SECTION 26 05 33

ELECTRICAL RACEWAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The Conditions of the Contract and applicable requirements of Divisions 0 and 1 and Section 26 00 01, “Electrical General Provisions”, govern this Section.

1.2 DESCRIPTION OF WORK:

A. Work Included: Provide electrical raceway and fitting work as shown, scheduled, indicated, and specified.

B. Conduit Systems: All electrical conductors shall be installed in conduit or surface metallic raceways, except where metal clad Type MC cable or modular wiring is allowed or specified. Conduit shall be as specified herein. In addition, empty conduit or surface metallic raceways shall be installed for the voice/data system and for other systems as indicated on the Drawings and in the Specifications.

C. Types: The types of electrical raceways and fittings required for the project include, but are not limited to, the following:

1. Rigid steel (RGS) and intermediate metal conduit (IMC). Indoor only, add aluminum.
2. PVC-coated rigid steel conduit.
3. Electrical metallic tubing (EMT).
4. Flexible metal conduit.
5. Liquidtight flexible metal conduit.
6. Rigid nonmetallic conduit.
7. Nonmetallic innerduct. For fiber optic only.

1.3 STANDARDS:

1. Conduit underground shall be nonmetallic sch.80, if not encased in concrete duct bank.
2. Sch 40 if not encased in concrete.

B. Products and installation shall comply with applicable sections of the following standards:

1. ANSI C80.1 Rigid Steel Conduit, Zinc-Coated.
2. ANSI C80.6 Intermediate Metal Conduit, Zinc-Coated.
3. ANSI C80.3 Electrical Metallic Tubing, Zinc Coated.
4. ANSI/NEMA FB 1 Fittings and Supports for Conduit and Cable Assemblies.
5. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.4 QUALITY ASSURANCE:

A. Manufacturers: Provide products complying with these specifications and produced by one of the following:

1. Rigid Steel and Intermediate Metal Conduit:
   a. Allied Tube & Conduit Corporation.
   b. Galvite/LTV Steel Tubular Products
   c. Republic Steel Corporation.

d. Triangle PWC, Inc.
e. Youngstown Sheet & Tube.
f. Wheatland.

2. PVC-coated Rigid Steel:
   a. Allied Tube & Conduit Corporation.
   b. Flexi-Guard, Inc.
   c. Occidental Coating Company.
   d. Perma-Cote.
   e. Republic Steel Corporation.
   f. Robroy.
   g. Triangle PWC, Inc.
   h. Youngstown Sheet & Tube.
   i. Wheatland.
3. Electrical Metallic Tubing:
   a. Allied Tube & Conduit Corporation.
   b. ETP-Uni-Couple.
   c. Republic Steel Corporation.
   d. Triangle PWC, Inc.
   e. Youngstown Sheet & Tube.
   f. Wheatland.
4. Flexible Metal and Liquidtight Flexible Metal:
   a. AFC.
   b. Alflex
   c. Anaconda Metal Hose.
   d. Electri-Flex Company.
   e. Flexi-Guard, Inc.
   f. Triangle PWC, Inc.
   g. Wheatland.
5. Rigid Nonmetallic Conduit and Innerduct:
   a. Carlon.
   b. Cantex.
   c. Triangle PWC, Inc.
6. Raceway Fittings:
   a. Appleton Electric Company.
   b. Cantex (PVC).
   c. Carlon (PVC).
   d. Crouse Hinds.
   e. Efcor Division.
   f. ETP-Uni-Couple.

g. O. Z. Gedney Company.
h. Raco, Inc.
i. Republic Steel Corporation.
j. Steel City.
k. Thomas and Betts.

7. Ductbank Spacers:
   a. Formex.
   b. Carlon.
8. Precast Manholes, Pull Boxes and Accessories:
   a. Brooks.
   b. A. B. Chance.

B. UL Label: All electrical raceways and fittings shall be UL-listed and labeled.

C. NEMA Compliance: All electrical raceways and fittings shall comply with NEMA standards applicable to raceway construction.

D. NEC Compliance: All electrical raceways and fittings shall comply with NEC requirements applicable to construction and installation.

