



***SPECIFICATIONS FOR CUSTOMER and AMEREN CONTRACTOR  
INSTALLED UNDERGROUND DISTRIBUTION FACILITIES (NON-RESIDENTIAL)  
Revised 10/01/2020***

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# ***SPECIFICATION FOR CUSTOMER-INSTALLED UNDERGROUND DISTRIBUTION FACILITIES (NON-RESIDENTIAL)***

This Specification covers the general requirements for the installation of conduit, pads, vaults, manholes and cable by a Customer/Contractor within the bounds of a development (including all trenching and backfilling), for purposes of providing Distribution Facilities to the Point(s) of Delivery designated by the Company. This Specification covers direct buried, directionally bored, concrete encased and steel encased conduit installations. *This Specification is not intended to apply in either residential subdivision or streetlight applications.*

## **1 Definitions**

- 1.1 Company or the Company** – Ameren Illinois or Ameren Missouri.
- 1.2 Company Representative** – Person(s) designated by the Company to coordinate various facets of the project between the Company and the Customer/Contractor.
- 1.2 Drawings** – Construction drawings provided by the Company which indicate the size, location, route and lengths of the Distribution Facilities to be installed, and which clearly define the Customer/Contractor’s accepted portion of the work.
- 1.3 Specification** – This document and any additional Drawings supplied for a specific development.
- 1.4 Conduit System** – That portion of the Distribution Facilities that includes the duct and/or duct bank, equipment pads and all subterranean structures, such as vaults, pulling boxes and manholes.

## **2 Scope of Work**

This specification provides the general requirements for the installation of conduit and cable systems and shall be considered a companion document to the project construction drawings. The project drawings provide the detailed limits of the project scope of work.

### **2.1 Customer/Contractor Responsibilities**

- 2.1.1 Fees and Permits.** The Customer/Contractor shall obtain all necessary excavation permits and shall adhere to all permit restrictions
- 2.1.2 Facility Locates.** The Customer/Contractor shall provide all labor and materials not provided by the Company.

In Illinois, the Customer/Contractor shall follow the Illinois Underground Facility Damage Prevention Law, including calling for underground utility locates through the Illinois One-Call system, prior to beginning any excavation construction. The Customer/Contractor

shall be responsible to contact all utilities and private underground facility owners that do not participate in Illinois One-Call.

In Missouri, the Customer/Contractor shall follow the Missouri Underground Facility Safety and Damage Prevention Law, including calling for underground utility locates through the Missouri One-Call system, prior to beginning any excavation construction. The Customer/Contractor shall be responsible to contact all utilities and private underground facility owners that do not participate in Missouri One-Call.

The Customer/Contractor shall take reasonable measures to identify any unmarked utilities such as opening and visually inspecting nearby manholes and pull boxes, water valve boxes and fire hydrants, and sewer inlets and access or cleanout manhole lids.

**2.1.3 Workmanship.** All Customer/Contractor material and workmanship failing to meet the requirements of the project drawings, specification, or the Company's Distribution Construction Standards, shall be repaired or replaced, at the discretion of the Company, at the Customer/Contractor's expense, and to the Company's satisfaction.

**2.1.4 Excavation.** Customer/Contractor shall exercise extreme caution while excavating around existing underground facilities in order to avoid damage and to minimize hazards. Alternate excavation methods, such as soft digging shall be considered in order to avoid disturbing fragile underground facilities

The Customer/Contractor is responsible for all costs to repair damage to any existing utilities.

**2.1.5 Conduit Installation.** All Customer/Contractor installed facilities shall be installed in accordance with the project drawings, this specification, and either copies of the applicable SPEC drawing or the Company's actual Distribution Construction Standard. Any proposed changes to the aforementioned shall require prior written approval from the Company. The Customer/Contractor is responsible to have all necessary Ameren Distribution Construction Standards prior to starting work. The Customer/Contractor shall contact the Company Representative to obtain necessary Company Distribution Construction Standards. The customer and/or customer's contractor shall follow this specification and the construction drawings to ensure facilities are installed properly. Ameren's contractor shall have the appropriate Ameren Distribution Construction Standards prior to starting work. The construction standards will cover standards not included in this specification such as primary cable splicing

**2.1.6 Notice to Inspect.** Conduit systems shall be subject to inspections by the Company Representative on a daily basis prior to backfilling, encasement in concrete, or otherwise covering or concealing. The Customer/Contractor shall coordinate with the Company representative to provide the Company an opportunity to inspect all construction work prior to any backfill, concrete encasement, or otherwise covered work that has been completed. At the Company's discretion, the Company representative may elect to allow the Customer/Contractor to backfill, encase, or cover construction without a prior inspection. However, any backfilled, encased, or otherwise concealed prior to inspection, shall be subject to being excavated, at the Customer/Contractor's expense, to facilitate inspection by the Company

- 2.1.7 Traffic Control.** The Customer/Contractor shall provide all traffic control which shall be in accordance with the Manual on Uniform Traffic Control Devices (MUTCD). The Customer/Contractor shall be fully responsible for development of their own project traffic control plan, whether or not any part of the project drawing traffic control plans are provided as part of the construction drawings. As part of the traffic control plan, the Customer/Contractor shall take special precautions to control pedestrian traffic away from the work zone. Reasonable measures shall be taken to keep all ADA ramps within proximity to the work zone open and accessible. This may include the construction of temporary ADA ramps in proximity to where existing ADA ramps are inaccessible
- 2.1.8 Steel Plates.** When steel plates are used, the Customer/Contractor shall be responsible to ensure that the steel plating is securely anchored to the street to prevent any movement. The steel plate shall be anchored such that crossing vehicles are not damaged. Cold patch shall be used to provide a ramped transition between the street grade and the steel plate. The cold patch ramp shall be installed in all directions of vehicle travel. Additionally, the steel plate shall be conform to the HS20 standard.
- 2.1.9 Materials.** The Customer/Contractor shall provide the following materials submittals to the Customer/Contractor Representative for Ameren review and approval, prior to the start of construction:
- All mix designs for the duct bank encasement, flowable fill, grout and street base concrete
  - Admixtures used in concrete mix designs

For material items that the Company provides, the Customer/Contractor shall make arrangements with the Company Representative in advance to have the materials for the particular project released for the Customer/Contractor to pick up. In the St. Louis Metro area, the Customer/Contractor shall pick up all released materials from the Company's general warehouse at 12121 Dorsett Road in Maryland Heights. Outside the St. Louis Metro area, the Customer/Contractor shall pick up these materials from the closest Regional warehouse. (The Customer shall refer to Section 100 of the *Ameren Electric Service Manual* for the locations and phone numbers of the Engineering and Estimating offices in these Regional areas.) In either case, at the time of pick up, the Customer/Contractor shall provide the Company's Work Request number, which identifies the project for which the material has been released.

- 2.1.9.1 Customer Installed conduit systems.** The Company shall make available various fiberglass and precast concrete pads for equipment such as transformers, switchgear and cable junction enclosures in order to maintain uniformity and quality control of these items (ref. SPEC 18, 18A, 18B, 18C, 18D, 19, 20 and 21). Provided that arrangements are made in advance with the Company Representative, the Customer may pick up items such as these for a specific project (ref. Section 2.1.6).

The customer shall provide all other material for customer installed conduit systems. All material must meet Ameren specifications.

**2.1.9.2 Ameren Contractor installations.** For work performed for Ameren by Ameren's contractor, the Company shall provide all required manholes, conduit, couplings, switchgear pads, bond wire, medium and low voltage cables, cable fire wrap, cable lubricants, pulling "mule" tape, cable racks, grounding materials (rods, couplers, bond wire, connector hardware), cable accessories (splices, terminations, crabs), and innerducts for fiber optic cable.

The Contractor shall provide all other materials not provided by Ameren, to include, but not be limited to the following project materials:

- All concrete materials (to include flowable fill and grout)
- Rock
- Steel encasement pipes (as required)
- Plastic Duct Spacers – Underground Devices, Inc. # 5W20-2 (not to be substituted)
- FoamGlas insulation (as required)
- Other consumables

**2.1.10 As Built Drawings.** The Customer/Contractor shall maintain an "as built" set of drawings showing all changes, additions and deletions to the project. Field changes not covered by the original drawings shall be clearly noted on the "as built" Drawings. Final "as-built" drawings shall include the following neatly marked up in red with changes and copious notes:

- All changes to duct bank configuration, orientation, and route
- Changes to the number of conduits in any duct section
- All changes to the location of manholes, bond wire, or other equipment.
- All changes to the conduit that is used for installed cable
- Offset distance to curb – dimensions for any changes from design drawing dims to curb
- Changes to duct bank profile details, including the duct bank profile depths
- All final face-to-face duct bank distances between manholes, in feet
- Any use of steel plating that is not specified on the construction drawings
- Any changes to the use of installation, any changes from the drawings in cable conduit assignments, cable types and conductor sizes, or designations
- Any changes from the drawings in equipment locations, configurations, orientation, other

The Customer/Contractor shall turn in "as-built" drawings to the Company Representative as soon as the work on the construction drawings is complete.

## **2.2 Company Responsibilities**

**2.2.1 Company Representative.** The Company shall designate a primary contact person. All communication between the Customer/Contractor and the Company shall be through the Company designated representative

**2.2.2 Job Drawings.** The Company shall furnish Drawings indicating the installation of the Conduit System according to the Company's layout and design. The Company shall provide detailed information for all the work on the Drawings, including the precise locations of manholes and vaults, padmount equipment, the conduit route, location, arrangement and number of ducts, in addition to information as to whether or not the conduit installation requires concrete encasement. In any case where an interpretation or clarification of the

intent of the project drawings, this specification or the Company's Distribution Construction Standards is required, the determination of the Company Representative shall prevail. If construction conditions are materially different from that shown on the construction drawings, the Customer/Contractor shall stop construction at that location and contact the Company Representative for further direction. Note that all field changes must be approved by an Ameren Representative

- 2.2.3 Conduit System Inspection.** Conduit systems shall be subject to inspections by the Company Representative on a daily basis prior to backfilling, encasement in concrete, or otherwise covering or concealing. The Customer/Contractor shall coordinate with the Company representative to provide the Company an opportunity to inspect all construction work prior to any backfill, concrete encasement, or otherwise covered work that has been completed. At the Company's discretion, the Company representative may elect to allow the Customer/Contractor to backfill, encase, or cover construction without a prior inspection. However, any backfilled, encased, or otherwise concealed prior to inspection, shall be subject to being excavated, at the Customer/Contractor's expense, to facilitate inspection by the Company

### **3 General Requirements**

**Adherence to Drawings.** The ducts shall be installed along the route specified on the Drawings. . Turns and bends that are introduced for purposes of avoiding physical obstructions shall be made within the limits specified either on the Drawings or by approval of the Company Representative.

### **4 Conduit Bends and Sweeps**

- 4.1 Bend Specification.** All conduit turns shall be made using factory made bends. Conduit bends (1-1¼", 2-2½", 45° or 90° bends) can be either 3 foot radius turns or 5 foot radius turns. Unless otherwise indicated on the drawings, the bend shall be assumed to be a 3 foot radius turn. Where noted, 5 foot radius turns are critical to a successful cable pull and where called for on the drawings, only 5 foot radius turns shall be installed. All bends male ends, if not beveled at the factory, shall have their inside edges beveled or made smooth in the field, to prevent the sharp edge from damaging the cable jacket, when pulled in the direction against the male end, inside edge.

At no instance shall 5" couplings be used in series where an integral size factory made bend (1-1¼", 2-2½", 45° or 90° bends) can be used. To the extent possible, the number of 5" couplings and bends shall be limited to as few as if possible.

- 4.2 Bend Radii - URD secondary voltage conduit bends shall have a minimum radius of 36".** Larger radius bends, as specified above, may be required to accommodate longer pulls, larger cable sizes, field obstructions or future considerations, and shall be called out specifically by the Company on the Drawings.
- 4.3 Sweep Bends.** Sweep bends may be formed with a combination of straight duct sections and 5" couplings. The overall sweep of straight line sections shall have a minimum bending radius of ten feet.
- 4.4 Sweep Bend Stabilization.** Sweep bends must be staked to prevent opening of the couplings during installation. Care must be taken to prevent any duct deformation at the stakes. No other operations producing visible stress on the couplings shall be allowed. Visible stress exists when there is more than 2" of offset on the coupling or where significant in-line offset is observed.

## 5 Direct Buried Conduit Installations

### 5.1 Conduit

- 5.1.1 Conduit Specification.** Electrical grade, rigid, nonmetallic, Schedule 40 PVC conduit in 2" (Illinois only - for single-phase primary voltage cable), 3", 4" or 5" sizes, as specified on the Drawings, shall be installed. It shall be 90° C rated PVC and meet the latest revision of NEMA Standard TC2. The Company specifies lengths of either 10' or 20', with belled or coupled ends.
- 5.1.2 Conduit Arrangement and Spacing.** Multiple conduit installations shall be such that they are all laid directly on the trench floor with a minimum 2" horizontal separation, not only between the ducts themselves but also between the outside ducts and the walls of the trench. The spacing allows for proper heat dissipation, while the horizontal arrangement helps eliminate backfill voids between the conduits that could result in settling and the collection of water. No two conduits shall be rolled or crossed in the trench midway between two endpoints.
- 5.1.3 Conduit Joining.** Individual duct sections shall be joined with couplings and PVC cement to ensure a continuous, leak-free duct with a consistent internal diameter throughout. No internal protrusions or obstructions are allowed. The Customer/Contractor shall ensure that no foreign material enters the ducts to be joined. The end of the duct shall be plugged with approved end plugs whenever work on the duct installation is stopped.
- 5.1.4 Pulling Tape Installation.** A flat pulling tape rated a minimum 2500 lbs. shall be installed in all completed duct sections, with a minimum of 10 feet left extending out each duct end. The tape shall be blown into the conduit after the duct section has been completed and the conduit cement is completely dry. During installation, the tape reel should be placed on a payout stand in order to allow the tape to pay out flatly into the duct in a single continuous piece. Neither knots nor frays shall be permitted inside a duct section.
- 5.1.5 Bend Reinforcement.** Horizontal and vertical bends that require reinforcement for cable pulling purposes shall be so noted on the Drawings and shall be stabilized by means of concrete encasement (ref. SPEC 2).

### 5.2 Backfilling and Compaction

- 5.2.1 Local Ordinance.** Local codes or ordinances shall prevail when their requirements exceed the backfill requirements herein. Where street crossings or other areas supporting vehicular traffic are concerned, alternate backfill material may be used as prescribed by such codes or ordinances.
- 5.2.2 Backfill Material.** Except as noted on the Drawings and Specifications, native soil free of rock and debris may be used as backfill material unless disqualified by the Company Representative. The soil shall pass through a 2" screen. ¼" minus limestone screenings may be used as an alternate to soil when backfilling. ***EXCEPTION: For transformer pad installations, 1" minus rock must be used as backfill material.***
- 5.2.3 Voids and Foreign Matter.** Voids around the conduit(s) where water can collect shall be avoided. Any conditions that produce crushing pressures on the duct are unacceptable. Trenches shall be kept clear of foreign materials such as grease, hydrocarbons, wood, rotting vegetation, or other debris during the backfill process

- 5.2.4 Alternate Backfill Materials.** Where the quality of the excavated material could damage the installation and/or prevent adequate compaction (as with shale, rock, paving materials, cinders, sharply angled objects, or corrosive materials), a granular backfill of sand, ¼” minus limestone screening, or flowable fill shall be used. In such cases, the backfill material shall be placed completely around the ducts in all directions in a thickness of at least 2”.
- 5.2.5 Compaction.** In undeveloped areas, the backfill shall be compacted to provide for supporting a man’s weight as the trench is walked upon. Otherwise, in established areas, compaction shall be obtained with hand or mechanical tampers to provide densities of at least 90% of that of the undisturbed soil. Hydro tamping methods are not acceptable.
- 5.2.6 Final Grade.** The backfill material shall be placed back in the excavation and compacted as necessary in approximately 18” lifts until final grade is re-established. The ducts shall be restrained to prevent movement, as required. No rock shall be placed in the backfill within 6” elevation of the topmost duct.
- 5.2.7 Backfill Settlement.** Settlement of the backfill material above the duct(s) is an indicator of improper compaction. Whenever required, the Customer/Contractor must re-establish final grade by placing additional backfill or by other means as appropriate.
- 5.2.8 Resurfacing.** Pavements, sod, or other surfaces shall be replaced with materials corresponding to those removed unless the Company Representative approves substitute materials. Thickness, strength, and final appearance shall match the original materials as closely as possible.

### 5.3 Directional Boring

- 5.3.1 Coilable Duct Specification.** In areas where surface obstructions make standard open trenching undesirable or cost-prohibitive, directionally boring a coilable duct provides a viable option to the Customer/Contractor. The coilable duct shall be high-density polyethylene (HDPE) in sizes of 2” (Illinois Only), 3”, 4” or 5” nominal inside diameter, as specified on the Drawings. The Company specifies the following for coilable duct:
- 2” SDR-13.5 (0.176” min. wall) per ASTM D-1248 (Illinois Only)
  - 3” SDR-13.5 (0.259” min. wall) per ASTM D-1248
  - 4” SDR-13.5 (0.333” min. wall) per ASTM D-1248
  - 5” SDR-13.5 (0.413” min. wall) per ASTM D-1248
- 5.3.2 Duct Markings.** The coilable duct shall be black with three UV-resistant red stripes extruded into the outside surface. The stripes shall have a thickness in the range of 10-15 mils and be 3/16” to 3/8” wide. The stripes shall be evenly spaced at 120° intervals around the circumference of the duct.
- 5.3.3 Boring Depths.** Coilable duct shall be directionally bored at standard burial depths of 36” of cover for ducts housing primary cables and 24”-36” of cover for ducts housing secondary cables. The Company Representative shall approve any exceptions to the specified burial depths, up to a maximum 60” of cover from final grade.
- 5.3.4 Duct Joining.** Sections of coilable duct shall be joined using fusion couplings. Where the coilable duct is to be joined with Company-installed PVC conduit, the Customer/Contractor



is to fuse a 24" straight piece of matching size PVC conduit to the coilable duct. Prior to fusing, the Customer/Contractor shall make circumferential scores around the outside of the PVC conduit at the end that is to be installed into the fusion coupling. This will allow the fusion coupling to adhere to the dissimilar PVC conduit. A special epoxy is also available that joins the coilable duct with standard PVC couplings. The Customer/Contractor shall confer with the Company Representative with regard to this epoxy.

**5.3.5 Vertical and Horizontal Bends.** All vertical bends shall be made using Schedule 40 PVC bends with belled or coupled ends as specified in Section 4. Under no circumstances shall a vertical bend be fabricated by "sweeping" it up to grade using the guided boring machine. The vertical bend shall be joined directly to a 36" straight piece of matching size PVC conduit, which is installed to transition between the bend and the coilable duct. Horizontal bends, however, may be swept using the guided boring machine. In places where the bend radius is too small for this, a PVC bend shall be installed between two 36" straight PVC transition sections.

**5.3.6 Connections into Vaults and Manholes.** Bored coilable duct shall end 4'-5' from a new vault or manhole. This coilable duct shall then be transitioned to the same size PVC before connecting into the structure. The transition to PVC shall be made using the techniques described in Section 5.3.4. If the vault or manhole already contains energized Company-maintained cables, the installation, including the straight PVC transition piece, shall stop roughly 10' from the structure or at a location otherwise determined by the Company Representative (ref. Section 5.4.7). The Company shall pick up the installation at this point and tie it into the vault or manhole.

## 5.4 Vaults, Splice Boxes and Accessories

**5.4.1 Material Provisions.** The Company shall make available a number of underground structures for purposes of splicing primary and secondary voltage cables in areas that do not require a traffic rating. The Company specifies a number of different sizes for use in Customer/Contractor-installed situations, depending on the number and sizes of cables involved (ref. SPEC 3, 4, 4A and 5). Provided that arrangements are made in advance with the Company Representative, the Customer/Contractor may pick up items such as these for a specific project (ref. Section 2.1.10).

**5.4.2 2 x 4 Splice Box.** The 2 x 4 splice box (ref. SPEC 3) is intended for concealed use, that is, it does not have a permanent access way for an individual. An electronic marker shall be laid flat inside for future locating purposes when it becomes necessary to cover it before the Company installs the cable. The splice box does not have a floor, nor any knockouts, couplings or pulling eyes built into the end walls. Conduits up to a 4" maximum diameter shall be brought in through drilled holes in the small end walls only, so as to avoid tight turning radii.

**5.4.3 3 x 5 and 4 x 8 Vaults.** The 3 x 5 and 4 x 8 vaults (ref. SPEC 4, 4A and 5) each have two PVC couplings built into each end wall, in 4" sizes for the 3 x 5 and 5" sizes for the 4 x 8. Couplings not used shall be end capped. Each has knockout capability along the sidewalls. They also all have threaded Richmond inserts for installing pulling eyes, and floor holes for draining water. (The Company shall install the iron grates over these drain holes.)

**5.4.4 Pit Excavation.** Each of the structures shall be installed in a pit that has been excavated for standard conduit depths of 36" for primary cable. Each structure shall be installed on a leveled 10" high base of 1" clean rock for draining purposes. Any overdig shall also be

filled with 1" clean rock that has been leveled and tamped to firm wherever the earth has been disturbed.

- 5.4.5 Conduit Connections (New Vaults).** Conduits shall be placed onto the couplings, through the concrete knockouts or into the polyethylene-drilled holes as required. Conduits placed through knockouts or drilled holes shall extend 6" into the vault. Conduits brought through knockouts shall be grouted or mortared at the concrete interface, while those brought through drilled holes shall be caulked at the poly interface.
- 5.4.6 Conduit Connections (Existing Vaults).** The Customer/Contractor shall not install new conduits directly into a vault or splice box that already contains energized Company-maintained cables, regardless of the structure's location on or off Customer/Contractor property, unless arrangements to that effect are made with the Company Representative. When the Drawings specify that Customer/Contractor-installed conduits are to be brought into such a structure, the Customer/Contractor shall stop the conduit installation roughly 10' from the structure, or at a location otherwise determined by the Company Representative. The Company shall pick up the installation at this point and tie it into the vault or splice box.
- 5.4.7 Riser, Frame and Cover.** Each precast concrete vault requires a 6" concrete riser to be set in the rectangular hole in the vault's roof. This riser is "notched" for the 24" x 42" cast iron frame and cover that completes the vault's access way. Sloped grades shall be accommodated by bricking and mortaring between the riser and the vault roof on three of the four sides. The frame shall be sealed to the riser with mortar in order to prevent tipping it when the cover is open on its hinges.

## **6 Concrete-Encased Conduit Installations**

### **6.1 Conduit and Arrangement of Ducts**

- 6.1.1 Conduit Specification.** Electrical grade, rigid, nonmetallic, Schedule EB-35 (Encased Burial) 5" PVC conduit, 90° C rated, and meeting the latest revision of NEMA Standard TC6. Any male section, if cut to a specific length, shall be cut straight and beveled on the inside to provide a smooth internal transition between sections that are field cut.
- 6.1.2 Duct Arrangement.** The duct bank routes shall be constructed in accordance with the plans and specifications and SPEC 6; however, the Customer/Contractor may deviate from the shown depths to bring the duct bank to a depth that provides the Company's minimum standard cover over the top of the duct bank, at 3 feet, as measured from the top of the duct bank to grade. This would only be allowed for long runs where other utility conflict are not encountered and the change in elevation can be accomplished by using 5° and 10° factory made couplings. Furthermore, deviations shall not be made that introduce significant changes in elevation, as to result in the cable pulls exceeding the cable pulling criteria, as noted in section 10.2.2 of the Construction Specification. Additionally, the shown clearances for over and under crossings of existing utilities, shall be maintained.
- 6.1.3** All conduits shall be proofed by pulling a mandrel through the conduit in order to verify the integrity of the conduit system. Mandrel type may be ball or cylindrical shaped and shall be approved for use on encased EB-35 PVC conduit systems, including on 3 or 5 foot radius bends (2-2½", 45°, or 90° bends). The mandrel shall be solid steel or aluminum. The mandrel shall have a minimum diameter of 4.5 inches to proof a 5 inch conduit sections. Conduit sections, manhole to manhole, shall be proofed within 10 days upon completion of

that section and after the concrete encasement has cured. Any conduit that fails the mandrel proof test shall be repaired, to the Company's satisfaction and at the Customer/Contractor's expense

- 6.1.4 Deviation from Drawings.** Any number of field conditions may warrant deviating from the duct formation specified on the Drawings, such as obstructions, poor soil conditions, the need for a shallower trench, etc. In such cases, the Company Representative shall approve the deviation prior to its being executed.
- 6.1.5 Conduit Joining.** Individual duct sections shall be joined with couplings, but no PVC cement is necessary, as the concrete is sufficient to hold the individual sections together. No internal protrusions or obstructions are allowed. The Customer/Contractor shall ensure that no foreign material enters the ducts to be joined.
- 6.1.6 Installation Stoppage.** Any duct bank that is not terminated at a manhole shall have each conduit capped using a Company provided end cap. Additionally, if the installed duct bank is to be encased and the trench backfilled in anticipation of a future duct bank that would be married to the capped duct bank, a plywood bulkhead shall be installed hard against the ends of the plugged ducts in order to minimize the amount of Customer/Contractor backfill that spills into the future Company trench. Additionally, the Customer/Contractor shall install a single 5 inch schedule 40 conduit, capped and extended to just below the street base concrete, to be used as a marker for where the duct bank has been stopped and capped.
- 6.1.6 Termination** Conduits terminating at the manholes nose terminators, if less than the maximum number of terminations, shall utilize the terminators starting at the bottom working up – if the duct bank conduit count is less than the maximum number of terminators, the spare terminators on the manhole shall be the upper terminators
- 6.1.7 Amount of Cover.** Minimum burial depth shall be 36 inches, as measured from the top of the duct bank encasement to the existing or final street grade.

For any duct bank run where the minimum desired cover of 3 feet cannot be achieved, or as indicated by the drawings, the Customer/Contractor shall contact the Company Representative for additional instruction. One option could be to install 1/8 inch steel plating over the duct bank. For occurrences where less than 3' of cover is possible, the Customer/Contractor shall install steel plating equal to the width of the duct bank, plus 6 inches on each side, for the length of the duct bank until the full 3 feet of desired cover can be achieved.

Multiple duct installations of any kind shall maintain a minimum 2" spacing between each conduit in all dimensions, as well as between the conduits and the outside walls of the trench. The trench floor shall consist of firm, well-compacted, undisturbed dirt, or backfill that is supplied for leveling or grading purposes. The bottom of the trench shall be leveled to plus/minus 2" in order to avoid "humps" in the conduit, and shall be at an elevation necessary to satisfy the standard burial depth requirements

- 6.1.8 Duct Formation at Manholes.** Concrete encased duct banks shall enter and exit traffic-rated manholes in one-column or two-column formations, regardless of whether their matrices are "rolled" horizontally in midspan, or modified in any way.
- 6.1.9 Pulling Tape Installation.** A flat pulling tape rated a minimum 2500 lbs. shall be installed in all completed duct sections, with a minimum of 10 feet left extending out each duct end.

The tape shall be blown into the conduits after the duct section has been completed. During installation, the tape reel should be placed on a payout stand in order to allow the tape to pay out flatly into the duct in a single continuous piece. Neither knots nor frays shall be permitted inside a duct section.

## 6.2 Spacers and Bond Wire

**6.2.1 Duct Bank Encasement** concrete shall conform to specifications outlined in SPEC 6. The spaces between the conduits shall be rodded during the concrete pour to ensure that all conduits are fully encapsulated.

The duct bank concrete encasement shall be allowed 24 hours to cure prior to installing any backfill material (flowable fill). Use of vibrator equipment during the concrete pour shall not be allowed. The top conduits shall have a minimum of 2 inches of encasement. Duct banks configured with more than 4 rows, encasement shall be completed in multiple pours (minimum of 2 pours, 4 rows covered per pour), with 24 hours curing time between successive pours.

Prior to cure of the duct bank concrete and before pour of the backfill material, the top of the duct bank shall be raked to show grooves on the top.

**6.2.2 Configuration.** The Company construction standard (SPEC 6) is designed around a conduit configuration of no more than four (4) conduits high for duct banks, except for the following special cases where deviation from the standard should be approved by the Customer/Contractor Representative:

- Vertical construction (2 columns) when transitioning to marry duct banks to manholes
- Existing field condition require a vertical orientation

On occasion, construction drawings may require construction methods that are not covered by this specification. In those situations, the Company shall provide the necessary construction specifications.

The duct bank standard specifies the use of EB-35 conduit and plastic spacers and provides the spacing dimensions for the plastic spacers. Plastic spacers shall rest on a concrete blocks with a minimum thickness of 1.5 inches and for a bearing area of at least 8x16 inches.

**6.2.3 Duct Arrangement.** The conduits in the duct bank shall be arranged in the trench in a tight, orderly matrix arrangement with the use of plastic spacers, as shown on the drawings. The plastic spacers provide structural support to hold the conduits in place during construction and concrete encasement. The spacers shall be installed as shown on the Distribution Construction Standard. Duct bank runs less than 100 feet in length between manholes can remain in a vertical construction configuration (2 columns); however, any conduit route with a face-to-face distance between manholes greater than 100 feet shall have its conduits rolled into a configuration that has conduits no higher than four (4) rows.

**6.2.4 Deviations.** If two column vertical duct bank construction is required, when not meeting the aforementioned allowed deviations from the standard or as shown on the drawings, prior written approval by the Company is required and multiple concrete encapsulation pours is required for greater than (4) four rows high, as noted above

**6.2.5 Bond Wire Location.** A bare 4/0 AWG, tinned copper, 19-strand, soft-drawn conductor shall be installed in the duct bank along its entire length for purposes of establishing a continuous ground reference. It shall be located centered at the bottom of duct bank, but such that the encasement shall be poured directly over and completely encapsulate the bare bond wire. The bond wire shall be extended into the manhole and approximately 10 feet shall be coiled up at the nose of the manhole.

### **6.3 Concrete and Backfilling**

#### **6.3.1 Duct Bank Encasement Concrete Mix Requirements**

- Minimum 28 day compressive strength of 2,500psi
- Maximum water to cement ratio of 0.55 by weight and include surface water in aggregates
- Maximum coarse aggregate size of 3/8in (torpedo aggregate)
- Provide aggregates from a single source
- 4in slump +/- 1in
- 6% air content by volume
- Portland Cement shall be ASTM C150 Type 1 or 2
- Water shall be potable per ASTM C94
- The use of calcium chloride or any admixture containing calcium chloride shall not be allowed

#### **Flowable Fill Concrete Mix Requirements**

- Minimum 28 Day compressive strength of 100psi with an allowable bearing strength of 4,000psf
- Maximum water to cement ratio of 4.2 by weight and include surface water in aggregates
- Maximum coarse aggregate size of 3/8in (torpedo aggregate)
- Provide aggregates from a single source
- 8in slump +/- 1in
- 30% air content by volume
- Portland Cement shall be ASTM C150 Type 1 or 2
- Water shall be potable per ASTM C94
- The use of calcium chloride or any admixture containing calcium chloride shall not be allowed

**6.3.3 Encasement Reinforcing.** The high granular nature of the concrete encasement mix shall facilitate the Company's need to be able to chip at the concrete as required, in order to expose ducts containing energized cables. Under no circumstances shall the duct bank encasement be reinforced with any foreign bonding agent or material such as steel rebar or the like.

**6.3.4 Traffic Area.** For duct banks in a traffic area, i.e. alley, street or highway (including a shoulder or other right-of-way), the layer above the duct encasement shall be flowable fill, to within 12 inches of final grade. The flowable fill concrete shall conform to the specifications in section 6.3.2. Restoration of City of St. Louis streets shall be in accordance with the current edition of the City of St. Louis Standard Specifications, Bid Items, and Standard Details for Street and Alley Construction. See section 12, entitled Restoration.

**6.3.5 Municipal** street base concrete shall include expansion joints, installed perpendicular to the run of the conduit every 75 feet (maximum spacing distance) and also at intersections greater than 45 degrees angle in plain view. Expansion joints shall consist of ½ inch thick fiber material and be placed the full depth and width of the pavement patch concrete. Asphalt expansion joints shall not be acceptable. The fiber expansion joint shall be set a ½ inch below grade using a ½ inch protective cap and after concrete has been poured and cured on both sides of the expansion joint, protective cap shall be removed and the joint sealed using W.R. Meadows "SOF-SEAL" Joint Sealant. Contraction joints shall not be required since the top two inches of pavement patch will be removed and replaced in the near future with asphalt.

#### **6.4 Manholes and Accessories**

**6.4.1 Location.** All manholes shall be located as shown on the drawings. Company traffic-rated manholes are pre-cast manufactured using steel-reinforced concrete, and are delivered to the site in two pieces. The Company specifies three different sizes for use, depending on the number and sizes of cables involved (ref. SPEC 8, 9 and 10).

**6.4.2 Pit Excavation.** The excavation depth to set the manhole shall be determined first as indicated by the drawings and second, by the specification. The excavation floor shall be leveled with a 6" layer of crushed rock or flowable fill prior to setting the manhole to the required depth. The manhole backfill shall be flowable fill.

**6.4.3 Set Extra Deep.** Locations where the drawings call for any manhole to be set extra deep (5 feet of cover or greater, over manhole), the neck shall be built up using 48 inch diameter 14 gauge corrugated steel pipe with rolled ends (see SPEC 12). The concrete mix used with this standard shall be 28 day strength 4,000 psi concrete.

**6.4.4 Frame and Cover.** The Company specifies a cast iron frame and lid with a 36" opening to cover the entrance to the manhole (ref. SPEC 13).

**6.4.5 Ground Rods.** The manhole grounding standard must be followed for all new installations. The ground rods shall be installed immediately after the manhole has been set, connected to the duct bank bond wires, tested for ground resistance, and their holes epoxy sealed.

#### **6.5 Tying Ducts into Manholes and Manhole Bays**

**6.5.1 End Wall Duct Configurations.** The wing walls of the 6x17½, the 6x14, and the 3-way manholes, contain manufactured knockout panels for purposes of tying in the conduits via bay construction. Conduit Bays are required to facilitate training the primary and secondary cables within the manhole, allowing for a turn to the long walls of the manhole (see SPEC 14). Bays shall be constructed in the locations and configurations as shown on the drawings. Under no circumstances shall a duct bank be brought into a manhole through either sidewall and under no circumstances shall a duct bank be brought into a manhole through the wing wall without the construction of a bay.

