261000 Medium Voltage Electrical Distribution

Sections Included In This Standard:

This section contains the requirements for equipment and installation (including manholes, switch vaults and pull boxes) relating to the ~~Sub-transmission,~~ Distribution, and Control of electric power ranging from 600-Volts to 25,000-Volts, such as substations, switchgear, circuit breakers, and transformers. Only contractors that can demonstrate current qualifications, acceptable materials, and equipment will be allowed to perform construction on these systems. On the job supervisor shall be qualified on work being performed. The project's electrical engineer of record will make this determination.

1.1 GENERAL

A. The medium voltage power system at the University of Florida is composed of ~~two distinct systems: the Sub-transmission system at 22.9 kV (25kV Nominal) and the Distribution system at lower voltages (15 & 5kV Nominal)~~ three different distribution voltage classes: 22.9kV (25kV Nominal), 12.47kV (15kV Nominal), and 4.16kV (5kV nominal) per IEEE 141.1983\ANSI C84.1-1989. Verify voltages based upon location on campus.~~The Sub-transmission 25kV system is used to maintain service to large loads and to electrical substations, which step down Sub-transmission voltages to Distribution voltages. Substations are located around campus and form the nodes of the Distribution system, which supplies power to campus facilities.~~

~~B.~~ For reliability, single unit redundancy shall be provided ~~on both the Sub-transmission and the Distribution System~~ across all voltage classes.

C. System design shall ensure that the failure of any single component of the Sub-transmission or Distribution system shall not prevent the system from carrying the full sectional Campus load. Projects adding load to the system shall include, upgrades or expansion of the system to maintain this redundancy.

D. New facilities ~~are normally to~~ should be powered ~~only form the Distribution system, but large projects may be powered from the Sub-transmission system with the approval of Facilities Services PPD (such as with the addition of very large, new loads, e.g., over 1,500 kVA)~~ from either the 25kV or 15kV voltage classes, unless otherwise approved in writing by FS. All new facilities shall be provided with the appropriate redundancy noted above. Over-current protection and switchgear shall be provided to maintain noted redundancy.

E. Underground ~~Transmission and~~ Distribution ~~are~~ is the preferred method~~s~~ of new electrical infrastructure construction on campus. It is preferred to **not** have ancillary support equipment, such as switchgear, placed underground. Above ground equipment, such as MV switchgear, shall be concealed from view. ~~Additions to existing overhead line~~

~~construction will be allowable in order to extend service or to upgrade existing system's reliability.~~

F. Additions to existing overhead line construction will be allowable in order to extend service or to upgrade existing system's reliability. All poles to be concrete unless approved by Facilities Services, with vertical construction. All cut outs shall be installed outside of the phases.

G. APPLICABLE STANDARDS:

Unless otherwise specified by FS, all products and designs shall conform to the following standards:

1. Cables:
    a) ICEA S-93-639/NEMA WC74/UL-1072/CSA C68.10/AEIC CS8 (Medium Voltage Cabling)
    b) ICEA S-95-658/NEMA WC70 (Low Voltage Cabling used for Ground Wire)
2. Switchgear:
    a) IEEE C37.74 (Requirements for Padmounted Load-Interrupter Switchgear)
    b) ASTM D877 (Test Method for Dielectric Breakdown Voltage of Insulating Liquids)
3. Transformers:
    a) ANSI C57.12 (General Requirements for Liquid-Immersed Distribution Transformers)
    b) NEMA TR 1 (Audible Sound Levels for Oil-Immersed Power Transformers)
    c) ASTM D877 (Test Method for Dielectric Breakdown Voltage of Insulating Liquids)
4. Underground Structures (Duct Bank, Manholes, Switch Vaults):
    a) ACI 318 (Building Code Requirements for Structural Concrete and Commentary)
    b) ANSI/NECA/NEMA 605 (Installing Underground Nonmetallic Utility Duct)
    c) ASTM C857 (Minimum Structural Design Loading for Underground Precast Concrete Utility Structures)
    d) ASTM C891 (Installation of Underground Precast Concrete Utility Structures
    e) ASTM A615 (Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement)
    f) ASTM A123 (Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products)

1.2 UNDERGROUND CABLE

A. GENERAL:

1. All New Medium Voltage (MV) Cables shall be three phase copper, single conductor, type MV-105, copper tape shielded power cable for installations in underground duct bank, unless otherwise approved in writing by FS. New MV cables shall be designed with 133% Ethylene Propylene Rubber (EPR) insulation and PVC jacket ~~conforming to AEIC CS 8, ANSI/ICEA S-97-682, ICEA S-93-639, NEMA WC 74, ANSI/NFPA 70,~~

~~and ANSI/UL 1072 Type MV-105~~. New MV cables shall be sized to the load they feed with 4/0 as the lowest allowed size unless otherwise approved in writing by FS.

2. Jacket shall be imprinted with size of conductor, manufacturer's name, type of insulation material, and date of manufacture.

3. All new MV Cable installations shall include a ground wire sized per ampacity, but no smaller than #2 wire. The ground wire shall be 600V rated with either THWN-2 or XHHW-2 insulation, unless otherwise approved in writing by FS.

4. Any cable not in conduit shall be fireproofed, individually by phase, with a tape for the purpose, equivalent to Scotch Brand #7700. Fire proofing tape shall be overlapped with a half turn and shall be installed into the conduit 1 inch or more.

5. All cables shall be designed and installed in compliance with the applicable standards listed under the "General" section.