1.5 SUBMITTALS:

A. Shop drawing submittals shall include, but not be limited to, the following:
   1. The Contractor shall submit to the Engineer for review, a list of the proposed manufacturers of electrical raceways and fittings selected from the manufacturers listed herein. The Contractor may install conduit and fittings furnished by any manufacturer listed on the UH specifications.
   2. Cut sheets of electrical raceways and fittings.
   3. Manufacturers data on manholes, pull boxes and accessories.
   4. Additional information as required in Section 26 00 01, “Electrical General Provisions”..

1.6 STORAGE AND HANDLING:

A. Handle raceways and fittings carefully to avoid damage, breaking, denting and scoring. Damaged materials shall not be installed.

B. Store raceways and fittings in a clean dry space and protect from the weather shall be new.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS:

A. General:
   1. Provide metal conduit, tubing, and fittings of the type, grade, size, and weight (wall thickness) as shown and required for each service. Where type and grade are not indicated, provide proper selection determined by this Section to fulfill the wiring requirements and complying with the NEC for electrical raceways and UH specifications.
   2. For each electrical raceway system indicated, provide a complete assembly of conduit, tubing, or duct with fittings, including, but not necessarily limited to, connectors, nipples, couplings, expansion fittings, bushings, locknuts, other components and accessories as needed to form a complete system of the type indicated.

3. Conduit fittings shall be designed and approved for the specific use intended. Conduit fittings, including flexible, shall have insulated throats or bushings. Rigid conduits shall have insulated bushings, except insulated throat grounding bushings shall be used & conduit where required by N.E.C. Article 250.

B. Rigid Steel or Intermediate Metal Conduit: Rigid Steel shall be UL 6 and ANSI C80.1, hot-dipped galvanized steel. Intermediate Steel shall be UL 1242 and ANSI C80.6, hot-dipped galvanized steel. Both ends of conduits shall be threaded with factory-installed thread protectors. Fittings shall be threaded Type UL 6/1242 and ANSI C80.1 and C80.6, hot-dipped galvanized steel. Expansion fittings shall be OZ Type "DX", Appleton Type "XJ", Crouse-Hinds Type "XC" or an approved equal and shall have bonding jumpers. Cut ends shall be recoated with cold galvanized paint.

C. PVC Externally-Coated Rigid Steel Conduit: Shall be ANSI C80.1 hot-dipped galvanized rigid steel conduit with an external 0.040" minimum PVC protective coating per NEMA Standard RN1. Both ends of conduit shall be threaded and thread protectors shall be factory-installed. Fittings shall be threaded type ANSI C80.4, hot-dipped galvanized with a 0.055" minimum PVC coating to match the conduit.

D. Electrical Metallic Tubing: Shall be UL 797 and ANSI C80.3 galvanized steel with plain ends. Fittings, couplings and connectors shall be UL 797 and ANSI C80.4 galvanized steel type. Fittings, couplings and connectors shall be all steel set-screw type. **All EMT connectors shall have insulated throats or bushings.**

E. Flexible Conduit:

1. Flexible Metal Conduit: UL 1, zinc-coated steel
2. Flexible Metal Conduit Fittings: UL 1, zinc-coated steel, insulated throat.
3. Liquidtight Flexible Metal Conduit: Liquidtight flexible metal conduit comprised of single strip, continuous, flexible, interlocked, double-wrapped steel, galvanized inside and outside; forming smooth internal wiring channel; with liquidtight jacket of flexible polyvinyl chloride (PVC) or neoprene. Must contain ground bond.

F. Liquidtight Flexible Metal Conduit Fittings: UL 1, liquidtight, zinc-coated steel, neoprene gaskets and O-rings, insulated throat.