**6.5.2 Conduit Connections (Existing Manhole).** On a case by case basis, when a proposed duct bank enters a manhole wingwall knockout or end nose, the Company may request the Customer/Contractor to complete additional work to facilitate future improvements, if feasible. This could include expansion of the bay to accommodate additional conduits into the bay or additional conduits stubbed out of the nose of the manhole.

Existing manholes that requires bay may contain energized Company facilities. The Customer/Contractor shall be OSHA qualified to work in enclosed spaces with energized facilities

- 6.5.3 Concrete Requirements.** Relative to bay construction concrete, the pour slump value shall be 2 inches; acceptance of any value higher or lower for use to construct a bay shall require prior Company approval. Concrete used for encasing the conduits and constructing the bay shall be in the quantities required to meet the requirements of this specification and the Distribution Construction Standards (i.e. excess concrete on truck shall not be poured at manhole or duct bank).

## **6.6 Manhole Grounding**

- 6.6.1** All manholes shall be grounded, in accordance with the Company's manhole grounding standard, Distribution Construction Standards 33-20-02-\*\* (4x10 -01; 6x14 -02; and 6x17½ -03) and 33-20-03-01 for 3-way manholes. Existing manholes shall be grounded similarly to the aforementioned grounding standards, material quantities and configuration adjusted based on the existing manhole size and configuration. Existing manholes with 6 feet headroom or less, the required 8 foot ground rods can be made up using two threaded 4 foot by 5/8 inch copper clad grounding rods (Ameren stock # 23-63-143), with the connection between 4 foot rods using the Company ground rod connector (Ameren stock # 23-13-143). The two 4 foot rods shall be connected together in accordance with the manufacturer's recommendations and tightened to prevent the rods from coming undone over time. The ground rods shall be driven at the locations shown on the standard drawing, thru the manhole floor.
- 6.6.2** For new manhole installations, the ground rods shall be installed at the same time as the manhole installation. Once the ground rods have been installed, the holes in the floor shall be completely closed using an epoxy compound, "Crack-Pac" Injection Epoxy, manufactured by Simpson Strong-Tie Company.
- 6.6.3** The manhole perimeter 4/0 bare grounding conductor (4/0 bond wire material) shall be connected to the ground rods as shown on the standard. All primary joint neutrals shall be connected to the manhole perimeter grounding conductor using the connectors called out in grounding standard.
- 6.6.4** Once the perimeter 4/0 bare grounding conductor has been installed and connected to both ground rods and the duct bank bond wires, in accordance with the grounding standard, the ground rod resistance to earth shall be tested using a portable ground resistance tester; AEMC Model 3711 portable tester or equivalent. At each manhole, both rods shall be tested and their resistance in ohms shall be recorded, along with date and time; the ground resistance readings for every manhole that included installation of manhole grounding, and the manufacture and model of the test equipment, shall be provided to the Company project engineer for review and approval. Any rod with a resistance of greater than 5 ohms, the Customer/Contractor shall consult the Company project engineer for further direction. Additional measures may be required to achieve the desired resistivity, including adding a rod(s) to achieve additional depth. Testing shall be in strict accordance with the testing equipment manufacturer's instructions and only after the ground rods have been interconnected using the 4/0 bare copper bond wire, and connected to the duct bank bond wire, in accordance with the Company grounding standard.

## 7 Steel-Encased Conduit Installations

### 7.1 Application and Excavation

- 7.1.1 Application.** Steel-encased conduit sections shall be called out on the Drawings in those cases where the Company anticipates the need for a perpetually maintenance-free installation of multiple ducts, whether due to future inaccessibility, inability to disturb grade, or the requirements of a third party.
- 7.1.2 Excavation Options.** The steel casing may be either be laid in an open trench or augured in (i.e. "tunneled") from a pit on one side, as the jobsite conditions permit. This decision shall be left up to the Customer/Contractor, as the Customer/Contractor shall have the responsibility for the restoration of whatever grade is disturbed in the installation.
- 7.1.3 Auger Pits.** In the case where the installation is to be drilled in, the Customer/Contractor shall excavate the pits as required at each end of the encasement, stockpiling the excavated soil for later use as fill, if possible. The overcutting of the earth for the casing itself shall be limited to 1" greater than the outer casing diameter.
- 7.1.4 Company Use of Pits.** If the Company will be completing the adjacent conduit installation at either end of the steel casing, the Customer/Contractor shall plug the conduit ends after the encasement is complete, thus keeping out precipitation and debris until the Company can begin work on that side. The Customer/Contractor shall arrange for the Company to use the existing pit and associated shoring to marry up the adjacent duct bank with the encasement, after which the Company shall backfill the excavation.
- 7.1.5 Open Trench.** In the case where any part of the encasement is to be laid in an open trench, the Customer/Contractor shall remove any soft, unsuitable soil from the casing bearing surface and replace it with stable, compacted, unfrozen soil or rock. Stable soil can be reused and imported as long as it is free of any organic materials and gravel larger than 3".

### 7.2 The Steel Casing

- 7.2.1 Duct Configurations.** The Company specifies cylindrical steel casing installations for configurations of both eight and ten ducts (30 inch diameter, see SPEC 15) and drawings provide details where a 12 duct configuration (36 inch diameter casing) is required. The conduits installed are encapsulated within the steel casing by a concrete grout to allow for duct bank heat transfer. The drawings provide the locations for the steel encased conduit crossings, the conduit configuration, and the steel encasement diameter requirements.
- 7.2.2 Casing Dimensions and Welds.** The steel casing shall be ½" thick steel and 30" or 36" in outside diameter (ref. SPEC 15). The casing installation shall be a continuous steel casing with welded joints, the quantity as required to achieve the total length as called for on the drawings. The welds shall be entirely circumferential in order to provide a complete containment of the injected grout and shall comply with industry welding standards. The Customer/Contractor shall use 10 foot steel casings; if casings less than 10 feet are required, the Customer/Contractor shall receive Company approval prior to proceeding with the steel casing installation.
- 7.2.3 Casing Standpipes.** A 4" female threaded flange shall be welded at the top of each end of the casing for the installation of standpipes. The standpipes, not to exceed 2 feet in length,



are required to allow for both the evacuation of air during grouting and the visual inspection of the grouting progress (at the both ends), to ensure full encapsulation of the conduits.

**7.2.4 Casing Guide Rails.** Light steel angles (approximately ½” x ½”) shall be welded along the inside of the casing over its entire length. These shall serve as guide rails, ensuring that the conduit spacers both remain upright and refrain from “spiraling” as they are rolled into the casing.

**7.2.5 Preparation for Conduits.** The steel casing shall be inspected for cracks, incomplete welds and other discontinuities prior to conduit assembly. The inside of the casing shall be cleaned of all debris and dirt in order to ensure a suitable bond between the steel and grout.

### **7.3 Conduit, Spacers and Bond Wire**

**7.3.1 Conduit Spacers.** The conduit shall be 5” Schedule 40 PVC conduit in either 10’ or 20’ lengths (ref. Section 6.1.1). The conduits shall be assembled, installed and held in place by plywood spacers uniformly arranged no more than 10’ apart. The spacers shall be round ¾” plywood with a 27½” outside diameter (ref. SPEC 15). The spacers shall have casters installed for rolling the conduit assemblies into the casing from one end. The spacers will hold the conduits in place inside the casing while the grout is being poured.

**7.3.2 Conduit Banding.** The conduits shall be secured using a non-destructive method (banding using steel, heavy duty tape or other method) to prevent movement of the spacers while the conduit assembly is rolled into the steel casing. Approximately 10’ of conduit shall be left extending out each end of the casing in order to allow room for pouring concrete end blocks prior to grouting.

**7.3.3 Bond Wire Location.** Use tape or cable ties to secure the bare 4/0 AWG tinned copper, 19-strand, bond wire to the bottom center conduit along its entire length, to prevent the ends from being sucked back into the casing as the grout is placed. A notch shall be cut into each plywood spacer in this location in order to accommodate the conductor. 10 feet of conductor shall be left extending out each end of the casing for connection to the adjacent married section of open trench duct bank’s bond wire.

**7.3.4 Casing End Caps.** Of dry mix aggregate concrete shall be placed at the ends of the casing in order to provide caps before the grout is placed. The excess lengths of conduit shall extend through these concrete end caps.

### **7.4 The Grouting Process**

**7.4.1 Grout Motility.** The grout that encases the ducts is required to conduct the heat dissipated by the power cables from the ducts to the steel casing and on into the ground. Any voids in the grout will insulate against this thermal conductivity and hence must be prevented. To this end, the grout shall be motile enough that all entrapped air moves to the top and ultimately out the standpipes.

**7.4.2 Constitution and Additives.** The grout that encases the ducts shall be sufficiently fluid that all entrapped air moves to the top and ultimately out the standpipes. Air voids in the grout shall be avoided. The grout shall be screened through ¼” hardware cloth to ensure that any aggregate are removed. Setting retardant additives may be used in the grout to improve motility, but these shall be minimized in order to maintain the thermal conductivity of the

grout after setting. Under no circumstances shall the use of calcium chloride or any other setting agent accepted.

**7.4.3 Outside Pouring Conditions.** The grout shall not be poured when the outdoor temperature is below 40° F or when freezing temperatures or lower are expected before final set. The grout shall be at or above 50° F when delivered and while being pumped. It shall be pumped continuously in order to prevent curing and the establishment of voids before the pour is completed. However, the grout shall be ordered one truckload at a time to ensure that fresh grout is always being poured.

**7.4.4 Standpipe Capping.** The 4” standpipe will allow the air to escape out of the casing while the grout is poured, and will also provide pressure as the grout rises in the standpipe. A 4 inch cap shall be available to cap the first of the two standpipes to fill up, while the second continues to bleed air.

## **7.5 FoamGlas Insulation Systems**

As noted on the drawings, conduit systems within proximity to steam shall be insulated in accordance with the construction drawings, this specification, and the manufacturer’s instructions. The Customer/Contractor shall use only Pittsburgh Corning FoamGlas insulation materials and accessories. All FoamGlas insulation shall be a minimum thickness of 6 inches. Installation shall be butt-joints, configured during install similar to running bond brick pattern (overlapping).

Relative to duct bank crossings over steam lines, the FoamGlas insulation shall be installed approximately 5' along the bottom of the conduit trench in each direction from the steam line and installed to the width of the trench. Per the manufacturer’s instructions, install a layer of Pittcourse™ 100 product – high performance bitumen damp proof course (DPC) over the same area that is to be covered by the FoamGlas insulation, install the FoamGlas insulation as shown on the drawings, and then install another layer of the DPC over the top of the insulation. Prior to encapsulation, the FoamGlas shall be secured from movement by non-destructive means, to prevent movement of the blocks during concrete encapsulation.

## **8 Terminal Poles and Risers**

**8.1 Customer/Contractor Responsibility.** The Customer/Contractor’s responsibility at terminal (i.e. “riser”) poles, regardless of voltage, includes installing the riser bend(s), extending the conduit(s) above grade, and backfilling the excavation. The Company will extend the conduit riser(s) up and attach to the pole. All secondary voltage riser cable (less than 600V) will be installed by the Customer/Contractor, while all primary voltage riser cable (greater than 600V) will be installed by the Company. The Company will terminate riser cables overhead in all cases.

**8.2 Riser Bend Location.** The Company Representative shall determine the proper location of the riser bend(s) on the pole (i.e. the quadrant) and specify this location on the Drawings. In the case where a riser bend is to be extended by the Customer/Contractor to a location requiring pole setting, replacement or alteration by the Company, the extension shall not be made until the pole work is completed, unless other arrangements are made with the Company Representative.

**8.3 Bend and Stub Specification.** The Customer/Contractor shall take special care to extend the conduit(s) out of the ground at the particular pole quadrant designated on the Drawings. The conduit bend(s) brought up at the riser pole shall be rigid Schedule 40 PVC as specified in Section 4.3. Each bend shall be buried below grade in its entirety, with the top of the bend being

approximately 6" below grade. Field conditions may make this impractical, and in these cases, the top of the bend can be up to 6" above final grade."

- 8.4 Pole Clearance.** For direct buried conduit installations, the conduit(s) shall penetrate the grade with 6" of clearance between it and the pole (ref. SPEC 16). For concrete-encased conduit installations, the conduit shall penetrate the grade "hard against" the pole for the sake of extending the encasement to at least grade level (ref. SPEC 16A).
- 8.5 Concrete-Encased Riser.** Conduit risers that are to be concrete-encased shall be encased using a fiber concrete-forming tube sized for the diameter of the conduit being installed (ref. SPEC 16A). The tube shall be cut lengthwise and tabs bent back for purposes of nailing to the pole and completing the form. Pole steps shall also be driven into the base of the pole (one on each side of riser) prior to cementing in order to hold the encasement against the pole.
- 8.6 Concrete-Encased Riser Elevation.** For concrete-encased risers in non-traffic areas, the top of the encasement form shall be at least up to grade, with the Schedule 80 conduit stub (ref Section 7.2 above) extending 6" above grade. In possible traffic areas, the top of the encasement form shall be at least 18" above grade, with the conduit stubbed 6" above that (Schedule 80 is not required this case).
- 8.7 Drainage Pit.** In those cases where the Company recognizes the potential for water drainage problems by virtue of a terminal pole's location, a drainage pit shall be installed at the base of the riser bend (ref. SPEC 17). Such problems can arise when the equipment to which the cable is to be connected sits at a lower elevation than that of the riser bend. Water entering the riser from above shall drain through a 30" long corrugated conduit section into a pit of 1" clean gravel directly below.

## 9 Equipment Pads

### 9.1 General Considerations

- 9.1.1 Customer-Poured Pads.** In lieu of utilizing a Company-provided concrete pad, the Customer may elect to pour his own pad (ref. SPEC 18). Customer-built pads shall be formed out and reinforced according to the layout and dimensions on the attached Specification Drawings (ref. SPEC 18A, 18B, 18C, and 18D).
- 9.1.2 Pad Orientation.** Just as important as the pad's location is its orientation at that spot. The pad's orientation shall be specified on the Drawings, taking into account the clearances necessary to install, open and operate the equipment, as well as the approach of all associated conduits (ref. SPEC 22). The Customer shall note the pad's orientation and set it, as well as arrange the conduit bends, accordingly.
- 9.1.3 Number and Spacing of Bends.** The conduit bends brought up through the openings in the pads shall be rigid Schedule 40 PVC (ref. Section 4.1). The Customer/Contractor shall carefully arrange the conduits to penetrate the openings according to the spacing indicated on the Specification Drawings for the pad in question. The Customer/Contractor shall also limit the number of conduits penetrating each opening to the maximum number shown and arrange them symmetrically within each opening to facilitate the training and termination of multiple cables.
- 9.1.4 Bends through Existing Pads.** There will be situations in which the Customer/Contractor is required to bring new conduits up and under existing pads that house energized Company equipment, such as transformers. In such cases, the Customer/Contractor shall either make

arrangements through the Company Representative or contact the Distribution Operating Department through the Call Center (ref. the *Ameren Electric Service Manual*) to have the equipment opened, de-energized and/or covered.

**9.1.5 Concrete Pad Backfilling.** All concrete pads shall be installed on 4" of level, well compacted, 1" minus rock extending 12" outside the pad. Dirt under the rock must first be compacted to 90%. Avoid filling pad opening before cable or conduit is installed.

**9.1.6 Concrete Pad Settlement.** Settlement of padmount equipment and other structures is an indication of improper compaction. All charges associated with correcting such adverse conditions shall be re responsibility of the Customer/Contractor. Once the Company installs its equipment on the pad, the Company may not allow the Customer/Contractor to correct any deficiencies directly. In such a case, and at the Company's discretion, the Company shall correct the deficiency and pass its charges on to the Customer.

## 9.2 Fiberglass Pad Installations

**9.2.1 Fiberglass Pad Elevations.** Fiberglass pads shall be installed in excavations that will allow their load-bearing surfaces at the top to sit at 6" above final grade for switchgear (ref. SPEC 20) and 4" above final grade for cable junction enclosures (ref. SPEC 21). The area of the excavation that bears the pad shall be tamped and then leveled with a carpenter's level.

**9.2.2 Ground Rod Sleeves.** Prior to backfilling a fiberglass switchgear pad, four 1" or 2" diameter PVC sleeves shall be installed vertically at each of the four inside corners of the pad in order to facilitate the Company's being able to drive 8' ground rods through them later, when the switchgear is set. The sleeves shall be 4" in length, installed 6" off the inside of each corner, and penetrate 6" above the final grade inside the pad. To this end, the fiberglass pad shall be situated in its final location over the conduit bends before the sleeves are driven.

**9.2.3 Fiberglass Pad Backfilling.** Fiberglass pads shall be stabilized in order to prevent them from shifting during backfilling. Backfilling shall begin with either flowable fill or a tamped layer of 1/4" limestone screenings both inside and outside the pad, up to the appropriate level indicated on the Specification Drawings for the pad in question. Provided the pad is not situated in a paved area, the rest of the exterior shall be backfilled with loose material and foot-tamped. The area around the fiberglass shall not be backfilled with large chunks of material or rocks, nor shall there be excessive tamping close to the sides of the pad, as its sides will tend to bow inward.

**9.2.4 Concrete-Encased Bends.** When the conduits coming up through the fiberglass pad are to be concrete encased, the concrete used in the conduit encasement shall not, under any circumstances, be substituted for the flowable fill or 1/4" limestone screenings used in backfilling the inside of the pad.

**9.2.5 Conduit Bend Height.** The conduit bends shall be cut off below the fiberglass pad's load-bearing mounting flange by the length indicated for the pad and conduit size in question (ref. SPEC 19 and 21) in order to make room for cable training and terminations.

**9.2.6 Switchgear pad** installation shall include site grade work to level off the area around the switchgear pad. The area around the switchgear pad shall be have a gradual slope to drain water away from the pad mount equipment and prevent pooling within the area defined on the drawing (approximately 1 inch rise over 12 inch run ratio). The switchgear pad shall be

installed in accordance with the current version of the Distribution Construction Standard and the Spec 25 or 25A drawing. The Construction Drawings may require protective bollards to be installed in accordance with SPEC 23 The Customer/Contractor/Contractor shall provide exterior weather resistant acrylic-latex based paint with primer and apply the paint to the hot dipped galvanized protective bollards, the color to be determined by the Company. The Customer/Contractor shall be responsible to ensure that the location of the bollards adheres to the Company's Distribution Construction Standard.

### 9.3 Pad Mount Switchgear Installation

**9.3.1** The pad mount switchgear shall be set such that the compartment assignments match the construction drawings and one-line. Additionally, the Customer/Contractor shall take all appropriate precautions to ensure that the installation of the pad mount switchgear equipment does not damage customer facilities, to include, but not be limited to landscaping, turf grass, sidewalks, asphalt or concrete pavement, and other equipment. Any damaged customer facilities shall be repaired or replaced to the customer's satisfaction, at no additional expense to Ameren.

**9.3.2 Labeling.** The pad mount switchgear unit shall be labeled and tagged as is given in Construction Standard 59-51-00-01. Switchgear exterior reflective labels will be provided by Ameren and shall be applied to the switchgear as follows:

- Pad number shall be applied to the two non-door (meaning cable access doors) sides of the switchgear, at the top of the side panel and shall be visible from the street
- Switchgear D number reflective stickers shall be affixed on the side small control panel door, where the manual operator handle is located; the format is D followed by the number (i.e. D12345)
- The feeder or DIP number reflective stickers shall be affixed on the cable access doors of the applicable switchgear compartment, located at the top of the switchgear door

## 10 Cable and Systems

### 10.1 Low Voltage Cables (less than 600V).

**10.1.1 Cable Ownership.** All cable (less than 600V) shall be provided and installed in the Conduit System by the Customer. Customer will retain and maintain ownership of cable and conduit. Such a cable shall be tagged as "customer owned" at both ends.

**10.1.2 Transformer Secondary Cables.** When the Company's designated Point of Delivery is a transformer, the Customer shall install the cables only after the Company has installed the transformer. It shall be the Customer's responsibility to mark the cables he installs and make them ready for termination.

**10.1.3 Pre-Bussed Tap Boxes.** Among the options for a distribution point in multi-tenant buildings is a sealable, pre-bussed tap box, typically mounted on the outside building wall. Combination or ganged meter centers are also a satisfactory alternative to pre-bussed tap boxes. The *Ameren Electric Service Manual* can be consulted for more details.

### 10.2 Primary Voltage Cables (Greater than 600V)

**10.2.1 Cable Pulling** All Ameren owned cables installed by Ameren's contractor shall be pulled into the conduits in accordance with the construction drawings, the Company Distribution Construction Standards, and this specification.

**10.2.2 Cable Pull Limitations** Cable pulls shall not exceed the conductor or pulling apparatus pulling tension, and the sidewall bearing pressure. All cable pulls shall include a generous amount of Company provided cable pulling lubricant, applied for the entire cable pull. The cable shall be fully lubricated as it enters the conduit at an approximately equal to one gallon of lubricant for per every 400 to 500 feet of cable. The Customer/Contractor shall ensure that an adequate supply of pulling lubricant is available to complete the pull, prior to starting the cable pull. The Contactor shall use swivels for all cable pulls. Pulling equipment use shall be as use as per the following table:

**Table 1 – Pulling Equipment Criteria**

<u>Cable Type</u>	<u>Cable Voltage (kV)</u>	<u>Pulling EQ (&lt; 500 LF)</u>	<u>Pulling EQ (&gt; 500 LF)</u>
<b>3-750 EPR</b>	15 kV	Conductor Crimp-On Bolt with 3-Way Bullet & Pulling Eye	Conductor Crimp-On Bolt with 3-Way Bullet & Pulling Eye
<b>3-750 AL EPR</b>	15 kV	Pulling Grip (Basket – single grip over entire 3Ø cable)	Conductor Crimp-On Bolt with 3-Way Bullet & Pulling Eye
<b>3-4/0 AL EPR</b>	15 kV	Pulling Grip (Basket – single grip over entire 3Ø cable)	Pulling Grip (Basket)
<b>3-500x4/0 BN,NW</b>	600V	Conductor Crimp-On Bolt with 3-Way Bullet & Pulling Eye	Conductor Crimp-On Bolt with 3-Way Bullet & Pulling Eye

The following is a table of cable information for determining cable pulling accessories.

**Table 2 – Cable Information**

<u>Cable Type</u>	<u>Cable Stock #</u>	<u>Cable Triplex O.D. (inches)</u>	<u>Cable Weight (pounds per linear foot)</u>
<b>3-750 EPR</b>	18-07-244	3.85	10
<b>3-750 AL EPR</b>	18-07-243	3.73	5.76
<b>3-4/0 AL EPR</b>	18-07-240	2.72	2.25
<b>3-500x4/0 BN,NW</b>	18-07-010	2.32	6.2

**10.2.3 Grips** for triplexed 3Ø cables shall be sized for the triplexed 3Ø diameter to be pulled – one pulling grip used to pull all three triplexed cables.

**10.2.4 Wrapping** All primary cables pulled into the manhole shall be fire wrapped, per Distribution Construction Standard # 59-40-90-42 and tagged per Distribution Construction Standard # 59-40-00-41.

**10.3 Cable Splicing** All cable splices (also known as JOINTS) shall be made in strict accordance with the Company's Distribution Construction Standards.

**10.4 Cable Racking** Cables shall be neatly trained within the manhole, as shown on the drawings. Only one primary cable shall be allowed per cable rack and the cable shall be cross tied to the cable rack using heavy duty cable-ties (minimum 50 pound test), per the Company cable racking spec, SPEC 28 Where there are conflicts between the drawings and spec, the requirements noted on the drawings shall prevail

## **11 Fiber Optics**

### **11.1 Innerduct Systems**

When indicated by the drawings, bundled innerducts, 4-1¼ inch inside diameter (I.D.) smooth wall innerducts will be supplied by the Company and will be delivered on a single reel. The four bundled innerducts are provided with three of the innerducts colored orange and one red colored innerduct.

**11.1.1 Color** The orange innerducts are designated as for future communications fiber cable use and red as for Company fiber optic cable use. The innerducts, both the bundled four and the single red, shall be pulled into the manhole and cut-off approximately 2 feet from the duct face. The innerducts shall not be continuous through the manholes.

**11.1.2 Installation** The innerducts shall be installed in accordance with industry standards and the manufacturer's instructions and per the drawings and this specification.

**11.1.3 Placement** shall be neatly trained within the manhole, hung from cable bridle saddle rings (similar to Garvin 1½ inch cable loop bridle ring, with ¼ x 20 threaded stud, item # BR-150-WH). The fiber optic cable shall be secured to the bridle rings using an industry approved tie-down device that will not damage the fiber optic cable.

### **11.2 Fiber Optic Cable**

**11.2.1 Cable.** The fiber optic cable shall be a continuous pull. Pull box locations are for future use and the fiber optic cable shall be neatly trained around the pull boxes in the manholes. The Customer/Contractor shall be qualified to pull and train fiber optic cables.

**11.2.2 Nomenclature.** The fiber optic cable provided by the Company is a 48 strand non-armored poly-jacketed fiber optic cable, rated for duct and outdoor use.

**11.2.3 Pulling Instructions** The fiber optic cable shall be pulled through innerducts and trained within the manholes in accordance with the drawings, this specification, the manufacturer's instructions, and current industry standards, including with regard to the proper pulling line, grips, and lubricants. The pulling tension for the fiber optic cable shall not exceed the manufacturer's maximum pulling tension, or 600 pounds (2,700 Newtons), whichever is less. The pulling device (wire mesh pulling grip) shall include a swivel. The maximum bending radius for the fiber optic cable shall not exceed the manufacturer's recommendations, or 15 times the cable's outside diameter, whichever is less. The pulling tension shall be monitored (dynamometer) at all times during the fiber optic cable pull with a slip clutch if the maximum pulling tension approaches 75% of the maximum pulling tension. Exceeding the maximum pulling tension could void the fiber optic cable warranty.

**11.2.4 Slack.** Fiber optic cables shall have intentional slack points, where 100 feet of slack is coiled up into a 3 foot diameter coil, and stowed within the manhole, on the wall as shown on the drawing details.

**11.2.5 Figure 8 Loops.** The Customer/Contractor shall follow the manufacturer's recommendation for figure 8 loops when handling excess cable slack between manhole pulls.

**11.2.6 Testing.** Once installed, the fiber optic cable shall be acceptance tested in accordance with the manufacturer's recommendations, to ensure that the fiber optic cable was not damaged during the installation procedure.

## **12 Restoration**

**12.1 Public Right-of-Way.** The Customer/Contractor shall restore all areas that are not part of the public right-of-way (R.O.W.) including vacated streets, to their previous condition or better or as specifically called out on the drawings or this specification.

In Illinois, consult the local municipality-and the Illinois Department of Transportation (IDOT) for restoration requirements within the R.O.W.

In Missouri, consult the local municipality-and the Missouri Department of Transportation (MODOT) for restoration requirements within the R.O.W.

**12.2 Asphaltic Pavement.** If specified within the project scope of work, the Customer/Contractor need not restore the 3 inch asphaltic pavement as the Company will coordinate restoration of the street asphaltic flatwork with the local municipality. In this situation, the Customer/Contractor shall pour the street base up to grade and dye the street base concrete black with a dry shake immediately following the pour, if the existing street has an asphaltic layer

**12.3 Parking Lots.** Replacement of parking lots shall be consistent with the existing parking lot construction. The asphaltic surface shall be restored to its existing condition or better and any disturbed parking striping shall be restored to its existing condition or better, as well.

**12.4 Landscaped Areas.** All landscaped areas disturbed as part of conduit systems construction shall be restored to their original condition. Grassy-lawn areas shall be seeded and mulched or be sodded. Any landscaping, plantings, bushes, trees, etc. shall be restored to their existing condition or better. The Customer/Contractor shall take care not to disturb established trees and large plantings; however, if required, any planting that requires replacement shall be replaced with an equivalent size plant. Customer/Contractor shall maintain the new grass area until new grass is established. Maintenance for the restored grass area or new plantings shall include watering, fertilizing, weeding, and replanting, as required. Maintenance shall continue until new grass and plantings are established, at a minimum period of 60 days.

**12.5 Customer Property.** Any construction and/or restoration work on customer property shall be coordinated with the customer.



## 13 Inspection and Approval

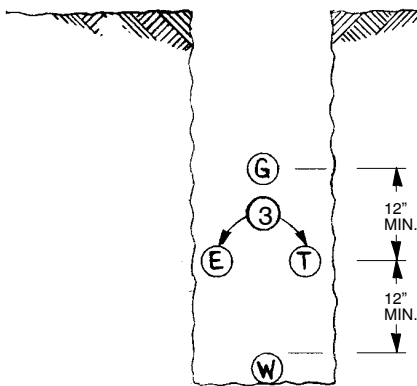
- 13.1 Deviation from Drawings.** All Customer/Contractor-installed facilities shall be installed per Company Drawings. Any proposed field changes to the Conduit System layout as indicated on the Drawings shall have prior approval from the Company Representative.
- 13.2 Interpretation of Specification and Drawings.** Where an interpretation of this Specification or clarification of the intent of any Drawing is required, the determination of the Company Representative shall prevail.
- 13.3 Conduit System Inspections.** Conduit System installations by the Customer/Contractor shall be subject to inspections by the Company on a daily basis prior to backfilling, embedding in concrete or otherwise covering or concealing. The Customer/Contractor shall notify the Company Representative with at least one full working day's advance notice before the start of Conduit System construction or the installation of material, thus allowing for the inspection of materials and workmanship by the Company. The decision to actually inspect or not shall be at the discretion of the Company.
- 13.4 Conduit System Rejection.** Any Customer/Contractor materials and/or workmanship failing to meet the requirements of this Specification, or Conduit System installations either performed without prior notice to the Company Representative or that fails to allow the Company to readily pull in its primary cable(s), shall be subject to rejection. Any work that is rejected shall be corrected to the Company's satisfaction at the Customer/Contractor's expense.
- 13.5 "As Built" Drawings.** The Company Representative shall maintain an "as built" set of Drawings showing all changes, additions and deletions to the project. Field changes not covered by the original Drawings shall be clearly noted on the "as built" Drawings.
- 13.6 Depth of Cover Deviations.** When the depth of cover of the Customer/Contractor's installation exceeds the design value by 50% or more, or is less than the design value by any margin, the Customer/Contractor shall provide the Company Representative with the actual depth, which shall then be noted on the "as built" Drawings.