B. MATCHING:

1. Existing Primary cables on Campus include PILC, EPRLC and EPR. New cables ~~may be matched to existing when repairs or splicing occurs~~ shall be compatible with existing cable for the purposes of splicing. ~~New cabling shall be designed with Ethylene Propylene Rubber (EPR) insulation and PVC jacket conforming to AEIC CS-8, ANSI/ICEA S-97-682, ICEA S-93-639, NEMA WC 74, ANSI/NFPA 70, and ANSI/UL 1072 Type MV-105.~~

~~2. Jacket shall be imprinted with size of conductor, manufacturer's name, type of insulation material, and date of manufacture.~~

~~3. All Medium Voltage cabling on the 5, 15, and 25kV systems shall have 133% insulation and circuiting shall be comprised of three phases of single conductor, copper tape shielded power cables plus a 600V insulated ground wire sized per circuit ampacity; unless otherwise approved in writing by FS. The ground wire shall not be sized smaller than a #2 wire.~~

~~4. Any cable not in conduit shall be fireproofed, individually by phase, with a tape for the purpose, equivalent to Scotch Brand #7700. Fire proofing tape shall be overlapped with a half turn and shall be installed into the conduit 1 inch or more.~~

C. EXECUTION:

1. ~~"High pot" all new~~ HIPOT or VLF Tan Delta cable testing shall be performed on new cable and splice installations without high potting entire system. Provide copy of test to Facilities Services at the time of Substantial Completion.

2. Splicing shall only be performed by certified cable splicers. "Y" splices ~~are not allowed on the 12kv or 23kv systems~~ shall be modular style unless otherwise approved in writing by FS. Splices shall conform to IEEE 404 (electrical ratings) and ANSI/IEEE 386 (water immersion tests).

3. Cables shall be identified at their point of termination and where they enter and exit a manhole, switch vault, etc. with a tag. Minimum size shall be 1" x 2" with ¾" letters, identifying the circuit number and source (source information provided by Facilities Services). Tags shall be attached with non-metallic, fungus-resistant, heat stabilized,

self-extinguishing cable ties made of nylon. See Figure 3 for an example.

4. Voltage phasing and 1st operation shall be maintained and guaranteed by the Contractor (or Electrical Subcontractor) on all feeders spliced or terminated prior to energizing electrical service to the building. Phasing and 1st operation shall be witnessed by Facilities Services ~~Opera~~tions Engineering inspectors or the Utilities group. Contact Facilities Services via the published i~~nspe~~ction process system.

5. All splices shall be individually grounded to the manhole grounding system.

1.3 MEDIUM VOLTAGE SWITCHES

A. GENERAL:

1. New switches shall have the following attributes:
    a) Switches shall be above-ground pad-mounted switchgear style, unless otherwise approved in writing by Facilities Services. See Figure 1 for details on the transition from duct bank to under Switch pad conduit and for concrete pad requirements. If accepted, new Medium Voltage switchgear intended for use underground shall have waterproof, stainless steel tanks. Control boxes shall not be mounted underground unless potted.
    b) Acceptable Switch manufacturers include S&C, G&W or FS approved equal.
    c) Switches shall be manually operated and load interrupting, with a “make before break” operation and visible blade source interruption.
    d) Switches shall be insulated using either SF6 gas or solid dielectric insulation.
    e) Switches shall incorporate vacuum bottle fault interruption on ways intended to feed transformers.
    f) Switching shall have the “anti-tease” feature. Ratings are to be pre-set, prior to energization, for all calculated operating load conditions.
    g) The vaults shall have operable, hinged doors (covers), an open bottom for drainage and adequate room for primary cabling to circle the vault prior to termination. The bottom of vault shall include a minimum of 8-inches of ¾ inch gravel to promote drainage.
    h) Switches shall comply with the applicable standards listed under the “General” section.
    i) All new Medium Voltage switchgear shall come System Control And Data Acquisition (SCADA) ready, unless otherwise approved in writing by FS, with the following features:
    - Auxiliary Switches: Indication of Fault Interrupter position and Load Interrupter position. Dry contacts to be terminated in a low-voltage enclosure with terminal blocks.
    - Remote Low Pressure Alarm: Provisions only (plugged pressure gage dog) for a future low pressure warning device.
    - Motor Operator Package: Provisions only to allow retrofit of motor operator to achieve remote control without replacement of the switch or the switch enclosure.
    - External Trip: Provisions to allow an external signal to open a fault interrupter.

2. If oil is used to refill an existing oil switch, it shall be tested per ASTM D877 testing procedures to 30k V prior to energizing.
3. New underground installations, which require interface with an existing oil switch, shall be responsible for replacement of the oil switch with a new SF6 or solid dielectric switch

B. EXECUTION:

1. If installing an SF6 switch the internal tank pressure shall be verified and approved in writing by FS prior to energization, with approval based on manufacturer requirements.
2. If installing an SF6 switch, provide one tank of extra SF6 gas at the time of Substantial Completion for future maintenance.

~~C. EXISTING SWITCHGEAR:~~

~~1. If oil is used to refill an existing oil switch, it shall be tested per ASTM D877 testing procedures to 30k V prior to energizing.~~

~~D. NEW SWITCHGEAR: New underground installations, which require interface with an existing oil switch, shall be responsible for replacement of the oil switch with a new SF6 or solid dielectric switch.SF6 Switches shall incorporate vacuum bottle fault interruption, visible blade source switching and gasinsulation to minimize the profile (size) of the gear. SF6 Switches shall also have the following attributes:~~

~~1. Switching shall have "make before break" operation.~~

~~2. Switching shall have the "anti-tease" feature.~~
~~ratings are to be pre-set, prior to energization, for all calculated operating load conditions.~~

~~3. Switches shall be above-ground pad-mounted switchgear style, unless otherwise approved in writing by FS. If accepted all new Medium Voltage switchgear intended for use underground shall havewaterproof, stainless steel tanks. Control boxes shall not be mounted underground.~~

~~4. The vaults shall have operable, hinged doors (covers), an open bottom for drainage and adequate room for primary cabling to circle the vault prior to termination. The bottom of vault shall include a minimum of 8 inches of ¾ inch gravel to promote drainage.~~

~~5. All new Medium Voltage switchgear shall come System Control And Data Acquisition (SCADA) ready, unless otherwise approved in writing by FS, with the following features:~~

~~a) Auxiliary Switches: Indication of Fault Interrupter position and Load Interrupter position. Dry contacts to be terminated in a low-voltage enclosure with terminal blocks.~~

