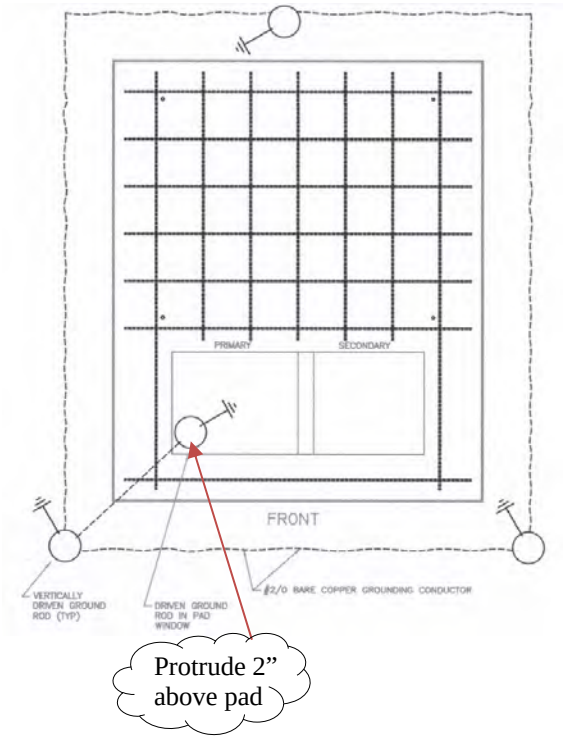
The Contractor is responsible for the following:

- Proper installation of the secondary/ service conductors which shall include accurate cable phasing and marking, cutting conductors to the proper length, and insulation resistance testing for any insulation problems, short circuits, or cross phasing connections.
- Forming, pouring and installing transformer pad as per **UNC-CH EDS** standards.
- Contractor shall install direct buried ground loop, grid, or counterpoise requiring buried connections, these connections shall be exothermic weld type connections.

- The transformer ground ring shall be installed within **10 inches** from transformer pad edge and at least **30 inches** below grade exothermic weld connect to each ground rod (**¾" x 10'**). There shall be at least three (**3**) ground rods driven vertically within **"Wet"** dirt in an Equilateral Triangle shape. Also, there shall be one (**1**) ground rod (**¾" x 10'**) ground rod driven vertically within the front left corner of the transformer primary window. The transformer primary window ground rod shall protrude **2"** above pad. Please refer to **Figure 14** for illustration.

Note: The Contractor must prove to UNC-CH EDS that the ground rods cannot be driven vertically before requesting an exception. The ground rods shall not be installed directly below transformer pad or below ductbank.

Figure 14: Transformer Ground Ring



261800 Primary Voltage Switchgear

Normally, new connections to the electric distribution system are made at switches. Locate these switches in utility manholes or surface mounted on a concrete pad sized for the switch that will be installed. Information regarding the switch type and location will be provided to the project designer at or near Schematic Design review time.

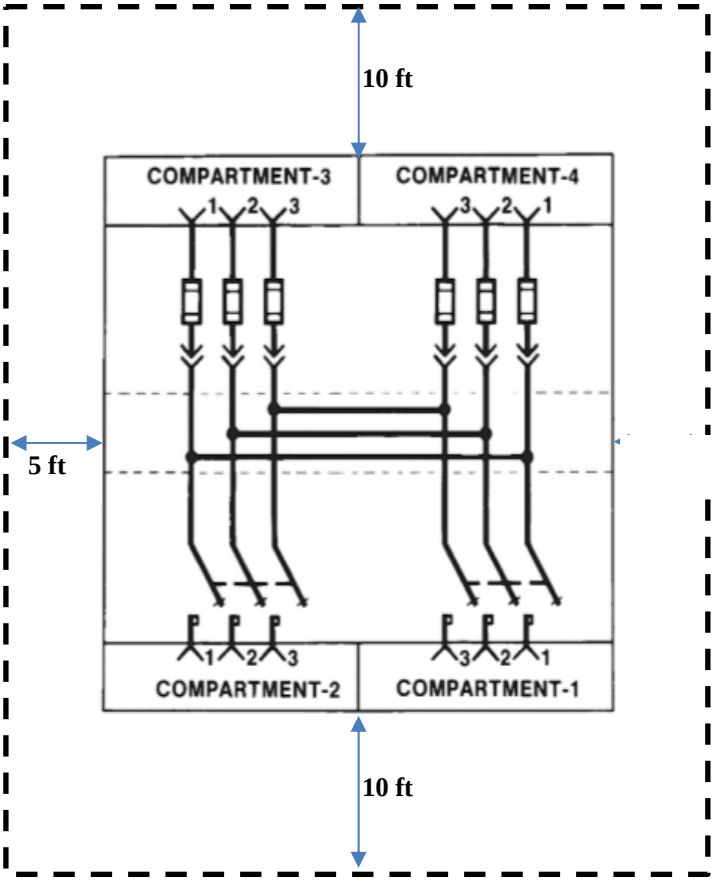
Since these switches are part of the electric distribution system, the design associated with switch installations is the responsibility of **UNC-CH EDS**. Coordinate any proposed connection to the system with **UNC-CH EDS**. The costs of system connections, including additional switches needed for the connection, are included as part of the project cost. **UNC-CH EDS** will provide and install system switches and will provide the cost for the installation to the project designer for inclusion in the project.

The Contractor is responsible for:

- Forming, pouring and installing switch pad as per **UNC-CH EDS** standards. Reference **Figures 15 & 16** for minimum working clearances.
- Contractor shall install direct buried ground loop, grid, or counterpoise requiring buried connections, these connections shall be exothermic weld type connections.
  - The switchgear ground ring shall be installed within **10 inches** from transformer pad edge and at least **30 inches** below grade exothermic weld connect to each ground rod (**¾" x 10'**). There shall be at least three (**3**) ground rods driven vertically within **"Wet"** dirt in an **Equilateral Triangle** shape. Also, there shall be one (**1**) ground rod (**¾" x 10'**) ground rod driven vertically within the front left corner of the pad window. The switch window ground rod shall protrude **2"** above pad. Please refer to **Figure 17 & 18** for illustration.

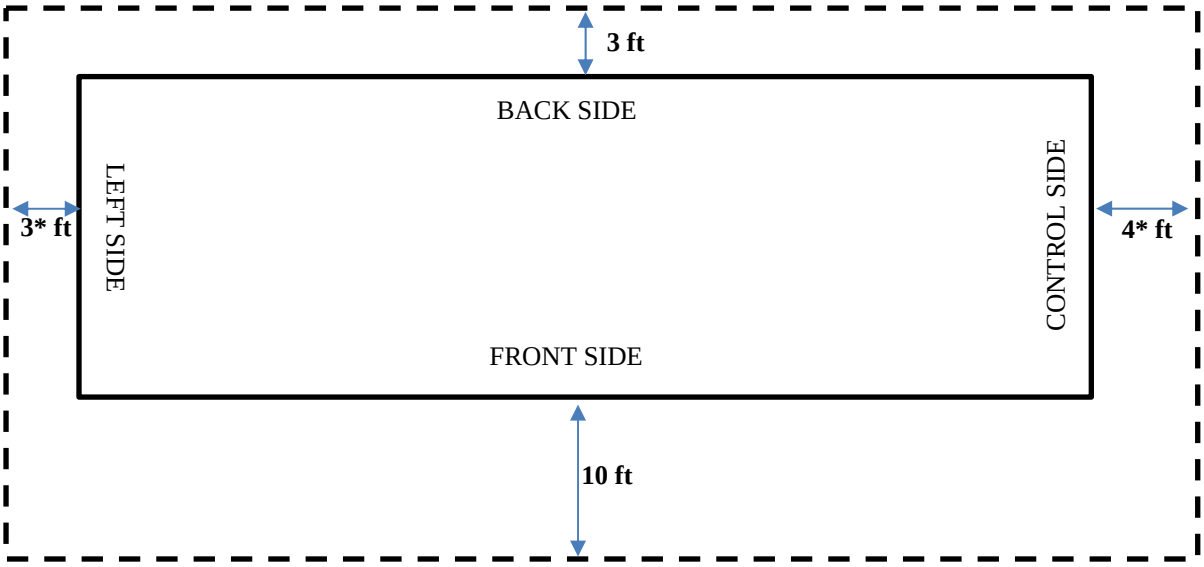
Note: The Contractor must prove to UNC-CH EDS that the ground rods cannot be driven vertically before requesting an exception. The ground rods shall not be installed directly below switchgear pad or below ductbank.