## **APPENDIX - Underground Specification Drawings**

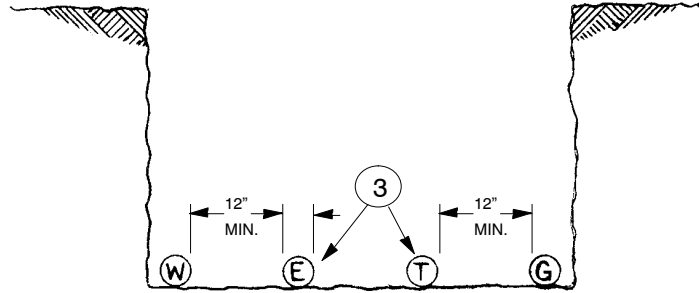
<b><u>Drawing Number</u></b>	<b><u>Drawing Description</u></b>
<b>SPEC 1</b>	Underground Lines Construction – Joint Trench Minimum Clearances (NESC)
<b>SPEC 2</b>	Conduit Structures – Underground Bend Restraint
<b>SPEC 3</b>	Underground Structures – 2’ x 4’ x 2’ Deep Polyethylene Splice Box
<b>SPEC 4</b>	Underground Structures – 3’ x 5’ x 42” Deep Precast Concrete Vault
<b>SPEC 4A</b>	Underground Structures – 3’ x 5’ x 42” Deep Polyethylene Vault
<b>SPEC 5</b>	Underground Structures – 4’ x 8’ x 4’ Deep Precast Concrete Vault
<b>SPEC 6</b>	Conduit Structures – Standard Duct Construction
<b>SPEC 7</b>	Manholes Structures - 3 Way Precast 10’6” x 14’0”
<b>SPEC 8</b>	Manholes Structures – 6’0” x 17’6” Straight Precast Manhole
<b>SPEC 9</b>	Manholes Structures – 4’0” x 10’0” Straight Precast Manhole
<b>SPEC 10</b>	Manholes Structures – 6’0” x 14’0” Straight Precast Manhole
<b>SPEC 11</b>	Manhole Structure Accessories – Precast Concrete Ring Sections
<b>SPEC 12</b>	Manhole Structure Accessories – Manhole Necks
<b>SPEC 13</b>	Manhole Structure Accessories – 36” Manhole Frame and Cover
<b>SPEC 14</b>	Manhole Structure Accessories – Standard Bay Construction (Wing Wall)
<b>SPEC 15</b>	Conduit Structures – Conduit Spacer for 30” Steel Casing (8 & 10 Duct Configuration)
<b>SPEC 16</b>	Cable Terminals – One or More Risers on Standoffs
<b>SPEC 16A</b>	Cable Terminals – One Riser for Cable in Concrete-Encased Conduit
<b>SPEC 17</b>	Conduit Structures – Conduit Drainage Pit
<b>SPEC 18</b>	Pad Structures – Padmount Transformer and Cable Enclosure Material Spec
<b>SPEC 18A</b>	Pad Structures – Single Phase Padmount Transformers (25 kVA to 167 kVA)
<b>SPEC 18B</b>	Pad Structures – Three Phase Padmount Transformers (75 kVA to 750 kVA)
<b>SPEC 18C</b>	Pad Structures – Three Phase Padmount Transformers (1000 kVA to 2500 kVA)
<b>SPEC 18D</b>	Pad Structures – Three Phase Padmount Transformers, 34.5kV, (1500 kVA to 3000 kVA Radial-Feed and 500 kVA to 2500 kVA Loop-Feed)
<b>SPEC 19</b>	Pad Structures – Three Phase Secondary/Service Cabinet
<b>SPEC 21</b>	Pad Structures – 3-Way & 4-Way Three Phase Primary Cable Enclosure
<b>SPEC 22</b>	Underground Lines Construction – Required Clearances for Padmount Equipment
<b>SPEC 23</b>	Underground Lines Instruction - Customer Installed Pad Installations, Protective Barrier Rail Installation
<b>SPEC 25</b>	Underground Equipment - Switching - Padmounted Primary Switchgear, Composite Pad
<b>SPEC 26</b>	Equipment - Switching - Padmounted - 3 Phase, 35kV, Vacuum Type
<b>SPEC 27</b>	Manhole Structures – Grounding System
<b>SPEC 28</b>	Manhole Structures – Cable Racking
<b>SPEC 29</b>	Manhole Structure – Fiber Optic Cable Training

**UNDERGROUND LINES INSTRUCTION**  
**Joint Trenching**  
**Minimum Cable Clearance Requirements ( NESC )**

**VERTICAL SEPARATION**



**HORIZONTAL SEPARATION**



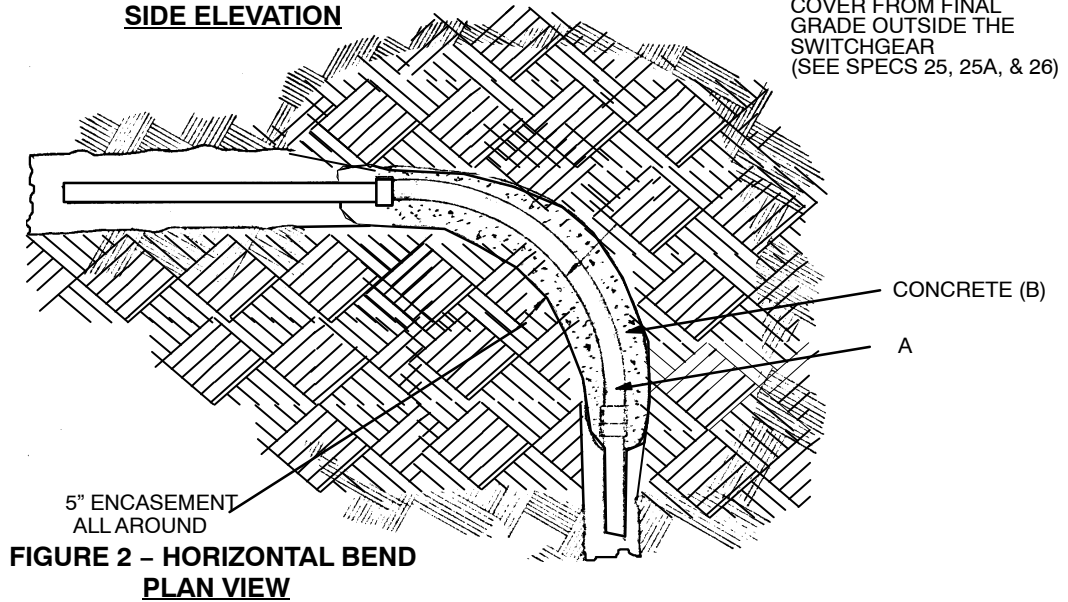
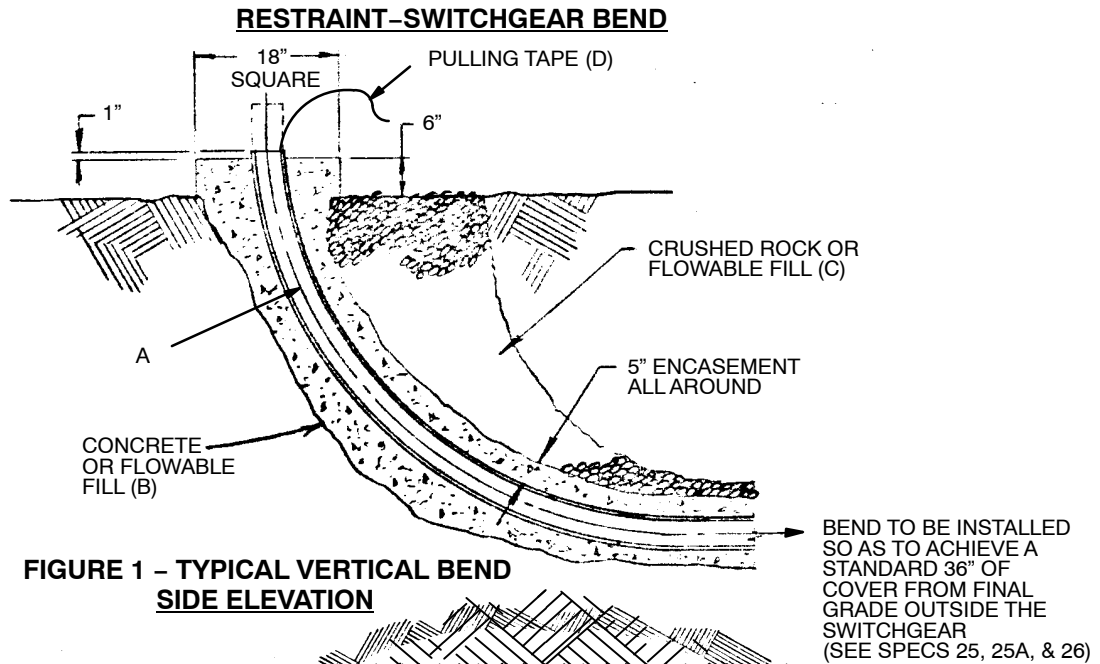
↑  
 REPRESENTS ONE OR MORE ELECTRIC CONDUITS, EITHER DIRECT BURIED OR MATRIX-CONFIGURED IN A CONCRETE ENCASEMENT.

LEGEND	
E	- ELECTRIC
G	- GAS
T	- TELEPHONE
W	- WATER

**NOTES:**

1. The use of a joint trench is acceptable only in the case where the parties involved agree to its use and their individual placements within.
2. Horizontal and vertical separations shall be 12 inches per NESC only. Local gas, telephone and water company clearance requirements shall prevail when their requirements exceed these minimum NESC separations.
3. Horizontal separation between electric and telephone (barring any stricter local telephone company requirements) shall be 12 inches. This dimension may be reduced to 6 inches minimum in Missouri providing all parties are in agreement to this reduction.

( DERIVED FROM CONSTRUCTION STANDARD 59 40 00 44 )

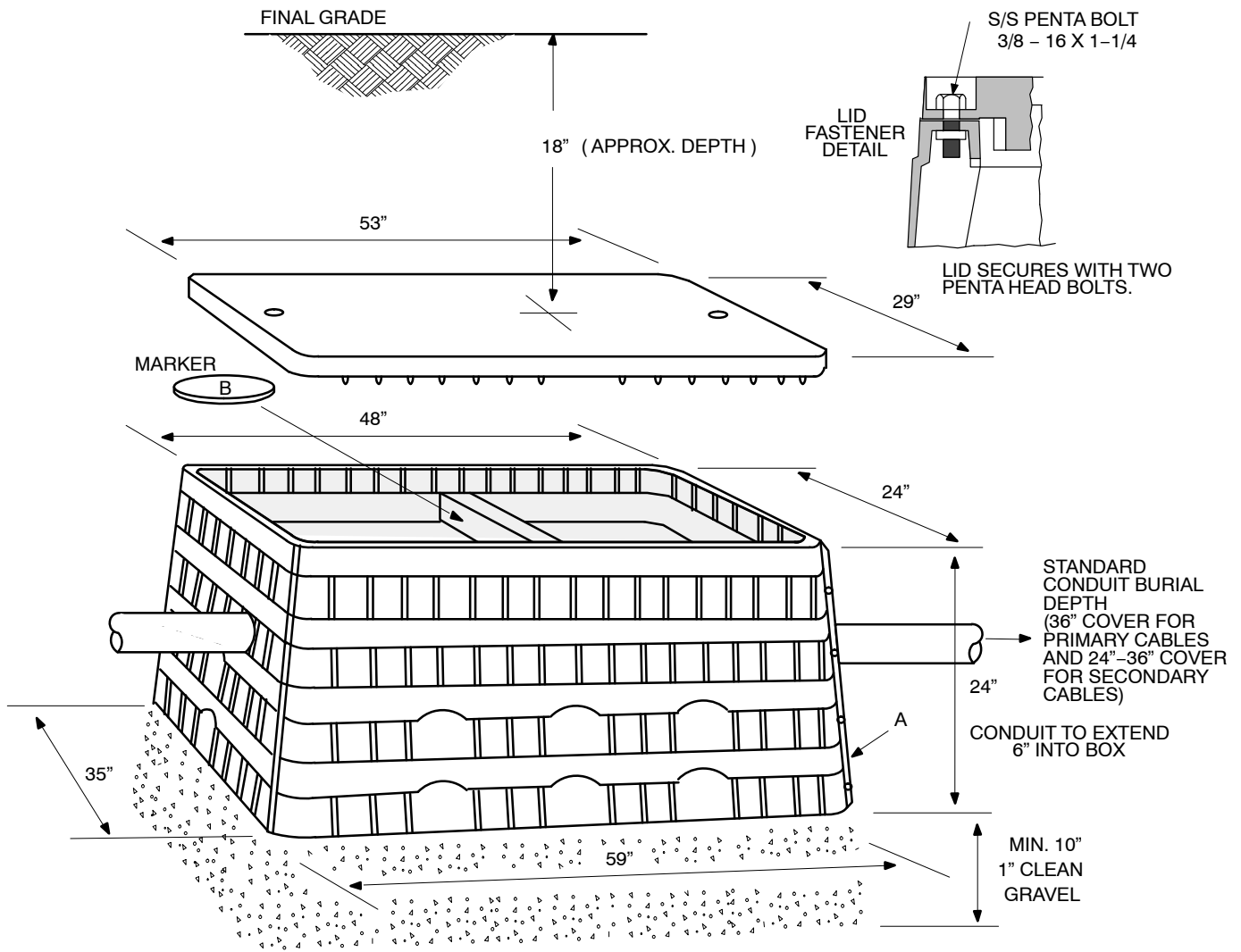


MATERIAL INSTALLED BY CONTRACTOR  
 ( DERIVED FROM CONSTRUCTION STANDARD 31 47 01 \*\* )

	Material / Stk. No.		Quantity					
			Horizontal			Vertical		
	12 51 173	Bend 3" x 36" Rad, Sch. 40	1			1		
A	12 51 176	Bend 4" x 36" Rad, Sch. 40		1			1	
	12 51 206	Bend 5" x 36" Rad, Sch. 40			1			1
B		Concrete or Flowable Fill (Cu. Ft.)	5	6	7	7	8	9
C		Crushed Rock or Flowable Fill (Cu.Yd.)				1/2	1/2	1/2
D	83 36 252	Pulling Tape – 3/4" Wide, 2500 lb. Strength (ft.)	As Req'd.	As Req'd.	As Req'd.	As Req'd.	As Req'd.	As Req'd.

# STRUCTURES

## Splice Box–High Density Polyethylene 2'x4'x2' Deep No Couplings Either End



**BOX - SPLICE 24" X 24" X 48"**  
**FOR USE IN NON-TRAFFIC AREAS**

**INSTRUCTIONS :**

1. Excavate and install box so that conduits remain at standard depths on 10 inch base of 1 inch gravel. Box lid located approximately 18" below grade.
2. Install conduits thru knockouts, or bore holes in the box. Seal conduits at box interface.
3. After installing box, place lid on box, partially backfill around lid and tamp soil.
4. Place electronic marker at the center inside of the box. **IMPORTANT:** Marker must be laid flat.
5. Duct tape over bolt holes on lid before covering box.

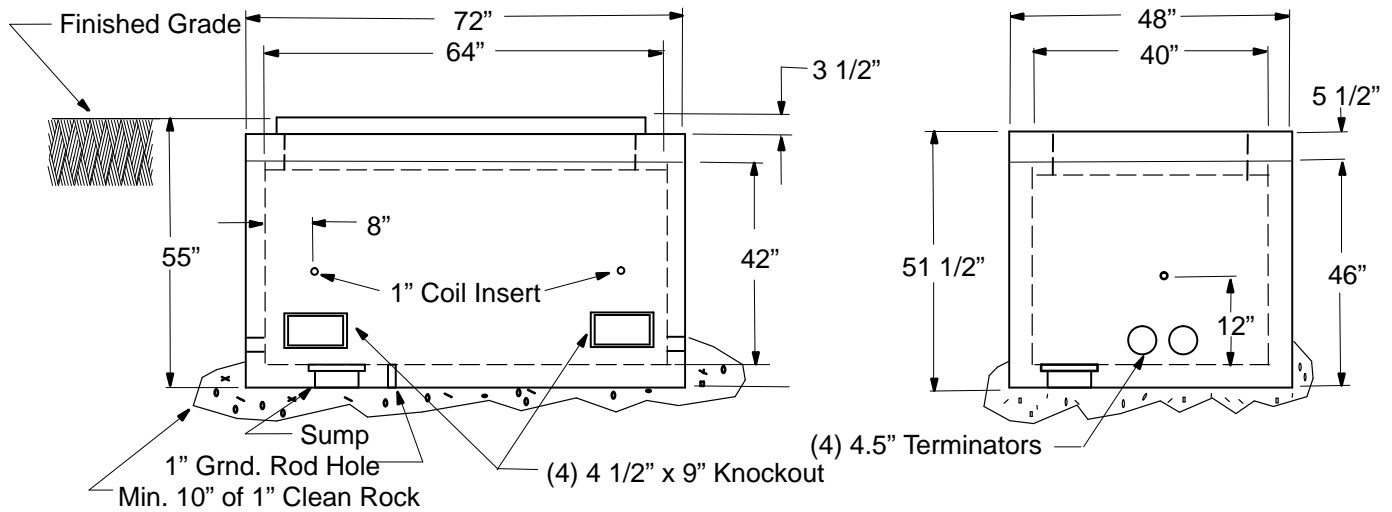
MATERIAL INSTALLED BY CONTRACTOR

( DERIVED FROM CONSTRUCTION STANDARD 31 21 02 01 )

	Material / Stk. No.	Description	Qty.	Weight
A	12 06 105	Box, Cable, 2' x 4' x 2' Deep (Provided by Ameren)	1	120 lbs.
B	49 05 519	Marker, Electronic (Provided by Ameren)	1	
		Rock, Crushed	As Req'd	

**UNDERGROUND STRUCTURES**  
 Vault – Precast 3' x 5' – 42" deep  
 2-4" PVC Couplings Each End

**\*\*THIS VAULT DOES NOT HAVE A TRAFFIC RATING.\*\***



Grade adjustments shall be made using the riser and necessary brick and mortar to meet the existing slope. The vault floor shall always be installed level.

1. This vault shall be situated out of the way of vehicular traffic in a location determined by Ameren.
2. Excavate a 5' x 7' pit to a depth necessary to obtain minimum cover for the conduits on a 10" base of 1' gravel. Outside dimensions are L-72"; W-48"; H-55"; Riser 6" tall. Note: riser, if needed, can be used - stock # 12 06 192.
3. Fill any overdig with crushed rock leveling the rock and tamping to firm wherever the earth has been disturbed.
4. To lift vault, use swivel plates mounted to the Richmond inserts with lag bolts that "Firmly" fasten the plate against the wall.
5. Place conduits into knockouts 6 inches as required. Grout or mortar around conduits entering thru knockouts.
6. FILL & TAMP - Replace and stabilize the earth around the vault and riser tamping to compaction.
7. Seal the cover frame to the riser with mortar.
8. Install 3" - 6" duct shields (12-53-017) as required.

MATERIAL INSTALLED BY CONTRACTOR

( DERIVED FROM CONSTRUCTION STANDARD 32 24 01 \*\* )

	Materials / Stk. No.	Description	Quantity			Weights
			UNIT	LEVEL	SLOPED	
A	12 06 097	Vault - Precast 3' x 5' (Provided by Ameren)	Ea	1	1	Vault 4200 lbs.
C	12 02 100	Cover - Vault Galv. Stl. 42" x 66" (Provided by Ameren)	Ea	1	1	Cover 500 lbs.
		Rock - Crushed ( 1" Clean )	Cy	1	1	
		Brick	Ea	--	As Req'd.	
		Mortar	Bag	0	1	

# UNDERGROUND STRUCTURES

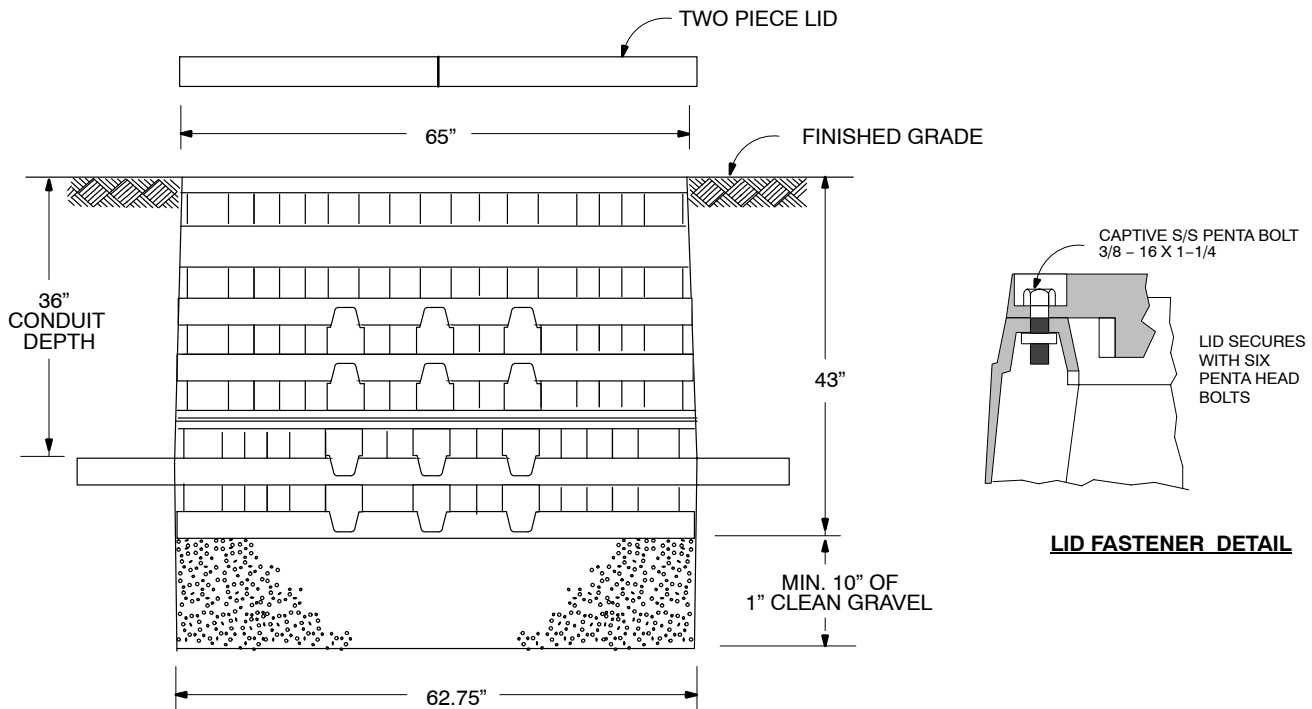
**SPEC 4A**



Vault – Polyethylene/Fibercrete 3' x 5' – 42" Deep  
2 – 4" Couplings Each End

Sheet 1 of 1

**"This vault does not have a traffic rating."**



**Instructions :**

1. This vault shall be situated out of the way of vehicular traffic in a location determined by Ameren.
2. Excavate and install vault at standard conduit depths on 10" base of 1" gravel.
3. Fill any overdig with crushed rock levelling the rock and tamping firm.
4. Install conduits in couplings or drill holes in desired conduit locations.
5. FILL & TAMP – Replace and stabilize the earth around the vault tamping to compaction.
6. Install 3" to 6" duct shields (12-53-017) as required.

**MATERIAL INSTALLED BY CONTRACTOR**

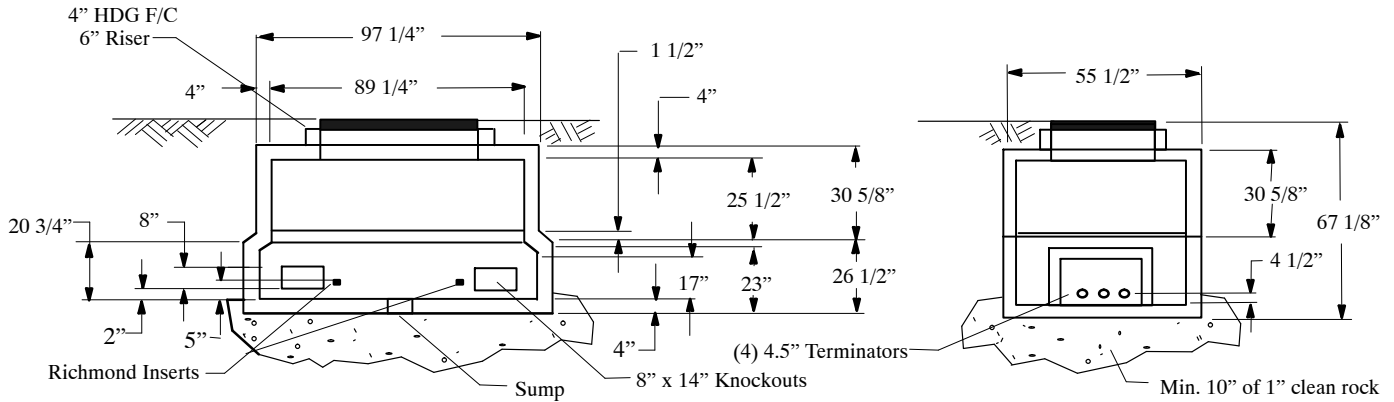
( DERIVED FROM CONSTRUCTION STANDARD 32 24 03 \*\* )

Std. / Stk. No.	Description	Unit	Quan.	Weight
12 06 122	Vault – Polyethylene 3' x 5' (Provided by Ameren)	Ea.	1	1472 lbs.
	Rock – Crushed	Cy	1	

**UNDERGROUND STRUCTURES**  
**Vault – Precast 4' x 8' – 4 Ft. deep**  
**3–5" PVC Couplings Each End**

**SPEC 5**  
**Sheet 1 of 1**

**\*\* THIS VAULT DOES NOT HAVE A TRAFFIC RATING\*\***



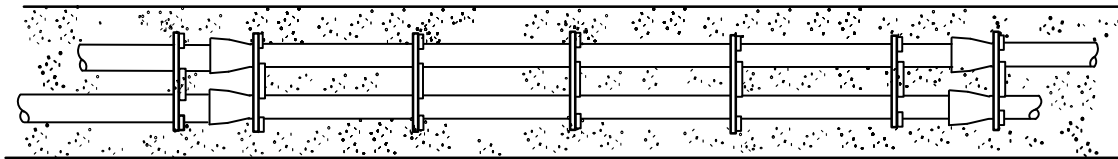
Grade adjustments shall be made using the riser to meet the existing slope. The vault floor shall always be installed level.

1. This vault shall be situated out of the way of vehicular traffic in a location determined by Ameren.
2. Excavate a 6' x 11' pit to a depth necessary to obtain minimum cover for the conduits on a 10" base of 1" gravel. Outside vault dimensions: L–8'10"; W–5'6"; H–5'–10"; Riser 6" tall. NOTE: RISER MUST BE USED.
3. Fill any overdig with crushed rock leveling the rock and tamping to firm wherever the earth has been disturbed.
4. Use swivel plates mounted to the Richmond inserts with lag bolts that "Firmly" fasten the plate against the wall.
5. Place conduits into knockouts 6 inches as required. Grout or mortar around conduits entering thru knockouts.
6. FILL & TAMP – Replace and stabilize the earth around the vault and riser tamping to compaction.
7. Brick and mortar between riser and keyway in manhole to accommodate the grade slope. Seal the cover frame to the riser w/aqua seal (25–54–053). Install pulling eyes firmly into wall above conduits.
8. Sod or resurface grade as necessary.
9. Install 3" to 6" duct shields (12–53–017) as required.

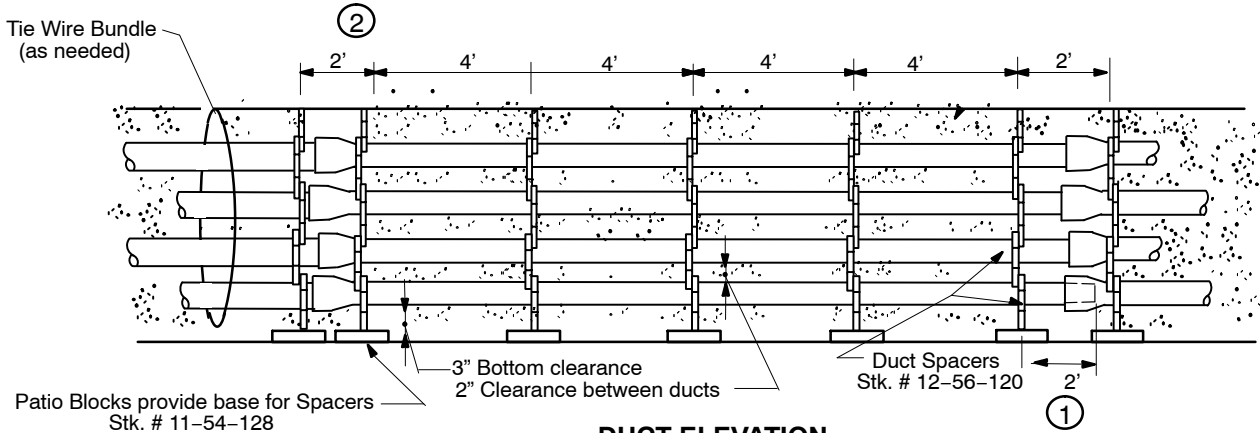
MATERIAL INSTALLED BY CONTRACTOR  
 ( DERIVED FROM CONSTRUCTION STANDARD 32 24 02 \*\* )

	Material / Stk. No.	Description	Quantity			Weights
			UNIT	LEVEL	SLOPED	
A	12 06 096	Vault – Precast 4' x 8' (Provided by Ameren)	Ea	1	1	Top 4420 lbs. Bottom 4560 lbs.
B	12 06 192	Riser–Concrete Neck 6" Extension (Provided by Ameren)	Ea	1	1	Riser 365 lbs.
C	12 02 100	Cover – Vault Galv. Stl. 42" x 66" (Provided by Ameren)	Ea	1	1	Cover 500 lbs.
		Rock – Crushed ( 1" clean )	Cy	2	2	
		Brick	Ea	--	As Req'd.	
		Mortar	Bag	0	1	

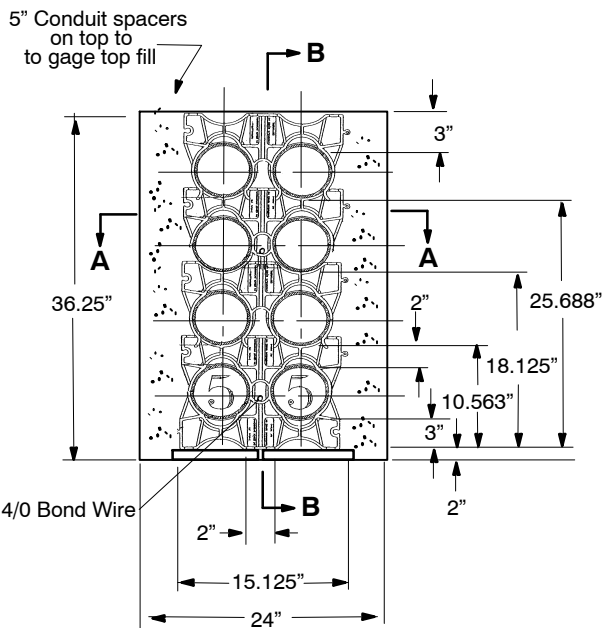




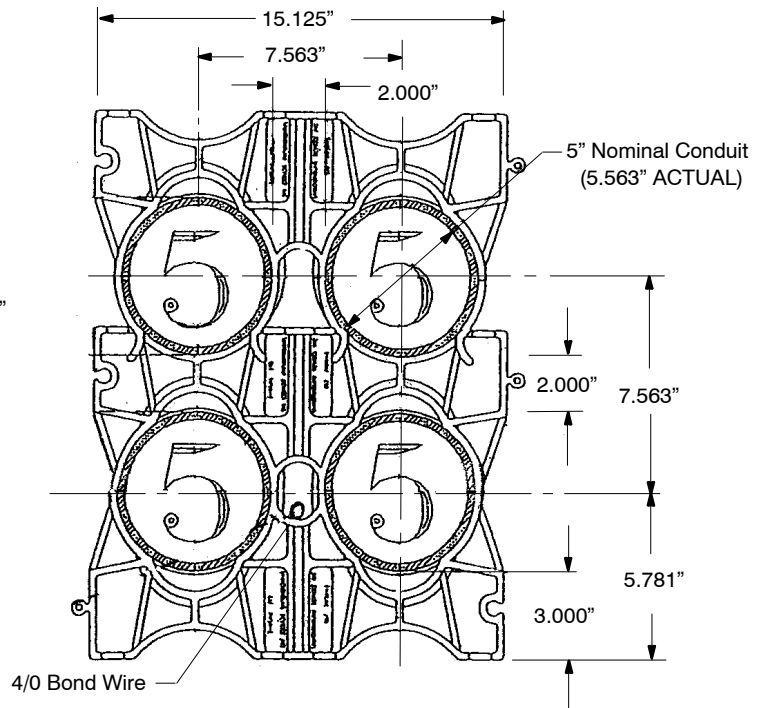
**Section A A**



**DUCT ELEVATION**  
**Section B B**



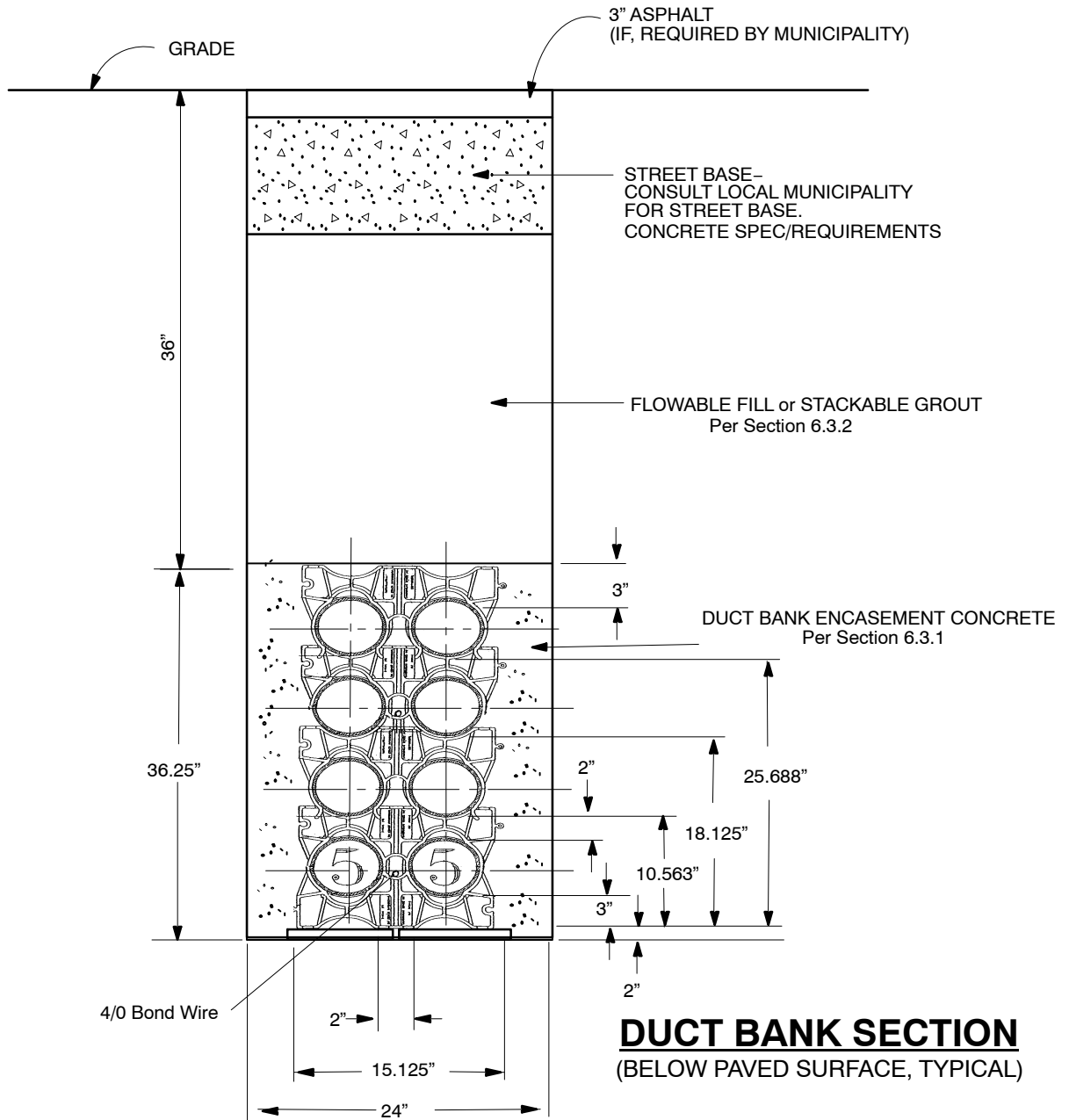
**MANHOLE TERMINATION**  
**ARRANGEMENT**



**Enlarged View of Spacers**

**NOTES:**

1. If in level terrain a minimum fall of 6" per 100' shall be provided.
2. Reduce this dimension to 1 ft. On each end when using 10 ft. Conduit. 4 ft. spacing stays the same.