G. Nonmetallic Conduit and Fittings:

1. Schedule 40 Rigid PVC Conduit: Per UL 651, and NEMA TC 2, 90^{3}C conductor temperature rating, only encased in concrete duct bank.
2. Schedule 80 Rigid PVC Conduit: Per UL 651 and NEMA TC 2, 90^{3}C conductor temperature rating not encased in concrete duct bank.
3. Type "EB" Encased Burial PVC Conduit: Per UL 651A and NEMA TC 8, ASTM F512 - heavy wall, 90^{3}C conductor temperature rating.
4. Quaduct PVC Conduit: Composite duct consisting of four nominal 1-1/2" Schedule 40 PVC conduits with an integral spacer, as manufactured by Teleduct Corporation, Logan, Ohio, (800)433-6931. Encased in concrete only.
5. PVC Conduit Fittings: Per NEMA TC 3 and compatible with PVC conduit system.
6. Ductbank Spacers: Spacers shall be interlocking plastic designed for the conduit sizes and nominal **[3"]** spacing being used.

H. Nonmetallic Innerduct: For fiber optic only.

1. Innerduct: PVC corrugated flexible conduit, Carlon Optic-Gard PVC or an approved equal. Duct shall be available in one inch (1"), 1-1/4", 1-1/2" and 2" sizes and orange, gray and white colors.
2. Couplings: PVC type, external, solvent cement type.

I. Conduit Tubing Accessories: Provide ANSI/NEMA FB I conduit and tubing accessories including straps, hangers and expansion joints as recommended by the conduit and tubing manufacturer and as specified in this Section.

J. Precast Concrete Manholes:

1. General: Provide precast concrete manholes as detailed on the Drawings and as required for installation of new ductbank systems and connection to existing ductbank systems at locations shown on the Drawings.
2. Design: Manholes shall be steel reinforced and the complete manhole assembly shall be designed for H-20-44 bridge loading. Submittals shall clearly indicate all dimensions and reinforcing steel.
3. Concrete: Manholes shall be constructed using concrete with a 4500 psi 28 day strength. Concrete mix shall be designed in accordance with ASTM standards.
4. Reinforcing Steel: Steel shall be intermediate or hard grade billet steel conforming to ASTM A15, deformed in accordance with ASTM A305.
5. Manholes: Manhole and pull box covers shall be cast iron cover mounted in a 30" Type "B" or "WRM" frame and shall be traffic type for heavy vehicular traffic. The frame and neck shall be doweled into the manhole to prevent movement away from the opening. Power manhole and pull box covers shall be marked "ELECTRIC". Communication manhole and pull box covers shall be marked "COMMUNICATIONS". Voice manhole and pull box covers shall be marked "TELEPHONE". Data manhole and pull box covers shall be marked "DATA".
6. Conduit Entry: Plastic conduits shall include a bell end inside the manhole or pull box, mounted flush and grouted to seal openings. Precast fiber type terminators shall be provided for each ductbank entry.
7. Grounding: A #4/0 bare copper ground wire shall penetrate the side wall in the bottom section of each manhole and pull box and extend 48" inside and outside of the manhole pull box.
8. Accessories: Knockouts, cable racks, sumps, steps, joint seals and other accessories shown on the Drawings or required for a complete installation shall be provided.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install electrical raceways and fittings as shown, in accordance with the manufacturer's written instructions, the applicable requirements of the NEC, and in accordance with recognized industry practices to ensure that products serve the intended function. Complete electrical raceway installation before starting the installation of wire and cable and comply with UH specs.

B. Conduit Size: Minimum conduit size for power wiring shall be **[1/2"] [3/4"]**, except that **[3/8"] [1/2"]** flexible metallic conduit may be used for fixture whips. Maximum conduit size for EMT shall be **[4”] [except for voice/data conduits which may be EMT up to 4"].** Minimum conduit size for control wiring shall be **[1/2"] [3/4"]**. Minimum conduit size for voice**[/data]**

wiring shall be **[3/4"] [one inch (1")] [____"]**.Minimum ¾"c for home run conduits to source. EMT minimum 1" pvc underground.

C. Rigid Steel and Intermediate Metal Conduit: Use rigid steel, aluminum or intermediate metal conduit to run all electrical raceway systems where exposed to weather; in damp or wet locations; where subject to physical damage; and where cast in concrete walls or floor slabs which have waterproof membranes and where cast in masonry walls. Use rigid steel conduit for all 5/15 kV power feeders, or aluminum unless otherwise noted. IMC conduit shall not be used in sizes larger than 4". Use threaded type couplings and fittings. Split type couplings and fittings are not acceptable. EMT conduit may be used instead of rigid steel or IMC for 600 volt feeder raceways, if the location is acceptable for use of EMT as described herein below, and if a properly sized ground wire is included with the feeder conductors in the EMT raceway. Ground wires are required in all conduits.