Figure 15: PME-9, PMH-9, and Source Transfer Switch Minimum Working Clearance



- ***Working Clearance shall be clear with no obstacles (i.e. fences, walls, vegetation, etc…) and level. There shall not be more than one (1) foot drop from top of equipment pad to grade level.**
- **Working Clearance shall always be accessible and allow Large Utility Vehicles to obtain access for Rigging (i.e. Cranes) and pulling cables. Typically, this accessible space needs to be approximately 30 feet wide by 50 feet long.**

Figure 16: High Speed Switch Minimum Working Clearance



- ***Control Side can be located either left or right side and must have four (4) feet clearance.**
- **Working Clearance shall be clear with no obstacles (i.e. fences, walls, vegetation, etc…) and level. There shall not be more than one (1) foot drop from top of equipment pad to grade level.**
- **Working Clearance shall always be accessible and allow Large Utility Vehicles to obtain access for Rigging (i.e. Cranes) and pulling cables. Typically, this accessible space needs to be approximately 30 feet wide by 50 feet long.**

Figure 17: Padmount Switch Ground Ring

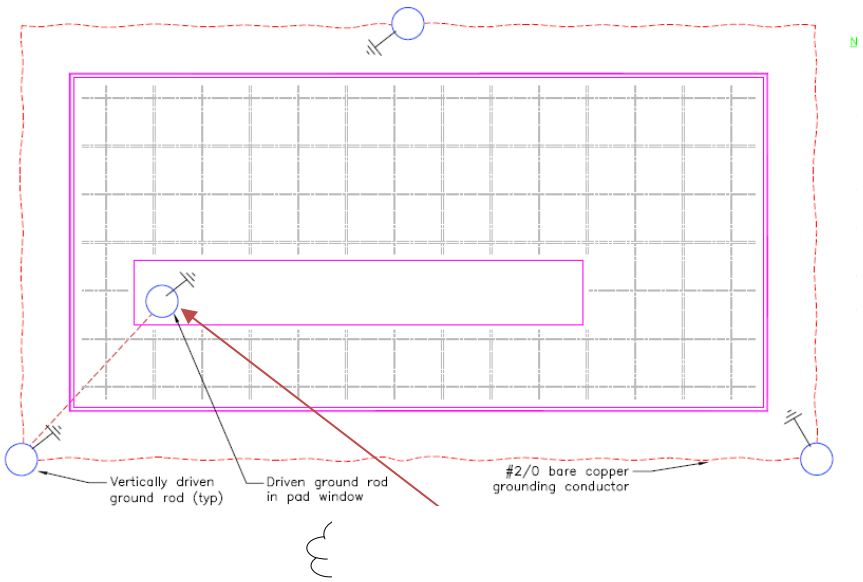
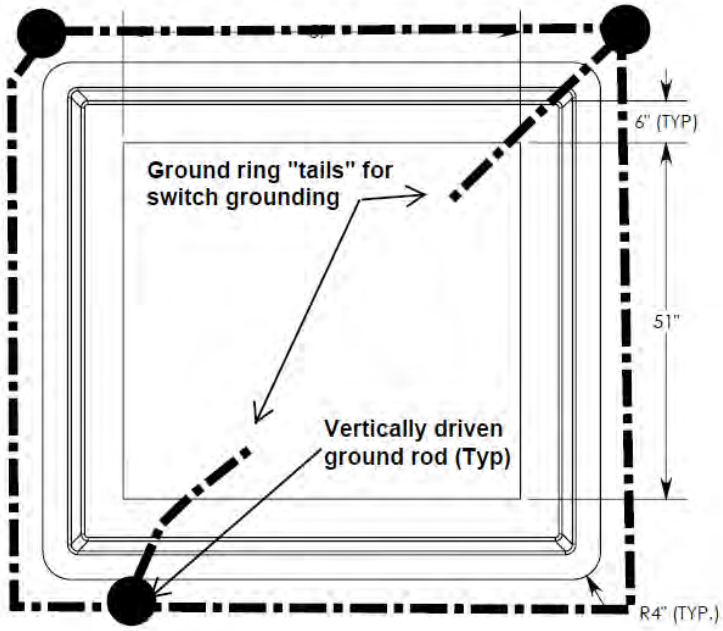


Figure 18: PME-9, PMH-9, and Source Transfer Switch Ground Ring



NOTES:

1. Ground rods to be 3/4 in dia. x 10 ft. long copper clad steel
2. Grounding conductor to be # 2/0 bare copper minimum
3. Grounding conductor depth to be 30 inches minimum
4. Mechanical/electrical connections in the ground shall be exothermic welds (ex. Cadweld)
5. Grounding conductor to be 10 to12 inches from the edge of box pad.
6. Any variations or conflicts must be reviewed and approved by Electric Distribution engineering.

265600 Site Lighting

Exterior lighting constitutes the first line of defense in the overall security and safety plan of the campus. It provides the needed visibility for vehicles and more importantly, pedestrians to safely travel around the University campus. At the same time, lighting that illuminates perimeter neighborhoods or the night sky is actively avoided.

UNC-CH EDS provides standards, approves selections and ultimately maintains all outside, pole mounted area, walkway, parking lot, and street lighting on the UNC campus properties. For projects which involve typically less than five lights, **UNC-CH EDS** may elect to provide materials and installation using project funding. Projects involving larger numbers of lights should be included in the requirements for the electric contractor and are subject to **UNC-CH EDS** approval and inspection. Refer to **Table 3** for **UNC-CH EDS** approved fixtures.

Note: Any variance from the UNC-CH EDS approved fixtures will be the responsibility of the project's customer/owner to maintain and repair.

Exterior lighting typically falls into the following categories:

TABLE 3: LIGHTING FIXTURE SCHEDULE

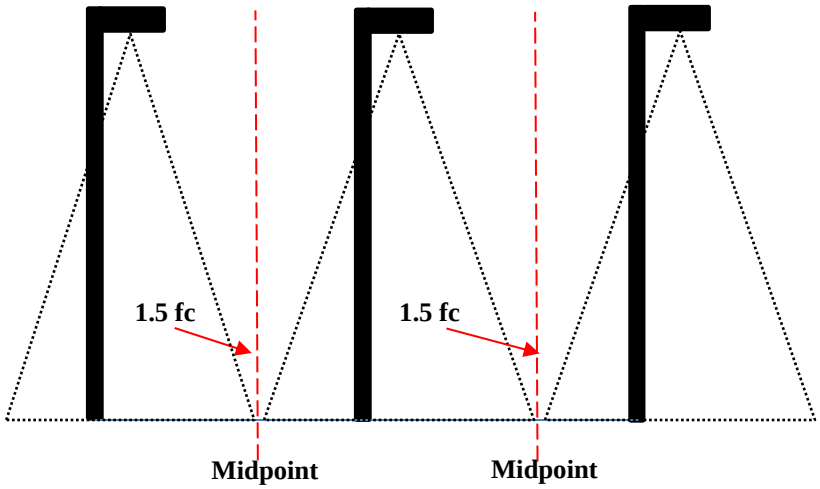
TYPE	DESCRIPTION	MANUFACTURER / CATALOG #	LAMPS	VOLTS	NOTES
Walkway Lighting	Main Street Lighting	AATF1410-L400-CL5	ONE	120/277	BULB SUPPLIED BY UNC-CH EDS
Parking Lot Lighting	GE Evolve LED Area Light	EALP030H4AF750NDD1DKBZ	140 WATT	120/277	LAMP SUPPLIED BY CONTRACTOR
Parking Lot Lighting	GE Evolve LED Area Light	EALPP010J4A0NDD1DKBZ	220 WATT	120 / 277	LAMP SUPPLIED BY CONTRACTOR
Streets Lighting	Cree Cobra Head LED Lighting	CREEBXSPAOFPAUS	101 WATT	120/277	LAMP SUPPLIED BY CONTRACTOR

In general, the University requires **1.5** footcandles **(fc)** minimum illumination for task lighting (i.e. Streets, Parking Lots, and Walkways). **Note: This does not pertain to Athletics Facilities.** The minimum illumination reading shall be recording by **UNC-CH EDS** between the fixtures midpoint segment as referenced from **Figure 19**.

Consideration shall be given to specifying exterior lighting such that exterior luminaries with more than **1,000 initial lamp lumens** are shielded and all luminaries with more than **3500 initial lamp lumens** meet the Full Cutoff **IESNA** Classification. In addition, consideration shall be to specifying luminaries within a distance of **2.5 times** its mounting height from the property boundary to have shielding such that no light from those luminaries crosses the property boundary **(IESNA RP-33-14)**.

Furthermore, lighting should be designed to reduce light pollution to the night sky. For more details on light pollution and light trespass, see the Illumination Engineering Society of North America's Recommended Practices for outdoor lighting **(IESNA RP-33-14)**.

Figure 19: Minimum Illumination Inspection



It is the goal of the University to preserve the ambiance of the campus while ensuring well-lit areas of travel throughout the campus. This requires the consistency, as is feasible, of fixture types and luminaries. The availability of several voltages requires special attention in design. There may be multiple voltages within any one particular area. Typical **voltages** are **120, 208** and **277**.

The electric source or feed for outside lighting shall be a minimum of one **60 amp**, **240** or **277 volts**, two pole circuit wired from the nearest service transformer.