~~b) Remote Low Pressure Alarm: Provisions only (plugged pressure gage dog) for a future low pressure warning device.~~

~~c) Motor Operator Package: Provisions only to allow retrofit of motor operator to achieve remote control without replacement of the switch or the switch enclosure.~~

~~d) External Trip: Provisions to allow an external signal to open a fault interrupter.~~

~~E. MAINTENANCE SUPPLY: Provide one tank of extra SF6 gas at the time of Substantial Completion.~~

~~F. ACCEPTABLE MANUFACTURERS: G&W or S&C or approved equal.~~

1.4 TRANSFORMERS

A. GENERAL:

~~1. Transformers shall have all-copper windings.~~

1. ~~Transformers shall be Radially fed only, with an upstream SF-6 switch to de-energize the design shall only be utilized for simplifying the wiring congestion within the High Voltage compartment. All unused connections shall be plugged "safe".~~
2. New Transformers shall have the following attributes:
    a) Transformers shall be pad-mounted, liquid-filled style. Pole mounted transformers are no longer allowed per Facilities Services' effort to eliminate overhead lines on campus.
    b) Acceptable Manufactures: ABB, Cutler Hammer, GE, Square D, Cooper or approved equal from an Original Equipment Manufacturer.
    c) The preferred design is to use a loop fed transformer (See Figure 2 for bushing configuration detail) with the surge lighting arrester inserted into the second set of loop bushings. When the transformer is internally wired as a Radial feed transformer, the surge arrester may be plugged into the back of the separable connector, or into special feed through inserts.
    d) Surge arresters shall be of the Metal Oxide Varistor Elbow (M.O.V.E) style. NOTE: All transformers shall configure with external, visible, separable connector type lighting/surge arresters. The lighting/surge arrester Basic Impulse Level (BIL) ratings shall be selected based upon actual design operating voltage and electrical system configuration (Wye/Delta).
    e) Primary side bushings shall be of the Load Break Elbow (separable connector) design. Secondary side bushings shall be configured with NEMA two hole spade type bushings for three phase transformers. Primary and secondary sides shall be separated by a protective grounded metal barrier.
    f) Transformer pad shall be level, with transformer sitting flat on pad. If All conduits shall enter & exit transformer from beneath the pad. On-site pad pours shall be subject to FS approval.
    g) All conduits shall enter & exit transformer from beneath the pad.
    h) Insulating liquid shall have a minimum dielectric rating of 30 kV, per ANSI test.
    i) Specify the following features: internally wired Loop feed transformers types may have source on/off switching only for energizing surge arrester, oil sampler; spare fuses (one set minimum); lifting hooks; externally operated tap changer with two taps at 2.5% above and two taps at 2.5 % below nominal voltage.
    j) On/Off switching on the primary side may be included as a feature to ease the operation of the local transformer.
    k) All three-phase oil filled transformers above 150kVA shall have a pressure/vacuum gauge, thermometer with re-settable maximum reading indicator, Schraeder valve, oil drain gate valve and a pressure relief device installed. Configure secondary conduit placement in a manner consistent with the Manufacturer's shop drawing information on the drain oil sampling valve location, and configure wiring to assure the sampling operation
    l) Drain valve to be installed on outside of the transformer within a lockable compartment.

3. Electric panels shall not be mounted inside transformer enclosures.

4. All new MV Transformers shall be installed outside of the building. Dry-type transformers shall not to be used on the exterior of buildings, unless approved by Facilities Services. Liquid Filled transformers are preferred.

5. All transformers are to be new. Rebuilt transformers are allowed under emergency conditions only when performing maintenance.

6. ~~Acceptable Manufactures: ABB, Cutler Hammer, GE, Square D, Cooper or approved equal from an Original Equipment Manufacturer.~~

7. ~~All conduits shall enter & exit transformer from beneath the pad.~~

B. ~~TESTING:~~ EXECUTION:

1. All transformers 300kVA and above shall be tested for winding resistance, Transformer Turns Ratio (TTR) and oil dielectric ~~per the latest ANSI C57 and ASTM D877industry standards~~ to the applicable standards listed under the "General" section. The test results shall be given to Facilities Services Utilities department prior to energization.
2. Transformers shall be turned over to Facilities Services Utilities department with a positive pressure of a 2-psi of Nitrogen Gas Blanket above the transformer oil. Facilities Services Utilities department may require retesting of and various transformer loadings.

~~C. Oil-type Liquid Filled, PAD MOUNT:~~

1. ~~Specify the following features: replaceable MOV Elbow surge arresters, internally wired Loop feed transformers types may have source on/off switching only for energizing surge arrester, oil sampler; spare fuses (one set minimum); lifting hooks; externally operated tap changer with two taps at 2.5% above and two taps at 2.5 % below nominal voltage.~~

2. ~~New transformers shall be of the Load Break Elbow (separable connector) design. Allow side bushings shall be configured with NEMA two-hole spade-type bushings for three-phase transformers. On/Off switching on the primary side may be included as a feature to ease the operation of the local transformer.~~

3. ~~All three-phase oil-filled transformers above 150kVA shall have a pressure/vacuum gauge, thermometer with re-settable maximum reading indicator, Schraeder valve, oil drain gate valve and a pressure relief device installed. Configure secondary conduit placement in a manner consistent with the Manufacturer's shop drawing information on the drain oil sampling valve location, and configure wiring to assure the sampling operation can occur without having to disconnect secondary cabling. Drain valve to be installed on the outside of the transformer within a lockable compartment.~~

4. ~~Oil Liquid shall have a minimum dielectric rating of 30 kV, per ANSI test.~~

5. ~~High voltage compartment shall be separated from low voltage compartment by a protective grounded metal barrier.~~

6. ~~Transformer shall be located to be visually unobtrusive. Provide a reinforced, cast in place (or pre-cast) transformer pad (minimum 6-inches in height) to protect the cabling and bottom of the transformer.~~

7. ~~See Figure 1 (at end of document) for details on the transition from duct bank to under transformer conduit and concrete pad requirements.~~

8. ~~Transformers shall be turned over to Facilities Services PPD Systems with a positive pressure of a 2-psi of Nitrogen Gas Blanket above the transformer oil. Facilities Services PPD Systems may require retesting of and various transformer loadings.~~

~~D. OIL TYPE LIQUID FILLED, POLE MOUNT: Specify two-bushing type. High side shall have "eyelet' connectors; low side shall have "eyelet" connectors. Transformers shall not be larger than 75kva. 50 kva & 75kva shall be provided with tap changers per industry standards.~~

1.5 MANHOLES

~~E. See Section 337000 for Electrical Manhole construction requirements including load rating, minimum size, waterproofing, sump and hatches.~~

A. GENERAL

1. All manholes and underground utility structures shall either be constructed with precast concrete units or reinforced cast-in-place concrete in compliance with the applicable standards listed under the "General" section..