D. PVC-coated Rigid Steel: Use polyvinyl chloride (PVC) externally-coated rigid steel conduit and fittings for electrical raceway systems for branch circuits to **[cooling towers and other]** wet areas; **[where exposed outdoors;]** and elsewhere, as shown. Conduit and fittings shall be installed such that the PVC-coating is continuous and watertight such that no portion of the metal conduit or fittings is exposed to moisture.

E. Electrical Metallic Tubing (EMT): Use EMT for branch circuit electrical raceway systems where concealed in furred ceilings or in walls; exposed inside 6'-0" above finished floor where not exposed to physical damage. EMT conduit shall not be installed where exposed to weather or in wet or damp locations. Use steel set screw type fittings, couplings and connectors made-up tight for all conduit sizes. Crimp type fittings, couplings and connectors are not acceptable.

F. Flexible Metal: Use flexible metal conduit (with internal ground wire) and fittings for lay-in lighting fixture connections and for other electrical equipment connections where subject to movement and vibration, but where liquidtight flexible metal conduit is not specified. Use flexible metal conduit in such lengths as required, 6'-0" maximum length and 3'-0" minimum length. **[[3/8"] [1/2"] diameter conduit may be used for lighting fixture "pigtails".]** Must contain grounding conductor.

G. Liquidtight Flexible Metal: Use liquidtight flexible metal conduit and fittings for all motor connections, including dry-type transformers**[, all connections in kitchens and laundries,] [, computer equipment branch circuits below raised floors,]** and for other electrical equipment connections where subject to movement and vibration and when subject to one or more of the following conditions: exterior location; moist or humid atmosphere where condensate can be expected to accumulate; corrosive atmosphere; subject to water spray; subject to dripping oil, grease or water. No SMURF tube anywhere (not in concrete). Install **[external ground wire on] [internal ground wire in]** flexible conduit with grounding bushings. Maximum length shall be 6'-0" and minimum length shall be 3'-0".1 1/2 " and bigger, add external ground bond.

H. Rigid Nonmetallic: Use PVC conduit directly buried in earth, concrete encased, cast in concrete slabs, and where subject to corrosive environment. PVC conduit shall only be used where shown on the Drawings. Use Schedule 40 where in concrete and Schedule 80 direct buried, where exposed, with size adjusted to have same fill area as if Schedule 40 were used. Type "EB" encased burial duct shall be used in concrete encased applications where shown on the Drawings. Schedule 40 if encased in concrete, Schedule 80 if NOT encased in concrete.

I. [Rigid Nonmetallic: Use rigid PVC Schedule 40 conduit and solvent type fittings for electrical raceway systems cast-in-place in parking garage slabs. No exposed conduit in parking garage shall be PVC. Conduit shall be Type "II" designated for underground installation with or without concrete encasement. Conduit system shall be UL-listed in accordance with Article 347 of the NEC. Conduit smaller than 3/4" in diameter will not be permitted.]

3.2 INTERIOR CONDUIT SYSTEM:

A. Ground all metallic conduit in accordance with the requirements of the latest edition of the NEC. All conduit system require grounding conductors.

B. Install all conduit as a complete system without conductors, continuous from outlet to outlet and from fitting to fitting. Make up threaded joints of conduit carefully in such a manner as to ensure a tight joint. Field-cut threads shall be cold-galvanized after cutting. The entire conduit system shall be secured at all joints and boxes in such a manner that each system shall be electrically continuous throughout. Fasten the entire conduit system securely into position. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of four quarter bends, including those bends located immediately at the outlet or fitting. Install approved expansion fittings in all conduit runs as specified in paragraph 3.2/P. No more than 270° above ground.