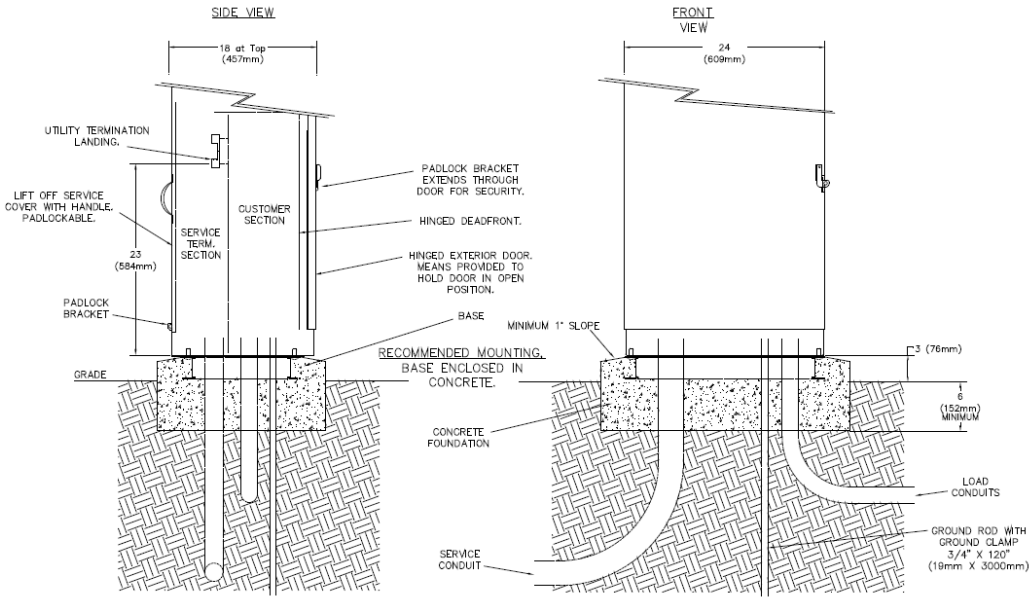
New and/or replacement fixtures shall conform to existing fixtures in and around the general area under consideration and shall be of equal or better quality. Temporary lighting may be required during the construction phase to ensure a safe area at night. Temporary lighting will be the responsibility of the construction project. All such lighting shall be of a cutoff design to reduce any light distribution above a plane equal to the plane of the fixture lens.

All pedestrian pole lighting is Light Emitting Diode (LED) with "Old Standard" style in accordance with **UNC-CH EDS** specifications **(Refer to Appendix B), ES 12-03** and **ES 12-04**. All such lighting shall be of a cutoff design to reduce any light distribution above a plane equal to the plane of the fixture lens. Further, consideration may be given to the use of LED light fixtures, in consultation with the **UNC-CH EDS Manager**.

All outdoor fixtures shall be fed from a free-standing lighting pedestal as referenced from **Figure 20**. There shall be at least three (**3**) **feet** clearance in front and back of this free-standing light pedestal.

Note: No other electrical and/or controls equipment may be wired directly from any Site Lighting circuits.

Figure 20: Free Standing Light Pedestal



Lighting Fixture Types

Lighting in relationship to a new or remodeled facility may typically involve:

- Removal and replacement of existing fixtures
- Addition of new self-standing fixtures
- Addition of new wall mounted fixtures
- Use of new technology LED type fixtures (subject to specific **UNC-CH EDS** conditions and specifications)

Removal of Existing Fixtures

It may be necessary to remove some existing fixtures to facilitate the transition between a new fixture and the existing fixtures or to improve the illumination level. Any light fixture removal must be addressed and approved by **UNC-CH EDS Engineering group**. Contractor is not allowed to disconnect any lighting connections without EDS providing the approval to do so. **UNC-CH EDS** personnel accomplish removal of all existing fixtures. Associated cost for this work is to be included within the project budget.

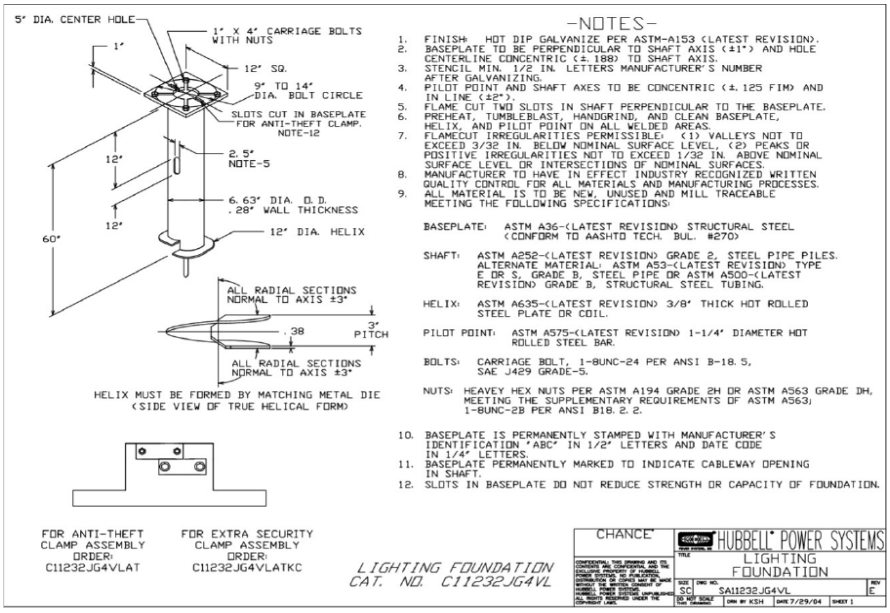
Note: Any legacy fixtures that pre-dates electricity shall be demolished and replaced with Main Street Light fixture.

Addition of New Free-Standing Fixtures

When the need arises for adding new freestanding fixtures, care must be given to ensure uniformity in fixtures and lighting levels with surrounding fixtures and lighting levels. Detail should be given to all obstructions that result in a "cutoff" of the required light pattern. All new freestanding fixtures and site lighting systems shall be **approved** by **UNC-CH EDS Engineering group**. The new site lighting system shall be served by a free-standing light pedestal (referenced **Figure 20**) and directly fed by the nearest transformer.

Each outdoor light fixture shall be installed with a screw in pole base (**preferred, Figure 21 - 23**) or concrete base (**alternate, Figure 24 & Figure 25**). **All bases and fixtures shall be approved by UNC-CH EDS Engineering Group.**

Figure 21: Screw in Pole Base (Preferred)



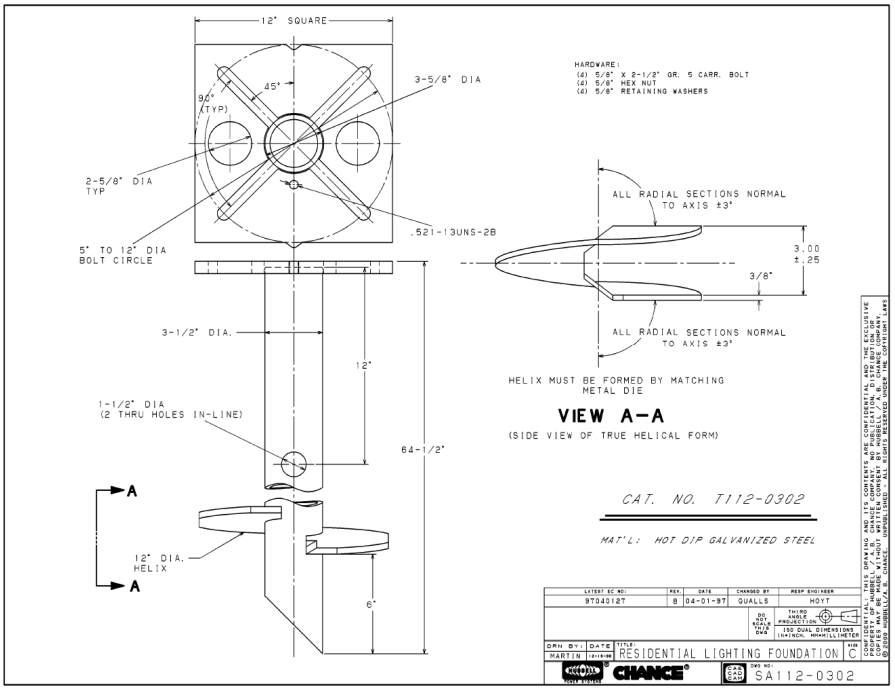


Figure 22: Screw in Base Kelly Bar Adapters (See UNC-CH EDS Engineering Group for Consultation)

KELLY BAR ADAPTERS

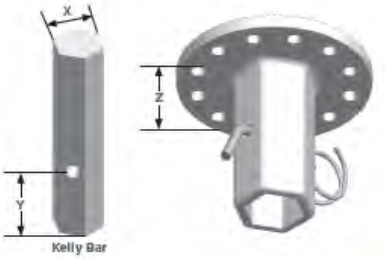
Selecting the correct Kelly bar adapter is key to building a proper drive string.

Follow these two easy steps:

1. Remove the auger from the driver and carefully measure the X and Y dimensions of the Kelly bar.
2. Match the shape of the Kelly bar and the X and Y dimensions with the Kelly bar adapter charts below. The Y dimension on the Kelly bar adapter must be equal to or greater than the Y dimension on the intended Kelly bar.