MATERIALS INSTALLED BY CONTRACTOR

	Stock. No.	Description	Req'd
A	12 01 335/336	Conduit–Plastic 5", Sch. EB(10ft. Or 20ft. lengths)	As Req'd
C	12 56 120	Spacer–Conduit	As Req'd
D		Concrete (c.y.)	As Req'd
E	18 52 030	Wire–4/0, Tinned, Soft Drawn	As Req'd

# STRUCTURES – MANHOLES

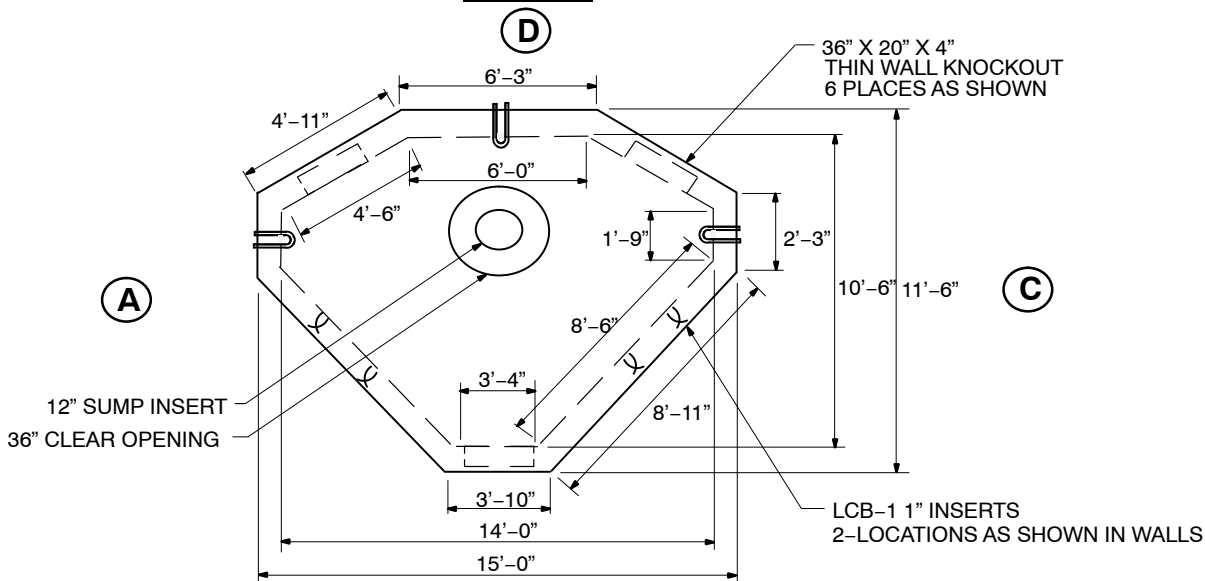
3 – Way – Precast

10'-6" x 14'-0" x 7'-0"

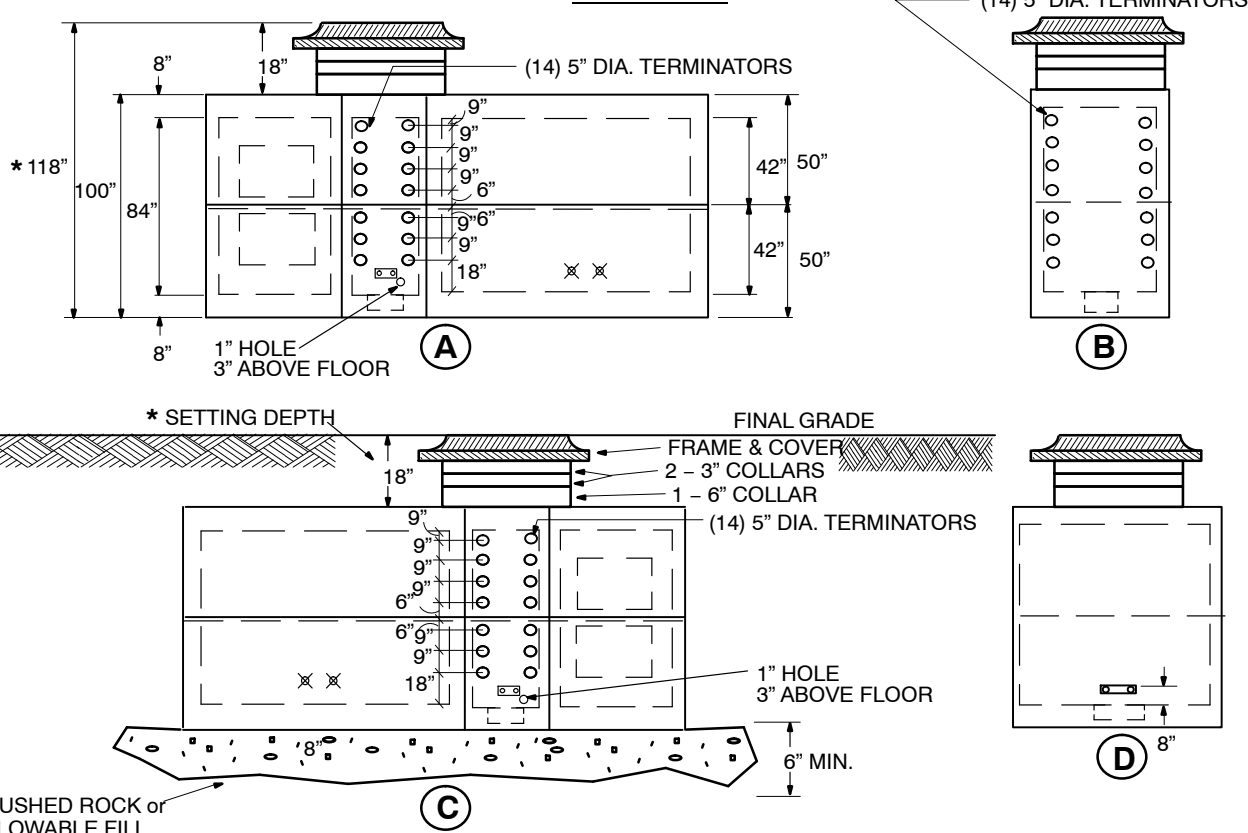
**SPEC 7**

Sheet 1 of 2

## TOP VIEW



## SIDE VIEWS



### COLLAR CONFIGURATION

PREFERRED – 1-6" & 2-3"  
3" NECKS ARE REQUIRED ON ALL MANHOLES  
AND SHALL BE TOP COLLARS

### \* SETTING DEPTHS

COORDINATE W/AMEREN REP.  
PREFERRED – 18" (AS SHOWN)  
MINIMUM – 12" TO FINAL GRADE  
MAXIMUM – 60" TO FINAL GRADE

### WEIGHTS

TOP SECTION	21,609 lbs.
BASE SECTION	22,305 lbs.
TOTAL	43,914 lbs.

**TRAFFIC RATED DESIGN**

(DERIVED FROM CONSTRUCTION STANDARD 32 22 01 \*\*)

**UNDERGROUND DISTR.  
CONCRETE ENCASED SPEC.**



ENG: JLH  
REV. NO: 4  
REV. DATE: 06/18/14

**STRUCTURES – MANHOLES**

3 – Way – Precast

10'-6" x 14'-0" x 7'-0"

**SPEC 7**

Sheet 2 of 2

	Stock. No.	Description	Traffic Rated	Deep Neck
A	12 06 237	Manhole – Top, Precast Conc.	1	1
	12 06 238	Manhole – Bottom, Precast Conc.	1	1
B	SPEC 12	Neck & Frame – 36" Round	1	
		Neck & Frame – 36" Round x 4' Long		1
C	19 04 327	Grate – 14"	1	1
D		Crushed Rock (c.y.)	12	12

NOTE

1. 4.586 Cubic yards of dirt removed per foot of excavation.
2. Add the required number of 6" concrete (Stk. # 12 06 063) and 3" concrete (Stk. # 12 06 062) necks so that the frame and cover are at final grade.
3. Set the manhole at the "Preferred Depth" or contact company rep. if not achievable.

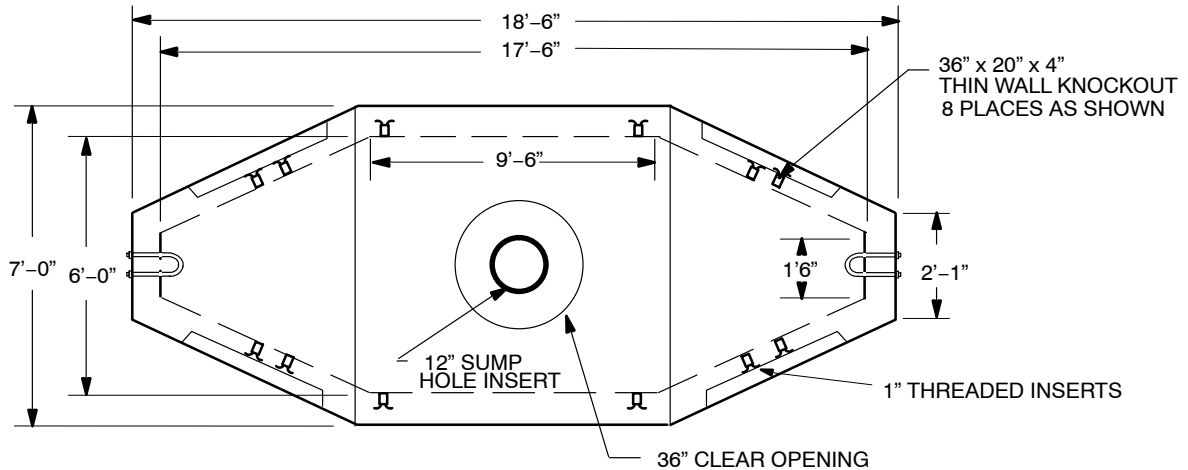
# STRUCTURES – MANHOLES

Straight – Precast  
6'-0" x 17'-6" x 7'-0"

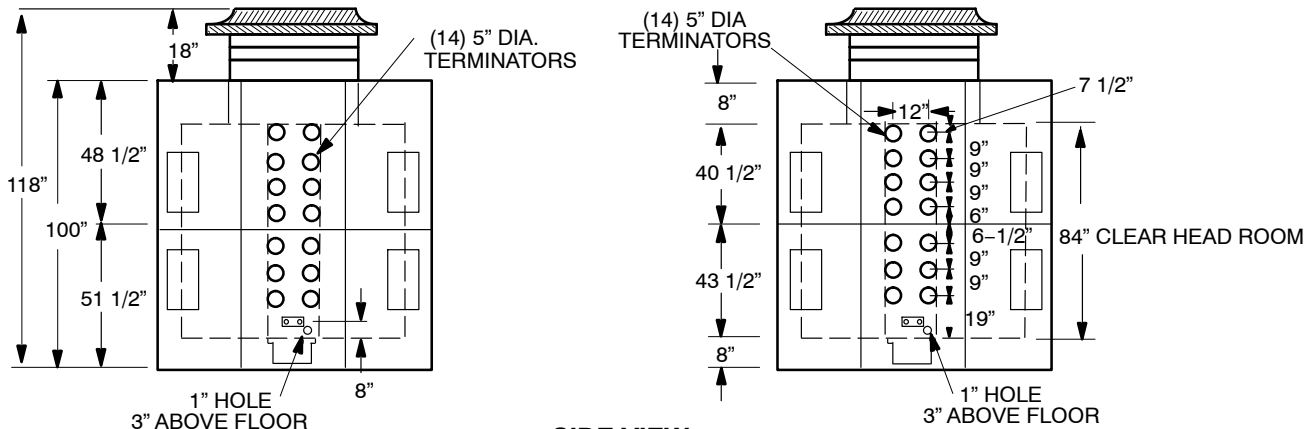
# SPEC 8

Sheet 1 of 2

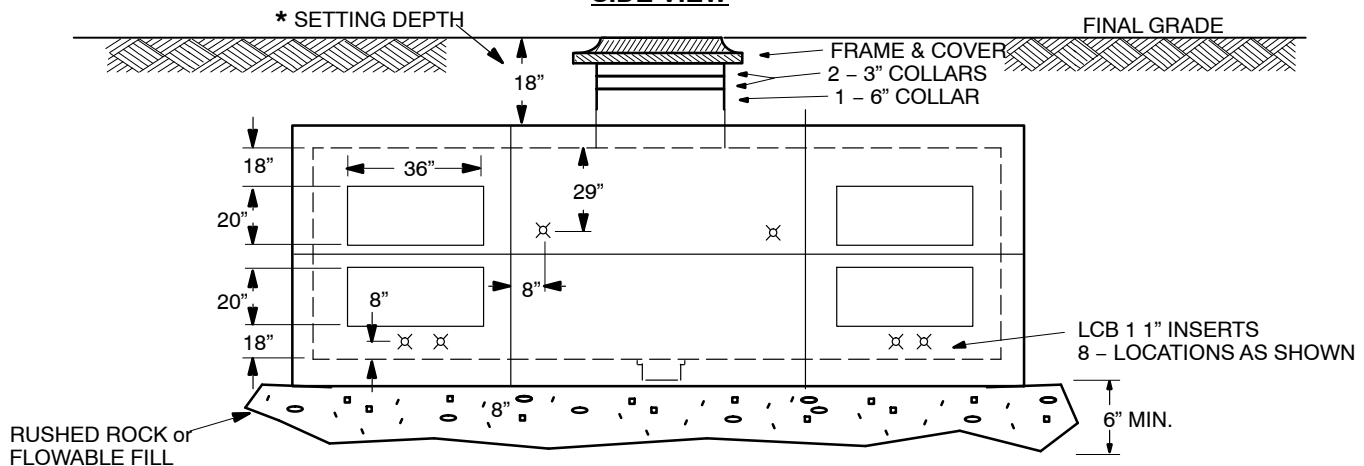
## TOP VIEW



## END VIEWS



## SIDE VIEW



### COLLAR CONFIGURATION

PREFERRED - 1-6" & 2-3"  
3" NECKS ARE REQUIRED ON ALL MANHOLES AND SHALL BE TOP COLLARS

### \* SETTING DEPTHS

COORDINATE W/AMEREN REP.  
PREFERRED - 18" (AS SHOWN)  
MINIMUM - 12" TO FINAL GRADE  
MAXIMUM - 60" TO FINAL GRADE  
(DERIVED FROM CONSTRUCTION STANDARD 32 21 01 \*\*)

### WEIGHTS

TOP SECTION	20,980 lbs.
BASE SECTION	21,599 lbs.
TOTAL	42,579 lbs.

**TRAFFIC RATED DESIGN**

**STRUCTURES – MANHOLES**

Straight – Precast  
 6'-0" x 17'-6" x 7'-0"

**SPEC 8**

Sheet 2 of 2

	Stock. No.	Description	Traffic Rated	Deep Neck
A	12 06 235	Manhole – Top, Precast Conc.	1	1
	12 06 236	Manhole – Bottom, Precast Conc.	1	1
B	SPEC 12	Neck & Frame – 36" Round	1	
		Neck & Frame – 36" Round x 4' Long		1
C	19 04 327	Grate – 14"	1	1
D		Crushed Rock (c.y.)	12	12

NOTE

- 5.32 Cubic yards of dirt removed per foot of excavation.
- Add the required number of 6" concrete (Stk. # 12 06 063) and 3" concrete (Stk. # 12 06 062) necks so that the frame and cover are at final grade.
- Set the manhole at the "Preferred Depth" or contact company rep. if not achievable.

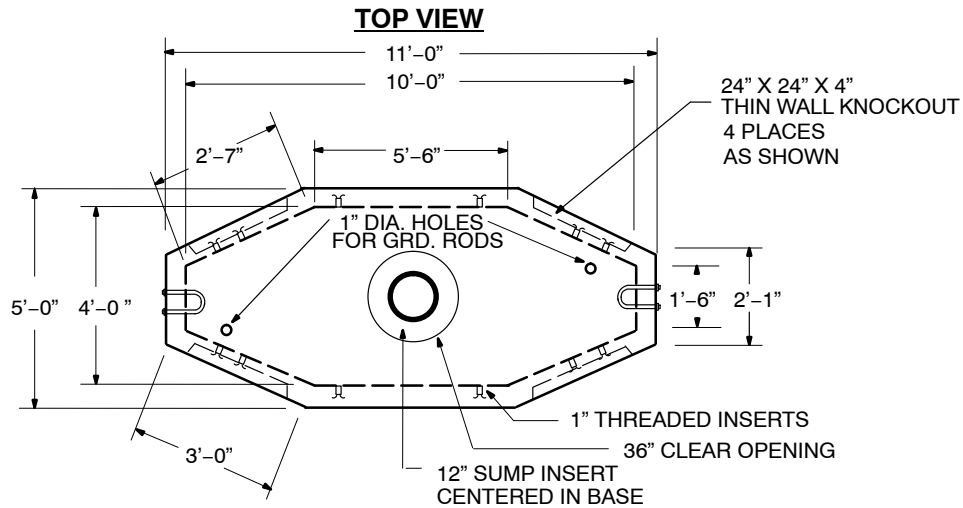
# STRUCTURES – MANHOLES

Straight – Precast

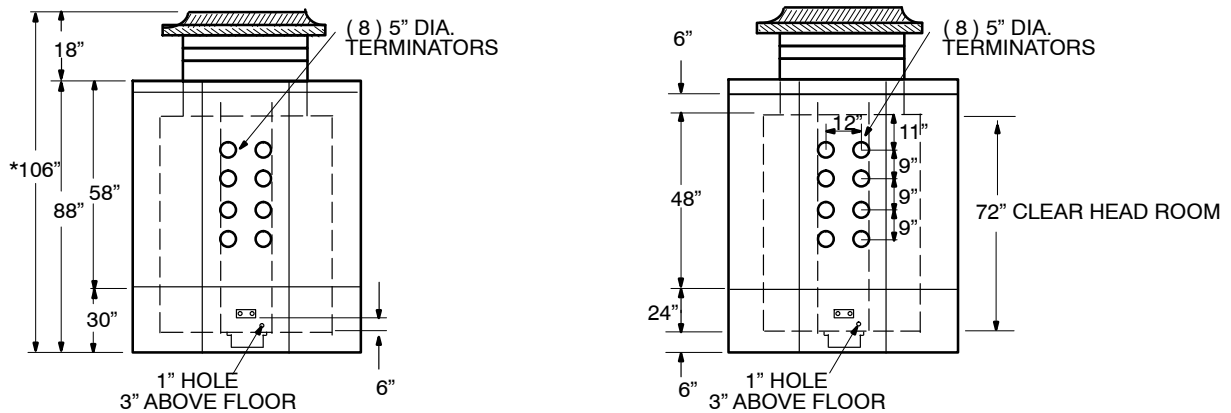
4'-0" x 10'-0" x 6'-0"

# SPEC 9

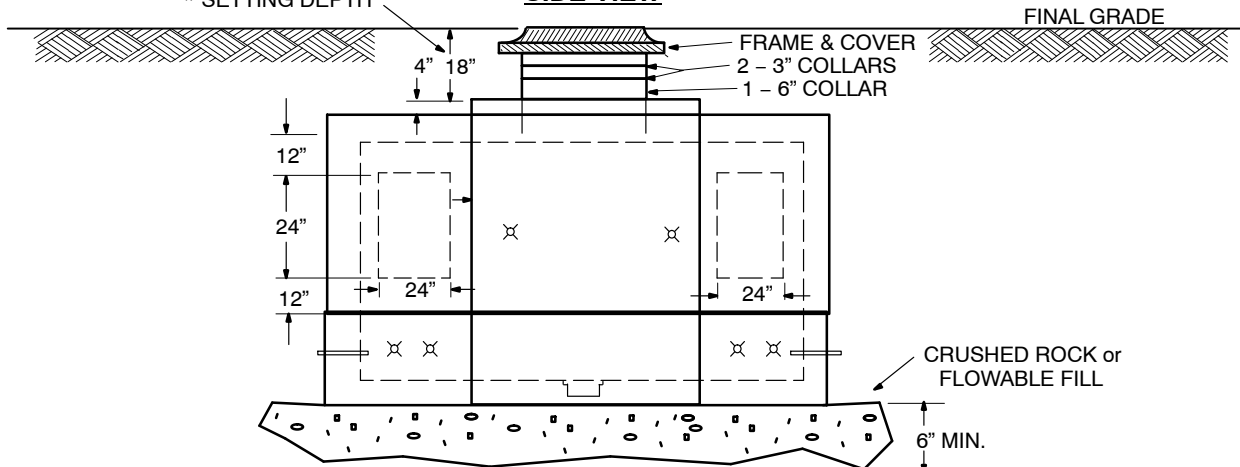
Sheet 1 of 2



## END VIEWS



## SIDE VIEW



### COLLAR CONFIGURATION

PREFERRED – 1-6" & 2-3"  
3" NECKS ARE REQUIRED ON ALL MANHOLES  
AND SHALL BE TOP COLLARS

### \* SETTING DEPTHS

COORDINATE W/AMEREN REP.  
PREFERRED – 18" (AS SHOWN)  
MINIMUM – 12" TO FINAL GRADE  
MAXIMUM – 60" TO FINAL GRADE

### WEIGHTS

TOP SECTION	13,200 lbs
BASE SECTION	7,350 lbs
TOTAL	20,550 lbs

TRAFFIC RATED DESIGN

(DERIVED FROM CONSTRUCTION STANDARD 32 21 02 \*\*)

UNDERGROUND DISTR.  
CONCRETE ENCASED SPEC.



ENG:DDG  
REV. NO: 6  
REV. DATE: 12/12/12

**STRUCTURES – MANHOLES**

Straight – Precast

4'-0" x 10'-0" x 6'-0"

**SPEC 9**

Sheet 2 of 2

	Stock. No.	Description	Traffic Rated Neck	Deep Neck
A	12 06 231	Manhole – Top, Precast Conc.	1	1
	12 06 232	Manhole – Bottom, Precast Conc.	1	1
B	SPEC 12	Neck & Frame – 36" Round	1	
		Neck & Frame – 36" Round x 5' Long		1
C	19 04 327	Grate – 14"	1	1
D		Crushed Rock (c.y.)	2/3	2/3

NOTE

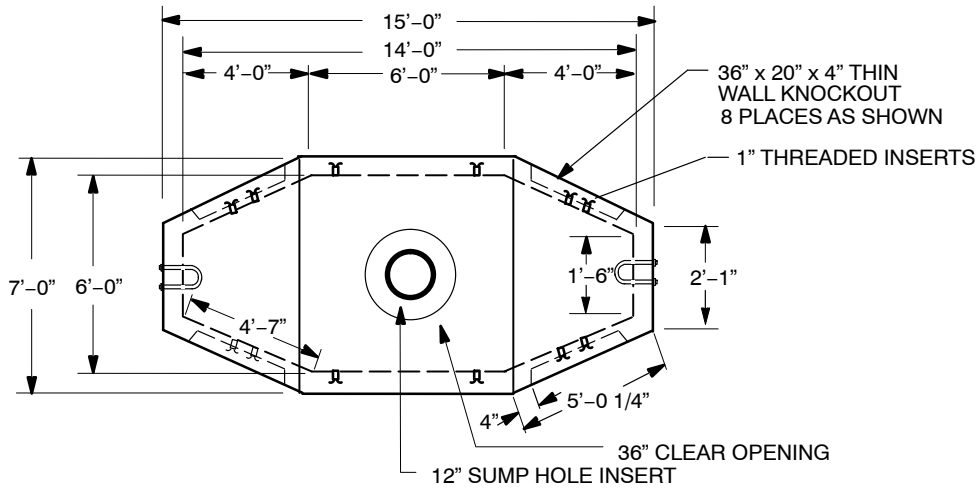
1. 2.45 Cubic yards of dirt removed per foot of excavation.
2. Add the required number of 6" concrete (Stk. # 12 06 063) and 3" concrete (Stk. # 12 06 062) necks so that the frame and cover are at final grade.
3. Set the manhole at the "Preferred Depth" or contact company rep. if not achievable.



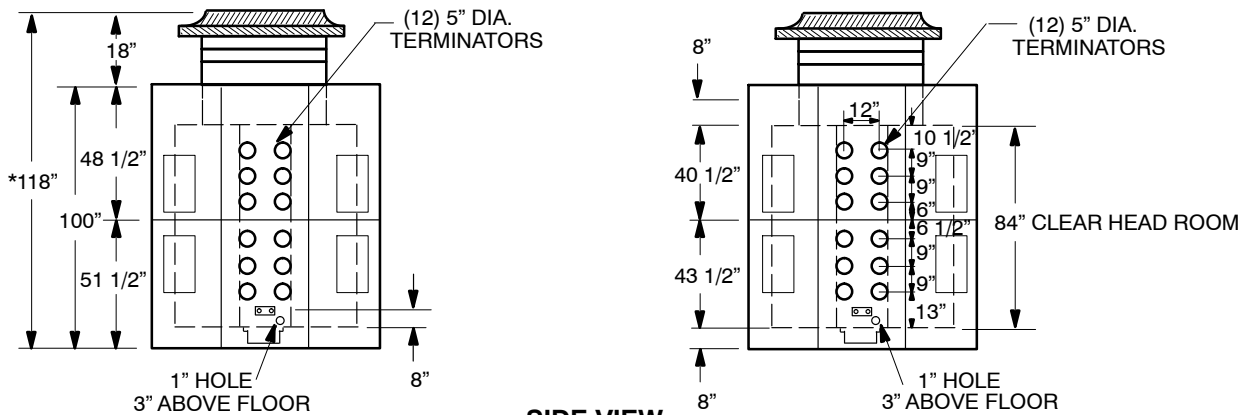
**STRUCTURES – MANHOLES**  
 Straight – Precast  
 6'-0" x 14'-0" x 7'-0"

**SPEC 10**  
 Sheet 1 of 2

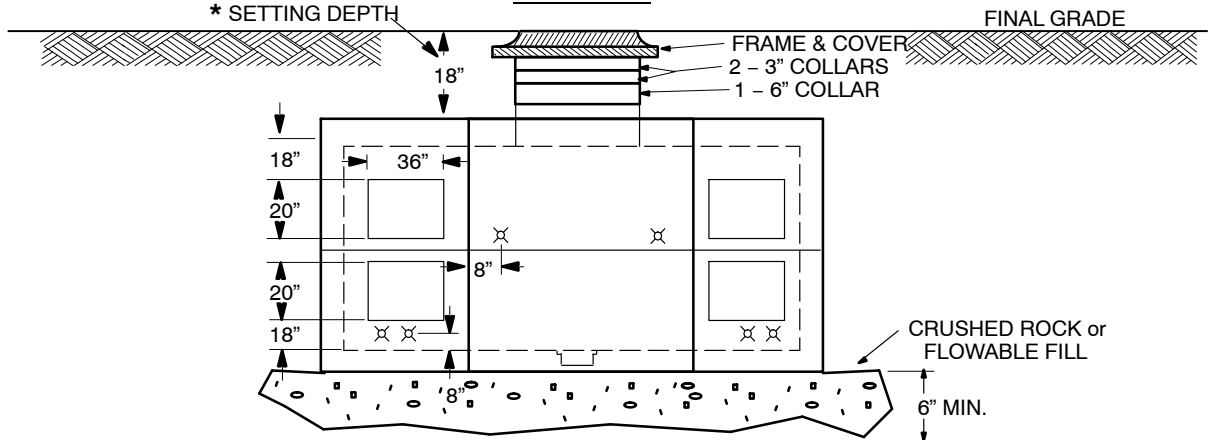
**TOP VIEW**



**END VIEWS**



**SIDE VIEW**



**COLLAR CONFIGURATION**

PREFERRED - 1-6" & 2-3"  
 3" NECKS ARE REQUIRED ON ALL MANHOLES  
 AND SHALL BE TOP COLLARS

**\* SETTING DEPTHS**

COORDINATE W/AMEREN REP.  
 PREFERRED - 18" (AS SHOWN)  
 MINIMUM - 12" TO FINAL GRADE  
 MAXIMUM - 60" TO FINAL GRADE

**WEIGHTS**

TOP SECTION	19,798 lbs.
BASE SECTION	20,526 lbs.
TOTAL	40,324 lbs.

**TRAFFIC RATED DESIGN**

(DERIVED FROM CONSTRUCTION STANDARD 32 21 03 \*\*)

**STRUCTURES – MANHOLES**

Straight – Precast  
6'-0" x 14'-0" x 7'-0"

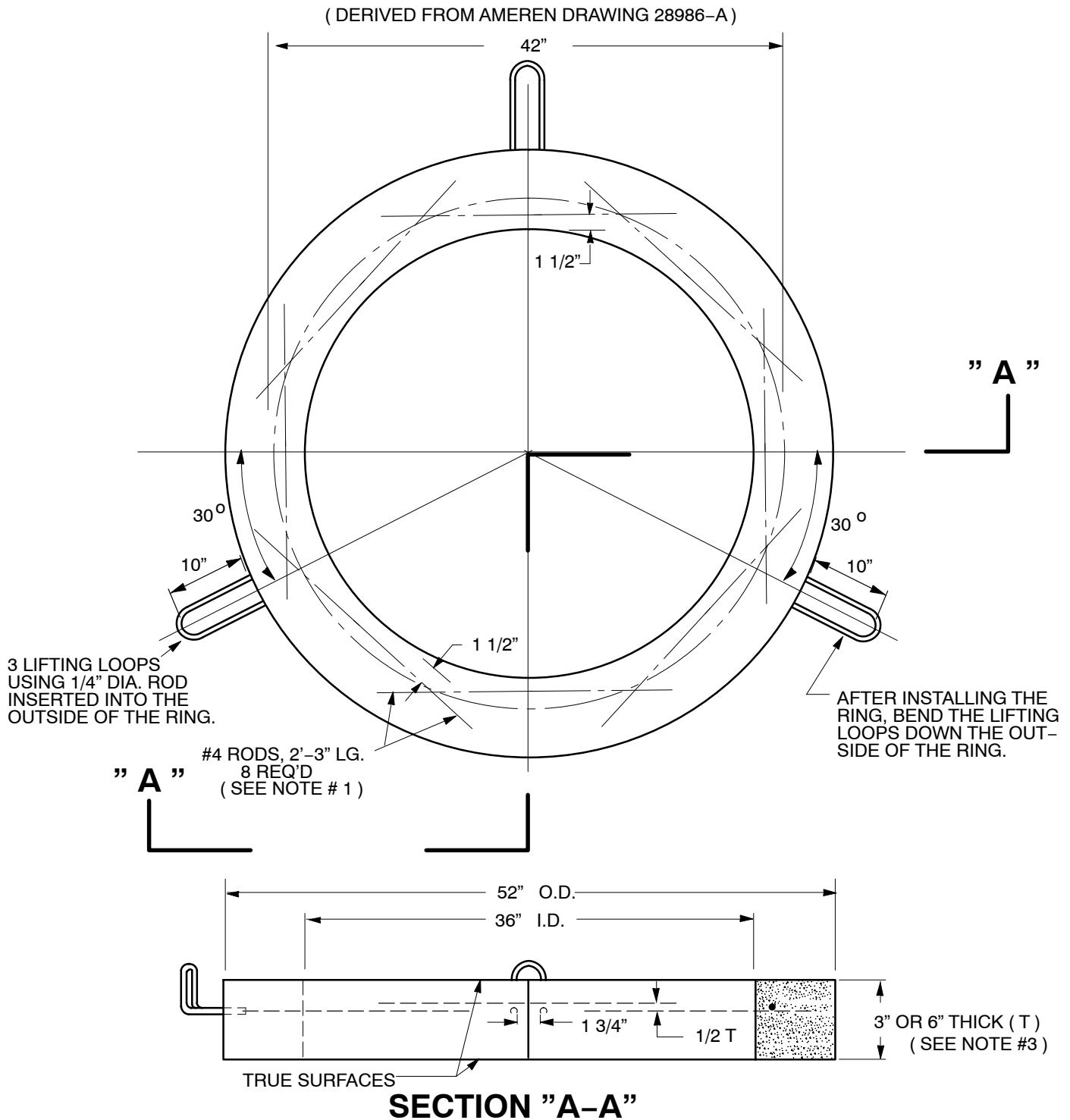
**SPEC 10**

Sheet 2 of 2

	Stock. No.	Description	Traffic Rated	Deep Neck
A	12 06 233	Manhole – Top, Precast Conc.	1	1
	12 06 234	Manhole – Bottom, Precast Conc.	1	1
B	SPEC 12	Neck & Frame – 36" Round	1	
		Neck & Frame – 36" Round x 5' Long		1
C	19 04 327	Grate – 14"	1	1
D		Crushed Rock (c.y.)	1	1

**NOTE**

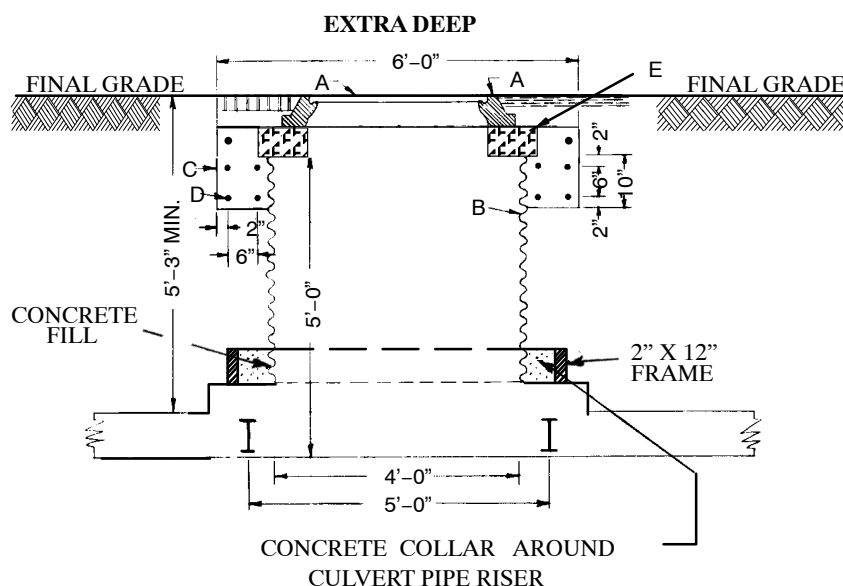
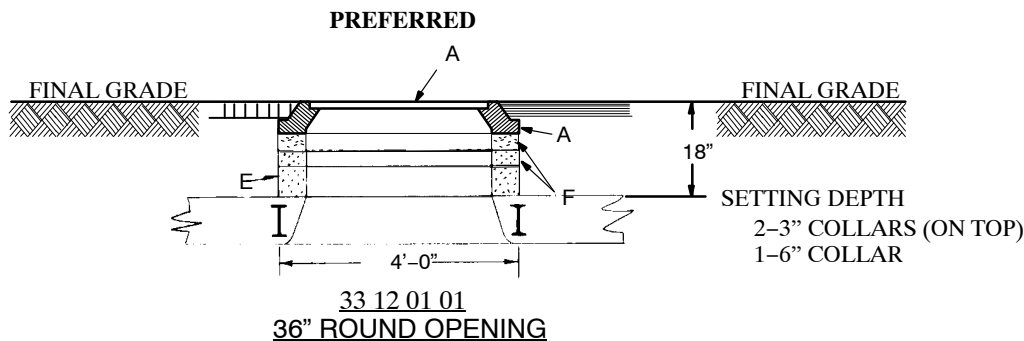
- 3.536 Cubic yards of dirt removed per foot of excavation.
- Add the required number of 6" concrete (Stk. # 12 06 063) and 3" concrete (Stk. # 12 06 062) necks so that the frame and cover are at final grade.
- Set the manhole at the "Preferred Depth" or contact company rep. if not achievable.