C. Ream all ends of conduit properly to remove rough edges. Whenever a rigid steel or IMC conduit enters a switchboard, panelboard, enclosure, or box, it shall be securely fastened by the use of a locknut inside and outside and an approved insulating bushing shall be installed. Whenever an EMT conduit enters a switchboard, panelboard, enclosure, or box, it shall be securely fastened by use of an insulated throat connector or a connector with an insulating bushing. Lay out and install all conduit systems as to avoid all other services or systems, the proximity of which may prove injurious to the conduit or the wires or conductors which the conduit confines.

D. Conceal conduit systems in finished areas. Concealed metallic conduits shall be run in a direct manner, basically parallel to, and at right angles with the lines of the building, and with as long a bend as possible. Conduit may be exposed in mechanical rooms and where otherwise shown or indicated. On exposed systems, run the conduit parallel or perpendicular to the structural features of the building and rigidly support clamps at intervals as required by NEC or on conduit racks, neatly racked and bent in a smooth radius at corners insofar as practicable. All bends shall be field-made using an approved bending machine designed for the purpose, or using standard ells having a radius not less than that shown in Chapter 9, Table 2 of the National Electrical Code, and with approved fittings or connectors. All bends shall be free from dents or flattening. Prefab bends for 2” and up are contractor’s option.

E. All conduit shall be run without traps. Where traps are unavoidable, a junction or pull box shall be placed at the low point. Metallic conduit systems which are exposed to the weather or water shall be made watertight. As soon as conduit has been permanently installed in place, conduit shall be capped or plugged with standard accessories. All metallic conduit shall be swabbed after plaster and dry wall is finished and dry. All outdoor exposed conduit shall have drain at low point.

F. Support exposed raceway or grouped concealed raceways on galvanized or stainless steel channel using compatible galvanized fittings (bolts, beam clamps and similar items) and galvanized threaded rod pendants to secure raceway to channel and channel to structure. Support single conduit runs using a properly sized galvanized conduit hanger with galvanized closure bolt/nut and threaded rod. Support-spacing shall not exceed 10' apart for all

EMT/IMC conduit and rigid conduit 2" and smaller and 15' apart for rigid conduit 2-1/2" and larger and within 3' from boxes and changes in direction. Support flexible conduit on maximum 4-1/2' centers and within one foot (1') of boxes. All raceway support system materials shall be galvanized and manufactured by Kindorf, Unistrut, Superstrut, Caddy, or Spring Steel Fasteners, Inc. Provide chrome or nickel-plated escutcheon plates on all conduit passing through walls and ceilings in finished areas. Must comply with current NEC.

G. Support 1" and smaller EMT conduit concealed in ceiling cavities with No. 13 AWG galvanized iron wire pendants, spaced not to exceed 10' apart and 3' from boxes and changes in direction, secured to conduit with clips and properly secured to structure. Perforated strap shall not be used for conduit supports. Branch circuit EMT conduit 3/4" trade size and smaller may be suspended using "caddy clips" attached to independent ceiling wire. Contractor must paint electrical support wires to identify. Support conduit sized one inch (1") and larger as described in Paragraph F.

H. Make all joints and connections to ensure mechanical strength and electrical continuity. PVC conduit shall be joined, or have fittings attached, by using a fusing (solvent) compound recommended by and applied as instructed by, the conduit manufacturer.

I. Run conduit to avoid proximity to heat producing equipment, piping and flues, keeping a minimum of 8" clear. Whenever possible, install horizontal raceway runs above water piping. Unless shown otherwise, all roof penetrations shall be made in adequate time to allow the roofer to make proper flashings, but provided by this division.

J. Unless shown otherwise, all roof penetrations shall be made in adequate time to allow the roofer to make proper flashings. Roof penetrations made by Division 26 are the ultimate responsibility for Division 26 to ensure the penetrations are correctly flashed and sealed. Coordinate any roof penetrations in an existing roof with the owner and the roof’s warranty holder to ensure the roof’s warranty is maintained.

K. Carefully review architectural, structural, mechanical, plumbing, and electrical Drawings and place boxes and conduit to avoid conflicts with structural members or other general construction.

L. Conduit larger than 3/4" shall not be embedded in structural slabs without prior written permission from the Structural Engineer. Conduits embedded in structural slabs shall be installed in the middle of the slab below the top and above the bottom reinforcing steel. Maintain a minimum concrete coverage of one inch (1") except where penetration is made. Conduit shall emerge from slab vertically, with no bend radius unless concealed in walls.