A Note about Bolt Circles

CHANCE® anchor installing tools are provided with appropriate bolt circles for the expected service. The torque limitations for the two standard bolt circles are given in the chart to the right. **Never exceed the rated torque of any CHANCE installing tool.**



Kelly Bar

Bolt Circle	Max. Torque
(6) 1/2" Grade 5 bolts on 5-1/4" bolt circle	10,000 ft-lb
(12) 5/8" Grade 5 bolts on 7-5/8" bolt circle	30,000 ft-lb

5-1/4" BOLT CIRCLE KELLY BAR ADAPTER
TABLE 2

Catalog No.	Kelly Bar Shape	Dimensions X	Y	Z	Weight (lb)
630016	Square	2-1/4"	2-1/4"	3-1/2"	10
630017	Square	2-1/4"	2-1/4"	3-1/2"	10
630013	Hex	2"	5"	6-1/8"	10
630013A	Hex	2"	3-1/4"	6-1/8"	10
360012HD	Hex	2-5/8"	4-1/4"	8-1/8"	12
630011HD	Hex	2-1/2"	4-1/4"	8-1/8"	12

For 10,000 ft-lb Maximum Installing Torque

Each of these Kelly bar adapters has six holes for 1/2" bolts on a 5-1/4" bolt circle and comes with six 1/2" Grade 5 bolts, nuts & lockwashers, bent-arm pin with coil lock.

7-5/8" BOLT CIRCLE KELLY BAR ADAPTER
TABLE 3

Catalog No.	Kelly Bar Shape	Dimensions X	Y	Z	Weight (lb)
C3030936	Hex	2-1/2"	4-3/8"	8-1/4"	23
C3030937	Hex	2-5/8"	4-3/8"	8-1/4"	23
C3030940	Hex	3"	3-1/2"	8"	27
C3030955	Square	2-1/2"	2-1/4"	7"	22
C3030958	Square	3"	3-1/2" & 2-1/16"	7"	23

For 30,000 ft-lb Maximum Installing Torque

Each of these Kelly bar adapters has twelve holes for 5/8" bolts on a 7-5/8" bolt circle and comes with twelve 5/8" Grade 5 bolts, nuts & lockwashers, bent-arm pin with coil lock.

BOLT CIRCLE ADAPTER

The T3030166N is for use between a tool having a 5-1/4" bolt circle and one having a 7-5/8" bolt circle. It is limited to 10,000 ft-lb.

BOLT CIRCLE ADAPTER
TABLE 4

Catalog No.	Description	Weight (lb)
T3030166N	Bolt circle adapter with one 1/2" x 5-1/4" bolt circle and one 5/8" x 7-5/8" bolt circle	11


T3030166N

Because Hubbell has a policy of continuous product improvement, we reserve the right to change design and specifications without notice.

Figure 23: Screw in Base Drive Tool (See UNC-CH EDS Engineering group for Consultation)

DRIVE TOOLS

C3031502

SS DRIVE TOOLS

These tools include our proprietary alignment window that helps reduce chance of finger pinch when anchor is inserted into tool. Alignment window also makes it faster and easier to line up the anchor and anchor tool.

These drive tools require the appropriate Kelly bar adapter (page 3). Each comes with bolts, nuts and lock washers.

SS DRIVE TOOLS
TABLE 7

Catalog No.	SS Anchor Series Tool	Bolt Circle, Holes	Approx. Weight (lb)
C3031502	SS125	5-1/4", (6) 1/2" holes	10
639001	SS5/SS150	5-1/4", (6) 1/2" holes	8
C3030195*	SS175	7-5/8", (12) 5/8" holes	18
C3030201*	SS200	7-5/8", (12) 5/8" holes	30
C3030202*	SS225	7-5/8", (12) 5/8" holes	30

**Coupling to a Kelly bar adapter with a 5-1/4" bolt circle requires use of T3030166N adapter and limits tool's maximum torque rating to 10,000 ft-lb.*

C3031650

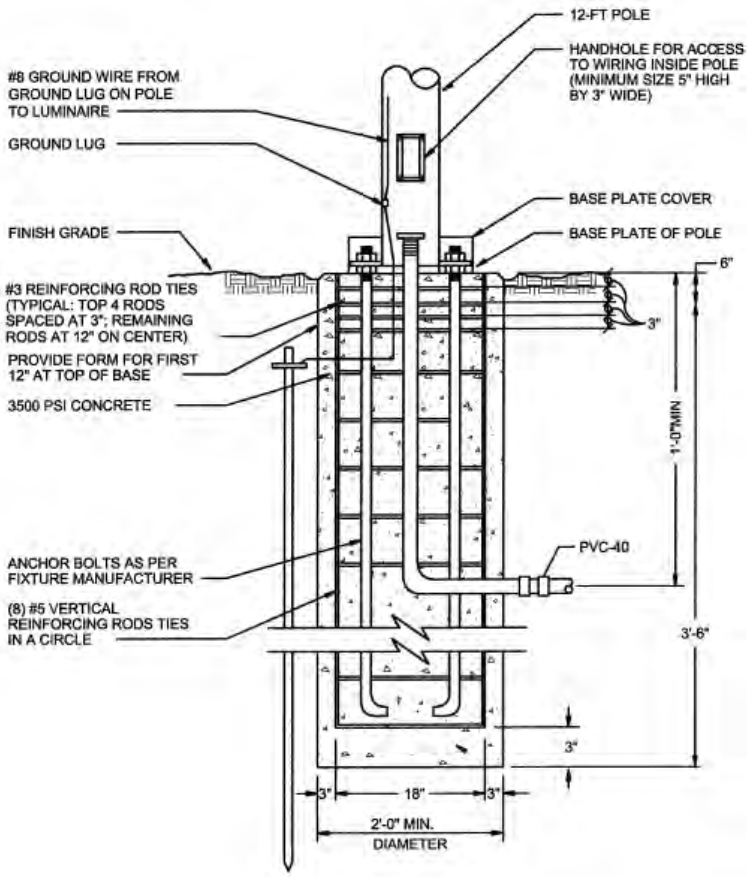
Each of these drive tools includes an integral set of locking dogs that attach the drive tool to the anchor. There is no need to use bent arm pin and coil lock to attach these tools to an anchor.

These drive tools require the appropriate Kelly bar adapter, sold separately. Each comes with bolts, nuts and lockwashers.

SS DRIVE TOOLS
TABLE 8

Catalog No.	SS Anchor Series Tool	Bolt Circle, Holes	Approx. Weight (lb)
C3031650	SS5, SS150	5-1/4", (6) 1/2" holes	10
C3031645	SS175	7-5/8", (12) 5/8" holes	21

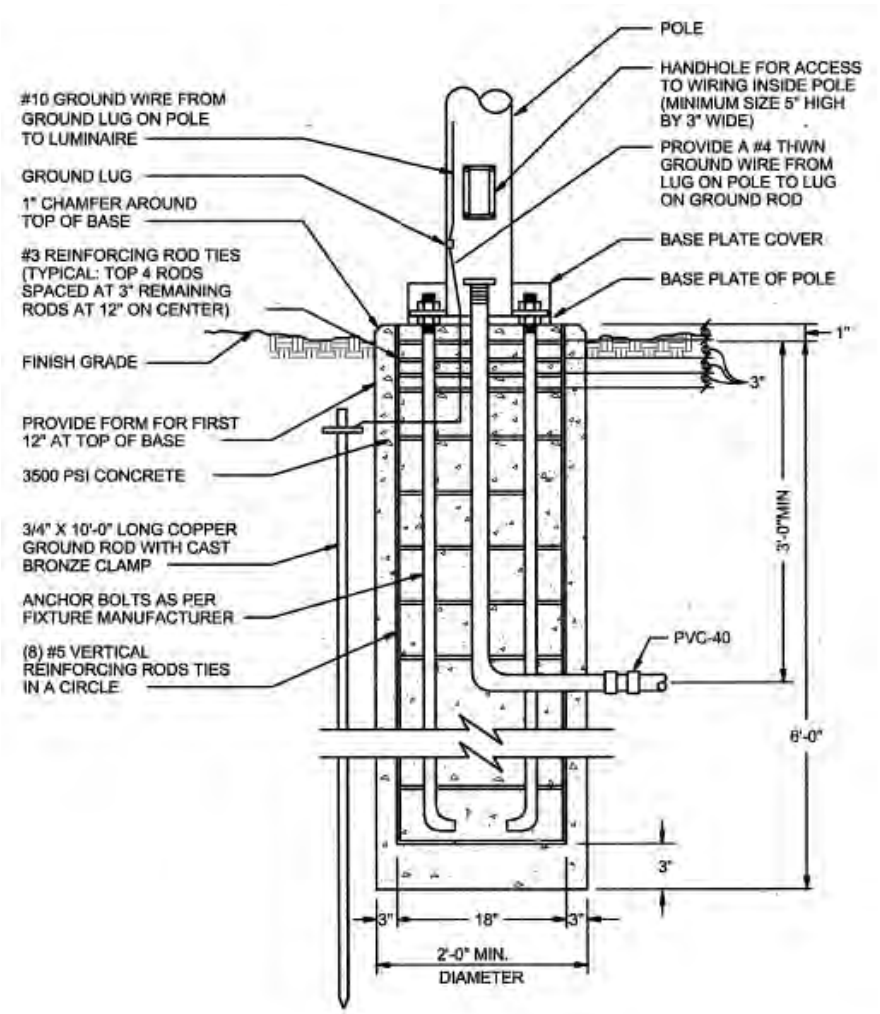
Figure 24: Concrete Pedestrian Pole Base Detail (Only use per UNC-CH EDS Engineering group approval)