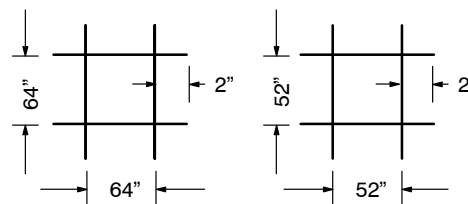
**NOTES:**

- #4 ROD, 40"-48" DIAMETER HELIX EQUALLY ACCEPTABLE.
- CONCRETE SHALL BE: 6.0 SACKS OF CEMENT PER CUBIC YARD, MAX. SIZE AGGREGATE 3/4", WATER CEMENT RATIO 6.00. MIN. 28 DAYS STRENGTH, 4,000 PSI
- 3 INCH THICK RING ( STK #12 06 062 ) 6 INCH THICK RING ( STK. #12 06 063 )

(DERIVED FROM DISTRIBUTION CONSTRUCTION STANDARD 33 12 01\*\*)



(Overlap 4 Bars)



DETAIL – #3 REINFORCING BARS

33 12 01 02  
48" CIRCULAR OPENING  
5'-3" MINIMUM DEPTH

	Stock No.	Description	Req'd		
			(1)	(2)	
	A	12 02 085	Frame and Cover	1	1
	B	12 02 076	Pipe, Culvert – 48" x 5'-0"		1
**@		12 02 077	Pipe, Culvert – 48" x 4'-0"		
	C	98 00 005	Concrete, 4000 PSI Cu Yrds		1
*	D	27 02 062	Bar, Reinforcing, #3 16 Ft.		6
	E	12 06 063	Neck – Section, 6" Thick Concrete	1	1
	F	12 06 062	Neck – Section, 3" Thick Concrete	1	

\* See Detail

\*\* 4' Length is available

NOTE: Manhole frame extension rings are used to raise the lid.

Stk. # 12 52 003 = 1.75" rise and Stk. # 12 52 004 = 2.25" rise.

(DERIVED FROM AMEREN MATERIAL SPECIFICATION 2.2.172)

DESCRIPTION

Frame and Cover – Manhole, 36" Opening, Cast Iron (Ameren Stock #12-02-085).

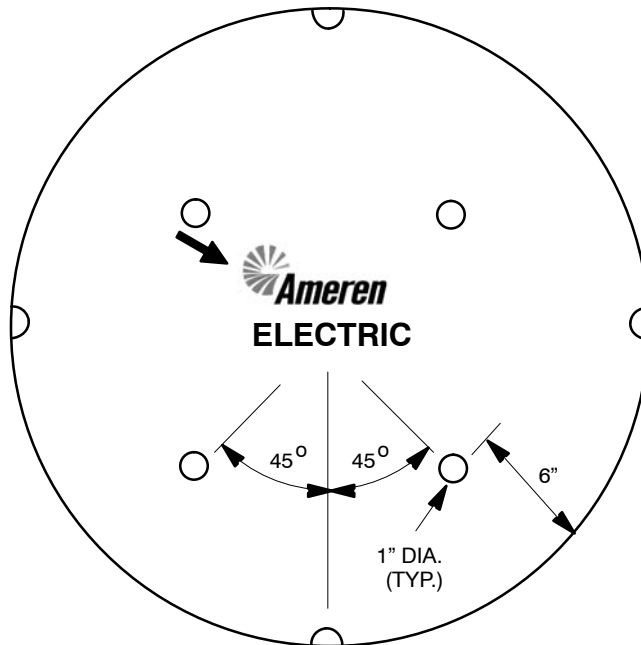
MAJOR USE

To cover the manhole entrance.

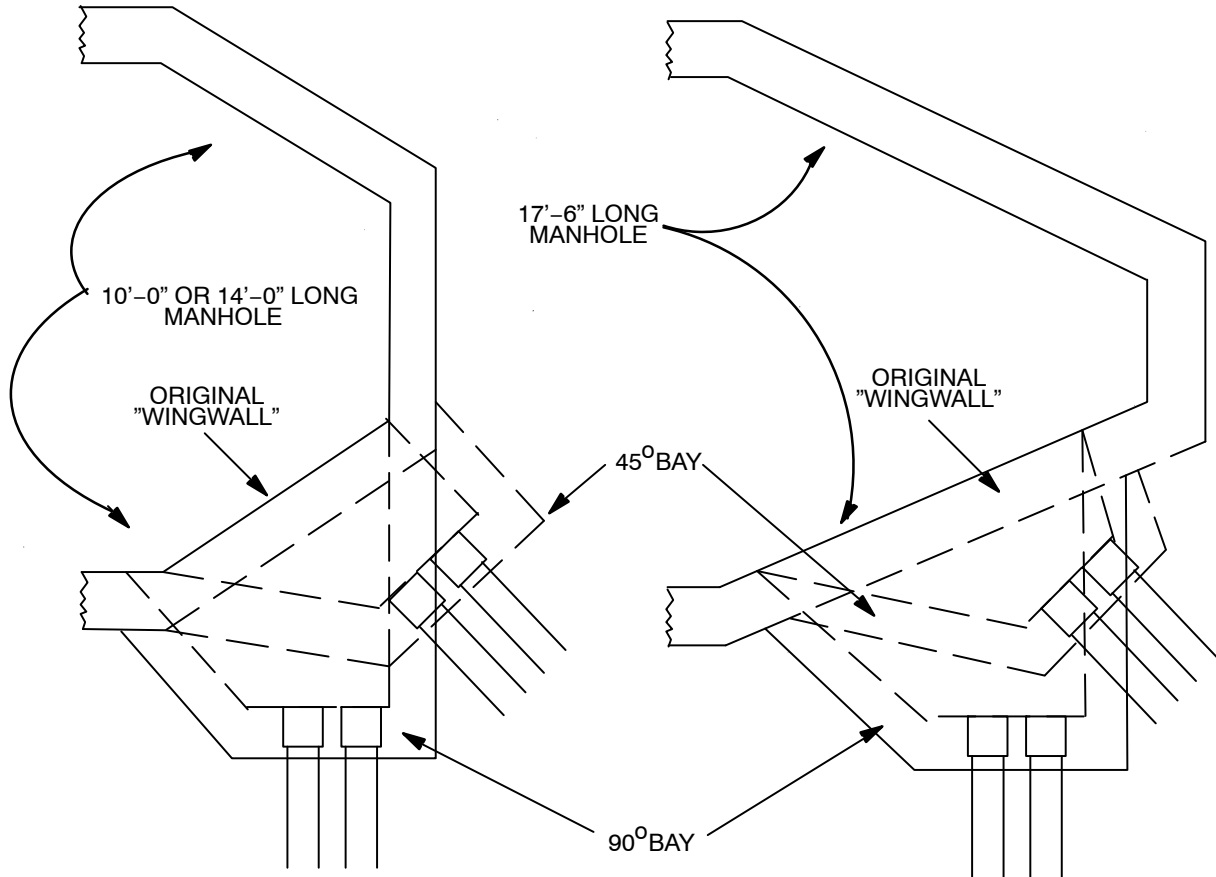
SPECIFICATIONS

Frame – Frame shall be ASTM A48 Class 35B gray iron or better. Frame base shall be 47-1/2" outside diameter. Opening shall be 36" diameter with machined horizontal and vertical bearing surfaces for the cover. Frame height shall be 6". Strength of frame and cover shall meet or exceed requirements of the American Association of State Highway and Transportation Officials (AASHTO) H-20 specification. ASTM test bar(s) results shall be furnished with each order.

Cover – Cover shall be ASTM A48 Class 35B gray iron or better. Cover diameter shall be approx. 37-3/4" with a bearing thickness of 1-1/2". Bearing surfaces shall be machined. Cover shall have four (4) 1" diameter holes located as shown on the sketch below. The logo and the word "ELECTRIC" shall be cast in the cover as shown on the sketch below. No painting. ASTM test bar(s) results shall be furnished with each order.



( DERIVED FROM CONSTRUCTION STANDARD 33 11 03 \*\* )

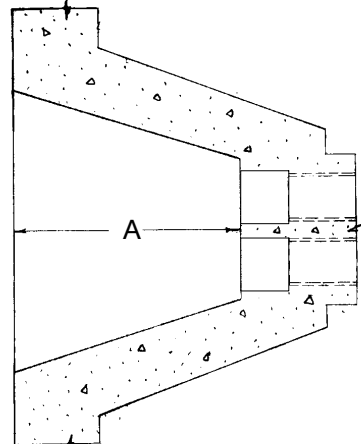
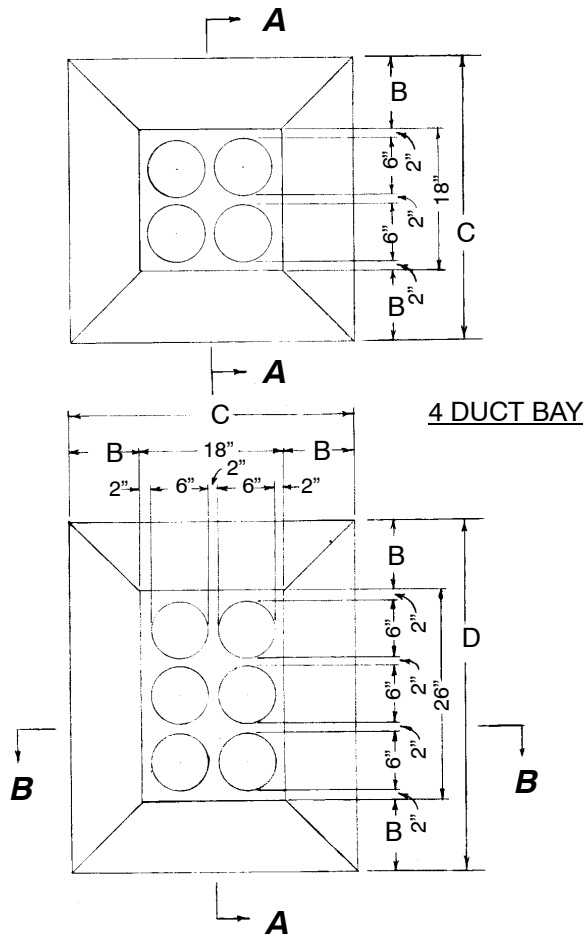


**INSTRUCTIONS:**

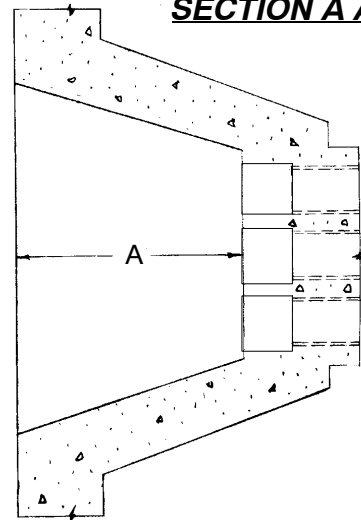
1. After removing the knockout in the wingwall of the manhole, construct a plywood form in the shape of a truncated pyramid. The base of this form shall be slightly larger than the knockout hole. (See dimensions on sheet 2.)
2. Insert the plywood form through the knockout opening from inside the manhole and brace it against the interior edge of the knockout opening.
3. Slide the conduits into the bay with straight couplings, attached to the ends, until they butt directly up against the truncated plywood surface. Do not drill holes into the plywood for the conduits. Seal all the couplings first with duct plugs, to prevent the poured encasement from entering the ducts.
4. Drill a small hole through the plywood and pull the 4/0 bond wire through it, leaving a sufficient length to drape the tail on to the manhole floor.
5. When pouring the duct encasement, run the concrete up against the entire outer plywood surface of the bay to re-establish a contiguous structure. Do not remove the form until the concrete sets up completely.

	Stock No.	Description	
A	98 00 005	Concrete – M.H. (c.y.)	1

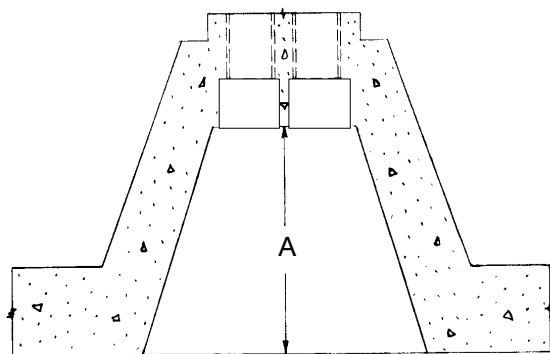
12", 24" AND 36" RECESS CONSTRUCTION  
( DERIVED FROM CONSTRUCTION STANDARDS 33 11 01 \*\*, 33 11 04 \*\*, AND 33 11 05 \*\*)



**SECTION A A**



**SECTION A A**



**SECTION B B**

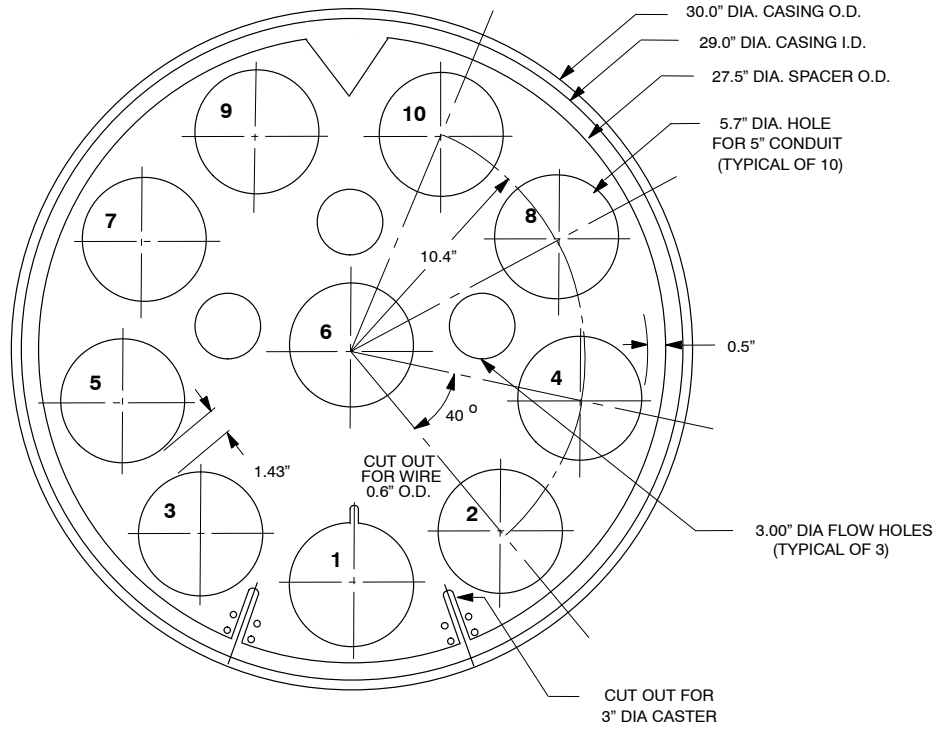
	DIMENSION			
	A	B	C	D
12" RECESS	12"	4"	26"	34"
24" RECESS	24"	7 1/2"	33"	41"
36" RECESS	36"	11"	40"	48"

**BAY DIMENSIONS**

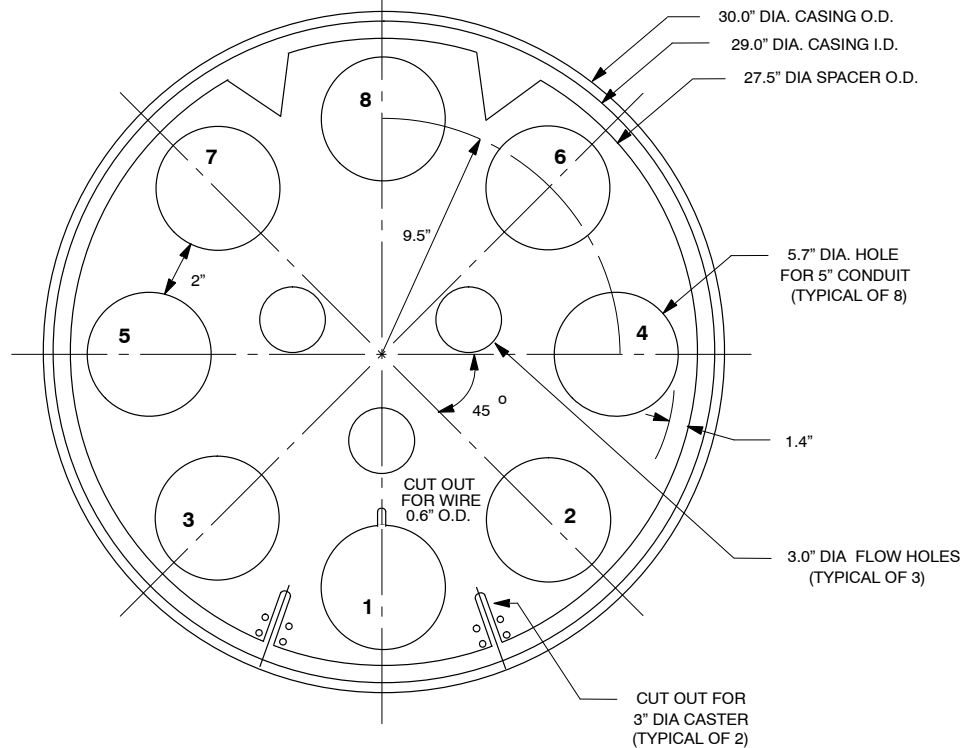
	Stk. No.	Description	Qty.
A	98 00 005	Concrete – M.H. (c.y.)	1
B	12 51 156	Couplings, 5" Plastic Sch 40	As Req'd

**STRUCTURES – CONDUIT**  
**Conduit Spacer for 30" Steel Casing**  
**8 and 10 Duct Configuration**

**3/4" Plywood**  
**10 Conduit Spacer Pattern**

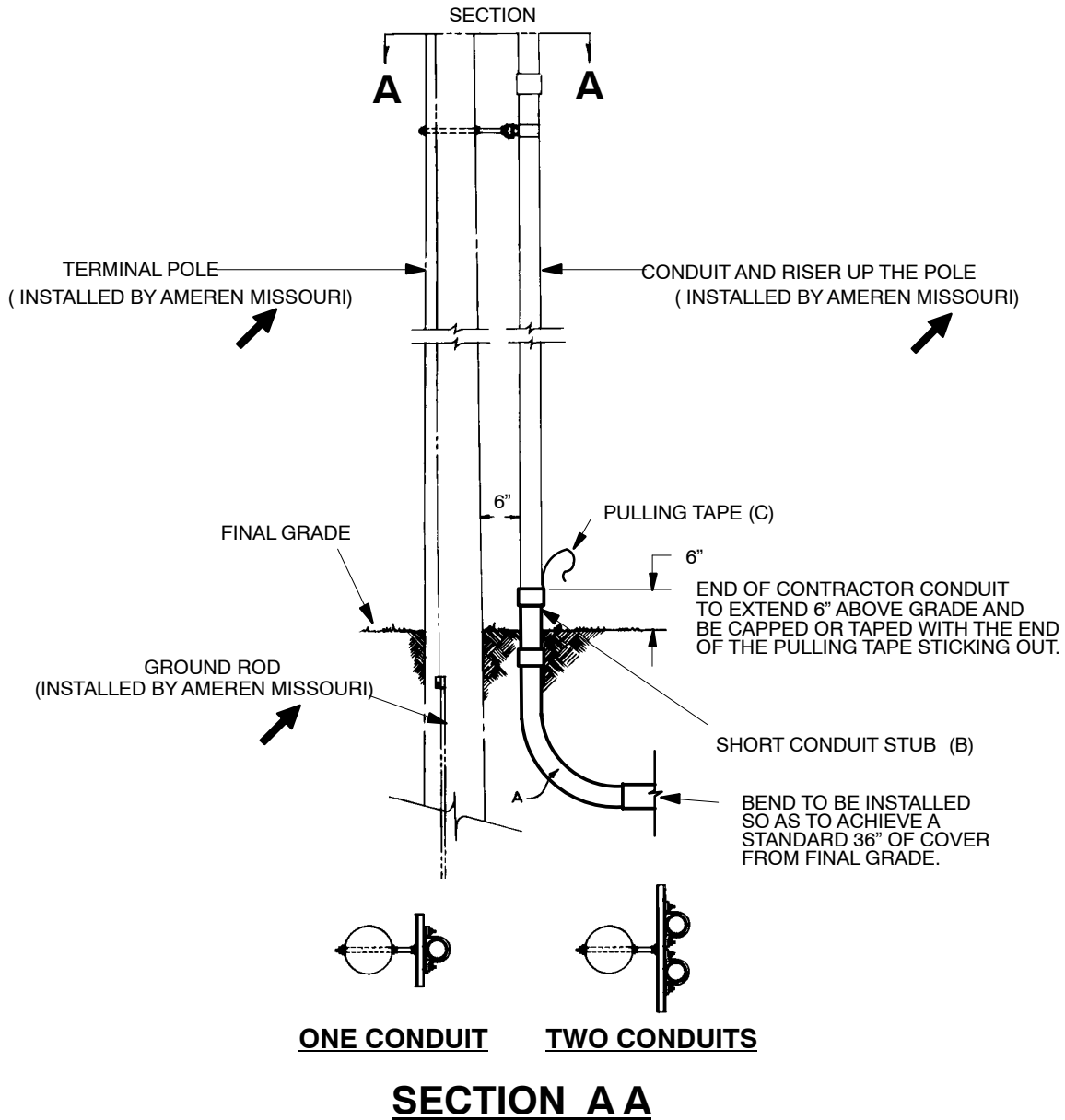


**3/4" Plywood**  
**8 Conduit Spacer Pattern**



**Any changes in material or design subject to approval by the Company Representative.**





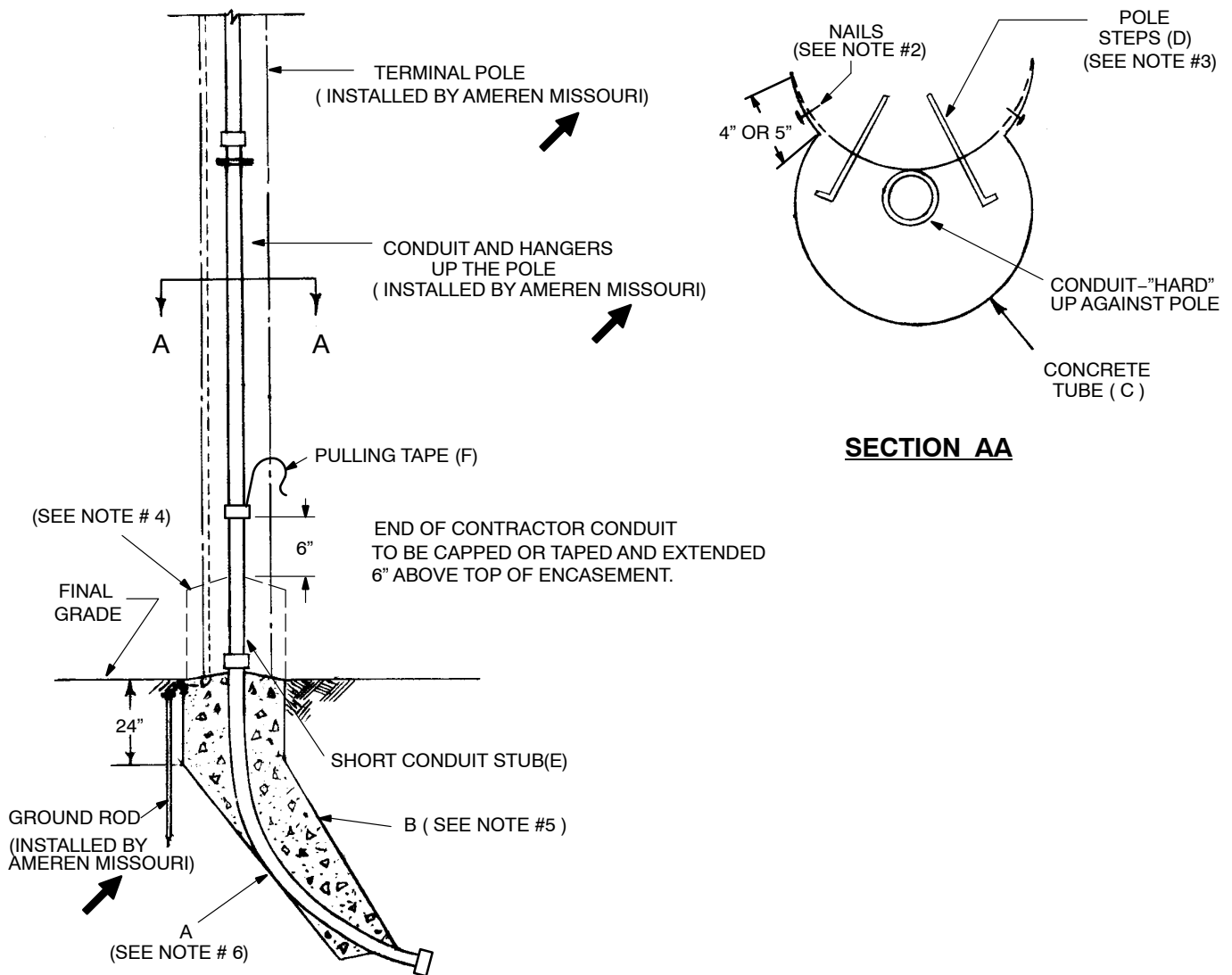
NOTE: AMEREN MISSOURI REP. WILL DESIGNATE THE QUADRANT OF THE POLE WHERE THE CONDUIT IS TO BE INSTALLED.  
 MATERIAL INSTALLED BY CONTRACTOR FOR ONE RISER  
 ( DERIVED FROM CONSTRUCTION STANDARD 14 00 26 \*\* )

**CABLE TERMINALS**  
 One or More Risers on Standoffs  
 Solid Round Conduits PVC

**SPEC 16**  
 Sheet 2 of 2

	Stk. No.	Description	Conduit Size		
			3"	4"	5"
A	12 51 173	Bend – 3" x 36" Rad, Sch. 40	1		
	12 51 176	Bend – 4" x 36" Rad, Sch. 40		1	
	12 51 206	Bend – 5" x 36" Rad, Sch 40			1
B	12 01 276	3" Conduit Stub, Sch. 80	1		
	12 01 273	4" Conduit Stub, Sch. 80		1	
	12 01 272	5" Conduit Stub, Sch. 80			1
C	83 36 252	Pulling Tape – 3/4" Wide, 2500 Lb. Strength (ft.)	As Req'd.	As Req'd.	As Req'd.

**CABLE TERMINALS**  
**One Riser For Cable In Conduit**  
**Solid Round Conduit PVC, Concrete Encased**



1. Ameren Missouri Rep. will designate the quadrant of the pole where the conduit is to be installed.
2. Cut the tube concrete form lengthwise: Bend back 4" tab for 10" dia. tube, 5" for 14" tube. Attach tubes to the pole with nails through the tabs.
3. Pole steps shall be installed by the contractor at the base of the pole – one on each side of the riser to help hold the concrete.
4. When located in possible traffic areas, the concrete cylinder protecting the conduit shall be extended up the pole. Bumper height 18 inches to 2 feet. Extend the conduit stub 6 inches above the concrete cylinder and either cap or tape the end with the end of the pulling tape sticking out.
5. 6 to 8 cubic feet of concrete to be poured around the bend.
6. Bend shall be installed so as to achieve a standard 36" of cover from final grade.

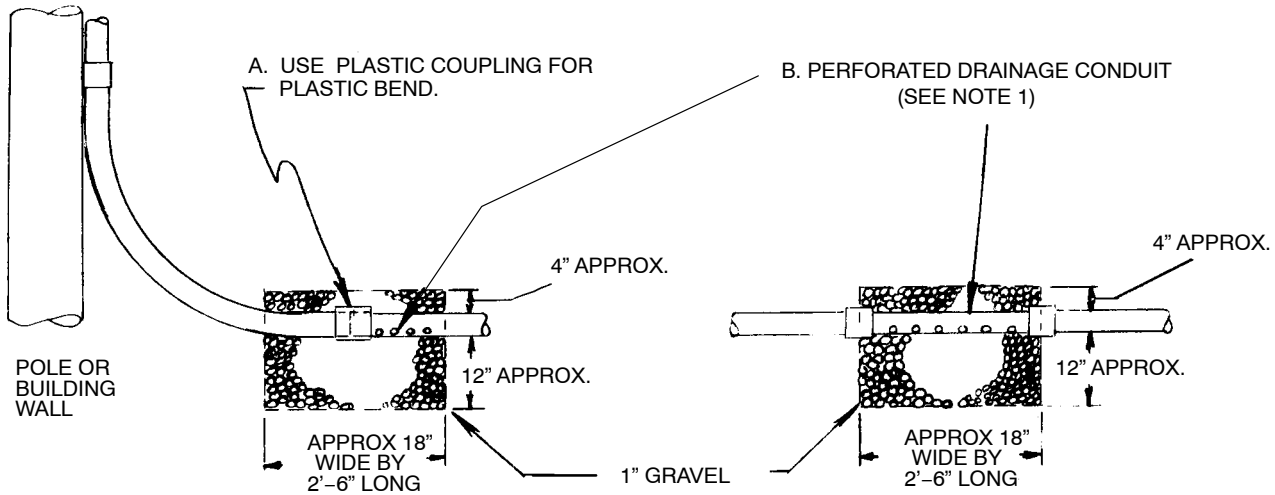
**CABLE TERMINALS**  
 One Riser For Cable In Conduit  
 Solid Round Conduit PVC, Concrete Encased

**SPEC 16A**  
 Sheet 2 of 2

**MATERIAL INSTALLED BY CONTRACTOR**  
 ( DERIVED FROM CONSTRUCTION STANDARD 14 00 24 \*\* )

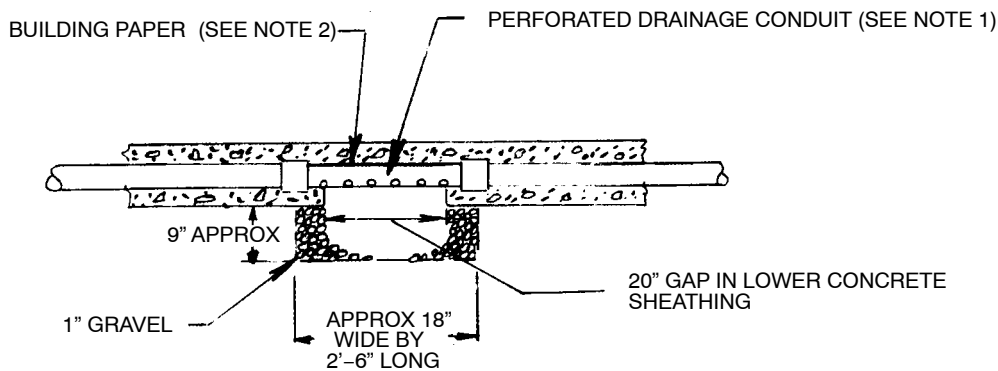
	Stk. No.	Description	Cond. Size		
			3"	4"	5"
A	12 51 173	Bend – 3" x 36" Rad, Sch. 40	1		
	12 51 176	Bend – 4" x 36" Rad, Sch. 40		1	
	12 51 206	Bend – 5" x 36" Rad, Sch. 40			1
B		Concrete			
C	11 04 109	Tube – Concrete 10" Dia.	2		
	11 04 110	Tube – Concrete 14" Dia.		2	2
D	23 67 036	Pole Step 5/8 x 10"		2	2
E	12 01 276	3" Conduit Stub, Sch. 80	1		
	12 01 273	4" Conduit Stub, Sch. 80		1	
	12 01 272	5" Conduit Stub, Sch. 80			1
F	83 36 252	Pulling Tape – 3/4" Wide, 2500 Lb. Strength (ft.)	As Req'd.	As Req'd.	As Req'd.

**STRUCTURES – CONDUIT**  
**Conduit – Direct Buried Drainage Pit**  
 ( When Required For Potential Water Problems )



**FIG. 1**  
**FOR BURIED PLASTIC CONDUIT**

**FIG. 2**  
**FOR BURIED PLASTIC CONDUIT**  
**AT LOWEST POINT IN RUN**



**FIG. 3**  
**FOR CONCRETE ENCASED PLASTIC CONDUIT**  
**AT LOWEST POINT IN RUN**

1. Drainage conduit shall be 30" long and perforated with six (6) 1/2" diameter holes drilled on 4" centers. Ream the inside of perforated conduit section to remove sharp edges.
2. Building paper shall be placed above perforated conduit section in order to prevent the upper concrete sheathing from filling the conduit perforations and the gravel pit below.

MATERIAL INSTALLED BY CONTRACTOR

( DERIVED FROM CONSTRUCTION STANDARD 31 47 02 \*\* )

Stk. No.	Description	Conduit Size		
		3"	4"	5"
	Conduit Perforated 30" long	1 Ea	1 Ea	1 Ea
	Rock, Crushed	As Req'd	As Req'd	As Req'd
83 36 252	Pulling Tape – 3/4" Wide, 2500 lbs. Strength (Ft.)	As Req'd.	As Req'd.	As Req'd.

**STRUCTURES – PAD**  
Padmounted Transformers and Cable Enclosures  
Material Requirements

**SPEC 18**  
Sheet 1 of 1

**STANDARD STOCK DESCRIPTIONS**

**Concrete, Poured In Place Pads –**

Pad – Transformer, 47" x 47" x 4", 1-phase, Concrete, Poured in place. (Spec 18A, sheet 1 of 2)

Pad – Transformer, 72" x 65" x 4", 3-phase, 75 kVA thru 750 kVA, Radial-Feed, Concrete, Poured in place. (Spec 18B, sheet 1 of 2)

Pad – Transformer, 84" x 72" x 5", 3-phase, 1000 kVA thru 2500 kVA Radial-Feed, and 75 kVA thru 1000 kVA Loop-Feed, Concrete, Poured in place. (Spec 18C, sheet 1 of 2)

**Composite Pads –**

Stk # 12 06 198 – Pad, Transformer, 42" x 47" x 4", 1-phase, Composite. (Spec 18A, sheet 2 of 2)

Stk # 12 06 123 – Pad, Transformer, 72" x 65" x 4", 3-phase, Composite. (Spec 18B, sheet 2 of 2)

Stk # 12 06 124 – Pad, Transformer, 84" x 72" x 5", 3-phase, Composite. (Spec 18C, sheet 2 of 2)

**MAJOR USE**

To be used for supporting single-phase and three-phase padmount transformers and for cable enclosures.

**MATERIALS**

A. References

ASTM C31 – Test Specimens

ASTM C39 – Compressive Strength of Cylindrical Concrete Specimens

ASTM C94 – Ready-Mixed Concrete

ASTM C150 – Portland Cement

ASTM C260 – Air Entraining Admixtures for Concrete

ASTM C330 – Lightweight Aggregates for Structural Concrete

ASTM A615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

B. Concrete Mix

Concrete shall be either Type I or Type III portland. Mix concrete in accordance with ASTM C94. Water shall be clear and drinkable. Ultimate strength at 28 days shall be 4,000 psi, 6 sacks minimum of cement per cubic yard. Maximum slump 4". Water to cement ratio shall not exceed 5.0 by weight, including free moisture on aggregate. Aggregate shall be white limestone rock with 3/4" maximum size. Use air entraining admixture. (3% to 6% air by volume).