M. Furnish sleeves for timely placing in construction for all conduit passing through concrete walls, partitions, beams, floors, and roofs while same are under construction and shall be sealed with fire seal or duct seal if applicable.

N. All conduit passing through the housing on connected equipment, shall pass through a cleanly cut hole protected with an approved grommet and shall be sealed with fire seal or duct seal.

O. Metallic conduit installed below grade shall have its entire length painted with two coats of protective finish. Each coat shall consist of 5 mils of PPG "Coat Cat Epoxy Coating" applied in accordance with the manufacturer's recommendations. The entire length of metallic conduit, including fittings, shall be protected to a point 6" above finished grade (or concrete slab).

P. Coordinate locations of raceways in fire rated partitions so as not to affect the fire rating of the partition. Notify the Architect in writing where additional construction is required to maintain the partition fire rating.

Q. Install expansion fittings in all conduit as follows:

1. All conduits crossing building expansion joints; unless some other form of thermal expansion compensation is approved in writing by the Engineer.
2. All conduit straight runs in excess of 200' and on 400' centers in all longer conduit runs.
3. Conduits entering environmental rooms.
4. Locations subject to thermal expansion and as required by NEC.
5. Unless expansion fitting has an integral bonding braid an external braid, approved for the purpose, shall be installed around the fitting.

3.3 EXTERIOR CONDUIT SYSTEMS:

A. Exterior conduit systems shall meet all of the general installation requirements for interior conduit systems.

B. All exterior conduit systems shall be completely watertight. All hangers, fasteners, and supports used with exterior conduit systems shall be hot dip galvanized, aluminum or stainless.

C. Conduit routed across roofs shall be attached to approved electrical support stands with unistrut sleepers spaced on maximum 5'-0" intervals, unless otherwise detailed on the Drawings. Sleepers shall be installed in pitch pans or as otherwise detailed on the Drawings.

D. Install underground conduits with sealing glands equal to OZ Type "FSK" or approved equal, exterior to the conduits and OZ Type "CSB" or approved equal internally at the point where conduits enter the building, to prevent water seepage.

E. Install conduits outside the building lines a minimum of below grade, & comply with NEC unless noted otherwise on the Drawings. Maintain 12" of earth or 2" of concrete separation between electrical conduits and other services or utilities below grade. Maintain **[10'-0"]** separation between parallel underground power and voice/data conduits. Where power and voice/data conduits cross below grade, crossing shall be at right (90 degree) angles with a minimum 2'-0" vertical separation.

3.4 POWER DUCTBANK SYSTEMS:

A. Power ductbanks shall be of individual conduit encased in reinforced concrete. Conduit shall be **[rigid PVC Schedule 40] [Type "EB"]** except that rigid steel conduit shall be used for the final 10' at the beginning and end of each ductbank and for all elbows. **[Unless shown otherwise, the type of conduit used shall not be mixed in any one ductbank and shall not be smaller than 4" in diameter.]** The reinforced concrete encasement surrounding the ductbank shall be rectangular in cross section, having a minimum concrete thickness of 3". Conduit shall be separated by a minimum concrete thickness of 2", except that light and power conduit shall be separated from control and signal conduits by a minimum concrete thickness of 3". Encasement concrete shall be red in color and rough out.

B. The power ductbank shall be routed underground and the top of the concrete envelope shall be not less than 36" below grade if possible due to existing utilities.

C. Changes in direction of ductbank runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 5'. All bends in a run shall be separated by a minimum of 10' of straight conduit, where possible.

D. During construction, partially completed ductbanks shall be protected from the entrance of debris such as mud, sand, and dirt by means of suitable conduit plugs. As each section of the ductbank is completed, a testing mandrel shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until each conduit is clear of all particles of earth, sand, or gravel. Conduit plugs shall then be immediately installed and temporarily sealed.

E. Ducts in concrete encased ductbanks shall be independently supported by interlocking module spacers by Formex or equal. Spacers shall provide separation between adjacent ducts as specified hereinabove. Spacers shall be installed at 6' maximum intervals.