3 **PEDESTRIAN POLE BASE DETAIL (L1)**
SCALE: NONE

*** Use bolt circle pattern provided by pole manufacture

Figure 25: Concrete Site Pole Base Detail (Only use per UNC-CH EDS Engineering group approval)

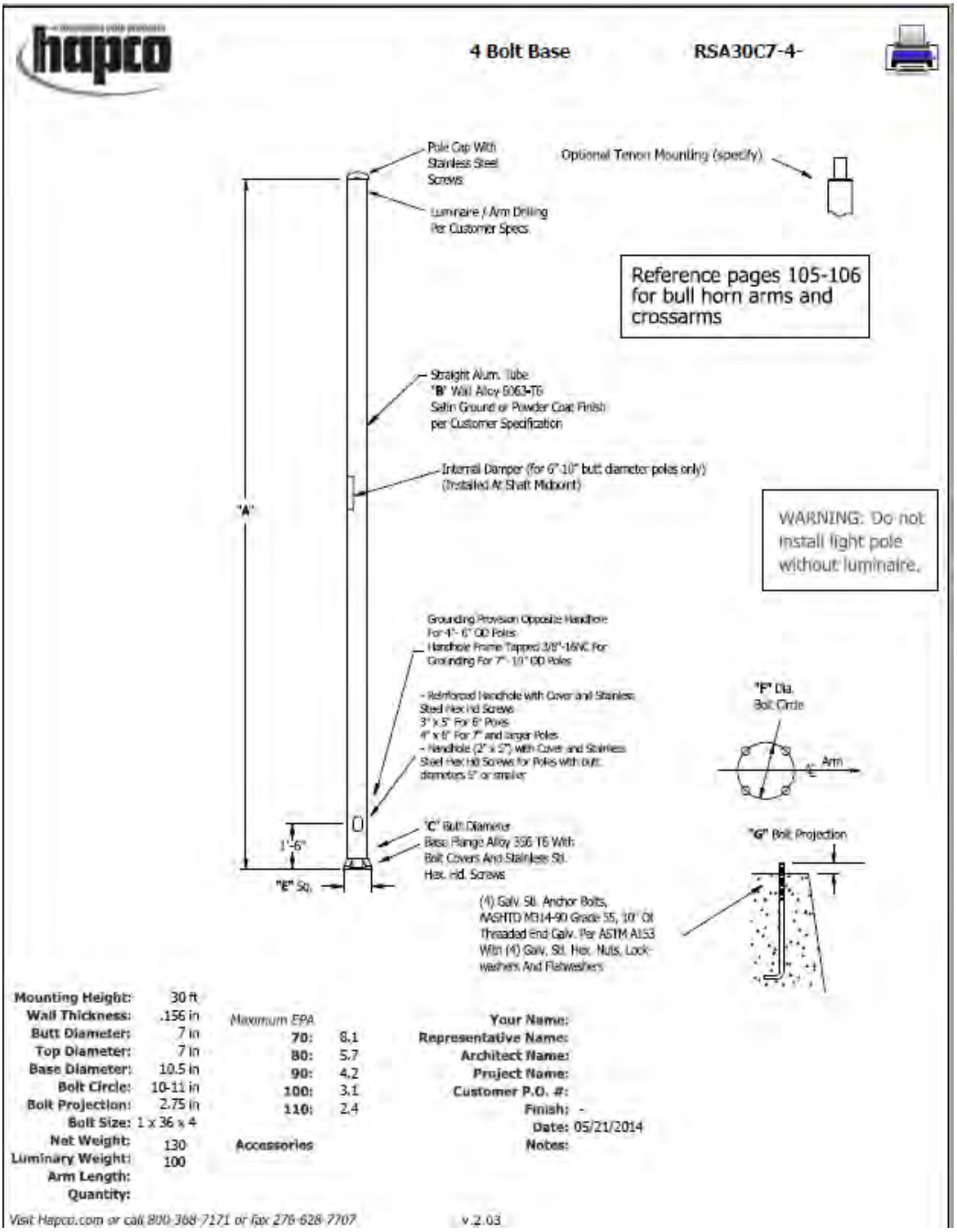


2 **SITE POLE BASE DETAIL (REL)**
SCALE: NONE

*** Use bolt circle pattern provided by pole manufacture

Note: All free-standing light poles are typically thirty (30) feet unless stated otherwise and approved by the UNC-CH EDS Engineer group. Refer to Figure 26 for preferred area light poles.

Figure 26: Area Aluminum Tube Light Poles



Appendix A (Solar Electric Generation Policy)

ENERGY SERVICES

SOLAR ELECTRIC GENERATION POLICY

Revision Initial issue

Approved: Director

Number SE-01

Effective Date: March 18, 2019

SCOPE

The electric distribution system of the University, including generation, is developed and controlled to provide the highest reliability and cost effectiveness to the advantage of all users. This is accomplished only through the appropriate ownership and management of all generation facilities on campus that are operated in parallel with the electric distribution system. This does not include emergency generation that is not part of the electric distribution system. This policy prescribes the responsibilities and authority to conduct the program for electric power generation by distributed generation equipment located on campus including those sustainable or renewable resources such as photovoltaic (PV) cells installed on the system, including those installed on buildings or any other structure.

DEFINITIONS

Photovoltaic	A large area electronic device that converts solar energy into electricity by the photovoltaic (PV) effect.
Array	A collection of PV cells that, when connected, provide the adequate voltage and current (electric power) output of the array to fully meet the electric generation design and interconnect functions to provide electric power as desired or designed.
EDS	University of North Carolina, Energy Services Department (specifically, Electric Distribution Systems)

POLICY

APPLICABILITY

This policy applies to all electric energy-producing installations of a permanent nature that will be connected to the electric distribution system on campus and that would be connected continuously.

SAFETY

PV cells, when used on the campus and if connected continuously to the electric distribution system, as applied in this policy, can generate and provide power to that system, with appropriate sunlight and energy input, at any time. They thus become a constant source of energy during sunlight hours. As such, they can and would provide electric energy to the electric distribution system regardless of the primary electric system condition. Safety for personnel working on the electric distribution system and for system integrity in general will have the highest priority in the management of the PV connections. Any connection from a PV source to the University electric distribution system shall be fully controlled in accordance with the connection policy below.

SYSTEM AND CONNECTION RESPONSIBILITY

The customer/building facility shall be responsible to submit the Duke Energy Interconnection Agreement, plus deposit (estimated: $20,000.00 (plus $1/kW)) to cover Duke Energy study expenses. Duke Energy assures most of these expenses will be refunded once the study is complete.

Note: All Generating Facilities connecting to lines greater than or equal to 35 kV are ineligible for the Duke Energy Fast Track Process, regardless of size. This pertains to all PVs connected to UNC electric distribution systems. The Duke Energy Interconnection Agreement must be approved by Duke Energy prior to construction.

The customer/building facility shall install PV System Meter CT Panel, meter base, 1 ¼" conduit, and lockable disconnect as defined in **Figure 1 and Figure 2**. The lockable disconnect shall be manual, load break, disconnect or safety switch with a clear, visible switch position indication between the University electric distribution system and the PV. This switch must have padlock provisions for locking in the "Open" position. The switch shall be readily accessible to EDS personnel. The switch must be in sight of the transformer serving the facility and on the PV array side of the point of electrical interconnection with the University electric distribution system. This switch must be labeled "Solar PV Disconnect Switch". The switch may isolate the PV array only and its associated load from the University electric distribution system. EDS, in its sole discretion, determines if the switch is suitable and necessary.

All PV systems installed on University property shall have a documented and stamped PV system design, using an industry standard method and provided by a NC licensed Professional Electrical Engineer.

All PV systems shall be designed and installed per all University, Town of Chapel Hill, Department of Labor and National standard/regulations (i.e. National Electrical Code, NFPA 70E, EDS Design & Construction Standards, NC OSHA 1910.269 (29 CFR 1910), etc…). The NC State Construction Office and EDS shall review/approve all PV system designs. These same entities shall inspect/approve construction prior to operational use.

EDS RESPONSIBILITIES

a. Review/Approve application of all PV technology proposed for use on University facilities.
b. Manage the overall PV system operation.
c. Review/Approve the design and construction of all such installations regardless of location when installed on University property that is served by and connected to the University electric distribution system.
d. Ensure that all necessary and appropriate disconnect devices / switches are installed, in accordance with EDS design and construction standards, to disable energy input to the electric distribution system at the nearest point of the PV connection in the event of any disturbance or disconnect on the electric distribution system. Please refer to Figure 1 for additional details.
e. Provide needed maintenance (preventive, corrective, predictive) with EDS specialists or contracted maintenance services.
f. Evaluate major equipment and/or system failures. Council with Energy Services customer to make decisions regarding PV System replacement.

ENVIRONMENTAL BENEFITS

The environmental benefits are any and all quantifiable credits and allowances resulting from the connection of the renewable energy source (PV system) to the University's electric distribution system. These may include Renewable Energy Certificates, Carbon Credits, offsets, Emissions allowances, "green tags", and any other asset or term that may be used to describe the environmental benefit associated with the generation and use of a renewable energy source. Generally, these environmental benefits will be used to meet the University's carbon reduction commitments. Energy Services shall be solely responsible to manage the environmental benefits associated with renewable energy sources for the University.