**The use of calcium chloride is prohibited.**

C. Placement

All concrete shall be well vibrated, dense and smooth. No honeycombs, fins or cold joints shall be present. Placement and vibration of concrete shall not disturb the reinforcement.

D. Reinforcement

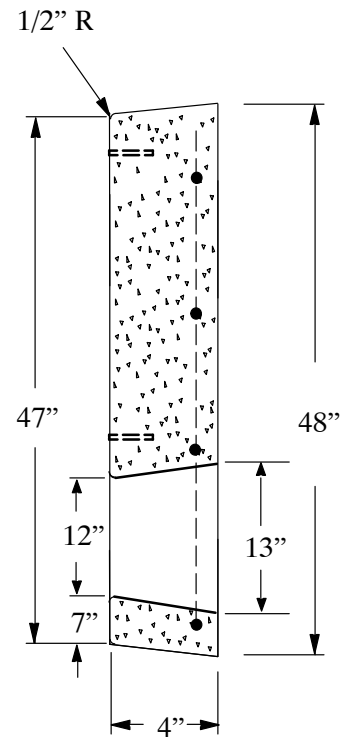
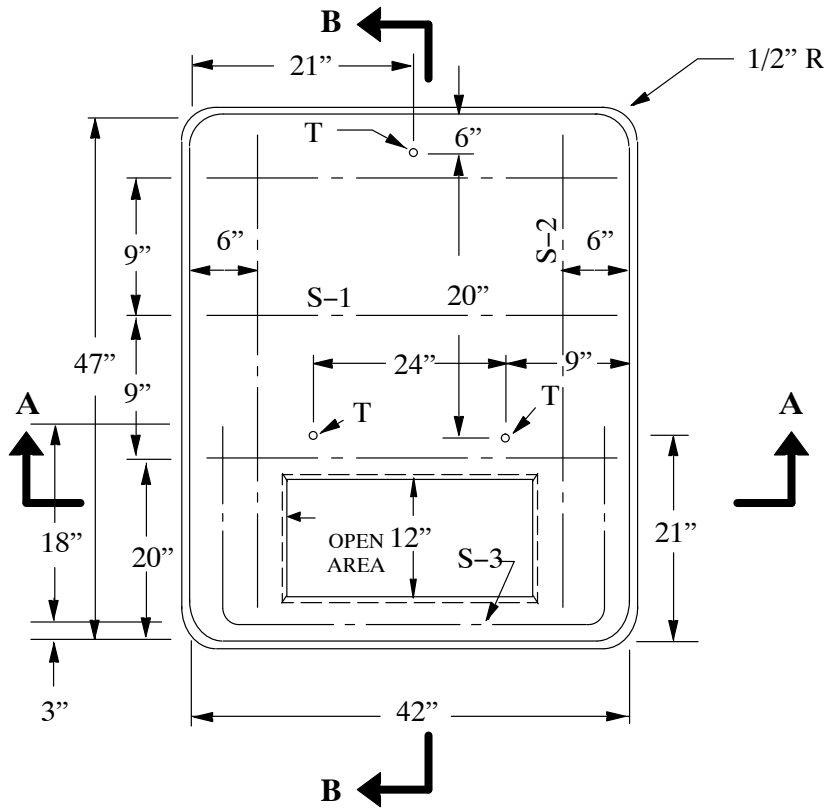
Reinforcement shall consist of #4 reinforcing bars (as shown on Spec 18A, 18B, and 18C) meeting the requirements of ASTM A615, minimum grade 40.

**DIMENSIONS**

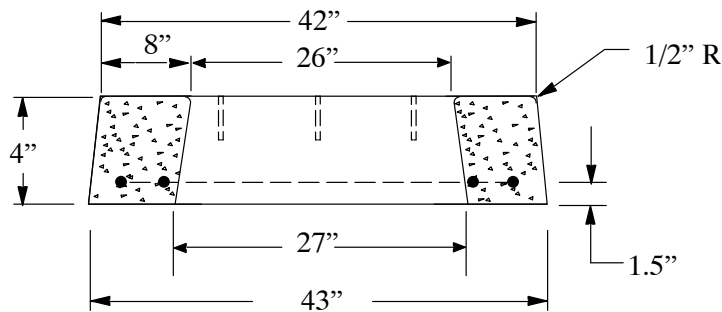
Dimensions shall be in accordance with the drawings shown in this specification. The top surface shall be true and free of mounds or depressions. A four foot level shall be placed at any location on the top and at no location may a #14 (American Wire Gauge) bare wire fit between the level and the top surface.

The finished pad shall be free of voids, flashings, or crumbling edges. No protrusion or flashing shall exceed 1/4" in length from the finished surface. **PADS NOT CONFORMING TO ANY DIMENSION OR SPECIFICATION CONTAINED HEREIN WILL NOT BE ACCEPTED.**

**POURED IN PLACE CONCRETE**



**SECTION B B**

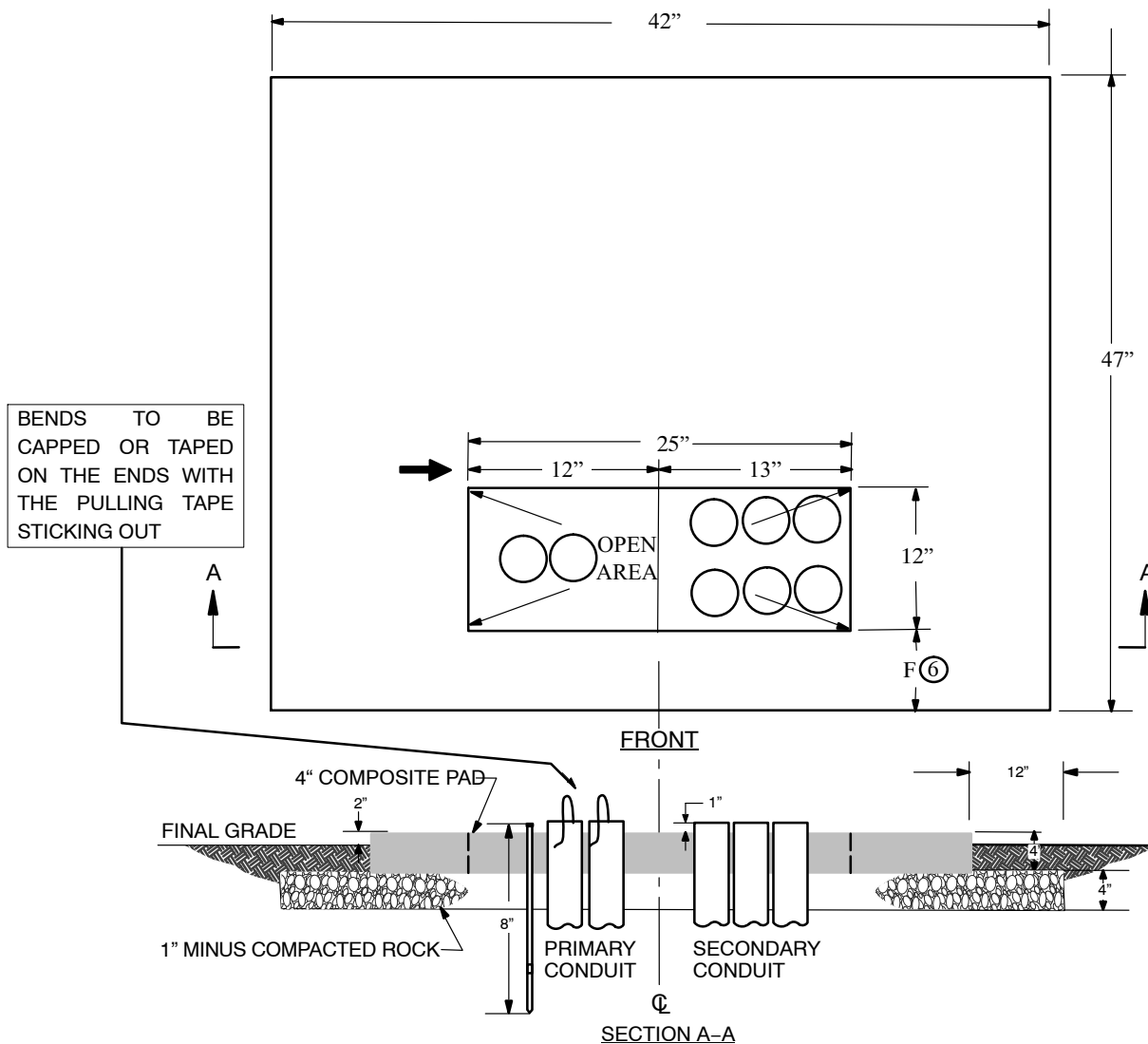


**SECTION A A**

REINFORCING SCHEDULE			
MARK	NO REQ'D	SIZE	LENGTH
S - 1	3	# 4	38"
S - 2	2	# 4	43"
S - 3*	1	# 4	72"
INSERTS			
MARK	NO REQ'D	SIZE	LENGTH
T	3	1/2"-13	2 1/2"

\* BAR MUST EXTEND  
 18 INCHES AROUND EACH  
 CORNER

**STOCK NO. 12 06 198**



( DERIVED FROM CONSTRUCTION STANDARD 34 21 05 \*\* )

1. All Conduit shall be rigid PVC Schedule 40 or approved PVC flexible conduit.
2. Secondary conduit shall be symmetrically located within a 13" x 12" area as shown above.
3. The maximum number of conduits is 6 – 3" for the secondary.
4. Up to two – 3" Conduits shall be installed on the primary side, as determined by Ameren.
5. Approximate weight of pad is 300 lbs.
6. Pad shall be installed on 4" of level, well compacted, 1" minus rock extending 12" outside the pad. Dirt under the rock must first be well compacted. Avoid filling pad opening before cable or conduit is installed.

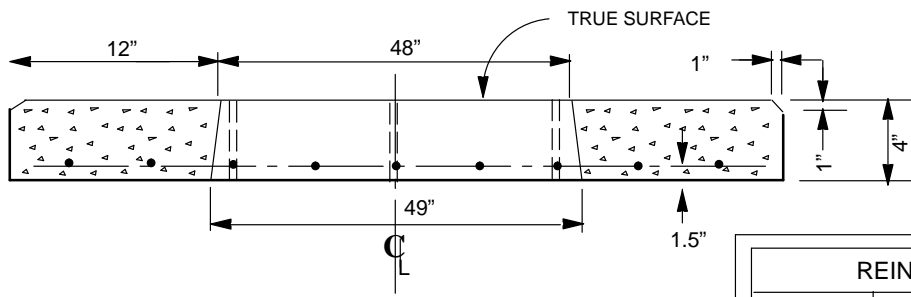
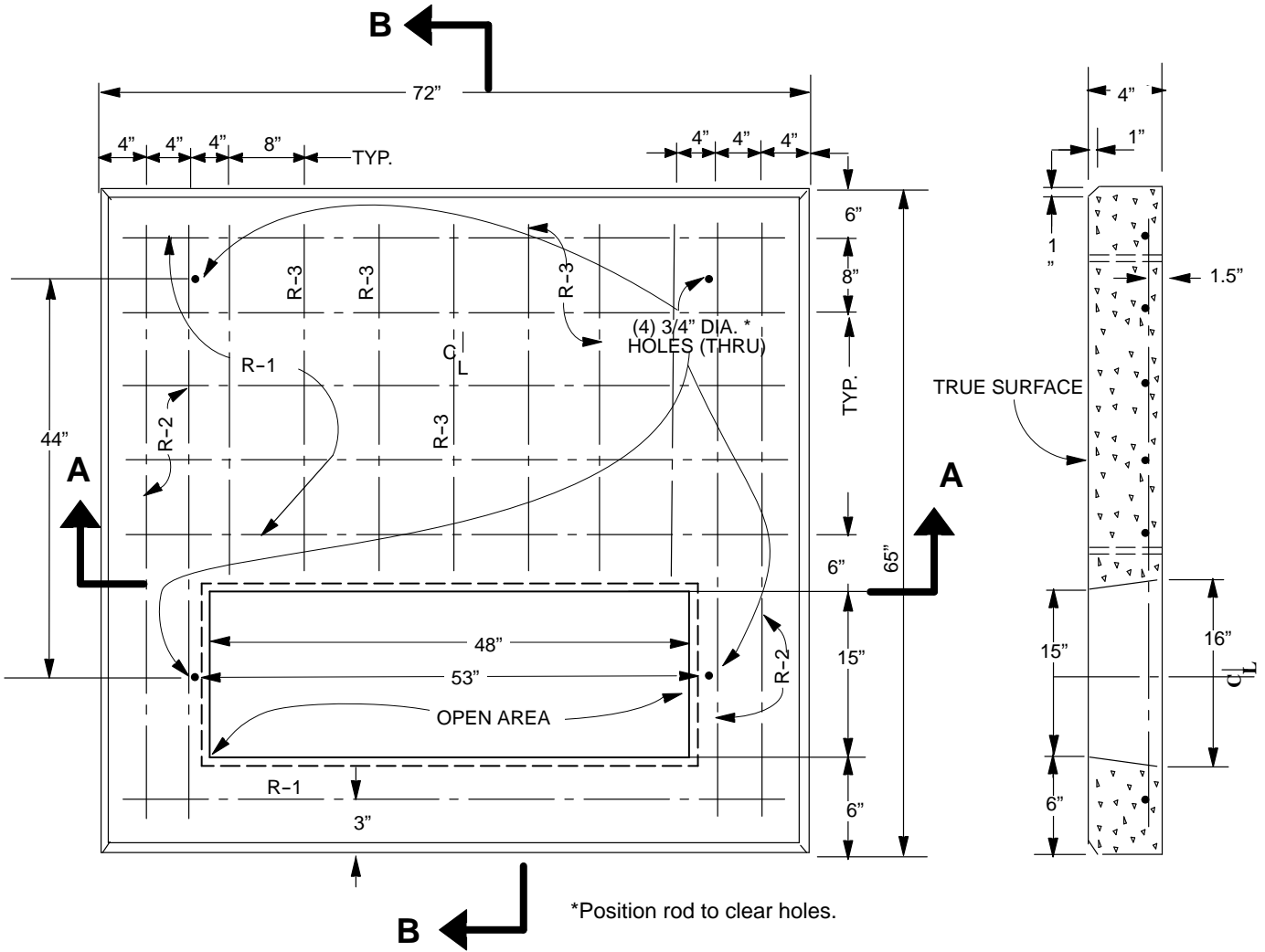


**STRUCTURES - PADS**  
 Three Phase Padmounted Transformers  
 75 KVA Thru 750 KVA Radial Feed

**SPEC 18B**

Sheet 1 of 2

Poured In Place Concrete



**SECTION A A**

**SECTION B B**

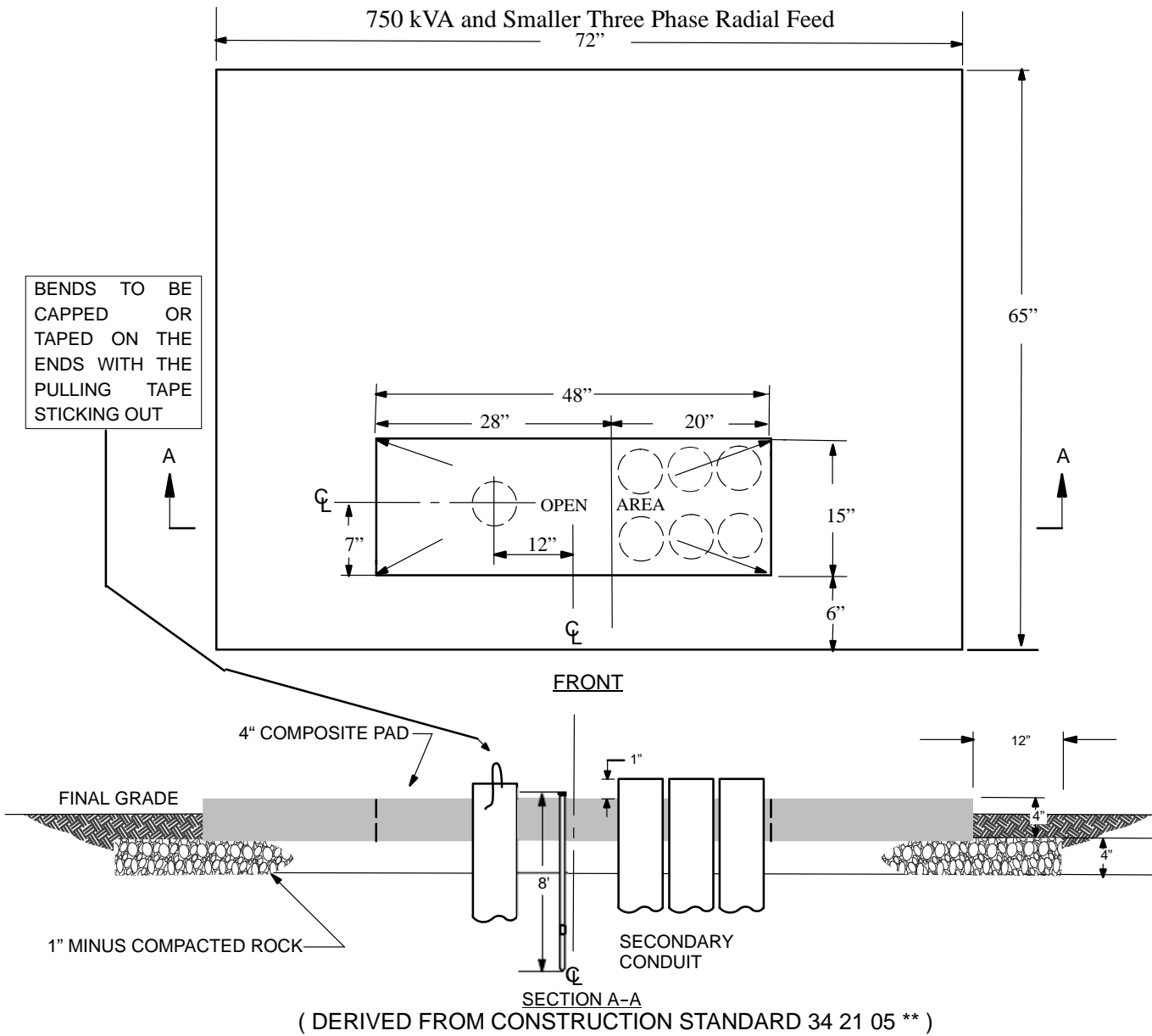
REINFORCING SCHEDULE			
MARK	NO REQ'D	SIZE	LENGTH
R-1	6	# 4	5'-8"
R-2	4	# 4	5'-1"
R-3	7	# 4	3'-0"

**STRUCTURES - PADS**  
 Three Phase Padmounted Transformers  
 75 KVA Thru 750 KVA Radial Feed

**SPEC 18B**

Sheet 2 of 2

#12 06 123



( DERIVED FROM CONSTRUCTION STANDARD 34 21 05 \*\* )

**INSTRUCTIONS:**

1. All conduit shall be rigid PVC Schedule 40 or approved PVC flexible conduit.
2. Secondary conduit shall be symmetrically located within 15" x 20" area.
3. Approximate weight of the pad is 600 pounds.
4. Pad shall be installed on 4" of level, well compacted, 1" minus rock extending 12" outside the pad. Dirt under rock must first be well compacted. Avoid filling opening before cable or conduit is installed. Unless situated in a paved area, the rest of exterior shall be backfilled with the excavated material and foot tamped.
5. The 5/8" x 8' ground rod can be located where most convenient in the pad opening to avoid the incoming and outgoing conduit elbows.

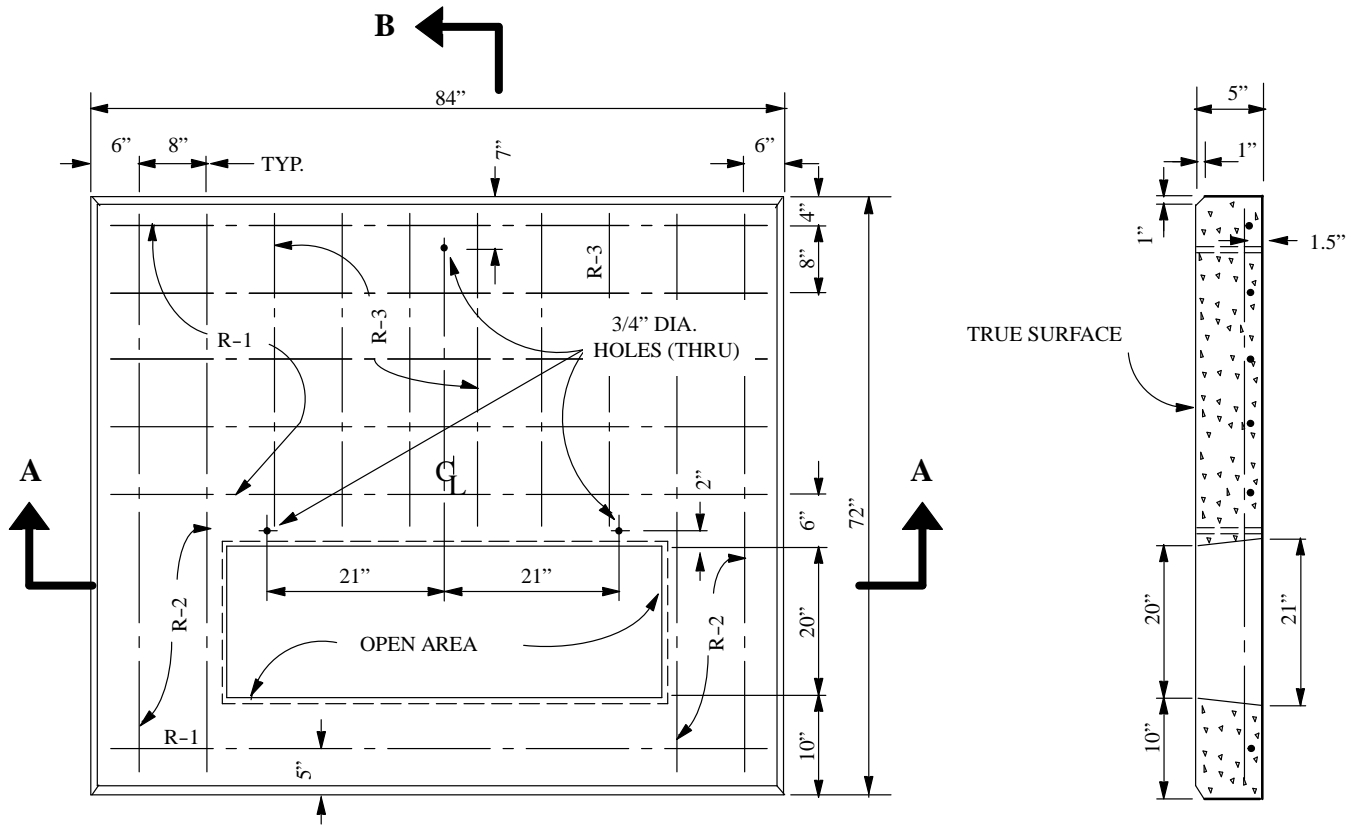
# STRUCTURES - PADS

Three Phase Padmounted Transformers - 1000 KVA Thru  
2500 KVA Radial Feed - 75 KVA Thru 1000 KVA Loop Feed

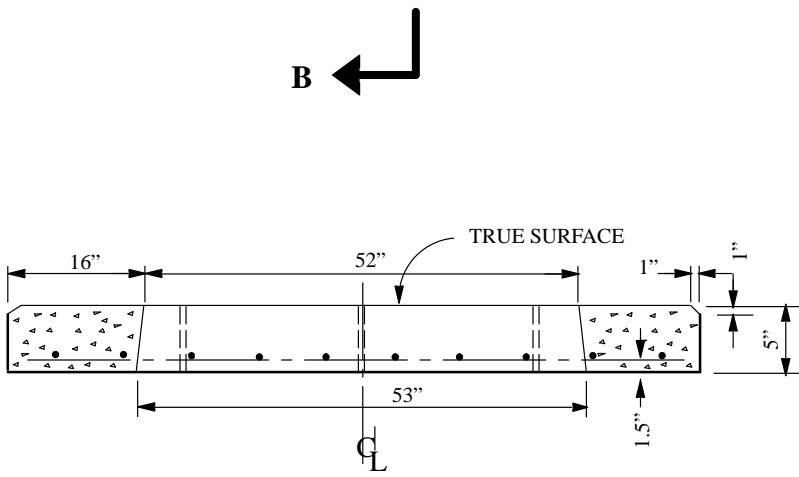
**SPEC 18C**

Sheet 1 of 2

POURED IN PLACE CONCRETE



**SECTION B B**



**SECTION A A**

REINFORCING SCHEDULE			
MARK	NO REQ'D	SIZE	LENGTH
R-1	6	# 4	6'-6"
R-2	4	# 4	5'-6"
R-3	5	# 4	3'-0"

# STRUCTURES - PADS

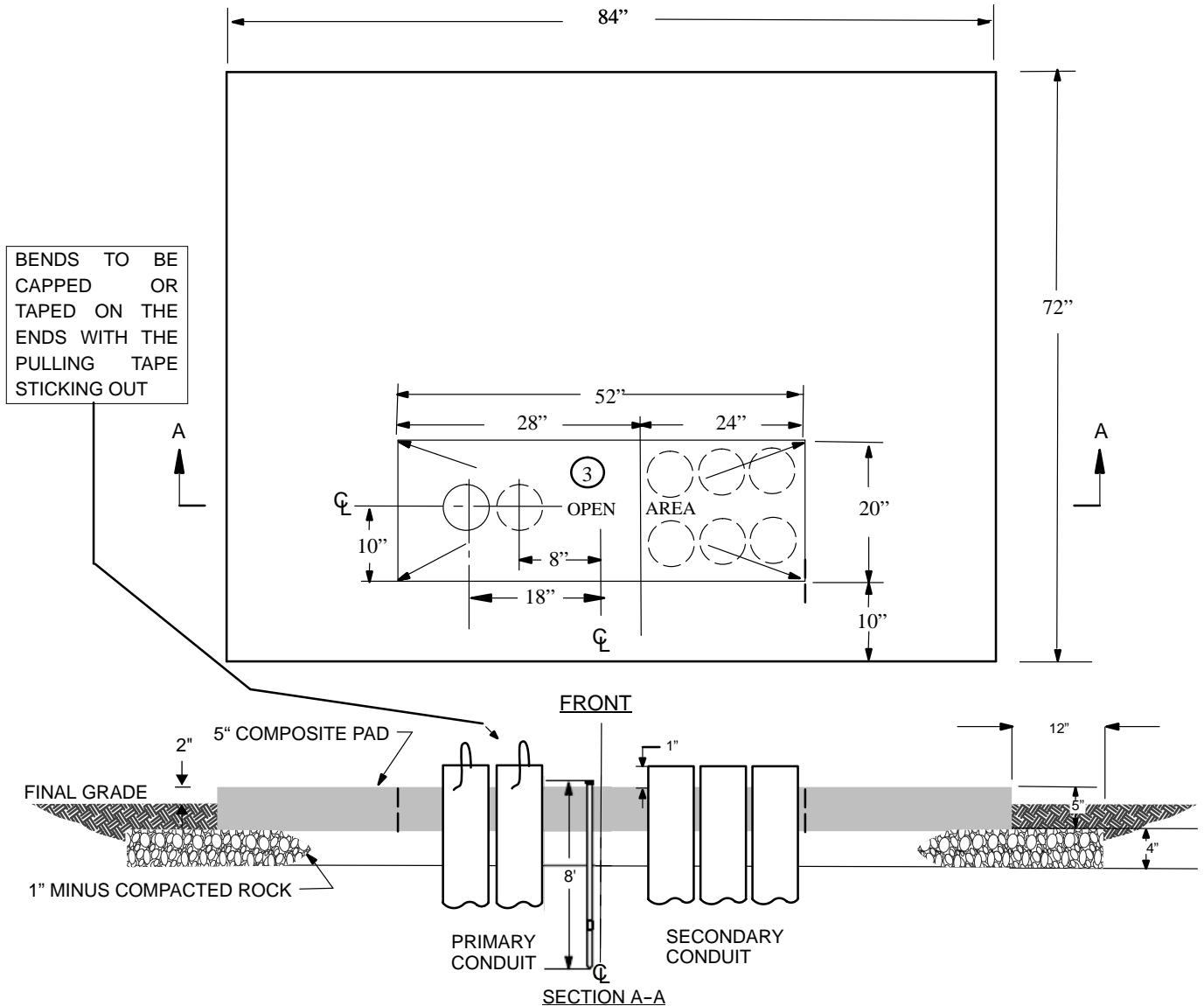
**SPEC 18C**

Three Phase Padmounted Transformers - 1000 KVA Thru  
2500 KVA Radial Feed - 75 KVA Thru 1000 KVA Loop Feed

Sheet 2 of 2

## Stock # 12 06 124

75 kVA thru 1000 kVA Three Phase Loop Feed  
1000 kVA thru 2500 kVA Three Phase Radial Feed



( DERIVED FROM CONSTRUCTION STANDARD 34 21 05 \*\*)

### INSTRUCTIONS:

1. All conduit shall be rigid PVC Schedule 40 or approved PVC flexible conduit.
2. Secondary conduit shall be symmetrically located within 20" x 24" area.
3. Approximate weight of the pad is 800 pounds.
4. Pad shall be installed on 4" of level, well compacted, 1" minus rock extending 12" outside the pad. Dirt under rock must first be well compacted. Avoid filling opening before cable or conduit is installed. Unless situated in a paved area, the rest of the exterior shall be backfilled with the excavated material and foot tamped.
5. For radial fed transformers, install the primary conduit in the left position ( shown as a solid circle ).
6. The 5/8" x 8' ground rod can be located where most convenient in the pad opening to avoid the incoming and outgoing conduit elbows.

**UNDERGROUND  
DISTRIBUTION SPEC.**



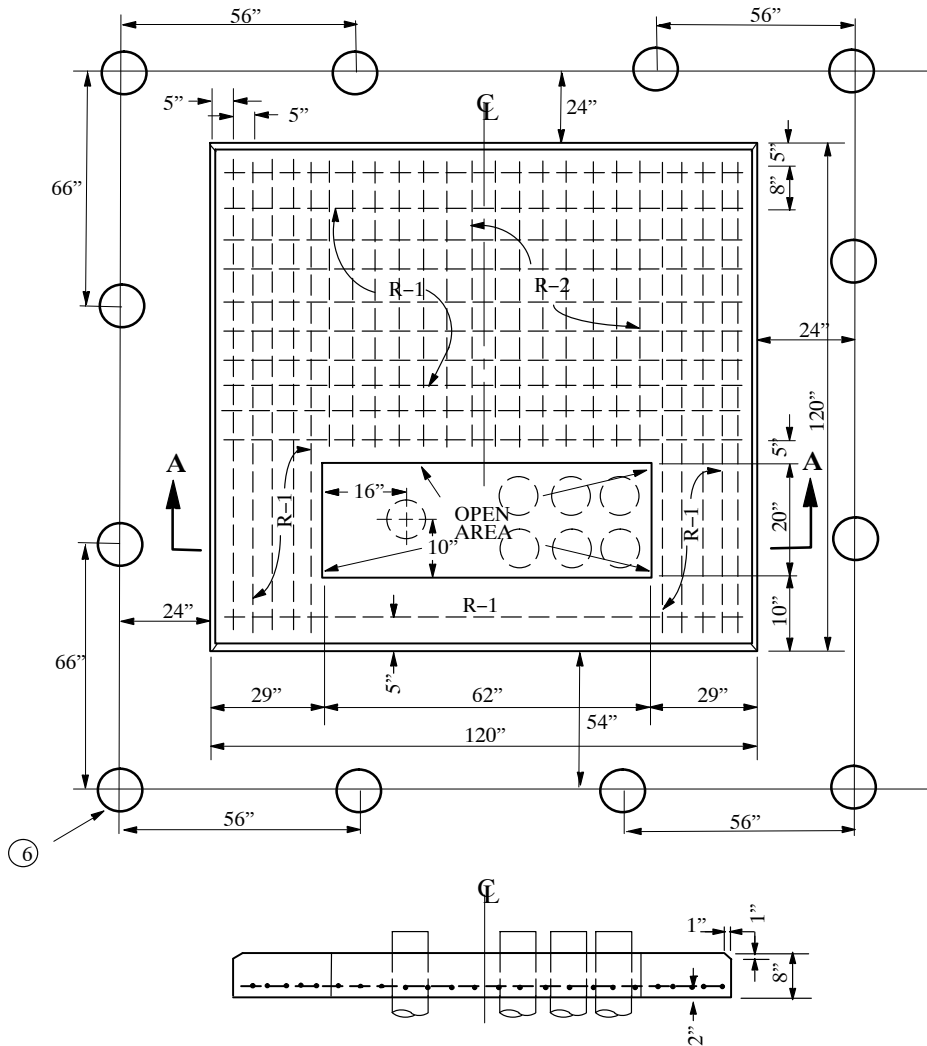
ENG: DG  
REV. NO: 8  
REV. DATE: 10/01/2020

**STRUCTURES-PADS**  
**Three Phase Padmount Transformers**  
**34.5kV (Poured-In-Place)**

**SPEC 18D**

Sheet 1 of 3

**RADIAL-FEED ONLY**  
**1500 kVA thru 3000 kVA**



**SECTION AA**

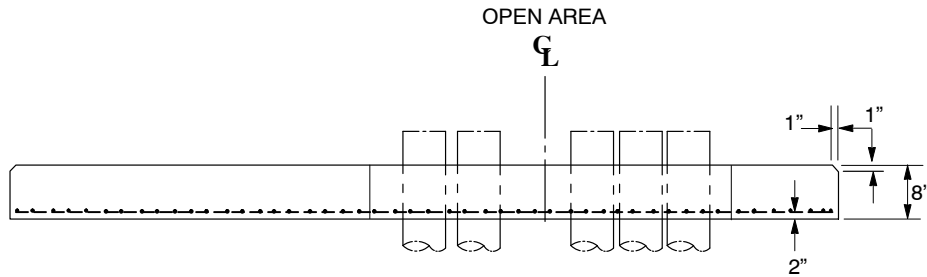
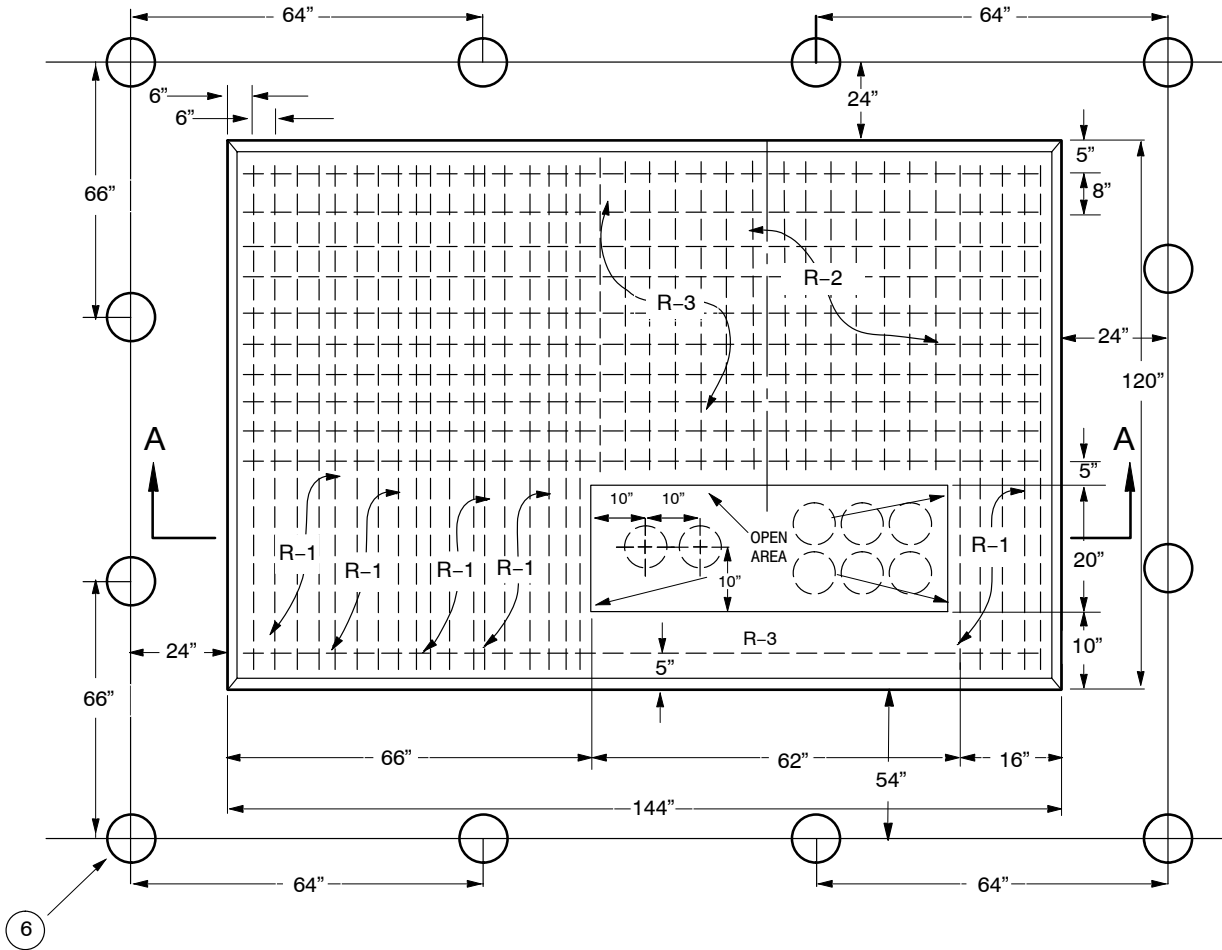
REINFORCING SCHEDULE			
MARK	NO REQ'D	SIZE	LENGTH
R-1	22	# 4	114"
R-2	13	# 4	84"

**STRUCTURES-PADS**  
**Three Phase Padmount Transformers**  
**34.5kV (Poured-In-Place)**

**SPEC 18D**

Sheet 2 of 3

**LOOP-FEED ONLY**  
**500 kVA thru 2500 kVA**



REINFORCING SCHEDULE			
MARK	NO REQ'D	SIZE	LENGTH
R-1	12	#4	114"
R-2	11	#4	84"
R-3	12	#4	138"

**STRUCTURES-PADS**  
Three Phase Padmount Transformers  
34.5kV (Poured-In-Place)

**SPEC 18D**

Sheet 3 of 3

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1. CONCRETE MIX

Concrete mix shall be either Type I or Type III Portland. Mix concrete in accordance with ASTM C94. Water shall be clear and drinkable. Ultimate strength at 28 days shall be 4,000 psi, 6 sacks minimum of cement per cubic yard. Maximum slump 4". Water to cement ratio shall not exceed 5.0 by weight, including free moisture on aggregate. Aggregate shall be white limestone rock, maximum size 3/4". Use air entraining admixture (3% to 6% air by volume.) **The use of calcium chloride is prohibited.**

2. PLACEMENT

All concrete shall be well vibrated, dense and smooth. No honeycombs, fins or cold joints shall be present. Placement and vibration of concrete shall not disturb the reinforcement.