2. All manhole openings shall be installed to minimize surface water intrusion through the lid.

   (a) In grassed areas, the opening shall be 3" above surrounding grade with a continuous gradual slope down from the opening; maximum slope is 1" per foot.

   (b) In paved areas, the opening shall be 1" above the surrounding grade with a continuous gradual slope down from the opening; maximum slope is 1/3" per foot.

B. STRUCTURAL REQUIREMENTS

~~1. Manholes and underground utility structures shall be designed by an engineer registered in the State of Florida based on ASTM C857 Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures with A-16 (AASHTO HS20) wheel loads. An additional load case consisting of A-12 (AASHTO HS15) wheel loads with 1/3 of the ASTM C857 impact and with Live Load Spacing of 32 inches rather than 4 feet shown in ASTM C857 Figure 1 shall also be considered.~~

~~2. As an alternate, precast, and reinforced cast in place, concrete manholes and underground utility structures with top slabs not longer than 48 inches maximum inside dimension conforming to the 2008 Florida Department of Transportation Design Standards Index No. 200 and Index No. 201 may be utilized without design by an engineer registered in the state of Florida.~~

3. Construction: Manholes shall be constructed according to the general layout shown in Figure 4 with sloped floors draining to the center sump pit.

4. Minimum Size: Electrical manholes shall be a minimum size of 10'x10' with a standard height of 96-inches minimum ceiling height. For shallow installations and only when avoiding conflicting conditions or utilities, a 78-inches minimum ceiling height is acceptable. Switch vault sizes shall be coordinated with the actual switchgear intended for proper clearance for cabling and operation of the switchgear. The minimum size for pull boxes shall be 6'x6'x6' deep. Larger size may be required for installed conductors.

5. Waterproofing:

   ~~(a) Specify exterior bituminous coating on electrical manholes to prevent infiltration.~~
   (b) Follow Standard 070000, 1.2 Below grade waterproofing for electrical manholes
   (c) Joints between precast units shall be made using "Ram-Nek" sealant.

6. Sump: Electrical manholes shall have a 12"x12"x12" sump with grate located directly beneath inner concentric cover (pumping ring) or below one of the double doors.

7. ~~Hatches~~ Lids: ~~Provide square or rectangular, checker plate, hinged, spring assisted for ease of opening hatches with frames of aluminum or steel galvanized in accordance with ASTM A123.~~ ~~Hatches~~ Lids shall be welded or brass marked "ELECTRIC," with permanent marking of manhole ~~or switch vault identification with~~ ID number. ~~Hatches for switch vaults shall be sized to accommodate replacement of the switch and the function of the structure. Hatches shall be designed by an engineer registered in the State of Florida utilizing the design loads from ASTM C857 Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures with A-16 (HS20) wheel loads. An additional load case consisting of A-12 (HS-15) wheel loads with 1/3 of the ASTM C857 impact and Live Load Spacing of 1 foot rather than 4 feet shown in ASTM C857 Figure 1 shall also be considered.~~ Manhole lids shall be of concentric style with dimensions shown in Figure 4. ~~Manhole lids shall conform to ASTM C857 if located within a road or area expecting vehicle traffic.~~

8. Electrical Manhole Throats: Throats for new or modified manholes shall be no more than ~~18" tall when the manhole is located under hardscape and no more than 24" tall when the manhole is located under landscaping~~ 30" tall.

9. Conduit Penetrations: Penetration through manhole walls shall not be done through cutouts. Conduits shall not penetrate through the floor of the manhole.

10. Buoyancy Collars: Buoyancy collars are not preferred, as the underground electrical system is interconnected via conduit rebar to counteract buoyant forces on manholes, but will be allowed pending approval by FS.

F. Locate pulling eyes opposite raceways.

G. All manholes shall have a minimum of two driven ground rods, ¾ inch by 10 foot in length, placed catty corner in the manhole, with a maximum resistance reading of 25 Ohms. Ground rod shall be cad-welded or crimped using an IEEE 837 compliant compression connector to connect to grounding conductor. Ground rod shall be connected to a fully closed loop of grounding conductor, which is usedto bond all splices and non-current carrying electrical equipment in manhole. Connections shall be made to racks with listed connectors suitable for the purpose. Loop of conductor shall be between 12 inches and 24 inches above floor and shall be securely attached to wall of manhole.

H. Cables in manholes shall be placed on porcelain insulators on suitable racks. Cables shall be secured by cable ties which are fungus resistant, ultra-violet, heat stabilized and made of self-extinguishing nylon material.

Each cable shall be fireproofed, individually by phase, with a tape listed for the purpose, equivalent to Scotch Brand #7700. Fire proofing tape shall be overlapped with a half turn and shall be installed into the conduit 1inch or more.

The length of any cable in manhole shall be not less than half the circumference of the interior of the manhole. This dimension shall be determined for a contiguous, unspliced length of cable, from the point where the cable enters the manhole to the point where it exits the manhole.

If the newly installed cable is to be connected to an existing cable within the manhole, the newly installed cable shall have a length of not less than one half circumference of the manhole from the point where the cable enters or exits the manhole, to the point of connection to the existing cable. The existing cable shall not be required to be one half manhole circumference if that amount of length does not exist. However, the existing cable shall not be shortened without written permission from the Systems Department Assistant Director.