F. Ducts in concrete encased ductbanks shall be terminated in manholes, pull boxes, and vaults with interlocking terminators by Formex or equal. A watertight tapered plug shall be furnished and installed in unused duct openings. Where terminators are installed in new work, they shall be poured-in-place.

G. Install underground conduits with sealing glands equal to OZ Type "FSK" exterior to the conduit and OZ Type "CSB", or equal internally at the point where conduits enter the building to prevent water seepage into the building. All conduits emerging from underground shall be sealed.

H. Furnish the exact dimensions and location of power ductbank to be encased in time to prevent delay in the concrete work.

I. Power ductbank shall be installed per Power Company standards.

3.5 VOICE/DATA DUCTBANK SYSTEMS:

A. Exterior voice/data ductbanks shall be of individual PVC conduit and direct buried without concrete encasement **[under landscaping grassy areas and sidewalks and concrete-encased below driveways, streets and roadways]**. Conduit shall be rigid PVC Schedule 80. Interior ductbanks shall be of individual conduit and conduit shall be PVC. The type of conduit used shall not be mixed in any one ductbank and shall not be smaller than 4" in diameter. Install innerducts and pullstrings in conduit and ductbank where noted.

B. Where the voice/data ductbank is routed underground, the top of the ductbank shall be not less than 30" below grade.

C. Changes in direction of voice/data ductbank runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 5'. All turn ups to above grade shall be long radius RGS elbows, coated as specified in paragraph 3.02N. All bends in a run shall be separated by a minimum of 10' where possible. There shall be no more than two 90 degree bends in any run of voice/data ductbank.

D. During construction, partially completed ductbanks shall be protected from the entrance of debris such as mud, sand, and dirt by means of suitable conduit plugs. As each section of the ductbank is completed, a testing mandrel with diameter 1/4" smaller than the conduit shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until each conduit is clear of all particles of earth, sand, or gravel. Conduit plugs shall then be immediately installed.

E. Sleeves for voice/data ductbank passing through basement walls shall be rigid steel conduit and shall extend a minimum of 24" outside basement wall.

F. Ducts in concrete encased ductbanks shall be independently supported by interlocking modular spacers. Spacers shall provide separation between adjacent ducts as shown on the Drawings. Spacers shall be installed at 6' maximum intervals.

G. Ducts in concrete encased ductbanks shall be terminated in manholes, pull boxes, and vaults with interlocking terminators. A watertight tapered plug shall be furnished and installed in unused duct openings. Where terminators are installed in new work, they shall be poured-in-place. All conduit emerging from underground shall be sealed.

H. Voice/data ductbank shall be installed per Telephone Company standards.

3.6 DUCTBANK MANHOLES AND PULL BOXES:

A. Install manholes and pull boxes in accordance with the manufacturer's written installation instructions. Manholes shall be rigidly supported and level with the top of manhole rings flush with finished paving or grade at the point of installation.

B. Seal all joints and openings to prevent the entry of water.

3.7 VOICE/DATA AND SIGNAL SYSTEM RACEWAYS:

A. General: Conduit shall be installed in accordance with the previous specified requirements for conduit and tubing and with the additional requirements that no length of run shall exceed **[100'] [ ]** for 3/4" trade sizes, and **[150'] [ ]** for one inch (1") or larger trade sizes, and shall not contain more than two 90 degree bends or the equivalent thereof. Pull or junction boxes shall be installed to comply with these requirements. Empty voice/data and signal system raceways shall include a pull wire or cord, as described in Paragraph 3.8 hereinbelow. Install innerducts with pullcords in raceways where noted.

3.8 EMPTY CONDUIT RACEWAY SYSTEMS:

A. General: Empty conduit in which wire is to be installed by others shall have pull wires installed. The pull wire shall be No. 14 AWG zinc-coated steel, or plastic having not less than 200 pounds tensile strength. Not less than 12" of slack shall be left at each end of the pull wire.

3.9 IDENTIFICATION:

A. General: Refer to Section 26 05 53, "Identification for Electrical Systems", for requirements concerning painting and marking of raceways and fittings.

END OF SECTION 26 05 33