COST MANAGEMENT

All power generated from PV sources shall be metered at the output of the PV cell or array. This metering is to allow constant observation of power generated by the PV facility. When any PV cell or array is connected in parallel with or supplies power to the electric distribution system on-line with the system, all power produced by the PV cell or array will be considered to reduce the net power delivered by the electric distribution system. The building utilities account will be credited for electricity generated based on the average cost per kwh minus an operations/maintenance fee to cover EDS owners and maintenance expenses. This operations/maintenance fee will be evaluated annually within each upcoming Fiscal year.

The installation of all PV electric power generators shall be consistent with the University policy regarding the cost of such installations. The customer can decide based on LEED points, building project goals, and criteria other than economic. An economic analysis shall be made for all such proposed installation to ensure that the cost guidelines are followed.

REFERENCE

NC OSHA 1910.269 (29 CFR 1910)
Electric Distribution Systems Design & Construction Guideline & Standards (2009)
NC Interconnection Procedures, Forms, and Agreements (October 9, 2018): Docket No. E-100, Sub 101 and E-2 Sub 1159
National Electrical Code Article 690
Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources, UL 1741 Edition 2 (January 28, 2010)

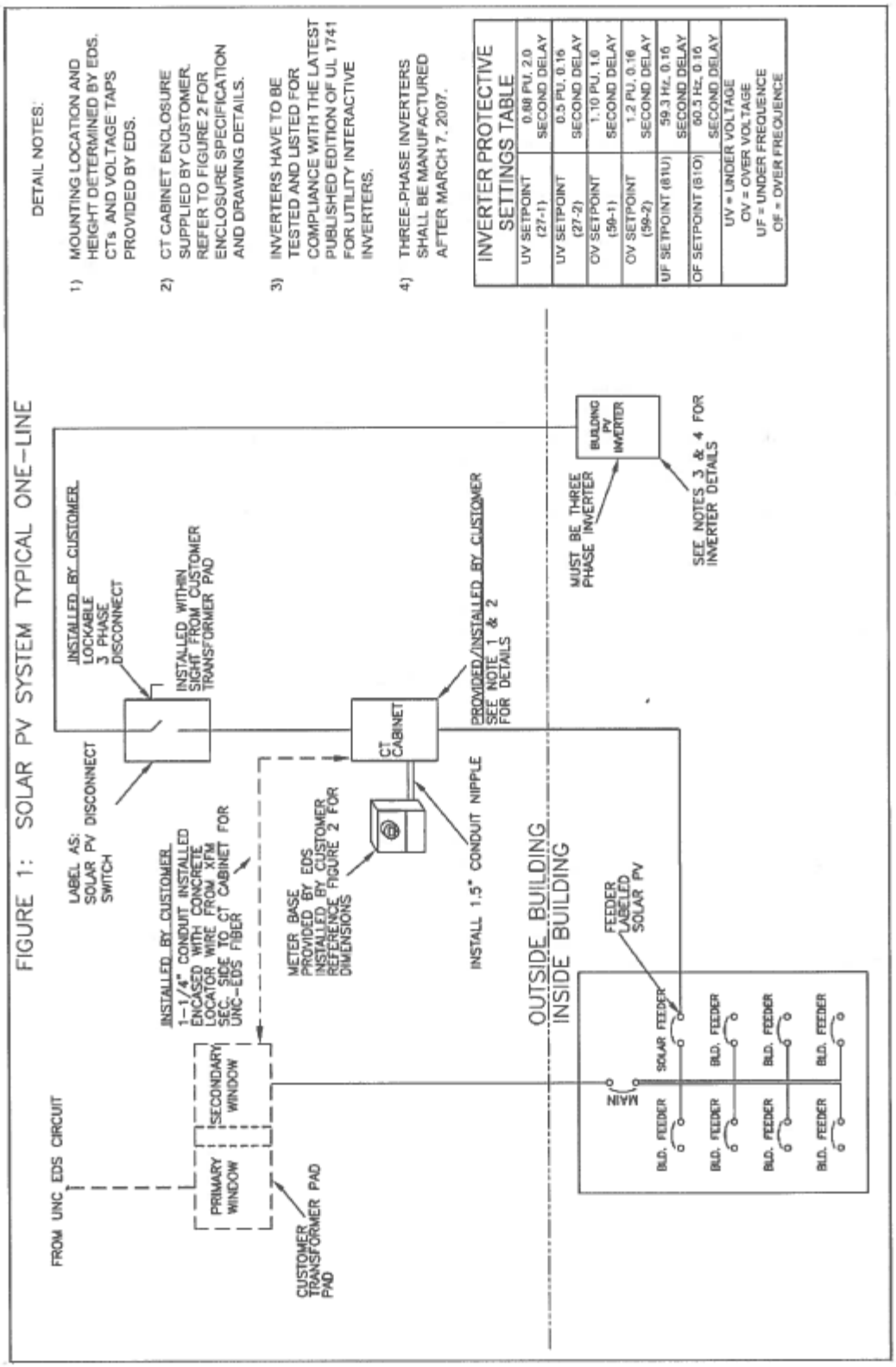


FIGURE 1: SOLAR PV SYSTEM TYPICAL ONE-LINE
DETAIL NOTES:
1) MOUNTING LOCATION AND HEIGHT DETERMINED BY EDS. CTs AND VOLTAGE TAPS PROVIDED BY EDS.
2) CT CABINET ENCLOSURE SUPPLIED BY CUSTOMER. REFER TO FIGURE 2 FOR ENCLOSURE SPECIFICATION AND DRAWING DETAILS.
3) INVERTERS HAVE TO BE TESTED AND LISTED FOR COMPLIANCE WITH THE LATEST PUBLISHED EDITION OF UL 1741 FOR UTILITY INTERACTIVE INVERTERS.
4) THREE-PHASE INVERTERS SHALL BE MANUFACTURED AFTER MARCH 7, 2007.
INVERTER PROTECTIVE SETTINGS TABLE
UV SETPOINT (27-1) 0.88 PU, 2.0 SECOND DELAY
UV SETPOINT (27-2) 0.5 PU, 0.16 SECOND DELAY
OV SETPOINT (59-1) 1.10 PU, 1.0 SECOND DELAY
OV SETPOINT (59-2) 1.2 PU, 0.16 SECOND DELAY
UF SETPOINT (81U) 59.3 Hz, 0.16 SECOND DELAY
OF SETPOINT (81O) 60.5 Hz, 0.16 SECOND DELAY
UV = UNDER VOLTAGE
OV = OVER VOLTAGE
UF = UNDER FREQUENCE
OF = OVER FREQUENCE
INSTALLED BY CUSTOMER
LOCKABLE 3 PHASE DISCONNECT
INSTALLED WITHIN SIGHT FROM CUSTOMER TRANSFORMER PAD
LABEL AS: SOLAR PV DISCONNECT SWITCH
INSTALLED BY CUSTOMER
1-1/4" CONDUIT INSTALLED ENCASED WITH CONCRETE LOCATOR WIRE FROM XFM SEC. SIDE TO CT CABINET FOR UNC-EDS FIBER
METER BASE PROVIDED BY EDS INSTALLED BY CUSTOMER REFERENCE FIGURE 2 FOR DIMENSIONS
CT CABINET
PROVIDED/INSTALLED BY CUSTOMER SEE NOTE 1 & 2 FOR DETAILS
INSTALL 1.5" CONDUIT NIPPLE
MUST BE THREE PHASE INVERTER
BUILDING PV INVERTER
SEE NOTES 3 & 4 FOR INVERTER DETAILS
OUTSIDE BUILDING
INSIDE BUILDING
FEEDER LABELED SOLAR PV
FROM UNC EDS CIRCUIT
PRIMARY WINDOW
SECONDARY WINDOW
CUSTOMER TRANSFORMER PAD
MAIN
SOLAR FEEDER
BLD. FEEDER