Maximum distance between primary wiring manholes shall be 450 feet. Distance between

secondary wiring manholes shall not exceed 450 feet, and shall not exceed distances, which would cause tensions to exceed (any of) the wiring manufacturer's recommended maximum pulling requirements.

I. All cable racks, mounting equipment, etc. shall be hot dipped galvanized, stainless steel, or industrial grade fiberglass/plastic. Porcelain insulators shall be utilized for cable supports when attaching cables to the racks. Provide tie wraps to attach cables to insulators, and then to racks.

1.6 SWITCH VAULTS

A. GENERAL

1. Use of underground vaults for switchgear is **strongly not preferred by FS**. The following standards for below-ground switch vaults only apply to designs that have been approved in writing by FS where below-ground vaults are absolutely necessary.
2. All Switch Vaults shall either be constructed with precast concrete units or reinforced cast-in-place concrete in compliance with the applicable standards listed under the "General" section.
3. Minimum Size: Switch vault shall be sized to the switch to placed inside with proper clearance for cable terminations and switchgear operation. Vaults shall have an open bottom for drainage and adequate room for primary cabling to circle the vault prior to termination. The bottom of vault shall include a minimum of 8-inches of ¾ inch gravel to promote drainage. ~~with a minimum of 10'x10' with a standard height of 96-inches minimum ceiling height. For shallow installations and only when avoiding conflicting conditions or utilities, a 78-inches minimum ceiling height is acceptable. Switch vault sizes shall be coordinated with the actual switchgear intended for proper clearance for cabling and operation of the switchgear. The minimum size for pull boxes shall be 6'x6'x6' deep. Larger size may be required for installed conductors.~~
4. Waterproofing: ~~Specify exterior bituminous coating on electrical manholes switch vaults to prevent infiltration.~~ Follow Standard 070000, 1.2 Below grade waterproofing for Switch Vaults
5. ~~Sump: Electrical manholes shall have a 12"x12"x12" sump with grate located directly beneath inner concentric cover (pumping ring) or below one of the double doors.~~
6. Hatches: Provide square or rectangular, checker plate, hinged, spring assisted for ease of opening hatches with frames of aluminum or steel galvanized in accordance with ASTM A123. All hatches shall be secured with stainless steel penta-head bolts. Hatches shall be welded, or brass marked "ELECTRIC," with permanent marking of ~~manhole or~~ switch vault identification with ID number. Hatches for switch vaults shall be sized to accommodate replacement of the switch and the function of the structure. In addition to the square or rectangular hatch, switch vaults shall also posses a single manhole for individual ease of access. ~~Each switch vault Hatches shall be designed by an engineer registered in the State of Florida utilizing the design loads from ASTM C857 Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures with A-16 (HS20) wheel loads. An additional load case consisting of A-12 (HS-15) wheel loads with 1/3 of the ASTM C857 impact and Live Load Spacing of 1 foot rather than 4 feet shown in ASTM C857 Figure 1 shall also be considered.~~
7. ~~Electrical Manhole~~ Switch Vault Throats: Throats for new or modified ~~manholes~~ switch vaults shall be no more than ~~18" tall when the manhole is located under hardscape and no more than 24" tall when the manhole is located under landscaping~~ 30" tall.

1.7 MEDIUM VOLTAGE PULL BOXES

A. GENERAL

1. Pull boxes shall not be installed on campus in place of manholes and shall be only installed where

necessary. Verify design with Facilities Services.

1.8 UNDERGROUND ELECTRICAL DUCT BANK

A. GENERAL

1. All Duct Bank shall be designed and installed in compliance with the applicable standards listed under the “General” section.
2. Underground primary wiring raceways shall have 30” minimum cover. Underground secondary wiring raceways shall have minimum cover as required by the NEC. All underground duct banks shall be designed, configured and installed to eliminate standing water, directing drainage to manholes, pull boxes, switch vaults, etc.
3. Conduits shall be sized according to the conductor running through them, with a minimum size of 4”.
4. Provide a minimum of one spare conduit, equal to or larger than the largest specified size.
5. Raceways shall be galvanized rigid conduit or PVC. Raceways shall be encased in steel-reinforced concrete.
    a) See Figure 1 for the detail on transition from duct bank to pad mounted equipment.

B. EXECUTION

1. All electrical duct banks shall contain reinforcing steel run parallel with the conduits. The number, size, and locations of rebar incorporated into the duct bank shall be sufficient to allow a minimum ten foot span of undermined duct bank to be self-supporting. The minimum individual rebar size shall be 3/8 inch in diameter. Wires to hold the rebar in place shall be incorporated into the duct bank at appropriate spacing and be of sufficient size to hold the rebar. Rebar shall be bonded to the system ground in each manhole. The use of Directional Drilling and Jack & Boring will be considered on a case-by-case basis in lieu of underground duct banks.
2. Chairs for steel-reinforced concrete raceways shall not be spaced over 6' apart.
3. All concrete duct bank shall be accomplished in one continuous pour and the process observed by FS. FS needs to be on-site to witness the pouring. Multiple pours for exceptionally long runs must be coordinated with FS for approval before pouring. The use of an approved cold joint solution is required.
4. In the manhole, rebar shall be installed in a hole that has been drilled from the inside. The rebar shall be set in place using epoxy and the end shall be flush with the side wall of the manhole. The ends shall be overlapped 2’ for the purpose of tying off.
5. Conduit shall be cut in a manner as to stagger the PVC pipe joints. When running multiple lengths of conduit, the stacking of joints is not allowed. The difference in joint placement shall be 6 to 8” in length.
6. FS prefers the use of red dyed concrete to identify electrical duct banks. We are aware that this process can be cost-prohibitive, and are open to different methods/means to achieve the goal of this requirement: that duct banks are easily identifiable. Please verify solution in writing with Facilities Services before installation.