3. REINFORCEMENT

Reinforcement shall consist of #4 reinforcing bars meeting the requirements of ASTM A615, minimum grade 40. All reinforcing bars shall be tied to prevent displacement during concrete placement.

4. DIMENSIONS

Dimensions shall be in accordance with the drawings shown in this standard. The top surface shall be true and free of mounds or depressions. A four foot level shall be placed at any location on the top surface and at no location may a #14 (American Wire Gauge) bare wire fit between the level and the surface. The finished pad shall be free of voids and crumbling edges. No protrusion or flashing shall exceed 1/4" in length from the finished surface. **Pads not conforming to any dimension or specification contained herein will not be accepted.**

5. CONDUITS

Secondary conduits shall be symmetrically located within a 20" x 24" area. Primary conduit shall be positioned as shown.

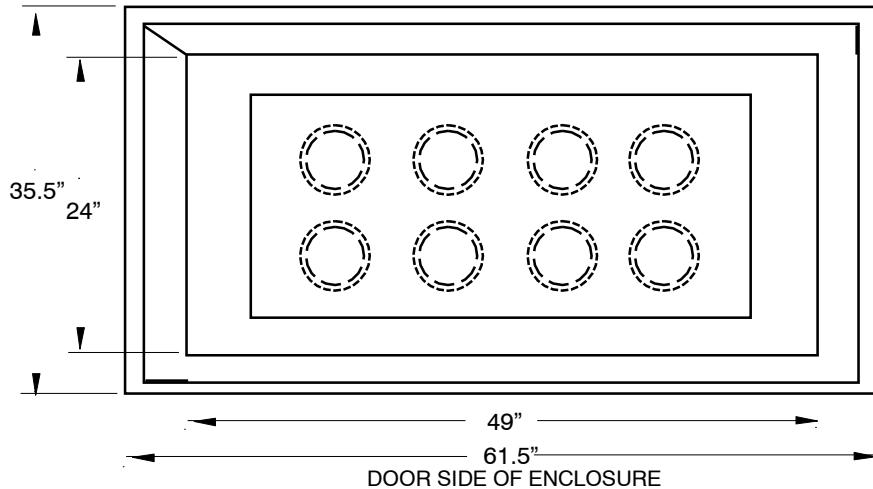
6. PROTECTIVE BARRIER RAILS

- Barrier rails to be railroad rails, 8'6" long, 50-100 lbs. per yard. An acceptable alternative is 4" iron pipe 8'6" long, concrete filled or power installed bumper posts.
- Barriers on sides not accessible to vehicles may be omitted.
- All Materials and labor for protective barrier rail installation shall be provided by the customer.
- Customer is encouraged to paint barrier rails with yellow street marking lacquer.

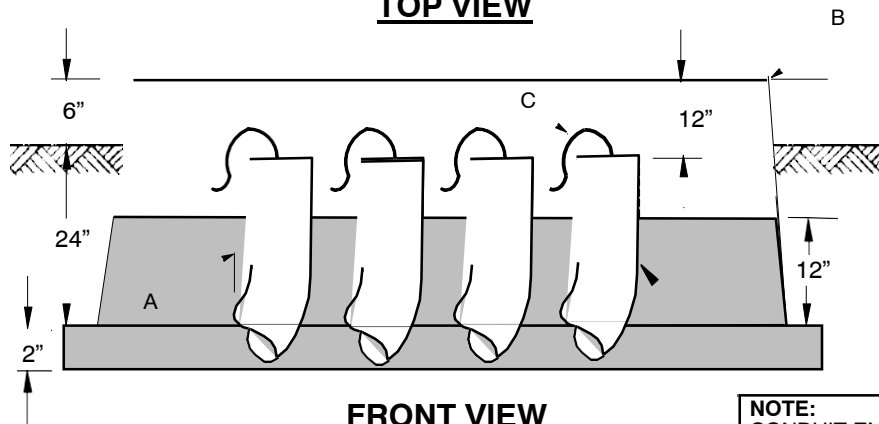
Caution: Installation of barrier rails must be coordinated with the conduit installation to avoid mutual interference.

(DERIVED FROM CONSTRUCTION STANDARD 34 11 00 00)





**TOP VIEW**



**FRONT VIEW**

**NOTE:**  
 CONDUIT ENDS EXTENDING INTO PAD MUST BE PLUMB AND PROPERLY POSITIONED PRIOR TO BACKFILLING. BUNDLE CONDUITS TOGETHER WITH DUCT TAPE TO PREVENT MOVEMENT. CAP OR TAPE THE ENDS SHUT WITH THE PULLING TAPE STICKING OUT.

MATERIAL INSTALLED BY CONTRACTOR  
 ( DERIVED FROM CONSTRUCTION STANDARD 52 10 01 00 )

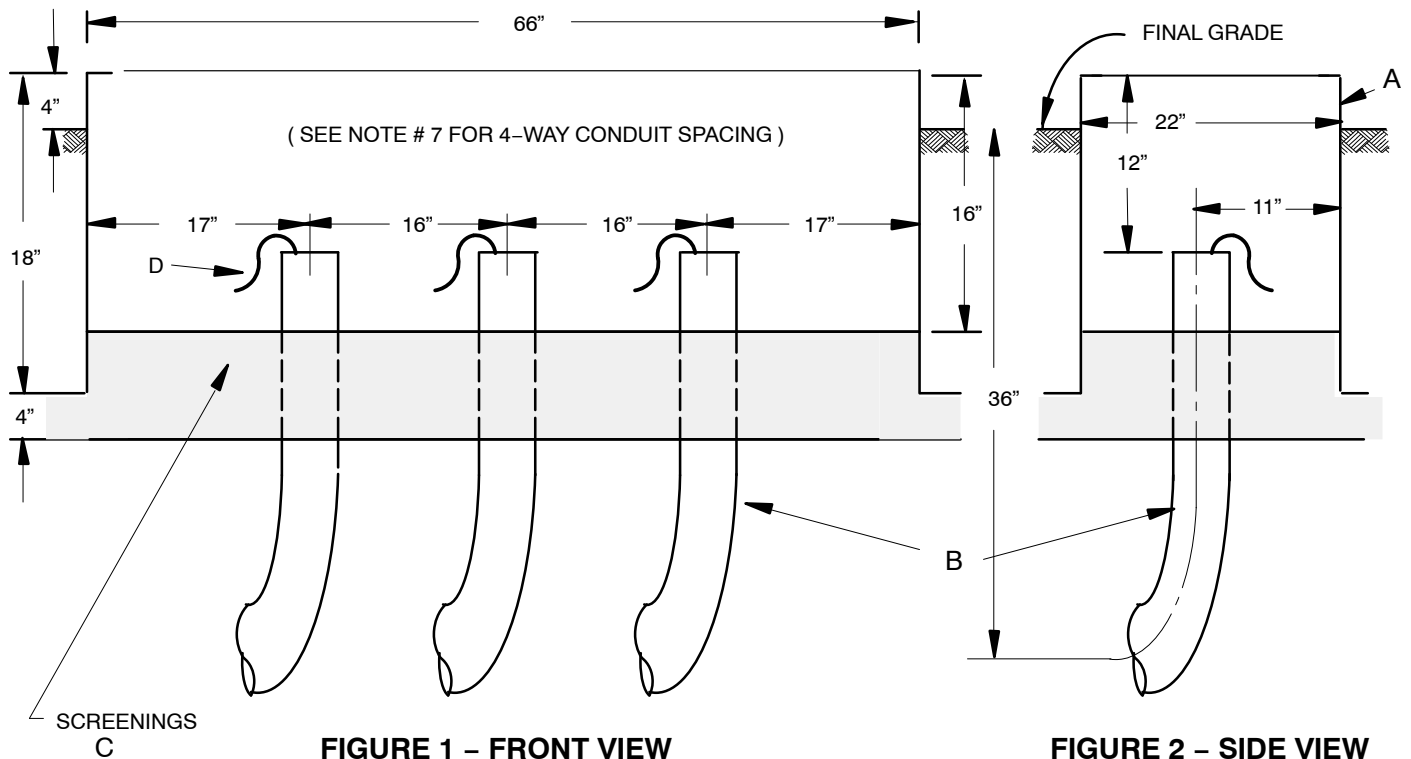
1. An initial depth of 26" shall be excavated and all loose soil shall be removed or tamped. The length + width of the hde shall be sized to allow a minimum of 6" of clearance on all sides.
2. Add 2" of screenings, compact, and set box pad.
3. Final depth should be adjusted to provide 6" of exposed ground pad at final grade.
4. Provide 12" of space between the top of the box pad and the end of the conduits.
5. Stabilize the box pad conduits by placing 12" of crushed stone screenings inside the box pad and tamp in place.
6. Backfill with loose material, DO NOT backfill next to the ground sleeve pad with chinks of material or rocks. Pack loose backfill by foot tamping and do not tamp excessively close to the ground sleeve pad sides. NOTE: Hydraulic tamping is not recommended.
7. Bend size may vary for secondary / service cabinet.



**STRUCTURES-MANHOLES**  
**STRAIGHT PRECAST**  
**Cable Racking**

**SPEC 19**  
Sheet 2 of 2

	<b>Material / Stk.No.</b>	<b>Description</b>	<b>Quantity</b>
A		Bend – Plastic, Sch. 40	As Req'd
B	12 06 196	Pad – Fibr. 49" x 24" x 30" (Provided by Ameren)	1
C	83 36 252	Pulling Tape – 3/4" Wide, 2500 lbs. Strength (ft.)	As Req'd.



**FIGURE 1 – FRONT VIEW**  
 ( DERIVED FROM CONSTRUCTION STANDARD 51 12 03 00 )

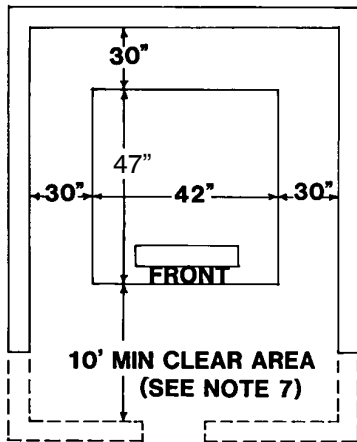
**FIGURE 2 – SIDE VIEW**

**INSTRUCTION FOR EXCAVATION AND PLACEMENT OF FIBERGLASS GROUND SLEEVE PAD- STK. NO. 12-06-120**

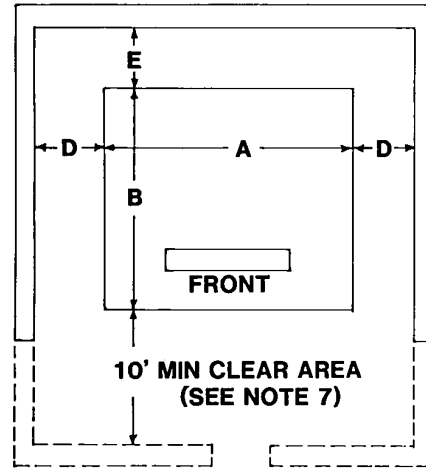
1. An initial depth of 18" shall be excavated and all loose soil shall be removed or tamped. The length and width of the hole should be sized to allow a minimum of 6" of clearance on all sides.
2. To install the 36" radius bends, an increase in the initial excavation depth will be required. After the bends have been installed, crushed stone screenings shall be placed and tamped to the level shown in Figure 1.
3. The final depth should be adjusted so that the top of the ground sleeve pad is 4" above final grade.
4. Stabilize the ground sleeve pad over the conduits before backfilling so that there will be no shifting. Provide 12" of space between the load bearing surface of the ground sleeve pad and the end of each conduit. See Figure 2.
5. To further stabilize the ground sleeve pad and the bends, place additional screenings inside the ground sleeve pad and hand tamp in place.
6. Backfill with loose material, DO NOT backfill next to the ground sleeve pad with chunks of material or rocks. Pack loose backfill by foot tamping and do not tamp excessively close to the ground sleeve pad sides. NOTE: Hydraulic tamping is not recommended
7. Reduce center to center conduit spacing to 13 inches for 4 – way installation
8. If restrained bends are required by Ameren, refer to Underground Distribution Spec. Drawing #2.

	<b>Std. / Stk. No.</b>	<b>Description</b>	<b>3 Way</b>	<b>4 Way</b>
A	12 06 120	Pad-Ground Sleeve, Fiberglass (Provided by Ameren)	1	1
B	12 51 176	Bend-Plastic, 4" x 36" Rad, Sch. 40	3	4
C		Screenings	As Req'd.	As Req'd.
D	83 36 252	Pulling Tape – 3/4" Wide, 2500 lbs. Strength (ft.)	As Req'd.	As Req'd.

**UNDERGROUND LINES INSTRUCTION**  
 Customer Installed Pad Installations Required  
 Clearances For Padmounted Transformers and Switchgear



1Ø Installations  
 25–167 kVA Transformers



3Ø Installations

3Ø Installations	A	B	D	E
75 Thru 300 kVA Radial Feed Transformers	72"	65"	30"	35"
500 & 750 kVA Radial Feed Transformers	72"	65"	45"	43"
75 Thru 1000 kVA Loop Feed Transformers	84"	72"	45"	44"
1000 Thru 2500 kVA Radial Feed Transformers	84"	72"	45"	56"
→ Switchgear	76"	74"	49"	120"

( DERIVED FROM CONSTRUCTION STANDARD 59 81 51 11 )

**NOTES:**

1. If pad mount is enclosed on all 4 sides, 10' minimum clearance from the front of transformer to inside of wall must be maintained for hot stick operations by Ameren personnel.
2. If a 4 sided enclosure is used, an opening or doorway shall be provided. If a lock is required provisions shall be made to provide continuous access by Ameren personnel.
3. Customer to provide drainage away from enclosed areas to prevent oil and/or water from standing.
4. If a 4 sided enclosure is used, a minimum of 10 square feet of venting space in the form of 50% effective louvers or 5 square feet of opening shall be provided located along the bottom of each wall. If a 3 sided wall is used, wall venting space is desirable, but not required.
5. Location must be accessible for installing or replacing transformer with crane.
6. Developer to provide plastic conduit of size specified by Ameren to a point designated by Ameren outside the wall 36" to 42" below final grade.
7. The 10' distance between the front of the pad and the wall may be reduced to 48" if an opening or gate is provided. The opening or gate should be centered on the front of the pad and should provide for a minimum opening of 3–1/2' for 1Ø and 9–1/2' for the 3Ø installation. A 10' clear area in front of the pad must still be available with the opening or when the gate is open for hot stick operations by Ameren personnel.
8. To provide for transformer replacement, enclosed area is to be free of overhangs or overhead obstructions. Wall height not to exceed 8' unless the above mentioned gate or opening is provided or an easily removable wall is used.
9. Should upgrading be required, the dimensions as shown provide adequate ventilation and space for 1 size larger transformer.
10. Walls shown in drawing, but clearances are required for any obstruction, i.e. switchgear, dumpsters, etc.

**UNDERGROUND LINES INSTRUCTION**  
 Customer Installed Pad Installations  
 Protective Barrier Rail Installation for 15 kV

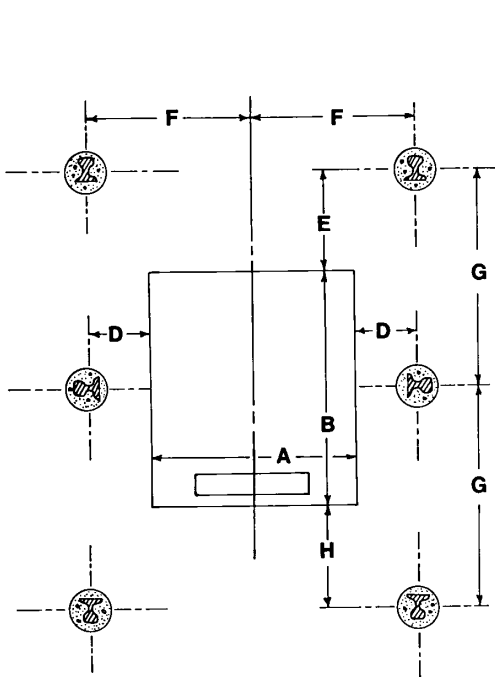


FIGURE 1

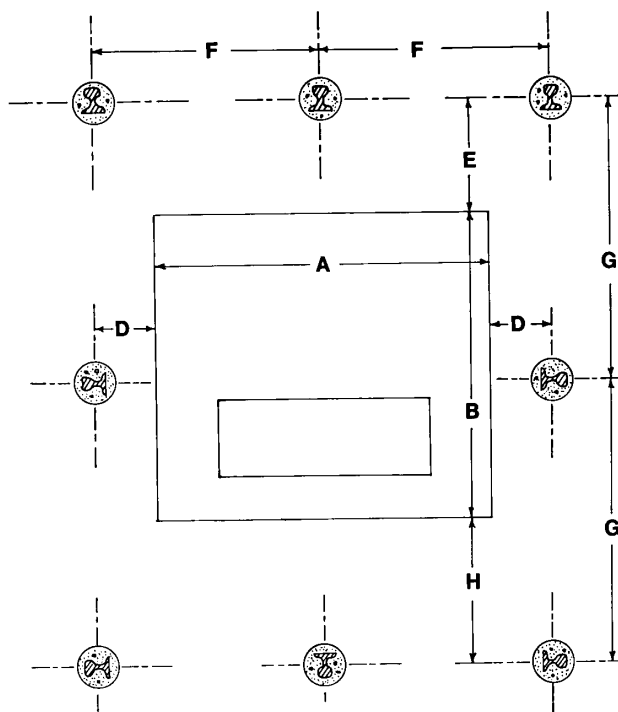


FIGURE 2

	TRANSFORMER SIZE	COMPOSITE PAD STOCK NUMBER	A	B	C	D	E	F	G	H
FIGURE 1	0-167 KVA 1Ø LIGHTWEIGHT PAD	12 06 164	42"	45"	4"	12"	15"	33"	40"	18"
FIGURE1	0-167 KVA 1Ø HEAVY PAD	12 06 198	42"	47"	4"	12"	15"	33"	40"	18"
FIGURE 2	75-750 KVA 3Ø RADIAL FEED	12 06 123	72"	65"	4"	32"	27"	68"	64"	36"
FIGURE 2	1000-2500 KVA, 3Ø RADIAL FEED	12 06 124	84"	72"	5"	32"	38"	74"	73"	36"
FIGURE 2	75-2500 KVA, 3Ø LOOP FEED	12 06 124	84"	72"	5"	32"	38"	74"	73"	36"

COMPOSITE SWITCH GEAR PAD STOCK NO.	FIGURE 3						
	A	B	C	D	E	F	G
12 06 109	69"	63"	36"	24"	36"	58.5"	67.5"
12 06 165	76"	74"	36"	24"	36"	62"	73"
12 06 165(Auto)**	76"	74"	36"	49"	36"	62"	73"

\*C = Height or thickness of pad.

(Auto)\*\* = Automated switchgears require larger side clearance (D) to open the doors on control boxes and motor operators.

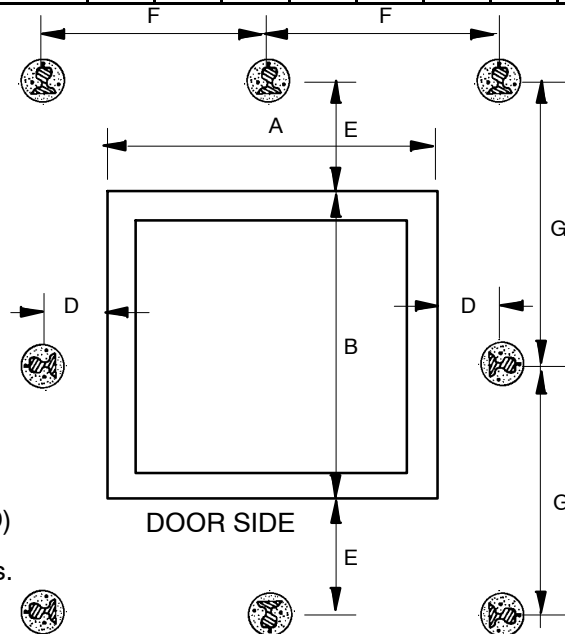
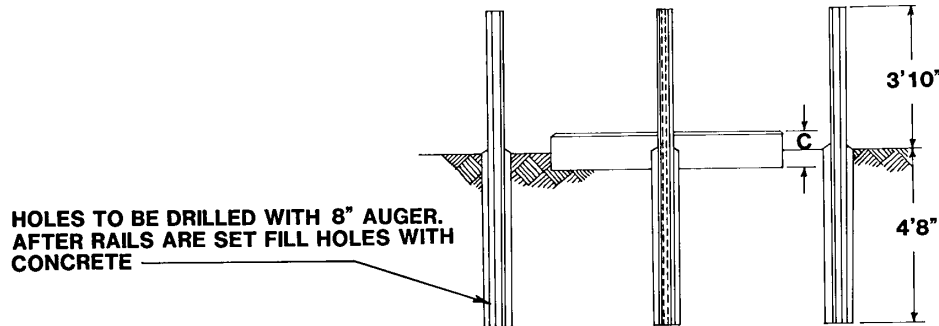


FIGURE 3



1. Barrier iron to be railroad rails, 8'6" long, 50–100 lbs. per yard. An acceptable alternate is 4" iron pipe, 8'6" long, concrete filled or see Dist. Std. 34 22 01 00 for a power installed bumper post.
2. Barriers on sides not accessible to vehicles may be omitted.
3. All materials and labor for protective barrier rail installation shall be provided by customer.
4. Customer is encouraged to paint barrier rails with yellow street marking lacquer.

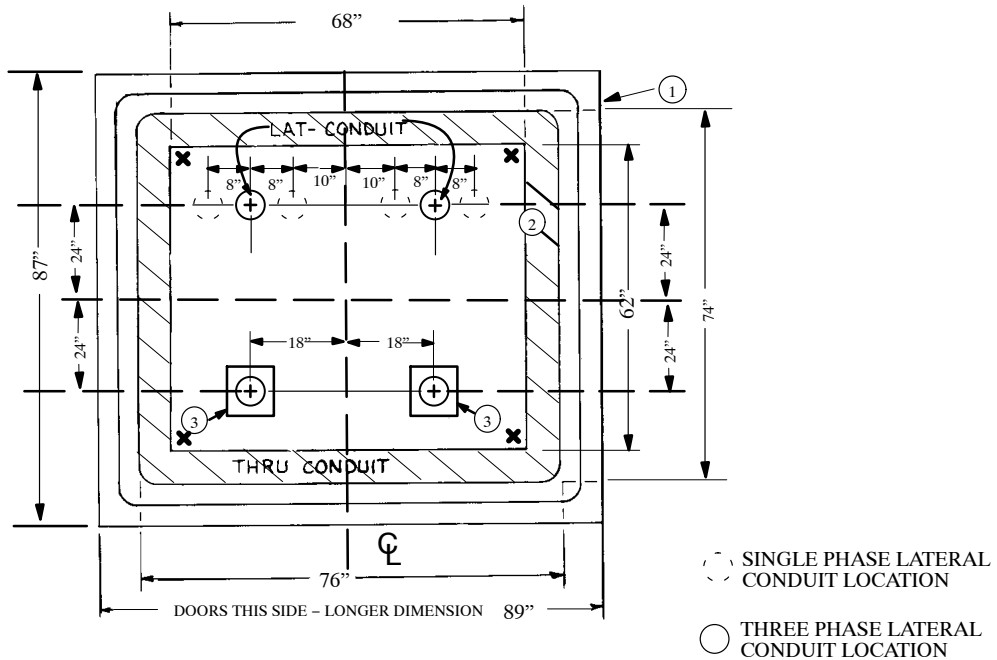
**MATERIAL INSTALLED BY CONTRACTOR**

(DERIVED FROM CONSTRUCTION STANDARD 59 81 51 10 )

Stk No.	Description	Qty.
68 05 024	Rail – Barrier, 8'6" (Ea)	As Req'd.
11 04 105	Concrete – Premix (Sk)	As Req'd.
30 57 025	Lacquer – Yellow (Gal)	As Req'd.

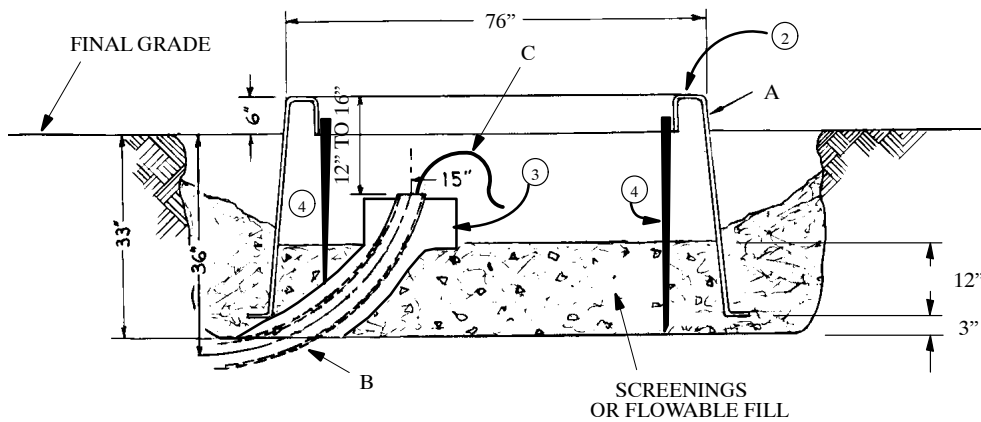
**CAUTION:** Installation of barrier rails must be coordinated with electric conduit installation to avoid mutual interference.

**COMPOSITE SWITCHGEAR PAD**



**TOP VIEW**

- 1 BASE OF PAD
- 2 LOAD BEARING SURFACE OF PAD
- 3 RESTRAIN THRU CONDUIT BENDS PER SPEC 2 AS REQUIRED BY AMEREN FOR PULLING LONG CABLE LENGTHS.
- 4 PLACE GROUND RODS AT CORNERS (X). AS AN ALTERNATIVE, FOUR 1 INCH PVC SLEEVES OF 18 INCHES MIN. LENGTH MAY BE INSTALLED



**SIDE VIEW**

**UNDERGROUND EQUIPMENT-SWITCHING**  
Padmounted Primary Switchgear – Deadfront, 15kV  
Composite Pad

**SPEC 25**  
Sheet 2 of 2

MATERIAL INSTALLED BY CONTRACTOR  
( DERIVED FROM CONSTRUCTION STANDARD 53 11 04 \*\* )

	<b>Material / Stk No.</b>	<b>Description</b>	<b>Quantity</b>
A	12 06 165	Pad – Switchgear, Composite (Provided by Ameren)	1
B	12 51 173	Bend – Plastic, 3" x 36" Rad, Sch. 40	As Req'd
	12 51 176	Bend – Plastic, 4" x 36" Rad, Sch. 40	As Req'd
	12 51 206	Bend – Plastic, 5" x 36" Rad, Sch. 40	As Req'd
C	83 36 252	Pulling Tape – 3/4" Wide, 2500 lbs. Strength (ft.)	As Req'd
D	23 63 027	Rod – Ground 5/8" x 8', Copper	4

**INSTRUCTIONS FOR EXCAVATION AND PLACEMENT OF SWITCHGEAR BOX PAD.**

Placing The Bends

Situate the bends as required by Ameren on the job drawings. Note that a 36 inch radius bend on the lateral side at a 36 inch depth will almost touch the side of the pad when it is placed at depth. An increase of final burial depth or angling of the conduit may be necessary to clear the pad flange.

Excavation And Final Depth

An initial depth of 33 inches shall be excavated removing or tamping all loose soil. The length and width of the hole should be 99" by 97". This allows 5" of side clearance. The longer dimension is the door side of the gear.

One inch clean gravel shall be placed and tamped to a final level depth of 30 inches. The area bearing the pad shall be leveled with a carpenter's level. The final depth of 30 inches will leave the required 6 inches of pad exposed at final grade.

Place The Pad

Place the pad with the longer side where the doors will be, as indicated on the job drawings provided by Ameren.

Backfilling

Stabilize the pad before backfilling the outside of the pad to prevent shifting.

Stabilizing

To further stabilize the pad and conduit bends, place 12 inches of screenings inside the pad and tamp in place.

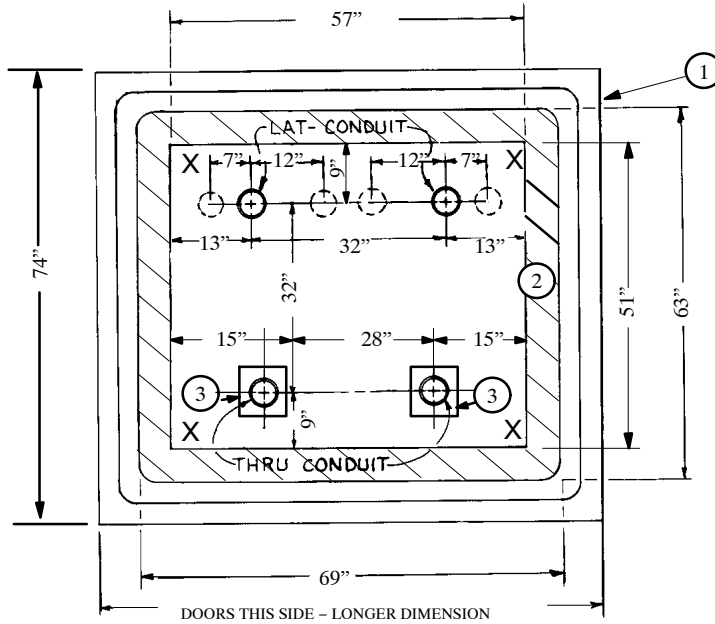
Bend – Final Preparation

The conduit bend should be cut off below the switchgear pad mounting flange. The rule is as follows: 5 inch diameter bend shall be cut a minimum of 16 inches below the flange. A 3 inch conduit cut a minimum of 12 inches below.