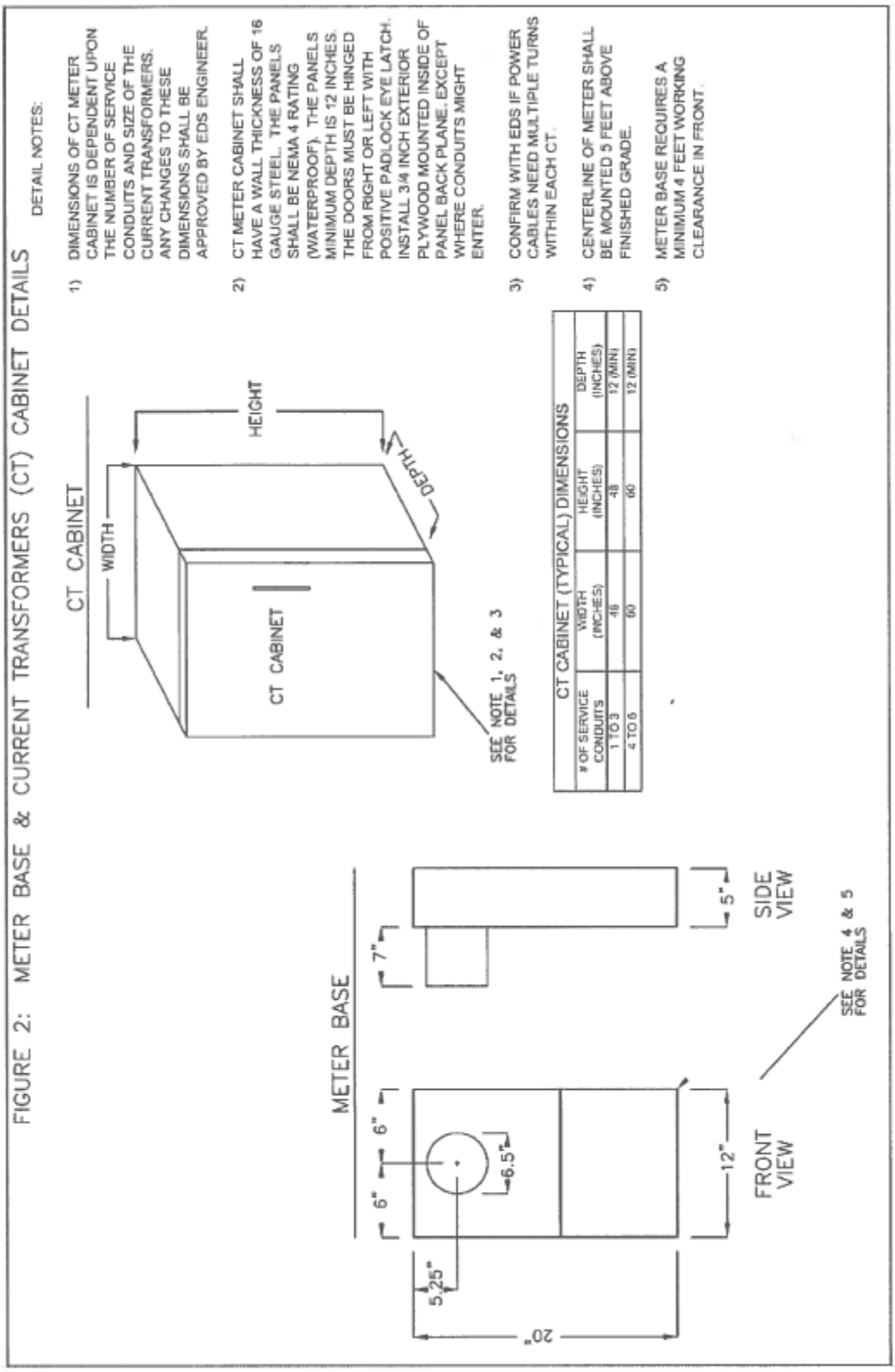


FIGURE 2: METER BASE & CURRENT TRANSFORMERS (CT) CABINET DETAILS
DETAIL NOTES:
1) DIMENSIONS OF CT METER CABINET IS DEPENDENT UPON THE NUMBER OF SERVICE CONDUITS AND SIZE OF THE CURRENT TRANSFORMERS. ANY CHANGES TO THESE DIMENSIONS SHALL BE APPROVED BY EDS ENGINEER.
2) CT METER CABINET SHALL HAVE A WALL THICKNESS OF 16 GAUGE STEEL. THE PANELS SHALL BE NEMA 4 RATING (WATERPROOF). THE PANELS MINIMUM DEPTH IS 12 INCHES. THE DOORS MUST BE HINGED FROM RIGHT OR LEFT WITH POSITIVE PADLOCK EYE LATCH. INSTALL 3/4 INCH EXTERIOR PLYWOOD MOUNTED INSIDE OF PANEL BACK PLANE, EXCEPT WHERE CONDUITS MIGHT ENTER.
3) CONFIRM WITH EDS IF POWER CABLES NEED MULTIPLE TURNS WITHIN EACH CT.
4) CENTERLINE OF METER SHALL BE MOUNTED 5 FEET ABOVE FINISHED GRADE.
5) METER BASE REQUIRES A MINIMUM 4 FEET WORKING CLEARANCE IN FRONT.
CT CABINET
WIDTH
HEIGHT
DEPTH
CT CABINET
SEE NOTE 1, 2, & 3 FOR DETAILS
CT CABINET (TYPICAL) DIMENSIONS
OF SERVICE CONDUITS
WIDTH (INCHES)
HEIGHT (INCHES)
DEPTH (INCHES)
1 TO 3
48
48
12 (MIN)
4 TO 6
60
60
12 (MIN)
METER BASE
6"
6"
6.5"
5.25"
20"
12"
7"
5"
FRONT VIEW
SIDE VIEW
SEE NOTE 4 & 5 FOR DETAILS

Appendix B (Old Standard Area Lighting)

EDS General Specification Number: ES 12-03

THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
ELECTRIC DISTRIBUTION SYSTEMS GROUP
ENERGY SERVICES DEPARTMENT

OLD STANDARD AREA LIGHT POLE

GENERAL SPECIFICATION NO. ES 12-03

APPROVED: John T. Laetz, Manager - Electric Distribution Systems DATE: Nov 2009

SCOPE

This specification covers the physical and structural requirements for specific light poles that will be used in designated areas on the campus of UNC-CH. It includes the standard features required and any optional features that may be specified and indicated on a purchase order.

DESCRIPTION

This pole and base shall be manufactured by or under the specifications of the Union Metal Company and shall be of the Euclid family or manufactured by or under the specifications of the Sternberg Company, Oxford Series, or manufactured by Main Street Lighting. The pole shall include those specific features listed below. This manufacturer and pole style is required to match other existing luminaries and light poles installed across the campus. A picture of the pole to match is attached on page 3. The pictures illustrate a Union Metal fixture and pole that meet this specification.

I. PHYSICAL ATTRIBUTES - POST

Post Structure Material - The post shall be cast or extruded aluminum conforming to the requirements of AA356.0F or AA319.0F aluminum.

Post Height – The post height shall be nominal twelve (12) feet, including the base assembly height, with the exact height from the tip of the luminaire finial to the base foundation of 14'-10-3/8".

Design – The post shall have 16 evenly spaced Doric-type flutes around the periphery of the post throughout the entire length. Metal thickness at the base of each flute shall be at least ½ the total thickness of the post material at the thickest point. The radius of the flutes crest shall not exceed the thickness of the metal in the post. The post shall be of one piece construction with a smooth surface suitable for painting. The post shall have a continuous taper of .14" per foot and shall be welded to the cast aluminum base by means of a continuous weld with an adequate heat temper to provide the necessary structural strength. A fabricated aluminum tenon that meets the requirements for a 6063 aluminum alloy shall be welded to the top of the shaft and sized to accept the luminaire head to be installed (3" long, 3-1/2" OD tenon on the shaft). All flutes shall be rolled simultaneously, with no flutes rolled individually. Flutes shall be an integral part of the pole and shall not be a sheath installed over a round pole.

Color – The color of the post, when finished, shall be UNC Dark Green RAL 6012, or equivalent. The post shall be coated to a finish coating (paint) thickness of 2 mils minimum.

II. ORNAMENTAL BASE ASSEMBLY

Base Material – The base, as a separate feature of the pole assembly, shall be by Union Metal, Sternberg or Main Street Lighting, to be compatible with the pole features and manufactured of cast aluminum conforming to the requirements of AA356.0F or AA319.0F aluminum. The base shall have 16 equally spaced flutes that conform to the shape of the flutes on the pole. It shall be one piece heavy wall construction with a removable access door suitable for hand access to connect wires internal in the base and secured with a bolt that requires an Allen wrench for installation or removal. The floor of the base shall be 1" thick and be an integral part of the base (also see **Mounting Provisions** below).

Height / Diameter– The base shall be 27 inches high from the foundation level to the post connection point. The base shall be 16.5" in diameter, round.

Electrical Connection – The base shall be furnished with a 1/2" – 13 UNC grounding provision internal in the base, including the stud, nut and washer, and be easily reached from the access door.

Mounting Provisions – The base shall have four (4) reinforced slots integrally cast into the bottom of the base to accept four (4) - 3/4" diameter anchor bolts on a 12" circle, one bolt per slot. The base shall also include 1-2" round holes on each opposite side of the base centerline, 3.5" on center from the centerline, to be used for conduit entry for conductors (2 holes total). The base shall not include mounting bolts as provisions other than cast-in-place concrete are made for providing the foundation.

Color – The color of the base assembly, when finished, shall be UNC Dark Green, RAL6012 or similar, to match the pole and luminaire. The post shall be coated to a finish coating (paint) thickness of 2 mils minimum. Paint is to be polyester powder or acrylic enamel, baked for the final finish at sufficient heat to provide a long-life surface.

EDS General Specification Number: ES 12-04

THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
ELECTRIC DISTRIBUTION SYSTEMS GROUP
ENERGY SERVICES DEPARTMENT

OLD STANDARD AREA LIGHTING FIXTURE HEAD

GENERAL SPECIFICATION NO. ES 12-04

APPROVED: John T. Laetz, Manager - Electric Distribution Systems DATE: Rev November 23, 2009

SCOPE

This specification covers the mechanical and physical requirements of specific lighting fixture / luminarie mounting heads that will be used in designated areas on the campus of UNC-CH. It includes the standard features required and any optional features that may be specified and indicated on a purchase order.