1.9 DISTRIBUTION SWITCHGEAR/SWITCBOARDS

A. GENERAL: Switchgear and switchboards shall be equipped with a Main Breaker, unless protected by an upstream circuit breaker. In that case, provide a non-automatic disconnect switch and/or MLO panel.

B. All main switchboards and switchgear shall be of the circuit breaker design, unless written permission for fusing has been granted by Facilities Services. If fusing, provide 10% spare fusing with a minimum of three spare sets (one set incorporates provisions for all the phases) of each size. Spare fusing shall be provided in weatherproof containers for long-term storage (such as in ammo cans). Spray paint container with the wording ‘Spare Fuses’ on the side.

C. ACCEPTABLE MANUFACTURERS: General Electric; Square D; Cutler – Hammer; Siemens.

1.10 APPENDIX

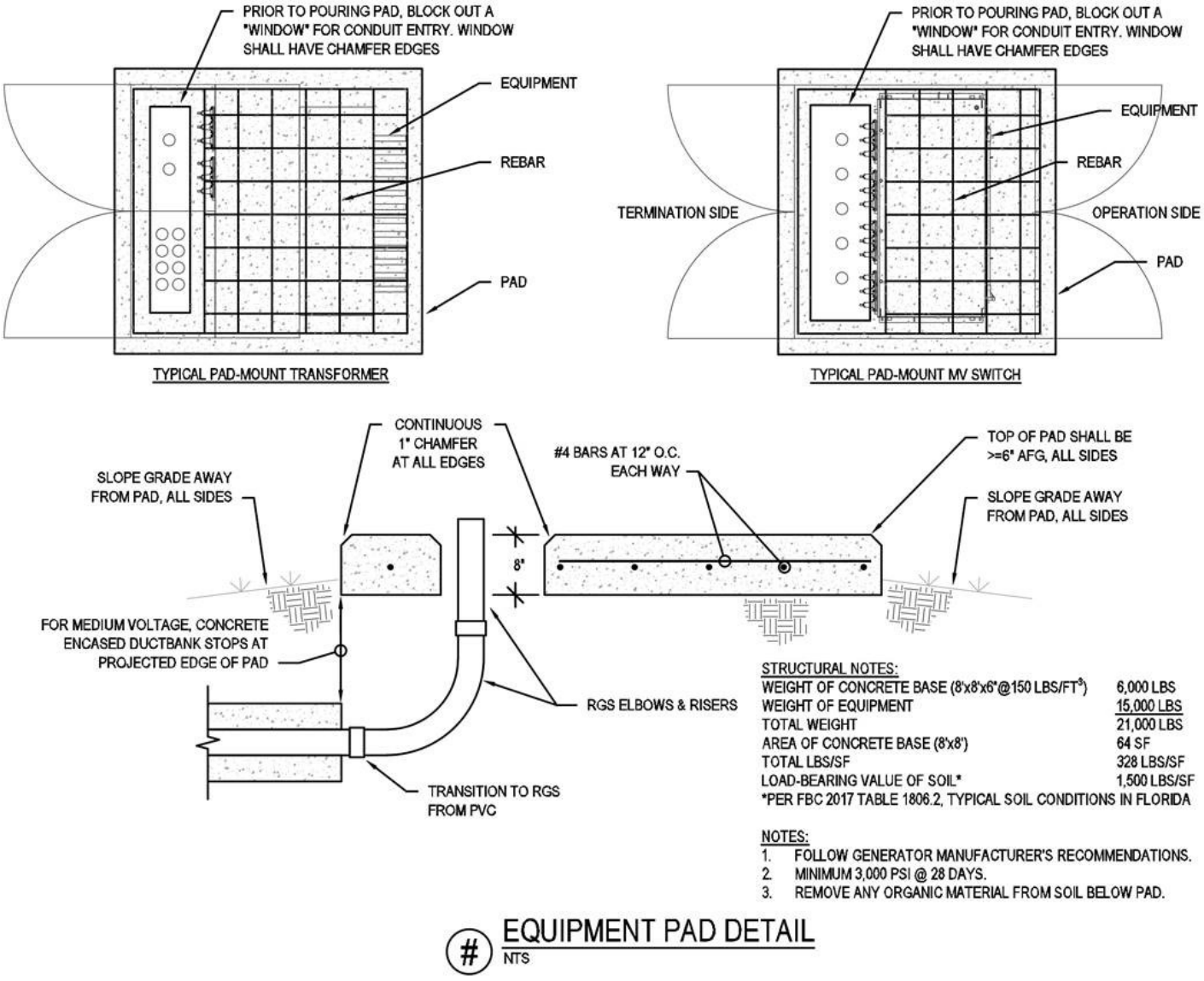
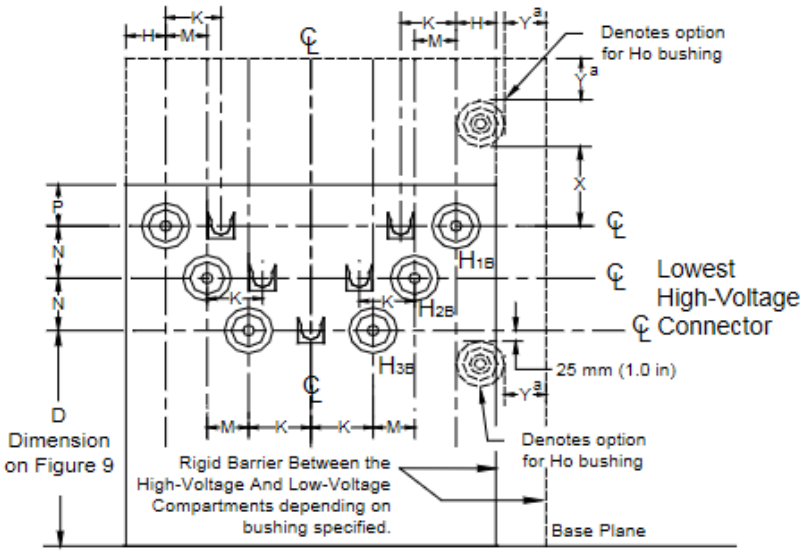
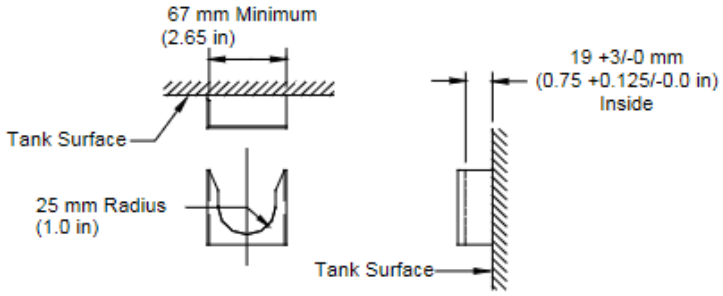


Figure 1. Pad mounted equipment detail



[a] If effectively grounded, this dimension will be 76 mm (3.0 in).