Ground Rods

Place the 4 ground rods in the corners of the pad opening. Drive the ground rods into the soil to a depth of 5 feet. Place the ground rods before adding screenings or flowable fill inside of the pad.

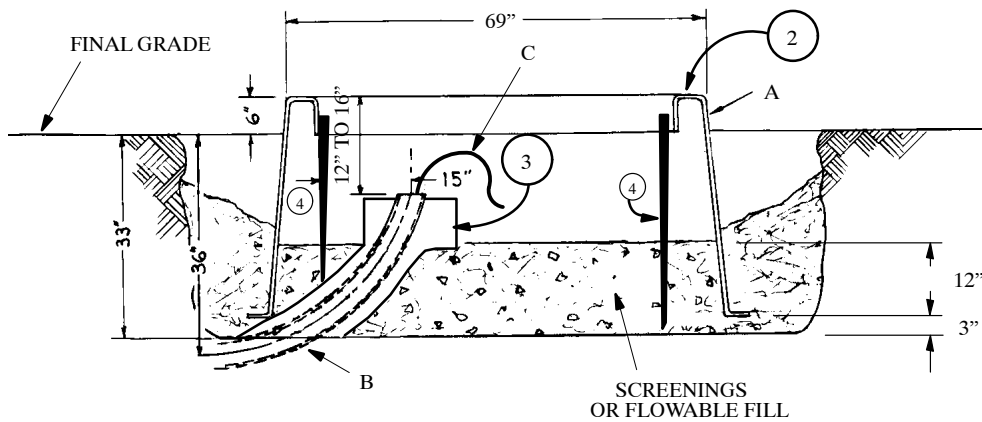
**COMPOSITE SWITCHGEAR PAD**



FOR USE WITH  
 SM-5 FUSED  
 LIVEFRONT  
 SWITCHGEAR

**TOP VIEW**

- ① BASE OF PAD
- ② LOAD BEARING SURFACE OF PAD
- ③ RESTRAIN THRU CONDUIT BENDS PER SPEC 2 AS REQUIRED BY AMEREN FOR PULLING LONG CABLE LENGTHS.
- ➔ ④ PLACE GROUND RODS AT CORNERS (X). AS AN ALTERNATIVE, FOUR 1 INCH PVC SLEEVE OF 18 INCHES MIN. LENGTH MAY BE INSTALLED.



**SIDE VIEW**



**UNDERGROUND EQUIPMENT-SWITCHING**  
Padmounted Primary Switchgear – Livefront , 4kV Only  
Composite Pad

**SPEC 25A**  
Sheet 2 of 2

MATERIAL INSTALLED BY CONTRACTOR  
( DERIVED FROM CONSTRUCTION STANDARD 53 11 04 \*\* )

	<b>Material / Stk No.</b>	<b>Description</b>	<b>Quantity</b>
A	12 06 109	Pad – Switchgear, Composite (Provided by Ameren)	1
B	12 51 173	Bend – Plastic, 3" x 36" Rad, Sch. 40	As Req'd
	12 51 176	Bend – Plastic, 4" x 36" Rad, Sch. 40	As Req'd
	12 51 206	Bend – Plastic, 5" x 36" Rad, Sch. 40	As Req'd
C	83 36 252	Pulling Tape – 3/4" Wide, 2500 lbs. Strength (ft.)	As Req'd
D	23 63 027	Rod – Ground 5/8" x 8', Copper	4

**INSTRUCTIONS FOR EXCAVATION AND PLACEMENT OF SWITCHGEAR BOX PAD.**

Placing The Bends

Situate the bends as required by Ameren on the job drawings. Note that a 36 inch radius bend on the lateral side at a 36 inch depth will almost touch the side of the pad when it is placed at depth. An increase of final burial depth or angling of the conduit may be necessary to clear the pad flange.

Excavation And Final Depth

An initial depth of 33 inches shall be excavated removing or tamping all loose soil. The length and width of the hole should be 85" by 79". This allows 5" of side clearance. The longer dimension is the door side of the gear.

One inch clean gravel shall be placed and tamped to a final level depth of 30 inches. The area bearing the pad shall be leveled with a carpenter's level. The final depth of 30 inches will leave the required 6 inches of pad exposed at final grade.

Place The Pad

Place the pad with the longer side where the doors will be, as indicated on the job drawings provided by Ameren.

Backfilling

Stabilize the pad before backfilling the outside of the pad to prevent shifting.

Stabilizing

To further stabilize the pad and conduit bends, place 12 inches of screenings inside the pad and tamp in place.

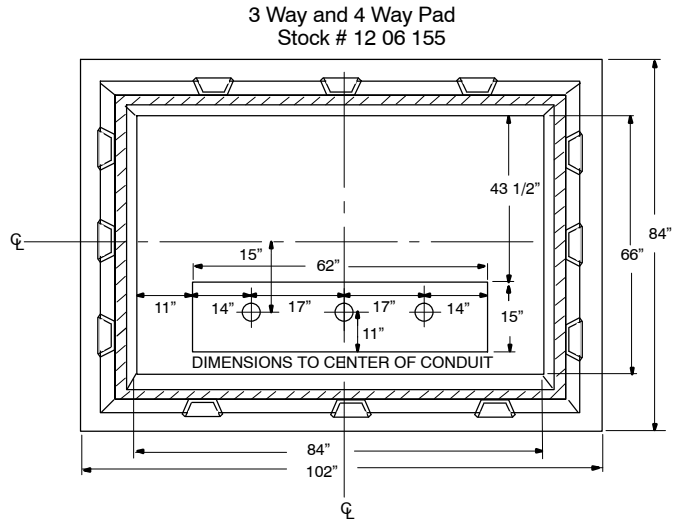
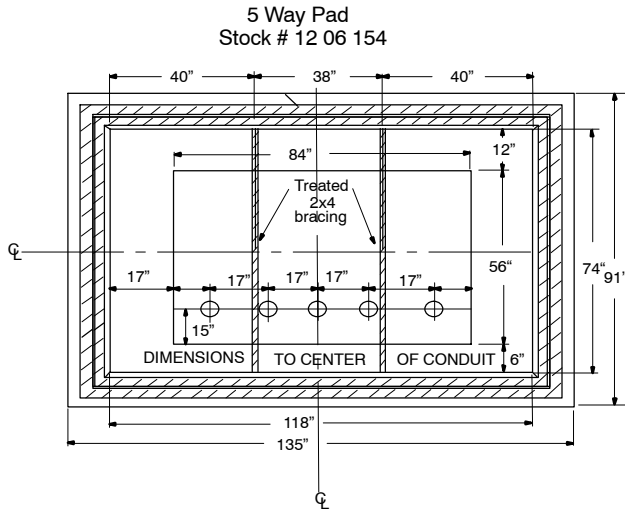
Bend – Final Preparation

The conduit bend should be cut off below the switchgear pad mounting flange. The rule is as follows: 5 inch diameter bend shall be cut a minimum of 16 inches below the flange. A 3 inch conduit cut a minimum of 12 inches below.

Ground Rods

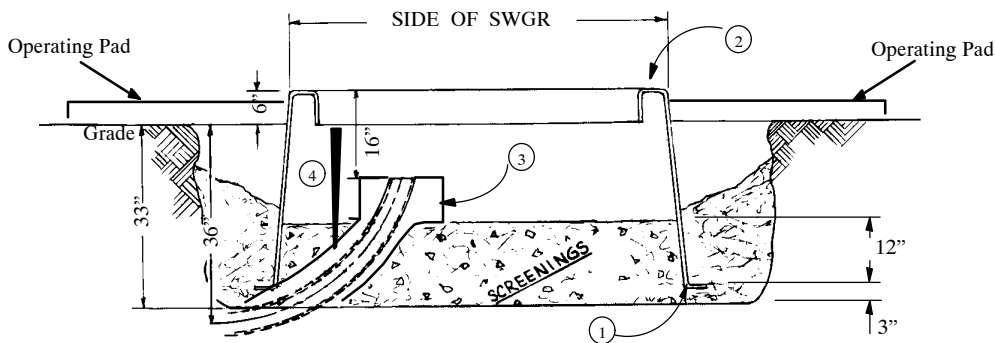
Place the 4 ground rods in the corners of the pad opening. Drive the ground rods into the soil to a depth of 5 feet. Place the ground rods before adding screenings or flowable fill inside of the pad.

**Fiberglass Pads with Conduit Bend Placements**



(Note: For 4-Way Swgr. add 1 conduit and reduce the end dimensions from 14" to 5.5")

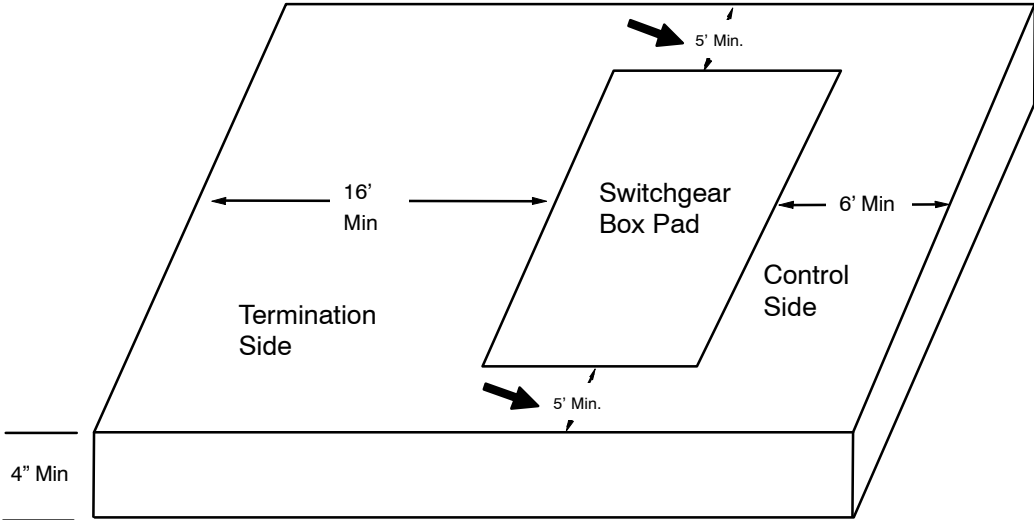
**Fiberglass Pads - Placement Depth**



- ① BASE OF PAD
- ② LOAD BEARING SURFACE OF PAD
- ③ RESTRAIN THRU CONDUIT BENDS PER STD. 31 47 01 \*\* AS NEEDED FOR PULLING LONG CABLE LENGTHS.
- ④ CONSTRUCT A COMPARTMENT GROUND BAR USING THREE 5/8" X 8' COPPER GROUND RODS AND TWO BOLT CONNECTORS.

(DERIVED FROM CONSTRUCTION STANDARD 53 11 06 \*\*)

**CONCRETE OPERATING PAD**



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INSTRUCTIONS FOR EXCAVATION AND PLACEMENT OF SWITCHGEAR BOXPAD

Placing The Bends

Place the bends as described in the figure. Note that a 36 inch radius bend on the lateral side at a 36 inch depth will almost touch the side of the box when it is placed at depth. An increase of final burial depth or angling of the conduit may be necessary to clear the box flange.

Excavation And Final Depth

An initial depth of 33 inches shall be excavated removing or tamping all loose soil. The length and width of the hole is the maximum length and width of the box plus 5" of clearance on each side. The longer dimension is the door side of the gear.

Crushed stone screenings shall be placed and tamped to a final level depth of 30 inches. The area bearing the pad-box shall be leveled with a carpenter's level. The final depth of 30 inches will leave the required 6 inches of box exposed at final grade.

Place The Box

Place the box with the longer side where the doors will be, as described on the Engineering Layout.

Backfilling

Stabilize the box before backfilling the outside of the box to prevent shifting.

Stabilizing

To further stabilize the box and conduit bends, place 12 inches of screenings inside the box and tamp in place.

Bend – Final Preparation

The conduit bend should be cut off below the box's switchgear mounting flange. A 5 inch diameter bend shall be cut a minimum of 16 inches below the flange.

Do not tamp excessively close to the box because the side will tend to bow in.

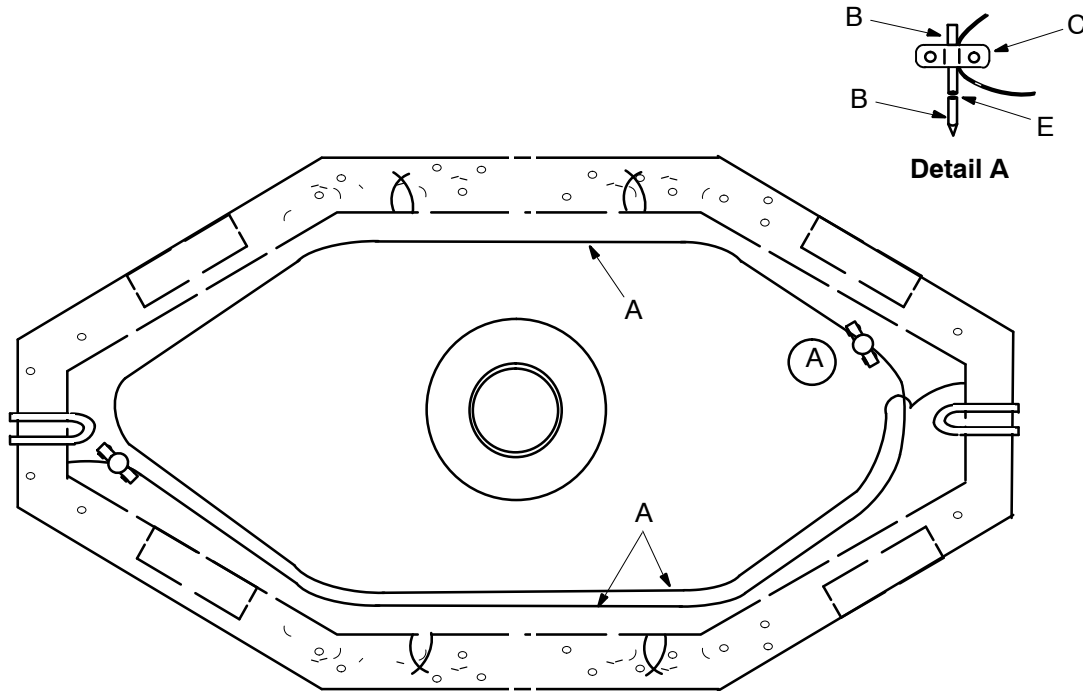
NOTE: This installation will not withstand pulling long cable lengths through the bends at the switchgear. Install re-strained bends per Spec #2. See fiberglass pad drawing.

CONCRETE OPERATING PAD

The switchgear box pad shall be surrounded by a concrete pad. The poured in place pad shall be a minimum of 4 inches thick. The pad shall be a minimum length of 16 feet on the cable termination side of the switchgear and a minimum of 6 feet on the switch/interrupter control side of the switchgear. The operating pad shall have a minimum width of 5 feet on both sides of the switchgear mounting sleeve.

**STRUCTURES – MANHOLES**  
 Straight – Precast  
 Grounding System

**SPEC 27**  
 Sheet 1 of 1



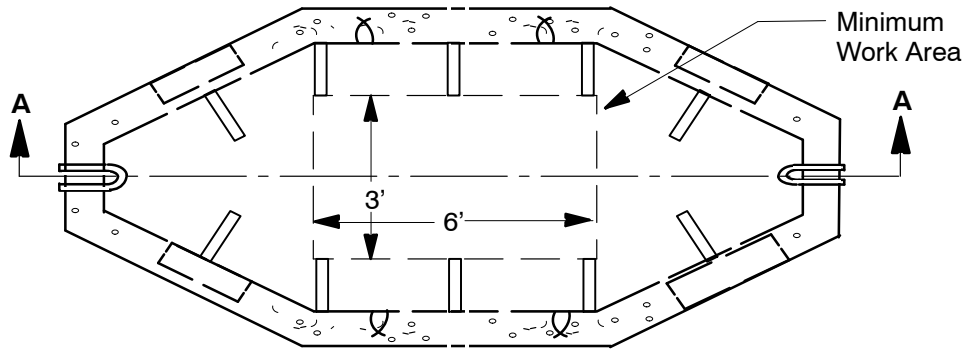
( DERIVED FROM CONSTRUCTION STANDARD 33 20 02 \*\* )

	Stock. No.	Description	01	02	03
3	A	Wire-4/0 AWG, Copper, Bare, Soft Drawn	43	54	65
	B	Rod-Ground, 5/8" x 4'	4	4	4
	C	Connector-Wire, 8-350 kcmil, CU	2	2	2
2	D	Hook - Plastic, 2 1/2" Diameter, Bond Wire Support	10	10	10
5	E	Coupling-CU Alloy, 5/8", Threaded	2	2	2
		Operation Code 308	1	1	1

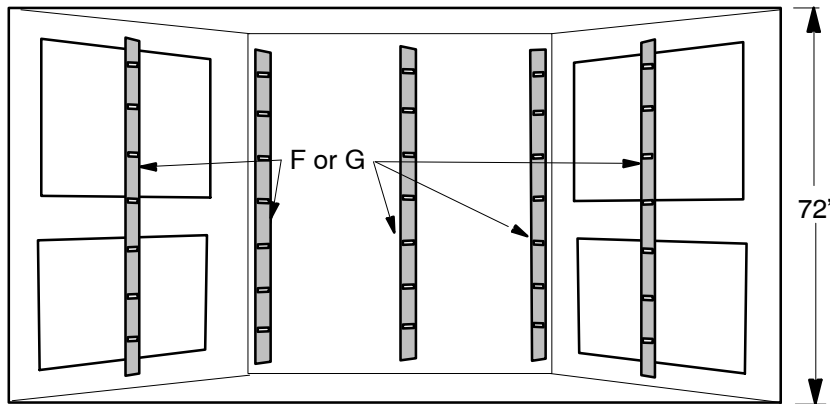
**NOTE**

- All splice ground and drain wires are connected to the grounding system using a two bolt connector.
- The Bond Wire is to be fastened 6 inches above the manhole floor using plastic hooks (D) attached to the cable mounting brackets.
- If the manhole is the first one in the substation do not drive the ground rods. Connect the end of the bond wire at two points to the substation ground grid.
- When making grounding attachments to the bond wire, clean the bond wire at the attachment point.
- Join two ground rods together with a coupling.

**SPEC 9**      4' x10' Manhole (01)  
**SPEC 10**     6' x 14' Manhole (02)  
**SPEC 8**      6' x 17" Manhole



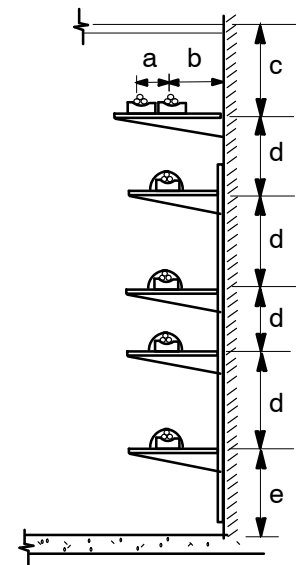
**Cable Rack Spacing in Manhole**



**SECTION AA**  
**Side View of Cable Racks in Manhole**

Standard Manhole (1 to 10 Ducts Used)  
 Maximum of 10 Network Cables on One Side  
 Maximum of 5 Primary Cables on Each Side  
 7 Brackets Maximum on Each Cable Rack

**Cable Bracket Spacing**



Dimension in Table

**SPACING REQUIREMENTS FOR CABLE BRACKETS**  
Standard Precast Manhole

	a	b	c	d	e
Network & 600V	6"	6"	12"	12"	12"
5 & 15 kV		6"	12"	12"	12"
35 kV		6"	12"	12"	15"

**STRUCTURES-MANHOLES**  
**STRAIGHT PRECAST**  
**Cable Racking**

**SPEC 28**  
Sheet 2 of 3

**MATERIALS INSTALLED BY CONTRATOR**  
**(DERIVED FROM CONSTRUCTION STANDARD 33 20 05 \*\*)**

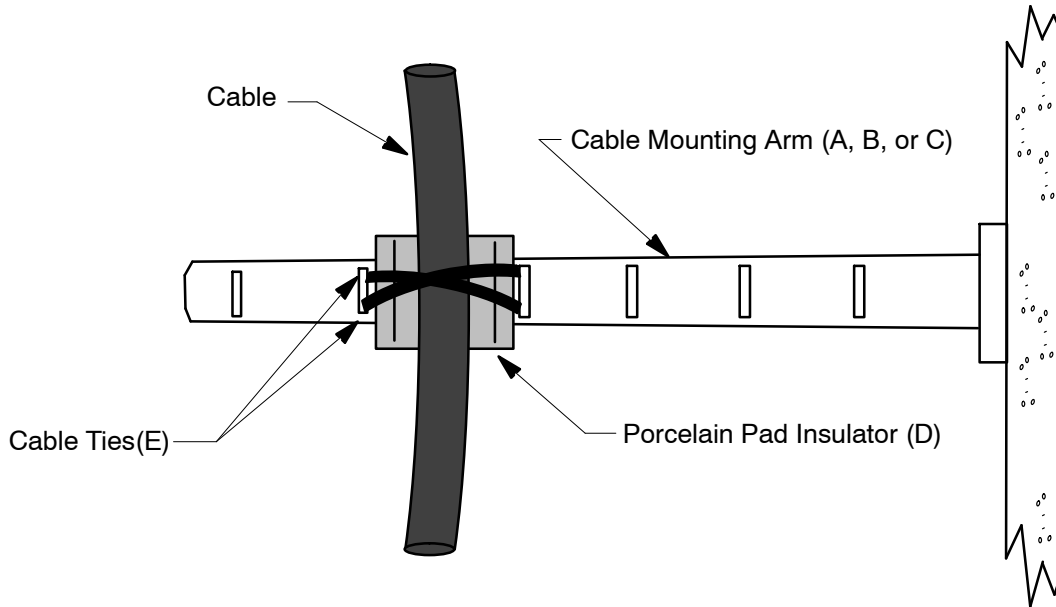
		<b>Std. / Stk. No.</b>	<b>Description</b>	<b>01</b>	<b>02</b>	<b>03</b>
	A	12 56 121	Arm – Cable Mounting 10"	5		
	B	12 56 113	Arm – Cable Mounting 14"		20	
	C	12 56 112	Arm – Cable Mounting 18"			20
	D	12 56 122	Insulator – Porcelain Pad	@	@	@
3	E	40 59 196	Tie – Cable, Black, 13 1/2" Dia.	10	40	200
4	F	12 56 115	Rack – Cable, Galv. Steel, 30" Long, 18 Holes	@	@	@
4	G	12 56 116	Rack – Cable, Galv. Steel, 55" Long, 37 Holes	@	@	@

- (01) Single Installation of 5 kV or 15 kV Primary Cable and Splice or a 35 kV Sub-transmission Cable and a Splice
- (02) Installation of One or Two 600 V Network Cables and Straight Splices or 2-3 Network Cables and a 3-way Crab Connector
- (03) 4-7 600 V Network Cables and Either a 5 or 7 way Crab Connector

**NOTES:**

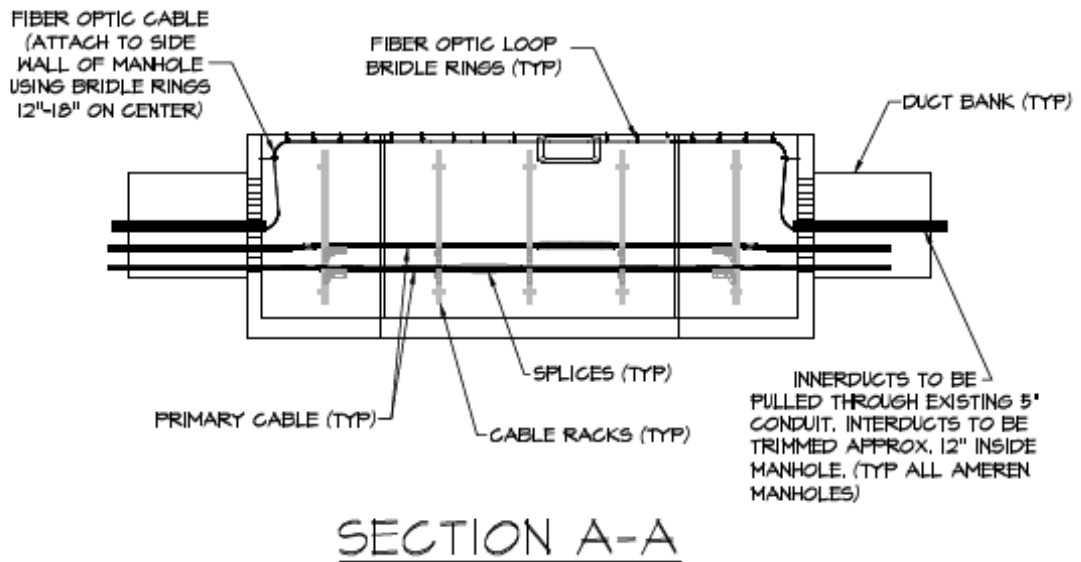
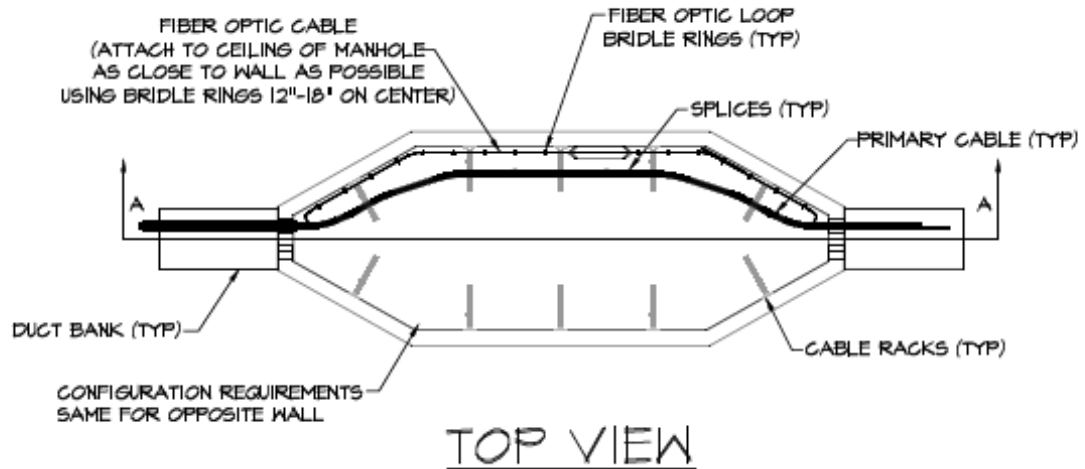
1. In combined Network & Primary manholes the Network cables should be located on the top 1-4 brackets and the Primary cables should be located on the next 1-3 brackets below the Network cables. The Sub-transmission cables (if needed) should be located below the Primary cables on the bottom bracket(s).
2. When training and racking cables avoid situations whenever possible where cables will cross each other.
3. At each cable mounting arm, tie the cable/splice down to the porcelain insulator pad and mounting arm using two cable ties in a cross pattern (see Detail on Sheet 3).
4. New precast manholes will be supplied with the cable racks already installed in them.

**Cable / Splice Cross Tie Down Detail**

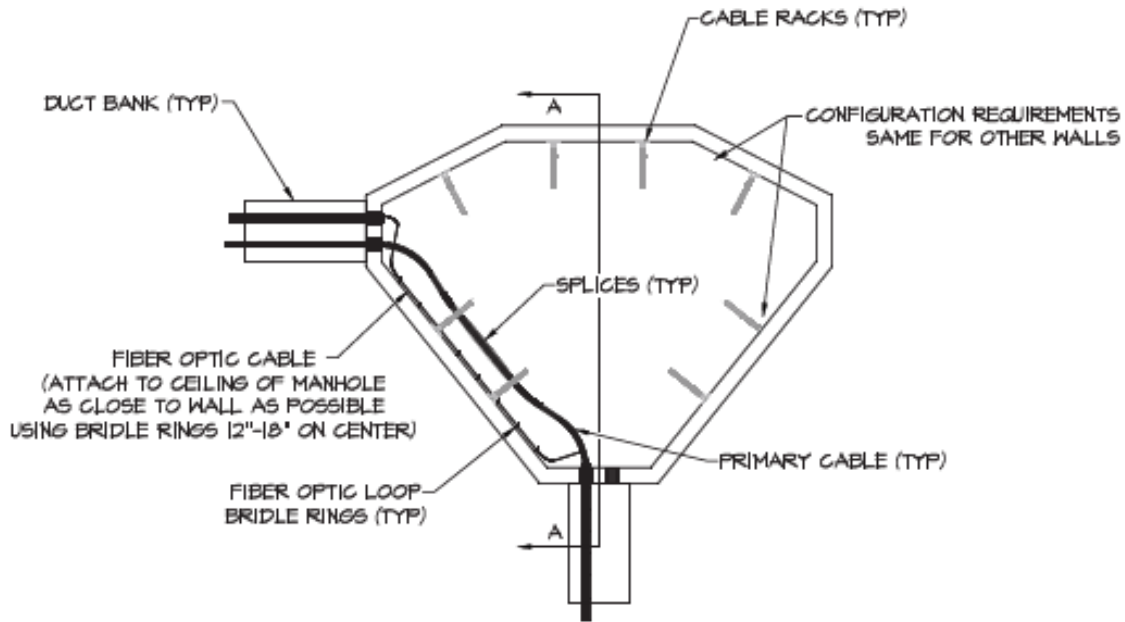




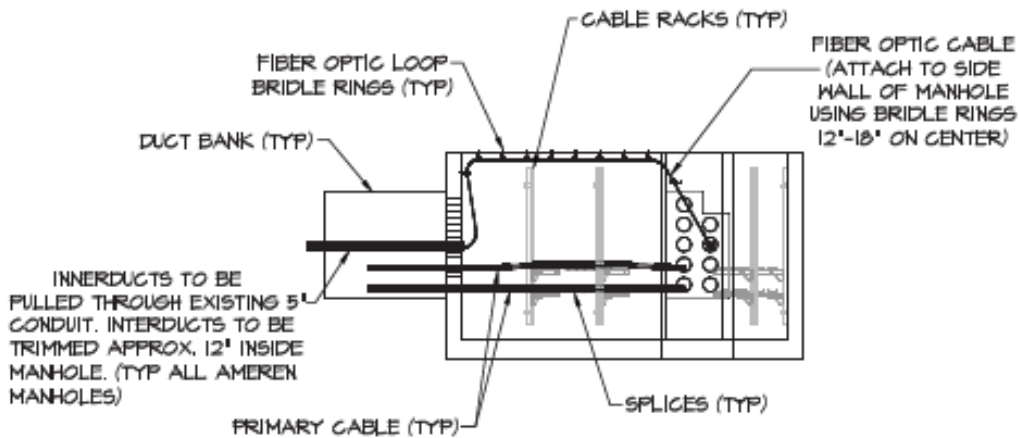
4' x 10', 6' x 14', or 6' x 17' Straight Manhole



10'-6" x 14'-0" x 7'- 0" Three Way Manhole

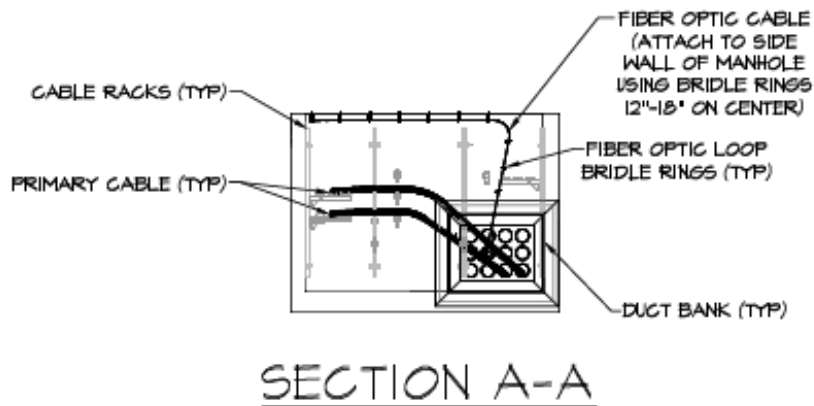
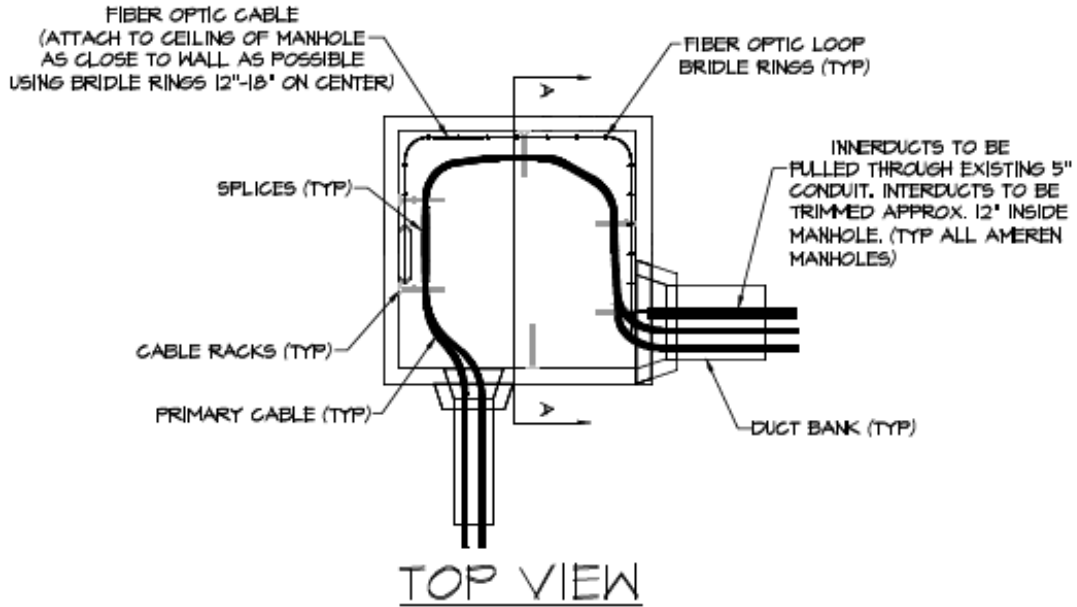


TOP VIEW



SECTION A-A

Square / Non-standard Manhole



Notes:

- 1) All fiber optic cables are to be wrapped with fire and arc proofing tape. Low smoke / flame resistant jackets are preferred on all fiber optic cables.
- 2) If secondary cables are present, fiber optic cables shall be located 4" – 6" above the finished floor, otherwise, locate the cables at the ceiling.
- 3) Ownership of all fiber optic cables is to be clearly marked on the fiber optic cable or using tags hung on the cable. For example, tags marked "Verizon F.O. Cable".