DESCRIPTION

The fixture head shall be manufactured by the Union Metal Company, Euclid family, or the Sternberg Company, Main Street family or the Main Street Lighting Company. This head shall include those specific features listed below. The style and type fixture specified herein is required to match other existing luminaries and lighting fixtures installed in designated areas across the campus. Pictures of the fixture and pole are included to assist in matching. The pictures illustrate a Union Metal fixture and pole that meet this specification.

I. PHYSICAL ATTRIBUTES

Body Design - The luminaire head shall consist of a framework that houses, in an octagonal pattern, lenses evenly spaced in accordance with the specifications used by Union Metal, Sternberg or Main Street. There shall be no upward spikes on the fixture. The luminaire shall be cast aluminum conforming to the requirements in AA319.0F and shall include a cast, hinged closed roof for easy access. The cageholder / luminaire head shall sit on a Capital / Fitter, secured by three (3) stainless steel set screws that are at least 1/4" in diameter. The cageholder shall have a base diameter (ID) of 3-1/2" to accept the tenon size of the Capital or Fitter.

Capital – The Capital shall be similar to a Union Metal No. 1B and shall fit a No. 1 Cageholder, or similar. The Capital shall be sized to fit a 3-1/2" tenon on the support pole and shall be included with the luminaire as a complete unit when assembled. The Capital shall be secured by three (3) stainless set screws that are at least 1/4" in diameter, with Allen heads. The dimensions and appearance shall be similar to this for any Fitter to be used.

Size – The overall height of the luminaire head, measured from the point where the head mounts to the pole to the top of the finial, will be 34-1/2" +/- ½". The finial will be 7-1/2" +/- ½" high. The overall outside width of the fixture shall be 17" +/- ½", measured between the widest projections of the cage members on opposite sides (straight parts of the sides, not the corners).

Decorative Finial – The finial, approximately 7-1/2" tall, shall be cast aluminum conforming to AA319.0F and it shall be securely attached to the top of the luminaire body.

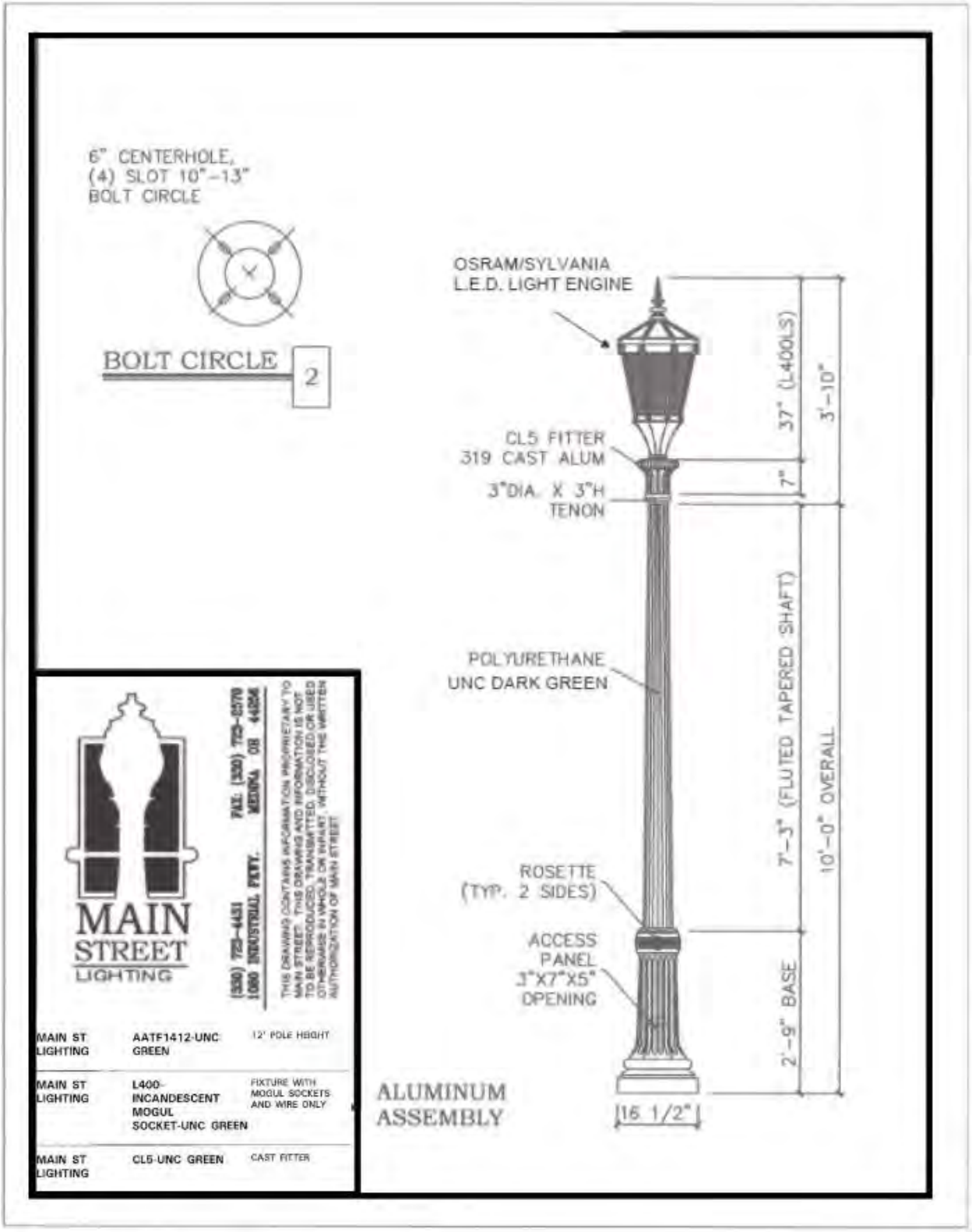
Color / Coating – The color of the luminaire, when finished and including the finial, shall be UNC Dark Green, RAL 6012 or equivalent. All parts (interior, exterior) of the assembly shall be coated to a finish coat thickness of 2 mils minimum. The coating will be a gloss type, polyester or acrylic enamel, applied over a prime coat and baked sufficiently to provide for a long life.

Internal Assembly Access – The top of the assembly shall be hinged to provide access, with the top held securely in place by a thumb screw.

Appearance – This specification includes color pictures of existing poles and fixtures to allow reasonable understanding of the fixture style, color, appearance, design and fitting complement, included to demonstrate the existing fixtures to match.

II. OPTICAL SYSTEM

A. The optical system shall consist of an octagonal shapes luminaire assembly with either:


6" CENTERHOLE,
(4) SLOT 10"–13"
BOLT CIRCLE
BOLT CIRCLE 2
OSRAM/SYLVANIA
L.E.D. LIGHT ENGINE
CL5 FITTER
319 CAST ALUM
3"DIA. X 3"H
TENON
POLYURETHANE
UNC DARK GREEN
ROSETTE
(TYP. 2 SIDES)
ACCESS
PANEL
3"X7"X5"
OPENING
ALUMINUM
ASSEMBLY
16 1/2"
37" (L400LS)
3'-10"
7"
7'-3" (FLUTED TAPERED SHAFT)
10'-0" OVERALL
2'-9" BASE
MAIN
STREET
LIGHTING
(330) 725-4431
(330) 725-0570
1060 INDUSTRIAL PKWY.
KENT, OH 44256
THIS DRAWING CONTAINS INFORMATION PROPRIETARY TO MAIN STREET. THIS DRAWING AND INFORMATION IS NOT TO BE REPRODUCED, TRANSMITTED, DISCLOSED OR USED OTHERWISE IN WHOLE OR IN PART, WITHOUT THE WRITTEN AUTHORIZATION OF MAIN STREET
MAIN ST LIGHTING | AATF1412-UNC GREEN | 12' POLE HEIGHT
MAIN ST LIGHTING | L400-INCANDESCENT MOGUL SOCKET-UNC GREEN | FIXTURE WITH MOGUL SOCKETS AND WIRE ONLY
MAIN ST LIGHTING | CL5-UNC GREEN | CAST FITTER

- a single prismatic refractive acrylic lens panel that will securely fit into the inside of the assembly, with an extruded edge at the top and bottom to allow placement of the lens panel so as to seal the unit against entry of insects, water and dirt.
- Individual refractive lens panels arranged around the luminaire structure, each of which fits securely into the inside of the assembly and adequately sealed to prohibit entry by insects, water or dirt.

The top and bottom will be self-sealing, using a rubber gasket, with insertion of the lens panel into the assembly. The lens panel shall be made from a polycarbonate material similar to LEXAN ® or CELEBRE ®, with sufficient resistance to cracking or shattering if impacted by objects (e.g., bricks or stones of approximate 4 lbs weight each) thrown at the lamp. The lens panel shall be resistant to the effects of UV radiation for at least a life of 20 years. Alternatively, the lenses may be single for each panel and be retained by fasteners installed on the inside of the luminaire assembly at the top, bottom and on each side. Other attributes of the panel apply to the alternate. Light distribution, other than from or through the refractor lenses, shall be limited to a plane not higher than 90 degrees from the vertical centerline of the fixture.

B. There shall be no canopy reflector mounted in the head. shall be mounted at the top of the luminaire assembly to create an optical cut-off feature.

II. ELECTRICAL REQUIREMENTS

None. These will be used for lighting but with different lighting mechanisms inside.