Cable Accessory Parking Stand

Separable insulated connectors with high-voltage ratings as follows:															
kVA ratings	8.3 kV and 8.3 kV/14.4 kV					15.2 kV and 15.2kV/26.3 kV					21.1 kV and 21.1 kV/36.6 kV[a]				
	H	N	M	K	P	H	N	M	K	P	H	N	M	K	P
45–10 000 without bails	76 (3.0)	102 (4.0)	76 (3.0)	102 (4.0)	114 (4.5)	76 (3.0)	102 (4.0)	89 (3.5)	114 (4.5)	114 (4.5)	102 (4.0)	102 (4.0)	95 (3.75)	152 (6.0)	191 (7.5)
45–10 000 with bails	76 (3.0)	102 (4.0)	76 (3.0)	102 (4.0)	279 (11.0)	76 (3.0)	102 (4.0)	89 (3.5)	114 (4.5)	356 (14.0)	102 (4.0)	102 (4.0)	95 (3.75)	152 (6.0)	432 (17.0)
X is the minimum phase to phase clearance as specified in Table 4. Y is the minimum phase to phase clearance as specified in Table 4.															
NOTE 1—All dimensions are in millimeters (inches) and are minimums. NOTE 2—Kilovolt-ampere ratings which are separated by a dash indicate that all ratings covered in this range as shown in 4.1 are included. NOTE 3—The above minimum dimensions do not provide for all types of parking-stand-mounted devices.															

Figure 2. High voltage loop feed bushing detail, per IEEE C57.12.34-2015

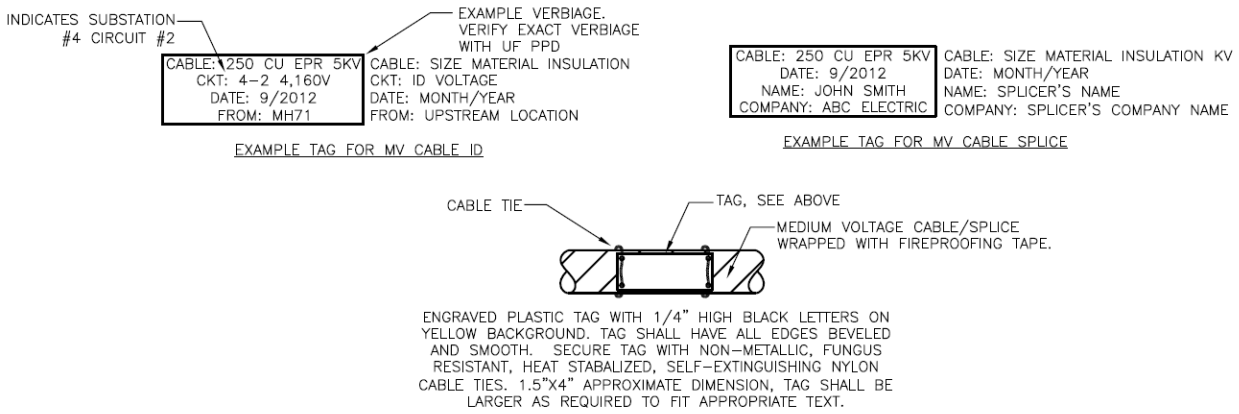


Figure 3. Medium Voltage Cable Tag detail

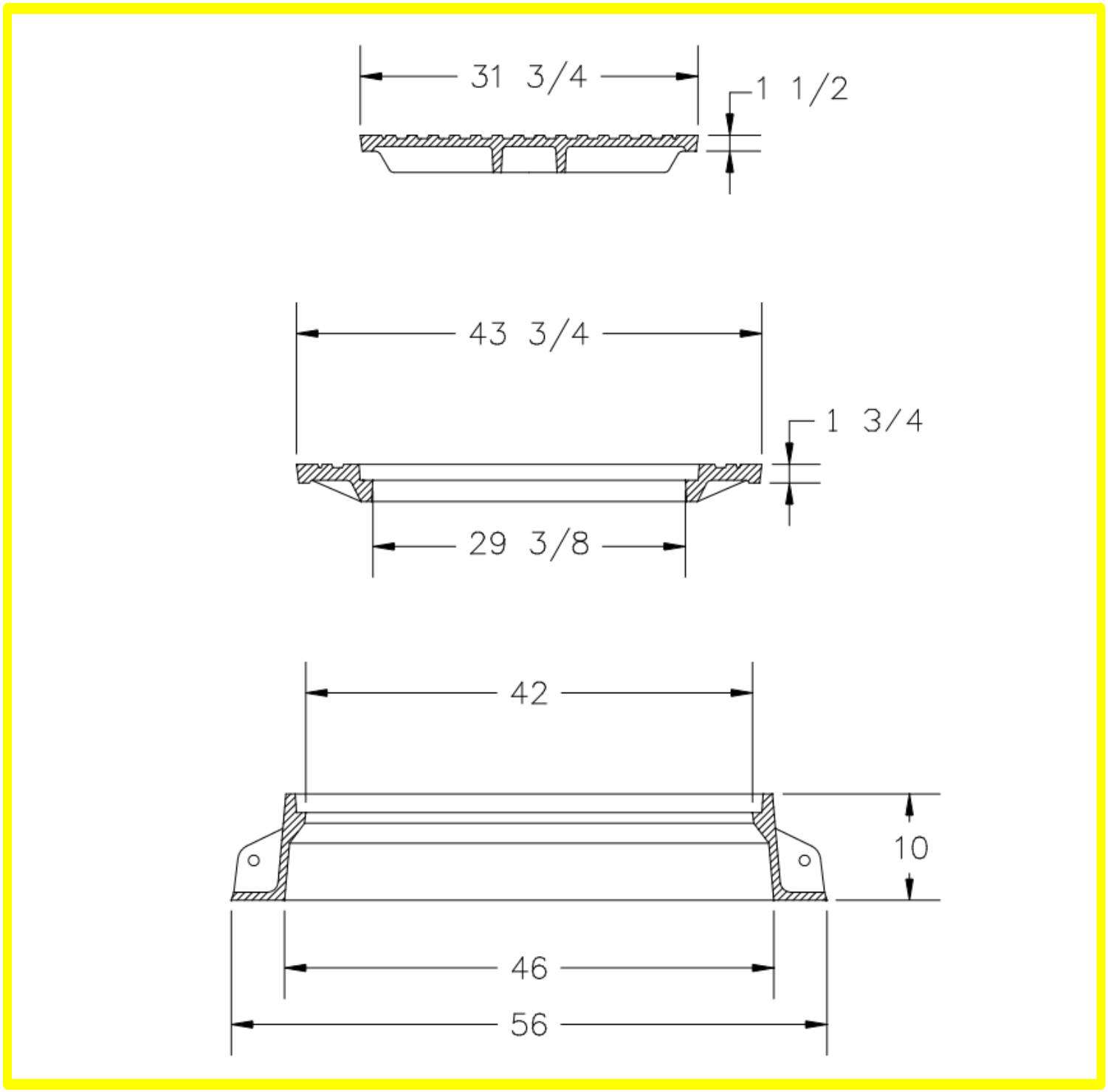


Figure 4. Manhole Lid detail

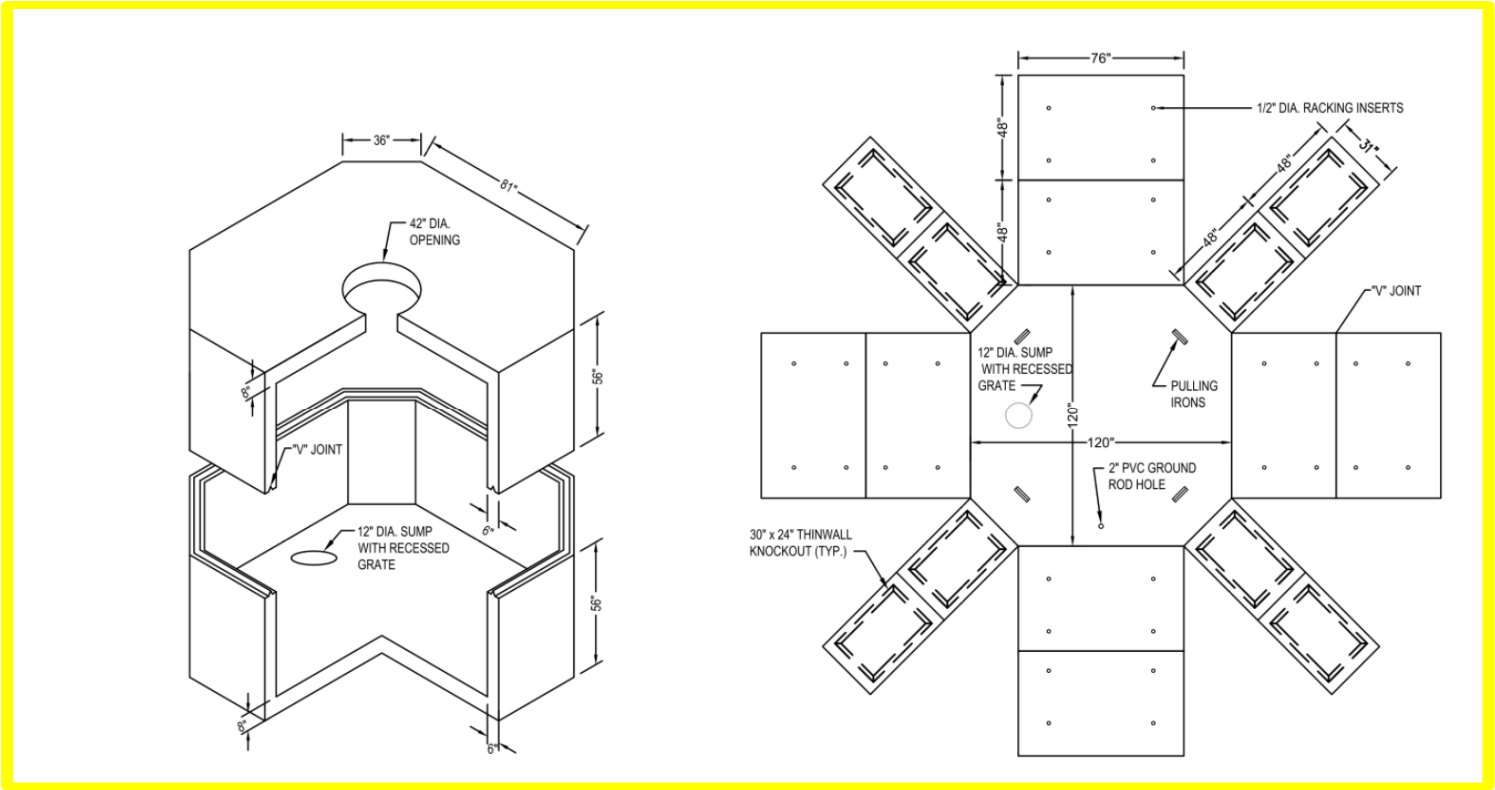


Figure 5. Manhole detail

END OF SECTION